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OPERABLE UNIT 3 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY REPORT VOLUME 1 OF 4 SECTIONS 1-6 - ****DRAFT**** - SEPTEMBER 1995 - (ALSO CONTAINS FACTSHEET ON PROPOSED PLAN FOR OPERABLE UNIT 3 FINAL REMEDIAL ACTION)

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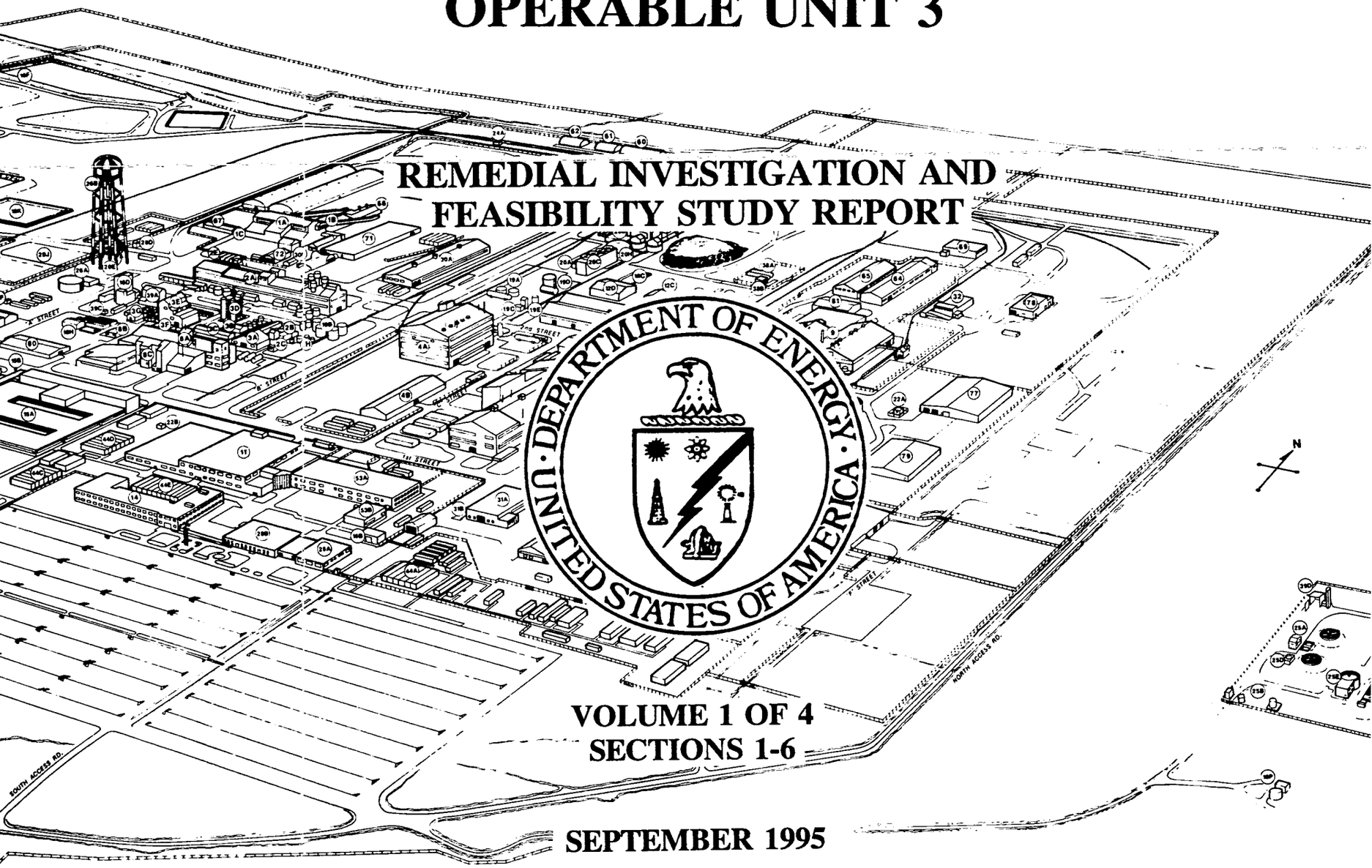
OPERABLE UNIT 3



REMEDIAL INVESTIGATION AND FEASIBILITY STUDY REPORT

VOLUME 1 OF 4
SECTIONS 1-6

SEPTEMBER 1995

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO

U.S. DEPARTMENT OF ENERGY
FERNALD AREA OFFICE

DRAFT

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Department of Energy
Fernald Environmental Management Project
P. O. Box 538705
Cincinnati, Ohio 45253-8705
(513) 648-3155

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SEP 08 1995

DOE-1473-95

Mr. James A. Saric, Remedial Project Director
U.S. Environmental Protection Agency
Region V - 5HRE-8J
77 W. Jackson Boulevard
Chicago, Illinois 60604-3590

Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

SUBMITTAL OF OPERABLE UNIT 3 REMEDIAL INVESTIGATION/FEASIBILITY STUDY REPORT AND PROPOSED PLAN

The enclosed Operable Unit 3 (OU3) combined Remedial Investigation/Feasibility Study (RI/FS) and OU3 Proposed Plan are submitted in compliance with the Amended Consent Agreement and consistent with subsequent agreements among the Department of Energy (DOE), U.S. Environmental Protection Agency (U.S. EPA), and Ohio EPA (OEPA). The OU3 RI/FS Report represents a combination of the typical RI/FS documents, resulting from efforts to streamline and expedite delivery of the OU3 decision. The OU3 RI/FS Report addresses the disposition of materials generated from the decontamination and dismantlement of the OU3 structures (under the OU3 Record of Decision (ROD) for Interim Action).

The OU3 RI/FS Report summarizes the nature of contamination found in the remedial investigation phase of the project in a variety of presentation approaches (raw data, analyte-specific, component-specific, and media-specific), identifies and screens 60 Constituents of Concern (COCs), segregates material by regulatory criteria, screens treatment options for potential use (supporting the original Initial Screening of Alternatives (ISA) milestone), develops media-specific waste acceptance criteria for on-property disposal of OU3 materials, defines and evaluates three remedial alternatives, and revalidates the Operable Unit 5 (OU5) Comprehensive Response and Risk Evaluation (CRARE) as applicable to OU3's leading remedial alternative.

The DOE's preferred alternative is identified in the enclosed OU3 Proposed Plan as Selected Material Treatment, On-Property Disposal, and Off-Site Disposition. This

alternative allows for off-site disposal for legacy wastes and materials with bulk contamination, recycling when cost-effective, treatment to meet waste acceptance criteria for on-site or off-site disposal, free release of materials conforming to DOE 5400.5 criteria, and disposal of acceptable wastes in the on-property disposal cell. This alternative was found to be similar in overall risk and protectiveness to the off-site disposal alternative, but significantly lower in overall cost. This alternative was also consistent with the "balanced approach" for disposition of site wastes, with the highest levels of contamination leaving the site and the larger volume of less contaminated materials remaining in the on-property disposal facility.

The RI/FS also requests an Applicable or Relevant and Appropriate Requirement (ARAR) waiver from the OEPA disposal facility siting requirements, consistent with the OU2 ROD, OU5 proposed ROD, and discussions with the EPAs. It also includes adoption of the Corrective Action Management Unit concept as proposed by OU5.

This submittal is complete and comprehensive for the operable unit, but because the data cutoff date for inclusion in this draft occurred in July 1995, validation of a small portion of the radiological data set had not yet occurred. These data are utilized in the document, but do not affect decision-making. The finalized data set will be reflected in the revised document. Additionally, several laboratory matrix spike results have been inadvertently included as data for several media in the main database, resulting in potentially overestimated source terms for several categories of media. The impact on the decision-making and completeness aspects of the document are minuscule and will be corrected in the final version of the document. These items should not affect consideration of this document as complete for the review process.

If you have any questions regarding this submittal or would like to arrange a document presentation/discussion session, please contact John Hall at (513) 648-3118.

Sincerely,

Johnny Reising

for Jack R. Craig
Fernald Remedial Action
Project Manager

FN:Hall

Enclosure: As Stated

cc w/enc:

K. H. Chaney, EM-423/GTN
B. Skokan, EM-423/GTN
G. Jablonowski, USEPA-V, 5HRE-8J
Manager, TSPP/DERR, OEPA-Columbus
F. Bell, ATSDR
D. S. Ward, GeoTrans
R. Vandergrift, ODOH
S. McClellan, PRC
R. D. George, FERMCO/52-2
T. Hagen, FERMCO/65-2
AR Coordinator, FERMCO

cc w/o enc:

R. J. Janke, DOE-FN
D. Pfister, DOE-FN
J. Reising, DOE-FN
T. Clark, FERMCO/52-3
S. Houser, FERMCO/52-3
C. Little, FERMCO
M. Yates, FERMCO

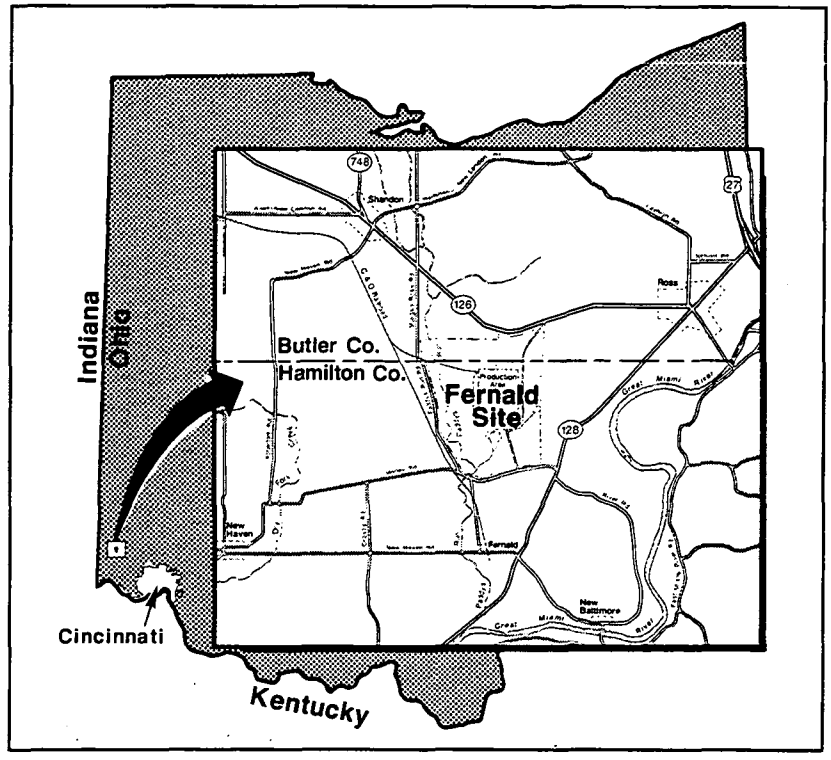
United States
Department of Energy
Fernald Environmental Management Project

Fernald Area Office
P.O. Box 538705
Cincinnati, Ohio 45253-8705

Proposed Plan for the Operable Unit 3 Final Remedial Action

Treatment and Disposition of Buildings and Structures at Fernald

SEPTEMBER 1995



This Proposed Plan Will Describe for You:

- The background of Operable Unit 3;
- The outcome of the Remedial Investigation and Feasibility Study process for Operable Unit 3;
- The three cleanup alternatives considered;
- DOE's preferred alternative for final remedial action;
- How to participate in the selection/modification of the preferred alternative; and
- Where to get more information.

You are invited to a public meeting

to discuss the alternatives being considered for the final cleanup of Operable Unit 3 at the Fernald Environmental Management Project. The U.S. Department of Energy (DOE), together with the U.S. and Ohio Environmental Protection Agencies (EPAs), encourage public participation in the decision-making process for the remediation of the Fernald site. Representatives from DOE and U.S. and Ohio EPAs will be present to discuss the alternatives, including the preferred alternative, answer questions, and accept comments. The meeting is scheduled for **{date, time, and location to be determined}**

INTRODUCTION

This *Proposed Plan for the Operable Unit 3 (OU3) Final Remedial Action* summarizes information presented in the *OU3 Remedial Investigation/Feasibility Study (RI/FS) Report*. This summary includes a discussion of the types and levels of contamination within OU3 and a discussion of the remedial alternatives evaluated for treatment and disposal of materials generated during the OU3 interim remedial action. Finally, this Proposed Plan identifies the preferred remedial alternative for the safe and cost-effective treatment and disposition of these building materials.

OU3 includes buildings (both production and administrative), equipment, unused uranium and thorium products, residues, and wastes associated with the former Production Area at the Fernald Environmental Management Project (FEMP), a former uranium processing facility owned by the U.S. Department of Energy (DOE). The previously approved interim remedial action, which is currently underway, consists of the decontamination and dismantlement of all structures in OU3. The preferred final remedial alternative,

discussed in more detail later in this document, involves selected material treatment, on-property disposal of OU3 material that presents minimal ***risk*** to human health, and off-site disposal of material that is highly contaminated. Environmental media, such as soils and groundwater underlying or in the vicinity of OU3, are being addressed within the scope of Operable Unit 5. Accordingly, this Proposed Plan does not address remediation of environmental media.

The remainder of this plan will present the rationale for proposing the preferred remedy, background information, and the proposed path forward for achieving final cleanup of OU3. This Proposed Plan is issued in accordance with the ***Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980***, as amended, and structured to solicit public involvement in the selection of the final remedy for OU3. Public involvement opportunities will be discussed on pages 19 and 20.

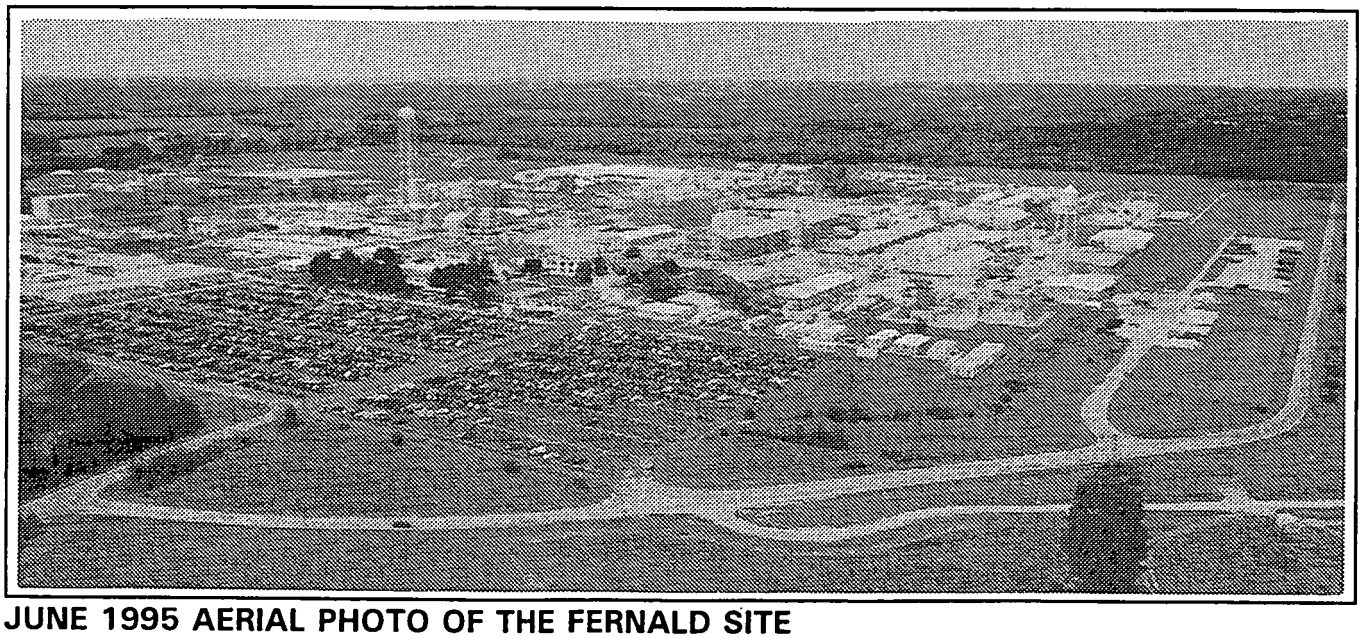
*Note: explanations of terms shown in **bold italics** are provided in the glossary on pages 21 and 22 of this Proposed Plan.*

SITE BACKGROUND

The FEMP was originally known as the Feed Materials Production Center (FMPC) and was constructed in the 1950s as part of the atomic weapons complex. The 1,050-acre site is located near the village of Fernald, Ohio, approximately 17 miles northwest of Cincinnati. The site's primary mission was to process uranium into metal products, which were shipped to other DOE and Department of Defense facilities for defense activities. Production operations began in 1952 and continued until the facility was closed in 1989, due to the declining demand for uranium metals.

Concerns about the impact that production operations and waste storage activities were having on human health and the environment were evident before production was suspended. Contaminants were released to the environment primarily through air emissions, wastewater discharges, leaks, and spills. In 1985, the U.S. Environmental Protection Agency (U.S. EPA) issued a Notice of Noncompliance to the DOE, which led to the signing of a Federal Facility Compliance Agreement in 1986. This agreement marked the initiation of the ***RI/FS*** to investigate environmental concerns at the Fernald site and to identify the most promising cleanup actions. In 1989, the Fernald site was included on the U.S. EPA's ***National Priorities List*** of sites requiring urgent cleanup attention. In 1990, a Consent Agreement was signed by U.S. EPA and DOE; this document detailed a schedule for conducting the RI/FS process and identified five ***operable units***. Operable units are established based on physical proximity of contaminated areas, similar types or amounts of contamination, or the potential for similar remedial technology types to be used in cleanup activities, among other criteria. The operable units, as currently defined, are as follows:

- Operable Unit 1 (OU1) consists of six waste pits, a burn pit, a clearwell, and associated liners and berms;



JUNE 1995 AERIAL PHOTO OF THE FERNALD SITE

- Operable Unit 2 (OU2) consists of two lime sludge ponds, two flyash piles, a disposal area containing construction rubble (the "South Field"), and a solid waste landfill;

- Operable Unit 3 (OU3), which consists of all building, structures, and equipment at Fernald, is discussed in detail in the next section;

- Operable Unit 4 (OU4) consists of four concrete storage silos, associated facilities, and stored wastes; and

- Operable Unit 5 (OU5) includes environmental media, such as soils and groundwater, not associated with other operable units.

Additional information about the operable units, as well as the remedial decisions made for each of them, is available through the Public Environmental Information Center (see page 20).

The DOE Fernald Area Office, as the lead agency, is responsible for oversight of the cleanup at Fernald in accordance with provisions of CERCLA. All remedial decisions reached for the Fernald site are subject to approval by the U.S. EPA, with input from Ohio EPA and the public.

OPERABLE UNIT 3 DESCRIPTION

OU3 consists of the former Production Area and production-associated buildings and equipment. This area includes a fenced, 136-acre tract of land near the center of the Fernald site and contains many buildings, containerized materials, storage pads, roads, railroad tracks, above- and below-ground tanks, and utilities. OU3 also includes an administrative area with several office buildings, a parking lot, several impoundments, ponds, rainwater collection basins, and a sewage treatment plant. Environmental media are addressed as part of OU5 but are important considerations because they are potential pathways between sources of contamination in OU3 and off-site ***receptors***.

Most OU3 remediation materials are typical of building materials used during the 1950s for industrial type construction. OU3 building materials have been divided into nine material categories, as shown in the table on this page, based on their physical properties and/or configurations, and then further divided into ***segregation categories*** based on regulatory waste classification (e.g., ***hazardous waste***, low-level radioactive waste, etc.).

VOLUMES OF MATERIALS IN OU3

OU3 Material Category	Volume (ft^3)
Accessible Metals	63,400
Inaccessible Metals	1,710,000
Process-Related Metals	191,000
Painted, Light-Gauge Metals	7,150
Concrete	4,800,000
Brick	20,700
Non-Regulated Asbestos-Containing Materials	60,300
Regulated Asbestos-Containing Materials	80,200
Miscellaneous Materials	564,000
Product, Residues, and Special Materials	1,800,000
Total	9,300,000

Also shown in the table, a tenth material category, termed "Product, Residues, and Special Materials," contains all non-building materials in OU3, such as nuclear product, ***hold-up material*** (i.e., product left inside machinery and buildings when production was shut down in 1989), wastes generated during daily decontamination activities, and "legacy" wastes. ***Legacy wastes*** are containerized waste materials which remained when production ceased, such as low-level radioactive waste, hazardous waste, and mixed waste (hazardous waste mixed with low-level radioactive waste). These non-building materials and wastes are currently being addressed through programmatic ***removal actions***, which are discussed later in this Proposed Plan. These removal actions will be included within the scope of the final remedial action ***Record of Decision (ROD)***.

The buildings, equipment, and other facilities within OU3 show concentrations of radiological and other hazardous substances at levels which represent a potentially unacceptable long-term threat to human health and the environment.

OU3 Interim Remedial Action

Although DOE maintains an active maintenance program, the former uranium processing facilities are at or beyond their design life and in a state of advancing deterioration. These current conditions present an increasing probability of further releases of hazardous substances to the environment in the event of structural collapse or other failure mechanisms.

For these reasons, DOE and U.S. EPA signed a Record of Decision for Interim Remedial Action (IROD) in July 1994. The IROD calls for the decontamination and dismantlement of all above- and below-ground improvements, including all buildings and support structures, to reduce any potential threat posed by these facilities. It also calls for the removal of equipment and machinery that have no identifiable role to support the site cleanup mission and removal of product, residues, and wastes. According to the IROD, the building debris and resultant waste would primarily be placed in interim storage until a final remedial decision is made, although some limited material disposition could occur. That decision will be made based on public comments received on the three alternatives offered in this Proposed Plan.

As part of the ***remedial design*** of the interim remedial action, a schedule for Fernald building dismantlement was submitted in June 1995 to the U.S. EPA and Ohio EPA in the *OU3 Remedial Design Prioritization and Sequencing Report*. This 31-year schedule, which was subsequently approved by the EPAs, was based on the anticipation of reduced funding levels. However, recent cleanup successes at Fernald, coupled with strong support from the public and other stakeholders, have led the U.S. Congress and DOE to endorse greater funding for the final cleanup of Fernald. Therefore, a ten-year dismantlement schedule can be anticipated. The first dismantlement project under the interim remedial action, Plant 4 (the Hydrofluorination Plant), is currently underway. Under the accelerated schedule, several other plants are anticipated to be dismantled starting in 1996.

OU3 Final Remedial Action

The final remedy will address treatment and final disposition of the materials and wastes resulting from performance of the interim remedial action. The two actions will be combined to provide a unified remediation approach to OU3. Under the IROD, all buildings and structures will be dismantled and the resulting materials will be segregated into ten material categories. The material categories (as described on page 3) will be evaluated for treatment and disposition options. However, as the figure on the following page illustrates, the materials placed within the "Product, Residues, and Special Materials" category will be handled and dispositioned off-site under existing removal actions. All items within the shaded area of the figure have been previously addressed as indicated and are not evaluated within the *OU3 RI/FS Report*. The final remedy for OU3 will determine the appropriate treatment and disposition of the materials generated by the dismantlement of OU3 buildings. The final remedy will be cost-effective, implementable, and protective of human health and the environment and will accommodate the application of new, more effective technologies which may emerge during the OU3 final remedial action.

In March 1995, the Fernald Citizens Task Force issued a recommendation on the disposal of soils, construction rubble, and other waste materials with relatively low levels of contamination in an on-property disposal facility. The Task Force, a DOE site-specific advisory board comprised of local residents and community leaders, is chartered to make recommendations to DOE and the EPAs about future courses of action, cleanup levels, and waste disposition options, including future land uses for the Fernald site.

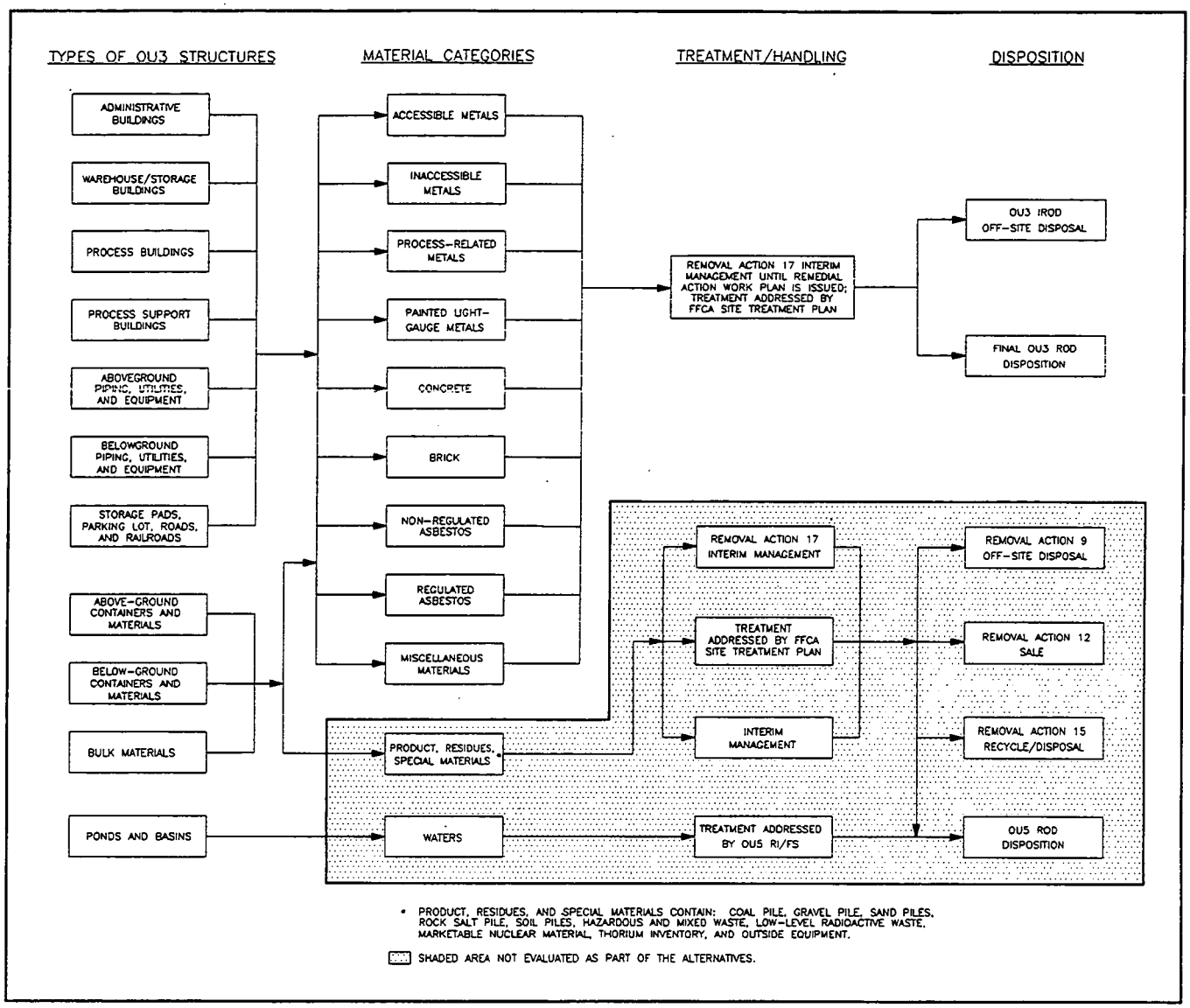
Integration of the Interim and Final Remedial Actions

The scope of the interim remedial action, as set forth in the IROD, consists primarily of the removal of gross surface contamination from material in facilities, dismantlement of facilities, limited off-site disposal for non-recoverable/non-recyclable remediation materials, and interim storage for the majority of resulting remediation materials until the OU3 final remedial action ROD is issued. The scope of the final remedial action encompasses the handling, treatment, and final disposition of OU3 materials not dispositioned under the IROD. Once the remedy is selected, requirements specifically related to that remedy will be integrated into the remainder of the interim remedial action to allow seamless execution of both the interim and final remedial actions.

Several elements developed to support the final remedial action may need to be incorporated into the interim remedial action. For example, any restrictions on the size of material prior to disposition, as required by the selected remedy, would be incorporated into the design specifications of the remaining dismantlement projects under the IROD. Since the implementation of the final remedial action may influence interim remedial action activities, the remedial design and remedial action work plans for the final remedial action would be integrated documents, representing both the OU3 interim and final remedial actions.

REMOVAL ACTIONS RELATED TO THE FINAL REMEDIAL ACTION

Removal actions are conducted to mitigate an immediate threat to human health and the environment, including actions necessary to monitor,



APPROACH TO OU3 MATERIAL MANAGEMENT

assess, or evaluate the threat. Of the thirty FEMP removal actions, four are considered "programmatic," since the scope of the activities applies to OU3 as a whole rather than targeting specific physical locations. The four programmatic removal actions are discussed below. The other OU3 removal actions are discussed in greater detail in Section 1 of the *OU3 RI/FS Report*.

Removal Action 9: Removal of Waste Inventories

This waste shipping program was initiated in August 1985, before the RI/FS process was initiated at Fernald. Removal Action 9 is a large-scale waste shipment program, which primarily involves transferring inventoried and newly generated wastes for off-site disposal. The program includes characterization of waste materials, treatment to meet the ***waste acceptance criteria*** of the off-site disposal facilities, and transport in a manner that ensures full compliance with DOE Orders and Department of Transportation requirements. This removal action also governs the treatment and disposition of mixed wastes and polychlorinated biphenyls (PCBs) in accordance with the *Site Treatment Plan*.

In late 1994, a new strategy was developed for managing waste materials that remained when production ceased (also called legacy wastes). This strategy was to continue waste management programs and removal actions as they currently exist to quickly reduce the volume of (and, therefore, the risks associated with) Fernald waste through off-site disposal. Because of this approval, issues related to the treatment and disposition of legacy wastes have not been evaluated in the *OU3 RI/FS Report*.

As of July 1995, approximately 589,000 drum equivalents (i.e., the amount of material that would fit in one 55-gallon drum) had been shipped to the Nevada Test Site (NTS) for final disposal. These waste shipments include legacy wastes as well as wastes generated through cleanup activities. Removal Action 9 will continue as a distinct program within the OU3 final remedial action until these wastes have been fully dispositioned.

Removal Action 12: Safe Shutdown

The Safe Shutdown Program was initiated in July 1991, while the site was being officially closed as a production facility. This removal action involves planning, engineering, and program control for the proper removal and disposition of uranium products and hold-up materials, residues, excess supplies, chemicals, and associated process equipment. This removal action also provides for the isolation and de-energizing of former production-related equipment and utilities.

The primary objective of the Safe Shutdown Program is to remove materials from previously operated production equipment to reduce the overall risk posed by the facilities. After the materials are characterized, they are placed in approved storage configurations and transported to NTS under Removal Action 9.

Another significant objective of this removal action is to identify other customers or users for Fernald equipment and nuclear products. For instance, some equipment in Plants 5 and 6 is being transferred to OU4 for use in remediation activities. Off-site customers are being sought as well. The equipment will be decontaminated as necessary prior to being transported off-site. Safe Shutdown Program activities will continue as necessary throughout the interim and final remedial actions. Safe Shutdown has been completed in Plants 4 and 1 to prepare the buildings for dismantlement and is currently underway in Plant 9.

Removal Action 17: Improved Storage of Soil and Debris

The primary goal of Removal Action 17 is to establish a site-wide management concept and implementation strategy for soil and debris storage at Fernald. Soils and debris generated by construction and removal action activities have been stored in accordance with this removal action. Removal Action 17 is being conducted to provide improved storage for this waste material and to establish procedures for managing future soil and debris storage. The scope of this removal action will continue during the interim remedial action for OU3. Generated materials will be retained in storage until the OU3 final remedial action ROD specifies a disposition option for debris and the OU5 ROD specifies disposition for soils.

Removal Action 26: Asbestos Removal

The asbestos abatement program was established to mitigate potential release and migration of asbestos during routine facility maintenance. Abatement within this program includes in situ repairs, encasement and encapsulation, and removal of asbestos-containing material.

Asbestos removal is also the first step in building decontamination and dismantlement. Therefore, Removal Action 26 will continue for OU3 facilities during the interim remedial action. The scope of this removal action will also be incorporated into the OU3 final remedial action ROD.

OUTCOME OF THE RI/FS

Issuance of the IROD had a significant impact on the data requirements for the OU3 RI/FS. Since the IROD already established the requirement for dismantlement of OU3 structures, the remaining tasks, were field characterization and determination of final disposition requirements for the materials remaining after the interim remedial action is complete. Collected data were used to determine:

- Accurate media volume and weight estimates for various waste classifications, which were used to determine the treatment and disposal needs, costs, implementability, and environmental impact of each alternative.
- Waste characteristics and potential treatability of various media to reduce waste volume, toxicity, or contaminant mobility.
- ***Source term*** estimates for contaminants in OU3 material.
- ***Leachability*** of contaminants from OU3 materials for use in the preparation of waste acceptance criteria for potential on-property disposal.

The sampling approach used for the characterization study was to collect one ***intrusive sample*** from each major medium (concrete, asphalt, acid brick, masonry, transite, and steel coatings) in each defined process area at the location of greatest known radiological and/or chemical contamination. Each major media sample was then, in general, analyzed for all radiological and chemical contaminants of potential concern. More than one sample was

collected if there were distinct areas of chemical and radiological contamination. Confirmatory field screening was conducted in representative buildings that were considered uncontaminated and, therefore, not sampled.

In addition to major media sampling, samples of supplemental media were collected, including loose material (e.g., residues, floor sweepings, sediment, sludges, etc.), unknown liquids, and heating, ventilation, and air conditioning (HVAC) filters. These samples were used to support major media sampling results or to confirm assumptions.

The data obtained from these sample analyses were used in conjunction with other data to determine the ***constituents of concern (COCs)*** within OU3 building materials. COCs are those contaminants that may substantially contribute to risks to human health and the environment. COCs are usually determined in the RI/FS process as part of a baseline risk assessment. However, the IROD has already determined that remedial action is necessary. In addition, the *Site-Wide Characterization Report* has already documented the general level of risk from the current condition of OU3. Therefore, the development of a baseline risk assessment as part of the *OU3 RI/FS Report* would have little added value. Since no baseline risk assessment was performed for the *OU3 RI/FS Report*, COCs were determined for each OU3 medium by comparing maximum detected concentrations against risk-based values for direct contact. This conservative approach ensures that all potentially significant risks to human health and the environment are considered.

Consistent with the production history at Fernald, the most common (and highest levels of) radionuclide contaminants found within OU3 major media were uranium-238 (and its decay products, uranium-234, thorium-230, and radium-226), uranium-235 (and its primary decay product, actinium-227), and thorium-232 (and its decay products, radium-228 and thorium-228). The most common (and highest levels of) inorganic chemical contaminants found within OU3 major media were lead, chromium, cadmium, and mercury. The most common (and highest levels of) organic chemical contaminants were 1,4-dichlorobenzene, hexachlorobutadiene, nitrobenzene, and tetrachloroethene.

A contaminant source term was developed for each COC in OU3, considering the projected volume and weight of the materials. Calculations of the contaminant source terms were based on the assumption that the maximum contaminant concentration within a medium in a process area provided a conservative estimate of the contaminant level for the entire process area.

The most meaningful way to develop the source terms was to group OU3 materials into ten distinct categories, which are listed in the table on page 3. The ten categories were then further subdivided into segregation categories to allow for evaluation of treatment and disposition options. The table on the top of page 8 shows the quantity and characterization of materials per material category.

The disposition of the material category termed "Product, Residues, and Special Materials" is being addressed under existing approved programs. The significant quantities within this category include various soil piles (almost one million cubic feet) and drummed wastes (approximately 620,000 cubic feet). The soil piles have been addressed within the OU5 Feasibility Study and will be dispositioned according to the OU5 ROD. For the drummed wastes, Removal Action 9 (discussed previously on pages 5 and 6) is the mechanism for off-site disposition. These materials will continue to be disposed of off-site in accordance with the approved removal action work plan. Therefore, the volumes within this material category have not been included further in this evaluation.

Remedial action objectives are established to mitigate the potential threat posed by contaminants to human health and the environment. These objectives are developed based on characterization information contained in Section 3 of the *OU3 RI/FS Report* and are consistent with provisions in the National Contingency Plan as well as U.S. EPA guidance.

For Fernald operable units that address environmental media, such as soils and groundwater, remedial action objectives reflect the conditions that may remain in place without causing unacceptable risk to human health or the environment. For OU3, there will be no material left in place; as stated in the IROD, all buildings, equipment, products, and wastes will be removed and placed in interim storage pending a final remedy decision. Residual contamination will not exist after remediation of OU3 is complete. Therefore, in general, the remedial action objectives are as follows:

- Remediate OU3 to mitigate the potential exposure of human and environmental receptors to contaminants; and

- Implement the final disposition of OU3 materials in a manner that ensures potential receptors are protected from the contaminants.

SUMMARY OF OU3 WASTE VOLUMES AS ESTIMATED BY CATEGORY (IN CUBIC FEET)

OU3 Material Category	Potentially Hazardous/ Mixed Waste	Regulated PCBs (TSCA)	Low-Level Radioactive Waste	Below *Baseline*	Total
Accessible Metals	0	0	63,400	0	63,400
Inaccessible Metals	0	14,900	1,700,000	0	1,710,000
Process-Related Metals	0	0	191,000	0	191,000
Painted Light-Gauge Metals	49	0	7,100	0	7,150
Concrete	55,800	0	498,000	4,250,000	4,800,000
Brick	10,200	0	10,500	0	20,700
Non-Regulated Asbestos-Containing Materials	7,770	0	49,800	2,680	60,300
Regulated Asbestos-Containing Materials	10,100	0	58,500	11,600	80,200
Miscellaneous Materials	22,800	0	53,100	488,000	564,000
Product, Residues, and Special Materials	54,400	0	1,740,000	0	1,800,000
Total	**161,000**	**14,900**	**4,370,000**	**4,750,000**	**9,300,000**

These objectives are achieved by establishing waste acceptance criteria for the disposal facilities, both on-property and off-site. Waste acceptance criteria, which are specifications and conditions under which waste can be accepted for disposal, include regulatory standards, facility design information, and risk-based analyses. For the on-property disposal facility, the waste acceptance criteria for OU3 were based on the OU2 and OU5 feasibility study modeling, and then adjusted to apply to OU3-specific materials.

Of the OU3 COCs, only uranium and technetium-99 were identified as having the potential to exceed acceptable groundwater levels beneath the on-property disposal facility. Experimental lab studies were conducted to determine uranium and technetium-99 leachability from various construction materials. For conservativeness, samples of OU3 materials with highest technetium-99 and uranium concentrations were used. The results of the studies demonstrated that uranium concentrations that leached from all test samples were well below acceptable levels for on-property disposal. Conservative modeling also showed that the small volume of OU3 materials that were not tested for uranium leachability were also acceptable for on-property disposal. Therefore, all uranium-contaminated materials, with the exception of highly contaminated process materials, can be safely disposed of in the on-property disposal facility.

On the other hand, the studies showed that technetium-99 has the potential to leach at levels that could impact groundwater. Modeling was then used to determine that a safe level of technetium-99 within the on-property disposal facility is 105 grams. This modeling used the conservative assumption that technetium-99 would completely leach out of the on-property disposal facility over a 70-year span (which is considered by EPA to be an average human lifespan). Therefore, an allowable mass of 105 grams was adopted as the OU3 on-property waste acceptance criteria for technetium-99. Specific details on the development of the waste acceptance criteria for the on-property disposal facility are provided in Appendix G of the *OU3 RI/FS Report*.

Waste acceptance criteria for the off-site disposal facilities are derived from the relevant permits and licenses of those facilities. Specific values for a representative facility are detailed in Appendix F of the *OU3 RI/FS Report*.

REMEDIAL ALTERNATIVES

One goal of CERCLA is to select remedial actions, or an appropriate combination of methods, that protect human health and the environment, maintain protection over time, and minimize the amount of untreated waste. This goal reflects the preference for treatment over ***engineering controls*** and/or ***administrative controls*** to reduce toxicity and/or mobility of contaminants whenever practical to

ensure that material remaining on-property can be reliably controlled over time. However, for secondary threat materials, or wastes that pose a relatively low long-term threat, U.S. EPA allows the use of engineering controls or a combination of engineering and administrative controls, where appropriate. Surface decontamination of buildings and structures will be performed during the interim remedial action. Based on the projected residual contamination of remediation materials following dismantlement, the decontamination steps associated with that process, and the results of treatment technology evaluation, the OU3 wastes are principally considered to be secondary threat materials. The OU3 remedial strategy provides for further treatment on a selected basis as necessary to ensure protectiveness during the final remedial phase.

The remedial alternatives were developed based on technology types and process options that were identified to achieve remedial action objectives. The primary focus of the alternative development was disposition rather than treatment. Treatment was evaluated as required to facilitate meeting the waste acceptance criteria for final disposal. Therefore, administrative and engineering controls were the primary bases on which alternatives were developed. Administrative controls have been established by the OU5 response actions. Engineering controls for on-property or off-site disposal are also limited because of the few facilities capable of disposing of radiologically contaminated materials.

Three alternatives for the final remedial action have been developed and are summarized below:

Alternative 1 -- No Further Action

This alternative is required by CERCLA so that a basis for comparison exists for any cleanup alternatives identified. Alternative 1, called the "No Further Action Alternative," assumes that the interim remedial action proceeds to completion and places all generated materials within a hypothetical interim storage area. The interim storage area would contain uncovered piles of accessible metals, inaccessible metals, concrete, and transite. All other materials would be staged in containers. At the completion of the interim remedial action, maintenance of the interim storage area would be terminated. Thus, materials would be exposed to the environment with potential releases of contamination to environmental media. Within an unmaintained area, no mechanisms would be employed to prevent trespassers from entering the area. Because of commitments to the public by DOE and U.S. EPA, the IROD specifically commits to performing a final remedial action that involves the disposition of OU3 materials. However, Alternative 1 is retained as a baseline against which the effectiveness of the other alternatives may be compared.

Alternative 2 -- Selected Material Treatment, On-Property Disposal, and Off-Site Disposition

As stated above, most OU3 remediation materials contain low levels of contaminants and are therefore not a principal threat. For these materials, the remedial strategy calls for disposition, using administrative and engineering controls, in an on-property disposal facility.

The RI/FS process estimated that the total amount of technetium-99 in OU3 materials is approximately 127 grams. However, leachability study data, supplemented with conservative modeling assumptions, showed that the maximum amount of technetium-99 that could safely be stored in the on-property disposal facility is 105 grams. In order to not exceed this 105-gram limit for the on-property disposal facility, those materials that have the highest amounts of technetium-99 will be packaged and transported to NTS or an off-site commercial disposal facility.

Process-related metals, acid brick, product, residues, and special materials generally have high concentrations of several contaminants, including technetium-99. By administratively deciding to disposition these materials off-site, the technetium-99 source term remaining in materials considered for on-property disposal is 117 grams. Of all materials contributing to this source term, the most significant contributor is concrete with a total 103 grams. In order to further reduce the amount of technetium-99 going into the on-property disposal facility, Alternative 2 includes scabbling the top inch of the three most contaminated concrete areas within OU3: the enriched uranium casting area in Plant 9; the uranium machining area in Plant 9; and the muffle furnace area in Plant 8. The removal and off-site disposition of this concrete would reduce the total amount of technetium-99 going into the on-property disposal facility to 59 grams, which is 44 percent below the 105 gram allowable mass limit.

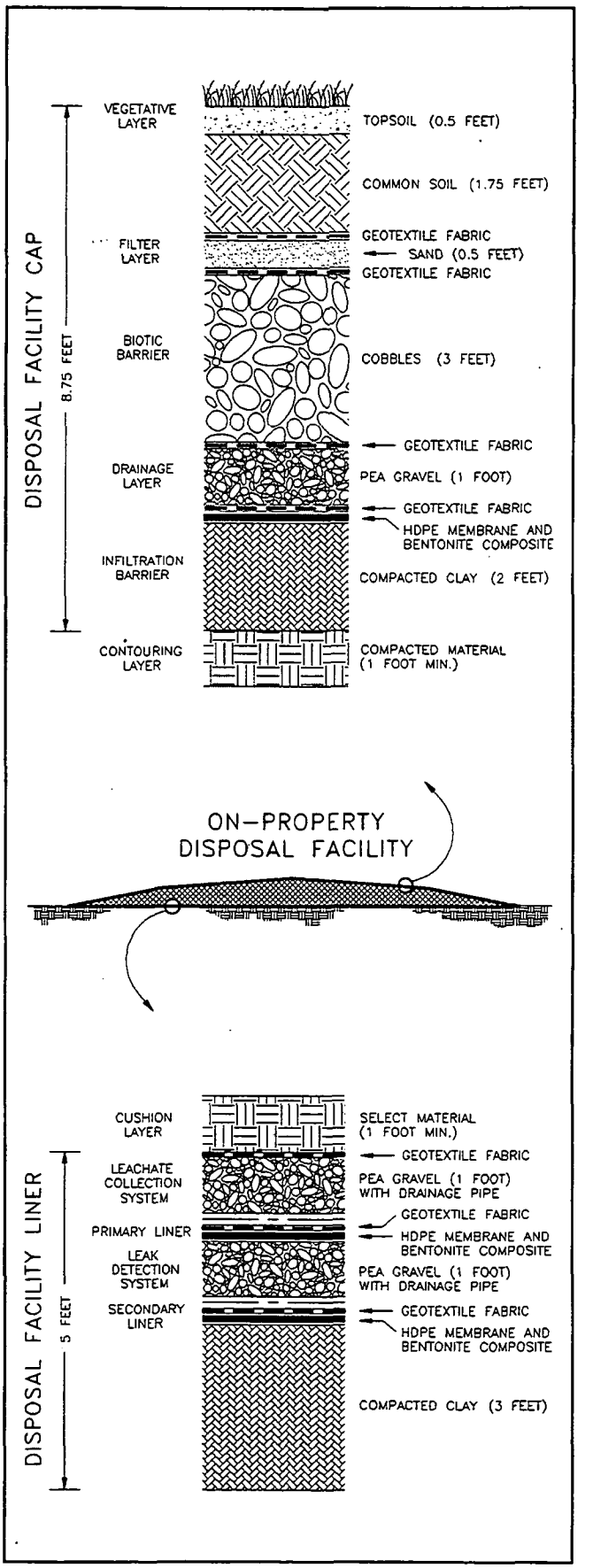
Under Alternative 2, most of the OU3 remediated materials would be permanently dispositioned in an on-property disposal facility, which would be designed and constructed in accordance with the relevant requirements of the Resource Conservation and Recovery Act and the Uranium Mill Tailings Remediation Control Act. As described in the OU2 ROD, the facility would feature a multi-layer capping

system, including a vegetative soil layer, a filter layer, a biotic barrier, a drainage layer, and an infiltration barrier. The disposal facility would also feature a multi-layer liner that would include a leachate collection system, primary and secondary liners separated by a leak detection system, and a low-permeability compacted clay layer. The layers of both the cap and liner would be separated by geotextile fabrics and high-density polyethylene (HDPE) and bentonite composites for added protection. The drawing on the right depicts a possible multi-layered capping and liner system for the on-property disposal facility. The disposal facility would prevent contaminant migration to the air and surface water and is modeled to protect groundwater for a 200- to 1,000-year performance period.

Key elements of Alternative 2 are summarized below:

- Provide for ***unrestricted release*** of materials, as economically feasible, for recycling, reuse, or disposal at a commercial landfill;
- Administratively disposition process-related metals and brick off-site because of the high concentration of COCs generally found in these materials;
- Remove identified material as necessary to achieve the technetium-99 mass limit for on-property disposal and dispose of it off-site;
- Dispose of all remaining wastes in the on-property disposal facility (along with wastes generated by OU2 and OU5);
- Treat materials, where required, to meet the waste acceptance criteria for the off-site disposal facility;
- Impose administrative controls through deed restrictions and access controls; and
- Incorporate post-remediation activities that include long-term monitoring and maintenance of the on-property disposal facility and operation of a groundwater monitoring network to evaluate the performance of the on-property disposal facility.

A summary of the disposition paths for OU3 materials is presented in the table on the top of page 11. As shown in this table, approximately 6.3 million cubic feet of OU3 materials (not including product, residues, and special materials) would be disposed of directly in the on-property disposal facility. Approximately 986,000 cubic feet of concrete and miscellaneous materials are not



MULTI-LAYERED LINER AND CAPPING SYSTEM FOR THE ON-PROPERTY DISPOSAL FACILITY

ALTERNATIVE 2 MATERIAL DISPOSITION QUANTITIES (IN CUBIC FEET)

OU3 Material Category	On-Property Disposal	Unrestricted Release	Off-Site Disposal	Total
Accessible Metals	63,400	0	0	63,400
Inaccessible Metals	1,710,000	0	0	1,710,000
Process-Related Metals	0	0	191,000	191,000
Painted, Light-Gauge Metals	7,150	0	0	7,150
Concrete	4,300,000	498,000	2,190	4,800,000
Brick	0	0	20,700	20,700
Non-Regulated Asbestos-Containing Materials	60,300	0	0	60,300
Regulated Asbestos-Containing Materials	80,200	0	0	80,200
Miscellaneous Materials	75,900	488,000	0	564,000
Total	6,300,000	986,000	214,000	7,500,000

contaminated and could be released, disposed of in a commercial landfill, or also included in the on-property disposal facility. Another 214,000 cubic feet is to be disposed of at NTS or an off-site commercial disposal facility.

Implementation of Alternative 2 would rely on coordination with other Fernald remedial actions to provide certain elements, including the on-property disposal facility, long-term monitoring, and security.

Based on the projected construction period for the on-property disposal facility, it is assumed that a three-year window exists with remediation materials in interim storage pending construction of an on-property disposal facility. Once an on-property disposal facility is capable of receiving OU3 remediation materials from interim storage and ongoing dismantlement projects, the movement of remediation material from interim storage to the disposal facility would be prioritized to reduce interim storage requirements. Once the disposal facility is available, remediation materials being generated by the ongoing dismantlement projects would be sent directly to the on-property disposal facility for placement.

Alternative 3 -- Selected Material Treatment and Off-Site Disposal

The primary difference between Alternatives 2 and 3 is the disposal location for OU3 materials. Under this alternative, all remediation materials would be dispositioned at an off-site disposal facility. Key elements of the alternative are summarized below:

- Provide for unrestricted release of materials, as economically feasible, for recycling, reuse, or disposal at a commercial landfill;
- Treat materials, where required, to meet the waste acceptance criteria for the off-site disposal facility; and
- Dispose of wastes in an off-site disposal facility if waste acceptance criteria are met.

Like Alternative 2, 986,000 cubic feet of concrete and miscellaneous materials, which are not contaminated, could be released or disposed of in a commercial landfill. The remaining material (6.51 million cubic feet) would be disposed of at NTS or an off-site disposal facility.

Implementation of Alternative 3 would rely on coordination with other Fernald remedial actions to provide for certain elements, including the waste shipment facilities, and the fencing and security prescribed under administrative controls. For this alternative, any rail shipment of materials off-site would be coordinated with the rail shipments occurring for OU1.

COMPARISON AND EVALUATION OF ALTERNATIVES

To provide a basis for selecting the preferred remedial action alternative, each alternative is evaluated against specific U.S. EPA criteria. These criteria are described in the shaded box on page 12.

EVALUATION CRITERIA

The following criteria are based on guidance published by the U.S. EPA and are used to evaluate each of the possible remedial action alternatives. The first seven criteria are discussed more thoroughly in this Proposed Plan along with how the criteria apply to each alternative. The last two criteria, *State Acceptance* and *Community Acceptance*, will be addressed during the public comment period.

1. *Overall protection of human health and the environment* addresses whether an alternative eliminates, reduces, or controls threats to public health and the environment.

2. *Compliance with ARARs* addresses whether an alternative meets federal and state environmental laws and regulations.

3. *Short-term effectiveness* considers the time needed for an alternative to achieve remedial response objectives and the risks posed to workers, residents, and the environment during the remedial action.

4. *Long-term effectiveness and permanence* considers the ability of an alternative to protect public health and the environment long after remedial action is complete.

5. *Reduction of toxicity, mobility, or volume through treatment* evaluates an alternative's use of treatment to reduce the harmful nature of contaminants, their ability to move in the environment, and the amount, or volume, of contamination present.

6. *Implementability* addresses the feasibility of an alternative, both from a technical and an administrative standpoint.

7. *Cost* considers the amount of money it will take to design, construct, operate, and maintain the alternative.

8. *State acceptance* addresses comments made by the Ohio EPA concerning the alternatives considered.

9. *Community acceptance* addresses the formal comments made by the public on the alternatives being considered. You can voice your opinion as a member of the public either by completing the attached comment sheet and sending it to DOE, or by speaking at the public meeting on **{date to be determined}**. At the end of the public comment period, DOE will respond to questions and comments. These responses will become part of the Record of Decision document.

The first two criteria are "threshold" criteria, meaning that they must be attained if the alternative is to be considered further in the evaluation and selection process. The one notable exception is that waivers to ***applicable or relevant and appropriate requirements (ARARs)*** can be obtained as long as protectiveness of human health and the environment can still be demonstrated. The next five criteria form the basis for the comparative analysis of viable remedial alternatives. These five are called "primary balancing" criteria because they are used to evaluate the relative tradeoffs among the alternatives that pass the threshold criteria. The last two criteria are "modifying" criteria because DOE and U.S. EPA may modify the preferred alternative or select another response action based on comments received during the public comment period.

Overall Protection of Human Health and the Environment

This criterion addresses the means by which a potential remedy would reduce, eliminate, or control the risks posed by OU3 materials to human health and the environment. The methods used to achieve an adequate level of protection may include engineering controls, waste treatment techniques, or other controls such as restriction on the future use of the site. Total elimination of risk is often impossible; however, a remedy must minimize risk to ensure human health and the environment are protected.

Under Alternative 1, all OU3 materials at the site would be stored without continued maintenance. Over the long-term, exposure of these materials to the weather would lead to unacceptable releases to the environment. This alternative would not protect human health or the environment. Alternative 2 would employ conservative design considerations from other engineered disposal facilities, including Uranium Mill Tailings Remediation Control Act standards and Resource Conservation and Recovery Act regulations, to ensure the long-term performance of the disposal facility. These standards would require the use of multilayered capping and lining systems, the development of contaminant- and material-specific waste acceptance criteria, and the use of a design which ensures protectiveness for 200 to 1,000 years. These design considerations would supplement the natural containment capabilities of the existing site geology to ensure the long-term performance of the disposal system. Alternative 3 would also protect human health and the environment because all OU3 materials would be removed from Fernald and dispositioned off-site.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

This criterion determines whether a selected remedy will meet all related federal, state, and local requirements. These requirements may specify maximum concentrations of chemicals that can remain at a site, specify design or performance requirements for treatment technologies, and impose restrictions that may limit potential remedial activities at a site because of its location.

Because of anticipated releases from ongoing storage, Alternative 1 would not comply with ARARs. Alternative 2 would comply with ARARs except those excluded upon receipt of a waiver from the U.S. EPA for the State of Ohio solid waste disposal facility siting requirements. To be granted the waiver, the DOE would be required to adopt an engineering design for the facility which, when coupled with existing site geologic conditions, would attain a standard of performance that is equivalent to that required under State of Ohio solid waste disposal facility siting requirements. Alternative 3 would comply with all ARARs.

Short-Term Effectiveness

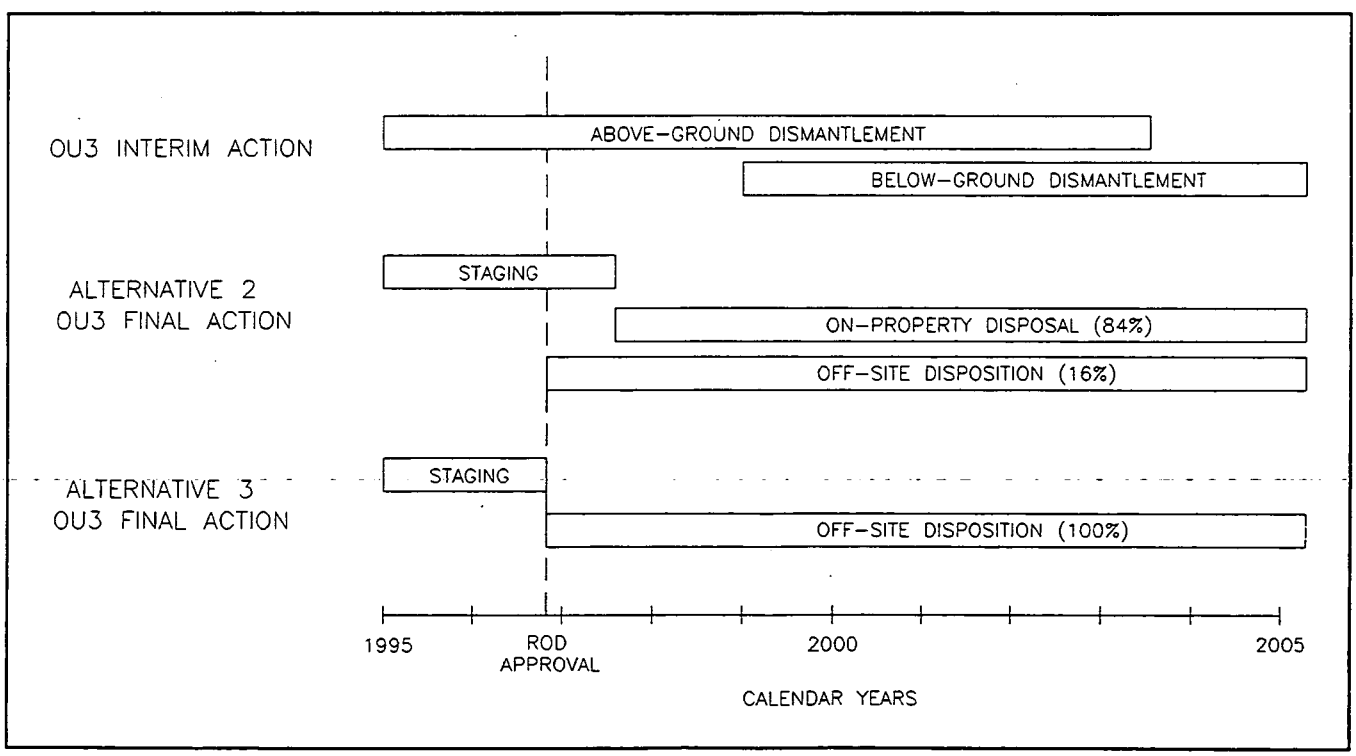
This criterion evaluates the potential impacts of the alternative to workers, the public, and the environment.

Alternative 1 presents no short-term impacts since no worker action would occur. Risks from radiological and chemical exposures from both Alternatives 2 and 3 are within acceptable levels. The most significant element of the short-term effectiveness of Alternatives 2 and 3 is the risk associated with projected injuries related to mechanical hazards. These risks are greater for Alternative 3 than Alternative 2 due to the greater number of manhours associated with weighing, certifying, and loading containers for off-site shipment. Additionally, the increased number of shipments off-site associated with Alternative 3 raises the risk for potential accidents. The schedule, as shown below, illustrates the overlap of the final remedial action and the interim remedial action. This schedule is based on site remediation under a DOE budget scenario that would enable the completion of OU3 remediation in approximately ten years.

Long-Term Effectiveness and Permanence

This criterion evaluates the ability of a potential remedy to reliably protect human health and the environment over a long period of time after the remedial goals have been accomplished.

Alternative 1 would present an unacceptable magnitude of risk remaining at Fernald and would provide the most limited amount of reliability and permanence. Long-term risks to potential trespassers from uncontrolled storage of



COMPARISON OF SCHEDULES FOR THE ALTERNATIVES (ACCELERATED CASE ASSUMPTION)

contaminated materials would exceed acceptable risk levels. Both Alternatives 2 and 3 achieve high levels of protectiveness and permanence. The implementation of Alternative 2 would rely on engineering and administrative controls to ensure the long-term performance of the remedy and maintain the protection of human health and the environment over time. Long-term monitoring activities are currently proposed by other approved remedial actions and would continue for OU3. For Alternative 3, the removal of all materials to off-site disposal locations would ensure the long-term protection of human health and the environment at Fernald. Under Alternative 3, no long-term requirements for continued administrative controls, surveillance, or maintenance would be necessary for OU3.

Reduction of Toxicity, Mobility, or Volume Through Treatment

This criterion assesses how effectively a proposed remedy will address the contamination problem. Factors considered include the nature of the treatment process, the amount of hazardous materials that will be destroyed by the treatment process, how effectively the process reduces the toxicity, mobility, or volume of waste, and the type and quantity of contamination that will remain after treatment.

Alternative 1 would provide no reduction in contaminant toxicity, mobility, or volume. Furthermore, by placing all materials into permanent storage without continued maintenance, the mobility of the contaminants would increase over time and would lead to eventual releases to the environment. For Alternative 2, all mixed wastes to be dispositioned off-site would be treated through solidification or encapsulation to meet land disposal restrictions and would thereby reduce the contaminant mobility. Because all material would be dispositioned off-site, Alternative 3 would provide the greatest reduction of toxicity, mobility, or volume by treating the greatest quantity of material to meet land disposal restrictions in comparison to the other alternatives.

Implementability

This criterion addresses the relative ease or difficulty with which a remedy can be put in place. Factors affecting implementability include materials and services.

Alternative 1 is the most readily implementable, since it requires no additional action beyond the implementation of the OU3 IROD. Because of the approval and construction of a site-wide on-property disposal facility for OU2 and OU5, Alternative 2 would be easier to implement than Alternative 3. The construction of an on-property disposal facility is considered readily implementable through the use of existing technologies and construction methods. Furthermore, under Alternative 2, a small portion of the OU3 materials would be dispositioned off-site, and would thus require truck transportation. For Alternative 3, implementation would require coordination with OU1 to transport OU3 material to the representative off-site disposal facility. This quantity to be transported off-site currently exceeds Fernald's shipping capacity. Considerable coordination would be required between DOE and various states and municipalities to facilitate the transportation of such large quantities of materials. If schedule delays were to occur to the implementation of Alternative 3, the available capacity at current facilities or facilities yet to be constructed is unclear. For these reasons, Alternative 3 is considered less implementable than Alternative 2.

Cost

This criterion includes capital costs for design and construction as well as projected long-term maintenance costs. The cost is considered and compared to the benefit that will result from implementing the remedy.

Two methods are used to present costs associated with implementing each of the alternatives. As shown in the "Summary Table for the Evaluation of Alternatives" on page 16, the first method illustrates the costs in current fiscal year (1995) dollars. In other words, if the entire cost of the alternative was paid during the 1995 fiscal year, then that cost would be considered to be in current year dollars. However, because of inflation, work performed in the future will undoubtably cost more than work performed today.

To account for this and the time value (or investment potential) of money, a second cost estimating approach is used, called present worth analysis. Present worth analysis calculates the amount of money that would have to be invested today to pay for the cleanup over the years of implementation. The real interest rate applied in the present worth analysis is determined by the Federal Government's Office of Management and Budget to be 4.8 percent, based on an investment interest rate minus the rate of inflation.

No additional cost is associated with Alternative 1 since no additional action would be required. Current estimates indicate that Alternative 2 would

cost $93 million in current year dollars, which is equivalent to a present worth cost of $70 million. Due to the higher costs associated with off-site transportation and disposal, the cost of Alternative 3 is estimated to be $194 million in current year dollars. This equates to a present worth cost of $150 million.

State Acceptance

State acceptance and/or concerns regarding the *OU3 RI/FS Report* and Proposed Plan have been incorporated in the final version of those documents. Any additional concerns identified during the public comment period will be incorporated in the final ROD and responsiveness summary.

Community Acceptance

During the public comment period, interested members of the public can voice their opinion on which parts of the alternative they support, which parts they may have reservations about, and which parts they oppose. Public comments may be submitted in writing using the attached comment sheet, or verbally during the public meeting. Community acceptance will be assessed after the public comment period and will be addressed in the ROD.

PREFERRED REMEDIAL ALTERNATIVE

Based on the comparative evaluation presented above and summarized on page 16, U.S. EPA and DOE have identified Alternative 2, *Selected Material Treatment, On-Property Disposal, and Off-Site Disposition,* as the preferred remedial alternative. This alternative calls for the release of certain items, such as equipment, tools, etc., to other DOE sites or as scrap material to the extent practicable. All OU3 materials that remain at Fernald following the interim remedial action will be evaluated, based on material type and contaminant levels, to determine the least-cost disposition option.

Alternative 2 is recommended because it provides a remedy which is reliable over the long term, is less costly, and is readily implementable. All short-term exposures from the preferred alternative are estimated to be within acceptable limits. Also, the alternative would be in compliance with all ARARs, except those excluded upon receipt of a waiver from the U.S. EPA for the State of Ohio solid waste disposal facility siting requirements.

The DOE will continue to assess the viability of emerging technologies to support the selected remedy in a more cost effective and equally or more protective manner.

SUMMARY OF RISKS FOR THE PREFERRED ALTERNATIVE

The proposed action was analyzed for potential health effects on the general public and workers and for general environmental impacts. Potential health impacts were analyzed for two general types of receptors: remediation workers involved in the proposed action; and the general public. An assessment of both radiological and chemical contaminants was performed to support this summary. Both potential ***doses*** and risks were developed as estimates; dose represents the amount of exposure to a contaminant that an individual receives, while risk is the affect of that dose and equals the chance of additional cancer incidence. The potential risks to the general public, the workers, and the environment are summarized in the following sections.

Health Effects: General Public

For the general public, two hypothetical receptors (an off-site resident and an individual along the primary transportation route) were assessed for radiological and chemical contaminants under maximum exposure situations. Based on this assessment, it is estimated that the total risk to each receptor, under the preferred alternative, is expected to be lower than the EPA acceptable risk range of 10^{-4} (one in ten thousand) to 10^{-6} (one in a million). The estimated risk to the maximally exposed off-site resident due to radionuclide inhalation associated with the preferred remedial alternative is about 1.9×10^{-6}, which represents a one in 530,000 chance of additional cancer incidence. The risk due to inhalation of chemicals is about 5.8×10^{-8} (one in 17 million). These potential risks would be minimized by implementing a combination of engineering (dust suppression) and administrative (physical barriers) controls.

Risks to the maximally exposed member of the public along the off-site transportation route are a result of direct radiation exposure and equal about 3.1×10^{-9} (one in 320 million) for incident-free transport. Under a potential traffic accident, the risks to the maximally exposed member of the public could be 1.2×10^{-7} (one in 8.3 million) chance of additional cancer incidence. These risks are below the EPA risk range and are, therefore, acceptable.

Health Effects: Workers

Potential health impacts were analyzed for three types of Fernald workers: remediation workers involved in the loading, inspection, and movement of containerized material within the Fernald site boundaries; administrative support staff at Fernald

SUMMARY TABLE FOR THE EVALUATION OF ALTERNATIVES

Evaluation Criteria	Alternative 1 No Further Action	Alternative 2 Selected Material Treatment, On-Property and Off-Site Disposal	Alternative 3 Selected Material Treatment and Off-Site Disposal
Overall protection of human health and the environment	Not protective of human health and the environment.	Provides overall protection of human health and the environment.	Provides overall protection of human health and the environment.
Compliance with ARARs	Not compliant because no further action would likely result in exposures to the public and releases to the environment.	Compliant with all ARARs, except those excluded upon receipt of a waiver from the U.S. EPA for the State of Ohio solid waste disposal facility siting requirements.	Compliant with all ARARs.
Short-term effectiveness	No short-term risks since no action would be taken.	All radiological and chemical exposures are estimated to be within acceptable limits. This alternative presents lower short-term risks associated with mechanical hazards than Alternative 3.	All radiological and chemical exposures are estimated to be within acceptable limits. Greater mechanical hazards than Alternative 2 due to injuries from transporting all materials to off-site disposal facilities.
Long-term effectiveness and permanence	Not protective in the long-term. Would result in unacceptable long-term risks to the public.	Is protective of human health and the environment through site geology, engineering, and administrative controls. However, Alternative 2 is less effective and permanent in the long-term than Alternative 3.	Is the most effective and permanent since all contaminated material would be removed from Fernald with no long-term requirements for continued administrative controls, surveillance, or maintenance activities.
Reduction in toxicity, mobility, or volume through treatment	Due to unmaintained storage of dismantled debris, contaminant mobility is expected to increase.	Potentially treats 11,600 cubic feet of material to meet land disposal restrictions for off-site disposal.	Potentially treats more material (an additional 95,000 cubic feet) than Alternative 2 because of land disposal restrictions for off-site disposal.
Implementability	Easier to implement than Alternatives 2 or 3 because no action occurs.	Easier to implement than Alternative 3 because this alternative only requires placement of OU3 materials into an on-property disposal facility already being constructed for OU2 and OU5 materials.	Hardest alternative to implement because it is dependent on whether agreements are reached with off-site disposal facilities to accept waste. Considerably more coordination would be required with state and local authorities along transportation routes. The volume of material would also require a longer time period to complete shipments.
Current year (1995) cost (in millions)	$0	$93	$194
Present worth cost (in millions)	$0	$70	$150
State Acceptance	Will be documented in the ROD and responsiveness summary.	Will be documented in the ROD and responsiveness summary.	Will be documented in the ROD and responsiveness summary.
Community Acceptance	Will be addressed when comments are received from the public.	Will be addressed when comments are received from the public.	Will be addressed when comments are received from the public.

referred to as non-remediation workers; and truck drivers who transport wastes to off-site disposal facilities.

The dose to the maximally exposed remediation worker as a consequence of direct radiation and inhalation of radionuclides is estimated to be 360 millirem per year, which is 14 times below the safe limit for occupational workers of 5,000 millirem per year, as specified in DOE Order 5480.11. These occupational doses are based on a remediation worker standing one meter away from waste containers and piles while inspecting them for eight hours per day, 250 working days per year. For comparison purposes, an average individual in the United States receives a radiation dose of about 300 millirem per year from natural ***background radiation***, or about 2,300 times larger than that estimated for the proposed action.

Based on the annual dose of 360 millirem and a ten-year schedule, the total project risk to a remediation worker from radionuclides would be about 2.8×10^{-3} (one in 360). The associated chemical risk to a remediation worker, based on inhalation, would be 9.8×10^{-7} (one in a million) for the entire ten-year action.

The non-remediation worker is an administrative worker who is located 300 meters from cleanup activities. Because of this distance, the annual dose of 0.01 millirem to non-remediation workers from inhalation of airborne radionuclides and direct radiation is considerably lower than the dose to the remediation worker. Based on a ten-year schedule, the total project risk to a non-remediation worker would be about 6.6×10^{-7} (one in 1.5 million) from radionuclides and 6.0×10^{-7} (one in 1.7 million) from chemicals.

The third type of worker is a truck driver, who is conservatively assumed to transport every container destined for off-site disposal. The cumulative dose from radiological direct exposure for this maximally exposed driver is estimated at 2,200 millirem over the duration of the ten-year project. The associated total project risk for this truck driver is 1.7×10^{-3} (one in 590).

Because of worker protection including engineering, administrative, and monitoring controls that would be used during the preferred alternative, all exposures to the three types of workers would remain within acceptable levels. In addition, the risks from inhalation for both remediation and non-remediation workers may be overestimated by two orders of magnitude. These risks were calculated using the conservative assumption that all contaminants within OU3 concrete would become airborne as the concrete is placed in the on-property disposal facility. However, dust suppressants would be used to control contaminants from becoming airborne.

Another consideration when determining project risk to workers is mechanical hazards (industrial accidents) associated with site remediation activities. The number of accidents from on-property activities estimated from the preferred remedial alternative is approximately 15 injuries and less than one fatality. Mechanical hazards associated with transporting waste materials are estimated to result in less than one injury to members of the public and truck drivers combined.

Environmental Effects

The preferred alternative would produce overall positive environmental impacts because disposing of the contaminated material generated during the interim remedial action would reduce the potential for releases to the environment. Also, cleanup activities would allow for the majority of the Fernald site to be returned to some form of beneficial use, like an undeveloped park.

SITE-WIDE INTEGRATION OF REMEDIES

Of the five operable units at Fernald, OU3 is chronologically the last to issue a Proposed Plan for public comment. Each of the operable unit FS reports has provided a progressive evaluation of the projected Fernald site-wide remedy, using the best information available at the time, to predict post-remediation site conditions. This site-wide remedy incorporates the selected or preferred alternative for each operable unit, as appropriate. The intent of the analysis is to progressively monitor the interfaces among the operable units to ensure that the final adopted site-wide remedy would be well thought out, would be cost effective, and would ensure the long-term protection of human health and the environment.

The *OU3 RI/FS Report* includes an evaluation employing the preferred OU3 alternative in conjunction with the selected remedies for other operable units listed in the table on the top of page 18.

Material with higher levels of contamination, deemed to represent the principal threat at the site, would be treated (if required) and shipped off-site for disposal. Material exhibiting lower contaminant concentrations distributed over a larger volume, termed a secondary threat, would be permanently disposed of at the

REMEDIES ADOPTED TO COMPLETE SITE-WIDE ANALYSIS

Operable Unit	Key Components
OU1 - Waste Pits	• Excavation of pit contents, caps, berms, and lining system • Excavation of contaminated soil underlying pits and placement of soil and oversized debris meeting the waste acceptance criteria in the on-property disposal facility • Drying of excavated soil and waste, as required • Shipment of excavated material (including soils and debris not meeting the waste acceptance criteria of the on-property disposal facility) by rail to off-site disposal facility • Decontamination and demolition of all OU1 structures and support facilities
OU2 - Other Waste Units	• Excavation of waste materials and adjacent contaminated soil • Shipment to off-site disposal facility of material not meeting waste acceptance criteria of on-property disposal facility • Placement of excavated material meeting waste acceptance criteria in on-property disposal facility
OU4 - Silos 1-4	• Removal and vitrification of waste inventories • Off-site disposal of vitrified waste • Excavation of contaminated soil and placement of soil and oversized debris meeting the waste acceptance criteria in the on-property disposal facility • Decontamination and demolition of silo structures and support facilities • Placement of rubble and debris in on-property disposal facility
OU5 -Environmental Media	• Excavation and consolidation of contaminated soil and sediment • Disposal of soil and sediment meeting waste acceptance criteria in the on-property disposal facility • Off-site disposal of soil and sediment not meeting waste acceptance criteria of on-property facility • Extraction and treatment of contaminated groundwater • Collection and treatment of contaminated stormwater • Decontamination and demolition of support facilities used during remedial activities • Recycling/reuse of generated debris and equipment to the extent practical • Disposal of all materials remaining after closure of the on-property disposal facility at an off-site disposal facility
Continuing Site-wide Issues	• Long-term environmental monitoring program for the Fernald site • Continued maintenance and surveillance of the on-property disposal facility • Performance of reviews of site conditions by EPA every five years • Continued federal ownership of on-property disposal facility area • Restrictions placed in FEMP property deed pertaining to future uses of the site

Fernald site in one central engineered disposal facility.

The analysis of the adopted site-wide remedy performed for the OU3 RI/FS included a risk analysis of the post-remedial site conditions. The purpose of this risk analysis was to determine whether the site-wide remedy could ensure the long-term protection of human health consistent with the adopted land use objective of the undeveloped park, as recommended by the Fernald Citizens Task Force and included in the draft OU5 ROD. The adopted land use objective was that of attaining a cleanup level which protects the hypothetical recreational users and an off-site farmer. This risk analysis examined the long-term performance of the disposal facility and the potential risks to future human receptors. The risks are due to residual concentrations of contaminants remaining at the site in soil and groundwater following the certified completion of remedial actions at Fernald.

The results of this risk analysis indicate that the adopted site-wide remedy would provide a maximum estimated risk to a future recreational user of the Fernald site within the 10^{-6} (one in a million) range. The maximum calculated risk to a hypothetical off-site farmer located immediately adjacent to the Fernald site for a 70-year lifetime would be within the 10^{-5} (one in 100,000) range.

In the unlikely event the projected administrative controls (i.e., continued federal ownership, deed restrictions, etc.) established to maintain the adopted land use were to fail, the maximum incremental risk a hypothetical on-property farmer would receive from the post-remediation site conditions was in the 10^{-4} (one in 10,000) range.

In completing the RI/FS for OU3 and the other Fernald operable units, DOE has acknowledged that uncertainties exist which may affect the course of remedial actions once field work is underway. Uncertainties can be managed by emphasizing conservatism for any assumptions made and by planning for additional data evaluation and assessment as the remedial actions are implemented. By acknowledging the existence of uncertainties, bounding assumptions on the conservative side, and planning for an iterative approach to implementation of the remedial actions, DOE and Fernald stakeholders can move forward with the decision-making process.

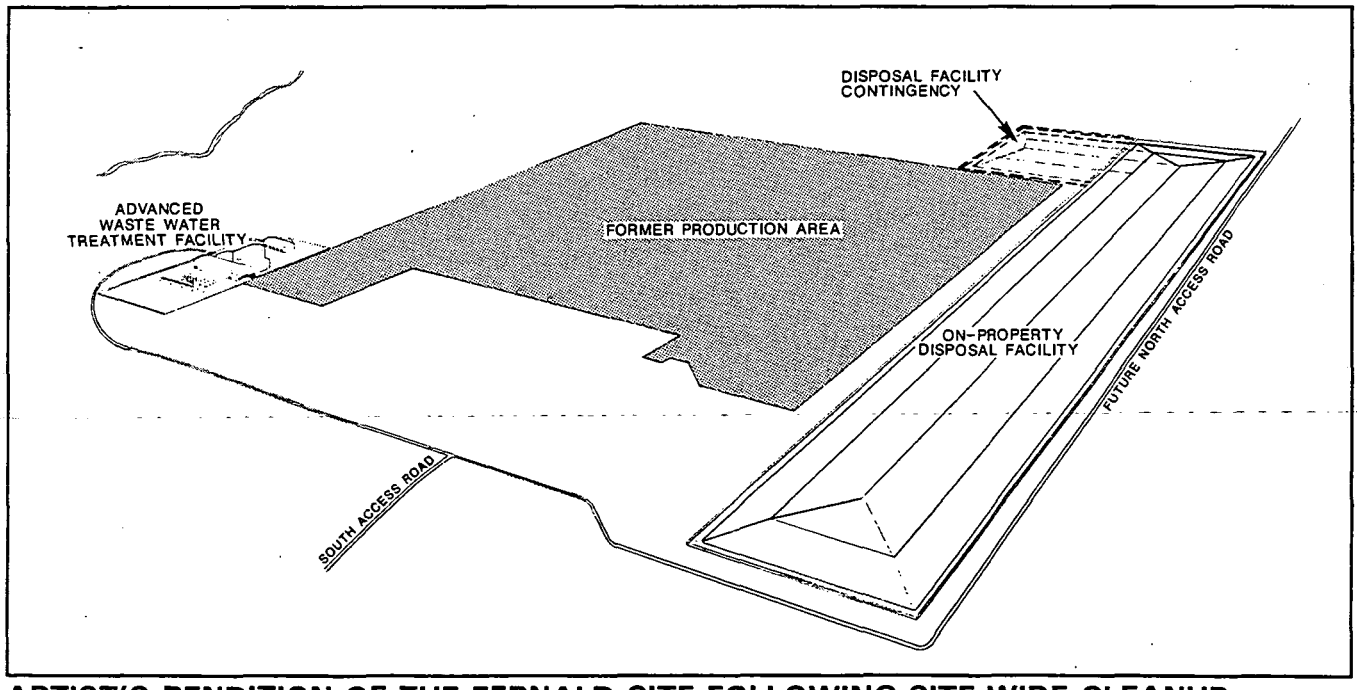
An artist's rendition of the appearance of the site following implementation of the adopted site-wide remedy is shown below. The proposed engineered disposal facility is estimated to be 4,300 feet by 800 feet and range in height from approximately 40 to 65 feet. The size of the facility is based upon the consolidation of about 2.5 million cubic yards of contaminated soil and construction debris from all operable units, with Operable Units 1 and 4 contributing a small portion of soil and debris.

The overall conclusion of the evaluation completed for the adopted site-wide remedy was that, collectively, the selected or preferred alternative for each operable unit would provide for the protection of human health and the environment over the long-term (i.e., up to or beyond 1,000 years). The evaluation further concluded that the adopted site-wide remedy would attain the adopted land use objective (i.e., restricted use of Fernald for industrial and recreational purposes) and provide for the long-term protection of the water quality in the Great Miami Aquifer.

COMMUNITY PARTICIPATION

DOE encourages public participation in the selection of the preferred alternative for the cleanup of OU3. Members of the public are encouraged to read and provide comments on the *OU3 RI/FS Report* and this Proposed Plan. The *OU3 RI/FS Report* describes the remedial action alternatives, based on field characterization, and describes the advantages and disadvantages of each alternative.

A final remedy selection for the disposal of OU3 materials will be made with consideration of stakeholder input. Based upon comments and information received, the preferred remedial alternative may be modified, another alternative identified in this Proposed Plan may be selected, or a new alternative may be selected.



ARTIST'S RENDITION OF THE FERNALD SITE FOLLOWING SITE-WIDE CLEANUP

The Public Environmental Information Center, or PEIC, houses the ***Administrative Record***, which is the official repository for documentation related to the RI/FS process at Fernald. The public is invited to review information on the OU3 RI/FS and other Fernald activities at the PEIC. The PEIC address and operating hours are:

Fernald Environmental Management Project
Public Environmental Information Center
10845 Hamilton-Cleves Highway (S.R. 128)
Harrison, OH 45030
phone: (513) 738-0164
fax: (513) 648-3081

Monday	9:00 a.m. - 7:00 p.m.
Tuesday	9:00 a.m. - 4:30 p.m.
Wednesday	9:00 a.m. - 4:30 p.m.
Thursday	9:00 a.m. - 7:00 p.m.
Friday	9:00 a.m. - 4:30 p.m.
Saturday	9:00 a.m. - 1:00 p.m.
Sunday and Holidays	Closed

For timely information on Fernald-related meetings and documents available for public comment or inspection, call the Fernald community information line at (513) 648-6272.

The OU3 public comment period will be open from ____ to _____. Any changes to these dates will be announced in the local media and posted at the PEIC (see the shaded box above).

THE NEXT STEP

Following the public comment period and associated public meeting, and assuming public acceptance of the preferred alternative, the DOE and U.S. EPA, with concurrence from Ohio EPA, will sign the OU3 final remedial action ROD. The ROD will describe the selected action and will include a responsiveness summary that provides responses to comments received during the public comment period and demonstrates how the remedy was modified by public input. After the document is signed, a plan for performing the remedial design and remedial action will be prepared. Once the design is complete, the final remedial action can begin.

This publication was printed on paper that is manufactured with at least 50% reclaimed fiber.

Public Comment Period

DOE and U.S. EPA will hold a 30-day public comment period for the Operable Unit 3 Proposed Plan from (?) to (?) **{to be scheduled}**. The comment period provides an opportunity for local residents and interested parties to express their views and concerns on the remedial alternatives being considered. Copies of the OU3 RI/FS Report and this Proposed Plan are available in the Fernald Administrative Record and at the U.S. EPA regional office in Chicago, Illinois.

Public Meeting

DOE, in coordination with the U.S. and Ohio EPAs, will also hold a public meeting during the public comment period to discuss the alternatives and to answer questions. The meeting is scheduled for **{date, time, and location to be determined}**. Written and oral comments will be accepted during the meeting.

Submitting Your Comments

Your comments on the final remedy for OU3 may be either presented at the public meeting or sent (via mail or fax) to either of the following addresses or fax numbers:

Mr. Gary Stegner
Public Information Director
DOE Fernald Area Office
P.O. Box 538705
Cincinnati, OH 45253-8705
phone: (513) 648-3153
fax: (513) 648-3073

Mr. James Saric
Remedial Project Director
U.S. EPA 5HRE 8J
77 West Jackson Blvd.
Chicago, IL 60604
phone: (312) 886-0992
fax: (312) 353-4788

The Ohio EPA is also participating in the remedy selection process. For additional information concerning the State of Ohio's role in the Fernald cleanup process, contact:

Mr. Tom Schneider
Fernald Project Manager
Ohio EPA
401 East Fifth St.
Dayton, OH 45402-2911
phone: (513) 285-6466
fax: (513) 285-6404

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GLOSSARY

Accessible Metals: a material category comprised of metals with large, accessible surface areas and thicknesses greater than or equal to 1/4-inch. This category also includes structural steel and decking.

Administrative Controls: the elimination of hazards through administrative means, such as management, procedures, record-keeping, and assessments. Administrative controls are not intended to physically stop individuals from entering hazardous areas or to remove hazards.

Administrative Record: the Administrative Record contains documentation of CERCLA-related activities for each operable unit. The documents in the Administrative Record are used to make decisions in Fernald's remediation program, as well as for short-term protective measures (removal actions) implemented until a final remediation plan can be put into effect. 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 Fernald site. The Administrative Record for the Fernald site is located at the Public Environmental Information Center.

Applicable or Relevant and Appropriate Requirements (ARARs): federal and state (usually included if they are more strict) standards that are legally applicable, or relevant and appropriate, at a Superfund site. ARARs, specifically, are cleanup standards, controls, and other measures which are borrowed from existing regulations to protect the environment.

Background Radiation: the radiation in the natural environment, including cosmic rays and radiation from naturally radioactive elements, both inside and outside the bodies of humans and animals. Many of the radiological and all of the inorganic contaminants present at Fernald exist naturally in measurable concentrations in all environmental media. The background concentration of each contaminant varies from point to point within a range for each material.

Baseline: an estimated concentration which is based on sampling data and literature values that represents a background level for an analyte in a material.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Superfund Amendments and Reauthorization Act (SARA): CERCLA is a Federal law, passed in 1980 and modified in 1986 (called SARA), that addresses the cleanup of contaminant releases to the environment. At Fernald, the DOE is the responsible party and is remediating the site with oversight from the U.S. EPA. The relevance of SARA to the Fernald site is that SARA contains provisions for setting up the Administrative Record as a vehicle for public involvement in cleanup activities.

Constituent of Concern (COC): chemical and/or radiological contaminants present within the operable unit that pose a risk of cancer or other adverse effects to human health and the environment as a result of exposure to the contaminants.

Dose: a term to describe the amount of exposure to a contaminant an individual receives. Exposures include inhalation (breathing), ingestion (swallowing), and external contact (touching).

Engineering Controls: the elimination of hazards through mechanical means or process design, which physically prevent entry, minimize hazards, or create some kind of barrier.

Hazardous Waste: a waste material exhibiting the characteristics of ignitability, corrosivity, reactivity, or toxicity or listed in 40 CFR 261, "Protection of Environment/Solid Waste/Resource Conservation and Recovery Act" or identified in applicable state regulations.

Hold-Up Material: feed stock, intermediate product material, and residual process material remaining in and on process equipment (i.e., clinging to the surfaces of the various pumps, pipes, vessels, or other equipment surfaces).

Inaccessible Metals: a material category consisting of metals with primarily inaccessible surface areas. This category includes non-process piping, conduit/wire, electrical fixtures, miscellaneous electrical items, doors, and other materials.

Intrusive Sample: a sample that is collected by disturbing the surface of the material from which the sample is to be collected. An example would be chipping concrete off a block, drilling through wood, or digging into the ground. A non-intrusive sample, in contrast, would be obtained by wiping the surface of the material.

Leachability: describes how readily a contaminant dissolves in a liquid (like rainwater).

GLOSSARY (continued)

Legacy Wastes: a term used at Fernald for the inventory of waste that was generated during the years of Fernald production (before 1989). Legacy wastes include containerized low-level radioactive waste, hazardous waste, mixed waste, and TSCA wastes (i.e., asbestos and PCBs). All materials generated after 1989 that are similar in nature to the production-related wastes will be handled as if they are legacy wastes.

National Priorities List (NPL): U.S. EPA's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action under Superfund. EPA is required to update the NPL at least once a year.

Non-Regulated Asbestos-Containing Material: a material category consisting of non-friable asbestos-containing materials, such as transite building siding and roofing, insulating bricks on boilers, and old floor tile.

Operable Unit: an operable unit (OU) can represent a number of separate activities undertaken as part of a Superfund site cleanup. At Fernald, five operable units make up the site for the purposes of cleanup. Each operable unit is defined based on a reasonable grouping or area of problems.

Painted Light-Gauge Metals: a material category consisting of painted metals less than or equal to 1/8 inch thick. All painted metals are assumed to have lead-based paint present. This category includes ductwork, louvers, metal interior and exterior wall panels, metal roof panels, and sheet lead.

Receptor: a person, animal, or plant exposed to cancer-causing or toxic agents which may cause health problems.

Record of Decision (ROD) and Interim Remedial Action Record of Decision (IROD): RODs and IRODs are public documents that explain which cleanup alternative(s) will be used at CERCLA sites.

Regulated Asbestos-Containing Material: a material category comprised of asbestos-containing material found in a loose or "friable" state. The largest source at Fernald is piping and ductwork insulation.

Remedial Action: the implementation of the action determined in the Record of Decision and represents the last phase of a Superfund site cleanup.

Remedial Design: the technical analysis and procedures that follow the selection of a site remedy, resulting in a detailed set of plans and specifications for implementation of the remedial action.

Remedial Investigation/Feasibility Study (RI/FS) Reports: two reports that are usually developed concurrently. The RI is conducted for collection of data and site characterization to determine the necessary remedial action and support the evaluation of remedial alternatives. The FS is conducted to define the objectives of the response action, develop remedial action alternatives, and undertake an initial screening and detailed analysis of the alternatives. For OU3, the RI/FS is being presented as a single document since the IROD and subsequent modification of the RI/FS Work Plan Addendum precludes much of the content normally presented in the RI and FS documentation.

Removal Action: a short-term, immediate action taken to address releases of hazardous substances that require a quick response.

Risk: the conversion of a dose value to an expected effect on living organisms is reported as a risk. Under CERCLA, risk is generally meant to indicate the probability for specific health effects as a result of dose.

Segregation Categories: the further subdivision of the ten OU3 material categories based on regulatory criteria and contaminant characteristics.

Source Term: the estimated amount of a contaminant present in a material.

Unrestricted Release: the release of materials for unrestricted use to a non-radiologically controlled environment.

Waste Acceptance Criteria: a set of specifications and conditions under which disposal facilities can accept waste. These criteria include (but are not limited to) packaging, external radiation levels, and analytical documentation.

COMMENT SHEET

DOE is interested in your comments on the cleanup alternatives being considered in the Operable Unit 3 Proposed Plan, including the preferred alternative. Please use the space provided below to write your comments, then fold, staple or tape, and mail this form. DOE must receive your comments on or before the close of the public comment period on (?), 1996. If you have questions about the comment period, please contact Gary Stegner, the DOE Fernald Area Office Public Information Director, at (513) 648-3153.

Name:_____

Address:_____

City:_____ **State/Zip:**_____

Phone:_____

MAILING LIST ADDITIONS:

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

YES____ **NO**____

For More Information

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

Public Environmental Information Center
JAMTEK Building
10845 Hamilton-Cleves Highway
Harrison, Ohio 45030
phone: (513) 738-0164
fax: (513) 648-3081

fold here

fold here

Name_____

Address_____

_____

Note: The final version of this Proposed Plan will have a postage pre-paid comment response sheet.

Mr. Gary Stegner
Public Information Director
DOE Fernald Area Office
U.S. Department of Energy
P.O. Box 538705
Cincinnati, Ohio 45253-8705

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LIST OF ACRONYMS AND ABBREVIATIONS

ACM	asbestos containing materials
AIRFA	American Indian Religious Freedom Act
ALARA	as low as reasonably achievable
ARAR	applicable or relevant and appropriate requirement
ASL	analytical support level
ATTIC	Alternative Treatment Techniques Information Center
AWWT	Advanced Wastewater Treatment (facility)
BDN	biodenitrification
BSL	biodenitrification surge lagoon
CAMU	corrective action management unit
CDD	chlorinated dibenzo p-dioxins
CDF	chlorinated dibenzofurans
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFOI	Census of Fatal Occupational Injuries
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
cm	centimeter
cm^2	square centimeter
CMSA	Consolidated Metropolitan Statistical Area
COC	constituent of concern
CRARE	comprehensive response action risk evaluation
DAPP	diamyl-amyl phosphate
D&D	decontamination and dismantlement
dB	decibel
dBA	A-weighted decibel
DFO	Director's Findings and Orders
DOE	United States Department of Energy
DOT	United States Department of Transportation
dpm	disintegrations per minute
DQO	data quality objective
EIS	environmental impact statement

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ACRONYMS AND ABBREVIATIONS (Continued)

EPA	United States Environmental Protection Agency
FACTS	Fernald Analytical Computerized Tracking System
FEMP	Fernald Environmental Management Project
FFCA	Federal Facilities Compliance Agreement
FMPC	Feed Materials Production Center
FS	feasibility study
ft	foot
ft^2	square foot
ft^3	cubic foot
FWP	field work package
g	gram
gpm	gallons per minute
GRA	general response action
HDPE	high density polyethylene
HEPA	high efficiency particulate air
HI	hazard index
HQ	hazard quotient
hr	hour
HVAC	heating, ventilating and air conditioning
HWMU	hazardous waste management unit
ILCR	incremental lifetime cancer risk
in.	inch
IROD	Record of Decision for Interim Remedial Action
ISA	initial screening of alternatives
K_d	leachability coefficient
K_L	leachability of media
kg	kilogram
L	liter
lb	pound
LDR	land disposal restriction
LLW	low level (radioactive) waste

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ACRONYMS AND ABBREVIATIONS (Continued)

LMB	long metal box
m	meter
m^2	square meter
mg	milligram
μg	microgram
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MDA	minimum detectable activity
MDC	minimum detectable concentration
Mhz	megahertz
mi	mile
mi^2	square mile
mrad	millirad
mrem	millirem
NAGPRA	Native American Grave Protection and Repatriation Act
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NORM	naturally occurring radioactive material
NRC	Nuclear Regulatory Commission
NTS	Nevada Test Site
OAC	Ohio Administrative Code
O&M	operation and maintenance
OEPA	State of Ohio Environmental Protection Agency
OHPO	Ohio Historic Preservation Office
ORC	Ohio Revised Code
OSHA	Occupational Safety and Health Administration
OU	operable unit
PCB	polychlorinated biphenyl
pCi	picocurie
PID	photoionization detector

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ACRONYMS AND ABBREVIATIONS (Continued)

PP	Proposed Plan
ppb	parts per billion
ppm	parts per million
ppmv	parts per million per volume
PRG	preliminary remediation goal
PSR	Prioritization and Sequencing Report
QA/QC	quality assurance/quality control
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RD/RA	remedial design/remedial action
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
ROB	roll off box
ROD	record of decision
SCQ	Sitewide CERCLA Quality Assurance Project Plan
SED	Sitewide Environmental Database
SNL	Sandia National Laboratory
SPL	sound pressure level
STP	site treatment plan
SVOC	semi-volatile organic compound
SWIFTS	Sitewide Waste Inventory Forecasting and Tracking System
SWMU	solid waste management unit
TAL	target analyte list
TBC	to be considered
TCL	target compound list
TCLP	toxicity characteristic leaching procedure
TSCA	Toxic Substances Control Act
TSS	tension support structure
UF_4	uranium tetrafluoride (green salt)
UF_6	uranium hexafluoride
UMTRCA	Uranium Mill Tailings Remediation Control Act

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ACRONYMS AND ABBREVIATIONS (Continued)

UST	underground storage tank
VISITT	Vendor Information System for Innovative Treatment Technologies
VOC	volatile organic compound
XRF	x-ray fluorescence
WAC	waste acceptance criteria
WMB	white metal box
WPA	Operable Unit 3 RI/FS Work Plan Addendum
yd^2	square yard
yd^3	cubic yard

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GLOSSARY

Accessible Metals - a material category comprised of structural steel and steel decking which has large accessible surface areas and thicknesses greater than 1/4 inch. The surface of accessible metals can be decontaminated, using physical surface decontamination techniques, and subsequently surveyed prior to disposition.

Administrative Controls - the elimination of hazards through administrative means, such as management, procedures, record-keeping and assessments. Administrative controls are not intended to physically stop individuals from entering hazardous areas or to remove hazards.

Amended Consent Agreement - an agreement between the US EPA and DOE to establish a procedural framework and schedule for developing, implementing, and monitoring appropriate response action at the FEMP in accordance with CERCLA, the NCP, and US EPA guidance and policy. The procedure and schedule were originally developed in 1986 and were modified in 1991. The Amended Consent Agreement also established the requirements for preparing RI/FS documentation, including PPs and RODs, for each of the five FEMP operable units.

Applicable or Relevant and Appropriate Requirements (ARARs) - Requirements, including cleanup standards, standards of control, and other substantive environmental protection requirements and criteria for hazardous substances as specified under federal and state laws and regulations that must be met when complying with CERCLA.

Background Radiation - the radiation in the natural environment, including cosmic rays and radiation from naturally radioactive elements, both inside and outside the bodies of humans and animals. Many of the radiological and all of the inorganic contaminants present at the FEMP naturally exist in measurable concentrations in all environmental media. The background concentration of each contaminant varies from point to point within a range for each medium.

Baseline Concentration - an estimated concentration that represents a background level for an analyte in a material based on sampling data and literature values.

Bulked Material Volume - the anticipated total volume of a material and the container required to transport the material off-site for disposal. The total volume is derived by multiplying the corresponding unbulked volume by a bulking factor. The bulking factors used for this RI/FS were originally developed in the OU3 Proposed Plan-Environmental Assessment for Interim Remedial Action, and they were periodically updated during preparation of this report. See also Unbulked Material Volume.

Characteristic Waste - a waste material which exhibits a hazardous characteristic and therefore requires management in accordance with RCRA Section 3008(h) and other applicable statutes. A characteristic waste remains hazardous only as long as it exhibits the hazardous characteristic. Characteristic wastes mixed with other hazardous materials are considered hazardous waste if they still exhibit the characteristic after being mixed.

Complex - a set of components, grouped by location, scope of work required, and/or cost of dismantlement, to be remediated under one or more design documents.

Component - the smallest physically distinct unit that is being considered separately in the development and implementation of the remedial action, including (but not limited to) buildings (including equipment and machinery inside), pads, roads, piping/utilities and ponds/basins.

GLOSSARY (Continued)

Component Category - one of eleven possible classifications used to categorize components for data collection purposes, such as development of remedial action objectives or ARARs. Each component is categorized according to its function. Examples of component categories include administration/support buildings, process buildings, ponds and basins, storage pads/parking lots/roads/railroad, and bulk material.

Comprehensive Environmental Response, Compensation and Liability Act, as amended (CERCLA) - enacted in 1980, CERCLA mandates the development of organizational structure and procedures to respond to releases, or threats of releases, of hazardous substances or pollutants/contaminants. CERCLA was amended in 1986 by the Superfund Amendments and Reauthorization Act, which made CERCLA applicable to federal facilities.

Comprehensive Response Action Risk Evaluation (CRARE) - an analysis of the residual risks to human health and the environment that would remain at a site after completion of remedial activities. The CRARE is prepared to determine the impact of each operable unit on the FEMP's total residual risk and provides a basis for revising cleanup levels as needed to meet US EPA decision-making criteria.

Concrete Core - measurements of contaminant depth profiles obtained through repeated grinding of exposed concrete surfaces.

Consent Agreement - see Amended Consent Agreement.

Consent Decree - see Stipulated Amended Consent Decree.

Constituent of Concern (COC) - chemical and/or radiological contaminants present within the operable unit that pose a risk of cancer or other adverse effects to human health and the environment as a result of exposure to the contaminants.

Constituent of Potential Concern (CPC) - a chemical or radiological contaminant that is known to be present within an operable unit prior to characterization. If, through characterization or site investigation, the contaminant is shown to exist in concentrations or at levels higher than background, or at levels which pose a risk of cancer or other adverse health effects to potential receptors, then it is re-classified as a constituent of concern.

Contamination Collection Point - sumps, pits, ditches or runoff points containing unknown solids.

Corrective Action Management Unit (CAMU) - a contaminated area of land, consisting of several solid waste management units, that is defined as a single unit for remediation and waste management purposes.

Disposal Cell - a facility equipped with engineering controls to meet requirements necessary for disposal of materials.

Dose - the amount of exposure to a contaminant absorbed by body tissue. For radiological contaminants, dose is generally measured in rem (Roentgen equivalent man), which accounts for the relative biological damage due to the type of radiation involved. Since the dose received from the FEMP is relatively small, millirem (mrem) is generally used to express dose instead of rem. One mrem is one one-thousandth of a rem.

GLOSSARY (Continued)

Drum Equivalent - the amount of material required to fill a 55-gallon drum. This measurement is commonly used when referring to waste storage or shipment.

Dry Process Area - a process area in which acidic or caustic substances were not used; therefore, corrosive conditions are not expected. See also Wet Process Area.

Engineering Controls - the elimination of hazards through mechanical means or process design; apparatus and/or mechanisms which physically prevent entry, minimize hazards, or create some kind of barrier.

Federal Facilities Compliance Agreement - an agreement between the US EPA and the DOE pertaining to the FEMP to: (1) ensure compliance by DOE with existing environmental statutes and implementation of regulations to include the Clean Air Act, RCRA, and CERCLA at the FEMP; and (2) to ensure environmental impacts associated with past and present activities at the FEMP are thoroughly investigated, and appropriate remedial response action is taken as contemplated by CERCLA.

Free Release - the release of materials, for unrestricted use, from DOE control to a non-DOE controlled environment. All free release materials must meet release criteria set forth in Nuclear Regulatory Commission Regulation 1.86 and DOE Order 5400.5.

Hazard Index (HI) - an index used as a measure of the potential for contaminants to present unacceptable noncarcinogenic toxic effects.

Hazard Quotient (HQ) - the ratio of a chemical's actual or potential dose via one pathway to a reference dose set by US EPA.

Hazardous Waste - a waste material exhibiting the characteristics of ignitability, corrosivity, reactivity, or toxicity or listed in 40 CFR 261, "Protection of Environment/Solid Waste/RCRA" or identified in applicable state regulations.

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. Examples of hazardous waste management units include a surface impoundment, a waste pile, a land treatment area, a landfill cell, an incinerator, a tank and its associated piping and underlying containment system, and a container storage area.

High-Level (Radioactive) Waste - highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid, that contains a combination of transuranic waste and fission products in concentrations requiring permanent isolation. The waste material at the FEMP is not classified as high-level waste.

Holdup Material - feed stock, intermediate product material and process residual material remaining in and on process areas (i.e., clinging to the surfaces of the various pumps, pipes, vessels or other equipment surfaces) as a result of production activities.

GLOSSARY (Continued)

Hot Spot - a localized source of radiation or radioactive material. The radiation levels of hot spots exceed the radiation level in the general surrounding area by more than a factor of 5 and are greater than 100 mrem per hour on contact.

Inaccessible Metals - a material category comprised of non-process piping, equipment in non-process areas, decontaminated process equipment, conduit/wire, electrical fixtures, miscellaneous electrical items, doors, and other miscellaneous metals. These materials have surfaces which cannot be easily decontaminated or surveyed and are thus considered inaccessible.

Incremental Lifetime Cancer Risk - a numerical value representing the risk of cancer incurred by receptors during their lifetimes (generally estimated at 70 years).

Interim Remedial Action - a remedy that may be conducted prior to issuance of the final Record of Decision to reduce existing risk to human health and the environment. In this report, the term refers to the decontamination, dismantlement and interim storage (or limited off-site disposal) of all Operable Unit 3 above- and below-grade improvements.

Intrusive Sample - a sample that is collected by disturbing the surface of the medium from which the sample is to be collected. An example would be chipping concrete off a block, drilling through wood, or digging into the ground. See also Non-intrusive Sample.

Isotope - a variation of an element that has the same atomic number (i.e., the same number of protons) but a different weight (a greater number of neutrons). Different isotopes of the same element may have different radioactive behaviors, and are generally unstable.

Land Disposal Restriction - a RCRA program that restricts land disposal of RCRA-regulated wastes and requires treatment of wastes to promulgated treatment standards.

Laydown Area - a cleared area located near a job site used to place materials from dismantlement operations for immediate further handling. Some of these materials, for example, may be placed in containers and eventually transferred to a staging area.

Leachability - the solubility of a contaminant in liquid (e.g., rainwater).

Legacy Waste - the inventory of waste that was generated during the production years (1952-1989). Legacy waste includes containerized LLW, hazardous waste, mixed waste, and TSCA waste (e.g., asbestos and/or PCBs). All materials generated after 1989 that are similar in nature to production waste (e.g., Safe Shutdown wastes) will be managed in the same manner as legacy waste.

Loose Solids - granular or particulate material, either containerized or randomly accumulated in a component, with variable moisture content.

Low-Level (Radioactive) Waste (LLW) - waste that contains radioactivity and is not classified as high-level waste, transuranic waste, spent nuclear fuel, uranium mill tailings, mixed waste or byproduct material as defined in Section 11e(2) of the Atomic Energy Act, as amended and DOE Order 5820.2A, Radioactive Waste Management. At the FEMP, LLW is defined as any radioactive waste that cannot be classified as high-level waste, spent nuclear fuel, transuranic waste (or containing transuranic nuclides in concentrations lower than 100 nanocuries per gram), uranium mill tailings, or

GLOSSARY (Continued)

mixed wastes. The DOE, Nuclear Regulatory Commission, and US EPA share responsibility for managing LLW.

Marketable Nuclear Material - uranium and thorium products which have retail value.

Material Type - solids and liquids generated through D&D operations, including recoverable material, recyclable material and waste.

Material Category - one of ten possible classifications of materials within OU3. Each category will be further defined according to the type and level of contamination within the material. Potential treatment and disposal options for each material will be evaluated at this level except for Category J, which will be dispositioned off-site as part of a removal action. Examples of material categories include brick, concrete, regulated ACM and non-regulated ACM.

Material Configuration - the size, shape and packaging of materials following completion of D&D; also used to refer to materials placed in interim storage pending issuance of the final ROD for OU3.

Material Description - one of 83 possible types of material found within OU3. Each material description falls into one of ten material categories.

Mixed Waste - waste containing both radioactive and hazardous components as defined by the Atomic Energy Act and RCRA, respectively.

National Environmental Policy Act (NEPA) - legislation covering basic government policy on protecting the environment. The primary purpose of NEPA is to ensure federal agencies consider the environmental impacts of their actions prior to making decisions. Operable Unit 4 has issued an Environmental Impact Statement (EIS), in conjunction with its FS/PP, which evaluates the cumulative environmental impacts associated with the implementation of remedial actions for all five of the FEMP operable units. The RI/FS and PP for Operable Unit 3 are written to tier off the Operable Unit 4 FS/PP-EIS, integrating NEPA values to examine the environmental impacts of implementing the final remedy selected for Operable Unit 3.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP) - US EPA's procedures and policies on preparing for, and responding to, discharges of oil and releases of hazardous substances, pollutants, or contaminants.

National Priorities List (NPL) - US EPA's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action under CERCLA. 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. The FEMP was added to the NPL in 1989.

Non-intrusive Sample - a sample that is obtained without penetrating or disturbing the media being sampled.

Nonregulated Asbestos Containing Material (ACM) - a material category comprised of transite walls and roofs, refractory (fire brick and insulating brick) materials, ceiling demolition, floor tile, and feeder cable. These materials are non-friable, i.e., they do not have loose asbestos fibers. See also Regulated Asbestos Containing Material.

GLOSSARY (Continued)

Operable Unit (OU) - as defined in the NCP, and adapted by the 1991 Amended Consent Agreement, operable units are defined based on several criteria, including geographical location, the potential for similar technologies to be applied to remediation, similar media types and similar contaminant types and levels. There are five such operable units at the FEMP; in addition, a Sitewide, Comprehensive Operable Unit was established to ensure that the remedial actions selected for the other operable units are protective of human health and the environment.

Painted Light-Gauge Metals - a material category comprised of ductwork, louvers, metal wall and roof panels, and sheet lead, and other painted metals less than 1/8 inch thick. Metals in this category are assumed to be painted with lead-based paint or, in the case of lead sheeting, to be made of lead themselves.

Picocurie - a unit of measuring radioactivity that expresses the rate of spontaneous, energy-emitting transformations in the nuclei of atoms. One curie is 37 billion transformations per second. At the FEMP, radioactivity is generally measured using the picocurie (pCi), which is one-trillionth of a Curie, or 2.2 transformations per minute. Picocuries are often expressed in units related to a liquid unit volume, such as picocuries per liter (pCi/L), or related to a solid mass unit such as picocuries per gram (pCi/g).

Post-Remediation Constituent of Concern - those constituents of concern, present in OU3 materials, which would potentially exceed an incremental lifetime cancer risk of 1×10^{-6} or exceed a hazard quotient of 0.2 if they were to leach into the Great Miami Aquifer.

Post-Remediation Source Term - predicted total mass of a constituent of concern following completion of remedial activities.

Principal Threat - FEMP wastes that have high concentrations of radioactive and/or hazardous substances. These wastes are to be treated and transported off-site for disposal. See also Secondary Threat.

Process Area - a distinct set of materials and equipment within a component where a particular chemical process was conducted. Each process area is assumed to have a uniform composition of contaminants, where the location of maximum surface level and/or depth of contamination, along with the types of contaminants, dictate treatment options. A single component can contain multiple process areas.

Process Knowledge - information obtained during review of a facility's processing records and/or interviews with long-term plant personnel. This information includes (but is not limited to) process chemistry, history of accidents/spills, maintenance chemicals/materials, or other uses of the process vessels or work space.

Process-Related Metals - a material category comprised of process equipment, electrical equipment not included in the Inaccessible Metals material category, and process piping which are assumed to be highly contaminated and to contain holdup material.

Production Area - as defined in the Amended Consent Agreement, the OU3 Production Area consists of production-associated facilities and equipment, including (but not limited to) all structures, equipment, utilities, drums, tanks, solid waste, waste, product, thorium, effluent lines, K-65 transfer line, wastewater treatment facilities, fire training facilities, scrap metal piles, feedstocks and coal pile.

GLOSSARY (Continued)

More simplistically, the Production Area is all above- and below-grade improvements, and includes production-associated buildings, equipment and facilities as well as administrative buildings (e.g., the Administration Building, the Service Building, and the Health and Safety Building) that were used to support production but in which actual processing did not take place.

Production Residue - production waste products currently stored on-property.

Proposed Plan (PP) - the Proposed Plan for Remedial Action presents the preferred remedial alternative identified for a site (or operable unit) for public review and comment purposes. The preferred alternative is identified based on the outcome of the FS, but may be reconsidered or changed altogether depending on the nature of public comments.

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

Receptor - a person, animal or plant exposed to cancer-causing agents or toxic agents which may cause health problems.

Record of Decision (ROD) - the ROD for a site (or operable unit) documents the remedy selected for cleanup and environmental restoration.

Record of Decision for Interim Remedial Action (IROD) - a ROD which accelerates the cleanup process within OU3 by eliminating known sources of potential contaminant release into the environment. The IROD calls for decontamination and dismantlement of all OU3 facilities, including former uranium processing buildings and equipment, support structures, utilities and identified ponds and basins. Essentially, all above- and below-grade improvements will be removed. Disposition and applicable treatment of these materials will be determined through issuance of the final ROD.

Recoverable - any material with some inherent value which can either be re-used as it is (whether contaminated or not) or can be recycled for restricted or unrestricted use.

Recycle - the application of a treatment process to modify a material for further use.

Regulated Asbestos Containing Material (ACM) - a material category comprised of piping insulation, ductwork insulation, and personal protective equipment which are classified as regulated because either the material matrix is potentially friable ACM (e.g., insulation) or, in the case of personal protective equipment, became contaminated with asbestos fibers during asbestos abatement activities. The copper scrap metal pile is included in this category because most of the material is copper conduit covered with a coating that contains ACM. See also Nonregulated Asbestos Containing Material.

Remedial Action - a series of cleanup activities that is consistent with the final remedy following completion of the RI/FS process and signature of the ROD. The remedial action is based on the remedial design.

Remedial Design - the technical analysis and procedures that follow the selection of a site remedy, resulting in a detailed set of plans and specifications for implementation of the remedial action.

GLOSSARY (Continued)

Remedial Investigation/Feasibility Study (RI/FS) - two reports that are usually developed concurrently. The RI is conducted for collection of data and site characterization to determine the necessary remedial action and support the evaluation of remedial alternatives. The FS is conducted to define the objectives of the response action, develop remedial action alternatives, and undertake an initial screening and detailed analysis of the alternatives. For Operable Unit 3, the RI/FS is being presented as a single document since the IROD and subsequent modification of the RI/FS Work Plan Addendum precludes much of the content normally presented in the RI and FS documentation.

Remediation Waste - all solid and hazardous wastes, and all media (including groundwater, surface water, soils and sediments) and debris which contain hazardous wastes or which themselves exhibit a hazardous waste characteristic, that are managed for the purpose of implementing corrective action requirements under 40 CFR 264.101 and RCRA Section 3008(h). For a given facility, remediation wastes may originate only from within the facility boundary, but may include waste managed in implementing RCRA Sections 3004(v) or 3008(h) for release beyond the facility boundary.

Removal Action - any action necessary to mitigate an immediate threat to human health and the environment, including actions necessary to monitor, assess, or evaluate the threat.

Resource Conservation and Recovery Act, as amended (RCRA) - legislation which establishes safe and environmentally acceptable management practices for specific wastes. RCRA requires strict "cradle to grave" control, documentation and proper management of hazardous wastes. At the FEMP, these requirements are integrated with CERCLA for a comprehensive environmental management approach.

Restricted Re-use - further use of a radioactively contaminated material for its original purpose or a modified purpose.

Restricted Release or Recycling - a recoverable material to which some form of treatment or processing was applied that left some radioactive contamination, thus requiring the material to remain under continued DOE control (such material may be used for shield blocks or waste containers). See also Unrestricted Release or Recycling.

Re-use - further use of a material for its original purpose or a modified purpose.

Risk - the conversion of a dose value to an expected effect on living organisms is reported as a risk. Under CERCLA, risk is generally meant to indicate the probability for specific health effects as a result of the dose.

Risk Assessment - Qualitative and quantitative evaluation of the risk posed to human health and/or the environment by the actual or potential presence and/or use of specific pollutants.

Safe Shutdown - a FEMP program, also known as Removal Action No. 12, which provides planning, engineering and program control for the proper disposition of all uranium products and in-process hold-up materials, excess supplies, chemicals and associated process equipment. The program is also intended to ensure the proper characterization, emptying, and isolation of utilities for the majority of existing previously operated, production-related equipment.

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GLOSSARY (Continued)

Secondary Threat - wastes that have low concentrations of radioactive and/or hazardous substances. These wastes will be disposed in an on-property disposal facility. Some of the wastes may require treatment prior to disposal so that they meet waste acceptance criteria. See also Principal Threat.

Segregation Category - the further subdivision of the ten OU3 material categories based on regulatory criteria and contaminant characteristics.

Solid Waste - non-liquid, non-soluble materials, ranging from municipal garbage to industrial wastes, that contain complex and sometimes hazardous substances. Solid wastes also include sewage sludge, agricultural refuse, demolition wastes, and mining residues. Technically, solid waste also refers to liquids and gases in containers.

Solid Waste Management Unit (SWMU) - a waste management unit from which hazardous constituents may migrate, irrespective of whether the unit was intended for hazardous or solid waste management. SWMU can also refer to any associated area of a facility that has become contaminated with hazardous wastes or constituents as a result of routine and systematic releases.

Source Term - the estimated mass of a contaminant present in a material. For OU3 materials, source term is calculated by multiplying the contaminant mass by the concentration of the contaminant in the material.

Staging Area - a temporary holding area established within a construction boundary by a remediation subcontractor for the transfer of containers and containerized material.

Stipulated Amended Consent Decree - an agreement between DOE and OEPA which states DOE will conduct all or part of the cleanup action at the FEMP site; cease or correct actions or processes that are polluting the environment; or otherwise comply with OEPA-initiated regulatory enforcement actions to resolve the contamination problem at the FEMP.

Surface Decontamination - the reduction of existing surface contamination levels, thereby reducing direct exposure potential, as well as reducing available sources for air- or water-borne contamination.

Toxic Substances Control Act (TSCA) - legislation that enables the US EPA to control chemicals and substances, such as PCBs, dioxins, and asbestos, by requiring that all old and new materials entering the environment be tested. TSCA also regulates the release of chemicals and substances when necessary.

Transuranic Waste - without regard to source or form, waste that is contaminated with alpha-emitting transuranic radionuclides with half-lives greater that 20 years and concentrations greater that 100 nanocuries per gram at the time of assay. Transuranic also refers to an element with an atomic number greater than that of uranium. The transuranic waste at the FEMP exists in concentrations less than 100 nanocuries per gram and is, therefore, included in the low level waste classification.

Treatment Residuals - concrete chips, sludges, decant liquid, decontamination liquid, and other materials resulting from treatment of remediation waste.

Turnover Area - a temporary holding area from which dismantlement materials are transferred to a staging area, depending on the disposal or recycling option identified for the material.

GLOSSARY (Continued)

Unbulked Material Volume - the volume of a waste material in its smallest reducible form without continuous physical manipulation to maintain its size. Unbulked volumes are used to estimate the amount of space required for OU3 materials in the on-property disposal facility. See also Bulked Material Volume.

Unrestricted Release or Recycling - the release of materials for unrestricted use to a non-radiologically controlled environment in accordance with NRC Regulation 1.86 and DOE Order 5400.5. See also Restricted Release or Recycling.

Waste - any material which is not being recovered or recycled.

Waste Acceptance Criteria (WAC) - a set of specifications and conditions under which disposal facilities can accept waste. These criteria include (but are not limited to) packaging, external radiation levels and analytical documentation.

Waste Stream - the total flow of solid waste from homes, businesses, institutions, and manufacturing plants that are burned or disposed of in landfills, or segments thereof such as the "residential waste stream."

Wet Process Area - a process area where acidic and caustic substances were used, which created potential corrosive conditions. See also Dry Process Area.

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Executive Summary

EXECUTIVE SUMMARY

INTRODUCTION

This document is a combined Remedial Investigation (RI) and Feasibility Study (FS) Report for Operable Unit 3 (OU3) at the Fernald Environmental Management Project (FEMP). OU3 was defined in the 1991 Amended Consent Agreement (ACA) between the United States Department of Energy (DOE) and the United States Environmental Protection Agency (US EPA). This RI/FS Report follows a decision documented in July 1994 (OU3 Record of Decision for Interim Remedial Action) to decontaminate and dismantle (D&D) all manmade structures associated with OU3 at the FEMP. The scope of the OU3 RI/FS Report is therefore focused on summarizing the OU3 field investigation findings and evaluations related to dispositioning the resulting D&D materials. This document also highlights the integration of ongoing FEMP activities with these evaluations by providing status of removal actions, illustrating the relationship of this RI/FS to the OU3 interim remedial action, and identifying integration points with other operable units.

As a result of the original FEMP mission to process uranium and thorium products for national defense, the site structures and environmental media were contaminated with radiological and chemical constituents. Decreasing demand for site products in the late 1980s, coupled with increasing environmental concerns about the impact of the FEMP on the environment led DOE to shut down production and refocus site activities on environmental restoration. The schedules for developing cleanup plans for each of five operable units were specified by the 1991 ACA. OU3, which was defined as the former production facilities, structures, equipment, and waste and product inventories remaining from site activities, was scheduled last in the sequence, because it was the last unit to be created. Early in the OU3 process to develop cleanup plans, it was determined that the structures comprising the operable unit had no defined future use or value for future use and could be decontaminated and dismantled. This formal decision to D&D the structures was developed by the OU3 ROD for Interim Remedial Action (IROD) (DOE 1994a), which was an additional cleanup plan not envisioned by the ACA.

Due to the unique attributes of OU3, a number of streamlining approaches, resulting in a reduced RI/FS scope, were possible and were subsequently pursued with the US EPA and Ohio EPA. These included eliminating a stand-alone baseline risk assessment, incorporating the initial screening of alternatives document into the FS, and combining the RI and FS reports into this single integrated document. These efforts complemented streamlining approaches that were employed in the field investigation portion of

the program (documented in the OU3 RI/FS Work Plan Addendum [WPA] and the WPA modification) and have resulted in the submittal of a RI/FS Report six and eleven months in advance of the original respective ACA schedules for the separate reports.

The IROD decision to decontaminate and remove the OU3 structures allowed the elimination of this scope from consideration and evaluation in the OU3 RI/FS Report. The IROD also allowed DOE to initiate remedial action and accelerate D&D activities for OU3 facilities and structures at least three years ahead of the 1991 ACA schedule.

Additional streamlining of the OU3 RI/FS Report resulted from the continuation of current programs established to disposition some of the waste streams from the site. These disposition activities continue beyond the final ROD for OU3 and do not require reevaluation in the OU3 RI/FS Report. For example, "legacy wastes" have been, and will continue to be, expeditiously dispositioned off-site under a previously approved removal action. A total of fourteen removal actions have been initiated for OU3 to mitigate threats to human health and the environment. Seven of the fourteen are considered complete; three others will be complete in the near term; the remaining four (Removal of Waste Inventories, Safe Shutdown, Improved Storage of Soil and Debris, and Asbestos Removal) are "programmatic" in nature, applying to OU3 as a whole, and representing activities that will continue for some time beyond the OU3 final ROD date. The scope of these activities will be incorporated into the OU3 final ROD and subsequent remedial action documents to integrate all OU3 action scopes.

CHARACTERIZATION OF OU3

The sampling and analysis activities undertaken during the OU3 field investigation program are discussed by the document, as are modifications to the program. The "hot spot" sampling methodology of the field program was used to gather radiological and chemical contamination data from the highest contaminated areas in each component process area. These data are used to conservatively estimate overall contamination (types and mass) and contaminated media masses, when coupled with the physical data (materials of construction, weights, and volumes) collected for the operable unit. These results support the alternative development and evaluation processes of the feasibility study, which comprises the second half of the combined document.

Data on the physical aspects of the operable unit were collected during the OU3 remedial investigation and are summarized in the report. OU3 is comprised of 233 buildings, structures and associated facilities. These contain over nine million cubic feet (~450,000 tons) of material. Nearly 80 percent

of the volume and weight of these materials are concrete-like materials or steels (60 percent asphalt, concrete, masonry, and transite) and (20 percent structural steel, piping and equipment). Another ten percent is inventory material (i.e. product, thorium, and drummed wastes), which was either in inventory when production operations ceased or has been (or will be) generated as a result of risk reduction and safe shutdown activities prior to the final remedial action. A significant portion of the final ten percent of material is bulk material (excavated soils, a coal pile, gravel, rock salt and sand). These latter types of material (inventory and bulk material) are not considered part of this RI/FS, since they are either being dispositioned as part of on-going, approved programs (inventory), are not wastes (bulk material), or are actually considered under other operable unit decisions (soils).

The data obtained from field characterization are evaluated and summarized in this document for use in decision-making. Chemical and radiological data resulting from the field program are presented in the RI/FS Report in several manners and levels of detail: initially as raw data, demonstrating the range of information collected for OU3; on a constituent-specific basis, to gain an understanding of the types of contaminants present in OU3 materials; as data organized around specific structures (i.e, components), to facilitate an understanding of contamination associated with individual structures; and by media, to allow consideration of material categories as a basis for decision-making.

Ninety-four percent of OU3 concrete, the single largest material type is uncontaminated. The contamination within the remaining material ranges from minimally contaminated, in many administrative and support facilities, to highly contaminated in former production and process-related areas. Consistent with expectations based on the former production mission at the site, by far, the highest levels and most extensive contamination is associated with uranium. The highest levels of uranium contamination are associated with residual material remaining in piping and equipment. As mentioned above, this primary-risk material is being removed and dispositioned as part of approved, on-going programs and is not part of the evaluation process in this report.

Technetium-99 (a trace impurity in recycled uranium) and thorium-230 (an impurity in ores and ore concentrates processed at the site) levels are also significant. Technetium-99 is a concern because it was detected in over 70 percent of all samples and is relatively mobile in the environment. Thorium-230 is a concern because it presents a potential inhalation risk during remedial activities. Secondarily, there are isolated instances of chemical contamination that result in a limited amount of OU3 materials (163,000 cubic feet) being considered as mixed waste. A portion of the mixed waste (50,000 cubic feet) has been

characterized as such because TCLP analytical results exceed regulatory limits. The remainder has been assumed to be mixed waste based on conservative interpretation of analytical results.

The chemical and radiological data collected from the field program were used in conjunction with other data to determine constituents of concern (COCs). A total of 60 COCs was identified for OU3 based on comparisons of results to regulatory and safety screening criteria. For each of the 60 COCs, a source term, or total mass is calculated using information on the concentrations of the COC in the different materials and the masses of these materials in OU3. This process is relatively involved, given the 74 different material types in OU3 requiring individual approaches for source term estimation. The source terms, combined with disposition options defined in the remedial alternatives, are utilized as a basis for estimating potential long-term impacts of the OU3 materials on human health and the environment.

To support the development of media-specific alternatives by the feasibility study, the numerous OU3 materials are grouped into ten distinct material categories based on similar inherent properties and configuration. These categories are further sub-divided into segregation categories based on regulatory status (low level waste, hazardous waste, mixed waste, PCB waste, and baseline) to evaluate treatment and disposition options.

REMEDIAL ALTERNATIVES

The data and results presented in this document are utilized to develop, screen, and perform detailed evaluation of remedial alternatives. In this RI/FS Report three alternatives have been identified and evaluated: Alternative 1 - No Further Action; Alternative 2 - Selected Material Treatment, On-Property Disposal, and Off-Site Disposition; and Alternative 3 - Selected Material Treatment and Off-Site Disposition. Each of the action alternatives includes the option to recycle materials and release clean materials for unrestricted uses. Each of the action alternatives is defined consistent with meeting the Remedial Action Objectives (RAOs) for OU3; mitigate the potential exposure of human and environmental receptors and implement remedies in a manner which ensures protectiveness of potential receptors. The results of the alternative evaluation support identification of a preferred alternative within the OU3 Proposed Plan (PP).

Alternative 1, the no further action alternative, represents a baseline condition for evaluation purposes and assumes no further remedial activity after completion of the interim remedial action. The D&D wastes would remain in interim storage and this storage configuration would ultimately deteriorate, allowing release of remaining contaminants to the environment. Alternative 2 provides for the on-

property disposal of most materials with a portion of wastes being dispositioned to off-site disposal facilities, including off-site local landfills. A portion of the materials; those that exhibit characteristic properties under RCRA, would require treatment in accordance with land disposal restriction (LDR) requirements prior to off-site disposal. Under Alternative 3, all remediation materials would be dispositioned off-site to both disposal facilities and local sanitary landfills. No OU3 materials would remain at the FEMP after completion of Alternative 3.

The two action alternatives were defined to retain future flexibility to select a variety of sub-options in the remedy. For example, recycling is an option within each of the action alternatives. Current evaluations indicate that available recycling options are prohibitively expensive, however the option to recycle is retained and could be incorporated into the remedy when determined cost effective and/or desirable. Comparative evaluation of the alternatives has determined that selection of options internal to the alternative definition can be done without affecting the overall protectiveness of the alternative (e.g. treatment of mixed waste materials on-property or off-site).

In evaluating the alternatives, the COCs defined from the original characterization results are further screened based on the specific aspects of each alternative. For both alternative 2 and 3, the COC list is evaluated against waste acceptance criteria (WAC) at the off-site disposal facilities to determine acceptability to receive OU3 materials. For on-property disposal (Alternative 2), the 60 COCs were further screened to ten that could potentially leach from the on-property disposal facility into the underlying Great Miami Aquifer during the performance period of the facility. Of these ten, only two (uranium and technetium) are sufficiently abundant in the materials that could be disposed in the facility to have the potential to reach levels of concern in the aquifer.

To determine the potential for OU3 uranium and technetium contamination to reach levels of concern in the aquifer, studies were developed to determine the specific leachability of these contaminants from the primary OU3 materials. The results of these studies were then used to establish protective levels (WAC) for uranium and technetium in OU3 media for on-property disposal. These studies demonstrated that uranium is relatively non-leachable from OU3 media, resulting in a WAC for uranium greater than any sample result for construction media from the OU3 field program. Conversely, technetium was found to be highly mobile, resulting in a need to limit the contribution of technetium from OU3 materials in the disposal facility to approximately 100 grams. WAC for off-site disposal were also determined (mainly based on permit limits for the representative sites) to support off-site disposal options within each of the action alternatives.

A detailed evaluation of each alternative versus the NCP evaluation criteria was performed. The alternative evaluation identified the no further action alternative as having unacceptably high risks in the long-term due to the potential for a trespasser to be exposed at levels above the 10^{-4} to 10^{-6} risk range and the potential for environmental releases from unmaintained materials left in permanent storage. The no action alternative also does not comply with ARARs, and hence fails to pass the threshold criteria screening. For the two action alternatives, the evaluation established that each is acceptable in terms of long-term risks. The Alternative 2 evaluation determined that the use of multilayered capping and lining systems and the development of contaminant- and material-specific WAC, would ensure the long-term protection of the Great Miami Aquifer underlying the on-property disposal facility. These design considerations would supplement the natural containment capabilities of the existing site geology to ensure the long-term performance of the disposal system. To allow on-property disposal of the OU3 material over the aquifer, the receipt of a waiver from the State of Ohio solid waste disposal facility siting requirements would be required from the US EPA and has been requested for OU3 wastes in this document. Alternative 2 meets all other ARARs; Alternative 3 meets all ARARs.

The NCP preference for treatment has been addressed in two ways for OU3. The OU3 interim action addresses treatment of OU3 materials through in situ gross decontamination actions. The OU3 final action utilizes treatment on a supplemental basis to ensure protectiveness and to meet WAC.

The alternatives were also comparatively evaluated to highlight the benefits and drawbacks of each. Both of the action alternatives meet the requirements of being effective and permanent in the long-term and reducing toxicity, mobility, and/or volume through treatment. However, for the remaining three balancing criteria of short-term effectiveness, implementability, and cost, Alternative 2 presents a less risky, easier to implement, and cheaper alternative. Alternative 2 would result in lower estimated industrial accidents; would be easier to implement, since materials would go directly to an on-property disposal facility being constructed for OU2 and OU5 wastes; and would cost significantly less to implement (approximately $90 million versus a cost of $190 million for Alternative 3). Each of the action alternatives could be implemented concurrent with the D&D schedules associated with the IROD, with the exception of a period of interim storage necessary under Alternative 2 prior to the availability of the on-property disposal facility.

<u>SUMMARY</u>

This RI/FS Report uses a customized approach to address the final remedial activity for OU3, reflecting the uniqueness of the unit resulting from the streamlined field program, the existence of prior decisions

for D&D of the site structures and ongoing programmatic removal actions. This report includes all information necessary to develop a final decision for the operable unit, and also provides information in a format necessary to support development of D&D Implementation Plans. This RI/FS Report satisfies CERCLA requirements by determining the nature of contamination within the operable unit and evaluating remedial alternatives. The OU3 Proposed Plan, which accompanies this OU3 RI/FS Report, identifies DOE's preferred alternative for remediation of the operable unit as Alternative 2 (Selected Material Treatment, On-Property Disposal, and Off-Site Disposition) based on the comparative evaluation included with this report.

Upon approval of the RI/FS Report and the Proposed Plan, a public comment period will be held to solicit stakeholder input into the decision making process for OU3. During the public comment period, the preferred remedial alternative may be modified or another alternative may be selected or developed. These activities and associated decisions will be reflected in the OU3 Record of Decision.

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Section 1

1.0 INTRODUCTION

This report documents the results of the Remedial Investigation/Feasibility Study (RI/FS) for Operable Unit 3 (OU3), one of five OUs at the United States Department of Energy (DOE) Fernald Environmental Management Project (FEMP). OU3 consists of the former Production Area and production support buildings, unused uranium and thorium products, and equipment from the former production of uranium and thorium metals. Many of the deteriorating production buildings, production support buildings, and equipment are radiologically and/or chemically contaminated. This RI/FS Report characterizes the contamination in OU3 and, based on these results, evaluates final remedial alternatives that will ensure protection of public health and the environment.

In June 1994, the DOE and the United States Environmental Protection Agency (US EPA[1]) jointly signed the OU3 Record of Decision for Interim Remedial Action (IROD) (DOE 1994a). The IROD was a provision established in the OU3 RI/FS Work Plan Addendum (WPA) (DOE 1993a) to accelerate the OU3 cleanup schedule. The IROD allowed DOE to begin decontamination and dismantlement (D&D), as applicable, of all buildings, equipment, and other above- and below-grade improvements. The post-D&D materials either will be dispositioned off-site or placed in interim storage on-property until a final remedial decision can be made for permanent disposition. The IROD has resulted in a three-year acceleration of the D&D schedule. D&D activity has already begun within OU3; one building has been dismantled and another is currently being decontaminated. By taking the initiative in accelerating the schedule, DOE is able to adopt a unique approach to this RI/FS.

In cooperation with the EPAs, DOE has been able to expedite final remedy selection for OU3 in several respects. The Initial Screening of Alternatives Report, a preliminary evaluation of remedial alternatives, generally submitted as a separate document, was incorporated into the alternative development and evaluation process presented in this document. Additionally, the Sitewide Characterization Report (DOE 1992a) and the IROD provided adequate documentation of the general level of risk to human health and the environment posed by current OU3 conditions. Consequently, a stand-alone baseline risk assessment for OU3 was not required. DOE also proposed that nuclear materials and wastes (i.e., legacy wastes) be disposed off-site through existing programs and removal actions, since prior evaluations outside the RI/FS have determined the merit of these disposition

[1]For the reader's convenience and to reduce confusion, the term "EPAs" is used where a joint reference to the United States and State of Ohio Environmental Protection Agencies is required.

decisions. Each of these factors, in conjunction with the IROD, reduced the scope of the remaining tasks to be completed for the RI/FS. DOE proposed a modification to the WPA which reflected this reduced scope; the modifications included streamlining the data collection program and combining the RI and FS reports into a single document. The combination minimizes the review and approval cycles, since one document is being issued rather than two. Essential information to support selection of a final remedy is provided in this report without revisiting decisions already made.

The following goals have been identified for this RI/FS Report:

- Discuss data needs and data collection methodology.
- Present characterization information of the nature of radiological and chemical contamination of OU3 materials.
- Estimate contaminant mass, material volumes, and material configuration for OU3 materials following the interim remedial action.
- Identify those chemical and radiological constituents of concern (COCs) present in OU3 materials.
- Identify remedial action objectives and general response actions which must be met through the remedial action alternatives.
- Document the development and screening of available technologies and process options to address the type and quantity of contaminated materials by material category.
- Document the development of remedial action alternatives to address the treatment and disposition of contaminated materials to satisfy the remedial action objectives.
- Evaluate remedial action alternatives in terms of EPA evaluation criteria.

This report documents the results of the OU3 field characterization program. The program was aimed at collecting radiological and chemical data to support fundamental decision making for the management and future treatment or disposition of OU3 materials generated by the interim remedial action. The report then develops and evaluates viable remedial activities for the final disposition of these building materials. The organization of the RI/FS Report is discussed in Section 1.3.

The draft Proposed Plan (PP) for the OU3 Final Remedial Action is being submitted simultaneously with this RI/FS Report. The PP summarizes key information from the RI/FS Report and identifies DOE's preferred remedial alternative. The public will be invited to provide input on preferences during a 30-day formal comment period, anticipated to begin in the spring of 1996. Responses to

public comments will be documented in a Responsiveness Summary, which will be submitted as part of the final Record of Decision (ROD) for OU3. The ROD will document the selected remedy for OU3, which may differ from the preferred remedy identified in the PP, depending on public comment. The target submittal date for the draft ROD is July 1996, nine months ahead of the original schedule specified in the Amended Consent Agreement.

1.1 BACKGROUND

This section discusses the FEMP's location, operating history, remediation history, regulatory drivers, and the application of the Comprehensive Environmental Response, Compensation and Liability Act, as amended (CERCLA), to OU3. It also provides background information on the regulatory considerations that affect the FEMP as a whole.

1.1.1 Site Overview

The FEMP is a 1,050-acre, government-owned facility located in southwestern Ohio, approximately 17 miles northwest of Cincinnati. The facility is located near Fernald, Ohio, and lies on the boundary between Hamilton and Butler Counties (Figure 1-1). Although environmental remediation is DOE's sole mission at the FEMP today, the site was originally built to support United States defense initiatives. The FEMP was constructed between 1951 and 1954 and began limited production in 1951 upon completion of the Pilot Plant. Full production began in 1954 upon completion of Plant 9. Known as the Feed Materials Production Center (FMPC[2]) until August 23, 1991, the FEMP produced more than 180,000 metric tons (200,000 tons) of high-purity uranium products, along with thorium products (FERMCO 1995); many were used as feed at other DOE nuclear facilities. Production peaked in 1965 at about 12,000 metric tons (13,000 tons) of uranium per year and then declined to about 1,300 metric tons (1,500 tons) in 1976. During the 1970s, consideration was given to closing the FEMP. Thus, capital improvements and staffing were minimized. In 1981, the FEMP began planning to accommodate increased demand for uranium metal products. Production levels increased significantly and there was a rapid staff buildup for several years, along with a major facilities renovation program. By 1989, demand began declining again; this factor, combined with increasing environmental concerns, led DOE to shut down all production operations. A closure plan was submitted to Congress and, in August 1991, the site was officially declared closed, with the facility's mission refocused on environmental restoration.

[2]Throughout this report, the acronym "FEMP" is used for this facility, even though it was known as the FMPC when in operation and is listed as such on the National Priorities List.

1.1.2 Remediation History

In 1985, the US EPA issued a Notice of Noncompliance to DOE, identifying its concerns over potential environmental impacts associated with the FEMP's production activities, which included the release of uranium and other substances to the air, surface soils, and water. In addition, large quantities of low-level radioactive waste (LLW) and hazardous wastes were (and continue to be) in storage at the site. Conferences were subsequently held between DOE and US EPA to discuss the conditions at the FEMP and to identify the steps proposed by DOE to achieve and maintain compliance with environmental regulations and standards. These steps are documented in a Federal Facilities Compliance Agreement (FFCA), signed by DOE and US EPA on July 18, 1986. In response to the FFCA, a sitewide RI/FS was initiated in July 1986 pursuant to CERCLA as amended by the Superfund Amendments and Reauthorization Act of 1986, or SARA, (hereafter jointly referred to as CERCLA).

A series of technical discussions was held with the EPAs which led to the development of a RI/FS Work Plan (DOE 1988). This document identified 27 units of the FEMP to be investigated during the RI/FS. Several modifications eventually increased the total to 39 units. In the course of the investigation, it became apparent that, for technical and program management purposes, these 39 units needed to be categorized and grouped accordingly. The FEMP was subsequently divided into five OUs to promote a more structured and expedient cleanup. The final RI/FS Work Plan was approved in May 1988.

In November 1989, the FEMP was placed on the National Priorities List (NPL), a list of sites identified by the US EPA for possible long-term remedial action under CERCLA. The NPL listing was considered appropriate because of the federal government's concern over the real or potential impacts to human health and the environment associated with the documented past releases of hazardous substances from the facility.

In conformance with the statutory requirements of CERCLA, the DOE entered into a Consent Agreement with the US EPA in 1990. The Consent Agreement established the procedural and schedule requirements for investigating the FEMP site, using the CERCLA-defined RI/FS process, to determine the most prudent cleanup actions that would address identified environmental concerns at the facility. The Consent Agreement also formally identified the FEMP OUs. The Consent Agreement was subsequently amended in 1991, modifying some of the schedules for completing the RI/FS and significantly revising the OU3 definition. The Amended Consent Agreement established

that separate RI/FS documentation, including RI and FS Reports, PPs, and RODs, be prepared for each OU. The OU concept is in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and is used in US EPA's RI/FS guidance (US EPA 1988) to define logical, physical groupings of environmental areas of concern at a site. The five FEMP OUs (see Figure 1-2) are defined as follows:

- OU1: Waste Pit Area, consisting of Waste Pits 1-6, the Burn Pit, the Clearwell, berms, liners, and soils within the OU boundary;
- OU2: Other Waste Units, consisting of two flyash piles, South Field disposal area, two lime sludge ponds, solid waste landfill, berms, liners, and soil within the OU boundary;
- OU3: Production Area, including the former Production Area, all structures, equipment, utilities, drums, tanks, solid waste, waste, product, thorium, effluent lines, a portion of the K-65 transfer line, wastewater treatment facilities, fire training facilities, scrap metal piles, feedstocks, and coal pile. Figure 1-3 is a site perspective map that depicts the former Production Area as well as most other improvements on the property.
- OU4: Silos 1-4, including the berms, decant tank system, and soil within the OU boundary.
- OU5: Environmental Media, consisting of groundwater, surface water, soil not included in the definitions of OUs 1-4, sediments, flora, and fauna.

In an effort to supplement available guidance and promote consistency among the OUs, the 1991 Amended Consent Agreement added a number of work elements to the ongoing RI/FS. Those elements included the issuance of a Risk Assessment Work Plan Addendum (DOE 1992a), the issuance of the Sitewide Characterization Report (SWCR) (DOE 1992b), and the formation of a Comprehensive Sitewide OU. The Risk Assessment Work Plan Addendum, which was approved by US EPA in June 1992, describes the models and technical approach for conducting risk assessments at the FEMP. The SWCR defines the final geographical boundaries of the individual source OUs (i.e., OUs 1, 2, 3, and 4).

Following the issuance of the ROD for OU3, the Amended Consent Agreement provides for the establishment of a Comprehensive Sitewide OU. The Comprehensive Sitewide OU was created to perform a final risk assessment from a sitewide perspective to ensure the remedies selected for the other five OUs are protective of human health and the environment. If the findings of this risk assessment indicate that sitewide risk has been sufficiently reduced to protective levels following completion of remedial actions for OUs 1 through 5, then a no-action ROD will be issued for the

Comprehensive Sitewide OU. If the risk assessment indicates the residual risk following remedial action implementation exceeds protective levels, then a sitewide FS will be issued, which will focus on determining what, if any, supplemental actions must be taken to reduce overall site risks to acceptable levels.

Consistent with DOE policy, the FEMP is integrating the requirements of the National Environmental Policy Act (NEPA) into the RI/FS process. On June 13, 1994, DOE issued a NEPA compliance policy, entitled the "Secretarial Policy on the National Environmental Policy Act," which allows for reliance on the CERCLA process to meet the procedural requirements of NEPA (DOE 1994b). Therefore, DOE has supplemented the evaluations contemplated in the RI/FS guidance to accommodate the incorporation of NEPA values in preparation of RI/FS documentation.

1.1.3 Sitewide Regulatory Issues

A statutory framework for the treatment, storage, and disposal of hazardous waste was established by the Resource Conservation and Recovery Act (RCRA). The State of Ohio, through its designated agency, the Ohio Environmental Protection Agency (OEPA), has been authorized by US EPA to enforce most provisions of RCRA regulations for facilities within Ohio, including the FEMP. The FEMP continues to store inventories of hazardous waste containing radiological constituents (termed mixed waste). These mixed-waste inventories remain because of limited or nonexistent treatment and disposal capacity. Only the hazardous waste component of mixed waste is managed under RCRA. Because of the lack of disposal alternatives, the FEMP applied for and obtained a permit from the State of Ohio for the storage of these mixed wastes under the terms of Ohio's hazardous waste regulations.

A program is being established to address the management of mixed wastes. The Federal Facility Compliance Act (FFCA) requires that a FEMP Site Treatment Plan (STP), addressing all mixed wastes at the site which are subject to land disposal restrictions (LDRs) under RCRA, be submitted to the EPAs. If future mixed wastes generated by the OU3 remedial actions are similar in composition to legacy mixed wastes, DOE proposes to treat these wastes in accordance with the STP. The term "legacy waste" is defined by DOE as the inventory of LLW hazardous, TSCA wastes (e.g., asbestos, PCBs), and mixed waste that was generated by production activities at the site. Decisions regarding treatment of new mixed waste types, if any, generated by OU3 remedial activities, will be made through the CERCLA process and will be indicated in future updates to the STP. The final proposed

STP was submitted to the EPAs for review and approval in March 1995; OEPA will issue an order to assure implementation of the STP.

To accommodate potential on-property disposal of RCRA wastes, the FEMP would utilize the RCRA Subtitle C Corrective Action Management Unit (CAMU) provisions for on-property disposal of debris as remediation waste. Under this strategy, specific waste acceptance criteria (WAC, i.e., specific requirements and conditions under which a facility may accept waste) that are deemed protective of human health and the environment would have to be met so that the waste could be placed in an on-property disposal facility in lieu of meeting LDRs. If disposal of materials contaminated with RCRA-regulated constituents would result in unacceptable risks to human health and the environment, these materials would either be treated prior to placement in an on-property disposal facility or be shipped off-site for disposal.

Programs related to the Toxic Substances Control Act (TSCA), the Clean Air Act, and the Clean Water Act are also ongoing at the FEMP. An active FEMP program exists for the storage and disposal of polychlorinated biphenyls (PCBs) in accordance with TSCA requirements. The FEMP has permits, which are required under the Clean Air Act, to operate active sources of atmospheric emissions and will continue to renew those permits for active sources that are not related to specific CERCLA activities. An active National Pollutant Discharge Elimination System (NPDES) permit (pursuant to the Clean Water Act) covers water discharges from the site to the Great Miami River, and the permit is expected to remain in place as long as activity continues at the site. Other regulatory issues associated with NEPA, including cumulative impacts, mitigative measures, irreversible and irretrievable commitment of resources, short-term uses, and long-term productivity, are addressed in appendices to this RI/FS Report.

1.2 SCOPE AND ROLE OF OPERABLE UNIT 3

OU3 is one of the five OUs being addressed by the RI/FS process at the FEMP. The focus for the OU3 remedy decision is narrowed by past and pending remedy decisions for the OUs, as discussed below:

- OU3 IROD (DOE 1994a) - Documented the decision that no future mission existed for the buildings and structures in their current state. As a consequence, DOE and US EPA agreed to conduct D&D for all above- and below-grade buildings and facilities, with the provision for interim storage and/or limited off-site disposition of generated debris. The IROD provided that the final OU3 ROD would establish the strategy for the final disposition of the debris generated from the interim remedial action.

- OU4 ROD (DOE 1994c) - Provided for off-site disposal of the highly contaminated silo materials and the disposition of OU4 construction debris consistent with OU3 construction debris.

- OU1 ROD (DOE 1994d) - Established that the LLW and mixed production processing waste stored in the FEMP waste pits would be dispositioned off-site (at a commercial disposal facility). The OU1 ROD also provided that oversized pit debris and processing facilities debris would be dispositioned in a manner consistent with OU3 debris.

- OU2 ROD (DOE 1995a) - Established permanent on-property disposal at the FEMP. To accommodate on-property disposal of OU2 waste, the OU2 ROD includes a waiver of two State of Ohio Solid Waste Disposal Facility siting requirements which are Applicable or Relevant and Appropriate Requirements (ARARs).

- OU5 draft ROD (DOE 1995b) - Established final site cleanup levels for soil and groundwater, and defined the soil WAC for on-property disposal of LLW and mixed waste, and proposed a CAMU to be used in concert with the proposed on-property disposal facility.

OU3 is chronologically the last of the FEMP OUs to issue a RI/FS Report. As a result, past and pending decisions for the other FEMP OUs affect the options to be considered for the final disposition of OU3 materials.

In the preamble to the NCP, the US EPA discussed the balance between the statutory preference for treatment of all materials to the extent "technically feasible" and the ability to rely on the "use of engineering and institutional controls" for managing risk (55 Federal Register 46, pp. 8701, March 8, 1990). US EPA specifically recognized the difficulties presented by its preference for treatment of all contamination, indicating that it expects to place a priority on the use of treatment to address the principal threats posed by a site, wherever practicable. For wastes that pose a relatively low, long-term threat (commonly termed "secondary threat" materials), or in instances where treatment is impracticable, US EPA expects the use of engineering controls or a combination of engineering and institutional controls, where appropriate.

As evidenced in the OU RODs that have been issued, the FEMP has generally taken a balanced approach in its remediation strategy, consistent with the remediation framework laid out in the NCP. The premise behind the FEMP balanced approach is that high-concentration waste materials, considered to represent the principal threat at the site, will be treated and dispositioned at off-site locations, whereas higher volume, low-concentration waste materials, considered to represent a

secondary threat, will be considered for on-property disposal. The high-concentration OU1 and OU4 waste streams will be treated (by drying and vitrification, i.e., encapsulating the waste into glass beads) prior to off-site disposal. In contrast, low-concentration remedial wastes and soils associated with OU2 and OU5 are being considered for on-property disposal.

1.2.1 Definition of Operable Unit 3

OU3 is comprised of the former production facilities, structures, equipment, and remaining inventories of waste and product at the FEMP. These facilities and materials are principally located in a 136-acre area near the center of the site, known as the former Production Area. Strict access controls are maintained to the former Production Area through the use of fences and security guards. The former production facilities and equipment contained in OU3 can be generally characterized as exhibiting elevated surface concentrations of uranium and other hazardous substances, including thorium, in both a fixed and removable form, that exceed established guidelines for protecting human health and the environment. This surface contamination on the facilities and structures exists as a result of direct contact with uranium feed materials, operational spills, or releases occurring over the 37-year production history. Refer to Section 2.1 of the WPA for a general description of the FEMP production history and to Figure 1-4 for an overall flow diagram of the former production process.

The WPA data collection strategy was based, in part, on a system of grouping components into one of 11 component categories based on similarity of structure and/or function. A component is the smallest physically distinct unit considered individually in the development and implementation of the WPA, such as a building, road, pond, basin, or storage pad. For example, Plant 4, the Green Salt Plant (Component 4A), is a component, and the equipment, piping, machinery, inside sumps, and utilities, inside and associated with the component, are considered part of that component. OU3 consists of 233 components, including 219 that existed when the WPA was originally written, and 14 additional components that were constructed following development and approval of the WPA. These 14 newer components are not contaminated and will not be addressed as part of the RI/FS. The detailed descriptions and rationale for the development of components and component categories are provided in the WPA (Section 2 and Appendix D.9). Table 1-1 lists the 233 OU3 components, 14 of which have been dismantled or removed to date, as denoted by a footnote on the list. For example, Plant 7 (7A) and the Plant 4 Maintenance Building (4C) have been dismantled under a removal action, as footnoted in Table 1-1. The foundations of these structures remain and will be remediated as part of the interim remedial action.

When OU3 was defined in the 1991 Amended Consent Agreement, all materials that had not previously been included within the scope of an operable unit were combined into the definition of OU3. At that time, the following items were incorporated into the scope of OU3:

- All man-made improvements (except the OU4 silos);
- Residues;
- Drummed wastes;
- Nuclear product material;
- Scrap metal piles; and
- Coal pile.

During the course of developing the WPA, this listing was expanded to cover all 233 components listed in Table 1-1. The expanded listing resulted in a further definition of items within the OU3 scope. This listing includes

- Building materials, including structures, equipment, tanks, etc.;
- Safe Shutdown residues;
- Decontamination residues;
- Drummed LLW;
- Drummed hazardous and mixed waste;
- Nuclear product material;
- PCB waste;
- Asbestos waste;
- Scrap metal piles;
- Soil piles and sediments;
- Coal pile; and
- Wastewater (ponds, basins, and decontamination washwaters).

1.2.2 Operable Unit 3 Scope Reduction

Over the last few years, significant regulatory issues have been considered regarding OU3; in addition, field remediation projects have been conducted to address immediate environmental risks outside the RI/FS process. These factors have narrowed the OU3 scope that is evaluated within this document.

The scope of OU3 has been reduced in accordance with several DOE proposals to the EPAs. In December 1993, DOE proposed to US EPA (DOE 1993b) that the Initial Screening of Alternatives Report (normally prepared as a preliminary evaluation of remedial alternatives) be consolidated with the screening of alternatives presented in this document. The US EPA approved this combination in January 1994 (EPA 1994). Section 4, Section 5, and Appendix D of this document satisfy the requirements of the Initial Screening of Alternatives Report through the evaluation and screening of technologies and the development of alternatives.

In September 1994, the US EPA approved a modification to the WPA (DOE 1994e), which included a strategy eliminating the need for a separate, OU3, stand-alone, baseline risk assessment. Other modifications include streamlining the field characterization program, focusing the FS on three alternatives, accelerating the remediation schedule, and consolidating the RI and FS reports into a combined document. A stand-alone, OU3 baseline risk assessment was eliminated for the following reasons:

- The general level of risk associated with current OU3 conditions has been evaluated through other documentation such as the SWCR;
- Remedial action has already been deemed necessary;
- No OU3 material will remain for which cleanup criteria may be applied following completion of the interim and final remedial action; and
- No significant risk management decisions would be derived from conducting a separate OU3 baseline risk assessment.

The streamlining of the field characterization program is detailed in Section 2, and the alternatives evaluated are discussed in Section 5.

In October 1994, DOE proposed to the EPAs that materials deemed "legacy waste" and similar materials be expeditiously dispositioned off-site through existing programs and removal actions (DOE 1994f). The DOE specifically proposed to disposition off-site (1) the existing inventory of wastes and materials at the FEMP, (2) all similar wastes generated by Safe Shutdown activities in the former production facilities, and (3) a small quantity of similar wastes generated by remedial activities. This approach also addresses decontamination residues generated by the interim remedial action because of their similarity to Safe Shutdown generated wastes.

For each of these three categories, materials are classified as one of three types: LLW, mixed wastes, or nuclear product. For LLW, the strategy is to continue off-site disposition of these materials under Removal Action No. 9 because of expected, relatively elevated levels of radiological contaminants, which may be unsuitable for on-property disposal. For the mixed wastes, all materials generated will be treated in accordance with the STP. Further, the disposition of any treated mixed wastes will be managed under Removal Action No. 9. Because nuclear product is not currently classified as a waste, it will be dispositioned off-site for re-use under Remedial Action No. 12 or re-classified as a waste for off-site disposal under Removal Action No. 9 (see Section 1.2.2.1).

The resulting impact of this proposal is that these materials are to be administratively dispositioned off-site. This approach eliminates the need to reevaluate issues related to the treatment and disposition of these materials, and therefore, these issues are not reevaluated within Sections 4, 5, and 6 of this document.

Finally, to prevent unnecessary reassessment of options for remediating environmental media through a separate assessment by OU3, the soil piles and wastewaters contained within OU3 will be remediated consistent with the OU5 ROD. Included within the wastewaters are waters currently contained in ponds and basins, as well as decontamination washwaters. These waters are expected to be treated within the OU5 wastewater treatment system.

In summary, DOE proposals to the EPAs have resulted in a reduced scope for OU3 remedial decisions. The most significant reduction occurred through the administrative decision to dispose of certain wastes off-site. The revised listing of materials that are within the scope of the OU3 RI/FS Report is as follows:

- Most building materials, including structures, equipment, tanks, etc;
- Scrap metal piles; and
- Coal pile.

These three items have been divided into ten material categories (A-J) based on their physical properties and/or configurations, as discussed in Section 3. Section 3 further provides a breakdown of these materials by waste classification (e.g., hazardous waste, LLW, etc.). The volumes of the OU3 materials are chronicled in the draft OU3 Estimated Material Quantities Report (DOE 1995c). For the materials addressed by previous agreements, volume estimates have been developed and are included in Material Category J (Products, Residues, and Special Materials). Disposition alternatives for these materials will not be evaluated in Sections 4, 5, and 6 because administrative decisions regarding their disposition have already been made.

1.2.2.1 OU3 Remediation Progress

OU3 remediation is currently proceeding under the interim remedial action, removal actions, and hazardous waste management unit closures, as defined and discussed below.

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Interim Remedial Action

As discussed in the IROD (DOE 1994a), the interim remedial action includes D&D of OU3 structures and facilities. This action was approved by the EPAs and is proceeding with the planned remediation of the Green Salt Plant (4A). The specific activities associated with the interim remedial action are

- Decontamination of more than 200 structures by removing loose contamination;
- Dismantlement of the structures;
- Removal of foundations, storage pads, ponds, basins, and underground utilities;
- Shipment, for off-site disposal, of no more than ten percent, by volume, of the waste generated through the interim remedial action; and
- Interim storage of the remaining wastes until a final decision is reached for treatment and/or disposition.

As referenced in the first bullet, all OU3 buildings and structures will first be decontaminated and then dismantled. The sequence and schedule by which the above-grade portions of all OU3 components will undergo D&D is outlined in the OU3 Remedial Design Prioritization and Sequencing Report (PSR) (DOE 1995d). At- and below-grade remediation of OU3 components will be integrated with soil remediation and will be sequenced and scheduled as part of the OU5 remedial design/remedial action (RD/RA) process. Decontamination is intended to address removable surface contamination only; however, if in situ methods can be used effectively to remove fixed surface contamination, they will be implemented. Additionally, any material classification established in this document will be incorporated into the interim remedial action to support waste segregation for treatment and/or disposal consistent with the final remedy.

Removal Actions

Since production operations were halted in 1989, removal actions have been used to address threats from the facilities, structures, and contaminants that remain. These actions have been implemented as precautionary measures until the interim and final remedial actions can fully address the threats to human health and the environment.

Table 1-2 provides details concerning OU3 removal actions that have been, or are soon to be, completed and the 14 components that are affected. These removal actions represent discrete project actions that are focused in scope.

In addition to the focused removal actions that have been completed, four additional removal actions were implemented for OU3:

- Removal Action No. 9 - Removal of Waste Inventories;
- Removal Action No. 12 - Safe Shutdown;
- Removal Action No. 17 - Improved Storage of Soil and Debris; and
- Removal Action No. 26 - Asbestos Abatement

These removal actions are programmatic in nature and are applied to OU3 as a whole. These programmatic removal actions, and the strategy for coordinating them with the interim remedial action, were introduced in the OU3 PP/Environmental Assessment for Interim Remedial Action (DOE 1993c) and have been previously described in the OU3 RD/RA Work Plan for the Interim Remedial Action (DOE 1994g). These removal actions will be incorporated into the final ROD for OU3, but the decisions associated with implementing these removal actions will not be re-evaluated within this document. A discussion of the major impacts of the programmatic removal actions on the OU3 remediation strategy is provided below, followed by a description of each removal action.

Removal Action Nos. 9, 12, and 17 have major impacts on the OU3 remediation strategy. As prefaced above, Removal Action No. 9 involves the safe, off-site disposal of existing waste inventories as well as decontamination residues generated during current remediation activities; these materials are considered high-concentration and thus require off-site disposal. Removal Action No. 12 (Safe Shutdown) is a precursor to the D&D of the buildings and structures, since it involves de-energizing the facilities, removing containerized wastes from storage areas within the building, and extracting process residues from piping and equipment. Removal Action No. 17 provides for controlled storage of debris removed from the buildings and structures, as well as wastes generated during the interim remedial action.

Finally, Removal Action No. 26 (Asbestos Abatement) is significant to the OU3 remedial strategy, since it is generally an ongoing maintenance operation that minimizes worker exposure to friable (loose) asbestos. The Removal Action No. 26 Work Plan is a compendium of work procedures that are used for building maintenance activities and to perform D&D during the interim remedial action.

<u>Removal Action No. 9 - Removal of Waste Inventories</u>. This removal action involves the safe, off-site disposal of existing waste inventories. It was initiated in August 1985 to provide for the transfer of inventoried and newly generated waste to the Nevada Test Site (NTS). The program involves the characterization, treatment, packaging, and transport of waste in a manner that ensures

full compliance with DOE Orders, Department of Transportation shipping requirements, and NTS WAC. As of July 1995, approximately 589,000 drum equivalents have been transferred from the FEMP to the NTS for disposal. The FEMP currently maintains an inventory of LLW, mixed waste, and PCB wastes generated as a result of production operations, facility maintenance, upgrades, and cleanup activities. Under Removal Action No. 9, these inventories will be removed. Mixed waste will be treated in accordance with the STP under the FFCA. Removal Action No. 9 will continue to disposition materials generated by the Safe Shutdown Program throughout the interim remedial action and will be incorporated into the final ROD.

Removal Action No. 12 - Safe Shutdown. This removal action was created to provide the planning, engineering, and program control for the proper disposition of all nuclear product and in-process residue materials, excess supplies, chemicals, and associated process equipment that were abandoned in place when the FEMP stopped production in 1989. After materials are removed, they are transported to NTS under Removal Action No. 9 or they are placed in interim storage pending final disposition under the final remedial action. This removal action also provides for the isolation and de-energizing of former production-related equipment and utilities. In addition, this removal action provides for the identification of customers for Fernald equipment and nuclear products. On a component basis, Safe Shutdown will be completed prior to the start of interim remedial activities for that component. On a programmatic basis, Safe Shutdown will be incorporated into the final remedial action.

Removal Action No. 17 - Improved Storage of Soil and Debris. Improved Storage of Soil and Debris was initiated to provide controlled storage of excess contaminated soils and debris generated during maintenance, construction, removal, and remedial actions at the FEMP through a soil and debris management plan. This removal action establishes procedures for the management and storage of soil and debris that will be generated through the interim remedial action. The revised draft work plan for this removal action is to be submitted to the EPAs in September 1995. The management approach outlined by this removal action will continue to be used throughout the interim remedial action for debris retained at the site.

Removal Action No. 26 - Asbestos Abatement Program. The Asbestos Abatement Program at the FEMP was established to mitigate potential asbestos release and migration. Abatement within this program includes in situ repairs, encasement, encapsulation, and removals. The activities are a necessary step prior to initiating D&D activities. Transite (wall and roof sheeting made of a mixture

of asbestos and cement), other nonfriable (fixed) asbestos-containing materials, and undamaged friable (loose) asbestos will remain within the buildings, facilities, or structures after completion of this removal action. Currently, only nonfriable asbestos can be transported to NTS under Removal Action No. 9; friable asbestos is retained in interim storage and managed under TSCA requirements pending final disposition under the final remedial action.

Hazardous Waste Management Units

Ohio hazardous waste regulations provide a regulatory framework for the operation and closure of hazardous waste treatment, storage, and disposal units, termed hazardous waste management units (HWMUs). The term HWMU is defined in 40 CFR 260.10 as "a contiguous area of land on/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." There were originally 54 HWMUs at the FEMP; of these, 50 were located in OU3. Since the initial identification, nine of the OU3 HWMUs were reclassified by the EPAs as solid waste management units (SWMUs), leaving 41 HWMUs in OU3. The HWMUs continue to be managed under RCRA; however, final closure of a number of these units will be initiated through implementation of response actions under the CERCLA process. Those HWMU wastes not addressed through CERCLA response actions will be managed under the terms of the Stipulated Amended Consent Decree and Ohio hazardous waste regulations. The Ohio hazardous waste regulations that are included in its authorized program are enforced in lieu of the federal RCRA regulations.

Table K-1, of Appendix K, provides additional information on HWMUs and SWMUs and summarizes the closure status of all HWMUs in OU3. The majority of these units are integral components of former Production Area structures or facilities (comprising OU3). As identified in Table K-1, the FEMP is pursuing closure of 14 OU3 HWMUs in accordance with Ohio hazardous waste regulations. Final dismantlement of the structural components of these 14 HWMUs will be performed concurrently with the implementation of remedial actions for OU3. Therefore, any hazardous waste that will be generated during the interim remedial action will be addressed through the final remedial action.

A joint initiative by DOE and the OEPA is being pursued for the integration of the CERCLA process for the remediation of contaminated environmental media and building materials with the State of Ohio hazardous waste regulations pertaining to the closure of the HWMUs through an OEPA Director's Final Findings and Orders (DF&O). The remaining 7 active and 20 inactive units, described in Table K-1, are tentatively scheduled for closure through this joint initiative. Final

cleanup will be achieved in conjunction with the conduct of the final remedial action for OU3, as well as the remedial action for OU5. Appendix K provides additional information on this process.

1.2.3 Scope of Operable Unit 3 Remedy Decision

As a result of previous agreements and ongoing remediation, the scope of OU3 for this RI/FS Report has been narrowed to building materials, copper piles, the coal pile, and other construction piles (sand, gravel). All other items have been removed from the scope of this report by being addressed under existing approved programs. For the coal pile and other construction piles, it is anticipated that these materials will be completely depleted through operation and construction activities prior to completion of remediation. Therefore, it is not expected that any of these piles will remain for remediation. The copper scrap pile has been addressed under Removal Action No. 15 by being containerized. However, the final disposition of the containerized copper will be addressed in this document. The items remaining within the scope of the RI/FS Report are the building materials, which represent the significant volume of materials within OU3.

Figure 1-5 shows the multiple program approach that describes the disposition of the items discussed in the previous two sections. Presented are the OU3 component categories, the waste streams generated by removal actions and D&D projects, the treatment and handling requirements, and the disposition options for these waste streams. Of the OU3 waste streams presented, the remediation materials constitute the largest quantity and constitute the only waste stream to be evaluated as part of the alternatives for this RI/FS. The various site removal actions and programs described above handle treatment and disposition of the other waste streams.

1.3 ORGANIZATION OF REPORT

This RI/FS Report consists of an Executive Summary, six sections comprising the main report, and supporting appendices. A brief overview of the content of the RI/FS Report is provided below.

The Executive Summary summarizes the findings, content, and conclusions of the RI/FS Report, including identification of COCs and analysis of the remedial alternatives.

Section 1, Introduction, presents a site overview and remediation history, discusses sitewide regulatory issues, defines the scope and role of OU3, presents a description and history of OU3, and outlines the remedial strategy and the scope of the OU3 remedy decision.

Section 2, Operable Unit 3 Study Area Investigations, includes a discussion of the data needs required to support decisions related to the final remedial action, the methodology employed for the data collection, and screening procedures as they relate to OU3. Section 2 also discusses the analytical program, the data validation process, and the usability and limitations of data collected to support the assessment of the nature of contamination. In support of Section 2, Appendix K contains both a log of general methodology and sample-specific variances written during the RI/FS characterization study and a description of the FEMP data management process that was in place at the time of the OU3 RI/FS was conducted. Appendix L presents the analytical data collected as part of the investigations described in Section 2 and provides assigned data validation qualifiers.

Section 3, Characterization of Operable Unit 3, provides a determination of COCs, baseline data and historical evidence of contamination, and a summary of the results from the RI/FS field characterization program. Conditions before the interim remedial action, removal actions, or HWMU closures are then described, including physical characteristics, contamination levels, and contamination source terms. Finally, projections of weights, volumes, and contamination according to regulatory waste classifications pursuant to the interim remedial action are included. In support of Section 3, Appendix A provides in-depth information on the contamination in OU3 based on sampling results. Appendix B provides detailed information on the development of contaminant source terms.

Section 4, Identification and Screening of Technologies Types, presents the OU3 remedial action objectives and general response actions for the final remedial action. Section 4 also discusses technology types relevant to the potential further treatment of OU3 materials during the final remedial action. Each technology type and associated process option was evaluated in terms of effectiveness, implementability, and cost. These evaluations are presented in Appendix D. Appendix C presents the potential strategy and regulatory requirements that must be considered when developing and evaluating the remedial alternatives.

Section 5, Development of Alternatives, presents the development and description of alternatives for the final disposition of all material generated during the interim remedial action. These alternatives have been developed from the representative technology types evaluated in Section 4 and Appendix D. Appendix E provides the estimated cost of each remedial alternative through the final remedial action; this estimate does not include costs associated with the interim remedial action. Appendix F presents WAC for the off-site disposal facilities being considered to receive OU3 wastes, whereas Appendix G presents WAC for the on-property disposal facility.

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Section 6, Detailed Analysis of Alternatives, presents an analysis of each alternative developed in Section 5 and then provides a comparative analysis of the alternatives based on the nine US EPA evaluation criteria. In support of Section 6, Appendix H provides an evaluation of short-term risks to human health and the environment resulting from implementation of remedial alternatives. Appendix I is the Comprehensive Response Action Risk Evaluation (CRARE), an assessment of long-term risk remaining at the FEMP following remediation within each OU required by the Amended Consent Agreement, and considers OU3 remediation in terms of the sitewide remedy. Appendix J examines the cumulative impact of site remediation on natural resources and wildlife at the FEMP.

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TABLE 1-1

OPERABLE UNIT 3 COMPONENT IDENTIFICATION LIST

Component	Component[a] Designation	Component[b] Category	Component	Component[a] Designation	Component[b] Category
Preparation Plant	1 A	3	Plant 7 [d]	7 A	2
Plant 1 Storage Shelter	1 B	2	Plant 7 Overhead Crane [c]	7 B	9
Plant 1 Ore Silos [c]	1 C	5	Recovery Plant	8 A	3
Ore Refinery Plant	2 A	3	Plant 8 Maintenance Building	8 B	4
General/Refinery Sump Control Bldg.	2 B	4	Rotary Kiln/Drum Reconditioning	8 C	3
Bulk Lime Handling Building	2 C	4	Plant 8 Railroad Filter Building	8 D	4
Metal Dissolver Building	2 D	3	Drum Conveyor Shelter	8 E	9
NFS Storage & Pump House	2 E	5	Plant 8 Old Drum Washer	8 F	9
Cold Side Ore Conveyor	2 F	9	Special Products Plant	9 A	3
Hot Side Ore Conveyor	2 G	9	Plant 9 Sump Treatment Facility	9 B	3
Conveyor Tunnel (from Plant 1)	2 H	10	Plant 9 Dust Collector	9 C	9
Maintenance Building	3 A	4	Plant 9 Substation	9 D	4
Ozone Building	3 B	4	Plant 9 Cylinder Shed	9 E	4
NAR Control House	3 C	1	Electrostatic Precipitator	9 F	3
NAR Towers	3 D	5	Boiler Plant	10 A	4
Hot Raffinate Building	3 E	3	Boiler Plant Maintenance Building	10 B	4
Harshaw Digestion Fume Recovery	3 F	5	Wet Salt Storage Bin	10 C	4
Refrigeration Building	3 G	4	Cont. Oil/Graphite Burn Pad	10 D	8
Refinery Sump	3 H	5	Utilities Heavy Equipment Building*	10 E	4
Combined Raffinate Tanks	3 J	5	Service Building	11	1
Old Cooling Water Tower	3 K	10	Main Maintenance Building	12 A	4
Electrical Power Center Building	3 L	4	Cylinder Storage Building	12 B	2
Green Salt Plant	4 A	3	Lumber Storage Building	12 C	2
Plant 4 Warehouse	4 B	2	Maintenance Building Warehouse*	12 D	2
Plant 4 Maintenance Building [d]	4 C	4	Pilot Plant Wet Side	13 A	3
Metals Production Plant	5 A	3	Pilot Plant Maintenance Building	13 B	4
Plant 5 Ingot Pickling	5 B	4	Sump Pump House	13 C	3
Plant 5 Electrical Substation	5 C	4	Pilot Plant Thorium Tank Farm	13 D	5
West Derby Breakout/Slag Milling	5 D	4	Administration Building	14 A	1
Plant 5 Filter Building	5 E	2	Building 14 EOC Generator Set	14 B	9
Plant 5 Covered Storage Pad	5 F	2	Laboratory	15 A	3
Plant 5 Ingot Storage Shelter	5 G	2	Laboratory Chemical Storage Building*	15 B	2
Metals Fabrication Plant	6 A	3	Main Electrical Station	16 A	9
Plant 6 Covered Storage Area	6 B	2	Electrical Substation	16 B	4
Plant 6 Electrostatic Precipitator (South)	6 C	3	Electrical Panels and Transformer	16 C	9
Plant 6 Electrostatic Precipitator (Central)	6 D	9	Main Electrical Switch House	16 D	4
Plant 6 Electrostatic Precipitator (North)	6 E	3	Main Electrical Transformers	16 E	9
Plant 6 Salt Oil Heat Treat Building	6 F	3	Trailer Substation #1	16 F	9
Plant 6 Sump Building	6 G	3	Trailer Substation #2	16 G	9

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TABLE 1-1 (Continued)

OPERABLE UNIT 3 COMPONENT IDENTIFICATION LIST

Component	Component Designation[a]	Component Category[b]	Component	Component Designation[a]	Component Category[b]
10-Plex North Substation*	16 H	9	Sludge Drying Beds	25 F	11
10-Plex South Substation*	16 J	9	Primary Settling Basins	25 G	11
BDN Surge Lagoon	18 A	11	Trickling Filters	25 H	5
General Sump	18 B	5	10-Plex Sewage Lift Station*	25 J	10
Coal Pile Runoff Basin	18 C	11	Pump House - HP Fire Protection	26 A	4
Biodenitrification Towers	18 D	3	Elevated Water Storage Tank	26 B	5
Storm Water Retention Basins	18 E	11	Main Electrical Strainer House	26 C	4
Clearwell Pump House	18 G	3	Security Building	28 A	1
BDN Effluent Treatment Facility	18 H	3	Human Resources Building	28 B	1
Methanol Tank	18 J	5	Guard Post on South End of D Street[f]	28 C	1
Low Nitrate Tank	18 K	11	Guard Post on West End of 2nd Street	28 D	4
High Nitrate Tank	18 L	11	Guard Post of T-81*	28 E	1
High Nitrate Storage Tank	18 M	5	Skeet Range Building	28 F	1
Dissolved Oxygen Building*	18 P	4	Guard Post South of Building 51*	28 G	1
IAWWT Valve House*	18 Q	4	Chemical Warehouse	30 A	2
Main Tank Farm	19 A	5	Drum Storage Warehouse	30 B	2
Pilot Plant Ammonia Tank Farm	19 B	5	Old Ten Ton Scale	30 C	8
Tank Farm Control House	19 C	4	Engine House/Garage	31 A	3
Old North Tank Farm	19 D	5	Old Truck Scale	31 B	8
Tank Farm Lime Slitter Building*	19 E	4	Magnesium Storage Building	32 A	2
Pump Station & Power Center	20 A	4	Building 32 Covered Loading Dock	32 B	2
Water Plant	20 B	4	Pilot Plant Annex	37	3
Cooling Towers	20 C	9	Propane Storage	38 A	4
Elevated Potable Storage Tank	20 D	5	Cylinder Filling Station	38 B	9
Well House #1	20 E	4	Incinerator Building	39 A	3
Well House #2	20 F	4	Waste Oil Decant Shelter	39 B	3
Well House #3	20 G	4	Incinerator Sprinkler Riser House	39 C	4
Process Water Storage Tank	20 H	5	Sewage Treatment Plant Incinerator	39 D	9
Gas Meter Building	22 A	4	Rust Engineering Building	45 A	1
Storm Sewer Lift Station	22 B	4	Utility Shed East of Rust Trailers	45 B	4
Truck Scale	22 C	4	Heavy Equipment Building	46	4
Scale House & Weigh Scale	22 D	4	Six to Four Reduction Facility #2	51	4
Utility Trench to Pit Area	22 E	10	Health & Safety Building	53 A	1
Meteorological Tower	23	9	In Vivo Building	53 B	1
Railroad Scale House	24 A	4	Six to Four Reduction Facility #1	54 A	3
Railroad Engine House	24 B	4	Pilot Plant Shelter	54 B	2
Chlorination Building	25 A	4	Pilot Plant Dissociator Shelter	54 C	4
M.H. #175/Eff. Line/Sampling Bldg.	25 B	4	Slag Recycling Building	55 A	3
Sewage Lift Station Building	25 C	4	Slag Recycling Pit/Elevator	55 B	3
U.V. Disinfection Building	25 D	4	CP Storage Warehouse	56 A	2
Digester and Control Building	25 E	4	Storage Shed (West)	56 B	2

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TABLE 1-1 (Continued)

OPERABLE UNIT 3 COMPONENT IDENTIFICATION LIST

Component	Component[a] Designation	Component[b] Category	Component	Component[a] Designation	Component[b] Category
Storage Shed (East)	56 C	2	Laboratory Pad	74 V	8
Quonset Hut #1	60	2	Building 39A Pad	74 W	8
Quonset Hut #2	61	2	Finished Products Warehouse (4A)	77	2
Quonset Hut #3	62	2	D & D Building	78	4
KC-2 Warehouse	63	2	Plant 6 Warehouse	79	2
Thorium Warehouse	64	2	Plant 8 Warehouse	80	2
(Old) Plant 5 Warehouse	65	2	Plant 9 Warehouse	81	2
Drum Reconditioning Building	66	3	Receiving/Incoming Materials	82	4
Plant 1 Thorium Warehouse	67	2	Clearwell Line	88	10
Pilot Plant Warehouse	68	2	Parking Lot	89	8
Decontamination Building	69	3	Railroad Tracks	G-001	8
General In-Process Warehouse	71	2	Roads	G-002	8
Drum Storage Building	72	2	Storm Sewer System	G-003	10
Fire Brigade Training Center Bldg. [g]	73 A	1	Utility Lines	G-004	10
Fire Training Pond [g]	73 B	11	Underground Storage Tanks	G-005	6
Fire Training Tank [g]	73 C	5	Process Trailers	G-006	1
Fire Training Burn Trough [g]	73 D	6	Non-Process Trailers	G-007	1
Confined Space Burn Tank [g]	73 E	5	Pipe Bridges	G-008	9
Plant 2 East Pad	74 A	8	Non-RCRA Drums [h]	G-009	5
Plant 2 West Pad	74 B	8	RCRA Drums [h]	G-010	5
Plant 8 East Pad	74 C	8	Inventory [i]	G-011	5
Plant 8 West Pad	74 D	8	Mobile Containers (Sea-Land) [h]	G-012	5
Plant 4 Pad	74 E	8	Soil Piles	G-013	7
Plant 7 Pad	74 F	8	Rock Salt Pile	P-001	7
Plant 5 East Pad	74 G	8	Sand Piles	P-002	7
Plant 5 South Pad	74 H	8	Gravel Pile	P-003	7
Plant 6 Pads	74 J	8	Copper Metal Scrap Pile [j]	P-004	7
Plant 9 Pad	74 K	8	Coal Pile	P-005	7
Building 65 West Pad	74 L	8	Scrap Metal Pile [j]	P-006	7
Building 64 East Pad & R.R. Dock	74 M	8	Outside Equipment Storage Area	P-007	7
Building 12 North Pad	74 N	8	Tension Support Structure #1 [k]	TS-001	2
Decontamination Pad	74 P	8	Tension Support Structure #2 [k]	TS-002	2
Plant 8 Old Metal Dissolver Pad	74 Q	8	Tension Support Structure #3 [k]	TS-003	2
Plant 8 North Pad	74 R	8	Tension Support Structure #4*	TS-004	2
Building 63 West Pad	74 S	8	Tension Support Structure #5*	TS-005	2
Plant 1 Storage Pad	74 T	8	Tension Support Structure #6*	TS-006	2
Pilot Plant Pad	74 U	8			

(a) See Figure 1-3 for component location
(b) See note for Component Category Definitions (next page)
(c) removed as part of Removal No. 13 - Plant 1 Ore Silos
(d) removed as part of Removal No. 19 - Plant 7 Dismantling (at-and below- grade materials remain)
(e) regarded as part of Removal No. 19 - Plant 7 Dismantling
(f) removed during operation and maintenance activities
(g) removed as part of Removal No. 28 - Contamination of the Fire Training Facility
(h) to be removed as part of Removal No. 9 - Removal of Waste Inventories
(i) to be removed as part of Removal No. 12 - Safe Shutdown
(j) removed as part of Removal No. 15 - Scrap Metal Piles
(k) removed as part of Removal No. 7 - Plant 1 Pad Continuing Release
* Denotes components constructed during or after the development of the WPA

TABLE 1-1 (Continued)

OPERABLE UNIT 3 COMPONENT IDENTIFICATION LIST

Note: The eleven component categories are defined as follows:

1. Administrative/Support Buildings - Category 1 includes all administrative and support buildings.

2. Warehouse/Storage Buildings - Category 2 consists of all warehouse and storage buildings.

3. Process Buildings - Category 3 includes all buildings that housed major processing activities.

4. Process Support Buildings - Category 4 includes all buildings that provided or provide support for plant operations.

5. Containers/Containerized Material, Aboveground (includes all drums) - Category 5 includes: all aboveground containers (whether empty or not) and containerized material; all waste and product inventories, including hold-up material; and all uranium and thorium inventories. Category 5 does not include tanking/piping/distribution systems or bulk stored materials.

6. Containers/Containerized Material, Belowground - Same as Category 5, except components are belowground.

7. Bulk Material (includes waste piles) - Category 7 includes all existing scrap metal piles, copper piles, soil piles, and similar items within OU3 scope. It also is intended that this category will include any newly generated soil piles, rubble piles, and the like that result from ongoing activities both in and out of the scope of OU3.

8. Storage Pads/Parking Lot/Roads/Railroads - Category 8 consists of waste storage or handling pads, railroads, roads, the parking lot, and sidewalks.

9. Piping/Utilities/Equipment, Aboveground - Category 9 includes all aboveground piping and utility systems, including outside tank and distribution systems.

10. Piping/Utilities/Equipment, Belowground - Category 10 includes all underground piping and utility systems.

11. Ponds and Basins - Category 11 includes surface impoundments, ponds, and basins. The largest of these are biodenitrification (BDN) surge lagoon and the storm-water retention basins.

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TABLE 1-2

OPERABLE UNIT 3 REMOVAL ACTIONS (NON-PROGRAMMATIC)

Removal Action	Status	Description
7 - Plant 1 Pad Continuing Release	Completed Feb 1995	A three-stage action designed to prevent continuing releases from the pad to the environment. The first stage provided interim run-off control and installed two temporary tension support structures (TSSs). The second stage included soil removal, additional pad installation, and two more TSSs. The third stage included the installation of sealed concrete over existing contaminated concrete and the replacement of three TSSs with one TSS. Components TS001-3 were removed as a result of this Removal Action.
13 - Plant 1 Ore Silos	Completed June 1995	This removal action involved dismantling the eight tile silos, six concrete silos, and their associated structural steel supports and support piers down to, but excluding, the concrete pad. Component 1C was removed as a result of this Removal Action.
14 - Contaminated Soils Adjacent to Sewage Treatment Plant Incinerator	Completed Nov 1994	Soils in the area of the incinerator that met or exceeded prescribed cleanup action levels were excavated. Excavation included a total of 3,020 yd^3, with 1,320 yd^3 from on-property and 1,700 yd^3 from off-site areas. Soils were containerized pending characterization under Removal Action No. 17 management guidelines.
15 - Scrap Metal Piles	Phase I - Completed Oct 1994 Phase II - Pending	Phase I of this two-phase removal action involved the recycling of the scrap metal from Production Area piles. 2254 tons were recycled into shielding blocks, 9 tons were free released under State of Tennessee requirements, and 16 tons were disposed at NTS. Phase II involved containerizing the scrap copper piles for treatment and disposition. This material is awaiting the selection of a viable treatment approach. Components P-004 and P-006 were removed as a result of this Removal Action.
19 - Plant 7 Dismantling	To be Completed Oct 1995	This removal action consisted of dismantling Plant 7 (a seven-story steel framed building) and the bridge crane located west of the building down to, but excluding, the concrete pad. The materials designated for disposal will be packaged and shipped off-site in accordance with Removal Action No. 9. All structural steel was segregated for recycling or beneficial reuse. The Plant 4 Maintenance Building was also dismantled, since it was adjacent to Plant 7. Components 7A, 7B, and 4C were removed as a result of this Removal Action.
20 - Uranyl Nitrate Stabilization	To be Completed Dec 1995	This removal action will stabilize and disposition approximately 226,000 gallons of Uranyl Nitrate Hexahydrate (UNH) solution stored in 21 tanks.
24 - Pilot Plant Sump	Completed Dec 1993	This removal action involved removing the sump and its contents, cutting and capping the drain line supplying the sump, removing contaminated soils immediately surrounding the sump and drain line, inspecting the remaining drain line prior to backfilling and excavation, and collecting field samples.
25 - Nitric Acid Tank Car/Area	Completed Nov 1993	The Tank Car contents were pumped into portable tanks, along with rinseate from a total of five rinses, and transferred to the Nitric Acid Recovery (NAR) System for ultimate disposition via the UNH System. Safe Shutdown separated the stainless steel tank from the rail car undercarriage, cut open the tank to prevent its reuse, and transferred these components to the scrap metal holding areas.

TABLE 1-2 (Continued)

OPERABLE UNIT 3 REMOVAL ACTIONS (NON-PROGRAMMATIC)

Removal Action	Status	Description
27 - Management of Contaminated Structures at the FEMP	Completed Dec 1993	This removal action was initiated to minimize the risk from uncontrolled release of contaminants from 25 structures within OU3. The scope of work for the decontamination and dismantlement of these 25 components was incorporated into the scope of the OU3 Proposed Plan/Environmental Assessment for Interim Action (DOE 1993c). This Removal Action is considered complete.
28 - Fire Training Facility	Completed June 1995	This removal action involved the removal, decontamination and disposal, treatment or storage of all structures, tanks, equipment, underground sump, and surface soils at the Fire Training Facility. Components 73A, 73B, 73C, 73D and 73E were removed as a result of this Removal Action.

Note: The status completion date is based on the submittal of a final report to the EPAs.

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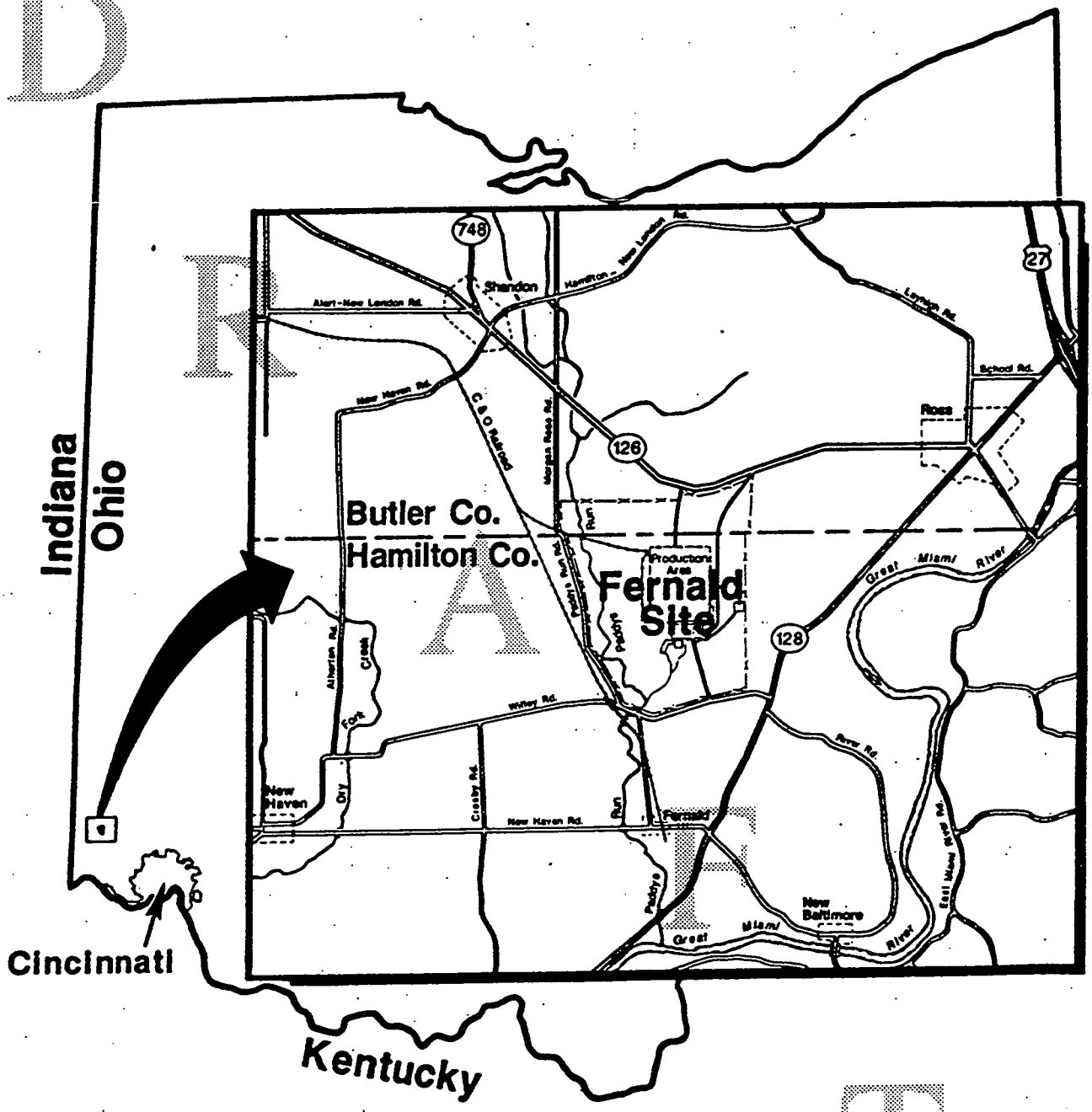

FIGURE 1-1. FEMP FACILITY LOCATION MAP

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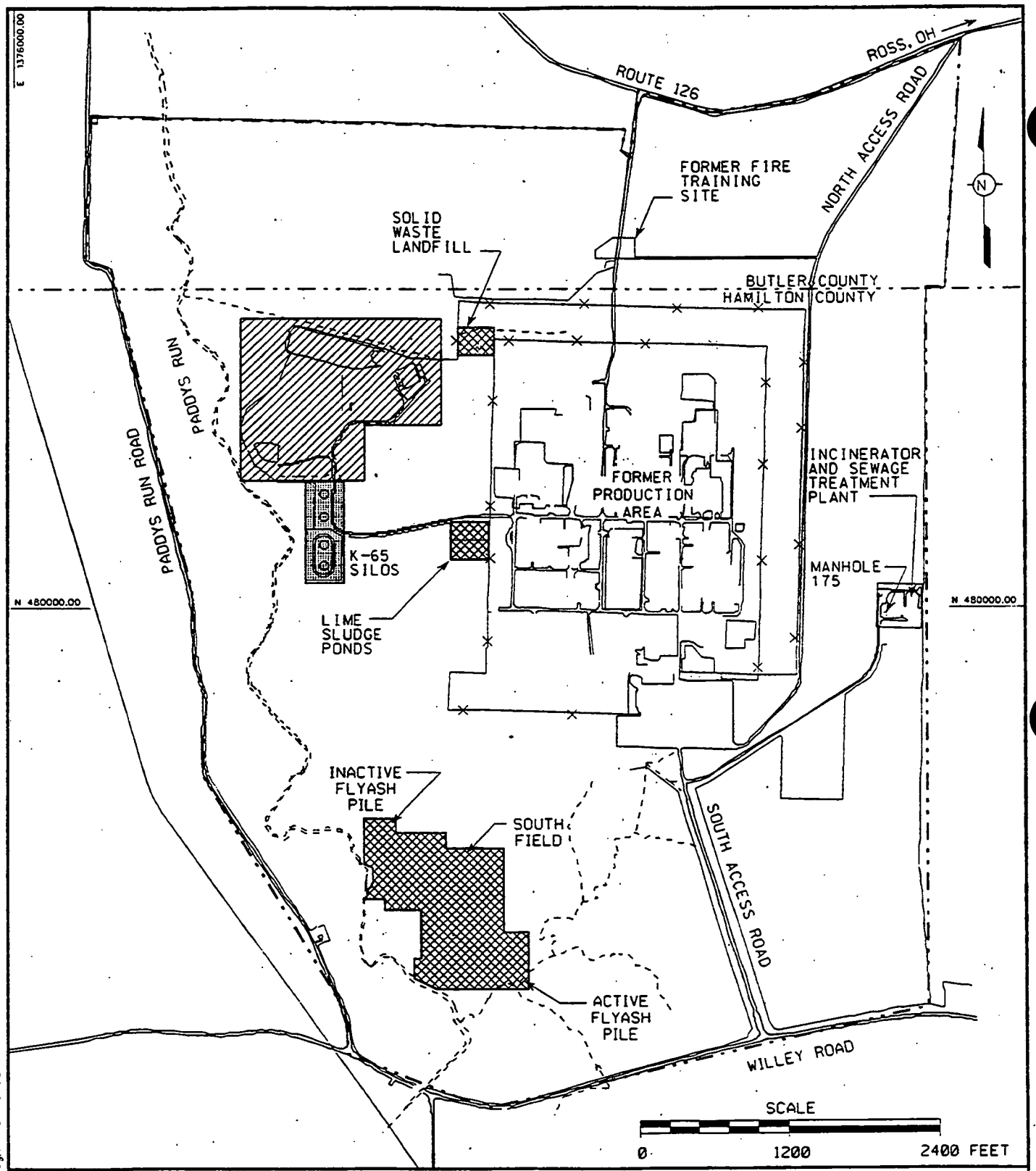

NOTE:

1. OPERABLE UNIT 3 INCLUDES ALL BUILDINGS, PIPELINES, AND ABOVE-GROUND STRUCTURES IN THE FORMER PRODUCTION AREA. OPERABLE UNIT 5 INCLUDES GROUNDWATER, SURFACE WATER, SOILS, SEDIMENTS, FLORA AND FAUNA IN THE REGIONAL AREA AS WELL AS THE FORMER PRODUCTION AREA.
2. STATE PLANER COORDINATE SYSTEM 1927 INDICATED.

LEGEND:

- FENCE LINE
- DRAINAGE WAY
- CSX RAIL LINE
- FEMP PROPERTY BOUNDARY
- OPERABLE UNIT 1
- OPERABLE UNIT 2
- OPERABLE UNIT 4

/usr/ermas/3aaat/dgn/rilig1-2.dgn 01/10/95

FIGURE 1-2. RI/FS OPERABLE UNITS WITHIN THE FEMP

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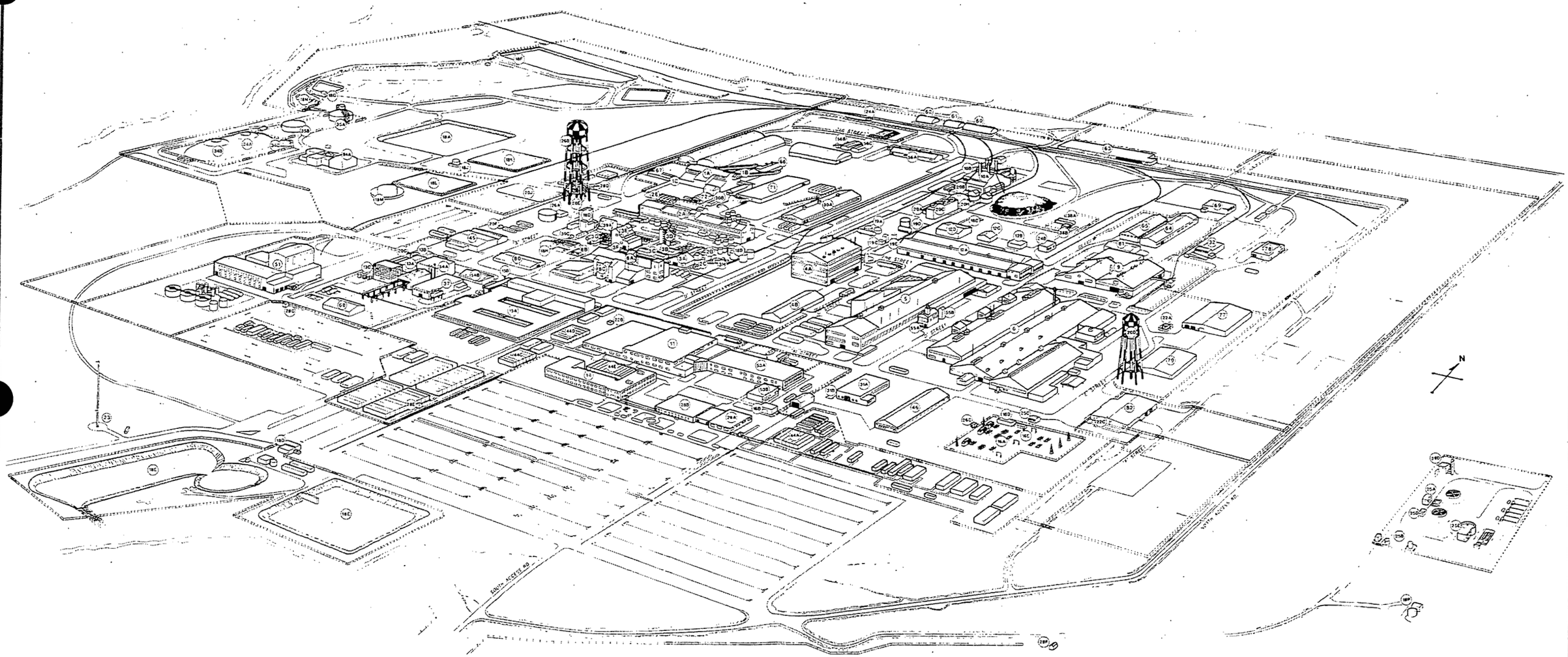

Figure 1-3. Site Perspective Map

NOTE: Refer to Table 1-1 for Component Name and Designation.

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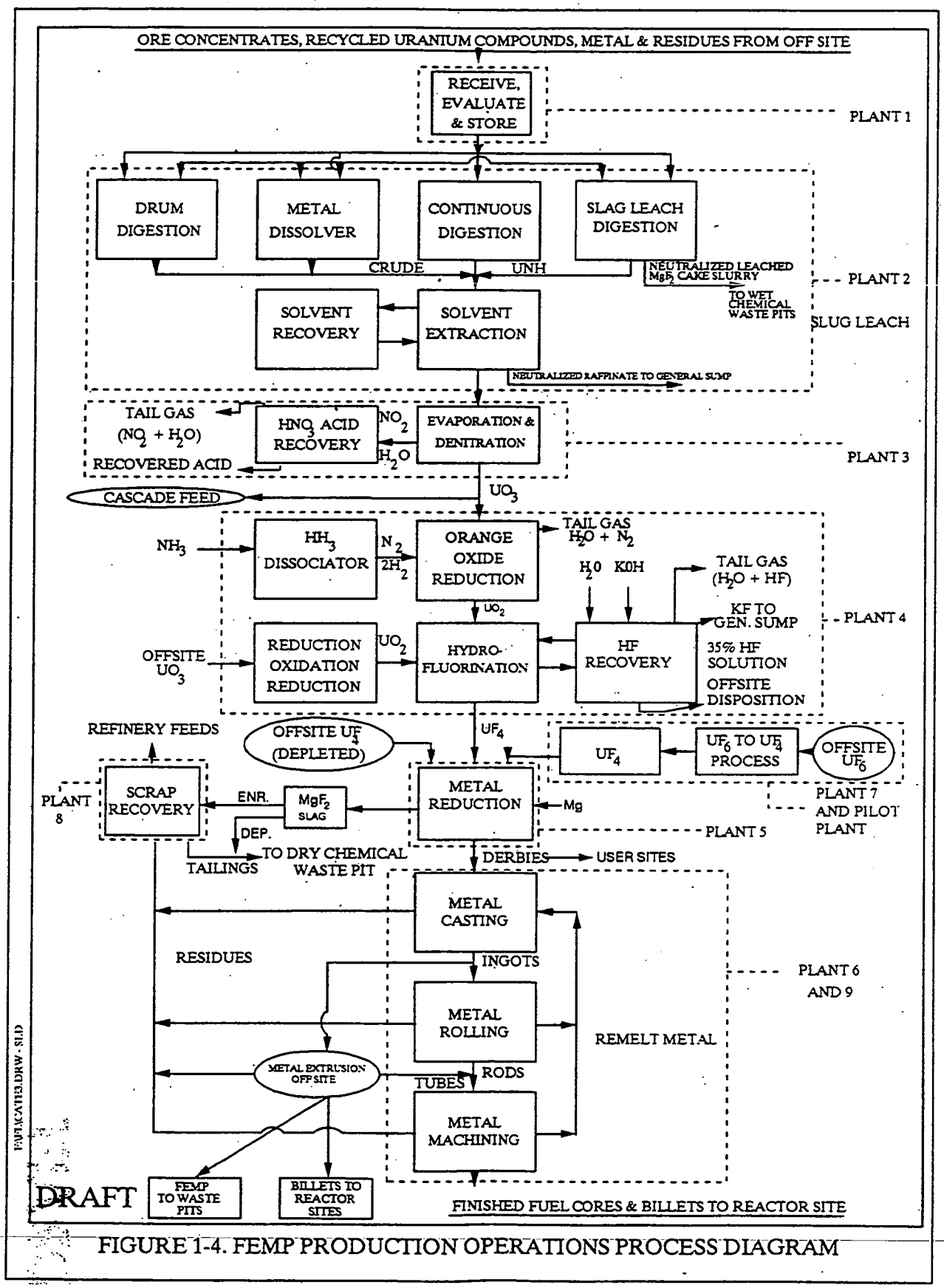

FIGURE 1-4. FEMP PRODUCTION OPERATIONS PROCESS DIAGRAM

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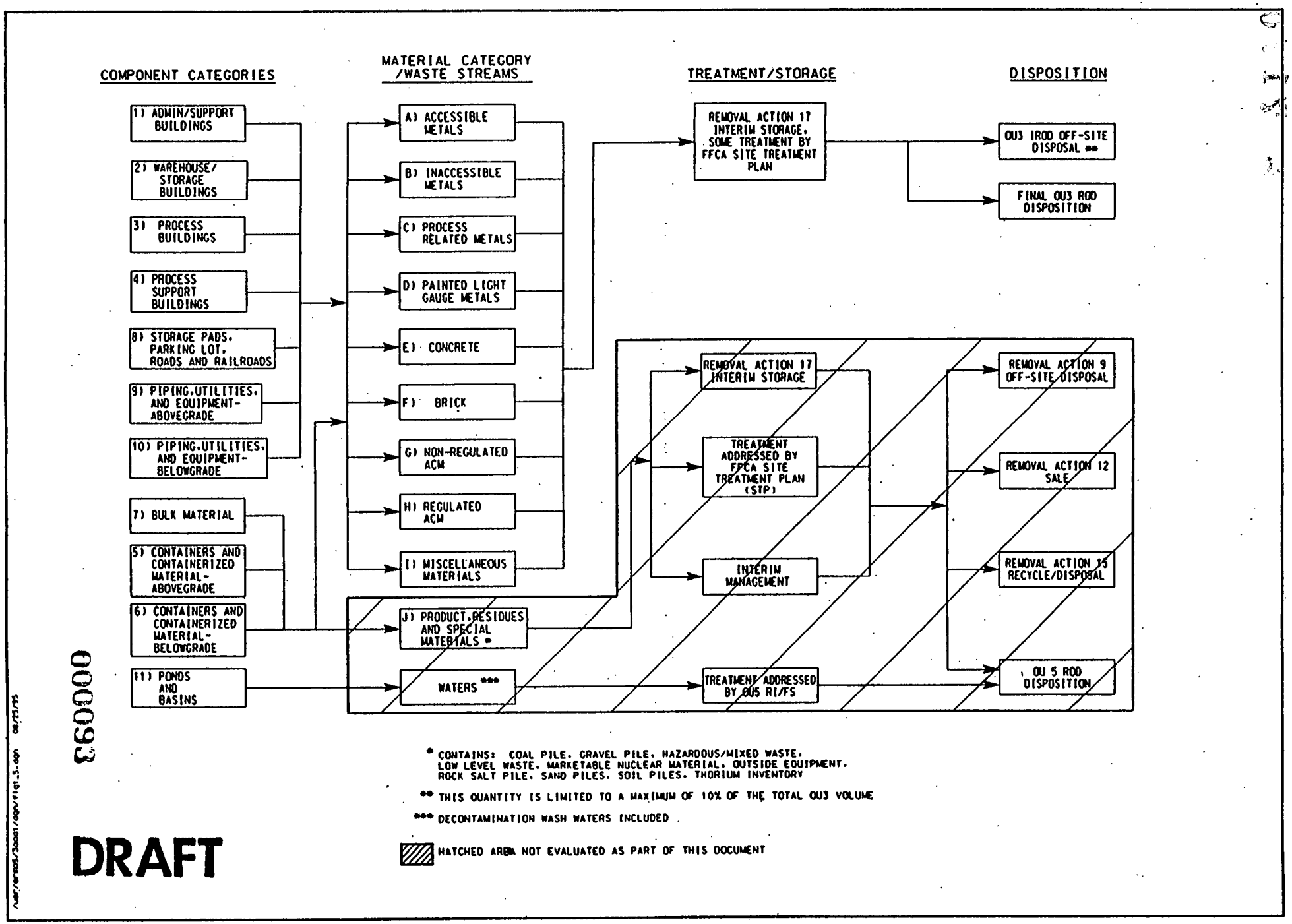

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FIGURE 1-5. FEMP MULTIPLE PROGRAM APPROACH FOR OU3 MATERIAL/WASTE STREAM

2.0 OPERABLE UNIT 3 STUDY AREA INVESTIGATIONS

Data needs for the OU3 RI/FS characterization study were originally established in the WPA (DOE 1993a). DOE revisited these data needs after the IROD had been signed and proposed a modification to the WPA (DOE 1994e). The primary focus of the modified characterization study was to determine the nature of contamination that would remain in the building materials after the interim remedial action is completed.

Section 2 presents a description of the field and laboratory programs employed to support the RI/FS characterization study. OU3 components were characterized to support development of estimates of the quantity of contaminated material, based upon material types and contamination levels, for contaminated facilities and structures. The characterization data were used to develop and evaluate the remedial alternatives as discussed in Sections 4, 5, and 6.

The WPA identifies data needs at OU3, lists program objectives and presents a data collection approach, as detailed in the WPA sampling and analysis plan. The WPA also provides the number and types of samples to be collected for each component, the method for determining sample locations, the procedure to be followed in the collection of each sample type (i.e., concrete, masonry, etc.), and the analytical methods/protocols to be followed by the laboratories when analyzing OU3 samples.

DOE proposed a modification to the WPA (DOE 1994e), which proposed a reduction of the scope of the RI/FS characterization program based on (1) revised data needs, (2) on recognition that OU3-specific baseline risk assessment requirements are satisfied by existing comprehensive site assessments, and (3) on sample trending analysis done using data obtained during the early stages of the characterization program. Section 2 describes the RI/FS characterization program, based on the modification of the WPA. The results are used to support the final remedy decision.

Section 2.1 outlines the data needs relating to remedial alternative development and comparison. Sections 2.2 through 2.4 detail the field investigation approach and activities, including field screening, intrusive sampling, and any variances from these activities. Section 2.5 describes other investigations and studies that were used to supply information and/or analytical results for this document. Analytical requirements, data validation, and sample tracking are discussed in Section 2.6. Section 2.7 focuses on the data quality assessment process and data evaluation.

2.1 DATA NEEDS TO SUPPORT REMEDY DECISION

Data needs related to supporting the final remedial action are:

- estimate of type and mass of contaminants (i.e., source terms) that would reside in OU3 materials after the interim action;
- media volume and weight estimates of various types of materials within OU3 requiring final disposition;
- waste characteristics and potential treatability of various media to reduce waste volume or contaminant mobility; and
- estimate of contaminant- and material-specific leachability from OU3 material for preparing WAC for on-property disposal.

Table 2-1 provides a detailed listing of data needs, including data uses and data objectives, as well as the data collection approach. These data needs, originally presented in the WPA, have been revised based on the modification to the WPA (DOE 1994e).

2.2 SUMMARY OF DATA COLLECTION APPROACH

This section reviews the WPA approach for collection of RI/FS data to support fundamental decision making for the management and future disposition of OU3 wastes. This approach included categorization of components, delineation of components into process areas, and an overall sampling strategy. This section also discusses how field work packages (FWPs) were used to specify sampling locations and protocols.

Figure 2-1 diagrams the characterization program presented in Section 2. This process begins with the initial categorization of OU3 components into "sampled components" and "non-sampled components" based on the radiological levels found in past radiological surveys performed at the FEMP. Next, radiological and chemical surveys were performed to identify sampling locations in "sampled components" and to verify the classification of the remaining components in the "non-sampled components" category. Finally, intrusive samples were collected at the selected locations as appropriate. The flow diagram presents the rationale for deciding whether to collect a sample for a particular material (i.e., loose media, unknown liquids), the type of sample to be collected (concrete core versus concrete chip), and the sample collection location. Each concept presented in the flow diagram is discussed in detail in Section 2.2 and 2.3.

2.2.1 Sampling Approach

The decision to D&D the OU3 structures had major implications for the data collection program under the RI/FS. The scope of the RI/FS characterization study was carefully designed to support evaluation of remedial alternatives that would be implemented following D&D activities. Most of these alternatives were expected to involve material disposition. The study was then focused on various types of construction materials within OU3 (e.g., concrete, masonry, etc.). Samples were collected from areas of highest radiological and/or chemical concentrations (hot spots) from each of the construction materials studied. Hot spot determinations were made by the field screening procedures described in Section 2.3.1. The types and levels of contaminants present in a given type of material (e.g., concrete) were assumed to be the same throughout a given process area within a particular component (e.g., OU3 building, pad, or other structure). For areas in which processing occurred, a process area was defined as the area taken up by a particular chemical process. For other areas, the term process area was used to indicate contiguous areas with common activities. All components, except those assigned to the bulk materials category, were divided into process areas (Component category descriptions are provided in Table 1-1). Given the definition of a process area, uniformity of types of contaminants within a particular material within a process area is a reasonable assumption. Expected uniformity of types of contaminants limited the necessity for multiple samples within a given material in a process area, while sampling from the location of highest concentration assured conservatism.

Based on these assumptions, the following sampling approach was devised: one intrusive sample, taken from each major medium (e.g., concrete, acid brick, masonry, steel coating) in each defined process area at the location of greatest known radiological and/or chemical contamination, was collected for analytes identified in Table 2-3. Table 2-4 provides a summary of analysis per medium. In the case where screening (e.g., x-ray fluorescence (XRF)) did not identify a separate chemical contamination location, chemical intrusive samples were taken at the same location as the radiological intrusive sample. Conversely, separate intrusive samples were collected if there were distinct areas of chemical and radiological contamination.

OU3 consists of 233 components (as noted in Section 1.2.1) representing the entire spectrum of structures and functions of the FEMP. Only 219 of these components were included in the WPA and are, therefore, part of the RI/FS characterization study. The additional 14 components were constructed after approval of the WPA and are considered uncontaminated. Because of the varying types of operations that were conducted in the various components, contaminant levels range from

negligible to high. Prior to preparation of the WPA, the site radiological monitoring and environmental data were examined to identify components that are likely to have either significant or no significant levels of contamination. Process knowledge, past sampling program information, drum storage and contents, etc., were also reviewed to determine possible contamination. Components with no significant contamination, based on radiological levels identified in DOE Order 5400.5 criteria for allowable surface contamination as listed in Table 2-2, were not sampled. Confirmatory screening (radiological surveys and XRF) was carried out in representative components identified as not contaminated (non-sampled). Such components were selected based on plausible risks or expected difficulty in remediation. Therefore, all OU3 components were classified into one of three categories based on the suspected level of contamination:

- Sampled: Components suspected of being contaminated;
- Confirmatory: Components having at most isolated pockets of relatively low levels of contamination; and
- Non-sampled: Components having at most isolated pockets of low levels of contamination.

Sampling component classifications were developed from detailed inspections, previous investigations (i.e., spill logs, process knowledge) and a review of radiological surveys from 1989 to July 1992. In addition, all components were radiologically surveyed as part of the RI/FS sampling program, and components were reclassified when the survey data exceeded the "significant radiological contaminant" levels identified in the DOE Order 5400.5 criteria for allowable surface contamination listed in Table 2-2. Of the 219 OU3 components listed in the WPA, 137 were classified as sampled and 82 were classified as non-sampled, with 16 of these classified as confirmatory (one of these was canceled; see Section 2.3.3). The individual component discussions in Section D.9 of the WPA list the category placement for each component.

2.2.2 Field Work Packages

As specified in the WPA, component-specific FWPs were prepared prior to field sampling. In essence, FWPs are mini sampling and analysis plans which specify exact sample locations, protocols, sample number designations, etc. to be employed by the sampling teams and supporting groups. Using a combination of the "Summary of Available Radiological Data" discussions in Section D.9 in

the WPA and additional radiological survey data and chemical survey data collected prior to writing the FWPs, sampling locations were identified based on radiological hot spots and chemical hot spots for each process area as described above. Any changes in the FWP requirements (i.e., change in, or elimination of, sample locations) were written in the sampling team's field logbooks and then documented in formal variance reports. Section 2.4 provides a discussion of all sampling variances reported in these field logbooks.

2.3 COMPONENT AND MEDIA CHARACTERIZATION

In support of the OU3 RI/FS, 1,127 intrusive samples were collected. This section discusses both screening and intrusive sampling that was performed as part of the OU3 characterization study. Radiological and chemical field screening is addressed in Section 2.3.1. Intrusive samples collected from major media (concrete, acid brick, masonry, steel coatings, asphalt, and transite) are discussed in Section 2.3.2. Additional supplemental media collected, including loose media (sediment, soil, sludge, wood), unknown liquids (collection point liquids, ponds and basins), and air filters, are discussed in Appendix K. These supplemental samples were used to support the general characterization of OU3 components rather than to directly support remedy selection. Results are presented in Appendix L.3. Section 2.3.3 reviews confirmatory sampling, while Section 2.3.4 describes the sampling program for construction material leachability testing. Appendix L.1 provides a listing of all samples collected as part of the OU3 RI/FS characterization study, including information such as the component and process area from which the sample was collected, the media collected, and the group of constituents analyzed.

2.3.1 Field Screening

Various sampling methods were used to fulfill specific data needs identified in the WPA. Results from the application of field screening methodologies were used as a basis for selecting final intrusive sampling locations, in addition to providing radiation exposure rates. Each of the screening methods employed during the RI/FS characterization study is based on protocols presented in the WPA. The methods are summarized below in the same sequence in which they were implemented in the field.

2.3.1.1 Surface Radiological Measurements

A variety of radioactivity measurements were obtained from construction material surfaces to select sampling locations. Screening locations were determined using an approach based on existing surface contamination data and process knowledge. Each process area with known and/or suspected

contamination was surveyed to either confirm the preliminary "hot spot" (local maximum) identified in the WPA or to designate another "hot spot."

The local maximum "hot spot" was generally designated based on the highest total beta-gamma activity. That information was supplemented with removable alpha and removable beta-gamma measurements from significantly contaminated locations. The beta-gamma surface contamination surveys were performed using a Geiger-Mueller (GM2) probe. The removable radioactivity, alpha and beta-gamma, was determined by the swipe sampling method using a standard paper or cloth material to swipe a 100 cm^2 area and analyzing in a Tennelec scintillation counter.

2.3.1.2 Metals Screening by X-Ray Fluorescence (XRF)

A field portable XRF instrument was used to screen selected components for suspected metal contamination. The XRF instrument was used to screen concrete, masonry, and steel coatings and identified metallic hot spots to guide intrusive sampling. The technique yielded qualitative and semi-quantitative data for metals with atomic number of 24 (chromium) or higher at detection limits of approximately 100 to 200 μg/kg and supplied electronic data downloads to a personal computer for user evaluation and review. Prospective XRF screening locations were based on visible staining and a review of process knowledge and potential contaminants. The XRF results were evaluated to determine the local maximum for the metal contaminants, primarily focusing on the RCRA hazardous waste toxicity characteristic metals, (i.e., arsenic, barium, chromium, cadmium, lead, selenium, silver, and mercury).

2.3.1.3 Organic Vapor Screening

A photoionization detector (PID) was used to screen components suspected of containing organic compounds. Screening locations were selected based on process knowledge, visual contamination or suspect areas. The PID instrument is sensitive to vapors at levels as low as 0.1 parts per million by volume (ppmv) and responds to a variety of chemical classes, particularly aromatics, including benzene, toluene and xylene, and olefins, such as chlorinated ethenes (e.g., trichloroethene [TCE]). The particular PID instrument employed is capable of automatically logging the high, low, and average reading every 15 seconds and has electronic data downloading features.

The component-specific FWPs specified the use of PID screening in 38 components, based heavily on visual observations and the component's history concerning use of chemical solvents, fuels, lubricants, and other organic-based liquids. The general protocol entailed air measurements in the

vicinity of runoff collection points or sumps, cracks in floors, unknown containerized liquids and loose solids, and soils.

2.3.1.4 PCB Screening Surveys

The use of field kits for PCB screening proved to be an effective tool for determining accurate semi-quantitative (order of magnitude) results for PCB levels in concrete and masonry floors. An immunoassay field kit was used for semi-quantification of the PCBs on surfaces by using a cloth wipe over a 100 cm^2 area, followed by solvent extraction of the wipe. Components were screened based on the presence of visible oil stains around electrical equipment and on suspicion of housing transformers containing PCB-contaminated oils. The screening kits were used to identify the highest area of PCB contamination, for intrusive sample collection and laboratory analysis, in 18 components.

2.3.2 Intrusive Sampling

Intrusive sampling was performed during the RI/FS characterization study to collect and analyze major media and supplemental samples. Major media samples consisted of concrete, acid brick, masonry, steel coatings, asphalt, and transite. Supplemental samples (i.e., loose media, unknown liquids, air filters) were collected as part of the RI/FS characterization study for the purpose of supporting general characterization, as discussed in Appendix L.3. A single sample of each major medium, if present, was collected from each process area within a component (those designated for sampling). Final sample locations were based on field radiological screening, field chemical screening, visual observations and/or a knowledge of process operations within each component as described above.

Intrusive samples were obtained from 137 components, which generated a total of 891 major media samples and a total of 236 supplemental media samples. All intrusive samples were analyzed at off-site laboratories for selected constituents (identified in Table 2-3) based on the media type and suspected contaminants. To ensure data sufficiency, each sampled medium, regardless of location, was analyzed for the same groups of constituents (e.g., concrete was always analyzed for radionuclides and target analyte list (TAL) metals). Table 2-4 provides a breakdown of the groups of constituents analyzed for each media type.

Table 2-5 consists of a detailed component summary, organized by the component type (process buildings, warehouse/storage buildings, etc.) of media-specific intrusive samples collected from each

component. Non-sampled and confirmatory components are included in order to provide a complete reference table that summarizes the sampling status of all components.

2.3.2.1 Major Media Sampling

Concrete Cores. Process areas where acids and caustics were used, which created potential corrosive conditions, are referred to as "wet" process areas. In components that contained these "wet" process areas, "core" samples of concrete floors were collected to evaluate the penetration of contaminants. "Concrete cores" are actually measurements of contaminant depth profiles obtained through repeated grinding of the exposed surfaces. Actual cores were not obtained. Radiological surface activity measurements were taken at each depth in the field, while the collected media were containerized for laboratory analysis. The term concrete core will be used in this document to address these latter samples.

Consistent with the local maximum sampling approach, one core sample was extracted from each process area at the location of the highest radiological and/or chemical concentrations. Concrete cores were collected as discrete samples from the following intervals: 0-0.5 inch, 0.5-1 inch, and 1-4 inch depths. A deeper interval, 1-6 inches, was used early in the field program but was reduced to 1-4 inches because of difficulty in attaining the six-inch depth and the potential hazard of encountering utility lines.

A combination of a diamond coring bit and a pneumatic bushing tool (an attachment, similar to a meat tenderizer, attached to a hammer drill that pulverizes the concrete into small pieces) was used to obtain concrete cores. Typically, the bushing tool was used to break up the 0-0.5 inch and 0.5-1 inch intervals. The coring bit was then employed to core the 1-4 inch interval, followed by the bushing tool to chip out the core material in situ.

All 375 concrete core samples (126 sample locations, one sample per depth, typically three depths per location) were analyzed at analytical support level (ASL)[1] D for both the radionuclides listed in Table 2-3 and the US EPA TAL for metals. Also, two samples were analyzed for PCBs at ASL D.

Concrete Chip, Masonry, and Acid Brick. Concrete was sampled in all process areas selected for characterization that were classified as "dry" components (i.e., where no chemical processes occurred). Because of the low permeability of concrete under normal conditions, samples in these

components were collected from the 0-0.5 inch interval. Masonry and acid brick from locations in both wet and dry components were also collected from the 0-0.5 inch interval. A bushing tool was used to remove the top half inch of concrete and masonry in situ.

All 294 concrete chip, acid brick, and masonry samples were analyzed at ASL D for radionuclides and TAL inorganics. In addition, 14 of the samples were analyzed for PCBs at ASL D.

Toxicity Characteristic Leaching Procedure (TCLP) Testing on Concrete Chips, and Acid Brick. Eight samples were collected from concrete and acid brick throughout the site for TCLP leaching tests. The results from these tests are used to provide an indication of what levels of contamination in these media may be potentially classified as hazardous under RCRA per the hazardous characteristic criteria in 40 CFR 261, Subpart C (described in Appendix A). These data will also be beneficial to the RI/FS in evaluating remedial alternatives and decontamination methods. SW-846 Method 1311, TCLP, was used to determine the leaching potential of the chemical and radiological constituents. Samples were collected from the following components: Plant 1 Pad (74T - concrete), Ore Refinery Plant (2A - concrete and acid brick), Metal Production Plant (5A - concrete), Pilot Plant Wet Side (13A -concrete and acid brick), and the Pilot Plant Wet Side (13A - concrete and acid brick). Regardless of whether the process area was considered wet or dry, sample collection depths were 0 - 0.5 inch. The TCLP extracts were analyzed at ASL D for target compound list (TCL) volatile organics, TCL semi-volatile organics, TAL inorganics, and radionuclides. In Table 2-5, these samples are listed under either Concrete Chips or Acid Brick.

Steel Coating Sampling

The coatings (paint and oxides) on structural steel (I-beams) were sampled to determine concentrations of surface radiological and metallic contaminants. Of 200 steel coating samples collected, 168 locations were sampled and analyzed for TAL inorganics, and 82 locations (either collected from the same location as the inorganics sample or from a separate location) were analyzed for radionuclides. The remaining radionuclide analyses were canceled based on data presented in the chemical analytical trending report as discussed in the modification to the WPA. In the evaluation of the trending-set data for the steel coatings, high levels of chromium, lead, and other RCRA metals were found as well as radionuclides. The presence of these contaminants would probably require the classification of the steel coating material as a hazardous waste under RCRA. This would require some type of decontamination process for release without restriction. Given the nature of the trending-set data, it was determined that sufficient data are now available to assess, conservatively, the volume of

structural steel that is both chemically and radiologically contaminated. Therefore, radiological analysis of all remaining steel coating samples was canceled.

As with other major media, the local maximum (hot spots) for radiological and chemical (metals) contamination observed during screening was selected for intrusive sampling of the steel coatings. These samples were usually obtained by employing a pneumatic needle scaler to chip away the coatings. The coatings (i.e., layers of paint and/or corrosion) varied in terms of thickness from one component to another. Similarly, the total scaled I-beam area required to generate sufficient sample mass for analysis varied. On the average, 15 ft^2 of surface area was required to obtain the necessary volume (625 grams) for analysis of radiological and chemical parameters.

Asphalt

Four asphalt samples were collected from the site roads (G2), the Plant 4 Pad (74E), and the Decontamination Pad (74P). All samples were analyzed for TAL Inorganics and radionuclides with the site road (G2) samples also analyzed for TCL volatile organics, TCL semi-volatile organics, and PCBs at ASL D.

Transite

Transite, a common construction material used as sheeting for the walls and roofs of many OU3 buildings, consists of asbestos fiber-reinforced concrete. For the purpose of waste volume estimates, it was assumed, and stated in the WPA, that all transite is radiologically contaminated. To evaluate the possibility of contamination (other than radiological and asbestos), ten samples were taken from transite at site locations with the greatest potential for chemical contamination based on process knowledge and visual inspection. The ten components sampled were Preparation Plant (1A); Ore Refinery Plant (2A) (two samples); Hot Raffinate Building (3E); Green Salt Plant (4A); Metals Production Plant (5A); Metals Fabrication Plant (6A); Recovery Plant (8A); Special Products Plant (9A); and the Incinerator Building (39A). Sampling locations were designated based on the presence of visual stains when possible. Samples were analyzed for TCLP metals, TCLP volatile organics, and TCLP semi-volatile organics at ASL B.

2.3.2.2 Supplemental Media Sampling

An additional 236 samples were collected from such supplemental media as air filters collected from heating, ventilating, and air conditioning (HVAC) equipment, along with loose media (e.g., removable material from floor drains, sediment/sludge collected from ponds and basins, and wood), bulk materials (e.g., soil piles), and unknown liquids (e.g., collected from ponds and basins). The objectives of collecting these samples were to support the data obtained from the major media samples in the characterization of OU3 components, to evaluate the possible transfer of contaminants to environmental media (i.e. OU5 media), and to determine potential health and safety risks during component D&D. Discussion of the supplemental media, including types, sample numbers, and sampling techniques, can be found in Appendix L.3. The analytical results with validation qualifiers can also be found in Appendix L.3.

2.3.3 Screening/Sampling in Confirmatory Components

Sixteen components were originally identified for confirmatory sampling in the WPA in order to verify the absence of significant contamination. These components, presented in Table 2-6, were selected on the basis of greatest plausible potential risk and/or difficulty in remediation. The Outside Equipment Storage Area (P007) was deleted from this list because it was removed as part of Removal Action No. 15 (see Table 1-2).

The screening approach confirming the absence of significant contamination in these components included the following steps: (1) each component was considered a single process area; (2) screening was employed systematically (screening conducted at intersections of a pre-determined grid pattern); and (3) intrusive sampling was performed only if resultant XRF survey levels exceeded TCLP regulatory limits (scaled to the "20 times the TCLP limit" value compared to the "total" analytical results of the solid material as defined in Section 3) or the radiological criteria listed in Table 2-3. Radiological surveys and XRF surveys were performed at the intersects of pre-determined grid patterns based on the dimensions of the area to be surveyed. Air monitoring for organic compounds was performed to initially obtain ambient component conditions; if necessary, more localized surveys were performed to locate potential sources of organic compounds.

The Boiler Plant (10A) and site roads (G02) were the only confirmatory components where intrusive samples were collected based on the confirmatory screening results. Concrete chip samples were collected in the Boiler Plant while asphalt samples were collected from the roads. See Section 2.3.1 for sampling and analysis information.

2.3.4 OU3 Construction Material Leachability Testing

An additional investigation was conducted following the completion of the primary RI/FS field activities. A leachability study (K_L Study) was implemented to establish the leachability primarily for uranium and technetium-99, from both porous and non-porous construction media, in order to evaluate viable disposal options.

Concrete cores (2" diameter x 2" depth), paint chips, and painted steel were collected from a variety of OU3 components. The method used for sample collection was similar to the methods used for the RI/FS characterization study, described in Section 2.3.1. However, the concrete cores for this study were collected intact using a diamond coring bit, unlike the RI/FS characterization study, where cores were actually collected at selected intervals as pulverized material. Table 2-7 provides a list of samples collected by material type and component. The rationale for deciding sample locations is discussed in Appendix G.

To determine the leaching potential of uranium and technetium-99 from the concrete and paint coatings, a series of two-phase desorption batch tests were conducted. The leaching solution used for these batch tests was deionized water adjusted to a pH between 4.5 and 5.0 using sulfuric acid. This leaching solution was chosen to simulate acid rain conditions.

Analytical testing was conducted on the concrete and paint immediately surrounding the concrete cores and the paint to determine the concentration of radionuclides in the solid media. This concentration is used to infer the radionuclide concentration in the test media. Total uranium and technetium-99 were analyzed at ASL D. The solid samples used in the leachability study were analyzed for total uranium and technetium-99 at the end of the desorption batch tests. These data were used along with the final leachate results to determine the mass balance value for total uranium and technetium-99 in the initial solid media. The mass balance result superseded the analytical results measured in the surrounding material.

Interim leachate samples from the desorption batch tests were analyzed at various time periods for total uranium at ASL B, with the final leachate solutions analyzed for total uranium and technetium-99 at ASL D. Composites of the final leachate solutions were also analyzed for metals at ASL D, inorganics (e.g., fluoride, nitrate, sulfate) at ASL B, and radionuclides other than total uranium and technetium-99 (e.g., isotopic uranium and isotopic thorium) at ASL D. The results of these composites were used to support the modeling used in the leachability study. Appendix G

provides a detailed description of the OU3 leachability study, including methodology, results and conclusions. A listing of samples for this study is located in Appendix L.5. The analytical results and the validation qualifiers are found in Appendix L.6.

2.4 GENERAL METHODOLOGY VARIANCES AND SAMPLE SPECIFIC VARIANCES

Variances between actual field sampling activities and the activities proposed in the WPA have been formally tracked and authorized during the entire OU3 RI/FS sampling program. A total of approximately 300 variances, both component specific and general, were written. The list of variances, along with a short description of each, is found in Appendix K. Component-specific variances include such things as addition/deletion of samples from those indicated in Section D.9 of the WPA, addition/deletion of process areas, deviations in grid spacing for a particular sampling event, and addition/deletion of a component from the RI/FS sampling program. General variances include such items as changes in the constituent list for a specific medium, changes in sampling protocols, or changes in air sampling requirements. All variances were approved prior to their inclusion in the OU3 RI/FS files in order to maintain the integrity of the data quality and are summarized in Table 2-8.

Types of variances and associated effects on the OU3 data set include:

- Variances that deleted scheduled samples within a component because the sample media (mostly supplemental media) did not exist at the time of sampling. Although the media may re-accumulate in the future, supplemental media will be removed prior to dismantlement of components.

- Variances that deleted entire process areas or components, mainly because the component is part of an existing removal action (refer to Section 1.2.2.2), which means that the area of contamination will not exist at the time the component is dismantled. Sampling and analysis plans for removal actions can be found in the individual removal action work plans.

- Variances that added components to the list to be sampled because increased radiological or chemical contamination was found during screening (i.e., XRF). The sampling of these components increased the data set and, more accurately, characterizes those components which were not originally scheduled to be sampled.

- Variances that added individual samples to those already scheduled because original data included unexpected results. The additional samples were to verify the original results and assist in determining the extent of the contamination.

- Variances that do not affect the OU3 data set but were used to document unusual occurrences or changes in field quality assurance/quality control (QA/QC) sampling.

2.5 ADDITIONAL DATA SOURCES

In addition to the data collected through the RI/FS characterization study, the following sources were used to supply data or volume estimates for this document.

Volume estimates of materials for OU3 components were produced and reported in the "OU3 Material Quantities Waste Inventory Report" (DOE 1995c). These estimates were added to the Sitewide Waste Inventory Forecasting and Tracking System (SWIFTS), a database developed in 1994 to maintain information related to materials and associated volumes and quantities. The data in SWIFTS were used to develop estimates of contaminated material discussed in Section 3.

A report entitled "Measurement of Naturally Occurring Radionuclides in Concrete Fill Materials," prepared by the University of Cincinnati (1987), was used as a source for baseline radiological values used as a comparison to the OU3 RI/FS sample results. Baseline levels for OU3 media is discussed in Appendix A.

Containerized wastes (e.g., drum waste inventory) were sampled, as part of Removal Action 9, for characterization using FEMP procedure "Sampling Waste for Hazard Identification." The characterization information for these wastes is located in SWIFTS. These data were used to develop estimates of contaminated inventory discussed in Section 3 and Appendix A. (This inventory is outside the scope of the OU3 RI/FS Characterization Study as discussed in Section 1.2).

2.6 ANALYTICAL REQUIREMENTS AND DATA VALIDATION

This section provides an overview of analytical requirements and data validation used for the OU3 RI/FS.

2.6.1 Analytical Laboratories and Requirements

Laboratory analytical requirements were determined for the OU3 RI/FS using the data quality objective process (see Section 4 of the WPA). Through the evaluation of measurement needs, it was determined that methods stipulated in the Sitewide CERCLA Quality Assurance Project Plan (SCQ)

(DOE 1993d) met or exceeded OU3 needs. ASLs were determined using the following SCQ definitions.

- **ASL A (Qualitative Field Analyses)**
  Provides the most rapid (real- or short-time) results. ASL A is often used for preliminary comparison to Applicable or Relevant and Appropriate Requirements (ARARs), for initial site characterization to locate areas for subsequent and more accurate analyses for field screening of samples to select those for fixed laboratory analysis, and for more engineering screening of alternatives (bench scale tests). In the OU3 RI/FS characterization study, ASL A was used for field screening as described in Section 2.3.1.

- **ASL B (Qualitative, Semi-quantitative, and Quantitative Analyses)**
  Provides more quality control checks than ASL A and results obtained can approach similar QA/QC credibility and accuracy/precision determinations to ASL C. These analytical results can be obtained in the field or laboratory, but with similar QC checks and QA protocols as those utilized in ASL C, the results can be validated to a level that offers confirmation and support to samples analyzed at ASLs C and D. Includes standard methods including SW-846 methods (EPA 1986). In the OU3 RI/FS characterization study, ASL B was used for XRF field screening and TCLP (SW-846 methods) analyses in transite.

- **ASL C (Quantitative with Fully Defined QA/QC)**
  Provides data generated with full QA/QC checks of types and frequencies specified for ASL D according to FEMP-specified analytical protocols for radiological and nonradiological parameters. Raw instrument data are not required in data packages submitted from the laboratories. ASL C was not used for the OU3 characterization study. The raw instrument data was determined to be necessary for all data packages. This would allow data validation to upgrade validation from ASL C to ASL D if problems were discovered during ASL C validation.

- **ASL D (Quantitative with Fully Defined QA/QC and Complete Data Package, Including Raw Data)**
  Provides data generated with full QA/QC checks of types and frequencies according to FEMP-specified analytical protocols for radiological and nonradiological parameters. The data package includes raw instrument output for validation of ASL D data. All OU3 chemical and radiological analyses were analyzed at ASL D except transite.

2.6.1.1 Chemical Data

Inorganic and organic chemical analyses were selected from SCQ Table G-1, "SCQ Analytical Methods Selection Table For Organic and Inorganic Analyses" (DOE 1993d). ASL D analyses adhered to the EPA Contract Laboratory Program (CLP) Statements of Work (EPA 1990) while ASL B analyses adhered to SW-846 methods (EPA 1986), including Method 1311 for TCLP extraction.

The following FEMP-approved chemical laboratories performed analyses in support of the OU3 RI/FS:

- Clemson Technical Center, Anderson, SC
- Datachem Laboratory, Salt Lake City, UT
- IT Corporation (Quanterra), St. Louis, MO
- Lockheed Analytical Services, Las Vegas, NV
- Twin City Testing (TCT) Laboratory, St. Louis, MO
- Weston Laboratory, West Chester, PA

2.6.1.2 Radiological Data

For radiological analytical methods, the laboratories were required to meet the performance-based criteria established in SCQ Table G-4, "Radiochemical Analysis Performance Specifications," for ASL D. Prior to acceptance by the FEMP, each laboratory was required to provide documentation proving that it could meet the SCQ criteria for soil and water analyses. After completion of each radioanalytical services task order, the laboratories were required to provide documentation showing that they did meet the SCQ performance-based criteria for the samples analyzed in the task order. Data package deliverable requirements were defined in the Radioanalytical Task Order Subcontract for each contract lab. These deliverables were analogous to an ASL D deliverable for chemical data (the CLP data package), requiring raw data and calibration control charts.

The following FEMP-approved radiological laboratories were awarded Radioanalytical Services Task Orders and performed analyses in support of the OU3 RI/FS:

- Core Laboratory, Casper, WY
- Datachem Laboratory, Salt Lake City, UT
- Environmental Physics, Inc., Charleston, SC
- Lockheed Analytical Services, Las Vegas, NV
- TMA Eberline, Albuquerque, NM

2.6.2 Data Validation

Data validation is an independent, systematic, after-the-fact process of evaluating data against established validation criteria in order to provide confirmation that the data are of sufficient technical quality for their intended use (i.e., a "data usability determination"). The validation process examines field data (for completeness), sampling and sample handling procedures (e.g., chain-of-custody documentation), laboratory analysis and data reporting procedures. Field and laboratory non-conformances and variances associated with specific samples are also evaluated for potential impacts on data usability. Following all these evaluations, data qualifiers are assigned per US EPA

guidelines, giving the user a level of confidence for each reported result. The level of validation was determined based on the following definitions:

- **ASL B (Chemical Analyses Only, not Radiological)**
  Validation is performed using summary forms (raw data not reviewed) and is based on requirements in SW-846 or other non-CLP Statement of Work. Verification of laboratory calculations is not required. Analytical data analyzed at ASL B is typically validated at ASL B. In the OU3 characterization program, ASL B validation was performed for TCLP analyses of transite samples.

- **ASL C (Chemical and Radiological Analyses)**
  Validation for chemical analyses is performed using summary forms and is based on requirements in CLP Statement of Work. Verification of laboratory calculations or calibration is not required.

  Validation for radiological analyses is performed using summary forms and raw instrument data as needed. Requirements are based on FEMP Radioanalytical Services Task Orders. Verification of laboratory calculations or initial calibrations is not required.

  ASL C validation is typically performed for analytical data analyzed at either ASL C or D. If problems are detected during the ASL C validation, the validation may be upgraded to ASL D.

  In OU3 characterization program, ASL C validation was performed for the majority (up to 90 percent) of chemical and radiological analyses.

- **ASL D (Chemical and Radiological Analyses)**
  Validation for chemical analyses is performed using summary forms and raw data. Requirements are based on CLP Statement of Work. Verification of at least ten percent of laboratory calculations and all calibrations are required.

  Validation for radiological analyses is performed using summary forms and raw instrument data. Requirements are based on FEMP Radioanalytical Services Task Orders. Verification of at least ten percent of laboratory calculations and all initial calibrations is required.

  ASL D validation is typically performed for analytical data analyzed at ASL D. In many cases, ASL D validation is only performed on a portion (e.g., ten percent) of the data with the remaining data validated at ASL C. The results of the more extensive validation is used to support the findings of the ASL C validation. If problems are detected during the ASL D validation, it may result in the necessity to upgrade the ASL C validation to ASL D.

  In the OU3 characterization program, ASL D validation was performed for at least ten percent of chemical and radiological analyses.

2.6.2.1 Chemical Data

The validation criteria for chemical data at the FEMP are consistent with the US EPA National Functional Guidelines for both organic and inorganic data review (EPA 1988, 1991). The validation program is an EPA requirement; the FEMP data validation program is presented in Appendix D of the SCQ.

OU3 RI/FS chemical data were validated as follows: one percent at ASL B, 75 percent at ASL C, and 24 percent at ASL D, which exceeds the requirements established in the WPA. Approximately two percent of the chemical results were qualified rejected (R) during data validation. Rejected data were not used in final decision making. Appendix L contains all analytical results and validation qualifiers.

2.6.2.2 Radiochemical Data

US EPA does not currently promulgate official methods for radiochemical analyses or guidance for validation. The FEMP developed specific validation criteria for each type of radioanalytical method (e.g., gamma spectroscopy, alpha spectroscopy, etc.) relative to the quality of laboratory QA/QC data associated with each analytical batch, including calibration verification, blanks, tracer yields, traceability of reference standards, counting and related efficiencies, matrix spike recoveries, lab duplicate results, and propagated uncertainty data.

OU3 RI/FS radiological data were validated as follows: 65 percent at ASL C and 35 percent at ASL D, which exceeds the requirements of the WPA. Rejected data were not used in final decision making. Appendix L contains all analytical results and validation qualifiers.

2.7 DATA QUALITY ASSESSMENT

This section discusses the evaluation process used to establish the quality and quantity of available data for use in the OU3 RI/FS with respect to regulatory guidance and work plan objectives. All data sets were evaluated in context with the proposed use of the information to meet current data needs, as discussed in Section 2.1, and thus support development and evaluation of the remedial alternatives.

Consistent with US EPA guidance and the SCQ, a number of factors were examined to assess the quality and quantity of data available for characterizing OU3. These factors included sample collection methods, analytical methods, and QA/QC procedures. This information, including the

WPA, the SCQ, Radioanalytical Services Task Orders, field sampling logbooks, and analytical results, were reviewed to indicate sample integrity and data comparability.

The quality of data received from the laboratory was evaluated through the data validation process, as previously described in Section 2.6.2. However, broader data quality issues were evaluated against regulatory guidance, as described below. Data quantity (percent completion) was evaluated by comparing the number of acceptable validated results against the number planned.

2.7.1 Data Quality/Quantity Criteria

Consistent with US EPA guidance and the SCQ, data quality was assessed in part by evaluating precision, accuracy, sensitivity, representativeness, comparability, and completeness, as described below:

- Precision: A quantitative measurement of the repeatability of a single field or laboratory measurement, evaluated from results of duplicates and split samples during data validation process. Data usability guidance specifies a confidence level of ± 10 to 20 relative percent difference for each sample with an overall confidence level of 80 percent.

- Accuracy: A measurement of the bias in an analytical system. Accuracy is determined by the analysis of laboratory spikes and method blanks. The FEMP SCQ criteria for accuracy on a per-sample basis, in ASL C and D chemical data is based on the CLP scope of work requirements. ASL B criteria is specified in SCQ Table G-2. For radiological data, the criteria are listed in Table G-4, Appendix G of the SCQ. Data usability guidance specifies an overall confidence level of 80 percent.

- Sensitivity: The achievement of specified method detection limits and quantitation limits. These limits are dependent on instrument sensitivity and matrix effects associated with the analysis. The sensitivity requirements for the OU3 remedial investigation sampling program can be found in Section D.3 of the WPA.

- Representativeness: The degree to which a data set accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition. This is addressed through selection of appropriate sample locations and design of adequate sampling procedures.

- Comparability: The confidence with which one data set can be compared with another. A factor of similar sampling techniques, analytical methodologies, and specified detection limits between different data sets.

- Completeness: A measure of the amount of usable data resulting from a data collection activity, given the sample design and analysis. Data usability guidance defines completeness as the number of acceptable data points divided by the total number of samples collected. Per the SCQ, completeness is expected to be at least 90 percent for FEMP projects. Completeness is assessed in terms of data quantity for this report.

2.7.2 Data Evaluation

The following section evaluates data quality and quantity for data collection within OU3 using the criteria above.

- Precision: The per-sample confidence (precision confidence of analytical results of each sample collected in the field) was determined to be within the recommended range of ±10 to 20 relative percent difference. Approximately ten percent of these samples had estimated quantitation values due in part to the matrix interference associated with the heterogeneous nature of the media. Overall confidence (precision confidence for all analytical results that is part of RI/FS Characterization Study database) levels were 90 percent, well within guidance criteria.

- Accuracy: Data validation qualified OU3 data as estimated or rejected in part based on an evaluation of spike recoveries, laboratory blank contamination, radiological tracer yields, total propagated uncertainties, and other laboratory QC sample results. Approximately two percent of the results were rejected because of low matrix spikes, low radiological tracer yields, or blank contamination. An additional ten percent of the non-rejected data exceeded criteria, but not enough to be rejected, and were therefore qualified as estimated by data validation. These estimated results introduced bias to the data, thus decreasing the overall usability of the validated data. An overall confidence level of 88 percent was achieved. This level is within guidance criteria.

- Sensitivity: Laboratories were not always able to meet the sensitivity requirements outlined in the WPA for the OU3 media because of matrix difficulties. As an example, for some chemical analyses, some laboratories diluted the concrete and masonry samples, ten times prior to analysis to prevent clogging of instrument tubing. For radiological analyses, approximately

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five percent of the data were qualified as estimated because the Minimum Detectable Concentration (MDC) exceeded the Highest Allowable Minimum Detectable Concentration (HAMDC) outlined in the SCQ. Matrix interferences also accounted for the increase in laboratory detection limits. The overall effect is a more conservative estimate of contaminants at or near the laboratory detection limits. This overestimation is minimized in the short-term risk assessment (see Appendix H) by use of one-half of the detection limit in the calculations.

- Representativeness: As discussed in Section 2.2.1, the OU3 characterization data were designed to be a conservative estimate of the contamination in a component. Samples were collected at the highest radiological contamination location or the highest chemical contamination location determined on screening results. One sample for each major media type was collected per process area in each sampled component. This result was to be applied for all like media throughout the process area.

- Comparability: Analytical results for each media type was comparable between components and laboratories. Sampling and analytical methodologies were consistent throughout the sampling program and followed standard methods identified in the SCQ. All variances to these methods are documented and are discussed in Section 2.4.

- Completeness: Consistent with the WPA, one sample per process area was collected for each major media type. Overall completeness of the OU3 characterization data was assessed to be approximately 98 percent as calculated based on the number of samples collected. This determination was based on information presented in the "Percent Useable" column in Tables 2-9 through 2-10 and is within the SCQ completeness criteria.

The OU3 RI/FS characterization has met the sampling requirements outlined in the WPA and the modification to the WPA, including the number and types of samples, analytical criteria, and validation quality requirements. As described in the data evaluation section above, the data met or exceeded all US EPA and SCQ guidance for both completeness and usability.

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TABLE 2-1
DATA NEEDS TO SUPPORT FINAL ACTION

Data Need	Data Use	Data Objective	Data Collection Approach to Meet Objectives
Volumes of material by material type	Used to determine the total volumes of the various materials in OU3 that may be treated or otherwise handled.	Total potential quantity of materials to be remediated, by material type (concrete, steel, etc.) and process type (wet/dry) (+50%/-30%).	Estimates by material and component are available. Estimates by process area were obtained from process knowledge.
Types and levels of contaminants by material type; depth of contamination	Used in estimating volumes of materials contaminated with various contaminants. Used to aid in the screening of treatment technologies, based on their effectiveness with selected contaminants at various depths in the various media. Also used to assist in assessing short-term effectiveness of the various alternatives, for which the types and levels of contamination are needed. Use in short-term risk assessment.	*Major Media (concrete, masonry, and structural steel)* — Type and conservative estimate of the surface levels of contaminants for each of the major media within each of the process areas in each component. Conservative estimate of depth of contamination for porous media and other media as necessary, by type of process. *Transite, Asphalt,* — Type and conservative estimate of concentrations of chemical contaminants in transite and chemical and radiological contaminants in asphalt for representative locations selected on an OU3-wide basis.	Radiological screening was used to locate or confirm locations with the highest levels of contamination. Chemical screening was performed at the locations with suspected chemical contamination. One intrusive sample (more if there are distinct areas of chemical and radiological contamination) was taken for laboratory analysis from each major medium at the location of highest known contamination within each process area in each component as determined based on survey data. Information on the media type and process (wet/dry) was used to determine if surface chips or multi-layer core samples were required. Intrusive samples were collected in a limited number of representative components at locations expected to have the greatest potential for chemical contamination. Ten transite and four asphalt samples were collected from representative components. All samples were collected at locations expected to have the greatest potential for radiological contamination.
Contaminant- and material-specific leachability	Used to develop waste acceptance criteria for on-property disposal of construction materials.	Representative value of K_L and K_c for concrete and paint chips (See Appendix G)	Concrete cores and paint chips were placed in water adjusted to a pH of 4.5-5.0 and the leachability coefficients (K_L and K_c) for uranium and technetium-99 were determined.

TABLE 2-1 (Continued)

DATA NEEDS TO SUPPORT FINAL ACTION

Data Need	Data Use	Data Objective	Data Collection Approach to Meet Objectives
Identification of the presence of hazardous and listed wastes (other than stored waste inventory)	Used to assess compliance with ARARs related to land disposal restrictions under RCRA.	Conservative estimates.	Eight samples of concrete and masonry that could potentially be classified as hazardous waste were collected at the locations of highest radiological/chemical contamination in representative components and subjected to TCLP extraction and the extract analyzed. Listed waste identification obtained from RI/FS sampling results and/or process knowledge.
Characteristics of materials and contaminants in treated wastes; characteristics of any emissions associated with treatment; volume of treated wastes	Used to determine the effectiveness of various remedial alternatives relative to the reduction of toxicity, mobility, and volume of wastes, and to assist in assessing the applicability of various disposal options for the final waste forms. Volume estimates will be used to assist in projecting the long-term effectiveness of the various alternatives and in determining potential transportation needs. Emissions characterization needed to assess short-term effectiveness.	Representative estimates of the physical/chemical characteristics of the waste form/residues/emissions. The types and representative levels of contaminants in the wastes/ residues/emissions, and the ability of these contaminants to leach out, or otherwise be released from the waste form/residue. Total quantity of material generated (+50%/-30%).	If information available on technologies and from site characterization is inadequate to screen or evaluate technologies, this objective will be addressed by treatability studies.
Physical and chemical characteristics of materials and contaminants	Used to aid in the screening/evaluation of treatment technologies, based on their effectiveness with various types of materials and contaminants.	Representative values of physical/chemical characteristics (e.g., density, friability, permeability, destructibility, hardness) for the various material types and characteristics, such as solubility, volatility, and leachability, for contaminants.	Estimates were developed using handbook values. Detailed analysis were performed as part of treatability studies, based on the specific needs of vendors/technologies, if necessary.

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TABLE 2-2

DOE 5400.5 CRITERIA FOR DEFINING CLASSIFICATION OF FEMP COMPONENTS [a]

Contamination Class	Average Removable Surface Contamination (dpm/100 cm²)	Average Total Surface Contamination (dpm/100 cm²)
No Significant Radiological Contamination	0 - 1,000	0 - 5,000
Significant Radiological Contamination	Above 1,000	Above 5,000

[a] Values apply to either alpha or beta-gamma radiation.
[b] dpm = disintegration per minute

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TABLE 2-3

OU3 RI/FS CHARACTERIZATION STUDY ANALYTE LIST

Radionuclides

Alpha/Beta Screening
Americium-241
Cesium-137
Isotopic thorium
Isotopic uranium
Isotopic plutonium
Lead-210
Neptunium-237
Plutonium-241
Polonium-210
Radium-226 and 228
Strontium-90
Technetium-99

TAL Metals

Aluminum
Antimony
Arsenic
Barium
Beryllium
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Manganese
Mercury
Nickel
Potassium
Selenium
Silver
Sodium
Thallium
Vanadium
Zinc

TCL Semi-Volatile Organics

1,2-Dichlorobenzene
1,2,4-Trichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
2-Chloronaphthalene
2-Chlorophenol
2-Methylnaphthalene
2-Methylphenol
2-Nitroanilene
2-Nitrophenol
2,2-Oxybis-(1-chlororpropane)
2,4-Dichlorophenol
2,4-Dimethylphenol
2,4-Dinitrophenol
2,4-Dinitrotoluene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
2,6-Dinitrotoluene
3-Nitroaniline
3,3-Dichlorobenzidine
4-Bromophenyl-phenyl ether
4-Chloro-3-methylphenol
4-Chloroaniline
4-Chlorophenyl-phenyl ether
4-Methylphenol
4-Nitroaniline
4-Nitrophenol
4,6-Dinitro-2-methylphenol
Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
bis(2-Chloroethyl) ether
bis(2-Chloroethoxy) methane
bis(2-Ethylhexyl)phthalate
Butylbenzylphthalate
Carbazole
Chryzene
Dibenzofuran
Dibenzo(a,h)anthracene
Diethylphthalate
Dimethylphthalate
Di-n-butylphthalate
Di-n-octylphthalate
Fluoranthene
Fluorene
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Ideno(1,2,3-cd)pyrene
Isophorone
Napthalene
Nitrobenzene
N-Nitroso-di-n-dipropylamine
N-Nitrosodiphenylamine
Pentachlorophenol
Phenanthrene
Phenol
Pyrene

TCL PCBs

Arochlor-1016
Arochlor-1221
Arochlor-1232
Arochlor-1242
Arochlor-1248
Arochlor-1254
Arochlor-1260

TCL Volatile Organics

1,1-Dichloroethane
1,1-Dichloroethene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
1,1,2,2-Tetrachloroethane
1,2-Dichloroethane
1,2-Dichloroethene (total)
1,2-Dichloropropane
2-Butanone
2-Hexanone
4-Methyl-2-pentanone
Acetone
Benzene
Bromodichloromethane
Bromoform
Bromomethane
Carbon tetrachloride
Carbon disulfide
Chlorobenzene
Chloroethane
Chloroform
Chloromethane
cis-1,3-Dichloropropene
Dibromochloromethane
Ethylbenzene
Methylene chloride
Styrene
Tetrachloroethene
Toluene
Total Xylenes
trans-1,3-Dichloropropene
Trichloroethene
Vinyl Chloride

TCLP Metals

Arsenic
Barium
Cadmium
Chromium
Lead
Mercury
Selenium
Silver

TCLP Semi-Volatile Organics

1,4-Dichlorobenzene
2,4-Dinitrotoluene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
Hexachloro-1,3-butadiene
Hexachlorobenzene
Hexachloroethane
m-Cresol
Nitrobenzene
o-Cresol
p-Cresol
Pentachlorophenol
Pyridine

TCLP Volatile Organics

1,1-Dichloroethylene
1,2-Dichloroethane
2-Butanone
Benzene
Carbon tetrachloride
Chlorobenzene
Chloroform
Tetrachloroethylene
Trichloroethylene
Vinyl chloride

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TABLE 2-4

OU3 RI/FS CHARACTERIZATION STUDY
SUMMARY OF ANALYSIS REQUESTS PER MEDIA

MEDIA	ANALYSES
Concrete	
Chips	Radionuclides, TAL [a] Inorganics, TCL [b] PCBs[c]
Cores	Radionuclides, TAL Inorganics, TCL PCBs[c]
Acid Brick/Masonry	Radionuclides, TAL Inorganics, TCL PCBs[c]
Structural Steel	Radionuclides, TAL Inorganics
Transite	TCLP Metals, TCLP VOC, TCLP SVOC
Asphalt	Radionuclides, TAL Inorganics, TCL VOCs[d], TCL SVOCs[d], TCL PCBs[c]
Loose Media	Radionuclides, TAL Inorganics, TCL VOCs, TCL SVOCs, TCL PCBs[c]
Unknown Liquids	Radionuclides, TAL Inorganics, TCL VOCs, TCL SVOCs, TCL PCBs[c]

[a] Target Analyte List. Defined by U.S. EPA's Contract Laboratory Program Statement of Work. List of analytes can be found in Table 2-3.
[b] Target Compound List. Defined by U.S. EPA's Contract Laboratory Program Statement of Work. List of analytes can be found in Table 2-3.
[c] To be sampled only in areas where field screening shows presence of PCBs.
[d] Sampled for site roads only.

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TABLE 2-5

OU3 RI/FS CHARACTERIZATION STUDY SAMPLES COLLECTED PER COMPONENT[a]

Component	Component Designation	Process Areas	Acid Brick	Asphalt	Concrete Chips	Concrete Core[b]	Loose Media	Masonry	Steel Surface	Transite	Unknown Liquids	TOTAL SAMPLES
Buildings - Administrative/Support												
NAR Control House	03C	1	0	0	1	0	0	0	2	0	0	3
Service Building	11	5	0	0	3	13	0	4	0	0	0	20
Administration Building	14A	1	0	0	1	0	0	1	0	0	0	2
Security Building	28A	1	0	0	1	0	0	1	0	0	0	2
Human Resources Building	28B	1	0	0	0	0	0	0	0	0	0	0
Guard Post on South End of 'D'	28C	1	0	0	0	0	0	0	0	0	0	0
Guard Post of T-81	28E	1	0	0	0	0	0	0	0	0	0	0
Guard Post South of Building 51	28G	1	0	0	0	0	0	0	0	0	0	0
Rust Engineering Building	45A	1	0	0	1	0	0	0	2	0	0	3
Health & Safety Building	53A	3	0	0	1	0	0	0	0	0	0	1
In-Vivo Building	53B	1	0	0	0	0	0	0	0	0	0	0
Fire Brigade Training Center Bldg.	73A	1	0	0	0	0	0	0	0	0	0	0
Skeet Range Building	90 (28F)	1	0	0	0	0	0	0	0	0	0	0
Process Trailers	G06	1	0	0	0	0	0	0	0	0	0	0
Non-process Trailers	G07	1	0	0	0	0	0	0	0	0	0	0
Buildings - Warehouse/Storage												
Plant 1 Storage Shelter	01B	1	0	0	0	0	0	0	0	0	0	0
Plant 4 Warehouse	04B	1	0	0	0	0	0	0	0	0	0	0
Plant 5 Filter Building	05E	1	0	0	1	0	0	0	0	0	0	1
Plant 5 Covered Storage Pad	05F	1	0	0	0	0	0	0	0	0	0	0
Plant 5 Ingot Storage Shelter	05G	1	0	0	1	0	0	0	1	0	0	2
Plant 6 Covered Storage Area	06B	1	0	0	1	0	0	0	1	0	1	3
Plant 7	07A	4	0	0	0	0	0	0	0	0	0	0
Cylinder Storage Building	12B	1	0	0	0	0	0	0	0	0	0	0
Lumber Storage Building	12C	1	0	0	1	0	0	0	0	0	0	1
Maintenance Building Warehouse	12D	1	0	0	0	0	0	0	0	0	0	0
Laboratory Chemical Storage Building 1	15B	1	0	0	0	0	0	0	0	0	0	0
Chemical Warehouse	30A	3	0	0	3	0	0	0	2	0	0	5
Drum Storage Warehouse	30B	1	0	0	0	0	0	0	0	0	0	0
Magnesium Storage Building	32A	1	0	0	0	0	0	0	0	0	0	0
Building 32 Covered Loading Dock	32B	1	0	0	1	0	0	0	1	0	0	2
Pilot Plant Shelter	54B	1	0	0	1	0	0	0	1	0	0	2
CP Storage Warehouse	56A	1	0	0	1	0	0	0	1	0	0	2

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TABLE 2-5 (Continued)

OU3 RI/FS CHARACTERIZATION STUDY SAMPLES COLLECTED PER COMPONENT[a]

Component	Component Designation	Process Areas	Acid Brick	Asphalt	Concrete Chips	Concrete Core[b]	Loose Media	Masonry	Steel Surface	Transite	Unknown Liquids	TOTAL SAMPLES
Buildings - Warehouse/Storage (Cont'd)												
Storage Shed (West)	56B	1	0	0	0	0	0	0	0	0	0	0
Storage Shed (East)	56C	1	0	0	0	0	0	0	0	0	0	0
Quonset Hut #1	60	1	0	0	0	0	0	0	0	0	0	0
Quonset Hut #2	61	1	0	0	0	0	0	0	0	0	0	0
Quonset Hut #3	62	1	0	0	1	0	0	0	0	0	0	1
KC-2 Warehouse	63	1	0	0	1	0	0	1	0	0	0	2
Thorium Warehouse	64	2	0	0	1	0	0	0	1	0	0	2
(Old) Plant 5 Warehouse	65	1	0	0	0	0	0	0	0	0	0	0
Plant 1 Thorium Warehouse	67	1	0	0	2	0	0	0	0	0	0	2
Pilot Plant Warehouse	68	1	0	0	1	0	0	0	1	0	0	2
General In-Process Warehouse	71	2	0	0	2	0	0	2	0	0	0	4
Drum Storage Building	72	1	0	0	2	0	0	0	1	0	0	3
Finished Products Warehouse (4A)	77	1	0	0	1	0	0	0	2	0	0	3
Plant 6 Warehouse	79	1	0	0	2	0	0	0	2	0	0	4
Plant 8 Warehouse	80	1	0	0	2	0	0	0	2	0	0	4
Plant 9 Warehouse	81	1	0	0	2	0	0	0	2	0	0	4
Tension Support Structure #1	TS-001	1	0	0	0	0	0	0	0	0	0	0
Tension Support Structure #2	TS-002	1	0	0	0	0	0	0	0	0	0	0
Tension Support Structure #3	TS-003	1	0	0	0	0	0	0	0	0	0	0
Tension Support Structure #4	TS-004	1	0	0	0	0	0	0	0	0	0	0
Tension Support Structure #5	TS-005	1	0	0	0	0	0	0	0	0	0	0
Tension Support Structure #6	TS-006	1	0	0	0	0	0	0	0	0	0	0
Buildings - Process												
Preparation Plant	01A	7	0	0	3	6	0	0	12	1	1	23
Ore Refinery Plant	02A	5	7	0	1	12	1	0	8	2	3	34
Metal Dissolver Building	02D	3	2	0	0	9	1	0	0	0	1	13
Hot Raffinate Building	03E	1	1	0	0	6	0	0	1	1	2	11
Green Salt Plant	04A	3	0	0	2	12	2	0	7	1	2	26
Metals Production Plant	05A	12	0	0	11	18	4	0	19	1	0	53
Metals Fabrication Plant	06A	7	0	0	6	15	1	0	7	1	2	32
Plant 6 Electrostatic Precipitator (South)	06C	1	0	0	0	3	0	0	0	0	0	3
Plant 6 Electrostatic Precipitator (North)	06E	1	0	0	0	0	0	0	0	0	0	0
Plant 6 Salt Oil Heat Treat Building	06F	1	0	0	0	3	0	1	1	0	1	6
Plant 6 Sump Building	06G	1	0	0	0	0	0	0	0	0	0	0
Recovery Plant	08A	16	0	0	22	9	7	2	29	1	2	72

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TABLE 2-5 (Continued)

OU3 RI/FS CHARACTERIZATION STUDY SAMPLES COLLECTED PER COMPONENT[a]

Component	Component Designation	Process Areas	Acid Brick	Asphalt	Concrete Chips	Concrete Core[b]	Loose Media	Masonry	Steel Surface	Transite	Unknown Liquids	TOTAL SAMPLES
Buildings - Process (Cont'd)												
Rotary Kiln/Drum Reconditioning	08C	2	0	0	2	0	0	0	0	0	0	2
Special Products Plant	09A	9	4	0	6	18	3	0	14	1	2	48
Plant 9 Sump Treatment Facility	09B	1	0	0	0	6	0	2	1	0	0	9
Electrostatic Precipitator	09F	1	0	0	0	3	0	0	0	0	0	3
Pilot Plant Wet Side	13A	3	10	0	4	55	4	6	6	0	8	93
Sump Pump House	13C	1	0	0	0	3	0	1	0	0	0	4
Laboratory	15A	3	0	0	1	8	1	3	0	0	2	15
Biodenitrification Towers	18D	1	0	0	0	0	0	0	0	0	0	0
Clearwell Pump House	18G	1	0	0	2	0	0	0	0	0	0	2
BDN Effluent Treatment Facility	18H	1	0	0	1	0	0	0	0	0	0	1
Engine House/Garage	31A	1	0	0	0	6	1	2	0	0	3	12
Pilot Plant Annex	37	7	0	0	18	0	0	12	1	0	6	37
Incinerator Building	39A	4	0	0	2	9	1	1	8	1	1	23
Waste Oil Decant Shelter	39B	1	0	0	0	3	1	0	1	0	1	6
Six to Four Reduction Facility #1	54A	8	0	0	7	9	0	10	11	0	0	37
Slag Recycling Building	55A	1	0	0	1	0	0	0	1	0	0	2
Slag Recycling Pit/Elevator	55B	1	0	0	1	0	1	0	2	0	1	5
Drum Reconditioning Building	66	4	0	0	3	6	1	0	5	0	3	18
Decontamination Building	69	1	2	0	0	3	1	1	0	0	1	8
Buildings - Process Support												
General/Refinery Sump Control Bldg.	02B	1	0	0	1	0	1	0	1	0	1	4
Bulk Lime Handling Building	02C	1	0	0	0	3	1	0	1	0	1	6
Maintenance Building	03A	1	0	0	0	6	0	2	1	0	0	9
Ozone Building	03B	1	0	0	0	3	0	0	2	0	0	5
Refrigeration Building	03G	1	0	0	0	3	0	0	2	0	0	5
Electrical Power Center Building	03L	1	0	0	1	0	0	1	2	0	0	4
Plant 4 Maintenance Building	04C	1	0	0	1	0	0	0	1	0	0	2
Plant 5 Ingot Pickling	05B	1	0	0	1	0	0	0	0	0	0	1
Plant 5 Electrical Substation	05C	1	0	0	1	0	0	0	1	0	0	2
West Derby Breakout/ Slag Mill	05D	1	0	0	0	0	0	0	0	0	0	0
Plant 8 Maintenance Building	08B	1	0	0	1	0	0	2	0	0	0	3
Plant 8 Railroad Filter Building	08D	1	0	0	0	0	0	0	0	0	0	0
Plant 9 Substation	09D	1	0	0	2	0	0	0	1	0	0	3
Plant 9 Cylinder Shed	09E	1	0	0	1	0	0	0	1	0	0	2
Boiler Plant	10A	1	0	0	2	0	0	0	0	0	0	2
Boiler Plant Maintenance Bldg.	10B	1	0	0	0	3	0	0	1	0	0	4

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TABLE 2-5 (Continued)

OU3 RI/FS CHARACTERIZATION STUDY SAMPLES COLLECTED PER COMPONENT[a]

Component	Component Designation	Process Areas	Acid Brick	Asphalt	Concrete Chips	Concrete Core[b]	Loose Media	Masonry	Steel Surface	Transite	Unknown Liquids	TOTAL SAMPLES
Buildings - Process Support (Cont'd)												
Wet Salt Storage Bin	10C	1	0	0	0	0	0	0	0	0	0	0
Utility Heavy Equipment Bldg.	10E	1	0	0	0	0	0	0	0	0	0	0
Main Maintenance Building	12A	6	2	0	0	33	2	12	11	0	0	60
Pilot Plant Maintenance Bldg.	13B	1	0	0	0	6	0	1	0	0	0	7
Electrical Substation	16B	1	0	0	1	0	0	1	0	0	0	2
Main Electrical Switch House	16D	1	0	0	1	0	0	1	0	0	0	2
Dissolved Oxygen Building	18P	1	0	0	0	0	0	0	0	0	0	0
IAWWT Valve House	18Q	1	0	0	0	0	0	0	0	0	0	0
Tank Farm Control House	19C	1	0	0	0	0	0	0	0	0	0	0
Tank Farm Lime Slitter Bldg.	19E	1	0	0	0	0	0	0	0	0	0	0
Pump Station & Power Center	20A	1	0	0	0	0	0	0	0	0	0	0
Water Plant	20B	1	0	0	0	0	0	0	0	0	0	0
Well House #1	20E	1	0	0	0	0	0	0	0	0	0	0
Well House #2	20F	1	0	0	0	0	0	0	0	0	0	0
Well House #3	20G	1	0	0	0	0	0	0	0	0	0	0
Gas Meter Building	22A	1	0	0	0	0	0	0	0	0	0	0
Storm Sewer Lift Station	22B	1	0	0	0	0	0	0	0	0	0	0
Truck Scale	22C	1	0	0	0	0	0	0	0	0	0	0
Scale House & Weigh Scale	22D	1	0	0	0	0	0	0	0	0	0	0
Railroad Scale House	24A	1	0	0	1	0	0	2	0	0	0	3
Railroad Engine House	24B	1	0	0	1	0	0	1	0	0	0	2
Chlorination Building	25A	1	0	0	0	0	0	0	0	0	0	0
M.H.#175/Eff. Line/Sampling Bldg.	25B	2	0	0	0	0	0	0	0	0	0	0
Sewage Lift Station Building	25C	1	0	0	0	0	0	0	0	0	0	0
U.V. Disinfection Building	25D	1	0	0	0	0	0	0	0	0	0	0
Digester & Control Building	25E	1	0	0	0	6	0	2	0	0	0	8
Pump House-HP Fire Protection	26A	1	0	0	0	0	0	0	0	0	0	0
Main Electrical Strainer House	26C	1	0	0	0	3	0	1	0	0	1	5
Guard Post on West End of 2nd	28D	1	0	0	0	0	0	0	0	0	0	0
Propane Storage	38A	1	0	0	0	0	0	0	0	0	0	0
Incinerator Sprinkler Riser House	39C	1	0	0	0	0	0	0	0	0	0	0
Utility Shed East of Rust Trailers	45B	1	0	0	0	0	1	0	0	0	0	1
Heavy Equipment Building	46	1	0	0	0	3	1	0	2	0	1	7
Six to Four Reduction Facility #2	51	1	0	0	0	0	0	0	0	0	0	0
Pilot Plant Dissociator Shelter	54C	1	0	0	2	0	1	0	2	0	0	5
D & D Building (Under Constr.)	78	1	0	0	0	0	0	0	0	0	0	0
Receiving/Incoming Mat'ls. Inspection	82	1	0	0	0	0	0	0	0	0	0	0

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TABLE 2-5 (Continued)

OU3 RI/FS CHARACTERIZATION STUDY SAMPLES COLLECTED PER COMPONENT[a]

Component	Component Designation	Process Areas	Acid Brick	Asphalt	Concrete Chips	Concrete Core[b]	Loose Media	Masonry	Steel Surface	Transite	Unknown Liquids	TOTAL SAMPLES
Containers/Containerized Material - Aboveground												
Plant 1 Ore Silos	01C	1	0	0	0	0	0	0	0	0	0	0
NFS Storage & Pump House	02E	1	0	0	0	5	0	1	0	0	0	6
NAR Towers	03D	1	0	0	0	3	0	0	2	0	1	6
Harshaw Digestion Fume Recovery	03F	1	1	0	0	3	0	0	2	0	1	7
Refinery Sump	03H	1	1	0	0	3	1	0	1	0	0	6
Combined Raffinate Tanks	03J	1	2	0	0	6	0	0	1	0	1	10
Pilot Plant Thorium Tank Farm	13D	1	0	0	2	0	0	0	0	0	1	3
General Sump	18B	1	0	0	0	3	1	0	1	0	0	5
Methanol Tank	18J	1	0	0	1	0	0	0	0	0	1	2
High Nitrate Storage Tank	18M	1	0	0	1	0	0	0	1	0	0	2
Main Tank Farm	19A	1	0	0	0	0	0	0	0	0	0	0
Pilot Plant Ammonia Tank Farm	19B	1	0	0	0	0	0	0	0	0	0	0
Old North Tank Farm	19D	2	0	0	0	12	0	0	1	0	2	15
Elevated Potable Storage Tank	20D	1	0	0	0	0	0	0	0	0	0	0
Process Water Storage Tank	20H	1	0	0	0	0	0	0	0	0	0	0
Trickling Filters	25H	1	0	0	0	3	0	0	0	0	1	4
Elevated Water Storage Tank	26B	1	0	0	0	0	0	0	0	0	0	0
Fire Training Tank	73C	1	0	0	0	0	0	0	0	0	0	0
Confined Space Burn Tank	73E	1	0	0	0	0	0	0	0	0	0	0
Drums (Non-RCRA)	G09	1	0	0	0	0	0	0	0	0	0	0
RCRA Drums	G10	1	0	0	0	0	0	0	0	0	0	0
Inventory	G11	1	0	0	0	0	0	0	0	0	0	0
Mobile Containers (Sea-Land)	G12	1	0	0	0	0	0	0	0	0	0	0
Containers/Containerized Material - Belowground												
Fire Training Burn Trough	73D	1	0	0	0	0	0	0	0	0	0	0
Underground Storage Tanks	G05	1	0	0	0	0	0	0	0	0	0	0
Bulk Material												
Soil Piles	G13	11	0	0	0	0	59	0	0	0	0	59
Rock salt pile	P-001	1	0	0	0	0	0	0	0	0	0	0
Sand piles	P-002	1	0	0	0	0	0	0	0	0	0	0
Gravel pile	P-003	1	0	0	0	0	0	0	0	0	0	0
Copper metal scrap pile	P-004	1	0	0	0	0	0	0	0	0	0	0
Coal pile	P-005	1	0	0	0	0	0	0	0	0	0	0
Scrap metal pile	P-006	1	0	0	0	0	0	0	0	0	0	0
Outside Equipment Storage Area	P-007	1	0	0	0	0	0	0	0	0	0	0

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TABLE 2-5 (Continued)

OU3 RI/FS CHARACTERIZATION STUDY SAMPLES COLLECTED PER COMPONENT[a]

Component	Component Designation	Process Areas	Acid Brick	Asphalt	Concrete Chips	Concrete Core [b]	Loose Media	Masonry	Steel Surface	Transite	Unknown Liquids	TOTAL SAMPLES
Storage Pads/Parking Lot/Roads/Railroads												
Cont. Oil/Graphite Burn Pad	10D	1	0	0	0	6	0	0	0	0	1	7
Old Ten Ton Scale	30C	1	0	0	0	0	0	0	0	0	0	0
Old Truck Scale	31B	1	0	0	0	0	0	0	0	0	0	0
Plant 2 East Pad	74A	1	0	0	1	0	0	0	0	0	1	2
Plant 2 West Pad	74B	1	0	0	1	0	0	0	0	0	0	1
Plant 8 East Pad	74C	1	0	0	1	0	1	0	0	0	1	3
Plant 8 West Pad	74D	1	0	0	2	0	1	0	0	0	1	4
Plant 4 Pad	74E	1	0	1	1	0	0	0	0	0	0	2
Plant 7 Pad	74F	1	0	0	1	0	0	0	0	0	0	1
Plant 5 East Pad	74G	1	0	0	1	0	1	0	0	0	1	3
Plant 5 South Pad	74H	1	0	0	1	0	0	0	0	0	0	1
Plant 6 Pads	74J	1	0	0	2	0	0	0	0	0	0	2
Plant 9 Pad	74K	1	0	0	1	0	0	0	0	0	1	2
Building 65 West Pad	74L	1	0	0	1	0	0	0	0	0	0	1
Building 64 East Pad & R.R. Dock	74M	1	0	0	1	0	0	0	0	0	0	1
Building 12 North Pad	74N	1	0	0	1	0	1	0	0	0	0	2
Decontamination Pad	74P	2	0	1	0	3	0	0	0	0	0	4
Plant 8 Old Metal Dissolver Pad	74Q	1	1	0	2	0	1	0	0	0	1	5
Plant 8 North Pad	74R	1	0	0	0	6	2	0	0	0	2	10
Building 63 West Pad	74S	1	0	0	1	0	0	0	0	0	0	1
Plant 1 Storage Pad	74T	4	0	0	6	0	3	0	0	0	2	11
Pilot Plant Pad	74U	1	0	0	1	0	0	0	0	0	0	1
Laboratory Pad	74V	1	0	0	1	0	0	0	0	0	0	1
Building 39A Pad	74W	1	0	0	0	6	0	0	0	0	1	7
Parking Lot	89	1	0	0	0	0	0	0	0	0	0	0
Railroad Tracks	G01	1	0	0	0	0	0	0	0	0	0	0
Roads	G02	1	0	2	0	0	0	0	0	0	0	2
Piping, Utilities, Equipment - Aboveground												
Cold Side Ore Conveyor	02F	1	0	0	1	0	0	0	1	0	0	2
Hot Side Ore Conveyor	02G	1	0	0	1	0	0	0	1	0	0	2
Plant 6 Electrostatic Precipitator (Central)	06D	1	0	0	1	0	1	0	0	0	0	2
Plant 7 Overhead Crane	07B	1	0	0	0	0	0	0	0	0	0	0
Drum Conveyor Shelter	08E	1	0	0	0	0	0	0	0	0	0	0
Plant 8 Old Drum Washer	08F	1	0	0	0	0	0	0	1	0	0	1
Plant 9 Dust Collector	09C	1	0	0	1	0	0	0	1	0	0	2
Building 14 EOC Generator Set	14B	1	0	0	0	0	0	0	0	0	0	0

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TABLE 2-5 (Continued)

OU3 RI/FS CHARACTERIZATION STUDY SAMPLES COLLECTED PER COMPONENT[a]

Component	Component Designation	Process Areas	Acid Brick	Asphalt	Concrete Chips	Concrete Core[b]	Loose Media	Masonry	Steel Surface	Transite	Unknown Liquids	TOTAL SAMPLES
Piping, Utilities, Equipment - Aboveground (Cont'd)												
Main Electrical Station	16A	1	0	0	2	0	0	0	0	0	0	2
Electrical Panels & Transformer	16C	1	0	0	1	0	2	0	0	0	0	3
Main Electrical Transformers	16E	1	0	0	2	0	0	0	0	0	0	2
Trailer Substation #1	16F	1	0	0	1	0	0	0	0	0	0	1
Trailer Substation #2	16G	1	0	0	2	0	0	0	0	0	0	2
10-Plex North Substation	16H	1	0	0	0	0	0	0	0	0	0	0
10-Plex South Substation	16J	1	0	0	0	0	0	0	0	0	0	0
Cooling Towers	20C	1	0	0	1	0	0	0	0	0	0	1
Meteorological Tower	23	1	0	0	0	0	0	0	0	0	0	0
Cylinder Filling Station	38B	1	0	0	0	0	0	0	0	0	0	0
Sewage Treatment Plant Incinerator	39D	1	0	0	3	0	0	0	1	0	0	4
Pipe Bridges	G08	1	0	0	0	0	0	0	0	0	0	0
Piping, Utilities, Equipment - Belowground												
Conveyor Tunnel (From Plant 1)	02H	1	0	0	1	0	2	0	1	0	1	5
Old Cooling Water Tower	03K	1	0	0	0	3	0	0	0	0	1	4
Utility Trench to Pit Area	22E	1	0	0	0	3	1	0	0	0	1	5
10-Plex Sewage Lift Station	25J	1	0	0	0	0	0	0	0	0	0	0
Clearwell Line	88	1	0	0	0	0	0	0	0	0	1	1
Storm Sewer System	G03	1	0	0	0	0	0	0	0	0	1	1
Utility Lines	G04	1	0	0	0	0	0	0	0	0	0	0
Ponds and Basins												
BDN Surge Lagoon	18A	1	0	0	0	0	7	0	0	0	13	20
Coal Pile Runoff Basin	18C	1	0	0	0	0	4	0	0	0	4	8
Storm Water Retention Basin	18E	1	0	0	0	0	7	0	0	0	5	12
Low Nitrate Tank	18K	1	0	0	0	0	1	0	0	0	1	2
High Nitrate Tank	18L	1	0	0	0	0	1	0	0	0	1	2
Sludge Drying Beds	25F	1	0	0	1	0	1	0	0	0	1	3
Primary Settling Basins	25G	1	0	0	0	6	2	0	0	0	1	9
Fire Training Pond	73B	1	0	0	0	0	0	0	0	0	0	0
TOTALS:			33	4	193	375	137	77	200	10	98	1127

[a] Samples collected at seperate chemical and radiological locations are counted as two samples.
[b] Concrete cores were collected at either two or three depths. Each depth collected was counted as an individual sample.

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TABLE 2-6
COMPONENTS WITH CONFIRMATORY SAMPLING

Component Description	Number
Category 1: Administration Buildings	
Human Resources Building	28A
Fire Brigade Training Center	73A
Category 2: Warehouse/Storage Buildings	
Plant 1 Storage Shelter	1B
Plant 4 Warehouse	4B
Drum Storage Warehouse	30B
Category 3: Process Buildings	
Biodenitrification Towers	18D
Category 4: Process Support Buildings	
Plant 8 Railroad Filter Building	8D
Boiler Plant	10A
Water Plant	20B
Manhole 175/Sampling Building	25B
Guard Post on West End of 2nd Street	28D
Category 5/6: Containers	
Pilot Plant Ammonia Tank Farm	19B
Fire Training Tank	73C
Category 7: Bulk Material	
None	
Category 8: Parking Lots, Roads, etc.	
Roads	G-002
Category 9/10: Equipment	
Plant 7 Overhead Crane	7B

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TABLE 2-7

OU3 CONSTRUCTION MATERIAL LEACHABILITY TESTING SAMPLE LOCATIONS

Component Name	Component Number	Process Area Name	Material Type	Number of Samples
Green Salt Plant	4A	UF_4 Packaging (1)	Concrete	4
Ore Refinery Plant	2A	Digestion (1)	Concrete	4
Metals Fabrication Plant	6A[a]	Chip Briquetting (3)	Painted Steel	7
Hot Raffinate Building	3E	Hot Raffinate	Paint	1
Recovery Plant	8A	Muffle Furnace (4)	Paint	1
Recovery Plant	8A	Green Salt Reversion (6)	Paint	1
Recovery Plant	8A	Old Rotary Kiln (7)	Paint	1
Plant 9 Sump Treatment Facility	9B	Sump Treatment Facility	Paint	1
Metals Fabrication Plant	6A	Machining Inspection (2B)	Paint	1
Metals Production Plant	5A	Reduction South Side (1)	Concrete	1
Metals Production Plant	5A	Water Treatment (10)	Concrete	1
Special Products Plant	9A	Enriched Uranium Casting (2)	Concrete	1
Combined Raffinate Tanks	3J	Combined Raffinate	Concrete	1
Ore Refinery Plant	2A	Drum Digestion (2)	Concrete	1
Metal Dissolver Building	2D	West Metal Dissolution (2)	Concrete	1
Recovery Plant	8A	Muffle Furnace (4)	Concrete	1
Recovery Plant	8A	Old Rotary Kiln (7)	Concrete	1
Recovery Plant	8A	Milling (1)	Concrete	1
Green Salt Plant	4A	UF_4 Packaging (1)	Concrete	1
6 to 4 Reduction Facility #1	54A	Reduction Reactor (2)	Concrete	1
Pilot Plant Wet Side	13A	Southern Extraction (1)	Concrete	1

[a] Original location of K_L sample is unknown; the RI/FS sample referenced for these K_L samples is assumed based on process knowledge.

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TABLE 2-8

SUMMARY OF GENERAL METHODOLOGY AND SAMPLE SPECIFIC VARIANCES [a]

Variance	Number of Variances from the OU3 WPA	Number of Variances to Field Program	Total
Changed number of scheduled intrusive samples - delete for lack of media, add additional samples, change media (i.e., liquid to loose media)	72	30	102
Add or Delete intrusive sampling from entire process areas or components [b]	12	0	12
Sample locations differ from FWP location	0	59	59
Chain of Custody documentation corrections	0	25	25
Laboratory/Sample Processing variances	0	12	12
Change in field Standard Operating Procedures	5	10	15
Miscellaneous/General/Field QC variances	5	69	74
Total	94	205	299

[a] Detailed list of specific variances are located in Appendix K.
[b] Reason for deletion includes: component sampled as part of ongoing removal action, or component no longer exists.

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TABLE 2-9

OU3 RI/FS CHARACTERIZATION STUDY ANALYTICAL COMPLETENESS PER MEDIUM

Media	Analyte Fraction	Planned Fractions	Reported Fractions	Percent of Fractions Validated	Percent Usable [a]
Surface Concrete Chips (0 to 1/2 inch)	TAL Inorganics	148	148	100	97.8
	TCL Volatile Organics	5	9	100	98.9
	TCL Semivolatile Organics	5	9	100	89.1
	PCB's/Pesticides	0	12	100	100
	Radionuclides	148	148	98.6	99.7
	TCLP extraction/TAL Inorganics	5	7	100	85.8
	TCLP extraction/TCL Volatile Org.	5	7	100	97.9
	TCLP extraction/TCL Semivolatile Org.	5	7	100	99.5
	TCLP extraction/Radiological	5	7	99.1	91.5
Concrete Cores (0 - 1/2 inch, 1/2 - 1 inch, and 1 - 4 [or 6] inch)	TAL Inorganics	252	247	100	97.4
	TCL Volatile Organics	0	18	100	97.5
	TCL Semivolatile Organics	0	3	100	92.2
	PCB's/Pesticides	0	6	100	100
	Radionuclides	252	256	98.8	98.9
	TCLP extraction/TCL Volatile Organics	0	9	100	97
Acid Brick (0 to 1/2 inch)	TAL Inorganics	23	23	100	98.6
	TCL Volatile Organics	0	4	100	98.1
	TCL Semivolatile Organics	0	4	100	99
	Radionuclides	23	22	98.1	98.3
	TCLP extraction/TAL Inorganics	4	4	97.1	86.6
	TCLP extraction/TCL Volatile Org.	4	4	100	98.5
	TCLP extraction/TCL Semivolatile Org.	4	4	100	99.2
	TCLP extraction/Radiological	4	4	98.2	98.2
Masonry Chips (0 to 1/2 inch)	TAL Inorganics	53	56	100	98.1
	TCL Volatile Organics	0	2	100	100
	TCL Semivolatile Organics	0	2	100	99.2
	Radionuclides	53	55	98.7	98.7
	TCLP Metals	0	2	100	100

[a] Percent Usable - analytes qualified as "R" (rejected) are not considered usable.

TABLE 2-9 (Continued)

OU3 RI/FS CHARACTERIZATION STUDY ANALYTICAL COMPLETENESS PER MEDIUM

Media	Analyte Fraction	Planned Fractions	Reported Fractions	Percent of Fractions Validated	Percent Usable *
Steel Coatings (paint and oxides)	TAL Inorganics	149	127	100	96.7
	Radionuclides	149	80	98.1	97.5
Asphalt	TAL Inorganics	0	4	100	100
	TCL Volatile Organics	0	2	100	97
	TCL Semivolatile Organics	0	2	100	98.4
	PCB's/Pesticides	0	2	100	100
	Radionuclides	0	4	100	100
Transite	TCLP Metals	10	10	100	94.4
	TCLP Volatile Organics	10	10	100	100
	TCLP Semivolatile Organics	10	10	100	83.7
Loose Media (Sediment, Soil, Sludge)	TAL Inorganics	77	80	100	98.6
	TCL Volatile Organics	77	78	100	98.6
	TCL Semivolatile Organics	77	78	97.4	99.1
	PCB's/Pesticides	0	14	100	100
	Radionuclides	77	79	94.2	98.8
Unknown Liquids	TAL Inorganics	68	81	100	98.7
	TCL Volatile Organics	68	82	100	98.9
	TCL Semivolatile Organics	68	81	100	98.6
	PCB's/Pesticides	0	2	100	100
	Radionuclides	68	81	97	95.3

* Percent Usable - analytes qualified as "R" (rejected) are not considered usable.

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TABLE 2-10

OU3 RI/FS CHARACTERIZATION STUDY ANALYTICAL DATA COMPLETENESS SUMMARY BY COMPONENT CATEGORY[a]

	Process Buildings		Process Support Buildings		Warehouse & Storage Buildings		Containers[b] & Containerized Material		Storage pads, Roads, Railroads, Parking Lots		Piping[b], Utilities, Equipment		Ponds & Basins		Soil Piles/ Bulk Material		Admin. & Support Building		TOTAL	
Fraction	Samples Reported	Samples %Usable[c]	Samples Reported	Samples %Usable[c]	Samples Reported	Samples %Usable[c]	Samples Reported	Samples %Usable[c]	Samples Reported	Samples %Usable[c]	Samples Reported	Samples %Usable[c]	Samples Reported	Samples %Usable[c]	Samples Reported	Samples %Usable[c]	Samples Reported	Samples %Usable[c]	Samples Reported	Samples %Usable[c]
Metals	402	97.2	108	97.8	40	97.5	53	97.3	56	97.4	35	98.2	45	99.2	11	99.6	25	96.7	775	97.5
Volatile organics	102	98.7	8	98.9	1	97.0	9	98.7	22	98.8	11	99.2	41	97.6	11	98.6	0	—	205	98.5
Semi-volatile organics	85	97.2	8	97.3	1	98.4	9	99.5	22	99.3	11	97.2	41	99.4	11	99.4	0	—	188	98.2
Radio-nuclides	414	98.0	111	98.6	35	98.2	50	98.8	63	97.6	29	99.1	44	98.9	12	99.4	33	99.7	791	98.3
PCBs/ Pesticides	4	100	2	100	1	100	0	—	7	100	10	100	1	100	11	100	0	—	36	100

[a] Includes samples discussed in Appendix L.3 that were identified in the WPA as supplemental media (i.e., loose media, unknown liquids).
[b] Includes aboveground and belowground components.
[c] Only constituents qualified by data validation as "R" (rejected) are not considered usable.

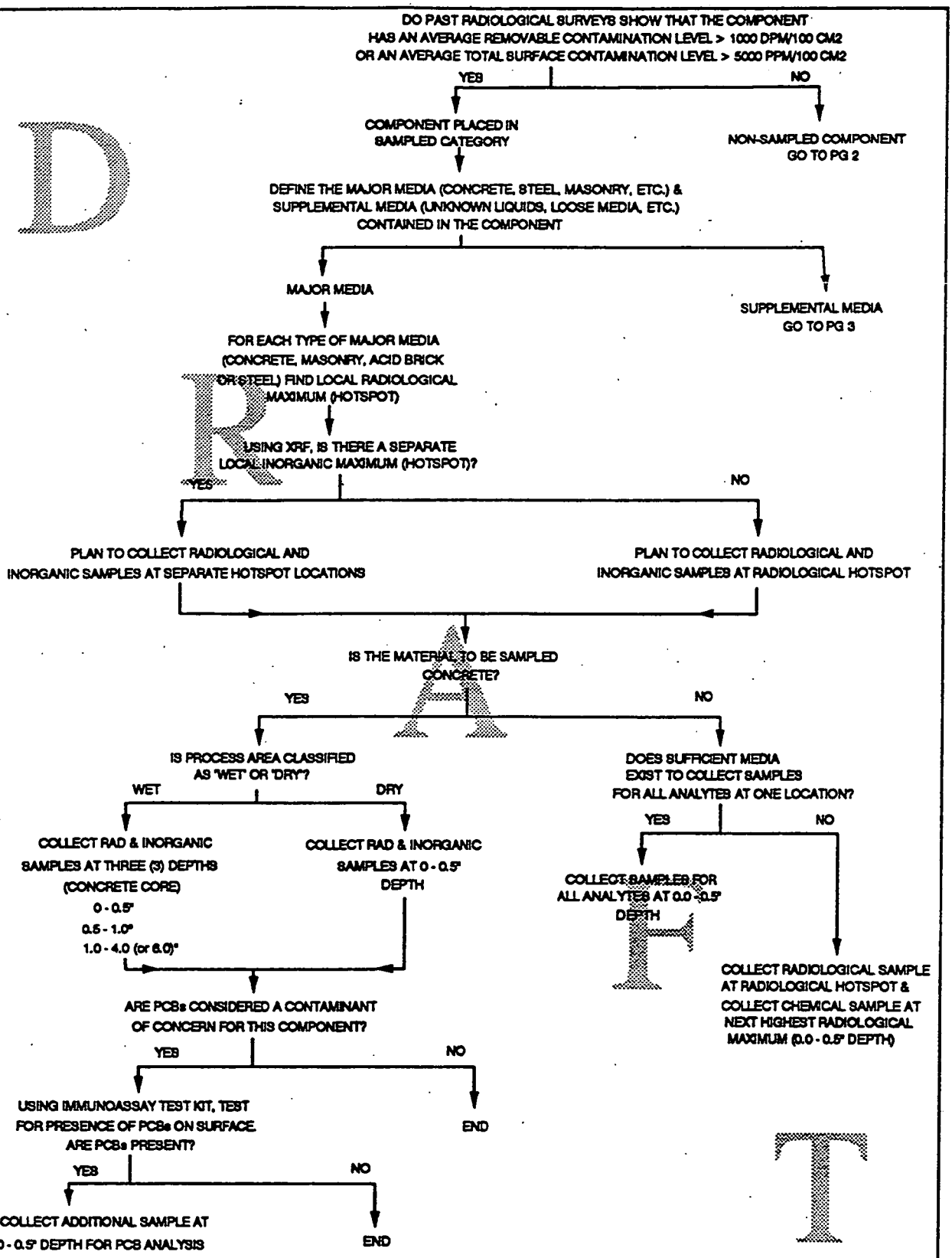

FIGURE 2-1 DIAGRAMMATIC REPRESENTATION OF OU3 RI/FS CHARACTERIZATION PROGRAM - PAGE 1 OF 3

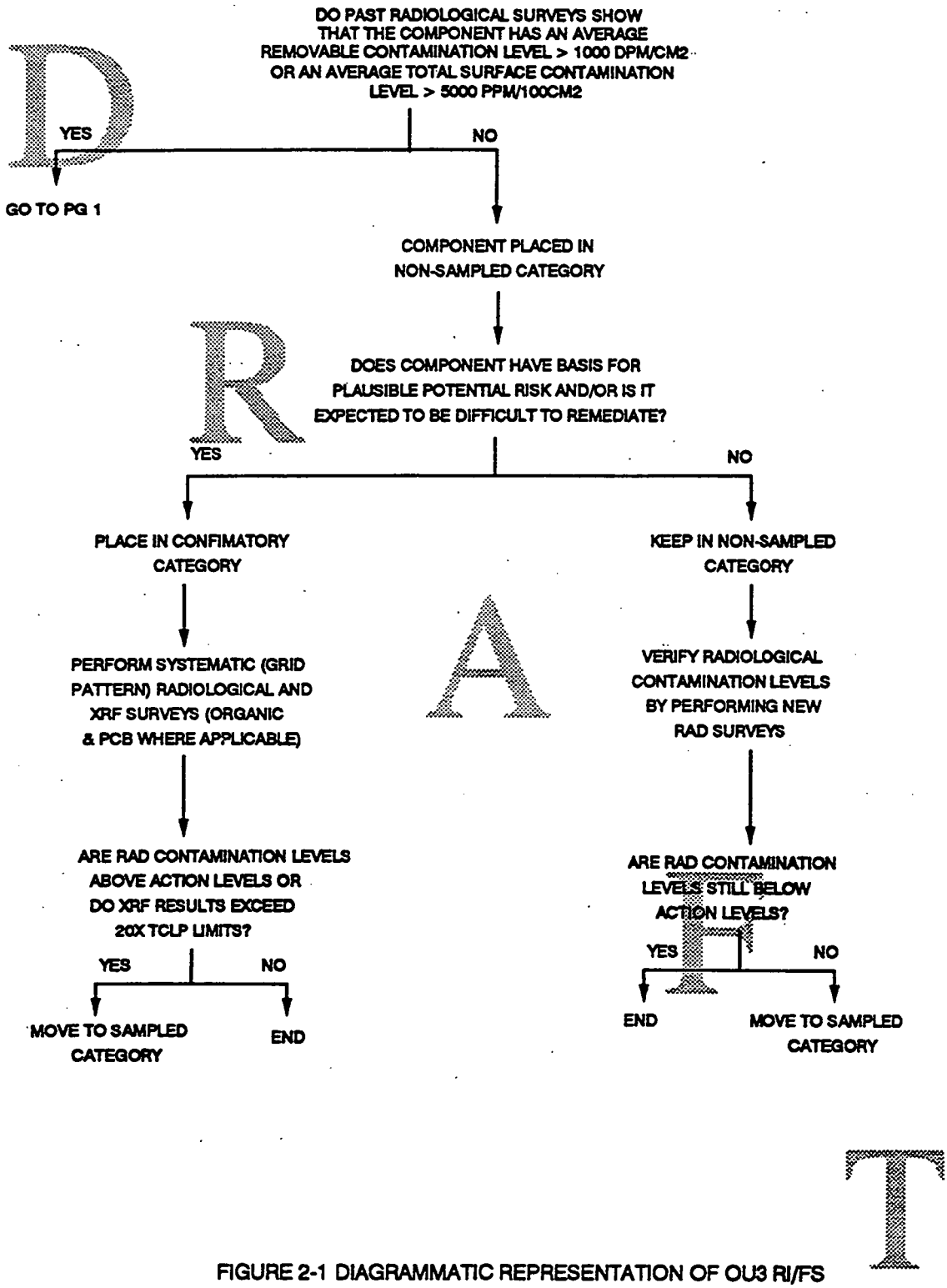

FIGURE 2-1 DIAGRAMMATIC REPRESENTATION OF OU3 RI/FS CHARACTERIZATION PROGRAM - PAGE 2 OF 3

NON-SAMPLED COMPONENTS

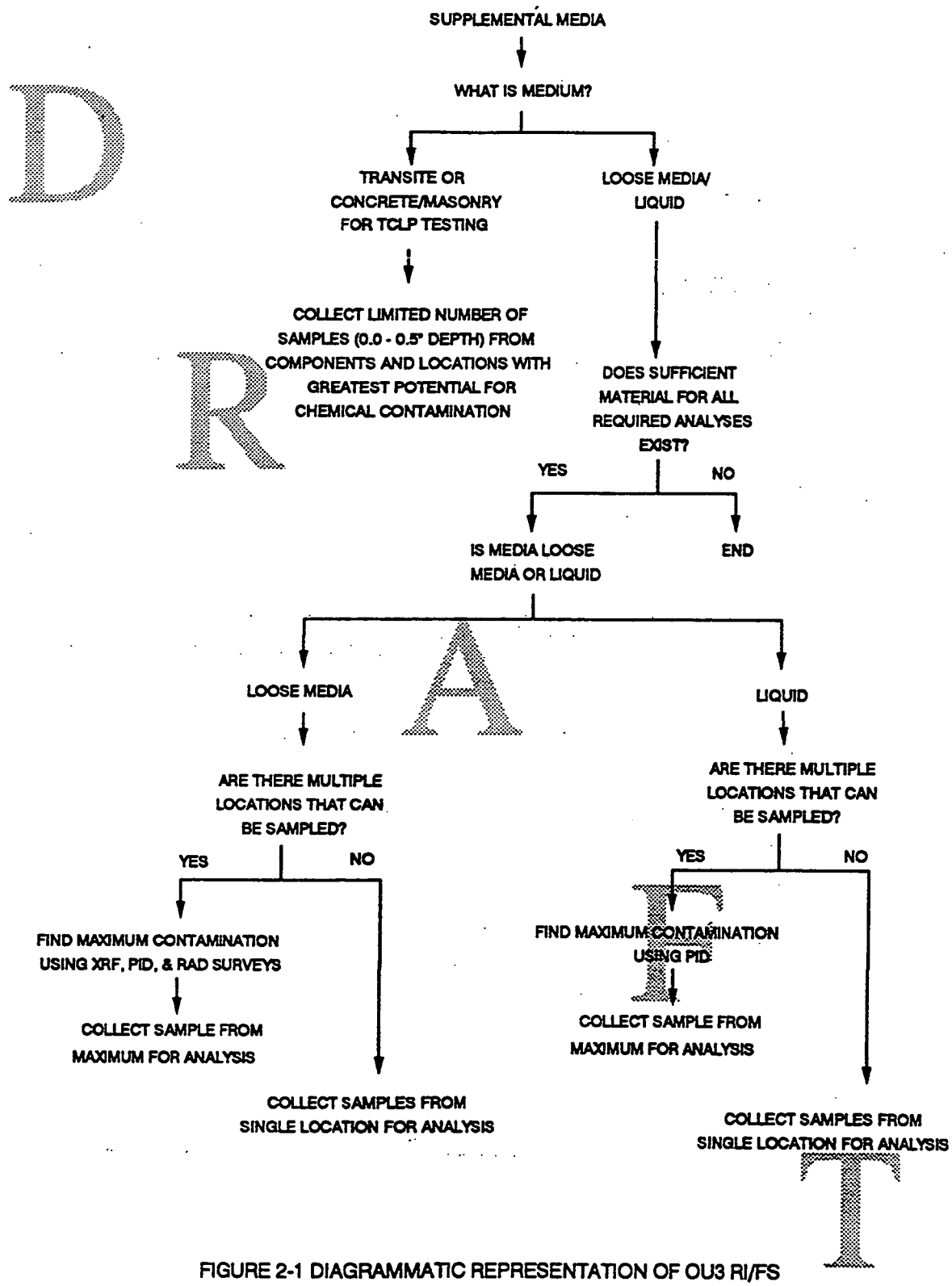

FIGURE 2-1 DIAGRAMMATIC REPRESENTATION OF OU3 RI/FS CHARACTERIZATION PROGRAM - PAGE 3 OF 3
SUPPLEMENTAL MEDIA

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3.0 CHARACTERIZATION OF OPERABLE UNIT 3

This section achieves the following goals of this RI/FS Report for OU3, as discussed in Section 1:

- Presents the OU3 COCs;
- Provides an estimate of the total volume and weight of OU3 materials;
- Summarizes the findings of the OU3 RI/FS characterization study;
- Provides a characterization of the nature of radiological and chemical contamination in OU3 materials;
- Presents estimates of the mass of various contaminants in OU3; and
- Presents the projected volumes and weights of OU3 materials in various regulatory categories after completion of interim actions.

Fulfillment of these objectives serves to characterize OU3 and supports the development and evaluation of alternatives for the treatment and disposition of OU3 materials.

These objectives are accomplished by first describing OU3 (Section 3.1), including the buildings, structures, and associated facilities (components) that comprise OU3; the material types that comprise these components and the expected contamination. A discussion of the process of developing COCs for OU3 is then presented (Section 3.2). Reference criteria used to evaluate the level of contamination within OU3 are subsequently described (Section 3.3), followed by a description of the contamination detected in OU3 as a result of the characterization study (Section 3.4). Estimates of contaminant source terms for key analytes in OU3 are presented (Section 3.5), followed by a discussion of uncertainties and limitations within the characterization data (Section 3.6). Finally, conclusions on data sufficiency are discussed (Section 3.7).

Figure 3-1 shows how the data available for characterization of OU3 are presented and used in this RI/FS. Two databases, the Sitewide Waste Inventory Forecasting, and Tracking System (SWIFTS) and the Sitewide Environmental Database (SED), provide the foundation upon which all information is developed. SWIFTS contains approximately 94,000 individual lines of data detailing the in-place volume and weight of the various materials within OU3 (see Section 3.1.1 for further details). The SED contains the analytical results from the OU3 RI/FS characterization study. These results indicate the type and level of contamination within a given type of sampled medium in a given structure.

These data are used in the RI/FS Report to provide a description of the type and level of contamination in OU3 as follows:

- The physical characteristics of OU3 are presented in Section 3.1.1. This is accomplished by
  - reviewing the components comprising OU3 (Section 3.1.1.1), including their grouping into component categories (detailed in Sections 1.2.1 and 2.3);
  - introducing the various material types included in OU3, as well as the categorization of these materials; and
  - summarizing the estimated weights and volumes of these materials from the SWIFTS database (detailed in Appendix B.2 and summarized in Section 3.1.1.2).

  The material categories are used in the screening of technologies and process options in Section 4 and in the description of alternatives in Section 5. The estimates of material volume and weight are used in Section 3.5, in conjunction with analytical data, to estimate the contaminant mass (source terms) associated with OU3.

- The actual contamination detected as a result of the RI/FS characterization study is presented in Section 3.4. A detailed characterization and evaluation of contamination, by contaminant, medium, and component, is presented in Attachments A.II, A.III and A.IV, respectively and summarized in Appendix A. The focus of the discussion in Section 3.4 is to first identify COCs which are key to decisions required in Sections 4, 5 and 6; and second to discuss the major media and identify the components and component categories where the key contaminants occur.

- The data contained in SWIFTS and the SED are then combined, through a series of assumptions and calculations, to provide an estimated, in-place contaminant source term (detailed in Appendix B.5 and summarized in Section 3.5.1).

- Categories for segregating this material during the interim remedial action are then introduced (Section 3.5.5) and the material weights and volumes associated with these categories are presented (detailed in Appendix B.8 and summarized in Section 3.5.5).

This information is the starting point for the development and screening of process options and technologies (Section 4), the development and screening of alternatives (Section 5), and the evaluation of alternatives (Section 6).

During the OU3 RI/FS characterization study, a total of 1,127 samples of 12 media types (acid brick, HVAC filters, asphalt, concrete, liquids, loose media, masonry, sediment, sludge, soil, transite, and wood) were collected from 137 components. These samples were analyzed for one or more fractions (radiological, inorganic, semivolatile, volatile, and pesticide/PCB - note that all but pesticides/PCBs include TCLP and total fractions), which include a total of 175 analytes. The result is a database of 53,293 separate results (such as elemental uranium for a given sample). The description of such a

large number of results for a study area as complex as OU3 suggests including multiple levels of detail to aid in the overall understanding of the types, levels and locations of contamination within OU3. Five levels of detail have been included in this RI/FS Report.

- Actual analytical results from the characterization study, organized by component category, are presented in Appendix L (Volume IV).
- Detailed discussions of the type and level of contamination within OU3, compared to reference criteria, are presented in the attachments to Appendix A. (See Appendix A.4 for details regarding reference criteria.)
- A mid-level summary of the type and level of contamination within OU3, based on the details provided in the attachments, is provided in Appendix A.
- The key characteristics and issues regarding contamination within OU3 that may affect the decision-making process are summarized in Section 3 (Volume 1).
- The major types and levels of contamination within OU3 are highlighted in the Executive Summary.

This organization allows the reader to examine the types and levels of contamination within OU3 at virtually any level required.

To further aid in understanding the types and levels of contamination within OU3, the discussions in Appendix A and Section 3 are presented from three different viewpoints:

- By contaminant (Attachment A.II and Appendix A.5);
- By sampled medium (Attachment A.III and Appendix A.6); and
- By component category/component (Attachment A.IV and Appendix A.7).

The significant issues resulting from these discussions are provided in Section 3.4. This presentation anticipates that different readers will require not only different levels of detail regarding contamination within OU3, but also a description from different viewpoints:

- The discussions by contaminant are useful in identifying the occurrence of specific constituents within OU3, such as what potentially hazardous/mixed wastes occur and at what levels, how widespread they are, and whether or not enriched materials are an issue.
- The media presentations are useful in identifying which media are of most concern as well as the types and levels of contamination within each media.

- The descriptions of the contamination by component category/component presentation are useful in identifying which components are of most concern as well as the types and levels of contamination within a different medium in a particular component/component category.

Although it is recognized that these levels of detail and viewpoints result in considerable repetition of information, the complexity of OU3 and the large number of sampling results require such an approach to facilitate an understanding of the significant contamination within OU3.

3.1 DESCRIPTION OF OPERABLE UNIT 3

This section describes OU3 to provide background information for the characterization information presented in Section 3.5. This is accomplished by presenting an overview of the buildings, structures, and associated facilities comprising OU3; discussing the materials from which these are constructed; and describing the expected types and relative levels of contamination in OU3.

3.1.1 Physical Characteristics of OU3

As discussed in Section 1.1, OU3 includes of all above- and below-grade facilities at the FEMP not included in other OUs. This section describes the physical characteristics of this extensive array of production, support, and related facilities.

3.1.1.1 Components/Component Categories

As discussed in Section 1.2.1, OU3 consists of 233 buildings, structures, and associated equipment, utilities, roads, parking lots, and railroads. Several of these components (25) contain multiple process areas (125 total), which, by reason of the activities performed, are somewhat different from other areas within the component.

The components comprising OU3 have been grouped into 11 categories (Section 2, Table 2-5). This categorization is primarily used for sampling purposes but is also useful for purposes of discussion and presentation. These component categories are as follows:

1. Administrative and Support Buildings
2. Warehouse and Storage Buildings
3. Process Buildings
4. Process Support Buildings
5. Containers and Containerized Materials - Above-ground
6. Containers and Containerized Materials - Below-ground
7. Bulk Material
8. Storage Pads, Parking Lot, Roads, and Railroads
9. Piping, Utilities, and Equipment - Above-ground

10. Piping, Utilities, and Equipment - Below-ground
11. Ponds and Basins

Some categories (such as administrative and support buildings) are expected to be minimally contaminated; thus primarily, confirmatory samples were collected. Other categories (such as the process and process support buildings) are more complex and are expected to be more contaminated; therefore, more samples were collected. Descriptions of contamination within individual components, discussed in Appendix A, are organized according to component categories to maintain the structure initiated in the WPA (DOE 1993a). A description of these component categories, and the components within them, is included in Appendix A.

3.1.1.2 Material Types/Categories

The buildings, structures, and associated facilities in OU3 consist of 74 material types or descriptions (i.e., concrete walls, asphalt, masonry, drywall, etc.). These material types have been grouped into ten categories according to, in most cases, similar physical characteristics to support potential disposition treatment options, as discussed in Sections 4 and 5. These material types and categories are shown on Table 3-1.

3.1.1.3 Material Mass/Volume Estimates

As detailed in Appendix B, an inventory of volumes and weights associated with these materials has been compiled into a database, referred to as SWIFTS. The weights and volumes of material comprising OU3 are summarized from this database in Appendix B and further summarized in Table 3-2. In total, OU3 is estimated to contain approximately 9.3 million ft^3 of material weighing approximately 454,000 tons. As shown on Figure 3-2, more than 50 percent of the volume and over 70 percent of the weight of this material is concrete-like material (i.e., asphalt, concrete structures, masonry, and transite). As indicated in Appendix B, the largest amount of this material (nearly 50 percent) is associated with at-grade floors and pads, and more than 40 percent is below-grade (foundations, electrical duct banks, drainage structures, etc.). The next most prevalent material is steel (structural, piping and equipment), which accounts for more than 20 percent of the total volume (ten percent of the total weight). A significant amount of the material associated with OU3 is inventory (product, thorium, and drummed wastes - see Attachment A.IV for an accounting). This material was either in inventory when production operations ceased or has been (or will be) generated as a result of activities to mitigate risks within OU3. As discussed in Section 1, this material is being dispositioned by ongoing, approved programs and is therefore not part of the decision-making process

in this RI/FS. A significant portion of the remaining material within OU3 is bulk material (coal, gravel, rock salt, and sand). This material is used in maintenance activities and considered uncontaminated. Since this material is currently not waste, it also is not part of the decision-making process. Soil piles are also included in the bulk material category, however, these soils are evaluated in the OU5 FS and will be dispositioned under the OU5 ROD.

Tables 3-3 and 3-4 summarize the volumes and weights of materials within OU3, according to component and material categories respectively. Approximately 21 percent of the total volume and weight is associated with Component Category 3 - Process Buildings; more than 16 percent of the total volume (six percent of the weight) with Component Category 1 - Administrative and Support Buildings; and more than 15 percent of the volume (22 percent of the weight) with Component Category 8 - Storage Pads, Parking Lot, Roads, and Railroads. Again, the predominant material within most of the component categories is concrete, comprising over 43 percent of the volume and 79 percent of the weight of buildings (Component Categories 1 through 4) and all of the Storage Pads, Parking Lot, Roads, and Railroads (Component Category 8).

3.1.2 Historical Evidence of Contamination

As described in Section 1, the historical mission of the FEMP was the purification of uranium for use in the nation's weapons program. Contamination within OU3 originated during production and waste management operations associated with this mission. These operations resulted in releases of contaminants to the environment through routine discharges, such as permitted air emissions, wastewater discharges, and storm water discharges, as well as nonroutine events, such as spills, leaks and fires. These discharges resulted in the contamination of the various materials associated with OU3.

The FEMP uranium refining and manufacturing process has been well documented in various reports and publications. These records provide an indication of the type and distribution of radiological and chemical contaminants expected. Expected types of contamination within each building and structure comprising OU3 are described in Attachment A.IV. Table 3-5 summarizes these expected contaminants within OU3.

3.1.2.1 Expected Radiological Contaminants

During its 37 years of operation, the FEMP produced more than 180,000,000 kilograms (200,000 tons) of uranium metal products. The feed materials for this production primarily included:

- High tonnages of purified uranium in solid (uranium metal, black oxide - uranium oxide [U_3O_8], brown oxide - uranium dioxide [UO_2], orange oxide - uranium trioxide [UO_3], and green salt - uranium tetrafluoride [UF_4]); semi-solid (uranium hexafluoride [UF_6]); and liquid (uranyl nitrate [$UO_2(NO_3)_2$] solution) forms.
- Intermediate tonnages of uranium ores and ore concentrates, containing primarily the isotopes of uranium and its progeny (thorium-230 and radium-226), as well as a wide variety of impurities (see discussion of thorium series and inorganic contaminants below).
- Relatively low volumes of recycled uranium residues and scraps containing fission products (strontium-90, technetium-99, and cesium-137) and activation products (americium-241, neptunium-237, plutonium-238, plutonium-239/240, plutonium-241, and uranium-236).

The FEMP also produced 369,000 kilograms (400 tons) of thorium-232 products in the late 1960s and early 1970s. The feed materials for this production were thorium compounds and metal containing thorium progeny (radium-228 and thorium-228), as well as thorium-230.

Consistent with the production history at the FEMP, the predominant radiological contaminants in OU3 are expected to be uranium and its more stable progeny (radium-226 and thorium-230), as well as small quantities of several fission and activation products. Since thorium-232 was also refined at the FEMP, this radionuclide and its more stable progeny (radium-228 and thorium-228) are also expected.

3.1.2.2 Expected Inorganic Contaminants

Inorganic chemicals were integral to the manufacturing process at the FEMP. The predominant inorganic chemicals used in the uranium refining process at the FEMP were nitric acid, hydrochloric acid, hydrofluoric acid, magnesium metal, calcium hydroxide (lime), and calcium-magnesium carbonate (dolomite). Sodium chloride, potassium chloride, calcium carbonate and lithium carbonate were used as salts in heat treating. Magnesium fluoride (MgF_2) was also a major waste from the metal production process. In addition, the ore concentrates processed at the FEMP contained elevated concentrations (greater than one percent) of impurities such as calcium, iron, magnesium, phosphorous (as phosphorous pentoxide - P_2O_5), sodium, silicon (as silicon dioxide - SiO_2), and sulfur (as sulfate - SO_4), as well as minor concentrations of several other impurities, including arsenic, carbon (as carbonate - CO_3), molybdenum, phosphorus (as phosphate - PO_4), and vanadium (as vanadium pentoxide - V_2O_5). These impurities were concentrated up to five-fold in the waste streams through the removal of the uranium in the refining process (DOE 1995e). Finally, lead-based paints were used throughout the FEMP through the early 1990s. These paints typically

contain elevated levels of lead, as well as other metals (such as cadmium, chromium, and mercury) which are used in the paint pigments.

3.1.2.3 Expected Organic Contaminants

Several uses of organic chemicals have been identified in the history of processing operations at the FEMP. A mixture of kerosene and tributyl phosphate was used as a solvent for the extraction of uranyl nitrate following nitration of uranium ores and recoverable wastes. A similar mixture using diamyl-amyl phosphonate (DAAP) was used for thorium extraction. Other organic materials include oils (lubricating, cutting, cooling, and water-soluble), PCBs from lubricants and electrical equipment, pesticides and herbicides, and various solvents and cleaning fluids. In general, volatile organic compounds (VOCs) were used in support functions, such as maintenance activities, or were progeny of parent chemicals used at the site. Because many of the oils and oily materials were burned in incinerators at the FEMP, chlorinated dibenzo p-dioxins/dibenzofurans (CDDs/CDFs), poly-aromatic hydrocarbons (PAHs), and phenols could have been produced.

3.2 DETERMINATION OF CONSTITUENTS OF CONCERN (COCs)

COCs are those contaminants that pose a 10^{-7} or greater Incremental Lifetime Cancer Risk (ILCR) or a Hazard Quotient (HQ) greater than 0.1 to the maximally exposed individual (MEI). The ILCR is incrementally additive to the number of people that would normally be expected to develop cancer when exposed to a given level of a contaminant over a 70-year lifetime (i.e., 10^{-7} implies one person in 10,000,000). The HQ is the intake of a toxic substance through a pathway divided by the total intake (i.e. an HQ of 0.1 indicates an uptake of 1/10 of an acceptable limit). See Section 5 for further discussions regarding risk. COCs are normally determined in a baseline risk assessment as part of an RI/FS study in consideration of constituent concentrations, plausible land uses, and exposure pathways. A baseline risk assessment establishes the risk to human health and the environment if no remedial action is taken. As discussed in Section 1, OU3 presents a special case to the RI/FS process and the applicability of a baseline risk assessment. The buildings, structures, and associated facilities within OU3 are being removed under an approved interim remedial action (DOE 1994a). Most of the waste material resulting from this action will be placed in interim storage until a decision is made concerning final disposition. Because DOE will not allow these wastes to remain permanently in interim storage, the focus of the OU3 RI/FS deals primarily with the final disposition of the wastes. For this and other reasons, as outlined in Section 1, the EPAs and DOE jointly agreed not to conduct a stand-alone baseline risk assessment for OU3.

Because no stand-alone baseline risk assessment was performed for OU3, and because a list of COCs is required for the FS portion of this combined document, an alternate method of determining COCs was utilized. This method, similar to the method used for determining constituents of potential concern in standard baseline risk assessments, removed analytes not contributing to risk while providing adequate human health and environmental protection.

The following sections summarize the COC selection process, the selection criteria, and the results of the screening process.

3.2.1 Methodology Used to Determine COCs

The knowledge of process operations and expected contamination within OU3 were used in the WPA (DOE 1993a) to develop a list of 87 potential contaminants of concern. This resulted in a list of 148 analytes to be analyzed during the RI/FS characterization study, although 175 analytes were finally included in the study (see Section 2). The results from this study were evaluated through the following four-step process to determine COCs for OU3.

1. Separate by Media

   As discussed in Section 3.1.1, OU3 consists of 74 types of material. As discussed in Section 2, the characterization study collected samples from 12 of these material types, representing 95 percent of the total material in OU3. Sampling results from 11 of these were used in the COC determination. Liquids were excluded from the screening because they were obtained from points where materials would tend to collect and concentrate, and, therefore, the results are not necessarily representative. The excavated soil piles are not directly applicable to the OU3 RI/FS, since they will be dispositioned by OU5. However, they are included in the COC determination because the analytical results were not available when the OU5 RI/FS was performed. This analysis confirmed that no COCs were overlooked in the analysis performed by OU5 (See Section A.3.4).

   Analytical information for each of the 11 media types (loose media, sediment, and sludge were combined) was examined for all chemical and radiological constituents specified in the WPA (1993a). In all, 170 constituents, consisting of 19 radiological constituents, 24 metals, 35 volatile organic chemicals, 66 semivolatile organic chemicals and 26 pesticides and PCBs, were included in the analysis. Note that five constituents inadvertently reported by analytical laboratories for several of the samples were excluded because they were not planned in the WPA and there was a limited number of sample results.

2. Determine Representative Concentrations

   As described in Section 1, OU3 consists of a complex combination of buildings, structures and appurtenances. Many of these facilities were directly involved in the production operation, but many were not. Even operations within the various facilities associated with production differed. Furthermore, the RI/FS characterization study was intended to

obtain samples of the maximum contamination within these facilities (see Section 2). As a result of these factors, there is no general relationship between the expected or actual type, level, or extent of contamination within these facilities (one particular contaminant may be of concern in one area, such as PCBs in electrical substations, but not in others). Therefore, the maximum detected value for each analyte in each sampled media type was used as the representative concentration for the COC screening. This extremely conservative assumption was made to increase the sensitivity of the COC selection process, making certain that all potentially significant contributors to the risk to human health and the environment were included.

3. Compare Representative Concentrations to Part B Screening Criteria

The representative (maximum) concentration for each analyte within a medium was compared to the Part B Screening Criteria for safe levels in residential surface soil (EPA 1991). If the representative concentration in a sampled media type exceeded the Part B Screening Criteria, the constituent was considered a COC for that media type. Part B Screening Criteria were calculated at an ILCR level of one in ten million (10^{-7}) and a HQ of 0.1 (see Attachment A.V for the development of these criteria).

4. Combine COCs for all Media

The final step of the COC selection process was to compile COCs for all media into a final list of COCs. If a constituent was a COC for any of the media considered, it was considered a COC for all media. Note that even COCs found exclusively in loose media and soil (media not directly related to this RI/FS) were marked for further consideration in the Sections 4, 5, and 6 of this document.

3.2.2 Results

The 60 OU3 COCs are listed on Table 3-6. These include 20 radioactive constituents, 16 inorganics, 15 semivolatile organics, three volatile organics, and six pesticides/PCBs.

3.3 REFERENCE CRITERIA FOR EVALUATION OF CONTAMINATION LEVELS

Characterization of the radiological and chemical contamination in OU3 involves comparison of constituent concentrations to known constituent-specific reference criteria. These reference criteria provide a perspective on the level of contamination within the sampled media. This is important to the characterization process because the comparison assists in the identification of dominant constituents and the media/components in which they predominate. This determination is needed to focus the remedial alternative selection process for OU3, because final disposition is partially dependent on the types, levels and locations of contamination. For instance, material with high levels of organic contamination may potentially require different handling, treatment, and final disposition than material contaminated with radionuclides.

The reference criteria used for comparison to sample constituent concentrations include:

- Media-specific baseline constituent concentrations,
- Derived constituent screening-level concentrations,
- Constituent-specific WAC at off-site disposal facilities,
- Constituent-specific TCLP concentrations,
- Constituent-specific TSCA-regulated concentrations.

These criteria are discussed in the following sections, and a summary is provided in Table 3-7.

3.3.1 Baseline Media Concentrations

A key reference criterion used for comparison is constituent baseline concentration. Baseline is the concentration of a constituent in a medium of interest that is considered not contaminated. Baseline concentrations were determined for concrete and for coatings on structural steel (i.e., paint baseline). Constituent baseline concentrations are addressed in Attachment A.I (Determination of Baseline Conditions) and are summarized in Table 3-7.

3.3.2 Part B Screening Levels

Another reference criterion used for comparison is constituent soil concentrations derived according to EPA guidance (EPA 1991). These Part B screening levels were used in the COC selection process (Section 3.2). Their development is discussed in Attachment A.V and they are summarized in Table 3-7.

3.3.3 Off-site Waste Acceptance Criteria

Another reference criterion used for comparison is the constituent-specific WAC at a representative commercial disposal facility. Disposal facility WAC are constituent concentrations specified by a waste disposal facility to limit the concentration and or total quantity of a constituent in waste that may be accepted for disposal. The WAC are established to ensure that the long-term impact of the disposal facility is protective of human health and meets appropriate regulatory stipulations. Numerical values for constituent WAC are discussed in greater detail in Appendix F and summarized in Table 3-7. These criteria are consistent with those presented in the OU5 FS report.

3.3.4 Constituent-Specific TCLP Concentrations

Another reference criterion used for comparison are the constituent-specific TCLP regulatory limit (40 CFR 261.24) and 20 times the TCLP limits. The EPA has promulgated standards for classification of solid waste as hazardous. One method for determining whether solid waste is hazardous is to determine the quantity of hazardous materials that could potentially leach from a sample into the environment. This determination is made using the toxicity characteristic leachate procedure (TCLP 40 CFR 261), in which a sample is exposed to an acid environment to allow constituent leaching. The leachate is then analyzed for contaminants, and the results are compared to regulatory limits (40 CFR 261.24). Since the TCLP process yields contaminant concentrations in leachate that are 20 times more dilute than contaminant concentrations in the solid sample (see Attachment A.II for a complete description), a solid sample with a contaminant concentration exactly 20 times the TCLP limit from which all of the contaminant leaches should yield a leachate concentration equal to the regulatory limit. Furthermore, a solid sample with a contaminant concentration that is less than 20 times the TCLP limit cannot yield a leachate concentration greater than the regulatory limit. Therefore, exceedance of the 20 times the TCLP limit indicates that a material may be hazardous. Numerical values for 20 times the TCLP limit for each regulated substance are summarized in Table 3-7.

3.3.5 Constituent-Specific TSCA-Regulated Concentrations

TSCA requires that wastes containing more than 50 mg/L (ppm) of PCBs be handled and dispositioned in accordance with specified procedures (40 CFR 761). This definition of liquid TSCA wastes has been used in this RI/FS report as a reference level for evaluating the level of contamination in solid material (i.e., PCB contamination exceeding 50 mg/kg [ppm]).

3.4 DISCUSSION OF SIGNIFICANT CONTAMINATION IN OU3

As discussed in the introduction to Section 3 and in Appendix A, several levels of detail and three viewpoints have been provided for the characterization of contamination within OU3. These are required by the complexity of OU3 and the large amount of information resulting from the field characterization study.

All of the sampling results are presented in Appendix L. These data are discussed in detail in Attachment A.II for each contaminant for which analyses were performed. The information for each COC is summarized at an intermediate level in Appendix A.4 for the purpose of identifying COCs that, by reason of extent or level of detection, are considered *more significant* than other COCs. The

discussion in this section consolidates information across media and components, and thus provides an overview of the occurrence of these *more significant* COCs in OU3 as a whole. This information is useful for identifying those constituents that may affect FS treatment or disposal options.

3.4.1 More Significant COCs

The extensive OU3 characterization data reveal that there are a limited number of constituents detected in numerous media within several components that may affect FS treatment/disposal options. It is not implied that other COCs should be ignored; however, the available data indicate that these other constituents will not influence overall remedial decisions and, in many cases, their treatment/disposition will be coincidental with that of the more significant ones. The COCs that are considered *more significant* are listed on Table 3-8. Each of the more significant COCs, along with the reasons they are considered more significant, is discussed in the following sections.

3.4.2 Summary of More Significant Radiological COCs

Because of the production mission at the FEMP, the dominant contamination within OU3 is expected to be radiological (see Section 3.1.2). To characterize radiological contamination in OU3, 795 samples were collected and analyzed for elemental uranium and 19 radionuclides. Almost 89 percent of these samples were from solid media (brick, concrete chips, concrete cores, loose media, masonry chips, sediment, sludge, soil, and wood), whereas the remaining 11 percent were from liquid media and air filters.

All 20 radiological constituents are COCs because EPA has defined them as Class A carcinogens. A Class A carcinogen is one for which there is evidence of cancer in humans caused by exposure to it. The characterization results for three of these radionuclides are summarized below. More detailed discussions for all 20 radioactive constituents are included in Appendix A and Attachment A.II.

3.4.2.1 Uranium

As discussed in Section 3.1, the major purpose of the FEMP during its 37 years of production was the purification of uranium. Thus, uranium is expected to be one of the major contaminants at the site. It was anticipated that the degree of contamination within a given component would be related to its historical role in the production process and its current role in the remediation operations. For example, it was presumed that a portion of every medium in the Process Buildings (Component Category 3) would contain elevated levels of uranium.

Uranium is a heavy metal and is chemically toxic in addition to its inherent radioactivity. Its target organ for chemical effects is the kidney. Uranium is made up of three radioactive isotopes: uranium-234, uranium-235, and uranium-238. One additional anthropogenic (man-made) isotope of uranium, uranium-236, associated with reprocessed fuel handling, is expected in trace amounts in some site locations. Because uranium is both a toxin (i.e., produces toxic effects) and a Class A carcinogen, and because it was found in elevated concentrations throughout large areas of the operable unit, uranium is considered a *more significant contaminant* of major concern in OU3. Its characterization was a major goal of this study.

Different analyses were used to characterize uranium within OU3. Total uranium analysis by kinetic phosphorescence analysis (KPA) was used to measure elemental uranium, and alpha spectral analyses were used to measure uranium-234, uranium-235/236, and uranium-238. Results from these four parameters provide information on the quantity and enrichment of uranium found within the operable unit. The geographic distributions and magnitudes of the concentration data for elemental uranium and the isotopic uranium results correlate well. To avoid a repetitious presentation, only elemental uranium results are used to characterize the geographical distribution of uranium within OU3. The isotopic data is featured in the discussion on uranium enrichment.

Elemental uranium results were reported for 771 samples from solid and liquid media sampled within OU3. Uranium was detected in 689 solid media samples, with concentrations ranging from 0.0263 μg/g to 52,0000 μg/g. It is interesting to note that about 38 percent of the reported uranium concentrations exceed 500 μg/g and thus would qualify as source material under 10 CFR 20. The highest concentration of uranium was detected in loose media from the Rolling Mill Area of the Metals Fabrication Plant (6A). The arithmetic and geometric means of this sample population are 4530 μg/g and 152 μg/g, respectively.

The baseline concentration of uranium in concrete and steel coatings (paint) serve as points of reference (see Table 3-7). This study compares concentrations in the other solid media, such as acid brick and masonry, to baseline levels of uranium in concrete. Although the concrete baseline concentration is not directly applicable in this case because it is from a different medium, it does provide a useful frame of reference. Over 70 percent of the uranium concentrations in solid media exceed the baseline level for concrete (12.55 μg/Kg). This percentage suggests widespread uranium contamination within OU3.

Figure 3-4 presents the volume of six solid materials by media and component category containing uranium concentrations that exceed baseline. This figure shows concrete contributing 35 percent of the contaminated volume to the total 1.1 million ft^3 above baseline. Acid brick constitutes four percent of the volume above baseline. Excluding asphalt, the largest percentage of the material volume containing uranium in concentrations above baseline levels (23 percent of the total volume) is located within the Process Building (Component Category 3). Asphalt has been excluded both from the figures and the discussions. The reason is because of the overwhelming volume of asphalt present in the roads and parking lots at the FEMP. The amount of contamination in the immense volume is slight.

The elemental and the isotopic uranium data indicate widespread uranium contamination of structural components and other solid materials within OU3. The isotopic data can also be used to determine the enrichment status of the uranium sampled. In general, uranium can be grouped into one of three categories, depending on the relative atomic abundance of the three naturally occurring isotopes (uranium-234, uranium-235, and uranium-238). The three categories are natural uranium, enriched uranium, or depleted uranium. A discussion of these three types of uranium, and the methods used to identify them, is provided in Appendix A.

In typical occupational settings, allowable exposures to soluble forms of natural and depleted uranium tend to be limited by its chemotoxicity, rather than its radiotoxicity. However, the radiotoxicity of uranium increases as its degree of enrichment increases. The level of enrichment at which radiotoxicity concerns supersede chemical toxicity concerns for soluble uranium is 1.3 percent uranium-235 enrichment (EG&G 1988). This level of enrichment has been selected as a convenient dividing line for focusing attention on samples containing significantly enriched uranium.

The majority of uranium handled at the FEMP was either natural or depleted uranium. A small fraction of the total quantity of uranium that passed through processes at the FEMP was enriched in uranium-234 and uranium-235. Based on a review of isotopic data sets from 498 sample locations, two samples contained the elevated isotopic ratios indicative of 1.3 percent uranium-235 enriched uranium. One of the two individual samples identified as containing enriched uranium came from masonry chips taken from the Nuclear Fuels Services Storage and Pump House (2E). This component was used to store enriched material received from the Nuclear Fuels Services facility in Erwin, Tennessee, before processing or transhipment. The other sample containing enriched uranium was composed of concrete chips taken from the floor of the General In-Process Warehouse (71).

3.4.2.2 Technetium-99

Technetium-99 is a radionuclide produced by fissioning uranium in a nuclear reactor. After the reactor run is finished, the uranium can be recovered and sent for reprocessing. The major source of technetium in OU3 is recycled uranium from the Hanford site, as a trace contaminant not fully removed by the purification processes at Hanford.

Technetium-99 is considered a *more significant contaminant* for three reasons: 1) it is a Class A carcinogen; 2) it is mobile in the environment; and 3) it has been found throughout large areas of the site.

Technetium-99 results were reported for 765 samples from all solid and liquid media sampled within the confines of OU3. Technetium-99 was detected in 75 percent of the solid media samples at concentrations ranging from 0.075 to 13,000 pCi/g. The arithmetic and geometric means of this sample population are 139 pCi/g and 5.2 pCi/g, respectively. All media contained detectable levels of technetium, but the highest concentrations were associated with unknown liquids, loose media, and sediment. Technetium-99 was detected in 136 components, with the highest solid media concentrations detected in the Process Buildings and the Ponds and Basins. In solid media, the maximum detected concentration of 13,000 pCi/g was found in loose media from the Rolling Mill (6A).

Figure 3-5 presents the volume of six solid materials containing technetium-99 concentrations that exceed baseline by media and component category. This figure shows contaminated concrete contributing 35 percent of the volume to the total contaminated volume of 1.1 million ft^3 above baseline. Acid brick constitutes another four percent of the volume above baseline. Excluding asphalt, the majority of material volume containing technetium-99 at concentrations above baseline levels (24 percent of the total volume) is located within the Process Buildings (Component Category 3).

3.4.2.3 Thorium

Thorium-230 was introduced to the FEMP in two different ways. Thorium-230 was a component of uranium ore and its residues. The FEMP handled uranium ore for a brief period of its early history. Uranium was extracted from this ore, and the remaining residues were stored in the Waste Storage Area, now known as OUs 1, 2, and 4. Thorium-230 contamination, attributable to ore processing operations, is expected in older areas of the site which housed the ore preparation and uranium

extraction operations. Thorium-230 was also introduced to the site by thorium fuel processing operations. Thorium-230 contamination attributable to fuel processing operations is expected in areas of the site that were associated with these operations. In addition, storage buildings in OU3 currently house containers of thorium.

Thorium-230 is a *more significant contaminant* for three reasons: 1) it is a Class A carcinogen; 2) its low allowable air concentration for occupational exposure may make it an occupational concern during remediation; and 3) it has been found throughout large areas of the site.

Thorium-230 results were reported for 743 samples from all solid and liquid media sampled within the confines of OU3. Thorium-230 was detected in 88 percent of the solid media samples. The arithmetic and geometric means of this sample population are 64.1 pCi/g and 3.9 pCi/g, respectively. All media contained detectable concentrations of thorium-230, and levels exceeded baseline concentrations in about 75 percent of the solid media sampled. The highest concentrations of thorium-230 were associated with unknown liquids, loose media, acid brick and steel coatings. Thorium-230 was detected in 134 components; the highest solid media concentrations were found in the Process Buildings (Component Category 3) and the Ponds and Basins (Component Category 11). The maximum detected concentration of 5,600 pCi/g was found in steel coatings from the Oil Centrifuge (8A).

Figure 3-6 presents the volume of six solid materials in OU3, by media and component category, containing thorium-230 concentrations exceeding baseline. This figure shows masonry contributing 34 percent of the contaminated volume to the total 1.1 million ft^3 above baseline. Concrete constitutes 29 percent of the volume above baseline. Excluding asphalt, the majority of the material volume containing thorium-230 above baseline levels (18 percent of the total volume) is located within the Process Building (Component Category 3).

3.4.2.4 Overview of Radiological Contamination in OU3

Figure 3-7 presents the volume of six solid materials in OU3, containing technetium, thorium-230, and/or uranium concentrations over their respective baseline levels, by media and component category. These three were selected for this presentation because they dominate all other radiological analytes investigated. This figure shows masonry contributing 33 percent of the contaminated volume to the total 1.1 million ft^3 above baseline. This percentage reflects the heavy influence of thorium-230 on the volume estimate (see Figure 3-6). Thorium-230 in masonry would contribute 30 percent of the

total volume even without the presence of uranium and technetium-99. Concrete constitutes 18 percent of the volume above baseline. Uranium and technetium-99 dominate the concrete volume estimates. This is especially evident in subsurface concrete within the Process Buildings. Excluding asphalt, the highest percent of the material volume containing at least one of these radioactive constituents in concentrations above baseline levels (20 percent of the total volume) is located within the Process Building (Component Category 3). Component Categories 1 and 4 (the Administrative/Support Buildings and the Process Support Buildings) contained the next two highest volumes, 15 percent and 9 percent, respectively.

Part of the purpose of the characterization study was to determine the vertical extent of contamination in concrete. This was the primary purpose in collecting concrete core samples from three depth intervals (0 - ½ inch, ½ - 1 inch, and greater than one inch) in areas where penetration was expected to occur (i.e., wet process areas). The volume of material shown on Figure 3-7 as exceeding baseline values appears to indicate that there is considerable contamination below the surface of concrete. This is for two reasons: first of all, the baseline value for concrete is relatively low compared to detected results. All detected results in the top ½-inch of concrete in the process area, and 93 percent of those in the second ½-inch, exceeded the baseline level. This indicates that 97 percent of the top 1-inch of concrete in sampled components in these buildings exceeds the baseline.

Secondly, all concrete is assumed to be eight inches thick (see Appendix B for further details). Any contamination below a depth of one inch is assumed to be representative of the contamination to a depth of four inches (the depth below four inches is assumed to be at the baseline concentration - see Attachment A.III for justification and Appendix B for further details). The fact that this volume of concrete is eight times the volume in the top ½-inch indicates that, unless there is an eight-fold decrease in the level of contamination between the top ½-inch (or the second ½-inch) and the next four inches, the volume of concrete exceeding baseline will increase with depth.

Detailed data are presented in Attachment A.III, and discussed in Appendix A, regarding the vertical extent of contamination in concrete. These data, combined with historical knowledge of the concrete pads and floors in OU3, suggest that contamination in most of the concrete within OU3 production areas will decrease with depth. However, the results can be unpredictable for some of the concrete from near cracks, in production areas where more soluble forms of contaminants were used, and in areas where construction modifications have been made (such as repaving a pad).

3.4.3 Summary of More Significant Inorganic COCs

As described in Appendix A.2.4, several inorganic chemicals were used at the FEMP and are therefore expected contaminants in OU3. Based on this knowledge, 643 major media samples and 85 supplemental media samples were analyzed for 23 inorganic contaminants. Based on these results, 16 inorganics have been identified as COCs in OU3 (see Appendix A.3). As described in the following sections and detailed in Appendix A.4, five inorganics (barium, cadmium, chromium, lead, and mercury) are considered *more significant* in comparison to the others. The following sections describe the expected source of each of these COCs, summarize the occurrence of each in OU3, and discuss the reasons each is considered more significant. A detailed description of the expected and actual occurrence of all 23 inorganics for which analyses were performed is provided in Attachment A.II, and an intermediate summary level of the COCs in presented in Appendix A.4.

3.4.3.1 Barium

Barium is expected in OU3 primarily because it is a trace constituent in concrete (barium is often found with limestone, a component of concrete). Furthermore, barium sulfate was used as an additive in paint to improve its covering characteristics and as a pigment in white paint; barium carbonate was used in thorium extractions in the Pilot Plant; barium chloride used in heat treating operations at an off-site facility was received and converted to barium sulfate to stabilize it in the Pilot Plant; and barium compounds were involved in operations at the Preparation Plant (1A), the Graphite Furnace and Oil Burner (10D), the Coal Pile (P-005), and the Laboratory (15A). The occurrence of barium at the FEMP is expected to be widespread at relatively low concentrations associated with concrete; widespread at higher concentrations associated with paint (much of the structural steel from which steel coatings were taken are grey, and therefore contain white pigment); and in isolated areas at elevated concentrations in most media in those components where it was used in the process.

Barium is a COC because five percent of the detected results exceeded the Part B Soil Screening Level, indicating a potential concern with direct contact. Barium is considered *more significant* compared to most other inorganic COCs because 33 samples (including some in major media) exceeded 20 times the TCLP limit.

Barium was detected in 98 percent of the samples of solid media, with concentrations ranging from 3.3 to 23,700 mg/kg (geometric mean of 109 mg/kg). Barium was detected in all sampled media and at the highest, and most consistently high, concentrations in a steel coatings (paint). Barium was detected in all 135 components in which samples were taken for analysis of inorganics. It was

detected most often in process buildings (Recovery Plant [8A], Special Products Plant [9A], Pilot Plant Wet Side [13A], and Six to Four Reduction Facility #1 [54A]), but at consistently high concentrations in many components.

Concentrations of barium in 33 samples exceeded 20 times the TCLP limit (2000 mg/kg) and are therefore potentially hazardous. These 33 samples include 24 steel coating samples, five concrete samples, two loose media samples, one masonry sample, and one sediment sample. However, based on TCLP results, as discussed in Appendix A.III.2.6.2, no painted material is considered hazardous.

Figure 3-8 presents the volume of material associated with samples exceeding 20 times the TCLP limit for barium (2000 mg/kg) by media type and component category. This figure indicates that all of the material considered potentially hazardous for barium is in the Process Buildings (Category 3) and that 87 percent of the volume of this material is masonry.

3.4.3.2 Cadmium

Cadmium is expected within OU3 primarily because it is a trace constituent in concrete, it is used as a yellow pigment in paint, and it was a minor impurity in uranium ores and ore concentrates used at the FEMP. Therefore, the occurrence of cadmium at the FEMP is expected to be widespread at relatively low concentrations in association with concrete; widespread at higher concentrations associated with paint; and in isolated areas at slightly elevated levels (up to 350 mg/kg) in most media in uranium processing facilities.

Cadmium is a COC because 20 percent of the detected results exceeded the Part B Soil Screening Level, indicating a potential concern with direct contact. Cadmium is considered *more significant* compared to most other inorganic COCs because 44 samples (including some in major media) exceeded 20 times the TCLP limit.

Cadmium was detected in 42 percent of the solid media samples, with concentrations ranging from 0.11 to 558 mg/kg (median of 1.2 mg/kg). Cadmium was detected in all sampled media, except asphalt, and at the highest, and most consistently high, concentrations in steel coatings (paint). It was detected in 86 of the 135 components from which samples were taken for analysis of inorganics.

Concentrations of cadmium in 44 samples exceeded 20 times the TCLP limit (20 mg/kg) and are therefore potentially hazardous. These 44 samples include 37 steel coatings samples, four loose

media samples, one concrete chip sample, one masonry sample, and one sediment sample. However, based on TCLP results, as discussed in Appendix A.III.2.6.2, no painted material in OU3 is considered hazardous.

Figure 3-9 presents the volume of material associated with samples exceeding 20 times the TCLP limit for cadmium (20 mg/kg) by media type and component category. This figure indicates that 98 percent of the material considered potentially hazardous for cadmium is in the Administrative and Support Buildings (Component Category 1) and the remainder is in the Process Buildings (Component Category 3). Approximately 89 percent of the volume of material considered potentially hazardous for cadmium is masonry.

3.4.3.3 Chromium

Chromium is expected within OU3 for the following reasons: because it is a trace constituent in concrete, it is used as a pigment in paints, it was used as a biocide in the treatment of cooling tower water at the FEMP, it is a major constituent in stainless steel, and it was a minor impurity in uranium ores and ore concentrates used at the FEMP. Therefore, the occurrence of cadmium is expected to be widespread at relatively low concentrations associated with concrete; widespread at elevated concentrations associated with paints; and in isolated areas at slightly elevated levels (up to 2250 mg/kg) in most media in uranium processing facilities.

Chromium is a COC because 24 percent of all results exceeded the Part B Soil Screening Level, indicating a potential concern with direct contact. Chromium is considered *more significant* compared to most other inorganic COCs because 175 samples (including some in major media) exceeded 20 times the TCLP limit.

Chromium was detected in 89 percent of solid media samples collected from OU3, with concentrations ranging from 1 to 17,300 mg/kg (geometric mean of 35 mg/kg). Chromium was detected in all sampled media, with the highest levels in steel coatings (paint). Concentrations of chromium in 175 samples exceeded 20 times the TCLP limit (100 mg/kg) (or exceeded the actual limit in the TCLP leachate of transite samples) and are therefore potentially (or actually) hazardous. These 175 included 123 steel coatings, 21 loose media, ten sediment, eight concrete core, five concrete chip, four acid brick, one masonry, one air filter, one transite, and one wood sample. However, based on TCLP results, as discussed in Appendix A.III.2.6.2, no painted material is considered hazardous.

Figure 3-10 presents the volume of material associated with samples exceeding 20 times the TCLP limit for chromium (100 mg/kg) by media type and component category. This figure indicates that 89 percent of the material considered potentially hazardous for chromium is in the Administrative and Support Buildings (Component Category 1) and the remainder is in the Process Buildings (Component Category 3). Nearly 90 percent of the volume of material considered potentially hazardous for chromium is masonry.

3.4.3.4 Lead

Lead is expected in OU3 because it is a trace constituent in concrete, lead dioxide is used in storage batteries used throughout the site, it has been used extensively in paints, and it was an impurity in uranium ores and ore concentrates used at the FEMP. Therefore, the occurrence of lead is expected to be widespread at relatively low concentrations associated with concrete; widespread at elevated concentrations associated with paints in general (lead-based paints were used extensively at the FEMP though the early 1990s) and in yellow paint more particularly; and in isolated areas at elevated levels (up to 239,000 mg/kg) in most media in uranium processing facilities.

There is no Part Screening Level for lead. However, it is a COC and considered *more significant* compared to most other inorganic COCs because 247 samples (including some in major media) exceeded 20 times the TCLP limit.

Lead was detected in 90 percent of solid media samples collected from OU3, with concentrations ranging from 0.54 to 375,000 mg/kg (geometric mean of 77.3 mg/kg). Lead was detected in all sampled media. It was detected most often, at the highest levels, and at the most consistently high levels in steel coatings (paint). It was detected in all 135 components in which samples were collected for analysis of inorganics.

Concentrations of lead in 247 samples exceeded 20 times the TCLP limit and are therefore potentially hazardous. These 247 samples were comprised of 131 steel coatings samples, 34 loose media, 23 masonry, 21 concrete core, 20 sediment, 13 concrete chip, and five acid brick samples. However, based on TCLP results, as discussed in Appendix A.III.2.6.2, no painted material is considered hazardous.

Figure 3-11 presents the volume of material associated with samples exceeding 20 times the TCLP limit for lead (100 mg/kg) by media type and component category. This indicates that 84 percent of

the material considered potentially hazardous for lead is in the Process Buildings (Component Category 3). Over 37 percent of the volume of material considered potentially hazardous for lead is acid brick, 26 percent is in the top ½-inch of concrete, and 20 percent is in masonry.

3.4.3.5 Mercury

Mercury is expected in OU3 primarily because it is a trace constituent in concrete, mercuric sulfide is used as a pigment in paints, and it was used in the dissolution of alloys in Plant 2/3, as well as in the Laboratory. Therefore, the occurrence of mercury is expected to be widespread at relatively low levels associated with concrete, widespread at higher concentrations associated with paint, and in isolated areas at elevated levels in most media in uranium processing facilities where it was used.

Mercury is a COC because ten percent of all samples exceeded the Part B Soil Screening Level, indicating a potential concern with direct contact. It is considered *more significant* compared to most other inorganic COCs because 50 samples (including some from major media) exceeded 20 times the TCLP limit.

Mercury was detected in 42 percent of solid media samples collected from OU3, with concentrations ranging from 0.024 to 223 mg/kg (median of 0.1 mg/kg). Mercury was detected in all sampled media, except asphalt and soil, and at the highest level in sediment, but at the most consistently high levels in steel coatings. It was detected in 74 of the 135 components in which samples were collected for analysis of inorganics. It was detected most often in Process and Support Buildings (Recovery Plant [8A], Main Maintenance Building [12A] and Pilot Plant Wet Side [13A]), but at consistently high levels in several components.

Concentrations of mercury in 50 samples exceeded 20 times the TCLP limit and are therefore potentially hazardous. These 50 samples include 32 steel coatings samples, five loose media samples, six sediment samples, two masonry samples, two acid brick samples, one concrete core sample, and two concrete chip samples. However, based on TCLP results, as discussed in Appendix A.III.2.6.2, no painted material is considered hazardous.

Figure 3-12 presents the volume of material associated with samples exceeding 20 times the TCLP limit for mercury (4 mg/kg) by media type and component category. This figure indicates that all of the material considered potentially hazardous for mercury is in the Process Support Buildings (Component Category 4). Nearly 47 percent of the volume of material considered potentially

hazardous for mercury is masonry; the remainder is divided approximately equally between acid brick and the top two depth intervals (0 - ½ inch and ½ - 1 inch) in concrete cores.

3.4.4 Summary of Key Semivolatile Organic Constituents of Concern

As described in Appendix A.2.4, semivolatile organic compounds were used at the FEMP and are therefore expected contaminants in OU3. Based on this knowledge, 20 major media samples and 159 supplemental media samples were analyzed for a total of 66 semivolatile organics. Based on these results, 15 semivolatiles have been identified as COCs in OU3 (see Appendix A.3). As described in the following sections and detailed in Appendix A.5, three semivolatiles -- 1,4-dichlorobenzene, hexachlorobutadiene, and nitrobenzene -- are considered *more significant* in comparison to the other semivolatile COCs. The following sections describe the expected source of these at the FEMP, if known, and summarize their occurrence. Note that most of the semivolatile compounds were used in various materials throughout the FEMP. Therefore, in most cases, their exact source and use are not known and therefore are not included in the discussions below.

A detailed description of the expected and actual occurrence of all 66 semivolatiles for which analyses were performed is provided in Attachment A.II.

3.4.4.1 1,4-Dichlorobenzene

1,4-Dichlorobenzene may have been a constituent in cutting and cooling oils used in the machining of uranium metal at the FEMP.

1,4-Dichlorobenzene is a COC because two results exceeded the Part B Soil Screening Level, indicating a potential concern with direct contact. It is considered *more significant* than most other semivolatile COCs because one result in major media exceeded the TCLP limit, indicating that the material is characteristically hazardous.

1,4-Dichlorobenzene was detected in only 2 of 112 solid media samples. It was detected in a loose media sample collected from the Green Salt Plant (4A) at a concentration of 39,000 μg/kg, well below 20 times the TCLP limit of 150,000. It was also detected in the TCLP leachate from a transite sample at 17.2 mg/L, exceeding the TCLP limit of 7.5 mg/L. The transite sample was collected from the Uranium Machining Area of the Special Products Plant (9A).

Note that because the volume of material associated with these samples is relatively small, a graph depicting the volume by media type and component category has not been included.

3.4.4.2 Hexachlorobutadiene

Hexachlorobutadiene may have been a constituent in cutting and cooling oils used in the machining of uranium metal at the FEMP.

Hexachlorobutadiene is a COC because one detected result exceeded the Part B Soil Screening Level, indicating a potential concern with direct contact. It is considered *more significant* than most other semivolatile COCs because the detected concentration exceeded the TCLP limit, indicating that the material is characteristically hazardous.

Hexachlorobutadiene was detected in only 1 of 102 solid media samples, with a concentration in the TCLP leachate of 14.9 mg/L, exceeding the TCLP limit of 5.0 mg/L. This transite sample was collected from the Uranium Machining Area of the Special Products Plant (9A).

Note that because the volume of material associated with this sample is relatively small, a graph depicting the volume by media type and component category has not been included.

3.4.4.3 Nitrobenzene

Nitrobenzene may have been a constituent in cutting and cooling oils used in the machining of uranium metal at the FEMP.

Nitrobenzene is a COC because one detected result exceeded the Part B Soil Screening Level, indicating a potential concern with direct contact. It is considered *more significant* compared to most other semivolatile COCs because its concentration in one major media sample exceeded the TCLP limit, indicating that the material is characteristically hazardous.

Nitrobenzene was detected in only 2 of 113 solid media samples. It was detected in a sediment sample collected from the BDN Surge Lagoon (18A) at a concentration of 140 μg/kg, well below 20 times the TCLP limit of 40,000 μg/kg. It was also detected in the TCLP leachate from a transite sample at a concentration of 28.3 mg/L, exceeding the TCLP limit of 20 mg/L. This transite sample was collected from the Uranium Machining Area of the Special Products Plant (9A).

Note that, because the volume of material associated with these samples is relatively small, a graph depicting the volume by media type and component category has not been included.

3.4.5 Summary of Key Volatile Organic Constituents of Concern

As described in Appendix A.2.2, volatile organic compounds were used at the FEMP and are therefore expected contaminants in OU3. Based on this knowledge, 35 major media samples and 160 supplemental media samples were analyzed for a total of 33 volatile organics. Based on these results, three volatiles have been identified as COCs in OU3 (see Appendix A.3). As discussed in the following sections and detailed in Appendix A.5, tetrachloroethene is considered *more significant* compared to the other volatile COCs. The following section describes the expected source of tetrachloroethene at the FEMP and summarizes its occurrence.

A detailed description of the expected and actual occurrence of all 33 volatiles for which analyses were performed is provided in Attachment A.II.

3.4.5.1 Tetrachloroethene

Tetrachloroethene is expected in OU3 because it was used in degreasing operations at the FEMP as well as a coolant in the Pilot Plant Remelt Furnace (13A).

Tetrachloroethene is a COC because one detected result exceeded the Part B Screening Level, indicating a potential concern with direct contact. It is considered *more significant* compared to the other volatile COCs because that same result exceeded the TCLP limit, indicating that the material is characteristically hazardous.

Tetrachloroethene was detected in 15 of 125 samples of solid media samples, with concentrations ranging from 1.0 to 1,180,000 μg/kg (geometric mean of 82 μg/kg). Six of the detected results were in loose media, seven in concrete, one in acid brick, and two in transite. For these statistics, the transite results were obtained by multiplying the actual TCLP result by 20 (to account for the dilution effect of the TCLP test - see Appendix A.3 for further details).

Tetrachloroethene was detected in the TCLP leachate from the transite samples at a concentration of 59 mg/L, exceeding the TCLP limit of 7.0 mg/L. This transite sample was collected from the Digestion Area of the Ore Refinery (2A).

Figure 3-13 presents the volume of material associated with samples exceeding the TCLP limit for tetrachloroethene (700 μg/kg) by media type and component category. This figure indicates, as described in the preceding paragraph, that all of the material considered potentially hazardous for tetrachloroethene is in the Process Buildings (Component Category 3) and associated with transite.

3.4.6 Summary of Pesticide/PCB COCs

As described in Appendix A.2.2, pesticides and PCBs were used at the FEMP and are therefore expected contaminants in OU3. However, they are expected to be limited in both level and abundance. Based on this knowledge, 22 major media samples and 16 supplemental media samples were analyzed for pesticides/PCBs. Based on these results, three pesticides and two PCBs have been identified as COCs in OU3.

Of the 28 pesticide/PCB contaminants for which analyses were performed, 16 were detected. Twenty seven of the samples analyzed for pesticides/PCBs exceeded the Part B Soil Screening Levels. However, none of the samples exceeded 20 times the TCLP limit. Also, none of the samples analyzed exceeded the 50 ppm TSCA limit for PCBs (40 CFR 761). Therefore, none of the pesticides/PCBs are considered *more significant* in terms of the overall types and levels of contaminants present in OU3.

A detailed description of the expected and actual occurrence of all 28 pesticides/PCBs for which analyses were performed is provided in Attachment A.II.

3.4.7 Overview of Chemical Contamination in OU3

Figure 3-14 presents the volume of material in OU3 considered potentially hazardous, as described in the preceding sections. Note that all more significant contaminants described in the preceding sections, including the semivolatiles for which individual figures were not presented in the preceding sections, have been included. A total of approximately 43,000 cubic feet of material within OU3 is considered potentially hazardous because of inorganic and organic contamination. In reality, this material is mixed waste since it contains radiological contamination in excess of baseline levels. This conservative estimate is based on actual sampling results applied widely to materials not sampled, and does not represent the result if truly representative samples had been collected (see Appendix A.II). As discussed in Section 2, samples were collected from the location of highest chemical and radiological contamination in a process area/component. These samples are assumed to be representative of the entire process area/component from which they were collected. The implication

of this assumption is that, if the concentration of a particular contaminant in a sample from the top ½-inch of concrete in a particular process area/component exceeded 20 times the TCLP limit, the top ½-inch of all concrete in that process area/component is assumed to exceed 20 times the TCLP limit. This assumption does not consider the high probability of reduced levels of contamination elsewhere in the top ½-inch of concrete in that process area/component or at lower depths, both of which possibilities would be accounted for if truly representative samples were collected.

The total volume considered hazardous (43,000 cubic feet) is based on the characterization study. Note that this volume is smaller than indicated on Table 3-19, which includes the application of sampling results to media which was not sampled (see Section 3.5.1). This difference is indicative of the conservatism of applying the assumptions described in Section 3.5

Figure 3-14 indicates that 73 percent of the volume of potentially hazardous material in OU3 is in the Process Buildings (Component Category 3), with approximately 14 and 11 percent in the Administrative and Support Buildings (Component Category 1), and Process Support Buildings (Component Category 4), respectively. Approximately 72 percent of this material is divided approximately equally between acid brick, masonry and transite, 17 percent is the top ½-inch of concrete and 11 percent the second ½-inch depth interval.

3.4.8 Overview of Contamination in OU3

As discussed in Sections 3.4.2.4 and 3.4.7, the most significant radiological and chemical contamination in OU3 is associated with the Process Buildings (Component Category 3). Figure 3-15 presents the volume of six solid materials in the Process Building category containing technetium, thorium-230, and/or uranium concentrations over their respective baseline levels by media and component. These three were selected for this presentation because they dominate all other radiological analytes investigated in this category (see Section 3.4.2).

Six components contribute 74 percent of the total volume identified as having concentrations of technetium, thorium-230, and/or uranium concentrations that exceed their respective baselines: the Ore Refinery Plant (2A), the Metals Production Plant (5A), the Metals Fabrication Plant (6A), the Special Products Plant (9A), the Pilot Wet Side (13A), and the Laboratory (15A). This figure identifies masonry from the Metals Fabrication Plant (6A) and the Laboratory (15A) contributing 16 percent and 11 percent, respectively, of the volume from the entire category. These two sources represent the two single largest contributions from one medium in a single component. Combined,

they contribute 59 percent of the contaminated volume to the total 1.1 million ft^3 above baseline. The volume reflects the numbers and locations of thorium-230 samples in the process buildings, as well as the concentrations of thorium-230 in those samples. Concrete constitutes 42 percent of the total volume projection, making it the second highest contributor to the category "volume exceeding radiological baselines." Uranium and technetium-99 both influence the concrete volume estimates.

Figure 3-16 presents the volume of the six media types which contain hazardous contaminants on excess of 20 times the TCLP limit. Contaminants include barium, cadmium, chromium, lead, mercury, 1,4-dichlorobenzene, hexachlorobutadiene, nitrobenzene, and tetrachloroethene, as described in Section 3.4.3. Note that steel coatings have not been included in this figure, but have been included in Figure 3-15 because no painted material is expected to be characteristically hazardous (see Attachment A.III). In addition, transite has been included in Figure 3-16, but not Figure 3-15, because there were no radiological results obtained for transite, although it is assumed to be radiologically contaminated. Note also that the volumes shown on this figure include those for materials in process areas/components for which either no sampling was performed or the sampling results were rejected and therefore results from another process area/component have been used for characterization. As an example, organic contaminants were detected in excess of the TCLP limit in the leachate from only three components. As shown on the figure, transite in ten components is assumed to contain organic contamination exceeding the TCLP limit. No transite samples were collected from the other seven components; therefore the maximum result from components in the same component category (i.e., the Process Buildings) was used to characterize the contamination in the transite in those other components.

Figure 3-16 indicates that more than 70 percent of the potentially hazardous material in the Process Buildings is associated with three components: the Ore Refinery Plant (2A), the Metals Fabrication Plant (6A), and the Special Products Plant (9A). These were the major production facilities at the FEMP and, as described above, are included in those components that significantly exceed baseline levels. Acid brick and transite each contribute approximately 32 percent to the total volume considered potentially hazardous. These are followed by the top and second ½-inch of concrete, which contribute 18 and 11 percent, respectively.

3.5 CONTAMINANT SOURCE TERM ESTIMATES

For the purposes of this document, source term is defined as the estimated mass of a contaminant present in and on a material. This estimated contaminant mass is the product of material mass and

the concentration of a contaminant on or in that material. A source term estimate is needed for each of the 74 materials (67 construction materials, known as material descriptions, and 7 types of inventory materials - see Attachment A.IV) defined in OU3. This process is more complex than source term estimates for environmental media, such as soil, because of the large number of different types of material in OU3 and since many of these materials require individual strategies for representation. The methodology used to develop the OU3 source term is based on assumptions and process knowledge for each of the OU3 materials. Knowledge of the weight or volume of the material evaluated and the contaminant concentrations in that media is required to determine contaminant mass. Detailed information regarding OU3 components was developed and entered into the SWIFTS for use in the RI/FS and remedial design/remedial action (RD/RA) processes. In addition to estimated weights and volumes of materials from SWIFTS, estimated weights and volumes of paint, corrosion/rust/undefined debris (CRUD), and holdup materials were developed from assumptions, discussed in Appendix B, and were added to original SWIFTS weights and volumes. These data, coupled with characterization analytical results, support preparation of source terms for each of the OU3 COCs.

The following sections describe this somewhat complicated and involved process.

3.5.1 Central Strategy

The overall strategy for developing the source terms, detailed in Appendix B (Figure B.1-1) consists of six steps:

1. Development of material data (SWIFTS);
2. Application of material-related assumptions to determine contaminated weights;
3. Estimation of additional coatings or layers;
4. Development and application of analytical data based on application of data-related assumptions;
5. Calculation of source term estimates by application of analytical results to contaminated weights.
6. Segregation of contaminated material into material categories.

Twelve OU3 media (concrete, masonry, steel coatings, asphalt, acid brick, transite, wood, loose media, sediment, sludge, liquids, and HVAC filters) were sampled as part of the RI/FS characterization study. Seven of these (concrete, masonry, steel coatings, asphalt, acid brick, transite, and wood) were used to develop the source terms. The remaining media were not used for two reasons: they do not represent the general character of contamination in OU3, because they are

isolated pockets of accumulated debris, although they are used to support the characterization; and because they are no part of the OU3 RI/FS decision-making process (see Section 1). These seven media constitute approximately 97 percent of the total weight of all OU3 materials. Analytical results from these materials were then extrapolated to similar OU3 materials (such as drywall, floor tile, etc.) that were not sampled. The extrapolation was based on material similarity and expected contamination similarity (process knowledge).

3.5.2 General Assumptions

The following is a summary of the primary assumptions developed and applied in determination source term. Detailed discussion of these assumptions is provided in Appendix B.

3.5.2.1 Metals

- A paint thickness of 10 mils (0.010 inch) was used as a conservative estimate of the thickness of all painted material.
- A thickness of five mil is used as an estimate of the thickness of all external dust on ductwork, piping, and equipment. Ductwork is assumed to have a 10 mil dust layer on the interior surface. Radiological contaminants in this dust are represented by paint sample results in adjacent sampled materials.
- Process piping and process equipment are assumed to have a layer of CRUD on the interior. CRUD is formed within process piping and process equipment over time from the general action of corrosion. Process piping is assumed to contain one percent of the interior volume as CRUD, whereas process equipment is assumed to contain one tenth percent of the interior volume as CRUD.
- Process piping and process equipment are assumed to have a layer of holdup. Holdup is defined as the material, primarily assumed to consist of uranyl nitrate hexahydrate (UNH) which remains after production ceased and has crystallized into a solid/semisolid mass. UNH is composed of 43 percent uranium; enrichment is not considered. Process piping is assumed to contain ten percent of the interior volume as holdup, whereas, process equipment assumed to contain one percent of the interior volume as holdup.

3.5.2.2 Analytical Result Assumption

There are 96 components that were not sampled as part of the RI/FS characterization study since they were not considered contaminated. Baseline values (see Section 3.3.1) were applied to materials located within the components not sampled.

3.5.3 Material Weights and Volumes

Estimated weights and volumes of OU3 construction materials, as documented in the SWIFTS database and reported in the 1995 OU3 Estimated Materials Quantity Report (DOE 1995c), are summarized in Table 3-2. Weights and volumes by material description, component, and where applicable, process area, were copied from SWIFTS into an ORACLE database table specific to OU3. The ORACLE database table was developed to:

- Provide an unchanging record for each volume and weight of material in SWIFTS.
- Establish the link between material described in SWIFTS and analytical results from material sampled during the OU3 RI/FS characterization program and documented in the Sitewide Environmental Database (SED); and
- Calculate the weight of contaminated material from the total weight of each material, based on assumptions discussed in Appendix B.2.3.

Three different approaches were used to calculate the weight of contaminated material based on the requirement of each of the 67 construction material descriptions; weight-based, volume-based, and takeoff-quantity-based (measured quantity from drawings or blueprints). Examples of calculations used in determination of the contaminated weights for each material are contained in Appendix B.2.4.

3.5.4 Contaminant Source Term by Analyte

This section summarizes the contaminant source terms within OU3 by COCs which have a high frequency of detection and/or are important in terms of potential risk. The COCs are grouped by analyte fraction: radionuclides, inorganics, and organics. A characterization of the source term by analytical fraction for all COCs is found in Appendix B (Volume 3). Table B-10 provides the contaminant source term estimates for each individual COC.

3.5.4.1 Radionuclides

Total uranium with 10,800,000 kg has the greatest amount of contaminant mass associated with it. Sixty-nine percent of this mass (7,503,000 kg) is associated with containerized waste inventory materials and will be dispositioned separately. Of the remaining 31 percent, 30 percent is associated with UNH holdup within process piping and equipment. Uranium-238 (90,700 kg), uranium-235/236 (958 kg), and uranium 233/234 (nearly 15 kg) have associated source terms which are also significant.

Thorium-232 (4,320 kg) is the only non-uranium analyte that has a source term greater than 1 kg, with technetium-99 at 0.127 kg and neptunium-237 at 0.069 kg. The presence of a high contaminant mass for uranium, uranium isotopes, and thorium, is expected since the FEMP processed more than 180,000 metric tons of uranium products during the years of production. The contaminant mass associated with technetium-99 is significant as discussed in Appendix A. Technetium-99 is also relatively soluble and is easily transported through water. This characteristic makes technetium-99 a concern for both risk and determination of possible disposition options. For these reasons, total uranium and technetium-99 are discussed in greater detail than other COCs in the following sections.

3.5.4.1.1 Elemental Uranium Source Term

The mass of total uranium at the site is associated with two major sources: inventory (including uranium product, thorium, RCRA, non-RCRA, and uncharacterized wastes - see Appendix A.IV) These materials are the major source of the total uranium contaminant mass and represent 7,510,000 kg or 69 percent of the total source term for total uranium. This material is inventoried containerized waste which is dispositioned separately. UNH associated with process piping or equipment (3,270,000 kg or 28 percent of the total source term for uranium).

Concrete materials (35,400 kg) were next, followed by paint (2,230 kg), asphalt (2,570 kg), CRUD (2,707 kg), dust, (1,390 kg) masonry (365 kg), acid brick (5,360 kg) and wood (12.4 kg). Components in which the contaminant mass for total uranium was highest are: the Plant One Storage Pad-74T (7,560 kg), the Special Products Building-9A (219,000 kg), and the Metal Fabrications Plant-6A (504,000 kg), correlating well with components where technetium-99 was also noted. As would be expected, most of the source term for total uranium is located in component Category 3, the process buildings. Table 3-10 summarizes the source term for total uranium by material category and component category.

The presence of a high contaminant mass for uranium, uranium isotopes, and thorium is expected since the FEMP processed more than 180,000 metric tons of uranium products during its years of production. The contaminant mass associated with technetium-99 is significant, as discussed in Appendix A. Technetium-99 is water soluble and is easily transported through water. This characteristic makes technetium-99 a major concern regarding both risk and determination of possible disposition options. For these reasons, total uranium and technetium-99 are discussed in greater detail.

3.5.4.1.2 Technetium-99 Source Term

The contaminant mass for technetium-99 is associated with concrete (0.098 kg), in particular concrete slabs (0.094 kg): collectively, masonry (0.30003 kg); acid brick (0.008 kg); asphalt (0.005 kg); paint (0.005 kg); CRUD (0.003 kg); and dust (0.01 kg) contribute about one percent to the total technetium-99 source term. Finally, wood (1.04×10^{-5} kg) and the soil piles (2.50×10^{-6} kg) contribute less than one percent of the contaminant mass associated with technetium-99. The source term for technetium-99, 0.127 kg, drops to 0.125 kg when Material Category J is excluded.

Most of the technetium-99 contaminant mass is located in the following components: the Special Products Plant - 9A (0.058 kg), the Plant One Storage Pad - 74T (0.015 kg) and the Recovery Plant - 8A (0.007 kg). A complete accounting of the technetium-99 source term by component is presented in Table 3-11. As discussed in Appendix A, the Special Products Plant (9A), Plant One Storage Pad (74T), and the Recovery Plant (8A) are all either process-related buildings or storage areas where process-related materials were stored. The source term by material category and component category is provided in Table B-13. Most technetium-99 is associated with the process and process support buildings, with the exception of the Plant One Storage Pad, which is in Component Category 8.

3.5.4.1.3 Thorium-230 Source Term

As discussed in Section 3.4.2.3, thorium-230 is of major concern in OU3 because it is a Class A carcinogen. The source term for thorium-230 (0.14 kg) is, as expected, mainly associated with concrete (0.033 kg). The source term for total thorium (800,000 kg) is associated with inventory (as described under elemental uranium above) in material category J. As presented in Table 3-12, the source term for thorium-232 (43,000 kg) is again associated predominantly with concrete materials (3533 kg).

3.5.4.2 Inorganics

Chromium (2,470,000 kg), nickel (1,730,000 kg), manganese (863,000 kg), and copper (182,000 kg) have the highest source terms, which are generally associated with the normal constituents of carbon and stainless steel present at the FEMP. Ninety percent of the source term is associated with carbon and stainless steel; the remaining five percent is associated with contamination from on-property activities (one percent), and the associated paint layer on painted materials (four percent). Carbon and stainless steel contain chromium, copper, manganese, and nickel as normal constituents, and are considered in the calculation of source terms to provide a complete accounting of OU3 materials but are not considered contaminants. Source term values for the RCRA metals, lead (101,000 kg),

barium (25,000 kg), silver (3000 kg), arsenic (2,100 kg), cadmium (770 kg), beryllium (400 kg), and mercury (28 kg), have a wide range and are primarily associated with contamination from the production processes. Inorganics in general are present at some level throughout the process and process-related components.

3.5.4.2.1 Barium Source Term

As shown in Table 3-13, the majority of the source term for barium (24,000 kg) is associated with concrete (17,000 kg). The remaining source term is distributed among: painted metals (2100 kg), asphalt (1180 kg), and acid brick (755 kg).

3.5.4.2.2 Cadmium Source Term

As shown in Table 3-14, 58 percent of the source term for cadmium (756 kg) is associated with concrete (440 kg). Thirty-two percent and 3 percent of the remaining source term is associated with asphalt (245 kg) and acid brick (25 kg), respectively.

3.5.4.2.3 Chromium Source Term

As discussed previously, most of the chromium source term is associated with stainless and carbon steel metals and is not considered contaminated. Table 3-15, presents the source term for chromium by material category. If metal and paint are excluded, the source term for chromium in concrete is still significant at 31,890 kg.

3.5.4.2.4 Lead Source Term

As shown in Table 3-16, the majority of the source term for lead (100,000 kg) is associated with painted metals (79,000 kg). The majority of the remaining source term for lead is associated with CRUD and dust (approximately 1600 kg), which is part of material category J.

3.5.4.2.5 Mercury Source Term

As shown in Table 3-17, the source term for mercury (28 kg) is associated with concrete materials in material category E (16 kg). The remaining source term is associated with metals with insignificant amounts found throughout the other materials.

3.5.4.3 Organics

Less than one percent of the contaminant mass estimated for OU3 materials comes from organics; thus, the overall contribution of organics to the source term is small. Organics were mainly

determined to be COCs based on analytical results from supplemental media (loose media, sediment, sludge, soil and unknown liquids) not considered in the source term (see Appendix B). Because of the insignificant amount of source term contribution from organics, only one organic (nitrobenzene) is presented in the attached tables.

3.5.4.3.1 Semivolatile Organic Source Term

The semivolatile organic analytes (SVOCs) with the most significant contaminant mass are nitrobenzene (155 kg), 1,4-dichlorobenzene (94 kg), and hexachlorobutadiene (82 kg), associated with transite in material category G (Non-regulated ACM materials). The summary of the source term for nitrobenzene by material category is presented in Table 3-18. The source term for all other semivolatiles were also associated with transite, concrete, and acid brick, but in insignificant amounts.

3.5.4.3.2 Volatile Organic Source Term

Tetrachloroethene (350 kg) accounted for the majority of the volatile organic source term, associated with transite in material Category G (Non-regulated ACM materials). As in semivolatiles, the source term for all other volatiles were associated with transite, concrete, and acid brick, but in insignificant amounts.

3.5.4.3.3 Pesticides/PCBs Source Terms

The pesticides/PCBs with the most significant source terms are Aroclor-1254 (16.7 kg) and Aroclor (10.5 kg). Pesticides/PCBs were associated with concrete, but overall the source term is less than one percent of the total mass associated with OU3 materials.

3.5.5 Material Quantities by Segregation Category

3.5.5.1 Definition of Segregation Categories

Categories have been established to facilitate the disposition of materials generated as a result of the interim remedial action. The segregation of materials by regulatory criteria sets the framework to develop and evaluate alternatives based on disposition and treatment options. Five categories were used to segregate OU3 materials: hazardous waste, mixed waste, low level waste (LLW), PCB waste, and below baseline material.

Hazardous waste is defined by the concentration of RCRA metals or organics present in a material. The first determination in the segregation process is if a result is greater than 20 times the TCLP limit

(or the limit itself for transite) for any of the RCRA constituents, the associated material is considered hazardous. (See Section 3.3.4 for a discussion of 20 times the TCLP criteria.)

Next, any result above the baseline value for a radiological constituent places the material in the LLW category. Table B-9 provides a listing of baseline values by media, with baseline values for elemental uranium and technetium-99 in concrete being 12.55 ug/g and 0.4 pCi/g, respectively.

Materials for which there is any single result greater than or equal to 20 times the TCLP limit with any single result above a baseline value is considered a mixed waste.

Any material for which there are PCB results, such as transformers, are considered PCB waste under TSCA. Transformers are considered PCB contaminated even after removal of PCB containing materials.

All results which are at or below radiological baseline values, and are not greater than 20 times the TCLP for a RCRA constituent are considered below baseline. These materials are considered to be uncontaminated.

3.5.5.2 Administrative Segregation of Materials

No painted material in OU3 is considered characteristically hazardous as a result of being painted with lead-based paint. This characterization of painted materials is supported by a study conducted at the FEMP DOE (1995b) to evaluate the leachability of lead-based paint on painted light-gauge metal (Appendix G). However, any paint that is removed from any surface will be considered characteristically hazardous waste unless actual TCLP results indicate otherwise. This conclusion is extended to the other toxicity characteristic (TC) metals because the maximum concentration for lead was so much higher than the maximum concentration for any of the other seven TC metals (375,000 mg/kg in lead vs 17,500 mg/kg in chromium, or 558 mg/kg for cadmium); thus, painted materials are only categorized as either LLW or below baseline.

Materials such as lead flashing, basin liners, and PPE were not sampled but are known from process knowledge to be radiologically contaminated. Lead flashing is categorized as mixed waste, basin liners and PPE are categorized as LLW. Material from the copper and soil piles are categorized as LLW based on the limited data available.

Material from the current waste inventory, i.e., thorium waste, product, and uncharacterized waste, is all categorized as either LLW or mixed waste based on the presence or absence of RCRA constituents within the material.

3.5.5.3 Segregation of OU3 Materials

Based on the criteria discussed above, fifty-one percent of the volume (Table 3-18) and sixty-five percent of the weight (Table 3-19) of all OU3 materials are categorized as below baseline. Most of the remainder of materials (33 percent of the weight and 47 percent of the volume) are categorized as LLW with two percent of the remaining volume categorized as mixed waste and less than one percent as either hazardous or PCB waste. Concrete slabs in material category E contribute the most material to mixed waste (39,300 ft3 and 2,950 tons); nearly 45 percent of this material is concentrated in the following components: the Metals Fabrication Plant (6A), the Ore Refinery Plant (2A), the Green Salt Plant (4A), and the Recovery Plant (8A). The associated source term for technetium-99 and elemental uranium for concrete slabs within these components is 0.0094 kg and 9206 kg, respectively. This represents less than one percent of the total source term for both technetium-99 and elemental uranium. The segregation of materials by component is provided in Appendix B, attachment B.II.

The other waste (RCRA) group from the current waste inventory in Material Category J contributes 49,700 ft3 and 2,720 tons to mixed waste. This material is containerized and will be administratively dispositioned off-site.

Acid brick contributes a significant weight and volume (717 tons and 10,200 ft3, respectively) to mixed waste. Approximately 90% of this material is associated with the Ore Refinery Plant (2A), the Metals Fabrication Plant (6A), and the Special Products Plant (9A). The associated source term for technetium-99 and elemental uranium for acid brick within these components is 0.0004 kg and 3,178 kg, respectively.

3.6 DATA UNCERTAINTIES

This section discusses uncertainties and limitations of the characterization data collected under the OU3 RI/FS sampling program. The primary objective in characterizing the contamination was to collect data sufficient to support the development and evaluation of remedial alternatives.

Characterization activities performed under the OU3 RI/FS sampling program focused on obtaining the quality and quantity of data necessary to meet the stated RI objectives.

During the course of collecting and evaluating data for the OU3 RI/FS, the reduced quality or quantity of certain data sets imposed limits in meeting the stated objectives. Table 3-21 summarizes the observed data limitations, identifies the significance of each toward achieving the RI/FS objectives, and provides actions taken or recommended to resolve these limitations. As apparent in the table, acceptable means to resolve the data limitations were identified but each of the data limitations is summarized to demonstrate that it was recognized and addressed.

3.6.1 Sensitivity Analysis of Selected Parameters

To further evaluate the source term estimates, a sensitivity analysis was performed. This analysis tests the impact of the assumptions described in Section 3.7. Three radiological (elemental uranium, technetium-99, and neptunium-237), one inorganic (chromium), and two organic constituents (gamma-Chlordane and tetrachloroethene) were used in these analyses as representative of other analytes in these groups.

The following provides a summary of the results of the most significant sensitivity analyses. A detailed discussion for each of the sensitivity analyses is provided in Appendix B (Volume 3).

- Use of Baseline for Process Areas/Components Not Sampled. In this sensitivity analysis, twice the OU3 baseline values were applied as a comparison to assess the impact of using baseline values to those process areas/components that were not sampled.

  The result of this analysis is an increase in the source term for elemental uranium from six percent of the total source term to 12 percent of the total.

  As discussed in Appendix A, OU3 baseline values represent the 95th-percentile values from the baseline data set. This implies that 95 percent of the data in this data set are at or below the selected baseline value. As a result, the use of baseline values (versus using twice the baseline values), for process areas/components that were not sampled, is considered conservative.

- Use of Limit Pesticides Results. In this sensitivity analysis, the maximum detected pesticide concentration was applied to the top ½-inch of all at- and above-grade concrete. This analysis was performed to assess the impact of using a value of zero for organic constituents for process areas/components in instances where either the analytical results were below the detection limit or where no samples were analyzed for pesticides.

The result of this sensitivity analysis is a significant increase in the source term for pesticides. Examples of this includes an increase in the source term for gamma-Chlordane of 7.13 percent and an increase for Dieldrin of 4.4 percent.

The impact of applying the maximum detected pesticide concentration to the top ½-inch of all at- and above- grade concrete would still result in an insignificant resulting source term. Therefore, the impact of using the current approach of applying zero values is insignificant.

- Assumption of 1.0 percent UNH Holdup on Interior of Process Piping. In this sensitivity analysis, the interior surface of all process piping is conservatively assumed to be contaminated with a one percent holdup layer of UNH consisting of 43 percent elemental uranium. This analysis was performed to assess the impact of currently applying a ten percent holdup layer of UNH.

  The result of this sensitivity analysis is a significant decrease in the elemental uranium of 88 percent.

  Therefore, the use of a ten percent UNH holdup is sufficiently conservative for use in the source term for process piping. The use of ten percent holdup is also consistent with process knowledge.

- Assumption of 0.1 percent UNH Holdup on Interior of Process Equipment. In this sensitivity analysis, the interior surface of all process equipment is conservatively assumed to be contaminated with a one percent holdup layer of UNH consisting of 43 percent elemental uranium. This analysis was performed to assess the impact of currently applying a ten percent holdup layer of UNH. The amount of material affected by this assumption and the assumption described above equals more than 30 percent material volume and more than 50 percent of the total weight.

  The result of this sensitivity analysis is a significant decrease in the elemental uranium of 85 percent.

  The use of a ten percent UNH holdup is considered overly conservative for process equipment. This is because the interior cavity of process equipment is generally much smaller than the interior diameter of piping and probably would not contain as much holdup as process piping.

3.6.2 Source Term Bounding Analysis

In addition to the sensitivity analyses discussed above, an estimate of maximum and minimum source terms to bound the expected results were used to validate the contamination source terms presented in Appendix B.5.

A maximum source term for representative COCs (technetium-99, elemental uranium, neptunium-237, strontium-90, lead, mercury, chromium, alpha-Chlordane, gamma-Chlordane, dieldrin, nitrobenzene,

and tetrachloroethene) was estimated based on the maximum analytical results for each sampled media.

A minimum source term for the same analytes were estimated based on the minimum analytical results for each sampled medium. Since no baseline values have been defined for organic compounds, a minimum result of zero was used for organics.

3.6.2.1 Comparison of Source Term Estimates

Table 3-22 summarizes the results of the source term estimates presented in Appendix B.5 and the maximum and minimum source term bounding estimates described above. The ratio between the maximum estimated source terms and the actual source terms varies from 1.1 (chromium) to 238 (alpha- and gamma -Chlordane). This ratio is generally lower for inorganics and higher for organics and radionuclides. This is expected for the organics since most of the organics were detected in relatively few samples. As discussed previously, this would result in the use of a value of zero in the source terms, while the maximum result was applied to all material for the estimated maximum. The lower ratio for inorganics compared to radionuclides is also expected since in general, inorganics results (especially those from steel scrapings/paint) are elevated. Baseline values are used extensively for radiological results in media such as concrete, whereas the maximum value was applied to all material in the estimated maximum. The ratios between the estimated maximum and the representative source terms indicate that the source terms appear to be reasonable, given the fact that the results are based on samples from the location of maximum contamination within each process area.

The ratio between the maximum and the minimum estimated source terms varies from zero (tetrachloroethene, dieldrin, alpha- and gamma-Chlordane) to one (chromium). The ratios for radiological contaminants were all less than one, the inorganics were close to or at one, and the organics were all zero, as discussed above. The source term estimates for organics were based on a few positive results with the majority being set to a zero value. The ratios between the estimated maximum and minimum source terms appear to be conservative for all but organics.

3.7 CONCLUSIONS

The characterization of OU3 is sufficient to meet the stated objectives of this RI/FS Report by providing a detailed understanding of the type and level of contamination within the material and

components comprising the OU. These characterization data are sufficient to support the analysis of potential remedial action alternatives.

The decision has already been made to decontaminate and dismantle OU3, thereby eliminating the need for an extensive determination of the nature and extent of contamination, fate and transport modeling, and a baseline risk assessment. Therefore, no additional site characterization activities are planned or necessary to support decision-making and preparation of a Record of Decision. Alternatives for the final disposition of material pursuant to the interim remedial action will be addressed in the remainder of this report.

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TABLE 3-1

OU3 MATERIAL CATEGORIES/DESCRIPTIONS

A ACCESSIBLE METALS	B INACCESSIBLE METALS	C PROCESS-RELATED METALS	D PAINTED LIGHT-GAUGE METALS	E CONCRETE	F BRICK	G NON-REGULATED ACM	H REGULATED ACM	I MISCELLANEOUS MATERIALS	J PRODUCT, RESIDUES AND SPECIAL MATERIALS
STRUCTURAL AND MISC. STEEL	DOORS	ELECTRICAL EQUIPMENT	DUCTWORK	ASPHALT	ACID BRICK	CEILING DEMO.	DUCTWORK INSULATION	PVC CONDUIT	COAL PILE
	CONDUIT/WIRE (2" AND LESS)	EQUIPMENT AND MISCELLANEOUS	LEAD FLASHING	CONCRETE		FEEDER CABLE	PIPING INSULATION	BASIN LINERS	GRAVEL PILE
	CONDUIT/WIRE (2-1/2" TO 4")	HVAC EQUIPMENT	LOUVERS	CONCRETE BEAMS		FIRE BRICK	PPE	FABRIC	HAZARDOUS/MIXED WASTE
	CONDUIT/WIRE/CABLE TRAY (OVER 4")	MATERIAL HANDLING EQUIPMENT	EXTERIOR METAL WALL PANELS	CONCRETE COLUMNS		FLOOR TILE	COPPER SCRAP METAL PILE	FABRIC ROOF	LOW LEVEL WASTE
	ELECTRICAL FIXTURES	PROCESS EQUIPMENT	INTERIOR METAL WALL PANELS	CONCRETE FOUNDATION		EXTERIOR TRANSITE PANELS		FABRIC WALLS	MARKETABLE NUCLEAR MATERIAL
	ELECTRICAL WIRING	PIPING (2" AND LESS)	METAL PANEL ROOF	CONCRETE SLABS		INTERIOR TRANSITE PANELS		DRYWALL	OUTSIDE EQUIPMENT STORAGE AREA
	MISCELLANEOUS ELECTRICAL ITEMS	PIPING (2-1/2" TO 4")		CONCRETE WALLS		TRANSITE ROOF		BUILDING INSULATION	ROCK SALT PILE
	ELECTRICAL EQUIPMENT	PIPING (OVER 4")		MASONRY				MISCELLANEOUS DEBRIS	SAND PILES
	EQUIPMENT AND MISCELLANEOUS			MASONRY WALLS				PPE	SOIL PILES
	HVAC EQUIPMENT			CLAY PIPING				PVC PIPING	THORIUM INVENTORY
	MATERIAL HANDLING EQUIPMENT							ROOFING, BUILT-UP	SCRAP METAL PILE
	PROCESS EQUIPMENT							PROCESS TRAILERS	
	ELECTRICAL TRANSFORMERS							NON-PROCESS TRAILERS	
	PIPING (2" AND LESS)							WINDOWS	
	PIPING (2-1/2" TO 4")							WOOD	
	PIPING (OVER 4")								

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Table 3-2
Summary of Material Quantities

FS Category	Material Description	Unbulked Volume (cu. ft)	Weight (tons)
A	STRUCTURAL AND MISC. STEEL	63,400	15,200
Totals for FS Category	A	63,400	15,200
B	CONDUIT/WIRE (2" AND LESS)	6,510	1,070
B	CONDUIT/WIRE (2-1/2" TO 4")	5,480	593
B	CONDUIT/WIRE/CABLE TRAY (OVER 4")	1,990	165
B	DOORS	10,300	214
B	ELECTRICAL EQUIPMENT	94,900	1,020
B	ELECTRICAL FIXTURES	26,200	173
B	ELECTRICAL TRANSFORMERS	14,900	334
B	ELECTRICAL WIRING	206	59.
B	EQUIPMENT AND MISCELLANEOUS	135,000	3,390
B	HVAC EQUIPMENT	64,400	346
B	MATERIAL HANDLING EQUIPMENT	103,000	650
B	MISCELLANEOUS ELECTRICAL ITEMS	16,600	419
B	PIPING (2" AND LESS)	12,500	1,410
B	PIPING (2-1/2" TO 4")	21,900	1,560
B	PIPING (OVER 4")	73,100	3,230
B	PROCESS EQUIPMENT	1,120,000	11,100
Totals for FS Category	B	1,710,000	25,700
C	ELECTRICAL EQUIPMENT	10,500	113
C	EQUIPMENT AND MISCELLANEOUS	15,000	377
C	HVAC EQUIPMENT	7,160	38.4
C	MATERIAL HANDLING EQUIPMENT	11,500	72.3
C	PIPING (2" AND LESS)	1,490	165
C	PIPING (2-1/2" TO 4")	2,580	187
C	PIPING (OVER 4")	8,290	374
C	PROCESS EQUIPMENT	134,000	2,040
Totals for FS Category	C	191,000	3,370
D	DUCTWORK	3,820	943
D	EXTERIOR METAL WALL PANELS	812	167
D	INTERIOR METAL WALL PANELS	125	25.7
D	LEAD FLASHING	49.4	17.5
D	LOUVERS	1,490	30.9
D	METAL PANEL ROOF	857	176
Totals for FS Category	D	7,150	1,360
E	ASPHALT	552,000	22,400
E	CLAY PIPING	7,910	554
E	CONCRETE	468,000	35,100
E	CONCRETE BEAMS	57,600	4,320
E	CONCRETE COLUMNS	22,400	1,680
E	CONCRETE FOUNDATION	921,000	69,100
E	CONCRETE SLABS	2,260,000	169,000
E	CONCRETE WALLS	139,000	10,400
E	MASONRY	16,800	462
E	MASONRY WALLS	358,000	9,830
Totals for FS Category	E	4,800,000	323,000
F	ACID BRICK	20,700	1,450
Totals for FS Category	F	20,700	1,450
G	CEILING DEMOLITION	1,230	14.7

Table 3-2 (Continued)

FS Category	Material Description	Unbulked Volume (cu. ft)	Weight (tons)
G	EXTERIOR TRANSITE PANELS	17,500	982
G	FEEDER CABLE	1,120	321
G	FIRE BRICK	5,590	391
G	FLOOR TILE	3,720	179
G	INTERIOR TRANSITE PANELS	12,300	680
G	TRANSITE ROOF	18,900	1,060
Totals for FS Category	G	60,300	3,630
H	COPPER PILE	47,800	1,370
H	DUCTWORK INSULATION	5,390	12.1
H	PERSONAL PROTECTIVE EQUIPMENT	6,860	10.4
H	PIPING INSULATION	20,200	45.4
Totals for FS Category	H	80,200	1,440
I	BASIN LINERS	2,140	69.1
I	BUILDING INSULATION	15,500	34.9
I	DRYWALL	20,400	538
I	FABRIC	35.7	1.15
I	FABRIC ROOF	382	12.3
I	FABRIC WALLS	176	5.68
I	MISCELLANEOUS DEBRIS	31,200	467
I	NON PROCESS TRAILERS	305,000	898
I	PERSONAL PROTECTIVE EQUIPMENT	36,000	54.5
I	PROCESS TRAILERS	71,100	210
I	PVC CONDUIT	408	13.3
I	PVC PIPING	283	1.22
I	ROOFING (BUILT UP)	29,000	1,040
I	WINDOWS	21,000	420
I	WOOD	30,900	463
Totals for FS Category	I	564,000	4,230
J	DUCTWORK	485	22.7
J	OTHER WASTE	541,000	9,330
J	PIPING (2" AND LESS)	857	72.6
J	PIPING (2-1/2" TO 4")	1,330	115
J	PIPING (OVER 4")	1,550	135
J	PROCESS EQUIPMENT	83,500	7,300
J	PRODUCT WASTE	107,000	8,380
J	SOIL PILE	985,000	47,300
J	THORIUM WASTE	77,500	2,080
Totals for FS Category	J	1,800,000	74,700
	Totals	9,300,000	454,000

TABLE 3-3
SUMMARY OF MATERIAL QUANTITY VOLUME[a] BY COMPONENT/MATERIAL CATEGORIES
OPERABLE UNIT 3 -FEMP

Component Category	Material Type Category										
	A	B	C	D	E	F	G	H	I	J	
	Accessible Metals	Inaccessible Metals	Process-Related Metals	Painted, Light-Gauge Metals	Concrete	Brick	Non-Regulated ACM	Regulated ACM	Misc-Materials	Product, Residues and Special Materials	Totals [b]
1 - Administrative Support	1,120	56,500	5,110	795	454,000	0	3,460	2,040	413,000	77.6	936,000
2 - Warehouse/Storage	6,100	12,400	415	1,130	660,000	0	2,640	1,790	19,300	1.55	704,000
3 - Process	35,100	974,000	113,000	4,130	1,020,000	14,700	40,600	13,600	70,700	75,700	2,360,000
4 - Process Support	8,740	293,000	32,600	799	406,000	301	11,700	2,700	21,900	11,900	790,000
5 - Aboveground Containers/Containerized Material	3,420	120,000	12,900	5.29	126,000	5,220	29.4	49,400	4,680	725,000	1,050,000
6 - Belowground Containers/Containerized Material	0	0	0	0	0	0	0	0	0	0	0
7 - Bulk Material	0	0	0	0	0	0	0	0	0	985,000	985,000
8 - Pads, Roads, Railroads, Parking Lot	0	0	0	0	1,810,000	437	0	0	0	0	1,810,000
9 - Aboveground Piping, Utilities, Equipment	2,640	191,000	20,100	297	25,200	0	776	390	6,700	2.22	247,000
10 - Belowground Piping, Utilities, Equipment	6,260	63,500	6,960	0	280,000	0	1,120	10,300	25,200	0	393,000
11 - Ponds/Basins	48.1	1,410	47.9	0	16,400	0	0	24.4	2,190	0	20,100
Totals [b]	63,400	1,710,000	191,000	7,160	4,800,000	20,700	60,300	80,200	564,000	1,800,000	9,293,706

[a] All volumes are in cubic feet (unbulked).
[b] Totals are rounded.

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TABLE 3-4
SUMMARY OF MATERIAL QUANTITY WEIGHT[a] BY COMPONENT/MATERIAL CATEGORIES
OPERABLE UNIT 3 -FEMP

	Material Type Category										
	A	B	C	D	E	F	G	H	I	J	
Component Category	Accessible Metals	Inaccessible Metals	Process-Related Metals	Painted, Light-Gauge Metals	Concrete	Brick	Non-Regulated ACM	Regulated ACM	Misc-Materials	Product, Residues and Special Materials	Totals[b]
1 - Administrative Support	267	987	73.1	176	26,700	0	147	4.48	2,000	3.63	30,400
2 - Warehouse/Storage	1,470	412	19.7	188	48,000	0	153	3.07	310	.07	50,600
3 - Process	8,400	13,600	2,070	867	71,500	1,030	2,270	28.5	1,120	6,600	107,000
4 - Process Support	2,100	5,640	709	116	26,800	21.1	691	5.03	267	1,040	37,400
5 - Aboveground Containers/Containerized Material	818	1,200	107	1.21	9,460	365	1.54	1,370	9.23	19,800	33,100
6 - Belowground Containers/Containerized Material	0	0	0	0	0	0	0	0	0	0	0
7 - Bulk Material	0	0	0	0	0	0	0	0	0	47,300	47,300
8 - Pads, Roads, Railroads, Parking Lot	0	0	0	0	117,000	30.6	0	0	0	0	117,000
9 - Aboveground Piping, Utilities, Equipment	632	640	43	11.7	1,890	0	45.7	.67	81.4	.1	3,340
10 - Belowground Piping, Utilities, Equipment	1,530	3,210	343	0	21,000	0	321	23.2	375	0	26,800
11 - Ponds/Basins	11.6	33.6	.91	0	1,230	0	0	.05	69.2	0	1,350
Totals[b]	15,200	25,700	3,370	1,360	323,000	1,450	3,630	1,430	4,230	74,700	454,000

[a] All weights are in tons.
[b] Totals are rounded.

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TABLE 3-5
SUMMARY OF EXPECTED CONTAMINANTS WITHIN OU3

Contaminant	Area																												Primary Sources/Uses
	Plant 1	Plant 2/3	Plant 4	Plant 5	Plant 6	Plant 7	Plant 8	Plant 9	Sewage Treatment Plant (STP)	Pilot Plant (13)	Laboratory (15)	General Sump	Administration (14)	Electrical Substation (16)	Maintenance/Stores Building (12)	Tank Farm (19)	Boiler House (10)	Drum Baling	Scrap Metal Pile, Decontamination Building ..	Graphite Furnace & Oil Burner (10D)	KC-2 Warehouse (63)	Garage	Health & Safety Building	Service Building (11)	K-65/Clearwell Line W. of Prod.	Clearwell Line E. of Prod.	Fire Training (73)	Outfall Pipeline	
Radionuclides																													
Uranium-238	●	●	●	●	●	●	●	●	●	●	●	●			●	●		●	●	●	●		●	●	●	●	●	●	Ores, ore concentrates, and recycled material.
Uranium-234	●	●	●	●	●		●	●	●	●	●	●			●	●		●	●	●			●	●	●	●	●	●	Ores, ore concentrates, and recycled material.
Thorium-230	●	●							●	●	●	●							●				●		●	●		●	Minor impurity (<1%) in ores and ore concentrates.
Radium-226	●	●							●	●	●	●						●	●				●		●	●		●	Impurity in uranium ores and ore concentrates.
Uranium-235/236	●	●	●	●	●	●	●	●	●	●	●	●			●	●		●	●	●			●	●	●	●	●	●	Ores, ore concentrates, and recycled material.
Thorium-232	●	●	●	●	●		●	●		●	●	●						●	●	●			●		●	●		●	Feed material (thorium nitrate tetrahydrate).
Radium-228	●	●	●	●	●		●	●		●	●	●						●	●				●		●	●		●	Impurity in thorium ores and ore concentrates.
Thorium-228	●	●	●	●	●		●	●		●	●	●						●	●	●			●		●	●		●	Feed material (thorium nitrate tetrahydrate).
Neptunium-237	●	●	●	●	●		●	●		●	●	●											●		●	●		●	Impurity in recycled uranium from other DOE facilities..
Plutonium-239/240	●	●	●	●	●		●	●		●	●	●											●		●	●		●	Impurity in recycled uranium from other DOE facilities.
Plutonium-238	●	●	●	●	●		●	●		●	●	●											●		●	●		●	Impurity in recycled uranium from other DOE facilities.
Strontium-90	●	●	●	●	●		●	●		●	●	●											●		●	●		●	Impurity in recycled uranium from other DOE facilities; fallout.
Technetium-99	●	●	●	●	●		●	●	●	●	●	●			●			●	●	●			●		●	●	●	●	Impurity in recycled uranium from other DOE facilities; fallout.
Cesium-137	●	●	●	●	●		●	●		●	●	●											●		●	●		●	Impurity in recycled uranium from other DOE facilities; fallout.

TABLE 3-5
SUMMARY OF EXPECTED CONTAMINANTS WITHIN OU3

Contaminant	Area																												Primary Sources/Uses
	Plant 1	Plant 2/3	Plant 4	Plant 5	Plant 6	Plant 7	Plant 8	Plant 9	Sewage Treatment Plant (STP)	Pilot Plant (13)	Laboratory (15)	General Sump	Administration (14)	Electrical Substation (16)	Maintenance/Stores Building (12)	Tank Farm (19)	Boiler House (10)	Drum Baling	Scrap Metal Pile, Decontamination Building ..	Graphite Furnace & Oil Burner (10D)	KC-2 Warehouse (63)	Garage	Health & Safety Building	Service Building (11)	K-65/Clearwell Line W. of Prod.	Clearwell Line E. of Prod.	Fire Training (73)	Outfall Pipeline	
Organic Compounds																													
Acetone	●	●	●				●			●	●	●	●		●		●	●		●	●		●						Laboratory solvent.
Benzene				●	●					●	●	●			●								●						Laboratory solvent, constituent in fuels.
2-Butanone (methylethyl ketone)							●				●	●											●						Laboratory solvent.
Carbon tetrachloride					●		●			●	●	●	●										●						Cleaning solvent.
Chlorobenzene					●						●	●																	Laboratory solvent.
Chloroform											●	●											●						Laboratory solvent.
Di-sec-butyl phenyl phosphonate										●	●	●								●									Solvent for thorium extraction.
Ethylbenzene							●																						Laboratory solvent, constituent in fuels.
Ethylene glycol											●	●										●	●						Antifreeze; laboratory chemical.
Methylene chloride	●										●	●											●						Laboratory solvent.
Pentachlorophenol																													Laboratory chemical.
Polychlorinated biphenyls	●	●		●				●		●	●	●		●						●	●		●				●		Coolant in transformers.
Solvesso-100										●	●	●								●									Thorium extraction/purification.
Tetrachloroethene	●	●	●	●	●		●	●		●	●	●			●					●	●		●	●					Cleaning solvent; coolant in pilot plant remelt furnace.
Toluene					●		●				●	●											●				●		Laboratory solvent, constituent in fuels.
1,1,1-Trichloroethane	●	●	●	●	●		●		●	●	●	●			●		●			●	●		●				●		Cleaning solvent.
Trichloroethene	●	●		●	●		●	●		●	●	●			●					●			●	●					Cleaning solvent.
Vinyl chloride																								●					Degradation product of trichloroethene and tetrachloroethene.
Xylene	●						●				●	●											●						Laboratory solvent, constituent in fuels.
Kerosene	●	●								●	●	●	●		●	●				●	●		●	●	●	●			Solvent for uranium/thorium extraction.
Various oils	●	●	●	●	●		●	●		●	●	●	●		●	●	●	●	●	●	●	●	●	●			●		Cooling, lubricating, hydraulics.

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TABLE 3-5
SUMMARY OF EXPECTED CONTAMINANTS WITHIN OU3

Contaminant	Area																											Primary Sources/Uses
	Plant 1	Plant 2/3	Plant 4	Plant 5	Plant 6	Plant 7	Plant 8	Plant 9	Sewage Treatment Plant (STP)	Pilot Plant (13)	Laboratory (15)	General Sump	Administration (14)	Electrical Substation (16)	Maintenance/Stores Building (12)	Tank Farm (19)	Boiler House (10)	Drum Baling	Scrap Metal Pile, Decontamination Building ..	Graphite Furnace & Oil Burner (10D)	KC-2 Warehouse (63)	Garage	Health & Safety Building	Service Building (11)	K-65/Clearwell Line W. of Prod.	Clearwell Line E. of Prod.	Fire Training (73)	Outfall Pipeline	
Inorganics																												
Aluminum	●	●						●		●	●	●			●		●		●				●					Minor impurity (<1%) in ores & ore concentrates; major (>10%) component in flyash; hydrated alumina used in raffinate treatment for fluoride removal; cladding on fuel elements.
Antimony	●	●									●	●																Minor impurity (<1%) in ores & ore concentrates.
Arsenic	●	●					●				●	●											●					Minor impurity (<1%) in ores & ore concentrates; minor component (<100 ppm) in flyash.
Barium	●	●			●					●	●	●											●					BaSO4 used in thorium raffinate treatment for radium removal; minor component (<0.5%) in flyash.
Beryllium												●											●					Minor component (<20 ppm) in flyash.
Boron	●	●									●	●											●					Minor impurity (<1%) in ores & ore concentrates.
Cadmium	●	●		●	●		●	●		●	●	●							●				●					Minor impurity (<1%) in ores & ore concentrates; used in yello paints.
Calcium	●	●			●		●	●	●	●		●			●		●		●				●					Lime [Ca(OH)2] used for neutralization; major impurity (<3%) in ores & ore concentrates; major component (>13%) in flyash; CaCO3 used in heat treating.
Hexavalent Chromium												●			●		●						●					Additive for process water treatment.
Chromium	●	●	●	●	●	●	●	●		●	●	●			●		●		●				●					Minor impurity (<1%) in ores & ore concentrates; used in paints.
Cobalt	●	●									●	●											●					Minor impurity (<1%) in ores & ore concentrates.
Copper	●	●	●	●	●	●	●	●		●	●	●			●				●				●					Minor impurity (<1%) in ores & ore concentrates; cladding on fuel elements.
Cyanide											●	●											●					Laboratory chemical.

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TABLE 3-5
SUMMARY OF EXPECTED CONTAMINANTS WITHIN OU3

Contaminant	Area																												Primary Sources/Uses
	Plant 1	Plant 2/3	Plant 4	Plant 5	Plant 6	Plant 7	Plant 8	Plant 9	Sewage Treatment Plant (STP)	Pilot Plant (13)	Laboratory (15)	General Sump	Administration (14)	Electrical Substation (16)	Maintenance/Stores Building (12)	Tank Farm (19)	Boiler House (10)	Drum Baling	Scrap Metal Pile, Decontamination Building	Graphite Furnace & Oil Burner (10D)	KC-2 Warehouse (63)	Garage	Health & Safety Building	Service Building (11)	K-65/Clearwell Line W. of Prod.	Clearwell Line E. of Prod.	Fire Training (73)	Outfall Pipeline	
Inorganics, continued																													
Iron	●	●	●	●	●	●	●	●		●	●	●			●		●	●	●				●						Major impurity (<5%) in ores & ore concentrates; major component (>5%) in flyash.
Lead	●	●		●	●		●	●		●	●	●			●		●						●	●					Minor impurity (<1%) in ores & ore concentrates; used in paints.
Lithium	●			●	●		●	●		●	●	●											●						LiCO3 used in heat treating.
Magnesium	●	●	●	●	●		●	●	●	●	●	●			●		●		●				●	●			●		Reduction of UF4 to U; major impurity (<4%) in ores and ore concentrates; major component (>4%) in flyash.
Manganese	●	●					●				●	●											●						Minor impurity (<1%) in ores & ore concentrates.
Mercury		●	●	●			●	●		●	●	●			●		●						●						Al/U alloy dissolution in Plant 2/3; laboratory uses; used in paints.
Molybdenum	●	●									●	●							●				●						Minor impurity (<1%) in ores & ore concentrates.
Nickel	●	●	●		●	●		●		●	●	●			●								●						Minor impurity (<1%) in ores & ore concentrates; cladding on fuel elements; corrosion product.
Potassium	●	●	●		●	●	●	●		●	●	●			●	●							●						KCl used in heat treating; HF neutralization and residue recovery.
Selenium												●																	Minor component (<100 ppm) in flyash.
Silicon	●	●					●			●	●	●			●								●						Major impurity (<5%) in ores & ore concentrates.
Silver	●		●								●	●			●				●				●						Algaecide in Plant 4 heat exchangers; photographic film coating/processing.
Sodium	●	●			●	●	●	●		●	●	●			●				●				●						Major impurity (<10%) in ores & ore concentrates; NaCl used in heat treating; neutralization (NaOH).
Thallium											●	●																	Laboratory reagent.

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TABLE 3-5
SUMMARY OF EXPECTED CONTAMINANTS WITHIN OU3

Contaminant	Area																											Primary Sources/Uses
	Plant 1	Plant 2/3	Plant 4	Plant 5	Plant 6	Plant 7	Plant 8	Plant 9	Sewage Treatment Plant (STP)	Pilot Plant (13)	Laboratory (15)	General Sump	Administration (14)	Electrical Substation (16)	Maintenance/Stores Building (12)	Tank Farm (19)	Boiler House (10)	Drum Baling	Scrap Metal Pile, Decontamination Building ..	Graphite Furnace & Oil Burner (10D)	KC-2 Warehouse (63)	Garage	Health & Safety Building	Service Building (11)	K-65/Clearwell Line W. of Prod.	Clearwell Line E. of Prod.	Fire Training (73)	Outfall Pipeline	
Inorganics, continued																												
Vanadium	●	●									●	●																Minor impurity (<3%) in ores & ore concentrates.
Zinc	●	●						●		●	●	●							●				●					Minor impurity (<1%) in ores & ore concentrates.
Zirconium	●	●		●				●		●	●	●											●					Cladding on fuel elements; coating on ingot molds.
Other Compounds																												
Ammonia		●	●		●	●	●	●		●	●	●				●									●	●		Minor impurity (<1%) in ores & ore concentrates; neutralization; residue from uranium recovery and UF4 production.
Carbonate	●	●			●		●	●		●	●	●			●										●	●		Major component in soil and groundwater; CaCO3 used in heat treating.
Chloride	●	●			●		●	●	●	●	●	●			●	●	●		●	●					●	●		Minor impurity (<1%) in ores & ore concentrates; NaCl & KCl used in heat treating; HCl used to dissolve U metal.
Fluoride	●	●	●	●	●	●	●	●		●	●	●			●	●			●	●					●	●		Minor impurity (<1%) in ores & ore concentrates; anhydrous & aqueous HF; used to convert UO2 to UF4 (green salt) and ThO2 to ThF4; UF4 was a feed material received from other facilities.
Nitrate	●	●			●		●	●	●	●	●	●			●	●			●						●	●		Nitric acid used to dissolve uranium and thorium feed materials for extraction.
Phosphate		●					●			●	●	●			●										●	●		Minor impurity (<1%) in ores & ore concentrates; UAP process.
Sulfate		●	●				●			●	●	●			●		●								●	●		Major impurity (<5%) in ores & ore concentrates; H2SO4 used for OU3 production.
Diamyl-amyl phosphonate										●	●	●								●								Solvent for thorium extraction.
Magnesium fluoride	●	●		●			●	●		●	●	●							●	●					●	●		By-product of reduction of UF4 to uranium metal.
Tributyl phosphate		●					●			●	●	●				●				●					●	●		Solvent for uranium extraction.

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TABLE 3-6

CONSTITUENTS OF CONCERN - OU3

Radionuclides

Americium-241
Cesium-137+1Daughter
Lead-210+2Daughters
Neptunium-237+1Daughter
Polonium-210
Plutonium-238
Plutonium-239/240
Plutonium-241
Radium-226+5Daughters
Radium-228
Strontium-90
Technetium-99
Thorium-227
Thorium-228+7Daughters
Thorium-230
Thorium-232
Uranium-234
Uranium-235/236
Uranium-238+2Daughters

Metals

Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Copper
Lead
Manganese
Mercury
Nickel

Metals (Cont'd)

[Selenium]
[Silver]
Thallium
Uranium
Vanadium
Zinc

Volatile Organics, ug/kg

[Benzene]
[Styrene]
Tetrachloroethene

Semi-Volatile Organics

1,4-Dichlorobenzene
[2,4-Dinitrotoluene]
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
[Benzo(k)fluoranthene]
[bis(2-Ethylhexyl)phthalate]
[Carbazole]
[Chrysene]
[Dibenzo(a,h)anthracene]
Hexachlorobutadiene
[Indeno(1,2,3-cd)pyrene]
[N-Nitroso-di-n-propylamine]Nitro
[Pentachlorophenol]

Pesticides/PCBs

alpha-Chlordane
Aroclor-1248
Aroclor-1254
Dieldrin
gamma-Chlordane

TABLE 3-7
OU3 REFERENCE CRITERIA CONCENTRATIONS PER ANALYTE

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Radionuclides, pCi/g							
Americium-241	0.24					0.10	0.12
Cesium-137	0.0021				560	0.15	0.34
Lead-210	0.12				230,000	0.89	0.60
Neptunium-237	0.0094	3.12E+09			2,000	0.10	0.23
Plutonium-238	0.36				10,000	0.09	0.33
Plutonium-239/240	0.34				10,000	0.10	0.18
Plutonium-241	22.0					3.30	10.00
Polonium-210	0.530				230,000	1.43	7.90
Radium-226	0.00069				2,000	1.75	4.54
Radium-228	0.79				1,800	0.30	2.71
Strontium-90	2.40	5.67E+10			20,000	NA	1.58
Technetium-99	61.0	29			100,000	0.40	1.45
Thorium-227	0.026					2.90	0.42
Thorium-228	0.00074				680	0.58	4.37
Thorium-230	5.7				15,000	0.86	15.00
Thorium-232	6.4				680	0.84	4.21
Uranium-234	4.8			167	37,000	7.75	64.00
Uranium-235/236	0.017			8	770	0.83	6.80
Uranium-238	0.11			167	28,000	6.50	63.00
Uranium-Total (ug/g)	0.25	1030		500		12.55	176.00
Metals, mg/kg							
Aluminum						5,039	14,371
Antimony	11					1.00	108.76
Arsenic	0.037		100			3.96	25.95
Barium	1,900	pure product	2000			50.4	3,279
Beryllium	0.015					1.40	1.10
Cadmium	14		20			2.40	66.52
Calcium						199,321	43,358
Chromium	140	pure product	100			8.15	4,540
Cobalt	1,600					2.89	253.04
Copper	1,000					11.1	318.65
Iron						10,438	129,610
Lead		pure product	100			3.42	239,000
Magnesium	270,000	pure product				50,632	6,396
Manganese	140					343	958.51
Mercury	8.2	5.66E+04	4			0.03	18.04
Nickel	550					9.37	134.74
Potassium						927	1,193
Selenium	140		20			0.47	0.83
Silver	140	pure product	100			5.42	6.40
Sodium						607	844.02
Thallium	1.9					0.32	NA
Vanadium	190					13.2	21.97
Zinc	8,200					27.5	55,005
Volatile Organics, ug/kg							
1,1-Dichloroethane							
1,1-Dichloroethene	110		14,000				
1,1,1-Trichloroethane							
1,1,2-Trichloroethane	1,100						
1,1,2,2-Tetrachloroethane	320						
1,2-Dichloroethane	702	pure product	10,000				
1,2-Dichloroethene (total)	250,000						
1,2-Dichloropropane							
2-Butanone	16,000,000	pure product	4,000,000				

TABLE 3-7
OU3 REFERENCE CRITERIA CONCENTRATIONS PER ANALYTE

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Volatile Organics, ug/kg (Cont'd)							
2-Hexanone	1,100,000						
4-Methyl-2-pentanone	1,400,000	pure product					
Acetone	2,700,000	pure product					
Benzene	2,200	pure product	10,000				
Bromodichloromethane	1,000	9.03E-01					
Bromoform	8,100						
Bromomethane	38,000						
Carbon disulfide	2,700,000						
Carbon tetrachloride	490		10,000				
Chlorobenzene	550,000		2,000,000				
Chloroethane	550,000						
Chloroform	10,000		120,000				
Chloromethane	4,900						
cis-1,3-Dichloropropene	360						
Dibromochloromethane	760						
Ethylbenzene	2,700,000	pure product					
Methylene chloride	8,500						
Pyridine	27,000		100,000				
Styrene	2,100						
Tetrachloroethene	1,200		14,000				
Toluene	5,500,000	pure product					
Xylenes, Total	55,000,000	pure product					
trans-1,3-Dichloropropene	350						
Trichloroethene	5,800		10,000				
Trichlorofluoromethane	8,200,000						
Vinyl Chloride	34		4,000				
Semi-Volatile Organics, ug/kg							
1,2,4-Trichlorobenzene	270,000						
1,2-Dichlorobenzene	2,500,000						
1,3-Dichlorobenzene							
1,4-Dichlorobenzene	2,700		150,000				
2,2-Oxybis(1-chloropropane)							
2,4,5-Trichlorophenol	2,700,000		8,000,000				
2,4,6-Trichlorophenol	5,800		40,000				
2,4-Dichlorophenol	82,000						
2,4-Dimethylphenol	550,000						
2,4-Dinitrophenol	55,000						
2,4-Dinitrotoluene	94		2,600				
2,6-Dinitrotoluene	94						
2-Chloronaphthalene	2,200,000						
2-Chlorophenol	140,000						
2-Methylnaphthalene	1,100,000						
2-Nitroaniline							
2-Nitrophenol							
3,3-Dichlorobenzidine	140						
4,6-Dinitro-2-methylphenol							
4-Bromophenyl phenyl ether	1,600,000						
4-Chloro-3-methylphenol	1,400,000						
4-Chlorophenylphenyl ether							
4-Nitroaniline	82,000	4.42E-02					
4-Nitrophenol	1,700,000						
Acenaphthene	1,600,000						
Acenaphthylene							
Anthracene	8,200,000						

TABLE 3-7
OU3 REFERENCE CRITERIA CONCENTRATIONS PER ANALYTE

Semi-Volatile Organics, ug/kg (Cont'd)							
Benzo(a)anthracene	58						
Benzo(a)pyrene	8.8						
Benzo(b)fluoranthene	71						
Benzo(g,h,i)perylene							
Benzo(k)fluoranthene	170						
bis(2-Chloroethoxy)methane							
bis(2-Chloroethyl)ether							
bis(2-Chloroisopropyl) ether	910						
bis(2-Ethylhexyl)phthalate	4,600						
Butyl benzyl phthalate	5,500,000						
Carbazole	3,200	7.27E+04					
Chrysene	2,000						
Di-n-butyl phthalate	2,700,000						
Di-n-octyl phthalate	550,000						
Dibenzo(a,h)anthracene	8.8						
Dibenzofuran	110,000						
Diethyl phthalate	22,000,000						
Dimethyl phthalate	270,000,000						
Fluoranthene	1,100,000						
Fluorene	1,100,000						
Hexachloro-1,3-butadiene	820		10,000				
Hexachlorobenzene	40		2,600				
Hexachlorobutadiene	820	pure product	10,000				
Hexachlorocyclopentadiene	190,000						
Hexachloroethane	4,600		60,000				
Indeno(1,2,3-cd)pyrene	32						
Isophorone	67,000						
m-Methylphenol	1,300		4,000,000				
N-Nitroso-di-n-propylamine	9.1						
N-Nitrosodiphenylamine	13,000						
Naphthalene	1,100,000						
Nitrobenzene	14,000		40,000				
o-Methylphenol	1,400,000		4,000,000				
p-Chloroaniline							
p-Methylphenol (cresol)	1,400,000		4,000,000				
Pentachlorophenol	530		2,000,000				
Phenanthrene							
Phenol	16,000,000						
Pyrene	820,000						
Pesticides/PCBs, ug/kg							
4,4'-DDD	270						
4,4'-DDE	190						
4,4'-DDT	190						
beta-BHC	35						
alpha-Chlordane	49	2.89E+00	6,000				
delta-BHC							
Dieldrin	4.0						
Endosulfan II	160,000						
Endosulfan sulfate	160,000						
Endosulfan-I	160,000						
Endrin	8,200	pure product	400				
Endrin aldehyde	8,200						
Endrin ketone							
gamma-BHC (Lindane)	49		8,000				

TABLE 3-7
OU3 REFERENCE CRITERIA CONCENTRATIONS PER ANALYTE

Pesticides/PCBs, ug/kg (Cont'd)							
gamma-Chlordane	49						
Heptachlor	14	pure product	160				
Heptachlor epoxide	7.0	pure product	160				
Methoxychlor	140,000	pure product	200,000				
Toxaphene	58	1.06E+05	10,000				
Aroclor-1016	8.3						
Aroclor-1221	8.3						
Aroclor-1232	8.3						
Aroclor-1242	8.3						
Aroclor-1248	8.3						
Aroclor-1254	8.3						
Aroclor-1260	8.3						

[a] Pu-239/240 value is actually 0.34 pCi/g for Pu-239 and 0.34 pCi/g for Pu-240.
[b] U-235/236 value is for U-235 only.
[c] Alpha-chlordane only.
[d] Hexavalent chromium value.
[e] Based on natural uranium.
[f] Pu-239/240 value is for Pu-240 only.

TABLE 3-8
CONSTITUENTS OF CONCERN CONSIDERED MORE SIGNIFICANT

Radioactive Constituents

Elemental Uranium
Uranium-234
Uranium-235
Uranium-238
Technetium-99
Thorium-230

Volatiles

Tetrachloroethene

Inorganics

Barium
Cadmium
Chromium
Lead
Mercury

Semivolatiles

1,4-Dichlorobenzene
Hexachlorobutadiene
Nitrobenzene

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Table 3-9
Source Term by Constituent of Concern *

Sort Class	Parameter	Source Term (kg)
INORGANICS		
	Antimony	770.00
	Arsenic	2,090.00
	Barium	24,600.00
	Beryllium	399.00
	Cadmium	765.00
	Chromium	2,470,000.00
	Copper	182,000.00
	Lead	101,000.00
	Manganese	863,000.00
	Mercury	28.30
	Nickel	1,730,000.00
	Selenium	24.30
	Silver	2,960.00
	Thallium	93.70
	Vanadium	6,700.00
	Zinc	36,500.00
PESTICIDES & PCBs		
	alpha-Chlordane	0.08
	Aroclor-1248	0.08
	Aroclor-1254	16.70
	Aroclor-1260	10.50
	Dieldrin	0.02
	gamma-Chlordane	0.08
RADIOISOTOPES		
	Americium-241	0.00
	Cesium-137	0.00
	Lead-210	0.00
	Neptunium-237	0.07
	Plutonium-238	0.00
	Plutonium-239/240	0.00
	Plutonium-241	0.00
	Polonium-210	0.00
	Radium-226	0.01
	Radium-228	0.00
	Strontium-90	0.00
	Technetium-99	0.13
	Thorium, Total	882,000.00
	Thorium-228	0.00
	Thorium-230	0.14
	Thorium-232	4,320.00
	Uranium, Total	10,800,000.00
	Uranium-233/234	9.58
	Uranium-234	5.47
	Uranium-235/236	41,700.00
	Uranium-238	7,550,000.00

Table 3-9 (Continued) *

Sort Class	Parameter	Source Term (kg)
SEMIVOLATILE		
	1,4-Dichlorobenzene	94.20
	2,4-Dinitrotoluene	0.00
	Benzo(a)anthracene	2.20
	Benzo(a)pyrene	0.25
	Benzo(b)fluoranthene	0.20
	Benzo(k)fluoranthene	0.01
	bis(2-Ethylhexyl)phthalate	6.31
	Carbazole	0.00
	Chrysene	6.90
	Dibenzo(a,h)anthracene	0.00
	Hexachlorobutadiene	81.60
	Indeno(1,2,3-cd)pyrene	0.00
	N-Nitroso-di-n-propylamine	0.00
	Nitrobenzene	155.00
	Pentachlorophenol	0.00
VOLATILE		
	Benzene	0.00
	Styrene	0.04
	Tetrachloroethene	351.00

* Note: Includes source term contribution from inventory and soil piles.

TABLE 3-10
SUMMARY OF SOURCE TERM FOR ELEMENTAL URANIUM BY COMPONENT/MATERIAL CATEGORIES
OPERABLE UNIT 3 -FEMP

	Material Type Category										
	A	B	C	D	E	F	G	H	I	J	
Component Category	Accessible Metals	Inaccessible Metals	Process-Related Metals	Painted, Light-Gauge Metals	Concrete	Brick	Non-Regulated ACM	Regulated ACM	Misc-Materials	Product, Residues and Special Materials	Totals [b]
1 - Administrative Support	1.09	4.84	0.323	3.26	329	0	1.73	0.055	3.94	1.21	345
2 - Warehouse/Storage	2.76	0.866	0.0253	3.17	2,610	0	4.17	0.0227	0.386	0.0116	2,620
3 - Process	2,380	1,960	283,000	1,390	22,400	5,100	14,100	111	212	2,540,000	2,870,000
4 - Process Support	208	131	44,600	72.2	404	21.8	707	1.45	31.5	402,000	448,000
5 - Aboveground Containers/Containerized Material	3.09	9.24	0.881	0.0633	230	235	3.05	3.96	0.00039	7,510,000	7,510,000
6 - Belowground Containers/Containerized Material	0	0	0	0	0	0	0	0	0	0	0
7 - Bulk Material	0	0	0	0	0	0	0	0	0	0	0
8 - Pads, Roads, Railroads, Parking Lot	0	0	0	0	12,100	3.48	0	0	0	0	12,100
9 - Aboveground Piping, Utilities, Equipment	1.46	3.1	0.337	0.113	96.1	0	0.0153	0.0000817	0.0563	0.0166	101
10 - Belowground Piping, Utilities, Equipment	.0000314	1.56	0.166	0	236	0	0	0.00777	0.418	0	238
11 - Ponds/Basins	0.0179	0.0564	0.00184	0	13.5	0	0	0.0000122	0	0	14
Totals [b]	2,600	2,110	328,000	1,470	38,400	5,360	14,800	116	248	10,500,000	10,800,000

[a] All weights are in kilograms.
[b] Totals are rounded.

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TABLE 3-11
SUMMARY OF SOURCE TERM[a] FOR TECHNETIUM-99 BY COMPONENT/MATERIAL CATEGORIES
OPERABLE UNIT 3 -FEMP

	Material Type Category										
	A	B	C	D	E	F	G	H	I	J	
Component Category	Accessible Metals	Inaccessible Metals	Process-Related Metals	Painted, Light-Gauge Metals	Concrete	Brick	Non-Regulated ACM	Regulated ACM	Misc-Materials	Product, Residues and Special Materials	Totals [b]
1 - Administrative Support	5.62E-06	3.01E-05	2.03E-06	1.76E-05	6.28E-04	0	2.82E-06	8.14E-08	2.02E-05	7.27E-06	7.14E-04
2 - Warehouse/Storage	9.38E-07	2.92E-07	8.63E-09	1.27E-06	7.11E-03	0	3.24E-06	2.27E-08	4.02E-06	4.23E-09	7.12E-03
3 - Process	2.51E-03	2.20E-03	3.80E-04	1.56E-03	7.14E-02	4.98E-03	7.27E-03	5.91E-05	9.89E-05	2.23E-03	9.27E-02
4 - Process Support	3.61E-05	2.30E-05	3.37E-06	1.27E-05	6.00E-04	4.80E-07	5.54E-05	1.45E-07	5.21E-06	1.56E-05	7.52E-04
5 - Aboveground Containers/Containerized Material	9.20E-07	1.24E-06	1.19E-07	7.73E-09	6.12E-04	2.57E-03	8.44E-08	1.02E-07	1.55E-08	1.38E-09	3.18E-03
6 - Belowground Containers/Containerized Material	0	0	0	0	0	0	0	0	0	0	0.00E+00
7 - Bulk Material	0	0	0	0	0	0	0	0	0	2.50E-06	2.50E-06
8 - Pads, Roads, Railroads, Parking Lot	0	0	0	0	2.23E-02	1.03E-05	0	0	0	0	2.23E-02
9 - Aboveground Piping, Utilities, Equipment	7.06E-07	1.50E-06	1.63E-07	5.47E-08	4.31E-05	0	8.76E-07	4.66E-09	1.48E-06	8.02E-09	4.79E-05
10 - Belowground Piping, Utilities, Equipment	1.52E-11	7.54E-07	8.05E-08	0	4.46E-04	0	0	4.44E-07	7.07E-06	0	4.54E-04
11 - Ponds/Basins	8.64E-09	2.73E-08	8.89E-10	0	3.42E-05	0	0	6.94E-10	0	0	3.42E-05
Totals [b]	2.55E-03	2.26E-03	3.86E-04	1.59E-03	1.03E-01	7.56E-03	7.33E-03	5.99E-05	1.37E-04	2.26E-03	1.27E-01

[a] All weights are in kilograms.
[b] Totals are rounded.

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TABLE 3-12
SUMMARY OF SOURCE TERM FOR THORIUM-230 BY COMPONENT/MATERIAL CATEGORIES
OPERABLE UNIT 3 -FEMP

	Material Type Category										
	A	B	C	D	E	F	G	H	I	J	
Component Category	Accessible Metals	Inaccessible Metals	Process-Related Metals	Painted, Light-Gauge Metals	Concrete	Brick	Non-Regulated ACM	Regulated ACM	Misc-Materials	Product, Residues and Special Materials	Totals [b]
1 - Administrative Support	3.09E-06	1.33E-05	8.88E-07	8.55E-06	9.99E-04	0	4.13E-06	1.13E-07	2.79E-05	3.31E-06	1.06E-03
2 - Warehouse/Storage	9.00E-06	2.73E-06	7.59E-08	1.04E-05	4.75E-03	0	5.35E-06	4.11E-08	8.66E-06	4.16E-08	4.79E-03
3 - Process	7.67E-03	7.39E-03	1.28E-03	6.32E-03	1.86E-02	7.00E-03	6.90E-02	4.97E-04	5.60E-04	7.81E-03	1.26E-01
4 - Process Support	1.81E-04	1.18E-04	1.71E-05	6.43E-05	1.21E-03	3.89E-06	1.14E-03	2.39E-06	3.52E-05	7.72E-05	2.85E-03
5 - Aboveground Containers/Containerized Material	7.94E-06	9.88E-06	9.40E-07	5.37E-08	1.19E-03	9.85E-04	3.83E-07	4.82E-07	3.44E-08	1.25E-08	2.19E-03
6 - Belowground Containers/Containerized Material	0	0	0	0	0	0	0	0	0	0	0.00E+00
7 - Bulk Material	0	0	0	0	0	0	0	0	0	0	0.00E+00
8 - Pads, Roads, Railroads, Parking Lot	0	0	0	0	5.69E-03	4.15E-06	0	0	0	0	5.69E-03
9 - Aboveground Piping, Utilities, Equipment	6.40E-06	1.36E-05	1.48E-06	4.95E-07	8.31E-05	0	1.94E-06	1.03E-08	2.17E-07	7.27E-08	1.07E-04
10 - Belowground Piping, Utilities, Equipment	1.37E-10	6.83E-06	7.29E-07	0	8.47E-04	0	0	9.83E-07	1.03E-06	0	8.57E-04
11 - Ponds/Basins	7.82E-08	2.47E-07	8.05E-09	0	4.94E-05	0	0	1.54E-09	0	0	4.97E-05
Totals [b]	7.88E-03	7.55E-03	1.30E-03	6.40E-03	3.34E-02	7.99E-03	7.02E-02	5.01E-04	6.33E-04	7.89E-03	1.44E-01

[a] All weights are in kilograms.
[b] Totals are rounded.

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TABLE 3-13
SUMMARY OF SOURCE TERM FOR BARIUM BY COMPONENT/MATERIAL CATEGORIES
OPERABLE UNIT 3 -FEMP

	Material Type Category										
	A	B	C	D	E	F	G	H	I	J	
Component Category	Accessible Metals	Inaccessible Metals	Process-Related Metals	Painted, Light-Gauge Metals	Concrete	Brick	Non-Regulated ACM	Regulated ACM	Misc-Materials	Product, Residues and Special Materials	Totals [b]
1 - Administrative Support	16.20	55.80	3.55	49.80	1660.00	0	42.40	1.67	127.00	14.40	1970.82
2 - Warehouse/Storage	90.60	23.90	0.56	75.60	2960.00	0	0.92	0.05	14.80	0.35	3166.78
3 - Process	476.00	425.00	71.30	286.00	4710.00	637.00	499.00	50.30	85.80	398.00	7638.40
4 - Process Support	170.00	151.00	19.50	72.80	1790.00	1.01	126.00	0.70	13.20	51.20	2395.41
5 - Aboveground Containers/Containerized Material	48.80	76.00	7.98	0.02	580.00	117.00	0.04	0.06	0.06	0.01	829.97
6 - Belowground Containers/Containerized Material	0	0	0	0	0	0	0	0	0	0	0.00
7 - Bulk Material	0	0	0	0	0	0	0	0	0	0	0.00
8 - Pads, Roads, Railroads, Parking Lot	0	0	0	0	6910.00	0.25	0	0	0	0	6910.25
9 - Aboveground Piping, Utilities, Equipment	51.30	107.00	11.70	3.38	117.00	0	0.77	0.02	0.92	0.34	292.42
10 - Belowground Piping, Utilities, Equipment	0.00	0.66	0.07	0	1290.00	0	0	1.71	0	0	1292.45
11 - Ponds/Basins	0.56	1.68	0.06	0	74.80	0	0	0.00	0	0	77.10
Totals [b]	853.00	841.00	115.00	488.00	20100.00	755.00	669.00	54.50	242.00	464.00	24600.00

[a] All weights are in kilograms.
[b] Totals are rounded.

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TABLE 3-14
SUMMARY OF SOURCE TERM FOR CADMIUM BY COMPONENT/MATERIAL CATEGORIES
OPERABLE UNIT 3 -FEMP

	Material Type Category										
	A	B	C	D	E	F	G	H	I	J	
Component Category	Accessible Metals	Inaccessible Metals	Process-Related Metals	Painted, Light-Gauge Metals	Concrete	Brick	Non-Regulated ACM	Regulated ACM	Misc-Materials	Product, Residues and Special Materials	Totals [b]
1 - Administrative Support	0.11	0.14	0.01	0.19	58.80	0	1.76	0.07	4.43	0.02	65.52
2 - Warehouse/Storage	1.63	0.45	0.01	1.44	105.00	0	0.05	0.00	0.38	0	108.97
3 - Process	9.15	9.00	1.47	9.10	157.00	1.78	0.35	0.04	1.13	9.26	198.29
4 - Process Support	3.68	2.85	0.35	1.08	56.50	0.01	4.00	0.02	0.32	0.92	69.73
5 - Aboveground Containers/Containerized Material	1.01	1.28	0.13	0.00	20.50	0.66	0.00	0.00	0.00	0.00	23.59
6 - Belowground Containers/Containerized Material	0	0	0	0	0	0	0	0	0	0	0.00
7 - Bulk Material	0	0	0	0	0	0	0	0	0	0	0.00
8 - Pads, Roads, Railroads, Parking Lot	0	0	0	0	246.00	0.06	0	0	0	0	246.06
9 - Aboveground Piping, Utilities, Equipment	0.22	0.47	0.05	0.02	4.12	0	0.02	0.00	0.00	0.00	4.91
10 - Belowground Piping, Utilities, Equipment	0.00	0.19	0.02	0	45.50	0	0	0.04	0	0	45.75
11 - Ponds/Basins	0.01	0.03	0.00	0	2.69	0	0	0.00	0	0	2.73
Totals [b]	15.80	14.40	2.04	11.80	696.00	2.51	6.18	0.18	6.26	10.20	766.00

[a] All weights are in kilograms.

[b] Totals are rounded.

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TABLE 3-15
SUMMARY OF SOURCE TERM[a] FOR CHROMIUM BY COMPONENT/MATERIAL CATEGORIES
OPERABLE UNIT 3 -FEMP

	Material Type Category										
	A	B	C	D	E	F	G	H	I	J	
Component Category	Accessible Metals	Inaccessible Metals	Process-Related Metals	Painted, Light-Gauge Metals	Concrete	Brick	Non-Regulated ACM	Regulated ACM	Misc-Materials	Product, Residues and Special Materials	Totals [b]
1 - Administrative Support	8.77	10.3	0.605	13.6	270	0	1.82	0.0565	11	1.39	318
2 - Warehouse/Storage	135	40.2	1.13	152	460	0	0.242	0.0106	2.75	0.0246	791
3 - Process	1,330	1,910,000	212,000	668	744	137	86.5	4.8	18.9	1,010	2,130,000
4 - Process Support	208	307,000	34,100	69.2	319	0.113	10.3	0.0763	2.83	50.1	342,000
5 - Aboveground Containers/Containerized Material	74	36	3.52	0.0959	94.2	1.83	0.00639	0.00577	0.00985	0.038	210
6 - Belowground Containers/Containerized Material	0	0	0	0	0	0	0	0	0	0	0
7 - Bulk Material	0	0	0	0	0	0	0	0	0	0	0
8 - Pads, Roads, Railroads, Parking Lot	0	0	0	0	1,060	0.1	0	0	0	0	1,060
9 - Aboveground Piping, Utilities, Equipment	52.9	110	12	4.11	23.9	0	0.122	0.00283	192	0.504	396
10 - Belowground Piping, Utilities, Equipment	0.00155	7.93	0.846	0	202	0	0	0.269	0	0	211
11 - Ponds/Basins	0.884	2.65	0.091	0	11.7	0	0	0.000421	0	0	15
Totals [b]	1,810	2,220,000	246,000	907	3,180	139	99	5	227	1,060	2,470,000

[a] All weights are in kilograms.

[b] Totals are rounded.

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TABLE 3-16
SUMMARY OF SOURCE TERM FOR LEAD BY COMPONENT/MATERIAL CATEGORIES
OPERABLE UNIT 3 -FEMP

	Material Type Category										
	A	B	C	D	E	F	G	H	I	J	
Component Category	Accessible Metals	Inaccessible Metals	Process-Related Metals	Painted, Light-Gauge Metals	Concrete	Brick	Non-Regulated ACM	Regulated ACM	Misc-Materials	Product, Residues and Special Materials	Totals [b]
1 - Administrative Support	712.00	2860.00	190.00	1850.00	163.00	0	6.86	0.26	590.00	660.00	7032.12
2 - Warehouse/Storage	3040.00	819.00	22.40	2410.00	241.00	0	0.59	0.02	16.60	0.35	6549.96
3 - Process	16700.00	14500.00	2430.00	10500.00	1290.00	204.00	2010.00	219.00	325.00	13700.00	61878.00
4 - Process Support	6100.00	5790.00	723.00	2170.00	176.00	0.39	213.00	1.00	38.80	1660.00	16872.19
5 - Aboveground Containers/Containerized Material	2040.00	1040.00	101.00	2.84	49.20	10.10	0.00	0.01	0.02	1.17	3244.34
6 - Belowground Containers/Containerized Material	0	0	0	0	0	0	0	0	0	0	0.00
7 - Bulk Material	0	0	0	0	0	0	0	0	0	0	0.00
8 - Pads, Roads, Railroads, Parking Lot	0	0	0	0	739.00	0.19	0	0	0	0	739.19
9 - Aboveground Piping, Utilities, Equipment	1070.00	2240.00	244.00	83.20	12.00	0	0.09	0.00	0.29	7.62	3657.20
10 - Belowground Piping, Utilities, Equipment	0.04	1180.00	126.00	0	103.00	0	0	0.20	0	0	1409.24
11 - Ponds/Basins	24.30	72.80	2.49	0	5.90	0	0	0.00	0	0	105.49
Totals [b]	29700.00	28500.00	3840.00	17000.00	2780.00	215.00	2230.00	220.00	971.00	16000.00	101000.00

[a] All weights are in kilograms.
[b] Totals are rounded.

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TABLE 3-17
SUMMARY OF SOURCE TERM FOR MERCURY BY COMPONENT/MATERIAL CATEGORIES
OPERABLE UNIT 3 -FEMP

	Material Type Category										
	A	B	C	D	E	F	G	H	I	J	
Component Category	Accessible Metals	Inaccessible Metals	Process-Related Metals	Painted, Light-Gauge Metals	Concrete	Brick	Non-Regulated ACM	Regulated ACM	Misc-Materials	Product, Residues and Special Materials	Totals [b]
1 - Administrative Support	1.97E-02	2.80E-02	1.70E-03	3.21E-02	1.67E+00	0	1.91E-01	7.57E-03	4.60E-01	4.43E-03	2.41E+00
2 - Warehouse/Storage	2.73E-01	7.68E-02	2.13E-03	3.08E-01	1.43E+00	0	3.22E-03	1.46E-04	3.53E-02	0	2.13E+00
3 - Process	.88E+00	1.32E+00	2.27E-01	9.64E-01	3.14E+00	4.61E-01	4.01E-01	4.12E-02	2.34E-01	1.31E+00	9.98E+00
4 - Process Support	5.36E-01	4.48E-01	5.29E-02	1.67E-01	1.65E+00	1.34E-01	1.07E+00	5.35E-03	5.94E-02	1.21E-01	4.24E+00
5 - Aboveground Containers/Containerized Material	1.84E-01	1.69E-01	1.68E-02	1.42E-03	3.63E-01	7.61E-01	9.49E-05	2.81E-04	1.41E-04	1.89E-04	1.50E+00
6 - Belowground Containers/Containerized Material	0	0	0	0	0	0	0	0	0	0	0.00E+00
7 - Bulk Material	0	0	0	0	0	0	0	0	0	0	0.00E+00
8 - Pads, Roads, Railroads, Parking Lot	0	0	0	0	6.69E+00	5.28E-03	0	0	0	0	6.70E+00
9 - Aboveground Piping, Utilities, Equipment	1.60E-01	3.36E-01	3.66E-02	1.13E-02	5.18E-02	0	1.80E-03	4.19E-05	1.29E-05	1.06E-03	5.99E-01
10 - Belowground Piping, Utilities, Equipment	3.29E-06	1.38E-03	1.46E-04	0	6.49E-01	0	0	3.99E-03	0	0	6.55E-01
11 - Ponds/Basins	1.88E-03	5.63E-03	1.93E-04	0	3.36E-02	0	0	6.24E-06	0	0	4.13E-02
Totals [b]	3.05E+00	2.38E+00	3.37E-01	1.48E+00	1.57E+01	1.36E+00	1.67E+00	5.86E-02	7.89E-01	1.44E+00	2.83E+01

[a] All weights are in kilograms.
[b] Totals are rounded.

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TABLE 3-18
SUMMARY OF SOURCE TERM[a] FOR NITROBENZENE BY COMPONENT/MATERIAL CATEGORIES
OPERABLE UNIT 3 -FEMP

	Material Type Category										
	A	B	C	D	E	F	G	H	I	J	
Component Category	Accessible Metals	Inaccessible Metals	Process-Related Metals	Painted, Light-Gauge Metals	Concrete	Brick	Non-Regulated ACM	Regulated ACM	Misc-Materials	Product, Residues and Special Materials	Totals [b]
1 - Administrative Support	0	0	0	0	0	0	0	0	0	0	0.00E+00
2 - Warehouse/Storage	0	0	0	0	0	0	0	0	0	0	0.00E+00
3 - Process	0	0	0	0	0	0	1.55E+02	0	0	0	1.55E+02
4 - Process Support	0	0	0	0	0	0	0	0	0	0	0.00E+00
5 - Aboveground Containers/Containerized Material	0	0	0	0	0	0	0	0	0	0	0.00E+00
6 - Belowground Containers/Containerized Material	0	0	0	0	0	0	0	0	0	0	0.00E+00
7 - Bulk Material	0	0	0	0	0	0	0	0	0	0	0.00E+00
8 - Pads, Roads, Railroads, Parking Lot	0	0	0	0	0	0	0	0	0	0	0.00E+00
9 - Aboveground Piping, Utilities, Equipment	0	0	0	0	0	0	0	0	0	0	0.00E+00
10 - Belowground Piping, Utilities, Equipment	0	0	0	0	0	0	0	0	0	0	0.00E+00
11 - Ponds/Basins	0	0	0	0	0	0	0	0	0	0	0.00E+00
Totals [b]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.55E+02	0.00E+00	0.00E+00	0.00E+00	1.55E+02

[a] All weights are in kilograms.
[b] Totals are rounded.

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TABLE 3-19
SUMMARY OF MATERIAL QUANTITY VOLUME BY SEGREGATION CATEGORIES
OPERABLE UNIT 3 - FEMP

	Material Type Category										
	A	B	C	D	E	F	G	H	I	J	
Component Category	Accessible Metals	Inaccessible Metals	Process-Related Metals	Painted, Light-Gauge Metals	Concrete	Brick	Non-Regulated ACM	Regulated ACM	Misc-Materials	Product, Residues and Special Materials	Totals [b]
BELOW BASELINE	0	0	0	0	4,250,000	0	2,680	11,700	488,000	0	4,750,000
HAZARDOUS	0	0	0	0	0	0	0	0	0	10.3	10
LOW LEVEL	63,400	1,700,000	191,000	7,100	498,000	10,500	49,800	58,500	53,200	1,740,000	4,370,000
MIXED	0	0	0	49.4	55,800	10,200	7,770	10,100	22,800	55,900	163,000
PCB WASTE	0	14,900	0	0	0	0	0	0	0	0	14,900
Totals [b]	63,400	1,710,000	191,000	7,150	4,800,000	20,700	60,300	80,300	564,000	1,800,000	9,300,000

[a] All volumes are in cubic feet.

[b] Totals are rounded.

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TABLE 3-20
SUMMARY OF MATERIAL QUANTITY WEIGHT BY SEGREGATION CATEGORIES
OPERABLE UNIT 3 - FEMP

	Material Type Category										
	A	B	C	D	E	F	G	H	I	J	
Component Category	Accessible Metals	Inaccessible Metals	Process-Related Metals	Painted, Light-Gauge Metals	Concrete	Brick	Non-Regulated ACM	Regulated ACM	Misc-Materials	Product, Residues and Special Materials	Totals [b]
BELOW BASELINE	0	0	0	0	292,000	0	404	26.3	3,510	0	296,000
HAZARDOUS	0	0	0	0	0	0	0	0	0	.48	0
LOW LEVEL	15,200	25,400	3,370	1,340	27,100	732	2,760	1,390	441	71,800	150,000
MIXED	0	0	0	17.5	3,680	717	466	22.6	287	2,920	8,110
PCB WASTE	0	334	0	0	0	0	0	0	0	0	334
Totals [b]	15,200	25,700	3,370	1,360	323,000	1,450	3,630	1,440	4,240	74,700	454,000

[a] All weights are in tons.
[b] Totals are rounded.

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TABLE 3-21

OPERABLE UNIT 3 DATA LIMITATIONS

Data Limitation	Significance to Alternatives Evaluation	Recommended Action/Justification
Per the WPA, sample locations within sampled process areas and components are based on survey data that identify the likely location of the maximum level of contamination within a particular media. In addition, some components were not sampled, based on process knowledge and observations that indicate the contamination is not expected.	Increased uncertainty in the contamination source terms (should be conservative) and volumes of material within a particular segregation category. This increases uncertainty in the cost estimates associated with all alternatives.	No additional sampling is required to support the RI/FS process. With few exceptions, components that were not sampled were visually inspected and/or surveyed with portable instruments. Components where contamination above prescribed limits was noted were included in the sampling program. Three components that were planned to be sampled were not because of health and safety considerations. These components were characterized using similar components. With few exceptions, as noted in Appendix B, sample data within a process area/component were applied to all material within that process area/component. Since samples were collected from the locations of maximum contamination within each process area/component, the amount of a particular contaminant and the volume/weight of material within particular segregation categories is expected to be conservative. Therefore, costs associated with the final disposition of these materials will be conservative. An indication of the amount of the conservatism in the estimates of the source term of each contaminant is provided in Appendix B, and summarized in Section 3.6, by estimating the source term based on both the actual sampling results within each process area/component. Therefore, the data are considered sufficient to evaluate remedial action alternatives. Following remedy selection, additional sampling may be performed during RD/RA to establish the specific boundaries of areas within specific components requiring additional decontamination or treatment. This would potentially reduce the amount of material requiring treatment or other special handling.
Fifty percent of the detected technetium-99 concentrations are estimated results (i.e., qualified by a "J" designation)	Increased uncertainty associated with technetium-99 results. Its presence is not in question, but its quantity is.	Employ caution when using technetium-99 data or results based on that data.
Data for uranium-235/236 exhibit a positive bias and are more variable than that for its companion isotopes.	Uranium enrichment calculated from direct measurement of uranium-235 is suspect.	Use uranium-234 data to calculate uranium enrichment.

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TABLE [illegible] (Continued)

Data Limitation	Significance to Alternatives Evaluation	Recommended Action/Justification
Some transite was inadvertently classified as low level waste (Tables 3-19 and 3-20) instead of mixed due to organics. This omission was due to a misapplication of the TCLP limits applied to transite in the computer program classifying material.	The amount of material considered hazardous is underestimated. However, the total amount of transite is only ten percent of the volume of material considered potentially hazardous, which is approximately one tenth of one percent of all OU3 materials, so the impact is insignificant.	This omission was discovered only during the final QC of the OU3 RI/FS Report. To correct the omission at that time was not practical. This will be corrected in the next draft of the OU3 RI/FS Report.

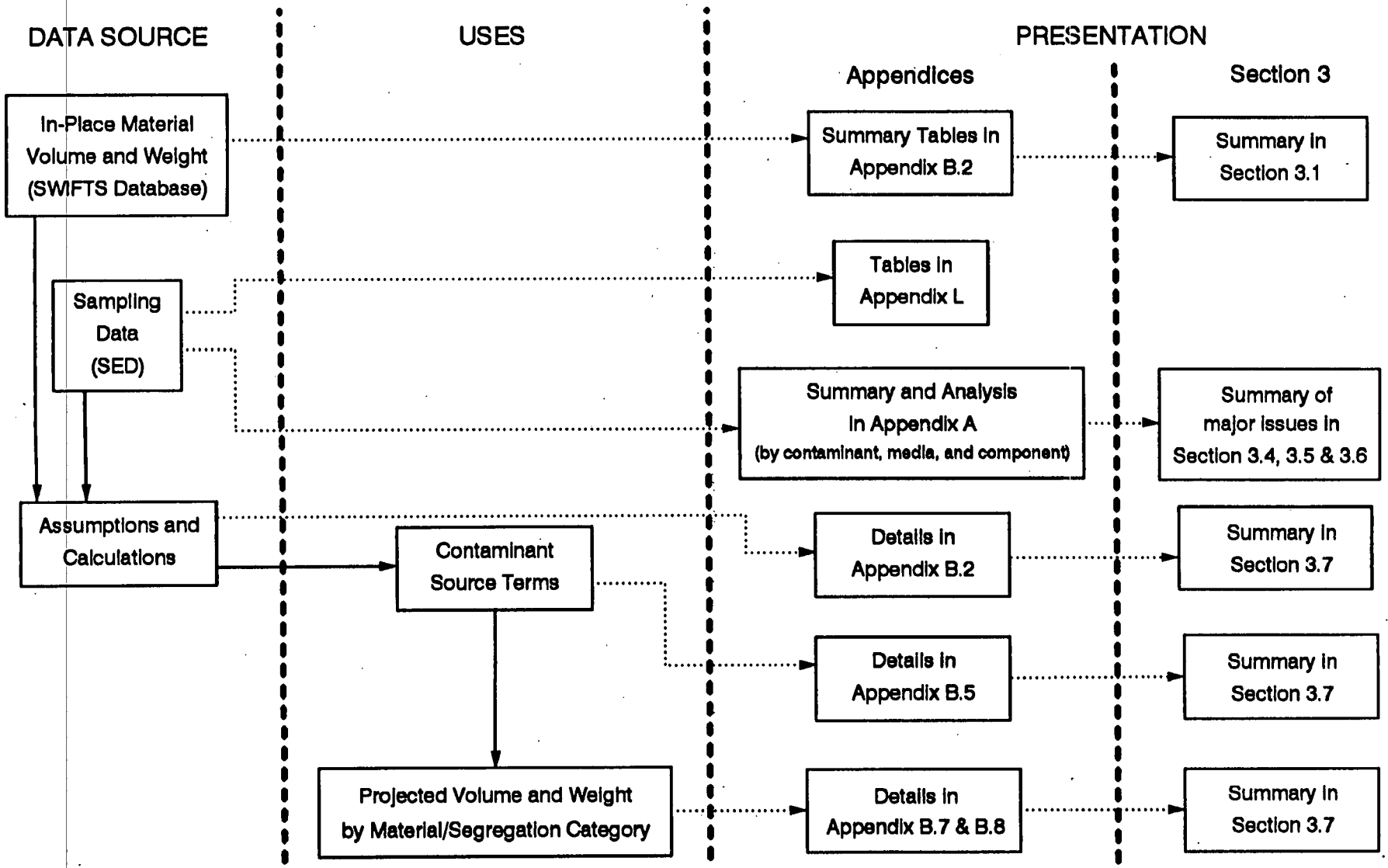
TABLE 3-22

COMPARISON OF MINIMUM/MAXIMUM SOURCE TERM ESTIMATES

Constituent of Concern	Minimum Source Term (kg)	Minimum ST/ST	Source Term (kg)	Maximum ST/ST	Maximum Source Term (kg)
Inorganics					
Chromium	2.47E+06	0.9989	2.47E+06	1.0709	2.64E+06
Lead	9.11E+04	0.8980	1.01E+05	10.8777	1.10E+06
Mercury	0.00E+00	0.0000	2.83E+01	120.5177	3.41E+03
Volatiles					
Tetrachloroethene	0.00E+00	0.0000	3.51E+02	8.3362	2.92E+03
Semivolatiles					
Nitrobenzene	0.00E+00	0.0000	1.55E+02	9.0318	1.40E+03
Pesticides/PCBs					
alpha-Chlordane	0.00E+00	0.0000	7.89E-02	236.8548	1.87E+01
Diedrin	0.00E+00	0.0000	1.64E-02	110.8549	1.82E+00
gamma-Chlordane	0.00E+00	0.0000	8.41E-02	237.8142	2.00E+01
Radionuclides					
Neptunium-237	4.37E-02	0.6294	6.95E-02	98.6799	6.85E+00
Strontium-90	0.00E+00	0.0000	2.92E-06	39.9011	1.17E-04
Technetium-99	7.00E-03	0.0550	1.27E-01	983.9258	1.25E+02
Elemental Uranium	3.27E+06	0.9808	3.34E+06	6.1505	2.05E+07

1- (Minimum ST/ST) is the ratio of the Minimum Source Term divided by the Source Term

2- (Maximum ST/ST) is the ratio of the Maximum Source Term divided by the Source Term



Note: Solid lines indicate primary flow of information, dotted lines indicate the generation of summary data.

FIGURE 3-1

USE AND PRESENTATION OF AVAILABLE DATA FOR CHARACTERIZATION OF OPERABLE UNIT 3

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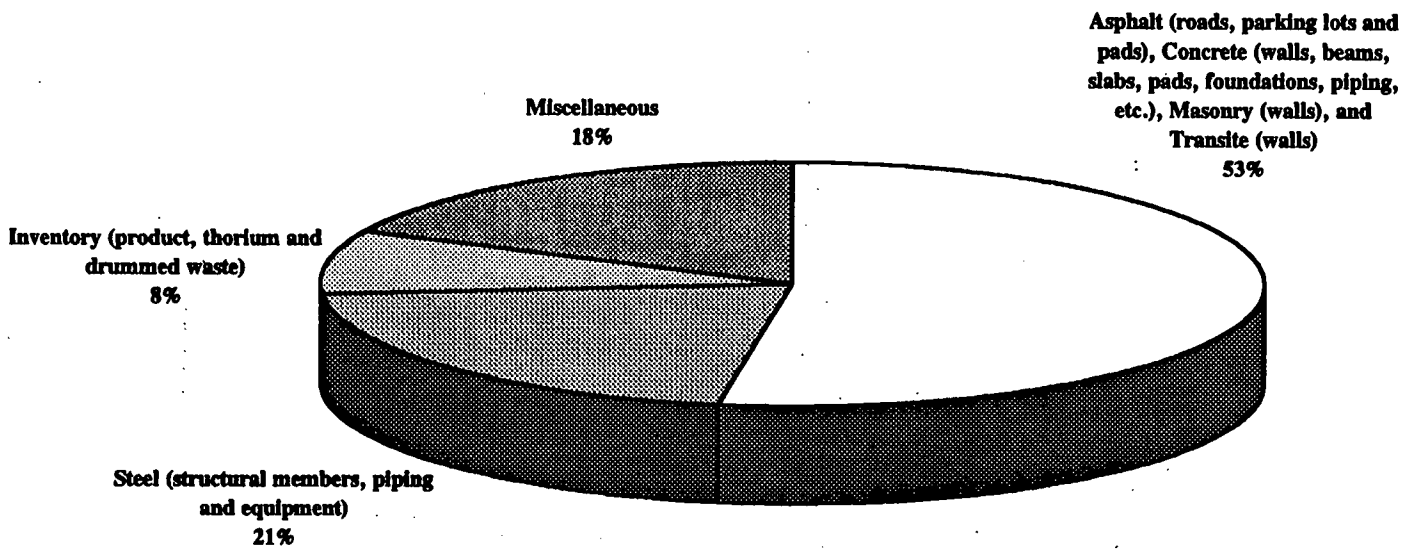

FIGURE 3-2
DISTRIBUTION OF MATERIAL VOLUME WITHIN OU3

000213

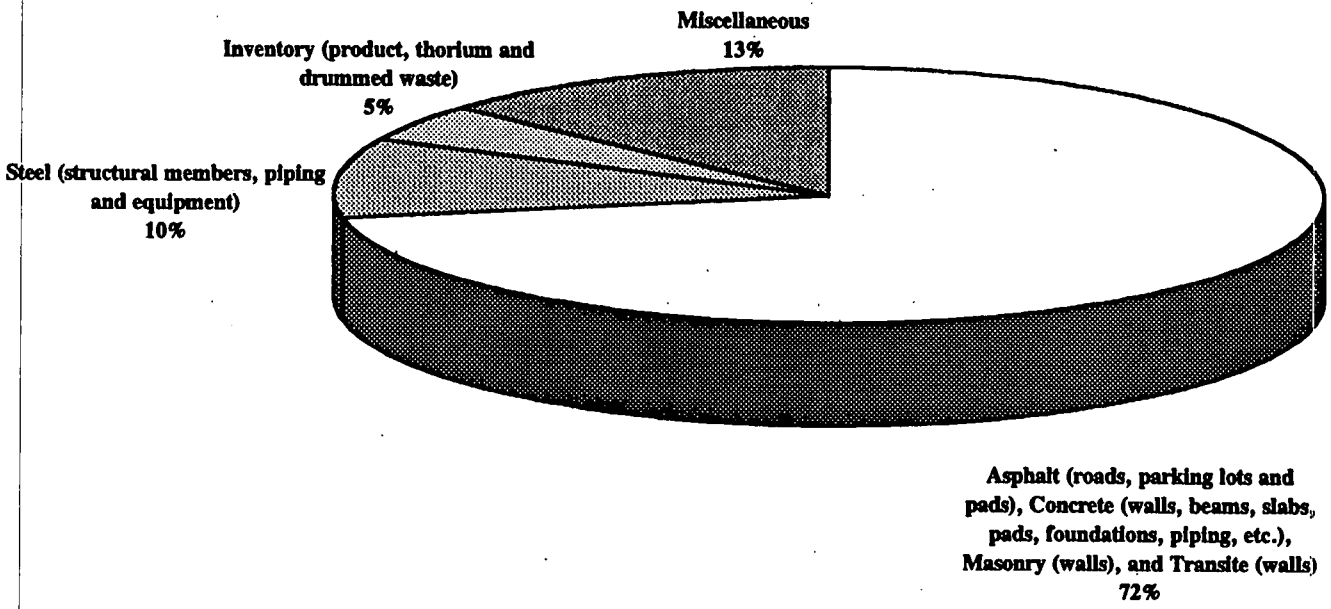

FIGURE 3-3
DISTRIBUTION OF MATERIAL WEIGHT WITHIN OU3

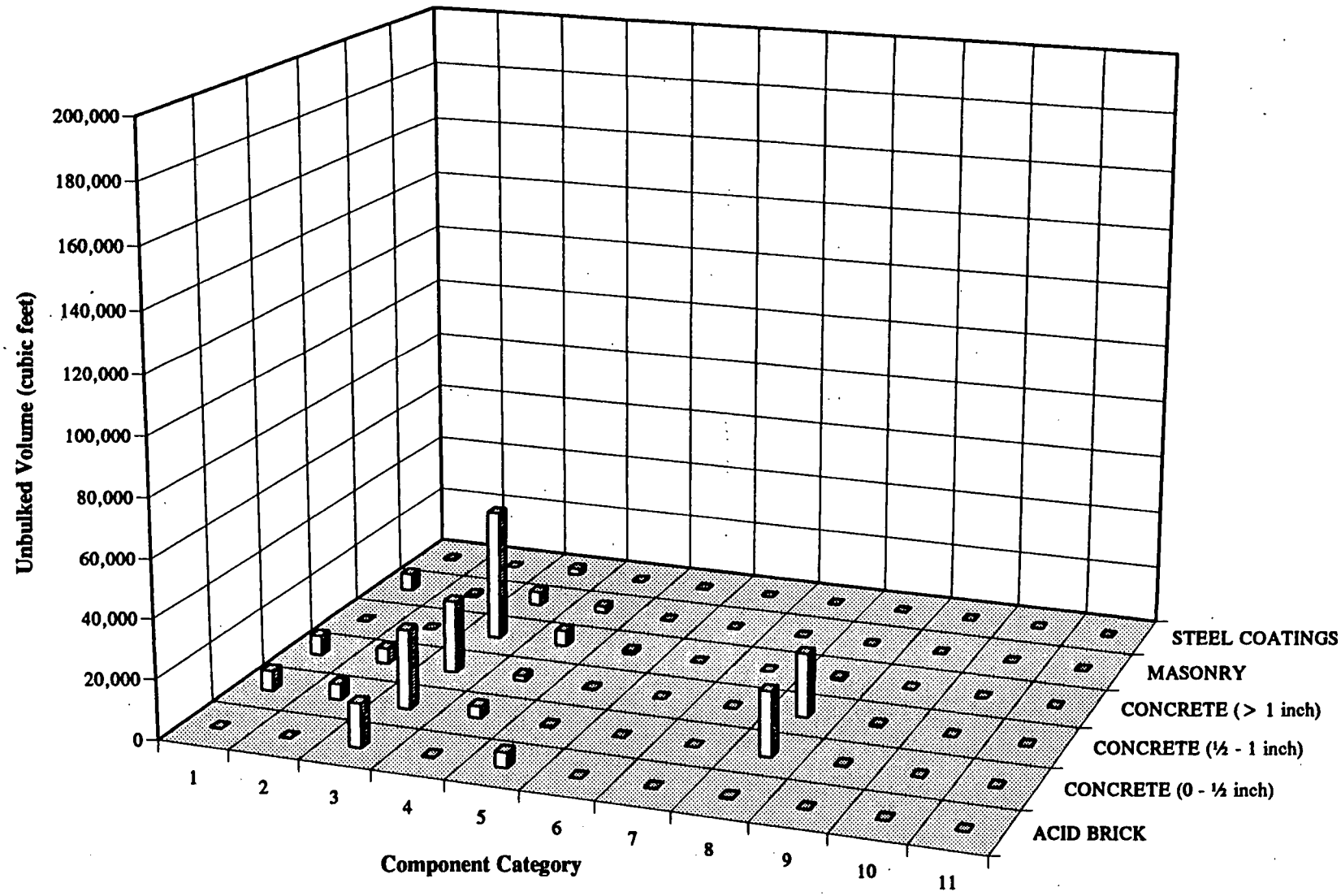

FIGURE 3-4
MATERIAL VOLUME EXCEEDING BASELINE FOR TOTAL URANIUM

000215

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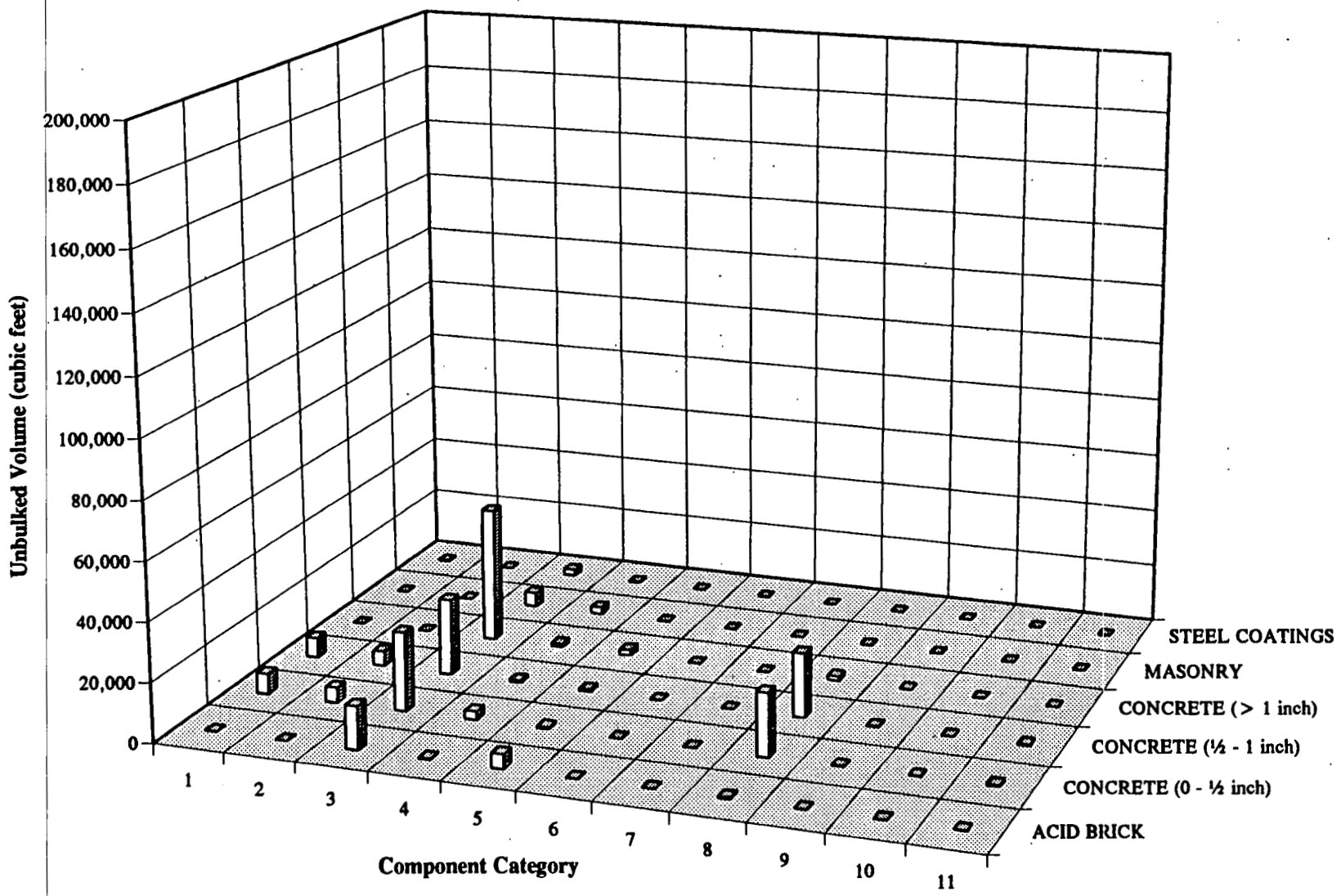

FIGURE 3-5
MATERIAL VOLUME EXCEEDING BASELINE FOR TECHNETIUM-99

000216

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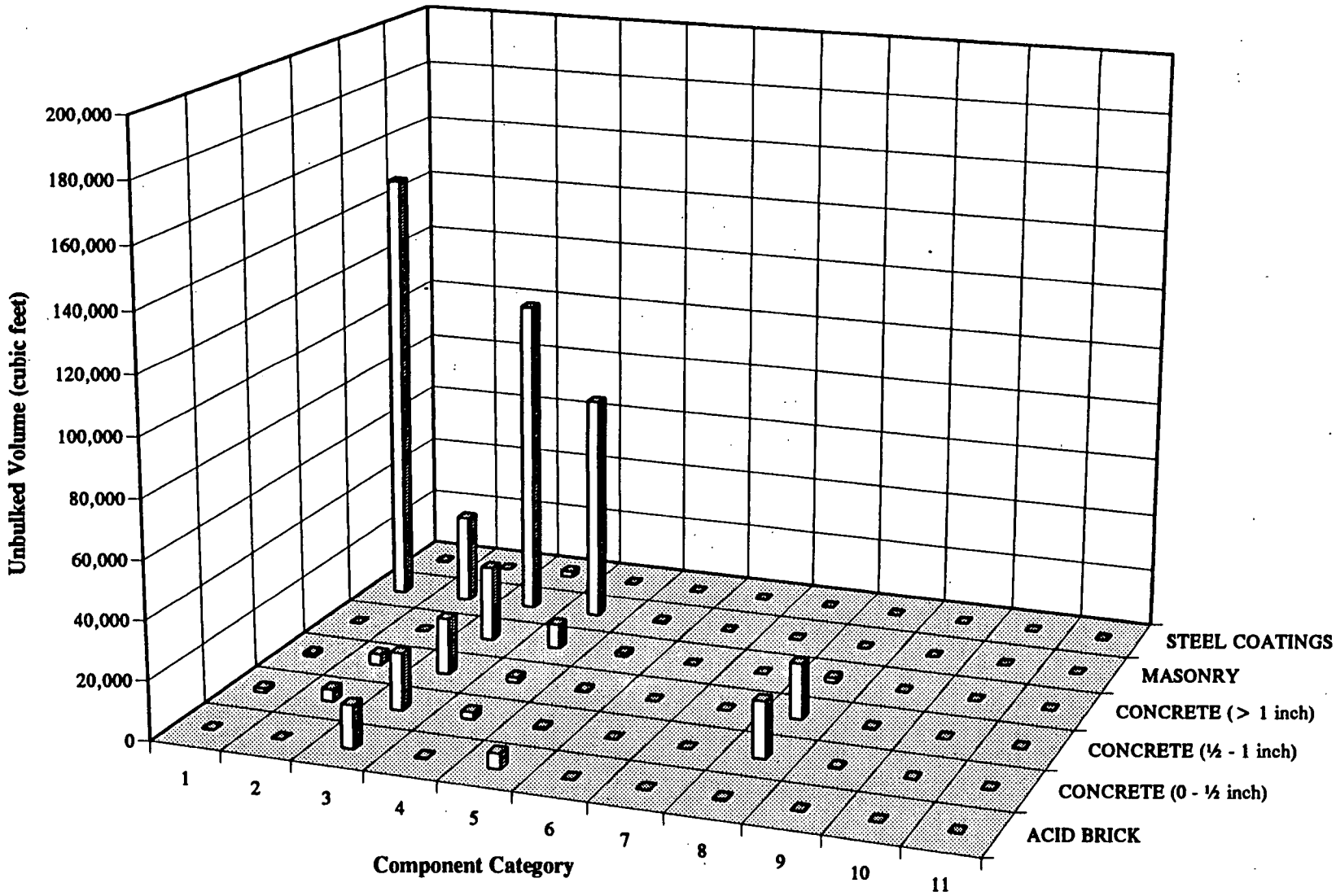

FIGURE 3-6
MATERIAL VOLUME EXCEEDING BASELINE FOR THORIUM-230

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000217

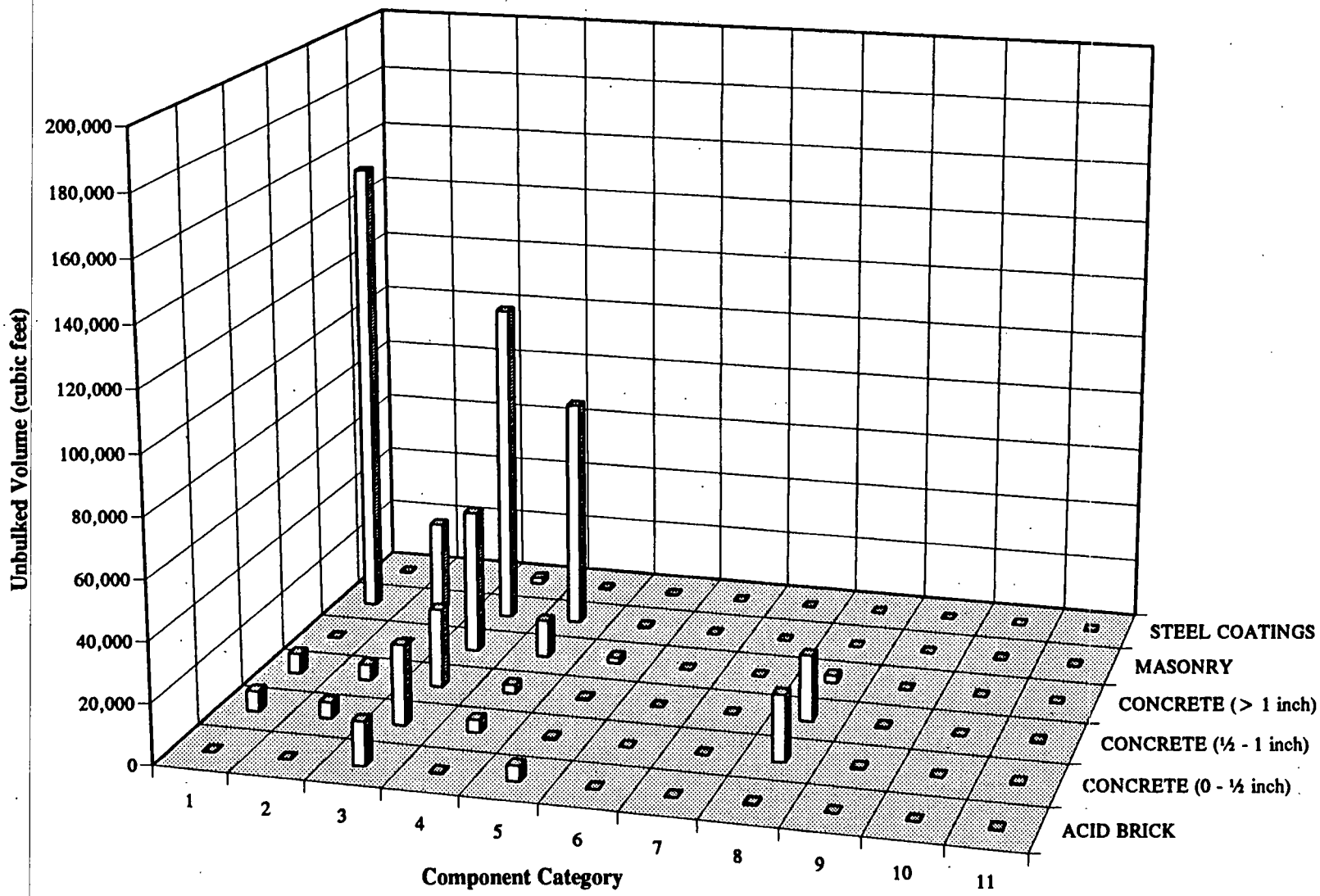

FIGURE 3-7
VOLUME OF MATERIAL EXCEEDING RADIOLOGICAL BASELINES
(for technetium-99, thorium-230 and uranium)

000218

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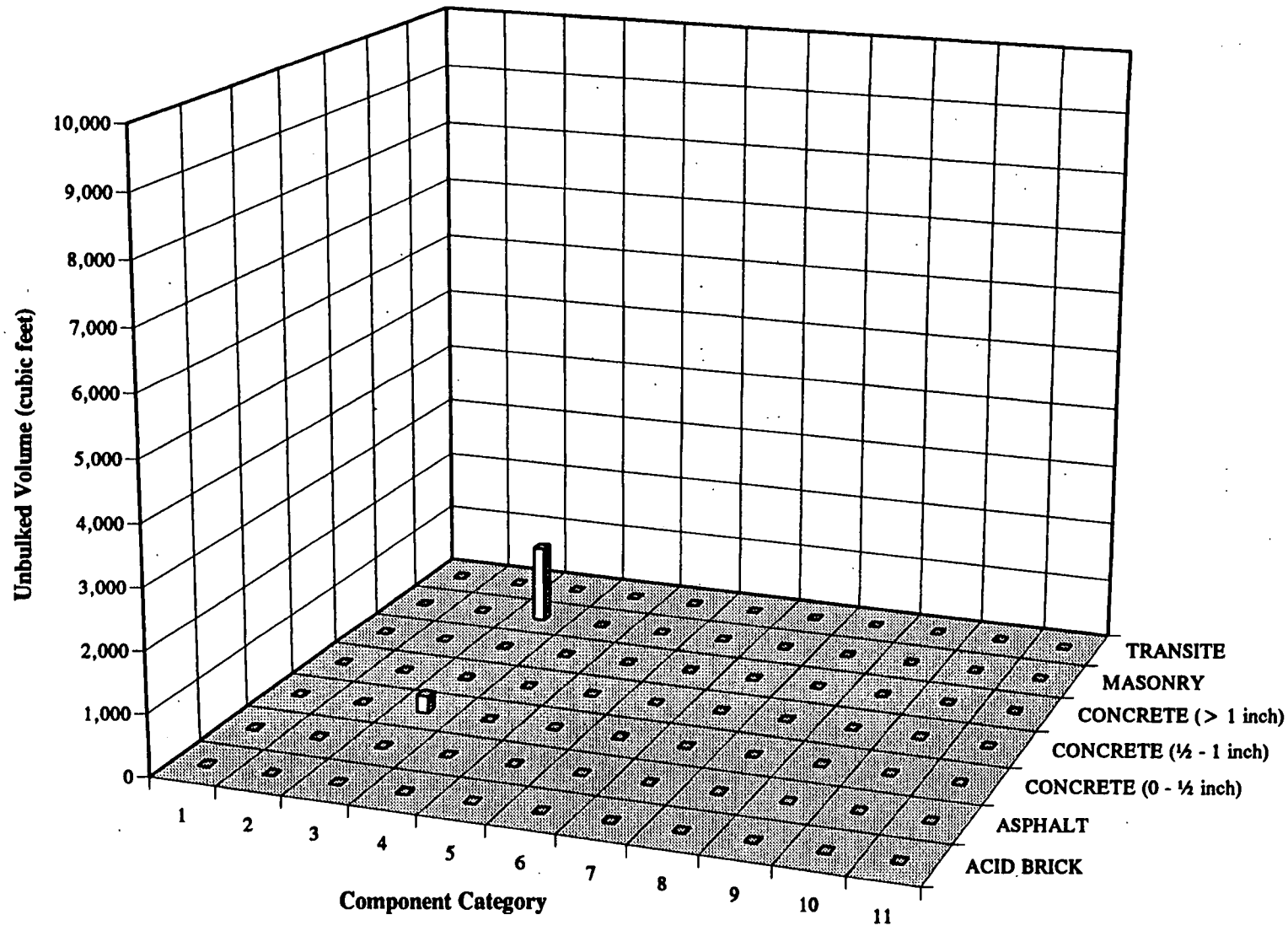

FIGURE 3-8
MATERIAL VOLUME CONSIDERED POTENTIALLY HAZARDOUS FOR BARIUM

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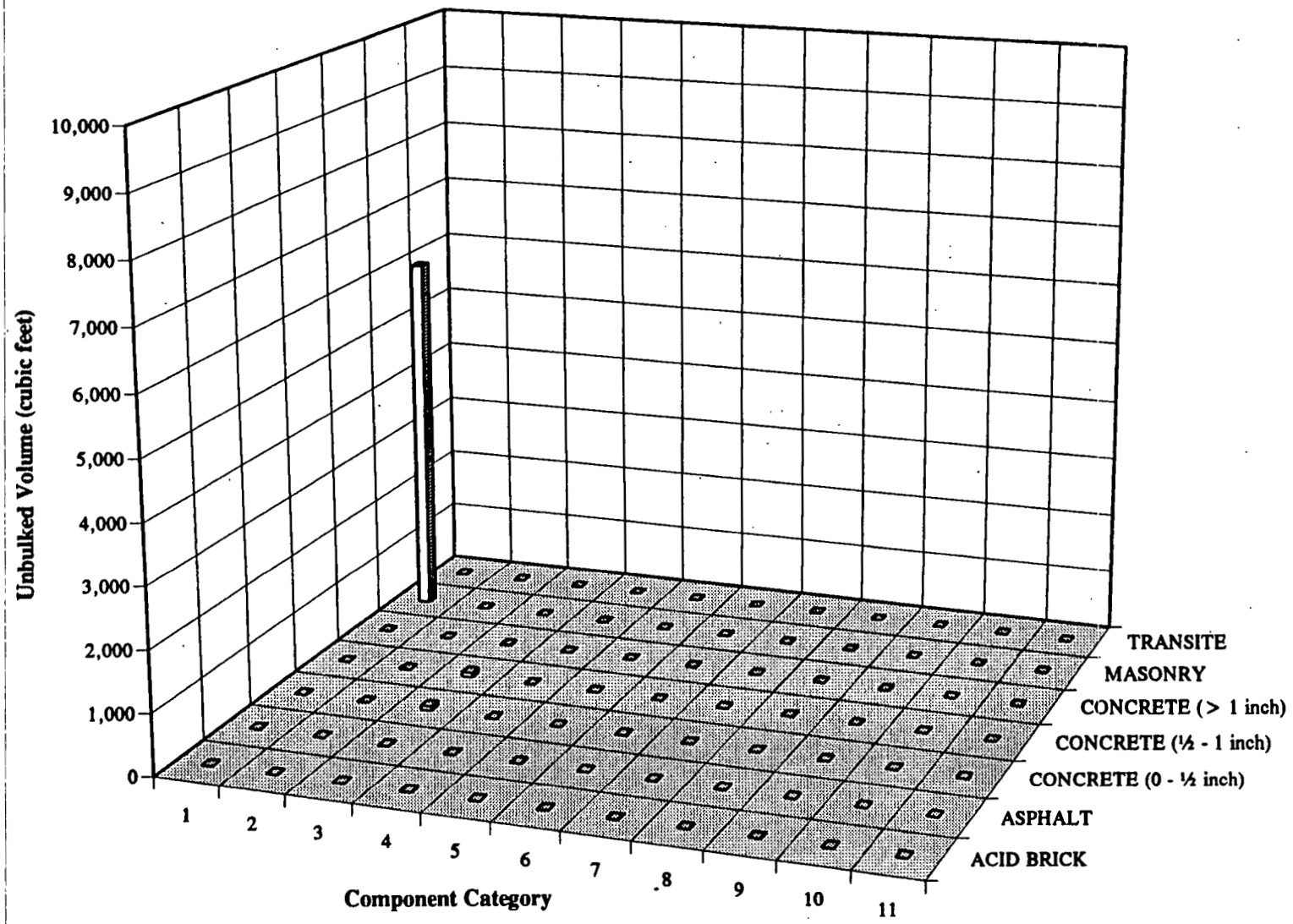

FIGURE 3-9
MATERIAL VOLUME CONSIDERED POTENTIALLY HAZARDOUS FOR CADMIUM

000220

0212

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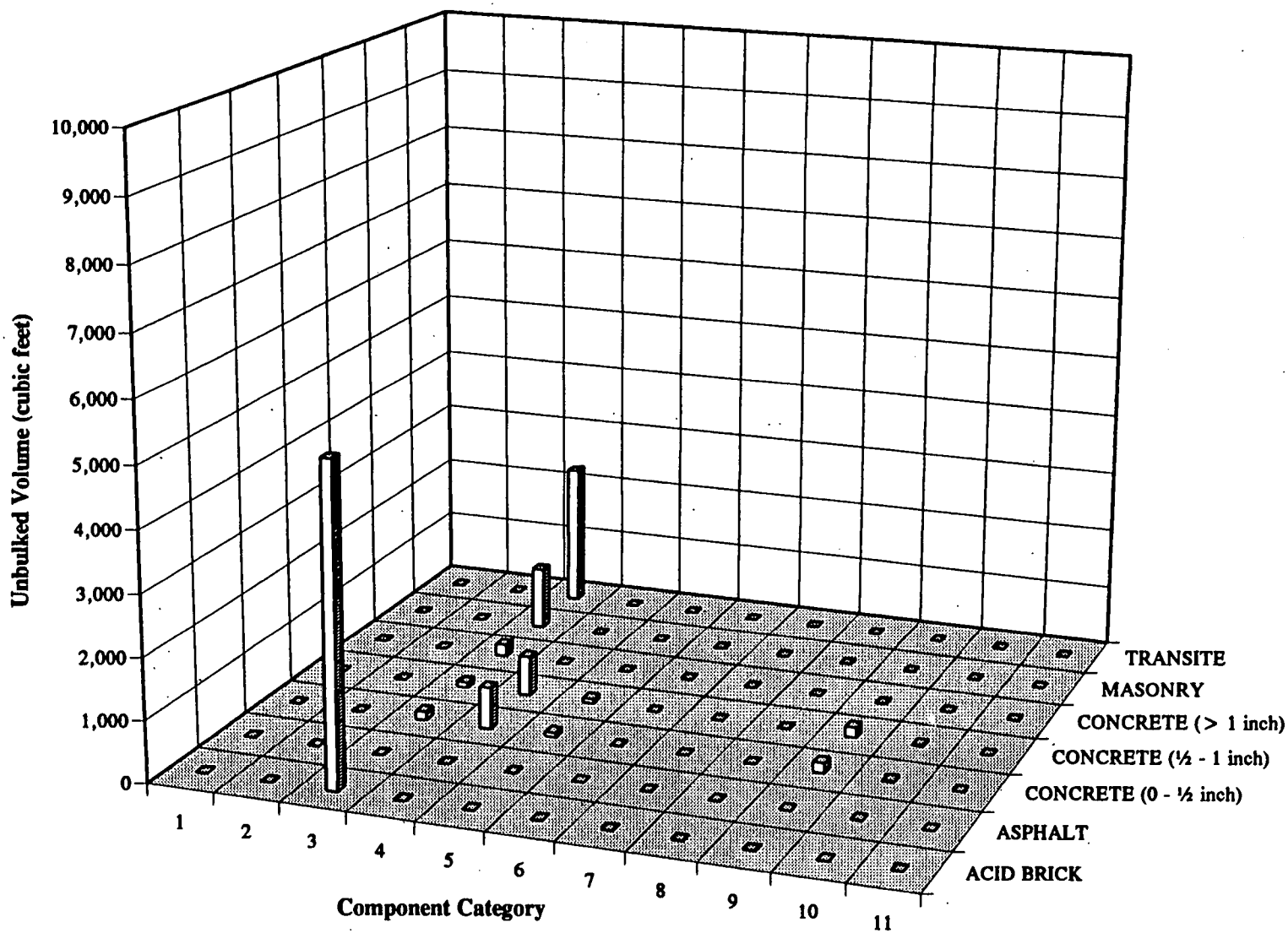

FIGURE 3-10
MATERIAL VOLUME CONSIDERED POTENTIALLY HAZARDOUS FOR CHROMIUM

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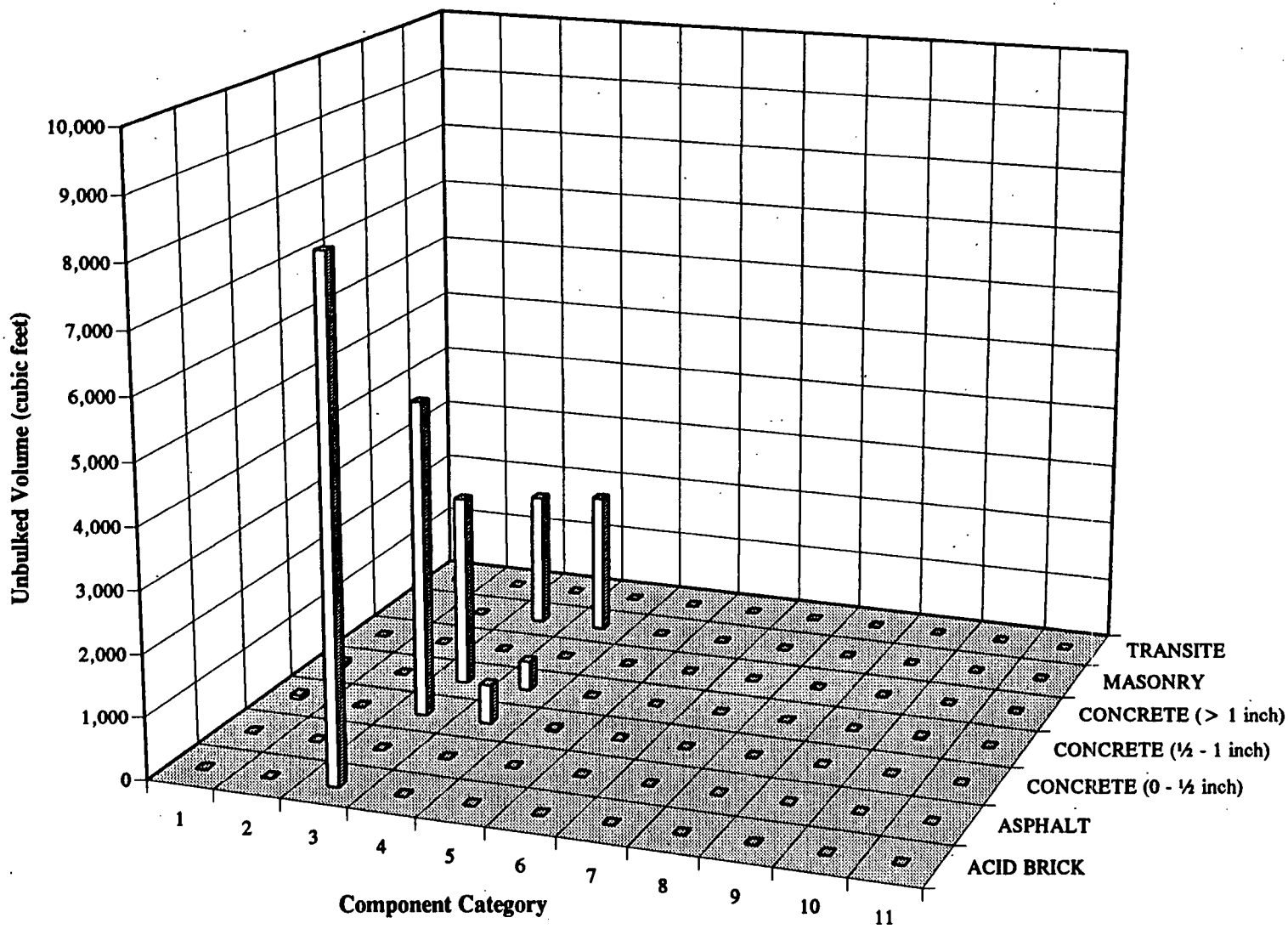

FIGURE 3-11
MATERIAL VOLUME CONSIDERED POTENTIALLY HAZARDOUS FOR LEAD

022200

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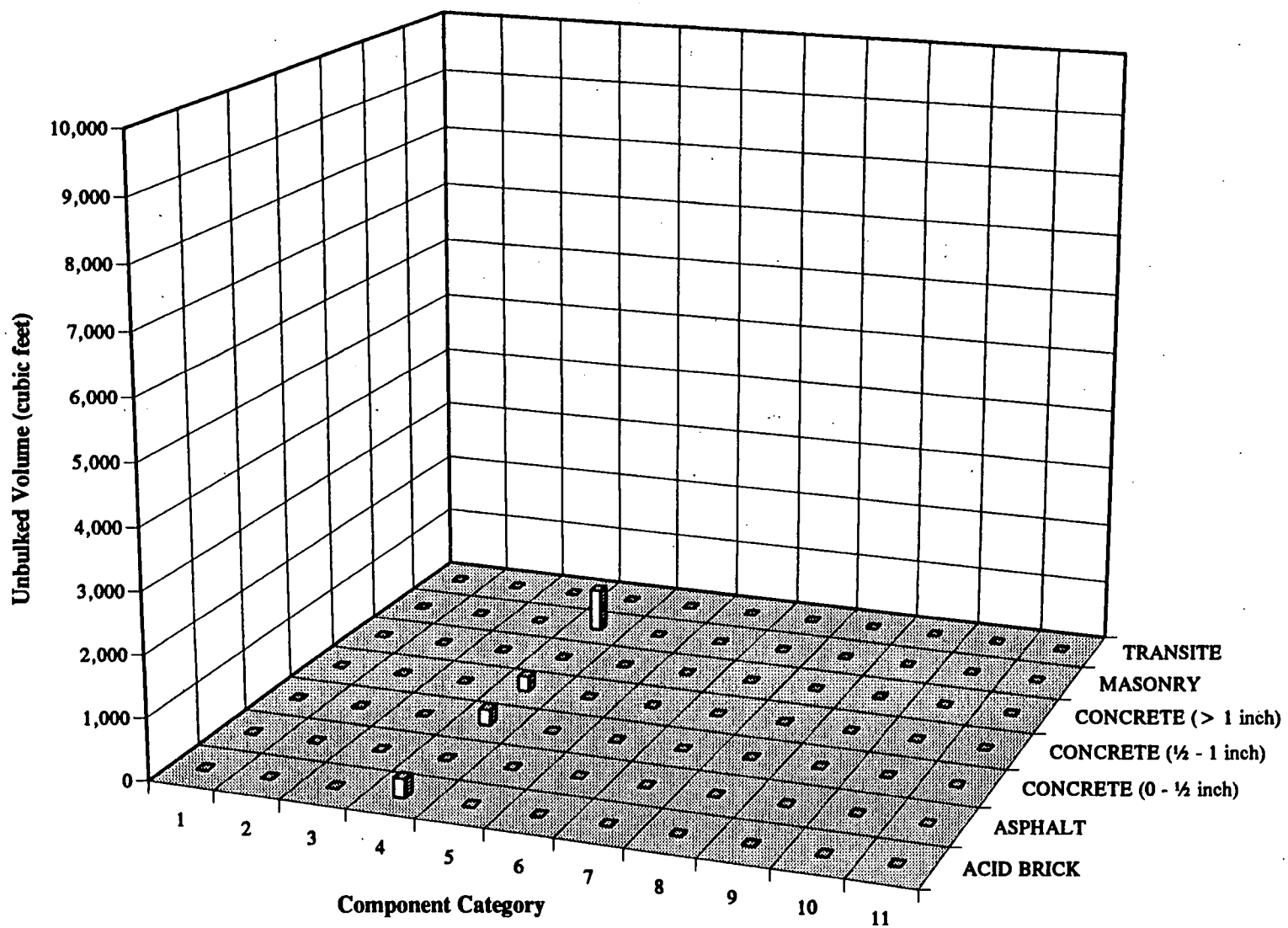

FIGURE 3-12
MATERIAL VOLUME CONSIDERED POTENTIALLY HAZARDOUS FOR MERCURY

000223

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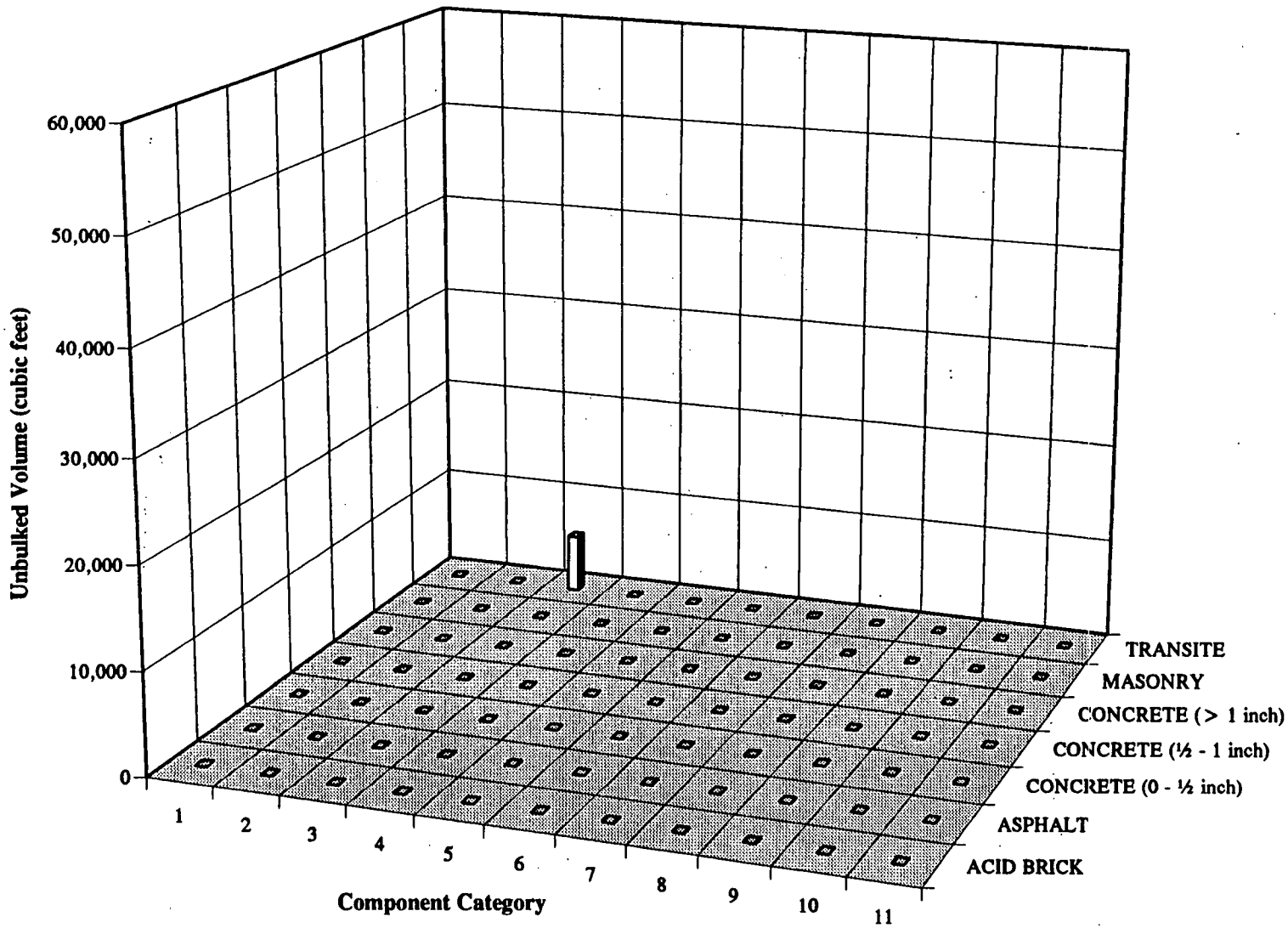

FIGURE 3-13
VOLUME OF MATERIAL CONSIDERED POTENTIALLY HAZARDOUS FOR TETRACHLOROETHENE

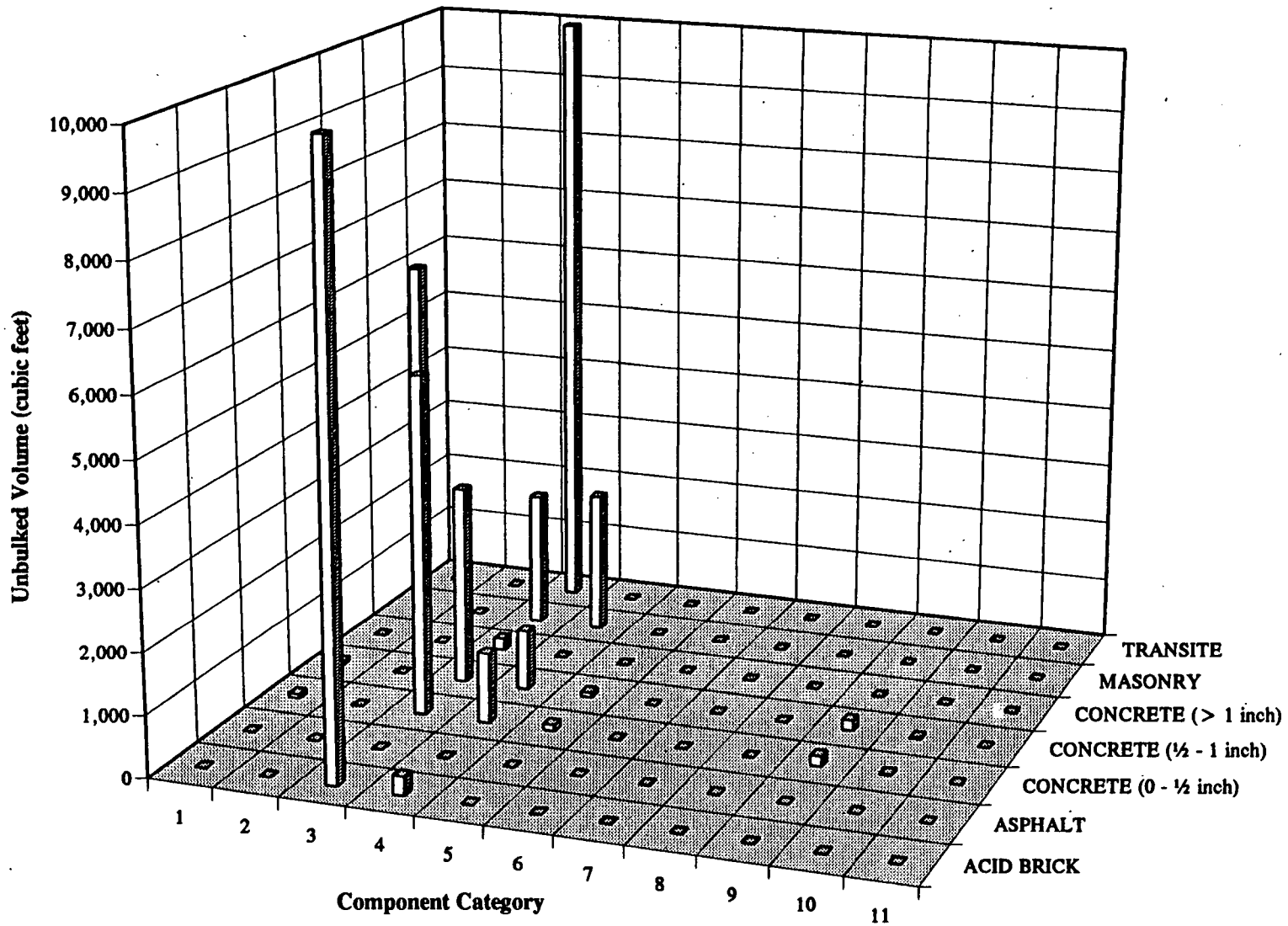

FIGURE 3-14
VOLUME OF MATERIAL CONSIDERED POTENTIALLY HAZARDOUS

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000225

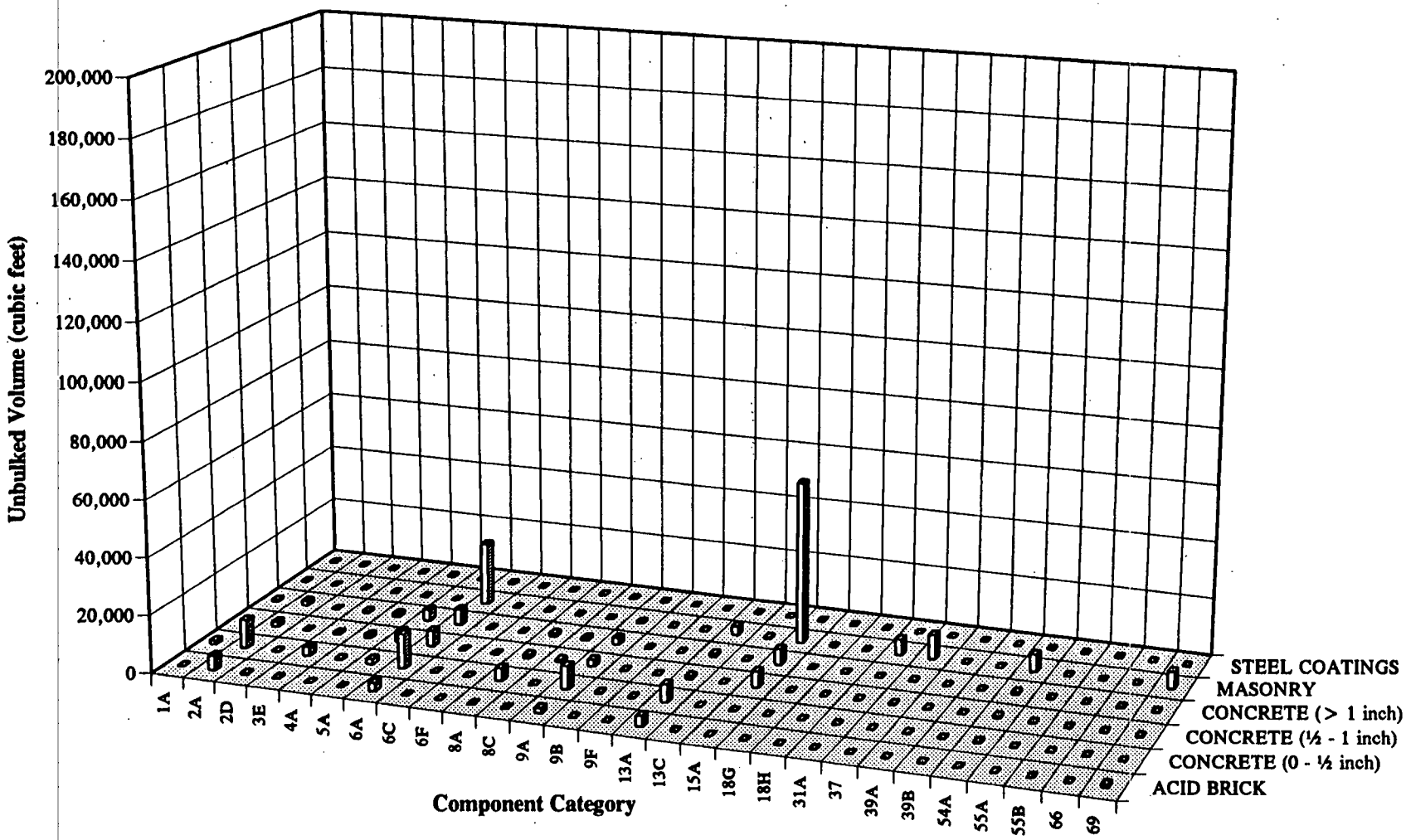

FIGURE 3-15
DISTRIBUTION OF MATERIAL EXCEEDING RADIOLOGICAL BASELINES IN COMPONENT CAREGORY 3
(for technetium-99, thorium-230, and uranium)

922000

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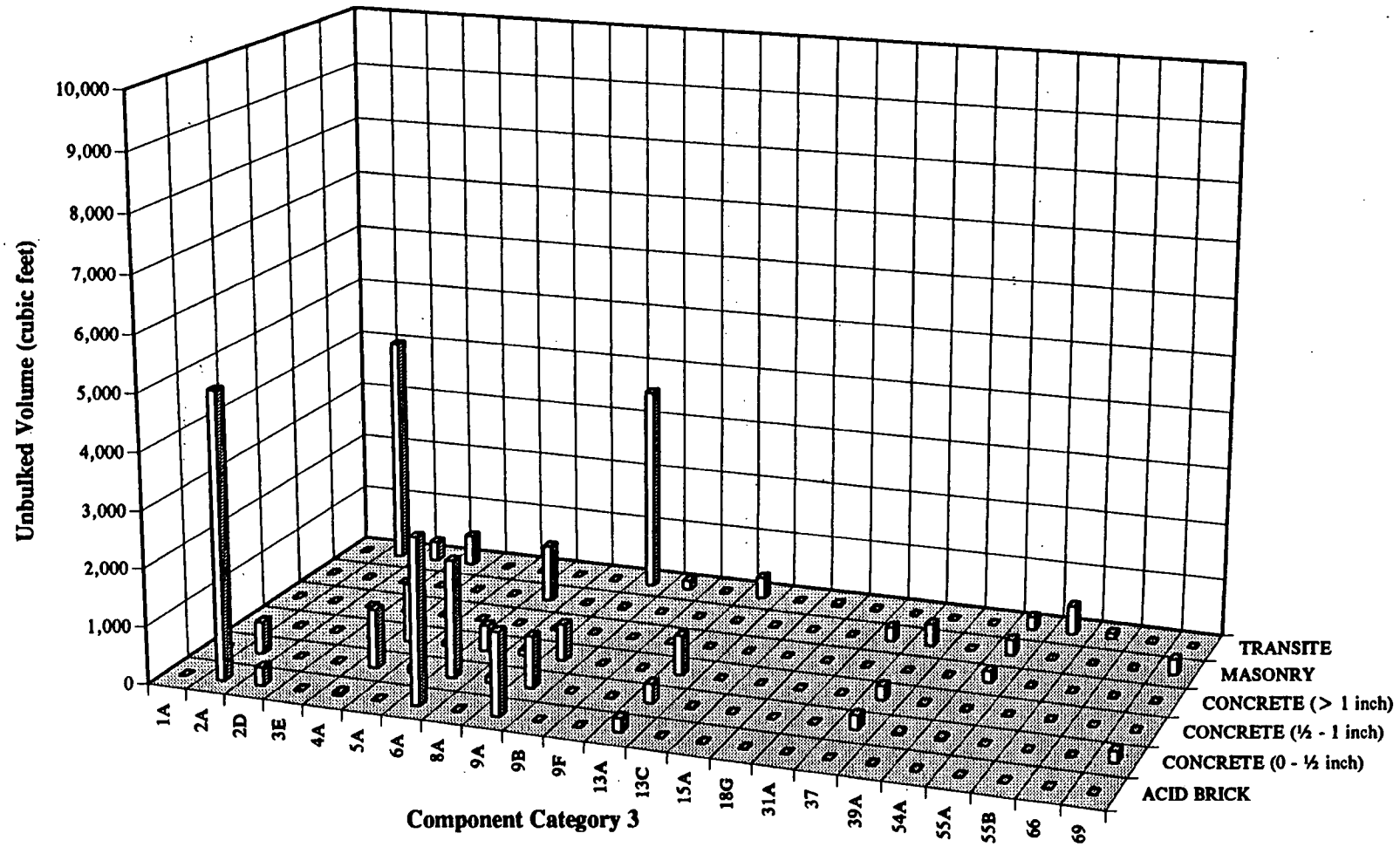

FIGURE 3-16
DISTRIBUTION OF POTENTIALLY HAZARDOUS MATERIAL WITHIN COMPONENT CATEGORY 3

000227

4.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

This section discusses the identification of remedial action objectives (RAOs) for the OU3 RI/FS and the identification and screening of applicable technology types and process options that may be used to meet the RAOs. This information will be used in Section 5 for development of remedial action alternatives for OU3. Section 4.1 identifies the RAOs for establishing protectiveness of human health and the environment; these objectives were modified from preliminary RAOs identified in Section 3.2.2 of the OU3 RI/FS WPA (DOE 1993a). Section 4.2 describes the general response actions (GRAs) that will satisfy the RAOs identified in Section 4.1. Section 4.3 presents initial identification and evaluation of technology types and process options for each type of OU3 material that may require further treatment during the final remedial action (refer to Section 1.2.2 for a list of material categories). The evaluation of technology types and accompanying process options will be based on overall effectiveness, implementability, and cost.

4.1 REMEDIAL ACTION OBJECTIVES (RAOs)

According to the NCP (EPA 1990b), RAOs specify contaminants and media of concern, potential exposure pathways, and remediation goals. Typically for purposes of the FS, RAOs adopt preliminary remediation goals (PRGs), which are based on readily available information such as chemical-specific ARARs or other reliable information. The PRGs are refined as additional information becomes available, and final remediation goals are determined when the remedy is selected.

As described above, PRGs are established in an FS to determine the extent of remediation required to meet RAOs (e.g., to determine how much of the contaminated media must be removed). For example, in the OU5 FS, which addressed environmental media such as soil and groundwater, preliminary remediation levels reflected the risk-based levels of contamination in specific media that may remain in place without causing unacceptable risks to human health and the environment. In the case of OU3, the IROD dictates that the final remedial action provides for the dispositioning all material resulting from the D&D of OU3 components. Because none of the OU3 material will remain "in place" with respect to its interim storage configuration, PRGs need not be specified in this report. Even though PRGs are not specified, RAOs are appropriate to support the decision to remediate the materials placed in interim storage and to guide the final disposition of these materials.

Table 3.6 of the WPA identified preliminary RAOs that serve both of these purposes. These RAOs are as follows:

- Prevent exposure of any member of the public to radionuclides and/or chemicals related to OU3 that would result in lifetime cancer risk exceeding the range of 10^{-4} to 10^{-6} (i.e., an increased cancer risk for one in 10,000 persons and one in 1,000,000 persons) for all exposure pathways as required by the NCP;

- Prevent exposure of any member of the public to toxic chemicals related to OU3 that would result in a hazard index (HI) of 1 or greater for all exposure pathways as required by the NCP and EPA risk assessment guidance (EPA 1991);

- Prevent exposure of any member of the public to radiation sources related to OU3 that would result, in a year, in an effective dose equivalent greater than 100 millirems (mrem) for all exposure pathways, as required by DOE Order 5400.5;

- Prevent emissions of radionuclides to the ambient air that would result in an effective dose equivalent due to inhalation to any member of the public, in any year, of greater than 10 mrem based on 40 CFR 61, Subpart H (National Emissions Standards for Emissions of Radionuclides Other Than Radon for DOE Facilities); and

- Prevent the release from OU3 without radiological restrictions of any materials and equipment with surface contamination levels that exceed those specified in DOE Order 5400.5.

In the simplest terms, the OU3 RAOs stipulate for the dispositioning of all materials remaining from the interim remedial action in a manner that confines risks to human health and the environment to acceptable limits. The above bullets provide a framework for implementing the selected OU3 final remedial alternative. It is the intent of this RI/FS document that these RAOs, the ARARs listed in Appendix C, and the post-remediation land use objectives prescribed in Section 2.2 of the OU5 FS will result in a final, sitewide remedy that is protective to human health and the environment.

4.2 GENERAL RESPONSE ACTIONS (GRAs)

GRAs describe the general actions that will satisfy RAOs for OU3 contaminated materials. Combinations of GRAs may be employed, as needed, based on the types of OU3 contaminated materials to be addressed during the final remedial action. As discussed in Section 3 of this report, OU3 materials have been grouped into nine categories for management purposes: accessible metals, inaccessible metals, process-related metals, painted light-gauge metals, concrete, brick, non-regulated ACM, regulated ACM, and miscellaneous materials. A tenth material category (products, residues,

and special materials) was included in the initial list of OU3 material categories to cover the total scope of OU3 materials addressed by the RI/FS Report and other programs. These materials are being addressed through other site programs (refer to Section 1.2.2), since they are not considered within the scope of the RI/FS. The OU3 GRAs that have been identified to potentially meet the RAOs are no further action, institutional controls, treatment, and disposition. These GRAs are composed of specific technology types and process options that will be evaluated to develop the OU3 remedial action alternatives. The following subsections provide descriptions of each OU3 GRA.

4.2.1 No Further Action

The No Further Action GRA is retained throughout the RI/FS process as required by the NCP [40 CFR 300.430(e)(6)]. The "no further action" response provides a comparative performance baseline against which other GRAs can be evaluated. Under this response, the DOE would retain site institutional and monitoring programs, until completion of remediation activities under OU2 and OU5, but OU3 remediation activities would cease after completion of the interim remedial action.

4.2.2 Institutional Actions

The institutional actions GRA involves the application of various access/land use restrictions to reduce or eliminate potential public access to the site. The application of access/land use restrictions (security fencing, guards, deed restrictions, or a combination of these technologies), to be used to maintain public safety during and after remedial activities, depends on future FEMP property use.

Decisions to retain the FEMP property in perpetual federal ownership were addressed within the OU2 ROD and the draft OU5 ROD. Concurrent decisions for the appropriate institutional controls limiting access to the site were also made. Therefore, access/land use restrictions will not be evaluated within the OU3 RI/FS.

OU3 does not directly address the remediation of environmental media, and, through implementation of the interim remedial action, no OU3 materials will remain in situ. The appropriate sitewide approach for long-term environmental media monitoring has been addressed by the OU2 ROD and the draft OU5 ROD. Therefore, long-term environmental monitoring will not be evaluated within the OU3 RI/FS.

The only institutional action to be addressed within the OU3 RI/FS is short-term, task-specific air monitoring. This monitoring will be evaluated for its effectiveness, implementability, and cost during OU3 material disposition activities that will take place during the final remedial action.

4.2.3 Disposition

This GRA includes the disposition (e.g., disposal) of OU3 material in an on-property disposal facility or in an off-site disposal facility. Disposition also includes technologies for the unrestricted release, restricted release, and transportation of materials. Unrestricted release has been defined as the release of materials from DOE control to a non-DOE controlled environment for any suitable purpose. Contaminant mobility may be reduced through the singular application of this GRA by means of engineering (e.g., security fencing) and institutional controls; however, other GRAs may be combined with the disposition GRA to reduce contaminant toxicity and volume.

4.2.4 Treatment

This GRA encompasses the potential ex situ treatment of OU3 materials, including physical, biological, chemical, and thermal technologies, as a means of further reducing the toxicity, mobility, and/or volume of potential contaminants that may remain after the interim remedial action. Ex situ treatment technologies may be used in combination with the disposition GRA to develop remedial action alternatives.

4.3 ROLE OF TREATMENT DURING OU3 FINAL REMEDIAL ACTION

This section addresses the role of material treatment during the OU3 final remedial action. A primary goal of the NCP is the selection of a remedial action, which includes a single method or an appropriate combination of methods, that will protect human health and the environment during and after the action. The goal also requires the maintenance of an acceptable level of protection over time and a minimization of untreated waste volumes. This goal reflects the NCP preference for treatment over engineering and/or institutional controls to reduce volume, toxicity, and/or mobility of COCs whenever practical to ensure that remediation material can be reliably controlled over time. The NCP also indicates that if the preference for treatment cannot be achieved, then a justification for the use of alternative protective measures must be offered.

4.3.1 Applicability of Treatment to OU3

As indicated in Section 10.4 of the IROD (DOE 1994a), the OU3 final remedial action will utilize permanent solutions and alternative treatment (or resource recovery) to the maximum extent

practicable. Resource recovery includes the use of recycling and reuse techniques. Section 10.5 of the IROD indicates that, through physical treatment of the OU3 materials, the interim remedial action attempts to satisfy the statutory preference for remedial actions that employ treatment to reduce toxicity, mobility, or volume as a principal element of the action. Section 10.5 of the IROD further explains that the final remedial action for OU3 will meet the statutory preference for treatment as a principal element or will provide justification for not meeting the preference.

It is the intent of this section to explain that the OU3 interim remedial action will satisfy the statutory preference and to explain the limited application of material treatment and resource recovery during the OU3 final remedial action. This section will also provide justification for the use of engineering and institutional controls (e.g., security fencing, deeds, etc.) during the final remedial action to protect human health and the environment.

The interim remedial action satisfies the statutory preference for treatment of OU3 materials through the application of in situ gross decontamination methods on OU3 materials during the interim remedial action. Based on the projected residual contamination levels on remediation materials following the in situ treatment and D&D of the OU3 components, the role of further treatment during the OU3 final remedial action will be on a supplemental basis to ensure protectiveness during the final disposition activities, and to meet WAC for an off-site disposal facility.

OU3 materials considered principal threat at the FEMP generally consist of the "legacy wastes" (Section 1.1.3). These materials will be treated, as required, in accordance with the STP and the FFCA. The "legacy wastes" that do not require treatment are currently scheduled to be dispositioned off-site under existing removal actions, and therefore would not require dispositioning during the final remedial action. The materials to be generated during the interim remedial action and dispositioned under the final remedial action constitute low-threat materials relative to the "legacy wastes."

None of the materials to be sent off-site during the OU3 final remedial actions will be in a liquid form. Furthermore, the materials are not expected to be highly toxic or highly mobile. Any mobile materials will be containerized as part of off-site disposal requirements or may receive a supplemental treatment (e.g., encapsulation) prior to disposal. Materials that might be placed in an on-property disposal facility will not display any of the characteristics mentioned above; therefore any further treatment requirements would be alleviated.

Because OU3 remediation materials will consist of construction debris rather than traditional environmental media, many traditional treatment options are not applicable. Additionally, construction debris is, by definition, a solid waste and must be managed as such. Except for materials viable for unrestricted-release or recycling, debris generated by the dismantlement of an OU3 component must be managed as a waste (solid, hazardous, radiological, or mixed).

Any additional treatment of a material during the final remedial action would result in the further reduction of toxicity, mobility, or volume through the destruction of, or through the concentration of, contaminants into a secondary waste form. However, for OU3 materials, the resultant material would continue to be classified as a solid waste. Additional treatment would not produce complete removal of the radiological constituents for most materials because of the unique physical qualities of construction debris. This lack of complete decontamination would reduce the opportunity for recycling or reuse and would result in the continued regulated control of the materials.

4.3.2 Scenarios Requiring Further Treatment

Although additional treatment of the OU3 materials during the final remedial action will be on a supplemental basis, four scenarios have been identified where further treatment may be required. These scenarios are the drivers for the identification and evaluation of technology types and process options to be discussed in Section 4.4 of this report. The four scenarios identified for potential further treatment are as follows:

- Meeting criteria for unrestricted release to a commercial sanitary landfill,
- Recycling and,
- Meeting LDRs and WAC.

Further Treatment for Unrestricted Release

OU3 materials derived from the interim remedial action may be released on an unrestricted basis if confirmatory radiological screening and potential confirmatory sampling are conducted prior to release for disposal in a municipal sanitary landfill or a commercial construction debris landfill. If areas of radiological contamination exceeding unrestricted release criteria were to be discovered during the confirmatory screening, then further treatment of the material would be required to meet unrestricted release criteria. The determination to employ treatment will be based on cost-effectiveness. The secondary wastes derived from the treatment would then require treatment prior to its disposition.

All materials will be evaluated for meeting the release criteria. However, it is anticipated that few materials from the former Production Area (materials associated with the uranium production period at the FEMP) will meet DOE material release criteria. Nevertheless, the materials within the Administrative Area, which have not been in contact with processing operations, are expected to meet the criteria. Within the Administrative Area, material Categories A (accessible metals), E (concrete), and I (miscellaneous materials) have the potential to be readily released for unrestricted disposition. These material categories have been identified as the only categories that exhibit at- or below-baseline levels of contamination, based on current data, as indicated in Table 3-26 of Section 3. Since baseline levels for these categories are less than DOE release criteria, it is assumed (for the purposes of this report) that only these volumes are eligible for unrestricted release.

The costs of screening materials for unrestricted release have been evaluated in Table E.1-2 in Appendix E of this report. These costs include screening of Category A, E, and I materials by a radiological technician, the oversight of the technician by a supervisor, and the transportation and disposal fees that would be incurred after unrestricted release eligibility is verified. Based on this estimate, it would be cost-effective to release Category A, E, and I materials from the Administrative Area, instead of placing them in an on-property disposal facility.

Further Treatment for Recycling

Table 4-2 presents recycling as a remedial technology type under the disposition GRA. Within recycling, there are two potential process options: restricted recycling and unrestricted recycling.

The extent to which recycling could be employed depends upon several factors, including economic feasibility, technical implementability, and marketability of the end product. Economic feasibility will typically be vendor-specific, but general rates have been developed based on recycling of steel from the Plant 7 Dismantling Project. Technical implementability will be based on the type of material, type and level of contamination, and available recycling technologies. Marketability includes the ability to sell or reuse the end product. This factor has the greatest influence on restricted recycling. For this option, the contaminated material would have to be used in a controlled environment. For example, surface-contaminated steel could be smelted and formed into volumetrically contaminated containers, for disposal of high-level waste, or shielding blocks for nuclear reactors. At this time, there are no such markets for these materials. If such a market does develop, then the restricted recycling of OU3 materials will be considered at that time.

For the second option, decontamination for unrestricted recycling, no OU3 materials other than Category A materials (Accessible Metal) are readily recyclable by this method because of material composition, recycling costs, and lack of marketability. Potential decontamination operations are suitable for Category A materials because of the structural carbon steel, accessible surfaces to allow easy surveying, and typically straight beams with limited bends. The cost of recycling Category A materials was compared to the cost of disposal. As detailed in Table E.3-1, the cost to recycle these materials is approximately 35 times the cost of on-property disposal and five times the cost of off-site disposal. For OU3, recycling will be considered only when the cost is equal to or less than the cost of disposal. Therefore, within Section 5, Section 6, and Appendix E of this document, recycling will not be considered for OU3 materials. However, treatment technologies to support the decontamination of materials will be identified, screened, and evaluated to allow for their possible inclusion into the final ROD for application if recycling becomes cost-effective compared to disposal.

Further Treatment to Meet LDRs

As discussed in Section 1.1.3 of this report, the FEMP would utilize the RCRA Subtitle C Corrective Action Management Unit (CAMU) provisions to accommodate potential on-property disposal of RCRA wastes. Under this strategy, specific WAC that are deemed protective of human health and the environment would have to be met so that the waste can be placed in an on-property disposal facility in lieu of meeting LDRs. If disposal of materials contaminated with RCRA-regulated constituents would result in unacceptable risks to human health and the environment, these materials would be treated prior to placement in a off-site for disposal facility. Treatment would apply to both listed and characteristic RCRA-regulated constituents present in the OU3 material.

Table 3-26 identifies material categories and accompanying volumes of materials that have been classified as potentially hazardous or mixed wastes. These materials may require further treatment during the final remedial action to meet LDRs. Therefore, treatment technologies to support the treatment of OU3 materials to meet LDRs will be identified, screened, and evaluated.

Further Treatment to Meet WAC

As stated in the preceding section, Section 1.1.3 introduces the concept of meeting facility-specific WAC to disposition OU3 materials on-property or off-site. Appendices G and F of this report present the technical justification for using WAC as a basis for specifying the acceptable disposition of OU3 materials.

It is anticipated that any treatment required for materials to meet the on-property WAC will be applied during the interim remedial action. Materials that exceed the on-property level would be dispositioned at an off-site facility. Additionally, available data indicate that some OU3 materials are projected to exceed the off-site WAC. These materials will require an assessment to determine the need for further treatment.

For the OU3 materials that exceed the off-site WAC, further treatment would depend on the specific material, the level of contamination, and the cost-effectiveness of the treatment compared to other disposal options. Therefore, technologies to support the potential further treatment of OU3 materials to meet the off-site WAC will be identified, screened, and evaluated.

4.4 IDENTIFICATION AND EVALUATION OF TECHNOLOGY TYPES AND PROCESS OPTIONS

The criteria for identifying, screening, and evaluating potentially applicable technologies are provided in the US EPA's RI/FS guidance (EPA 1988) and in the NCP. The final remedy must protect human health and the environment and comply with ARARs unless specific waivers are obtained from the regulations.

Remedial technologies will be developed by identifying, screening, and evaluating process options that may be applied to the materials generated by the OU3 interim remedial action. Process options that generally will not be included in the initial screening are treatment methods used during the interim remedial action. These process options are listed in Table 4-1. However, two of the interim remedial action process options, abrasive blasting and water washing, will be screened, since they may be used for further treatment of interim remedial action generated materials prior to final disposition.

To assist with the disposition of materials, the OU3 FS is adopting the concept of on-property WAC for those alternatives for which on-property disposal is contemplated. This concept was originally presented in the OU5 FS. The concept suggests that all OU3 materials that meet WAC would be dispositioned of in an on-property disposal facility. Those materials that cannot meet WAC would require off-site disposition, or if at some point in the future, treatment technologies become available to cost-effectively meet WAC, the materials would be treated prior to disposal. This designation of on-property WAC would thus result in the low-volume, relatively more contaminated materials within

OU3 being treated as needed or otherwise managed off-site, separate from the high volume, relatively lower threat materials being placed in the on-property facility.

Designation of the OU3 materials in this manner is consistent with the expectations and intentions of using engineering and institutional controls for material disposing as envisioned in the NCP, and conforms to the sitewide strategy of sending materials inappropriate for on-property disposal, given the site-specific constraints that are present at the FEMP, to off-site facilities.

The following subsections present the framework for the identification, screening, and evaluation of potentially applicable technology types and process options for the nine material categories being considered in this RI/FS.

4.4.1 Initial Screening of Technology Types and Process Options

The initial screening of technology types and process options was based on the applicability of a process option to a given material and contaminant. The initial screening is presented in Appendix D. Table D-1 presents information that is potentially common to all material categories and is not repeated for each material category. The remaining initial screening tables (D-2 through D-4) are separated based on groupings of the material categories described in Section 3. The grouping was performed because specific technology types and process options were applicable to more than one material category. The grouping serves to reduce redundant information throughout Appendix D. The tables are further divided by the GRA, remedial technology type, and process option. The process options are grouped by similar characteristics within a remedial technology type (i.e., biological, thermal, and physical for the treatment GRA). The tables further present information relative to the applicability of the process option to a contaminant (i.e., low-level radiological, inorganic, organic, and PCBs). If the process option has been demonstrated or is proven to be effective on a specific contaminant material type and/or material geometry, it is considered potentially applicable. A process option description is included, which provides information related to how the particular process option works, whether it is a proven or emerging technology, and its contaminant-specific limitations. Process options that are potentially applicable will be further evaluated. Such screening ensures that the safest, most effective technology types are used throughout the final remedial action, as required. The initial screening comments state whether the process option is potentially applicable or, if not applicable, provide a brief discussion on why the process option was not retained.

To categorize and perform initial screening of technology types and process options, several sources, including databases, were consulted; these sources include the U.S. Department of Energy Decommissioning Handbook (DOE 1994k), Oak Ridge National Laboratory Technology Logic Diagram (DOE 1993l), Idaho National Engineering Laboratory D&D Technology Logic Diagram U.S. (DOE 1994k), the DOE Office of Technology Development Program Research Development Announcement (PRDA) and Research Opportunity Announcement (ROA) programs, K-2073 Oak Ridge K-25 Site Technology Logic Diagram (DOE 1993f), the EPA Vendor Information System of Innovative Treatment Technologies VISITT database (EPA 1995a), and Alternative Treatment Techniques Information Center (ATTIC) database (EPA 1995b). The initial screening was conducted in accordance with US EPA guidance (EPA 1988).

The shaded process options shown in Tables D-2 through D-4 represent process options that are "not applicable" and have not been retained for further consideration during the evaluation process. The shaded process options represent emerging technologies or technologies that have not been proven for a given material type, material geometry, and/or contaminant. Also, a process option will not be retained from the initial screening if it is demonstrated or proven for the contaminant but for not the material category, or if the process option is in the developmental stage and similar techniques are available for further evaluation.

Table 4-2 summarizes the initial screening process and presents the technology types and process options that have been retained for further evaluation based on the initial screening. Process options that have not been retained for further evaluation, based on an initial screening of process options, include biodegradation, flash lamp cleaning, laser ablation, electro-kinetic migration, electrical resistance, electro-refining, leach/electro-wining, gas-phase decontamination, ozone/ultra-violet light activation, catalytic extraction process, gamma radiolysis, nitrate to ammonia and ceramic process, chemical conversion, electromagnetic processing system, electro-hydraulic scabbling, steam cleaning, microwave scabbling, and vitrification. The technical development and potential applicability of these process options will be periodically evaluated to determine future viability. Future viable options may be incorporated into the final remedial activities to ensure that the safest and most effective process options are implemented to the extent practicable.

4.4.2 Evaluation of Technology Types and Process Options

The evaluation of the process options that have been retained from the initial screening is also presented in Appendix D. The purpose of the evaluation is to determine which process options may

be retained for further evaluation. The retained process options will form the basis for the selection of representative process options during the development of the remedial action alternatives that will be discussed in Section 5 of this report. The selection of representative process options will not preclude the inclusion of additional applicable process options that may be identified subsequent to the issuance of this report.

This evaluation compares the performance criteria of each process option relative to other process options within a technology type. (An exception to this methodology is presented in the Cost discussion below.) The criteria for the evaluation of the process options are effectiveness, implementability, and cost. The effectiveness of each process option will be the primary focus of this evaluation, as suggested in the regulatory guidance documentation. The three criteria combined will determine process option retention or elimination. A brief discussion of the effectiveness, implementability, and cost criteria, as they apply to the evaluation process, is presented below.

- Effectiveness - This criterion will focus on the potential effectiveness of a process option's ability to treat the estimated volume of contaminated media, to meet the remediation goals, and to minimize the potential impacts to human health and the environment during the remedial design and implementation. This criterion will also evaluate how proven and reliable a process option is with respect to the contaminants and conditions at the site.

- Implementability - This criterion will encompass both the technical and institutional feasibility of implementing a process option. The implementability criterion was the primary focus during the initial screening of technology types and process options to eliminate those that were clearly ineffective or unworkable at the site. The implementability evaluation will provide a more detailed analysis of the technical aspects of process options. It will also place an emphasis on the institutional aspects of implementability, such as regulatory agency acceptance; availability of treatment, storage, and disposal services; and availability of necessary equipment and resources.

- Cost - This criterion plays a limited role in this screening. A cost analysis will be based on engineering judgment rather than a detailed analysis. Each process option will be evaluated as to whether costs are high, medium, or low relative to the other options in the same technology type. If only one process option is being evaluated for a technology type, then the costs will be compared to those of process options in other technology types. Both capital costs and operation and maintenance (O&M) costs will be considered.

Section D.2 of Appendix D presents the evaluation of technology types and process options retained from the initial screening. Tables D-5 through D-7 provide summaries of the evaluation process for the material category groupings. The shaded process options in Tables D-5 through D-7 represent

process options that will not be retained for further evaluation. Table 4-3 of this section presents a summary of the process options that were retained from the evaluation.

4.4.3 Development of Representative Treatment Technologies

Table 4-3 summarizes the treatment technology types and process options for each material category that were retained from the evaluation process. Process options that have not been retained for further evaluation include electropolishing, incineration, thermal desorption, and turbulation. The development and applicability of these process options will be periodically evaluated to determine whether these process options become viable. Future viable options may be incorporated into the final remedial activities to ensure the safest and most effective process options are utilized.

In Table 4-4, the treatment process options are organized by material category and are listed as either retained or representative with respect to potential further material treatment during the final remedial action. The CERCLA RI/FS guidance suggests selecting a representative process option for each technology type retained for consideration. The representative process option should also represent a broader range of process options within a technology type. The representative process options shown in Table 4-4 have been selected for material categories that may require further treatment prior to final disposition. The selection of these technologies was based on the category segregation volumes presented in Table 3-26 and represent the expected types of materials to be generated during the interim remedial action.

Material categories that do not have selected representative process options will draw upon the pool of retained process options which have been identified for each category. The retained process options are methods that could be used as alternatives or contingencies which, if selected, would provide the additional treatment of materials during the final remedial action. The retained process options will be used only if treatment requirements are identified, on a case-by-case basis, for material within a category prior to final disposition.

Because decontamination technologies listed in Table 4-1 support the implementation of the interim remedial action and have thus been addressed in the OU3 Remedial Design/Remedial Action Work Plan (DOE 1994g), and the retained process options listed in Table 4-4 are merely listed as potentially available treatment options, neither of these process option groups will be evaluated in the detailed analysis of alternatives. Representative treatment process options are those methods which may be

potentially incorporated into the final remedial alternatives. Representative process options will be discussed further in Section 5 of this report.

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TABLE 4-1
OU3 INTERIM REMEDIAL ACTION TREATMENT TECHNOLOGIES

Final Remedial Material Categories	Treatment Technologies (Technology Descriptions found in Appendix D)
A-Accessible Metals	Vacuuming; water washing; mechanical/thermal cutting; abrasive blasting
B-Inaccessible Metals	Vacuuming; water washing; mechanical/thermal cutting
C-Process-Related Metals	Vacuum; water washing; mechanical/thermal cutting
D-Painted Light-Gauge Metals	Vacuuming; water washing; mechanical/thermal cutting; abrasive blasting
E-Concrete	Vacuuming; water washing; encapsulation; scabblers/scarifiers; mechanical cutting; abrasive blasting
F-Brick	Vacuuming; water washing; mechanical cutting
G-Non-Regulated ACM	Vacuuming; water washing; encapsulation; mechanical cutting
H-Regulated ACM	Vacuuming; water washing; encapsulation; mechanical cutting
I-Miscellaneous Materials	Vacuuming; water washing; mechanical cutting

TABLE 4-2

TECHNOLOGY TYPES AND PROCESS OPTIONS RETAINED FROM THE INITIAL SCREENING

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	METALS				Concrete	Brick	Asbestos-Containing Materials		Miscellaneous Materials
			Accessible Metals	Inaccessible Metals	Process-Related Metals	Painted Light-Gauge Metals			Non-Regulated ACM	Regulated ACM	
No Further Action	None	Not Applicable	●	●	●	●	●	●	●	●	●
Institutional Controls	Monitoring	Short-Term Air Monitoring	●	●	●	●	●	●	●	●	●
Treatment	Thermal	Incineration									●
		Smelting*	●	●	●	●					
		Thermal Desorption	●	●	●	●	●	●			
	Chemical	Chemical Conversion								●	
		Chemical Leaching	●	●	●	●					
		Electropolishing	●	●	●	●					
		Proprietary Solvents	●		●	●	●	●	●		
		Surfactants	●	●	●	●	●	●	●	●	●
		Turbulation	●	●	●	●					
		Ultrasonic Cleaning	●	●	●	●					
	Physical	Abrasive Blasting	●			●					
		Compaction		●	●	●				●	●
		Crushing					●	●			
		Encapsulation	●	●	●	●	●	●	●	●	●
		Shredding	●	●	●	●					●

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TABLE 4-2 (Continued)

TECHNOLOGY TYPES AND PROCESS OPTIONS RETAINED FROM THE INITIAL SCREENING

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	METALS				Concrete	Brick	Asbestos-Containing Materials		Miscellaneous Materials
			Accessible Metals	Inaccessible Metals	Process-Related Metals	Painted Light-Gauge Metals			Non-Regulated ACM	Regulated ACM	
Treatment (Cont'd)	Physical (Cont'd)	Solidification (of decontamination residues)	●			●	●	●			
		Vibratory Finishing	●	●	●	●					
		Water Washing	●	●							
Disposition	On-Property	Landfilling	●	●	●	●	●	●	●	●	●
	Off-Site	Nevada Test Site	●	●	●	●	●	●	●		●
		Representative Commercial Disposal Facility	●	●	●	●	●	●	●	●	●
	Unrestricted Release	Sanitary Landfill - Subtitle D	●	●	●	●	●	●	●	●	●
		Unrestricted Reuse	●		●	●					●
		Unrestricted Recycle	●		●	●					
	Restricted Release	Restricted Reuse	●								
		Restricted Recycle	●		●	●					
	Material Transportation	Rail Transport	●	●	●	●	●	●	●	●	●
		Truck Transport	●	●	●	●	●	●	●	●	●

Category J - Product residues and special products will not be included in the OU3 screening process. These materials will be addressed under current FEMP programs.
* Also referred to as metal melting.

TABLE 4-3

TECHNOLOGY TYPES AND PROCESS OPTIONS RETAINED FROM THE EVALUATION

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	METALS				Concrete	Brick	Asbestos-Containing Materials		Miscellaneous Materials
			Accessible Metals	Inaccessible Metals	Process-Related Metals	Painted Light-Gauge Metals			Non-Regulated ACM	Regulated ACM	
No Further Action	None	Not Applicable	●	●	●	●	●	●	●	●	●
Institutional Controls	Monitoring	Short-Term Air Monitoring	●	●	●	●	●	●	●	●	●
Treatment	Thermal	Smelting*	●	●	●	●					
	Chemical	Chemical Conversion								●	
		Chemical Leaching	●	●	●	●					
		Proprietary Solvents	●	●		●	●	●	●		
		Surfactants	●	●	●	●	●	●	●	●	●
		Ultrasonic Cleaning	●	●	●	●					
	Physical	Abrasive Blasting	●			●					
		Compaction		●	●	●				●	●
		Crushing					●	●			
		Encapsulation	●	●	●	●	●	●	●	●	●
		Shredding	●	●	●	●					●
		Solidification (of decontamination residues)	●			●	●	●			
		Vibratory Finishing	●	●	●	●					

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TABLE 4-3 (Continued)

TECHNOLOGY TYPES AND PROCESS OPTIONS RETAINED FROM THE EVALUATION

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY TYPE	PROCESS OPTIONS	METALS				Concrete	Brick	Asbestos-Containing Materials		Miscellaneous Materials
			Accessible Metals	Inaccessible Metals	Process-Related Metals	Painted Light-Gauge Metals			Non-Regulated ACM	Regulated ACM	
Treatment (Cont'd)	Physical (Cont'd)	Water Washing	●								
Disposition	On-Property	Landfilling	●	●	●	●	●	●	●	●	●
	Off-Site	Nevada Test Site	●	●	●		●	●	●		●
		Representative Commercial Disposal Facility	●	●	●	●	●	●	●	●	●
	Unrestricted Release	Sanitary Landfill - Subtitle D	●	●	●	●	●	●	●	●	●
		Unrestricted Reuse	●		●	●					
		Unrestricted Recycle	●		●	●					
	Restricted Release	Restricted Reuse	●	●	●	●					
		Restricted Recycle	●		●	●					
	Material Transportation	Rail Transport	●	●	●	●	●	●	●	●	●
		Truck Transport	●	●	●	●	●	●	●	●	●

Category J - Product residues and special products will not be included in the OU3 screening process. These materials will be addressed under current FEMP programs.
* Also referred to as metal melting.

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TABLE 4-4

REMEDIAL ACTION TREATMENT TECHNOLOGIES

Final Remedial Material Categories	Final Remedial Action	
	Retained Process Options	Representative Treatment
A-Accessible Metals	Encapsulation; proprietary solvents; surfactants; ultrasonic cleaning; shredding; solidification; vibratory finishing	* Abrasive blasting; chemical leaching
B-Inaccessible Metals	Chemical leaching; Encapsulation; surfactants; ultrasonic cleaning; shredding; vibratory finishing	Encapsulation
C-Process-Related Metals	Chemical leaching; Encapsulation; proprietary solvents; surfactants; ultrasonic cleaning; abrasive blasting; compaction; shredding; vibratory finishing	Encapsulation
D-Painted Light-Gauge Metal	Chemical leaching; Smelting (metal melting) proprietary solvents; surfactants; ultrasonic cleaning; abrasive blasting; compaction; shredding; solidification; vibratory finishing	Encapsulation
E-Concrete	Encapsulation; Proprietary solvents; surfactants	Solidification
F-Brick	Encapsulation; Proprietary solvents; surfactants	Crushing; solidification
G-Non-Regulated ACM	Chemical conversion; proprietary solvents; surfactants	Encapsulation
H-Regulated ACM	Chemical conversion; Encapsulation; surfactants; compaction	Solidification
I-Miscellaneous Materials	Surfactants; shredding	Encapsulation

* These process options will be utilized only if material recycling is pursued.

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5.0 DEVELOPMENT AND DESCRIPTION OF ALTERNATIVES

This section presents the development and description of alternatives for the final disposition of materials generated during the OU3 interim remedial action. These alternatives are assembled from the representative technologies and associated process options evaluated and selected in Section 4. Section 5 is divided into five major subsections as discussed below.

Section 5 presents an overview of the process through which the OU3 final remedial alternatives will be developed based on the NCP and the CERCLA remedy selection process. Section 5.2 discusses integrating the OU3 final remedial action with the sitewide remedial strategy and coordinating the approach with the remedial actions selected for other OUs. Section 5.3 discusses the general strategy used as a basis for developing alternatives that will satisfy the OU3 RAOs and for integrating the OU3 interim and final remedial actions. Section 5.4 provides an overview of the framework and key considerations that are used to develop alternatives based on the technology and process options presented in Section 4, on the sitewide remedial strategy, and on integration of the OU3 interim remedial action with other OU remedial actions. Section 5.5 provides descriptions of the remedial alternatives. The detailed analysis of the developed alternatives according to the nine NCP evaluation criteria is presented in Section 6 of this report.

5.1 REMEDIAL ALTERNATIVE DEVELOPMENT PROCESS

This section provides an overview of the framework and key considerations used to develop the alternatives based on the GRAs discussed in Section 4.

The purpose of the RI/FS and the overall remedy selection process is to implement remedial actions that eliminate, reduce, or control risks to human health and the environment (40 CFR Part 300). The national program goal for the RI/FS process, as defined in the NCP, is to select remedies that are protective of human health and the environment, that maintain protection over time, that minimize untreated waste, and that are cost-effective. The criteria for identifying potentially applicable technologies to achieve these goals are provided in the EPA's Guidance for Conducting RI/FS Under CERCLA (EPA 1988) and in the NCP. A strong statutory preference for remedies that will result in a permanent and significant decrease in toxicity, mobility, or volume and provide long-term protection is identified in CERCLA. The primary requirements for the final remedy are that it be protective of both human health and the environment and that it comply with ARARs, which are presented in Appendix C. Alternative development, therefore, focuses on these criteria.

In addition to the above objectives and as previously mentioned in Section 4 of this report, the NCP defines certain expectations in developing remedial action alternatives:

- The expectation that material treatment will be used to address the principal threats to human health and the environment posed by a site, wherever practical;

- The expectation that engineering controls, such as containment, will be used for waste that poses a relatively low, long-term threat or where treatment is impracticable;

- The expectation that a combination of methods, as appropriate, will be used to protect human health and the environment. In appropriate site situations, treatment of the principal threats posed by a site, with priority placed on treating waste that is liquid, highly toxic, or highly mobile, will be combined with engineering controls and institutional controls, such as deed restrictions, for treatment residuals and untreated waste;

- The expectation that institutional controls will be used to supplement engineering controls, as appropriate, for short- and long-term management to prevent or limit exposure to hazardous substances, pollutants, or contaminants;

- The expectation that using innovative technology will be considered when it offers the potential for comparable or superior treatment performance or implementability, fewer adverse impacts than other available approaches, or lower costs for similar levels of performance than demonstrated technologies; and

- The expectation that usable groundwaters will be returned to their beneficial uses, wherever practicable.

Consistent with Section 4.3 (Role of Treatment), addressing low-toxicity, high-volume wastes through engineering and institutional controls are considered an appropriate approach since it is anticipated that the application of these measures is considered protective of human health and the environment.

Beyond these basic regulatory requirements, certain sitewide considerations limit the potential remedial action alternatives for OU3. These include the need to develop alternatives that are consistent with the sitewide remedial strategy and coordinated, to the extent practical, with the remedies selected for other operable units. Furthermore, planning of any final remedial action for OU3 must be closely integrated with the planning and implementation of the ongoing OU3 interim remedial action D&D projects. These considerations are discussed in the following two subsections.

5.2 INTEGRATION WITH SITEWIDE AND OTHER OPERABLE UNIT REMEDIES

This section discusses integrating the various potential OU3 disposition actions with the remedies selected for other OUs. OU3 is the last of the five FEMP OUs for which a final ROD will be developed. Through the CERCLA process, RODs, identifying the selected remedial alternative, have been issued for OUs 1, 2, and 4. A draft ROD for OU5 (DOE 1995b), is currently proceeding through the approval process. The IROD has also been issued for OU3, which stipulates the interim remedial action. These documents, in addressing the statutory preference for treatment as a principal element, are consistent with the sitewide remedial strategy for attaining the adopted land use objective as detailed in the draft OU5 ROD. The sitewide remedial approach and the integration of potential OU3 remedial actions with other FEMP CERCLA remedial actions are discussed below.

5.2.1 Sitewide Remediation Strategy

The sitewide remedial strategy for the FEMP, as presented in the draft OU5 ROD, is based on attaining long-term (minimum of 200 years, with a goal of 1,000 years) protection of the environment consistent with a restricted land use objective (DOE 1995b), which includes on-property recreational use (undeveloped park) of a portion of the site. The representative receptors evaluated with regard to this objective are recreational users and an off-property farmer. This objective also includes long-term protection of water quality in the Great Miami Aquifer.

The projected sitewide remedy to achieve this objective considers the selected, preferred (i.e., identified in a PP), or leading remedial alternative for each operable unit, as appropriate. The degree to which the sitewide remedial objective (i.e., land use objective) will be met has been estimated through the CRARE, prepared in conjunction with each OU FS. The CRAREs have progressively estimated the cumulative, post-remediation residual human health risks remaining on property for 1,000 years following completion of all remedial actions to ensure the proposed remedy meets the sitewide remedial objective.

In general, the adopted sitewide remedy incorporates a balanced approach to waste disposition that recognizes the technical and economic impracticality of removing and disposing of all contaminated FEMP materials at an off-site disposal facility. As previously discussed in Section 1, materials contaminated with relatively higher radiological and chemical concentrations (e.g., OU1 waste pit materials and OU3 "legacy wastes"), deemed to represent the principal threat at the FEMP, would be treated, if required, and shipped off-site for disposal. Secondary threat materials, exhibiting relatively lesser concentrations, would be permanently disposed of at the FEMP. Consistent with this approach,

the OU1 and the OU4 remediation wastes are considered principal threat materials because of the nature and concentration of their constituents; treatment and off-site disposal has been selected as the remedy for these OUs. Also in accordance with this approach, relatively low concentration wastes and soils associated with OU2 and OU5 are being considered for on-property disposal. For OU3, the materials (Material Categories A-I) remaining within the scope of this RI/FS Report evaluation are predominantly low-impact materials. Potentially highly toxic or highly mobile wastes (Material Category J), representing the OU3's principal threats, are being addressed through existing removal actions and are therefore not addressed in this evaluation (see Section 1.2.2). Some hazardous and mixed wastes may be generated through D&D activities and will be addressed within each developed alternative.

Adopted remedies for the other OUs employ various waste disposal approaches and treatment technologies that are readily available and appropriate for the waste types and volumes that have been evaluated through the RI/FS process. For OU1, the remedy is to excavate and dry the pit contents and associated materials (e.g., pitliners and surrounding soils). The OU2 ROD and the draft OU5 ROD provide for the construction of an on-property disposal facility for waste materials meeting acceptance criteria. Materials exceeding the criteria for on-property disposal will be shipped to either a permitted commercial disposal facility or the NTS. For OU4, DOE has selected vitrification as the treatment technology for the silo contents and has initiated construction of a pilot vitrification plant. The pilot plant operations will be used to establish design criteria and process parameters for the full-scale facility which is expected to become operational in 1997. Vitrified materials are scheduled to be shipped to the NTS.

The site strategy for disposing of materials that contain RCRA-regulated constituents and that are subject to LDRs differs for on-property and off-site disposal (DOE 1995b). For on-property disposal of listed or characteristic wastes, the FEMP would use the CAMU provisions for defining compliance measures for the LDRs. Under this strategy, the remediation materials that are "remediation wastes" under 40 CFR 260.10 would be placed within the on-property disposal facility. The materials would be required to meet specific WAC that are deemed protective of human health and the environment. This criteria refers to the maximum allowable contaminant concentration, or mass, that may be dispositioned in a particular manner. The numerical value of a WAC is specific to the material being dispositioned, the contaminant, the leachability of the contaminant in the material, and the degree to which the disposal method must protect human and environmental receptors from additional exposure to the contaminant. Materials that exceed the WAC for on-property disposal and are identified as

listed or characteristic wastes would require further treatment in accordance with both RCRA and the FFCA, to meet LDRs. The treatment application could occur on-site, but would generally occur at an off-site facility. The material would then be dispositioned at an off-site facility.

As part of the public comment process for the OU5 PP, the OEPA and some of the public expressed a concern that no characteristic RCRA waste should be placed in the on-property disposal, which was part of the preferred alternative for OU5. The agency's specific concern was the possibility that materials could meet the protective WAC, yet fail the TCLP test. The WAC development process, as detailed in Appendix G, focuses on the behavior of the COCs in the environment (i.e, mobility), rather than on the explicit regulatory definition of whether the material would be labeled as hazardous or mixed waste. Defining the behavior assists in determining the viability for the material to be placed within the on-property disposal facility. Materials that are contaminated with any COC at levels that could impact the Great Miami Aquifer would not be placed within the on-property facility, regardless of contaminant classification, unless additional treatment were applied to render the material suitable for disposal.

Additionally, the materials that exhibit any of the remaining RCRA waste characteristics (reactivity, ignitability, and corrosivity) have been administratively removed from consideration for on-property disposal. These additional restrictions were added as a best management practice to ensure worker safety, to help maintain the integrity of the facility lining system, and promote overall protection to human health and the environment.

The CAMU provisions cited above apply only to on-property waste disposition activities. All off-site disposal actions must meet the LDR treatment standards for the RCRA-regulated constituents. The off-site strategy requires that a determination be made whether RCRA constituents are a listed waste (i.e., on a federal list of contaminants) or a characteristic waste (i.e., materials that exhibit toxicity, ignitability, corrosivity, or reactivity characteristics). All media contaminated with listed constituents will require treatment to meet LDR treatment standards and will be dispositioned off-site as RCRA Subtitle C mixed waste (hazardous and radioactive). Conversely, all media contaminated with characteristic contaminants will need to be treated to meet LDR treatment standards and disposed of as LLW (RCRA Subtitle D nonhazardous) waste upon passing the TCLP test. The categorization of the material as either listed or characteristic would be accomplished during remedy implementation by considering RI/FS field investigation results, process knowledge, and HWMU history. Selective

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additional sampling would be performed, as needed, to effect proper characterization of materials when existing information is insufficient.

Consistent with the remedial action selected for each OU, cost-effective implementation of the sitewide remedy will require integrating efforts and using common, on-property facilities and treatment processes. The key interfaces among OU3 and the other OUs are discussed below.

5.2.2 On-Property Disposal Facility

As discussed in Section 5.2.1, OU3 materials include a high volume of low-contaminant-level material that is potentially suitable for on-property disposal in accordance with the sitewide balanced approach. The OU2 ROD and the draft OU5 ROD both provide for permanently disposing of excavated wastes and soils in an on-property disposal facility. Therefore, an expanded, common facility, located primarily east of the former Production Area, is proposed to accommodate all material slated for on-property disposal. In accordance with the sitewide remedial strategy, only materials that meet WAC could be accepted for disposal in the on-property disposal facility. The draft OU5 ROD has prescribed WAC for the environmental media to be placed within the on-property facility. Appendix G of this report details the development of WAC specified for OU3 materials proposed to be placed in the facility as well.

The proposed on-property disposal facility would be an above-grade cell featuring a multilayered capping system with a multilayered liner and leachate collection system. Based on currently available geological and hydrogeological data, the eastern area of the FEMP would be suitable for disposal facility construction. This area is on that portion of the property where the thickness of the subsurface gray clay is greater than 12 feet, residential wells are no closer than 1,000 lateral feet, and the site boundary is no closer than 300 lateral feet. The specific location for this facility is being determined during the OU2 remedial design process.

In general, the OU2 ROD and the draft OU5 ROD established the use of an on-property disposal facility, which requires a separate waiver from State of Ohio solid waste disposal facility siting requirements for each OU. A waiver was granted to OU2 upon approval of its ROD. The granting of a waiver for OU5 is contingent upon the approval of its ROD. Such an on-property facility could be effective, more implementable, and present lower overall risks when compared to off-site alternatives. Placing remediation materials in the facility would preclude the potential for future direct contact, incidental ingestion/inhalation, and/or direct radiation exposure, and would reduce the

potential migration of residual contaminants to air, surface water, and groundwater, and thus protect human health and the environment. The preliminary design of the proposed on-property disposal facility included OU3 remediation materials by increasing the capacity of the facility. Therefore, any on-property disposal alternative to be considered for OU3 will be based on the concept of a common, on-property disposal facility.

The common on-property disposal facility presents coordination issues that must be addressed in the development of the OU3 alternative for on-property disposal. Coordination issues include managing fill materials and OU3 debris remediation materials in proper proportions. The minimum required ratio of soil to debris would be approximately 2 to 1, to ensure proper compaction within the on-property facility. However, a 3 to 1 ratio is anticipated during actual on-property disposal activities. Therefore, adequate volumes of excavated soil and/or waste must be supplied through OU2 and OU5 remedial activities to facilitate OU3 material placement. Otherwise, fill from other sources (off-site supply) would be required; such an adjustment to the alternative would increase project cost estimates. Because limited quantities of soils are available until the OU5 remediation of the former production area, OU3 materials may require temporary storage prior to placement in the on-property facility.

5.2.3 Off-Site Disposal/Waste Shipment

As discussed in Section 5.2.1, further treatment and disposition of OU3 materials at an off-site disposal facility is an option. Therefore, the FEMP's waste shipment capacity, as well as the disposal facility's ability to accept this material over the expected duration of waste generation, must be considered in alternative development.

The respective, specific WAC for the off-site facilities are based on federal, state, and local laws and regulations, as well as on each facility's own requirements. Disposal facilities are restricted by operating permits as to the waste categories accepted (LLW, mixed waste, RCRA-regulated, etc.). Individual facilities have established criteria, including characterization, packaging, waste form, and documentation, that waste generators must meet. The WAC and shipping requirements for two disposal facilities (NTS and a commercial disposal facility near Clive, Utah) that could accept OU3 materials are discussed in Appendix F.

As discussed in Appendix D, OU3 LLW contaminated materials could be transported for permanent disposal at the NTS. As a condition of disposal at the NTS, no wet waste or free liquids are

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accepted. The NTS currently cannot accept mixed waste; however, a permit to accept mixed waste is pending. In addition, materials cannot contain PCBs at concentrations greater than 50 ppm. Furthermore, all materials shipped to the NTS must be containerized. No bulk material will be accepted. Currently, radiologically contaminated materials from the FEMP are being shipped to the NTS. Material transportation to the NTS would be generally by truck, as there is no rail line leading directly to the facility. However, a combination of rail and truck transport systems may be used, if practicable.

For the purposes of this report, a commercial disposal facility near Clive, Utah, which is typical of the available commercial disposal facilities, provides the basis for cost, technical, and administrative considerations for the off-site disposal of OU3 materials that cannot be disposed of at the NTS. It is anticipated that only Category C (Process-Related Metals) materials will be disposed of at the NTS because of projected exceedance of the commercial facility WAC for LLW and because performing additional treatment to meet WAC would not be cost-effective. For the remainder of this report, the aforementioned commercial facility will be referenced as the representative commercial disposal facility.

The representative commercial disposal facility has a license that allows disposal of naturally occurring radioactive material, LLW, and mixed waste. The facility also holds a RCRA Part B Permit allowing the treatment of mixed and hazardous wastes to meet LDRs and subsequent disposal of the treated materials. The total developed and permitted capacity of this facility for mixed waste and LLW is 0.9 million cubic yards (yd^3) and 5 million yd^3, respectively. Of this permitted capacity, 0.8 million yd^3 has been used, leaving over 5.0 million yd^3 available. The OU1 selected alternative specifies the shipment of approximately 0.63 million yd^3 to the facility. The total developed capacity could be expanded, subject to a permit revision, to as many as 14 million yd^3.

The representative commercial disposal facility is directly accessible for large-volume shipments by rail and by truck. For example, under the OU1 ROD, processed, treated pit waste would be rail-shipped in bulk using existing on-property rail spurs. Improvements to the FEMP rail shipment facilities will be required to accommodate the increased activity. These improvements would create a potential for other OUs, including OU3, to ship materials off-site by rail.

5.2.4 Institutional Controls and Post-Remediation Monitoring

For any necessary institutional controls and post-remediation monitoring elements, an on-property disposal alternative developed for OU3 will adopt measures stipulated in the OU2 ROD and the draft OU5 ROD. As discussed in Section 5.2.2, the basis of any OU3 on-property disposition alternative is the proposed FEMP on-property disposal facility. The OU2 ROD and the draft OU5 ROD specify the institutional controls and the long-term monitoring measures for this facility. These measures include maintaining federal ownership, fencing the disposal facility, operating a groundwater monitoring network, and performing five-year reviews. Since OU3 has no environmental media that will remain in place after the final remediation, the proposed OU2 and OU5 measures are anticipated to be adequate for OU3. Therefore, the adequacy of these institutional controls or post-remediation monitoring elements are not evaluated in this report.

5.3 STRATEGY FOR FINAL OU3 REMEDIAL ACTION

Because of its process history, and the magnitude and diversity of the materials that comprise it, mitigation of OU3's environmental threats requires a multiple-project approach that will terminate upon completion of the final remedial action. Projects preceding the final remedial action include the RCRA closures for HWMUs, CERCLA removal actions for releases and potential releases, and the interim remedial action for the D&D of OU3 components. The scope of these projects and their progress is discussed in Section 1.2.2.1. The following discussion outlines the general approach for developing the final OU3 remedial action alternatives in coordination with the OU3 multiple-program remedial strategy and for incorporating aforementioned projects into the final OU3 remedy. Key elements of the OU3 treatment and disposition strategy pertaining to integration with the interim remedial action are also addressed.

5.3.1 Remedial Strategy for Operable Unit 3 Remediation Material/Waste Streams

In summary, the OU3 RAOs call for the dispositioning of all materials remaining from the interim remedial action in a manner that restricts risks to human health and the environment to acceptable limits, as defined by the US EPA. The specific RAOs provide a framework for implementing a selected OU3 final remedial alternative. A selected remedy must comply with all ARARs, as required by CERCLA. Additionally, to evaluate conformance with the RAOs and ARARs, the identified alternatives for OU3 are developed based on remediation material categories, as discussed in Section 3 of this report.

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As discussed in Section 3, the OU3 material categories are based on the physical properties and/or configurations of the materials. Section 3.6.4 provides a further breakdown of these materials by segregation category, based on regulatory waste classification (i.e., hazardous waste, LLW, etc.). The material and segregation categorization serves as a waste management tool to determine any additional treatment and the material-specific disposition pathway. For each material category, comparisons are made of segregation categories against the criteria for on-property and off-site disposition to develop the remedial alternatives.

Figure 1-5 of this report shows the overall remediation approach that correlates the disposition of the materials from the OU3 component categories, established in the WPA (DOE 1993a), with ongoing remedial programs. The storage, treatment, and disposition of materials in Category J (Product, Residues and Special Materials) are within the scope of various ongoing removal actions and programs. These programmatic removal actions (Removal Actions Nos. 9, 12, 17, and 26) are not evaluated in this report but will be incorporated into the OU3 final remedial action. The remediation materials in Categories A - I, consisting of building materials and miscellaneous construction debris, constitute approximately 75 percent of the OU3 material volume. These materials constitute the material/waste streams for which disposition alternatives are developed and evaluated.

RCRA requirements for closure of specific HWMUs in OU3 will be integrated with CERCLA remedial activities. The hazardous wastes generated by closure activities at these HWMUs during the OU3 D&D phase will fall within the Categories A - J. RCRA-regulated waste may require additional treatment during the final remedial action to comply with LDRs. This additional treatment would be consistent with that identified in the FEMP STP, for a particular hazardous/mixed waste, and the FFCA.

Since on-property disposal remedies have previously been developed for OU2 and OU5, the potential alternatives featuring on-property disposal for OU3 will be partially defined by the conditions under which OU2 and OU5 have established the facility acceptability. Therefore, it is not necessary to develop another alternative, in this report, based on the design and construction of a separate disposal facility for OU3 materials, provided it can be demonstrated that protection is achieved through placement of materials in the proposed, on-property facility. Additionally, the development and evaluation of institutional controls and monitoring elements suitable for the selected post-remediation land use objective are not necessary in this report, as these issues have been adequately addressed by the OU2 and OU5 selection process for the on-property disposal remedy. However, issues of

coordination regarding interaction of the various OU3-specific activities and interaction of OU3 activities with those of other OUs are considered.

5.3.2 Integration of the Interim and Final Remedial Actions

The scope of the interim remedial action consists primarily of D&D and interim storage of, and limited off-site disposal of, nonrecoverable/nonrecyclable materials. Remediation materials generated by ongoing D&D projects would be either stored on an interim basis or transported directly to a disposal facility. Once the disposition remedy is selected in the OU3 ROD, requirements specifically related to the selected remedy will be integrated into the remainder of the interim remedial action to allow effective segregation of materials to meet the requirements of the selected treatment and/or disposal option.

The current OU3 remedial action project schedule, which is based on a ten-year, $276 million annual budget scenario, specifies initiation of the OU3 interim remedial activities in 1995 and approval of the OU3 final ROD in November 1996. The implementation of the selected remedy in the final ROD would then begin in 1997 and would continue concurrently with the interim remedial action until 2005.

The ten-year schedule was developed in the spring of 1995 as a proposal, from the DOE to the United States Congress, to accelerate the remedial activities at the FEMP. The proposal requested the appropriation of remedial action funds in the amount of $256 million in Fiscal Year 1996, and $276 million for each of the nine years thereafter, to complete an accelerated cleanup of the FEMP. All cost, risk, and alternative evaluations in this report are based on this scenario.

It should be noted that, prior to the adoption of the ten-year plan, a schedule for the OU3 interim remedial action had been prepared in the OU3 PSR for the above-grade D&D of OU3 components. The PSR was a requirement of the Final OU3 RD/RA Work Plan for Interim Remedial Action (DOE 1994g) to satisfy the ACA requirement for scheduling the implementation of RD/RA tasks during the OU3 interim remedial action.

The PSR had specified a duration of 31 years for the interim remedial action based on anticipated reductions in DOE project funding. The final remedial action, therefore, would have had a 31-year schedule as well. If remediation funds were to be reduced during the expected ten-year remediation effort, the project duration might possibly be increased. If so, the cost and risk evaluations in the

PSR may be drawn upon to provide guidance for D&D sequencing and remediation materials disposition.

As stated above, the ten-year schedule specifies initiation of the OU3 interim remedial activities in 1995. These actions would commence with the D&D of the above-grade elements of Plant 4A and would continue with the D&D of the remaining above-grade components until 2003. The removal of the below-grade OU3 elements would begin in 1999 and would also continue until 2005.

An estimation of OU3 remediation materials that would require interim storage is presented in Table 5-1. Interim storage would be required because the commencement of the final remedial action would not occur until calendar year 1997. These materials would be generated from the D&D of Plant 4A beginning in 1995. The respective D&D of Plants 1A and 9A would then follow beginning in late 1995 and ending in late 1996 or early 1997.

The material volumes presented in Table 5-1 have been calculated as unbulked and bulked. The materials proposed for placement in the on-property disposal facility or a representative commercial facility have been estimated in unbulked volumes. An unbulked volume is defined as the volume of a material in its smallest reducible form without continuous physical manipulation (e.g., pressurization) to maintain its size. Unbulked volumes are used for these disposition options because it is anticipated that all void space around the unbulked materials would be filled via soil backfill and compression measures.

The materials that may require disposal at the NTS have been estimated in bulked volumes. These volumes were derived by multiplying the corresponding unbulked volumes by a bulking factor. The bulking factors represent the anticipated increase to the volume of materials as a result of containerization. The bulking factors used for these estimates were originally derived from the OU3 PP/EA and were periodically updated during the compilation of this report.

Depending on the disposition decision, requirements to support the final remedial action would be incorporated into the interim remedial action. The material configuration and size restrictions (i.e., WAC for disposal facility) required by the selected remedy would be incorporated into the remaining D&D projects.

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In addition, the types of containers identified to support the final remedial action would be integrated into the remaining D&D projects. The configuration of remediation materials in interim storage would vary by material category and selected remedy. The potential configurations include various containers and controlled stockpiles. Descriptions and capacities of the various containers used at the FEMP are provided in Table 5-2. Depending upon the density of the materials to be containerized, each container can be limited by material volume or weight. For example, a piece of processing equipment (e.g., a furnace) may occupy greater volume than the same weight of concrete.

A key integration factor is the potential for certain D&D techniques (e.g., waterwash and scabbling) to precede a given disposition pathway for a remediation material. Once the final remedy is selected, the disposition would be considered in the development of design specifications to guide a remediation subcontractor toward appropriate dismantling techniques.

5.4 DEVELOPMENT OF ALTERNATIVES

This section discusses OU3's preliminary alternative development and screening process. The remedial alternatives address the remediation of 7,500,000 ft^3 of material in Categories A - I. Category J materials, totaling 1,800,000 ft^3, are addressed by existing programs and are not evaluated in this report. Preliminary alternatives are developed and assembled from the process options and technologies identified in Section 4 to achieve the RAOs. Typically, preliminary alternatives are initially screened against the short- and long-term aspects of effectiveness, implementability, and cost to reduce the number of alternatives that undergo an extensive detailed analysis. As discussed in Section 1.2.2, the submittal of a separate Initial Screening of Alternatives Report for OU3, was eliminated. Had an Initial Screening of Alternatives document been prepared, it would have consisted of the screening of technologies, the identification of alternatives, and the screening of alternatives. For OU3, the technologies screening described in Section 4 and Appendix D, along with the identification of alternatives in this section, satisfies the requirements for an Initial Screening of Alternatives Report.

The results of the technology screening and evaluation process indicate that there are few applicable technologies for containment and treatment response actions, as well as limited disposition technologies. A response action based on material containerization and long-term storage is not appropriate because of administrative requirements of the IROD, which specifies that OU3 remediation materials are not to be kept in an interim storage configuration for an extended period of time. Although many treatment technologies have been retained, most materials will not require

additional treatment prior to final disposal. The portion of OU3 materials that may require further treatment to meet the selected disposition criteria has been identified. As stated in Section 5.3.1, treatment technologies for hazardous and mixed waste materials will be in accordance with the FEMP STP and the FFCA.

Revised preliminary alternatives, presented in the modification to the WPA (DOE 1993a), were based on the interim remedial action and the roles of treatment and disposal in managing OU3 remediation materials, as discussed in Section 5.2.3. The three revised preliminary remedial action alternatives are:

- No further action,
- On-property disposal, and
- Off-site disposition.

In accordance with the IROD, materials from the dismantling of the former production facilities will not remain in on-property, interim storage for an indefinite time. Although the "no further action" alternative cannot be implemented, it provides a baseline for comparing alternatives. Each of the two action alternatives feature recycling and unrestricted release options, when practical, as well as additional treatment, when necessary, to meet criteria for disposal. In addition, for the on-property disposal alternative, an option for off-site disposal of materials that do not meet the on-property disposal criteria is included.

The material volumes to be dispositioned during the final remedial action have been estimated in the FEMP SWIFTS database. The SWIFTS database is the official FEMP database for material estimates and is periodically updated with improved estimation data.

5.4.1 Identification of Alternatives

Although the two action alternatives primarily address on-property and off-site disposal options, the following approaches are used to develop the final alternatives.

- Recycling and unrestricted release of OU3 materials is used when practical;
- Additional treatment is applied when necessary to meet the criteria for off-site disposition at the representative commercial disposal facility; and

- For the on-property disposal alternative, materials that do not meet the on-property disposal criteria will be sent to the representative commercial disposal facility or the NTS for disposal.

Three alternatives were developed for OU3 to satisfy the RAOs as follows:

Alternative 1 - No Further Action
Alternative 2 - Selected Material Treatment, On-Property Disposal, and Off-Site Disposition
Alternative 3 - Selected Material Treatment and Off-Site Disposition

The two action alternatives reflect that engineering and institutional controls are the primary elements to be finalized in developing the alternatives. However, engineering controls in the form of on-property or off-site disposal are somewhat limited. The ARARs pertaining to LLW limit the disposal options to the FEMP itself and to facilities permitted to accept such materials. Additionally, the on-property disposal facility, proposed by OU2 and OU5, eliminates the need to design and construct a disposal facility dedicated to OU3 materials.

5.4.2 Elements Common to Alternatives Evaluated

Certain elements are common to all three alternatives evaluated in this report, whereas other elements are only common to Alternatives 2 and 3. Elements common to all alternatives include specific, ongoing FEMP programs that would be continued regardless of the alternative selected. The similarities between the two action alternatives pertain to the possible further treatment of remediation materials. Representative technologies will be selected, as needed, to provide the best balance of trade-offs with respect to the evaluation criteria, regardless of the disposal decision. These representative technologies will automatically be common to both action alternatives. The following elements are common to all three alternatives:

- Performance of D&D during the OU3 interim remedial action;
- Treatment of hazardous and mixed waste Category J materials (Product, Residues, and Special Materials) in accordance with the OEPA approved STP and the FFCA;
- Continuation of the waste shipping program for the off-site, final disposal of inventoried and newly generated Category J materials (Removal Action No. 9);
- Continuation of the Safe Shutdown program for the proper removal and disposal of uranium products, holdup materials, excess supplies, chemicals, and associated process equipment (Removal Action No. 12);

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- Continuation of the soil and debris storage program for management of debris generated by D&D of OU3 (Removal Action No. 17);
- Continuation of the asbestos abatement program to mitigate potential release and migration of asbestos (Removal Action No. 26);
- Closure of HWMUs, as listed in Appendix K, under the integrated RCRA/CERCLA process; and
- Treatment and disposal of soil piles consistent with the draft OU5 ROD.

Elements also common to both Alternatives 2 and 3 include:

- Unrestricted release of materials meeting release criteria, as established by DOE Order 5400.5, if an appropriate disposition mechanism is available (i.e., material meets commercial landfill acceptance criteria or can be recycled),
- Possible additional treatment of materials to further reduce the mobility, volume, or toxicity of residual contaminants to allow the disposition of materials at the representative commercial disposal facility,
- Controlled recycling of materials that meet criteria for recycling/reuse of materials while maintaining radiological controls (i.e., metal recycling for use within the DOE complex), and
- Absence of a comprehensive recharacterization program conducted to support material segregation during the RD and RA phases.

5.5 DESCRIPTION OF ALTERNATIVES

This section will describe the three alternatives developed for final remediation of OU3. The following subsections will match disposal options with the series of representative technologies, or technology schemes that provide the best programmatic balance of trade-offs (e.g., on-property disposal versus off-site disposal).

The alternative descriptions and costing within this RI/FS are based on materials derived from the interim remedial action based on a ten-year schedule. Figure 5-1 presents a comparison of schedules for Alternatives 2 and 3.

5.5.1 Alternative 1 - No Further Action

CERCLA requires evaluation of a no-action alternative, which implies no further action even if some remedial activity has already occurred, to provide a baseline against which other remedial alternatives can be evaluated. For OU3, the No Further Action alternative represents the condition that results if

no additional remediation activity occurs following completion of ongoing removal actions and the interim remedial action. Under this alternative, all materials generated during the D&D of the former Production Area buildings and structures would remain indefinitely stored on-property. No final disposition of the remediation materials would occur, and no additional containment, removal, additional treatment, or other mitigating action would occur beyond that provided by ongoing removal actions and the interim remedial action. All current site wastes, residues, and materials considered principal threat (see Section 1.2) would continue to be removed from the FEMP and be appropriately dispositioned under existing programs and removal actions.

The No Further Action alternative does not provide for OU3 to maintain any active or passive institutional controls (e.g., physical barriers or deed restrictions) to reduce the potential for exposure to contaminants. However, because of required institutional controls and monitoring programs associated with the anticipated OU2 and OU5 remedial activities, the site would remain under federal ownership.

In the absence of final disposition of the interim remedial action materials, all OU3 materials not removed from the FEMP during the interim remedial action would be stored in multiple configurations, including piles and containers (metal boxes and 55-gallon drums), depending on the material type. Concrete materials, structural steel, inaccessible metals, and other materials that have no or very low levels of remaining removable surface contamination (as defined by DOE Order 5400.5) would be stored in piles. Specific storage requirements for the various types of materials are outlined in the OU3 interim remedial action RD/RA Work Plan (DOE 1994g) and the project-specific implementation plans.

Table 5-3 presents a summary of the material volumes to be placed in storage under Alternative 1 and the storage configuration (e.g., pile, container). Based on below-grade remediation by OU5, no storage pads within the production area would be available for storage. Therefore, a new storage area for OU3 materials would be constructed in the southeast corner of the site near Willey Road and the south entrance.

An estimated 13,100,000 bulked ft^3 of materials would be stored in 72 covered piles. The piles would be approximately 65 ft x 220 ft x 20 ft high. Approximately 1,940,000 bulked ft^3 of materials would be stored in large metal boxes (LMB), and approximately 27,000 ft^3 of material would be stored in white metal boxes (WMB).

Based on the $276 million scenario, the OU3 interim remedial action will start in 1995 and require approximately ten-years to complete. Although the federal government will still own the FEMP when the interim remedial action is completed in 2005, the No Further Action alternative assumes that maintenance of the interim storage facilities would be terminated. These facilities and containers storing the OU3 remediation materials would no longer be maintained and eventually would deteriorate. The result would be exposure of the remediation materials to the elements, potential exposure to trespassers, and release of contamination to environmental media.

In the IROD, DOE determined, and the EPA concurred, that the interim storage of OU3 materials would not be permanent (DOE 1994a). Actions to safely and permanently dispose of OU3 remediation materials must be taken under the final ROD. This alternative is retained throughout the detailed analysis of alternatives as a baseline to support the comparative evaluation of the action alternatives.

5.5.2 Alternative 2 - Selected Material Treatment, On-Property Disposal, and Off-Site Disposition

Under Alternative 2, a majority of the OU3 remediation materials would be permanently disposed of at the FEMP by placement in an on-property disposal facility along with excavated materials generated by the remediation of OU2 and OU5. Criteria for the disposal of OU3 materials in the on-property facility was developed through contaminant fate and transport modeling based on conservative assumptions, as discussed in Appendix G. Remediation materials will be evaluated based on material category and the associated mass of each COC to determine a range of least-cost disposition options, beginning with unrestricted release and ending with off-site disposal. Materials that do not meet the criteria for unrestricted release, recycling, or on-property disposal would be permanently dispositioned of at an off-site disposal facility.

As discussed in Section 5.2.3, two off-site disposal facilities (the NTS and a representative commercial disposal facility) have been identified to potentially accept OU3 remediation materials that exceed the on-property disposal facility criteria. The NTS currently accepts only FEMP materials contaminated with LLW constituents. The representative commercial facility is licensed for the disposal of naturally occurring radioactive material (NORM), LLW, and mixed waste (MW). This facility also holds a RCRA permit allowing treatment and disposal of solid mixed waste that requires stabilization to meet LDRs. A summary of the representative commercial disposal facility WAC is presented in Table 5-4, further information on disposition requirements and criteria is provided in Appendix F.

To reduce the quantity of material requiring permanent disposal at the on-property disposal facility, the representative commercial disposal facility, or at the NTS, unrestricted release, in accordance with DOE Order 5400.5, or recycling would be employed if cost-effective and technically feasible. Materials released for unrestricted use could be reused within the DOE complex or dispositioned to a commercial recycler or a commercial sanitary landfill.

Key elements of Alternative 2 are summarized below:

- Provide for unrestricted release of materials for recycling, reuse, or disposal at a commercial landfill;
- Administratively designate the off-site disposition of Category C (Process-Related Metals) and Category F (Brick) materials;
- Remove material that is above the allowable technetium-99 mass limit and dispose of off-site;
- Dispose of all remaining materials in the on-property disposal facility;
- Treat materials, where required, to meet the off-site disposal facility WAC;
- Characterize and monitor material when required to support final disposition selection;
- Adopt institutional controls through deed restrictions and access controls as specified in the OU2 ROD and the draft OU5 ROD;
- Adopt post-remediation activities also specified in the OU2 ROD and the draft OU5 ROD that provide:
  - Long-term monitoring and maintenance of the on-property disposal facility, and
  - Groundwater monitoring to evaluate the performance of the disposal facility;
- D&D any support facilities no longer needed with disposal as appropriate.

5.5.2.1 Detailed Description of Alternative 2

The following description of Alternative 2 is based on conceptual design. The level of engineering detail provides documentation to estimate costs and evaluate the alternative. This alternative would rely on coordination with other FEMP OUs to provide for certain elements, including design, construction, and operation of an on-property disposal facility; long-term monitoring; and security.

Costs of these elements are estimated on a unit-cost basis or a prorated cost for OU3. If this alternative is selected, the substantive components of the design will be finalized during the remedial design phase consistent with the ROD. The key elements of Alternative 2 are described in further detail below.

Remediation Material Flow

The major efforts regarding remediation material flow under Alternative 2 would be 1) material segregation, containerization, and tracking, 2) on-property disposal, 3) off-site shipment, 4) possible further material treatment, and 5) off-site disposal. These final remedial action efforts would occur concurrently with, and would be fully integrated with, the interim remedial action. Specifically, the material segregation and containerization necessary to support the Alternative 2 disposition activities would be carried out as part of the interim remedial action to promote efficiency and minimize risks through double handling of materials. In general, all material transportation, treatment, and disposition activities occurring after materials leave the D&D work area would fall within the scope of Alternative 2. Based on the current D&D schedule, it is anticipated that the interim storage facility would only be utilized for storage of Plant 4A, 1A, and 9A remediation materials generated before the on-property disposal facility is completed (See Section 5.3.2).

During the ten-year schedule for the OU3 interim remedial action, approximately 7,500,000 ft^3 (unbulked) of remediation materials (Material Categories A - I) would be transported from the D&D project work zones to the interim material storage areas or directly to shipment and/or disposal operations. A breakdown of the projected dismantlement sequence is provided in the ten-year schedule. Figure 5-2 provides a summary of the projected Category E (Concrete) material to be generated annually during the ten-year D&D time frame. Figure 5-3 provides a summery of the remaining material categories to be generated annually during the ten-year time frame. Table 5-5 provides a summary of projected disposition of unbulked remediation materials by segregation category and material category based on the RI field characterization results. The classification of materials as discussed above reveals that 86 percent of the materials on a volume basis, or 6,300,000 ft^3, meet the criteria for on-property disposal. Of the remaining approximate volume of 1,200,000 ft^3, 214,000 ft^3 would exceed the on-property criteria and would require off-site disposal, whereas 986,000 ft^3 are anticipated to meet DOE criteria for unrestricted-release and this could be dispositioned in a commercial sanitary landfill.

As discussed previously, the possible further treatment and the disposition requirements for each material category differ according to the segregation category. Material flow diagrams presented in Appendix E (Section E.6) provide details on configuration, potential treatment, and disposition for each of the nine material categories (A-I) being addressed in the RI/FS. The cost estimate for Alternative 2 is based on the indicated activities.

Material Segregation, Containerization, and Tracking

Treatment and disposition requirements would be identified for all material covered by each D&D project during the design phase. These requirements would be based on the available RI/FS characterization data, process knowledge, and possible additional sampling performed to support a particular D&D project. The process knowledge and RI/FS data would also form the basis for making administrative decisions regarding the disposition of certain material categories. For example, all materials within Category C (Process-Related Metals) would be excluded from the on-property disposal facility since the piping and equipment in this category are expected to contain uranium and/or thorium compounds that potentially would exceed the on-property disposal criteria. These materials would be disposed of at an off-site disposal facility. Likewise, Category F (Brick) materials would be excluded from on-property disposal.

Material segregation, according to disposition requirements, would be performed as part of each D&D project. A fenced work zone would be established for security and control of material and equipment flow. Within the work zone, remediation materials generated would be segregated into batches according to material and segregation categories listed in Table 5-5. Segregated materials identified to receive additional treatment would be sized and containerized (metal boxes of various sizes or drums) or bulk loaded into roll-off boxes (ROBs).

Container selection would be based on the material properties, contamination migration potential during subsequent transportation and storage, and disposition pathway for the material. Container types, descriptions, and applications are presented in Table 5-2. Containerized materials would then be transferred from the work zone to the various areas for further processing according to the designated disposition. Most material would be transported directly to the staging area for the on-property disposal facility or to the transportation center for off-site disposition. These areas would be designed for contaminated material storage. Materials would be kept in interim storage only in cases where disposition is pending.

Materials would be handled and stored in accordance with Site Standard Operating Procedure 0044, Management of Excess Soil, Debris, and Waste from a Project. Materials in staging, transportation, or storage areas would be segregated, based on anticipated disposition, and would be stored in multiple configurations, including stockpiles and containers (LMBs, ROBs, WMBs).

All remediation material containers would be tracked through SWIFTS. Under this system, each container used in the disposition of remediation material would be assigned an inventory identification number. When a container is filled, information pertaining to the container, the material, and its disposition would be entered into SWIFTS, which is an integrated ORACLE database system. SWIFTS provides "cradle to grave" tracking of materials and containers through routine input of data. This system can provide status of the containers and contents while stored on site until disposition occurs.

On-Property Disposal

The information presented in this section has been developed as a result of the OU2 on-property disposal facility design efforts. The information portrays a feasible approach for designing and constructing an on-property disposal facility. It should noted that the OU2 design process is ongoing and will modify, refine, and finalize the design considerations for the on-property disposal facility. The current on-property facility information will be used for the evaluation of remedial alternatives in Section 6 of this report.

The FEMP on-property disposal facility would be designed as an above-grade unit to provide permanent disposal for affected soils, wastes, and materials generated by site remedial actions, including the OU3 interim remedial action. Containment of materials in the facility would minimize the potential for direct contact or incidental ingestion/inhalation of residual contaminants. It would also prevent migration of contaminants to air and surface water, and would protect groundwater for a period of a minimum of 200 years and a maximum of 1,000 years. Since the FEMP is situated over the Great Miami Aquifer, which is a sole-source drinking water aquifer, the placement of OU3 materials in the on-property facility would require a waiver from State of Ohio solid waste disposal facility siting requirements. A summary description of the on-property disposal facility location, design, and operation follows, with a detailed description provided in Appendix G of this report.

The capacity of the on-property disposal facility is projected to be 2.5 million yd^3. Approximately 90 percent of the capacity would be allocated to excavated soils and wastes from OU2 and OU5. OU3

materials would account for approximately ten percent of the remaining capacity. A small amount of affected materials and soils is expected from OU1 and OU4.

Figure 5-4 presents the selected location of the on-property disposal facility according to the draft OU2 Predesign Investigation andSite Selection Report for hte on-property disposal facility. The facility would occupy an area of approximately 800 ft by 4,300 ft. It would feature a multi-layer capping system, including a vegetative soil layer, a filter layer, biotic barriers, high-permeability drainage layer, and low-permeability infiltration barrier. The disposal facility would also require a multilayer liner system that would include a leachate collection layer, a primary liner, a leak detection layer, and a secondary liner.

Approximately 6,300,000 ft^3 of OU3 remediation materials would be placed in the facility over a seven year period spanning the years 1997 to 2005. On average, 900,000 ft^3 would be sent to the facility annually; however, the actual rate would depend on the progress of the former Production Area dismantlement. Approximately 86 percent of the OU3 material volume would consist of LLW from various material categories. As mentioned in Section 5.5.2.1 of this report, the on-property disposal facility would not be used for the disposal of OU3 materials from two categories: Category C (Process-Related Metals) and Category F (Brick).

Construction of the facility, as specified by the OU2 design efforts, would begin at the northern end of the designated construction site. Stormwater runoff would be collected during the facility construction and transferred to the Advanced Wastewater Treatment (AWWT) facility for treatment prior to release to the environment. Leachate collected from the disposal facility underdrain system would also be transferred from the facility to the AWWT facility for treatment before discharge to the environment.

Covered trucks, tarps, and water sprays would be employed to mitigate fugitive dust emissions during the facility construction and fill operations. Based on current designs, the OU3 remediation materials would be brought into the holding area directly from the D&D work zones or, in limited cases, from interim storage facilities. The materials would be transported in 40-ton (net capacity) ROBs or dump trucks. Approximately 26,800 truck trips would be required to convey the OU3 material to the facility. From the holding area, OU3 materials and soils would either be sent directly to the facility for immediate placement or be placed in the staging area located within a vacant portion of the facility on a short-term basis to await placement.

OU3 material would be transported using existing FEMP roads or newly constructed temporary haul roads. New roads would be constructed within the Former Production Area and old ones would be demolished as the disposal facility expands. The south entrance road to the FEMP Willey Road would be maintained throughout the remediation effort, whereas the north entrance road State Route 126 would be relocated.

Current waste placement strategies developed in the OU2 design stipulate that remediation materials would be disposed in bulk and layered between contaminated soil lifts. The soils would generally be obtained from OU5 remedial actions. Soil lifts above OU3 material layers would be compacted mechanically to achieve the specified design density. Certain OU3 materials, such as ACM and transite panels, would require special handling and placement measures during the fill operation. To achieve stability and compacted density of the fill, a minimum soil to material ratio of 3 to 1 would be specified. Final waste placement strategies will be developed in forthcoming OU2 remedial design documentation.

Operations regarding placement of materials in the on-property disposal facility could occur 40 hours per week, year round, weather permitting. The operations would cease if cold weather conditions prevented attainment of specified soil compaction or prevented because of adequate dust suppression. It is expected that operations would occur only nine months of the year because of compaction difficulties during the winter months.

The facility would be secured by fencing and guards during the active operations period. After completion and sealing of the facility, a permanent security fence would be completed and maintained around the facility. Signs warning against unauthorized entry would be erected. Long-term monitoring of the on-property disposal facility would be provided until the year 2035.

Implementation of WAC for the On-Property Disposal Facility

The objective of developing contaminant-specific WAC is to ensure protection of the underlying Great Miami Aquifer since, as discussed in the OU5 ROD, the primary exposure pathway of contaminants to receptors is vertical migration through the on-property disposal facility liner system and through the geologic overburden to the aquifer. WAC are designed to adhere to maximum contaminant levels (MCLs) in the aquifer, or meet a 1×10^{-5} ILCR or HQ = 0.2 for contaminants when an MCL is not available for a given COC. Based on sitewide remedial objectives, the MCLs must be maintained for a period of 1,000 years after the remediation is complete and materials are disposed in the on-

property disposal facility. As presented in Appendix G, a detailed screening process was applied to identify the OU3 COCs and respective source terms that would have had the potential to exceed acceptable groundwater criteria. Those COCs that did not have the potential to exceed acceptable groundwater criteria were screened out in Appendix G from being a post-remediation concern.

The COCs that were identified for the construction materials being considered for on-property disposal, based on maximum concentrations detected above the Part B Screening Criteria (see Appendix A), were used as the initial COC list for determining potential long-term impacts from OU3 materials. There were 60 initial COCs identified on this list. For these 60 COCs, the first screening step was the travel time screening, in which computer modelling was used to screen out contaminants that would not reach the Great Miami Aquifer within the 1,000 year period. This screening was based on the decay rates of radiological and organic contaminants and the mobility of contaminants through the geologic overburden under the natural infiltration rate (6 inches of rainwater per year).

This screening step indicated that there were only 10 COCs which had the potential to break through the overburden under natural conditions (i.e., without considering the engineering controls in the disposal facility) and reach the Great Miami Aquifer. These COCs were considered potential breakthrough COCs.

Current contaminant source inventories for the 10 potential breakthrough COCs were then evaluated to screen out additional COCs that did not have the potential to create unacceptable impacts after disposal, considering the effects of engineering controls in the disposal facility. The EPA 70-year rule, which considers the maximum potential lifetime impact to human health, was used as the basis for this determination. The 70-year rule was used to determine the maximum lifetime average exposure concentration for risk assessment purposes. This rule was also applied to conservatively estimate the leachability of contaminants when specific information is not available. An allowable mass in the disposal facility for OU3 materials for each of the 10 potential breakthrough COCs was developed using the 70-year rule assumption to meet acceptable groundwater criteria. The total source inventories for the 10 potential breakthrough COCs from OU3 materials considered for on-property disposal (excluding primary threat materials which would be disposed off-site) were assumed to dissolve into infiltration waters in the disposal facility within a 70-year period. Source term estimates were then compared to the OU3 allowable mass.

In addition to the source term developed to support Section 3 of this report, a sensitivity analysis was performed to establish an upper bound on the source term estimates. These maximum source terms were used for comparison purposes to ensure that the allowable mass screening remained conservative. Among the potential breakthrough COCs, only source terms for uranium and technetium-99 exceeded the conservatively determined OU3 allowable mass estimates. Therefore, uranium and technetium-99 were identified as the only post-remediation COCs for OU3. Other potential breakthrough COCs were screened out from additional evaluations, since source term estimates were generally orders of magnitude lower than the OU3 source term allowed in the on-property disposal facility under the 70-year rule assumption.

Through this screening process, uranium and technetium-99 were identified as the only COCs that have the potential to exceed groundwater criteria. Since material-specific leachability of uranium and technetium-99 in various construction materials was unknown, laboratory leachability studies were conducted to determine contaminant- and material-specific leachability and to develop WAC, as needed, for OU3 materials.

These studies demonstrated that uranium leachate concentrations, produced from samples indicating highest uranium concentrations in OU3, did not approach acceptable liquid phase WAC for the on-property disposal facility. Conservative leaching assumptions for uranium were applied to evaluate materials that were not studied in the leachability experiments, and source term estimates for these materials were much lower than the uranium allowable mass for these materials. Therefore, uranium was screened out as being a post-remediation COC for all OU3 materials considered for on-property disposal.

Technetium-99, however, was determined to be highly mobile from OU3 materials. Source term estimates exceeded the conservative allowable mass for on-property disposal. The leachability study demonstrated that technetium-99 had the potential to leach at unacceptable levels. Therefore, the allowable mass of technetium-99, developed for the allowable mass screening using the 70-year rule, was established as the technetium-99 WAC. The results established an allowable mass of 105 grams for technetium-99 as the OU3 WAC for the on-property disposal facility.

Given the technetium-99 WAC, the primary objective of Alternative 2 is to then ensure that the on-property disposal of OU3 materials is protective of human health and the environment. As presented in Section 3 and Appendix B, the total source term for technetium-99 in OU3 materials equals 127

grams. Based on this conservative source term, remedial actions would be implemented to reduce the estimated quantities of technetium-99 below the 105 gram limit. This reduction would ensure the safe disposal of OU3 materials within the on-property disposal facility. Figure 5-5 summarizes the approach to implement the on-property facility WAC for OU3 materials.

Because the estimated source term exceeds the allowable mass, some OU3 materials would require removal and off-site disposal to reduce the source term by a minimum of 22 grams. Before determining which materials are necessary to remove, previously made administrative decisions have to be considered. As discussed in Section 1, under the balanced approach Categories C (Process-Related Metals) materials, Category F (Brick) materials, and Category J (Product, Residues, and Special Materials) are to be dispositioned off-site.

As a result of these administrative decisions, the technetium-99 source term remaining to be evaluated for on-property disposal would be 117 grams. Of the materials contributing to this source term, the significant contributor is Category E (Concrete) materials, with 103 grams. As detailed in Appendix G, the specific material that contributes the majority of the 103 grams is concrete slabs, with a mass of 93.8 grams. The mass of technetium-99 associated with the concrete slabs is isolated predominantly within the top one-half to one inch of the material, with decreasing concentrations at depth.

Given the quantity of technetium-99 in the concrete, the most efficient approach to meet the allowable mass limit is to determine the portions of concrete to be removed. To facilitate this evaluation, the concrete within each process area has been ranked to determine the location with the highest concentration and its associated technetium-99 source term. At the top of this ranking, process area 2 of Plant 9A is the location of the highest technetium-99 concentration at 8100 pCi/g in the top half-inch of concrete; the technetium-99 source term associated with this top half-inch of concrete is approximately 13 grams. To reduce the technetium-99 to below the allowable mass limit, the concrete in the top half-inch of this process area would be removed through mechanical scabbling (see Appendix D for description); the 13 grams would be removed as a result, leaving a source term of approximately 104 grams of technetium-99, which is below the allowable mass limit.

Based on the conservative source terms, the removal of the above area would meet the allowable mass limit for technetium-99; however, as a best management practice to ensure protection of human health and the environment, additional concrete removal would occur. The selection of the concrete to be

removed would occur based on the maximum technetium-99 concentrations, with the top inch of concrete in the identified process area being removed. In ranking the concrete concentrations, two distinct ranges of sample results can be identified: values between 8,100 and 2,900 pCi/g and values below 838 pCi/g. (Appendix A contains detailed information regarding technetium-99 sample results.) To implement this approach, concrete with concentrations at or above 2,900 pCi/g of technetium-99 would be removed. The three process areas at or above this level are Plant 9A, process area 2 (as mentioned above), Plant 9A, process area 4, and Plant 8A, process area 4. The removal of an additional half-inch of concrete in Plant 9A, process area 2 and the top inch of concrete in Plant 9A, process area 4 and Plant 8A, process area 4, would reduce the total technetium-99 source-term by approximately 58 grams and would generate approximately 2,190 ft^3 of residue. As a result of this process, the remaining mass of technetium-99 estimated for disposal within the on-property disposal facility is 59 grams.

Treatment

As shown in Table 5-5, the only treatment anticipated during Alternative 2 would involve various treatment options that may be applied to mixed or hazardous wastes and residues to meet LDRs for the representative commercial disposal facility. Treatment processes that generally would be used, as needed, to meet LDRs are solidification and encapsulation. Any treatment employing these techniques would be performed either on-property or at the representative commercial disposal facility. A brief description of the material potentially to be further treated and the treatment processes follows.

Solidification - The solidification operation would use cement or similar reagent to create a stable matrix. The materials that may be processed would be approximately 1,420 ft^3 of mixed waste concrete residues generated by scabbling operations. The finished product would pass a TCLP analysis and meet the WAC for disposition at the designated disposal facility.

Encapsulation - This operation would encapsulate crushed and shredded materials within a polymer. The resulting matrix would comply with TCLP criteria of the LDRs. Material that may be processed by this facility would consist of approximately 10,200 ft^3 of brick classified as mixed waste.

Off-Site Disposition

Materials with no contamination above background levels and contaminated materials not meeting the criteria for the on-property disposal facility would be shipped by truck transport to off-site facilities

for disposition. The FEMP can support this activity by using existing on-property truck loading facilities. Discussions of the two off-site disposition processes listed are provided below.

Off-Site Unrestricted Release/Disposal

As shown in Table 5-5, 498,000 ft^3 of Category E (Concrete) materials and 488,000 ft^3 of Category I (Miscellaneous Materials) have been characterized, using process knowledge and RI/FS sampling data, as having no contamination that exceeds baseline levels. The Category E (Concrete) materials would consist of sidewalk and parking lot debris from the Administrative Area. These materials would be loaded into ROBs and transported by truck for disposal in a local commercial sanitary landfill located approximately eight miles from the FEMP. An estimated 2,900 truck loads over eight years would be required to transport this material from the FEMP to the landfill. These unrestricted release materials must be in compliance with the surface contamination guidelines found in DOE Order 5400.5. This approach has been applied in the past at the FEMP for similar materials. These materials would undergo radiation screening and would require monitoring to ensure that surface contamination is within allowable limits and would require potential sampling to assess at-depth contamination.

Off-Site Restricted Disposal

It is estimated that 214,000 ft^3 of OU3 remediation materials would be shipped to either a representative commercial disposal facility or the NTS facility over the duration of the D&D program. Depending on a material category, these materials would be containerized in LMBs, ROBs, WMBs, and B-12 boxes. Tentatively, these materials would be shipped off-site by truck. The approximate total number of truck shipments required for disposal of materials at the NTS and at the representative commercial facility would be 650 and 80, respectively. Each shipment would consist of one LMB for transport to the NTS and six B-12 boxes for transport to the representative commercial disposal facility. Through coordinated efforts with OU1, the off-site shipment of OU3 materials to the representative commercial disposal facility could be combined with the off-site rail shipment of OU1 remediation materials.

Support Facility Decontamination and Dismantlement

Any facilities and structures constructed to support the OU3 D&D phase and the disposition phase would likewise undergo D&D when no longer needed to support the remediation effort. It is anticipated that most of these materials would be placed in the on-property facility based on meeting the on-property disposal facility WAC. If the on-property disposal facility is not available for

disposition activities, then the materials will be disposed of either at the NTS or the representative commercial disposal facility.

Institutional and Administrative Control Requirements

To ensure the long-term performance of the remedial action, Alternative 2 would require long-term groundwater monitoring and maintenance for the on-property facility, as well as the adoption of a series of institutional and administrative controls, as specified in the OU2 ROD and draft OU5 ROD, including the following:

- Establishing and maintaining a fence around the disposal area, including appropriate postings on the fence notifying individuals of the buried materials;
- Establishing permanent markers (monuments) demarcating the footprint of the disposal area;
- Placing deed restrictions noting the existence of the buried materials prohibiting intrusive activities into the area;
- Establishing continued federal government ownership of, at a minimum, the footprint of the disposal area;
- Maintaining the fencing and the cap system of the disposal area;
- Operating a long-term groundwater monitoring network; and
- Performing reviews (at least every five years following completion of remedial actions) to assess the continued effectiveness of the remedial action to protect human health and the environment.

5.5.3 Alternative 3 - Selected Material Treatment and Off-Site Disposition

Under Alternative 3, all OU3 remediation materials would be dispositioned off-site. Materials that do not meet the criteria for unrestricted release or recycling would be permanently dispositioned at the representative commercial disposal facility and at the NTS. Remediation materials would be evaluated, based on material category and contaminant levels, to determine a range of least-cost disposition options, beginning with unrestricted release and ending with off-site disposal. Materials that do not meet the representative commercial disposal facility's WAC would be treated to meet the specific criteria for disposal. A summary of the representative commercial disposal facility's WAC is provided in Table 5-4.

The major difference between Alternative 3 and Alternative 2 is the location of the disposal facilities. Another difference is that, because of the quantity of material that would be transported from the FEMP to the representative commercial disposal facility, rail transport would be used instead of truck transport. The OU3 materials would be shipped in conjunction with OU1 remediation wastes, by utilizing the FEMP rail system, which is scheduled to be upgraded under the OU1 ROD. However, several components of the two action alternatives are identical. Under both alternatives, the material that may require further treatment and the treatment processes are the same. The concept of unrestricted release of material below baseline levels is also the same. Additionally, Category C (Process-Related Metals) materials would be transported by truck for disposal at the NTS, since these materials are expected to exceed the representative commercial disposal facility WAC for LLW and since additional treatment would not be cost-effective.

To reduce the quantity of material requiring permanent disposal at the representative commercial disposal facility or at the NTS, unrestricted release in accordance with DOE Order 5400.5, or recycling would be employed as practicable. These actions would be subject to economic, technical, and marketability factors discussed in Section 4.3. Materials released for unrestricted use could be reused within the DOE complex or dispositioned to a commercial recycler or a commercial sanitary landfill.

Key elements of Alternative 3 are summarized below:

- Provide for unrestricted release of materials for recycling, reuse, or disposal at a commercial landfill;
- Recycle materials for unrestricted or restricted release at a commercial recycling vendor, when practicable;
- Dispose of all remediation materials not released for unrestricted use or recycling to a representative commercial disposal facility in accordance with ARARs;
- Further treat materials, where required, to meet the off-site disposal facility's WAC;
- Characterize and monitor material where required to support final disposition selection; and
- D&D any support facilities no longer needed, with disposal off-site as appropriate.

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5.5.3.1 Detailed Description of Alternative 3

The following description of Alternative 3 is based on a conceptual design. The level of engineering detail provides documentation for cost estimating and alternative evaluation purposes. This alternative would rely on coordination with other FEMP remedial actions to provide support for the disposition of OU3 materials, including the OU1 waste shipment facilities. Estimated costs for these elements are based on a unit cost or a prorated cost for OU3. If this alternative is selected, the substantive components of the design will be finalized during the remedial design phase consistent with the final ROD. The key elements of Alternative 3 are described in further detail below.

Remediation Material Flow

The major remediation material flow efforts occurring under Alternative 3 are 1) material segregation, containerization, and tracking; 2) possible further material treatment; and 3) off-site shipping and disposition. These final remedial action efforts would occur concurrently with, and would be fully integrated with, the interim remedial action. Specifically, the material segregation and containerization necessary to support the Alternative 3 disposition activities would be carried out as part of the interim remedial action. It is anticipated that the interim storage facility would be used for storage of Plant 4A, Plant 1A, and Plant 9A remediation materials generated prior to the implementation of off-site disposition activities.

During the ten-year schedule for the OU3 interim remedial action, approximately 7,500,000 ft^3 (unbulked) of remediation materials would be transported from the D&D project work zones to the material storage areas or directly to shipment and/or disposal operations. A breakdown of the projected dismantlement schedule is provided in the ten-year schedule for interim remedial action. Figure 5-1 provides a summary of projected remediation material generation during the ten-year D&D time frame. Table 5-6 provides a summary of projected disposition of remediation materials on an unbulked volume basis by material category and segregation category based on the OU3 RI/FS field characterization results. It is anticipated that a majority of OU3 remediation materials would meet the WAC for the representative commercial disposal facility. A minority volume of OU3 materials will be disposed of at the NTS. These materials, Category C (Process-Related Metals), exceed the commercial facility's WAC for LLW and are not expected to be further treated in a cost-effective manner. A volume of 191,000 ft^3 would be dispositioned at the NTS. Additionally, a volume of 986,000 ft^3, consisting of Category E (Concrete) materials and Category I (Miscellaneous Materials), would meet the criteria for unrestricted-release and therefore, could be shipped to a commercial

sanitary landfill for disposal. Consequently approximately 6,300,000 ft^3, or 86 percent of the total unbulked volume, would be dispositioned at the representative commercial disposal facility.

Material flow diagrams presented in Appendix E (Section E.6) provide details on configuration, potential treatment, and disposition for each of the nine material categories. The Alternative 3 cost estimate is based on the indicated activities.

Material Segregation, Containerization, and Tracking

Additional treatment and disposition requirements would be identified for all material covered by each D&D project during the design phase. These requirements would be based on the available RI/FS characterization data, process knowledge, and additional sampling performed to support a particular D&D project. Some administrative decisions would be made regarding disposition for certain material categories.

The material segregation, containerization, and tracking components of Alternative 3 would be identical to Alternative 2, as discussed in Section 5.5.2.1. The container requirement would differ for the material destined for disposal at the representative commercial disposal facility, since a special container would be used for rail shipment.

Treatment

The estimated volumes that may require additional treatment prior to disposition at the representative commercial disposal facility are presented in Table 5-6.

Off-Site Disposition

Under Alternative 3, all materials, except materials with no contamination above baseline levels, would be shipped to the representative commercial facility by rail transport or to the NTS by truck transport. Improvements and additions to the existing rail loading facilities would be necessary to support this activity. These improvements are currently scheduled under the OU1 ROD. The materials that meet the criteria for unrestricted release would be shipped to a commercial sanitary landfill by truck. The FEMP could support this activity by using existing on-property truck loading facilities. Category C (Process-Related Metals) materials would be shipped, by truck, to the NTS.

Off-Site Unrestricted Release/Disposal -- This component of Alternative 3 is identical to the off-site unrestricted release/disposal activity under Alternative 2.

Off-Site Disposal - It is estimated that 6,300,000 ft^3 of OU3 remediation materials would be shipped to the representative commercial disposal facility by rail, and 191,000 ft^3 would be shipped to the NTS by truck over the duration of the D&D program. Off-site shipment to the representative commercial disposal facility involves packaging the materials in sealed, intermodal transport containers that comply with DOE orders and DOT requirements. Intermodal containers would be loaded on articulated spine rail cars. Each articulated rail car can hold six intermodal containers. It is estimated that 150 28-car train shipments will be required to transport all OU3 materials designated for disposal at the commercial facility. It is anticipated that the same number of truck shipments to the NTS would be the same as in Alternative 2.

Off-Site Treatment/Disposal - This component of Alternative 3 is identical to the off-site unrestricted release/disposal activity under Alternative 2.

Support Facility Decontamination and Dismantlement

Any support facilities and structures constructed to support the D&D phase and the disposition phase would be decontaminated and dismantled when no longer needed to support the remediation effort, in accordance with the same procedures implemented for the former Production Area facilities. It is anticipated that most of these materials would be dispositioned at the representative commercial disposal facility.

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TABLE 5-1

PROJECTED MATERIALS IN INTERIM STORAGE (1995 - 1997) GENERATED BY D&D OF ABOVEGRADE ELEMENTS OF PLANT 4A, PLANT 1A, AND PLANT 9A

FS Category[1]	Unbulked Volumes (ft^3)	Bulked Volumes (ft^3)	Weight (tons)
A Accessible Metals	13,600	227,000	3,300
B Inaccessible Metals	206,000	691,000	4,300
C[2] Process-Related Metals	23,200	80,000	590
D Painted, Light-Gauge Metals	1,710	3,400	350
E Concrete	45,200	58,800	1,500
G Non-Regulated ACM	14,000	17,000	800
H Regulated ACM	3,000	12,000	7
I Miscellaneous Materials	16,600	30,000	370
Totals	323,000	1,120,000	11,200

(1) No Category F materials are contained in the above-grade elements of Plant 4A, Plant 1A, Plant 9A.

(2) Category C materials generated are to be dispositioned off-site as soon as practical.

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TABLE 5-2
CONTAINER DESCRIPTIONS AND CAPACITIES

Type of Containers	Exterior Dimensions (l x w x h)	Interior Volume (ft^3)	Net Weight Capacity (lbs.)	Vertical Stacking
55 gallon drum	23.5" d x 29.5" h	7.4	832	Yes, on a pallet/ 4 high indoor 3 high outdoor
B-25 box	6' x 3.9' x 2.3'	44	9,000	Yes/4 high
Small White Metal Box	6.7' x 4.6' x 3.5'	83	6,800	Yes/3 high
Large Metal Box	20' x 8' x 8.5'	1,025	35,000	Yes/2 high
Reusable Roll-off Box	23.5' x 8' x 6.5'	810	33,000	No
Intermodal Transport Containers	20' x 8' x 6.4'	675	40,500	Yes/2 high

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TABLE 5-3

ALTERNATIVE 1 TOTAL MATERIAL VOLUMES AND CONTAINER REQUIREMENTS

FS Category	Unbulked Volume (ft^3)	Bulked Volume (ft^3)	Weight (tons)	Type of Storage Configuration	Total Number of Containers/Piles
A	63,400	1,060,000	15,200	Piles	8
B	1,710,000	5,710,000	25,700	Piles	32
C	191,000	649,000	3,370	Large Metal Box	503
D	7,150	14,300	1,360	Large Metal Box	27
E	4,800,000	6,240,000	323,000	Piles	32
F	20,700	26,900	1,450	Small White Metal Box	426
G	60,300	74,800	3,760	Large Metal Box	230
H	32,400	110,000	68	Large Metal Box	108
I	564,000	1,090,000	4,230	Large Metal Box	1,713

Notes:

(1) Number of containers is calculated based on interior volume and weight restrictions for a particular container and the bulked density of the material being containerized (i.e., some material/container combinations are volume restricted, some are weight restricted).

(2) Pile dimensions were assumed to be 220' x 65' x 20'h. Number of piles was based on bulked volumes.

(3) All hazardous and mixed wastes will be containerized for storage in accordance with RCRA requirements.

(4) Respective box dimensions are presented in Table 5-2.

(5) An unbulked volume is defined as the volume of a material in its smallest reducible form without continuous manipulation.

(6) Bulked volumes are derived by multiplying corresponding unbulked volumes by a bulking factor. The bulking factors represent the anticipated increase to the volume of materials as a result of containerization.

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TABLE 5-4

REPRESENTATIVE COMMERCIAL DISPOSAL FACILITY WASTE ACCEPTANCE CRITERIA

Accepted Waste Categories/Forms	Required Waste Acceptance Information/Size/Weight

• Naturally Occurring Radioactive Material/Low Activity Radioactive Waste (NORM/LARW).[1]
• Permitted hazardous waste include all D-characteristic and most F-, P-, U-, and some K- listed wastes.[2]
• NOT permitted for F-listed dioxins or most K-listed wastes for disposal.
• Mixed-waste accepted.
• Containerized and bulk wastes (i.e., bags, drums, boxes, or roll-off containers) are permissible.
	• Generator required to complete several forms, which include but may not be limited to:
	  • Low-activity profile sheet (EC-0200).
	  • Physical properties form (EC-0500).
	  • Radiological evaluation form (EC-0650).
	  • Mixed-waste profile form (EC-0175).
	• Pre-shipment grab samples required to be sent to representative off-site disposal facility.
	• RCRA analyses must be performed by a Utah-certified laboratory.
	• Radiological analysis may be performed on-site if at least 10% of the samples are sent to a Utah certified laboratory for QA purposes.
	• Size of loaded waste container - Bulk or packaged waste is permitted. Unpackaged debris shall be less than 10 inches in at least one dimension and no longer than 8 feet in any other dimension.
	• Weight of waste container - per DOT requirements.
	• Accepted delivery by truck or rail.

(1) See Tables F-1, F-2 and F-3, Appendix F, for radiation limits.
(2) Types of RCRA listed wastes.

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TABLE 5–5

PROJECTED DISPOSITION SUMMARY FOR ALTERNATIVE 2

Disposition	Segregation Category	Material Category(1)	Treatment	Volume(2) ft3 (unbulked)		
					Subtotals	Totals
On–Property Disposal Facility	Mixed Waste	D. Painted Light–Gauge Metal		50		
		E. Concrete		54,400		
		G. Non–Regulated ACM		7770		
		H. Regulated ACM		10,100		
		I. Miscellaneous Materials		22,800		
					95,100	
	TSCA Waste	B. Inaccessible Metals		14,900		
					14,900	
	Low–Level Waste	A. Accessible Metals		63,400		
		B. Inaccessible Metals		1,700,000		
		D. Painted Light–Gauge Metals		7,100		
		E. Concrete		498,000		
		G. Non–Regulated ACM		49,800		
		H. Regulated ACM		58,500		
		I. Miscellaneous Materials		53,100	2,430,000	
	At or Below Baseline	E. Concrete		3,750,000		
		G. Non–Regulated ACM		2,680		
		H. Regulated ACM		11,600	3,760,000	6,300,000
Off–Site Disposal Facility(3)	Mixed Waste	E. Concrete	Solidification	1,420		
		F. Brick	Encapsulation	10,200		
					11,600	
	Low–Level Waste	C. Process–Related Metals(4)		191,000		
		E. Concrete		770		
		F. Brick		10,500		
					202,000	
						214,000
Unrestricted Release	At or Below Baseline	E. Concrete		498,000		
		I. Miscellaneous Materials		488,000		
					986,000	
						986,000
				Grand Total		7,500,000

(1) Category J material volumes not included.
(2) All estimated volumes have been rounded to three significant figures.
(3) Exceeds On–Property Disposal Facility WAC
(4) All Category C materials will be dispositioned at the NTS.

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TABLE 5–6

PROJECTED DISPOSITION SUMMARY FOR ALTERNATIVE 3

Disposition	Segregation Category	Material Category(1)	Treatment	Volume(2) ft3 (unbulked)		
					Subtotals	Totals
Off–Site Disposal Facility	Mixed Waste	D. Painted Light–Gauge Metal	Encapsulation	50		
		E. Concrete	Solidification	55,800		
		F. Brick	Solidification	10,200		
		G. Non–Regulated ACM	Encapsulation	7,770		
		H. Regulated ACM	Solidification	10,100		
		I. Miscellaneous Materials	Encapsulation	22,800		
					107,000	
	TSCA	B. Inaccessible Metals		14,900		
					14,900	
	Low–Level Waste	A. Accessible Metals		63,400		
		B. Inaccessible Metals		1,700,000		
		C. Process–Related Metals (3)		191,000		
		D. Painted Light–Gauge Metal		7100		
		E. Concrete		4,250,000		
		F. Brick		10,500		
		G. Non–Regulated ACM		52,500		
		H. Regulated ACM		70,100		
		I. Miscellaneous Materials		53,100		
					6,400,000	
						6,520,000
Unrestricted Release	At or Below Baseline	E. Concrete		498,000		
		I. Miscellaneous Materials		488,000		
					986,000	
						986,000
				Grand Total		7,500,000

(1) Category J material volumes not included.
(2) All estimated volumes have been rounded to three significant figures.
(3) All Category C materials will be dispositioned at the NTS.

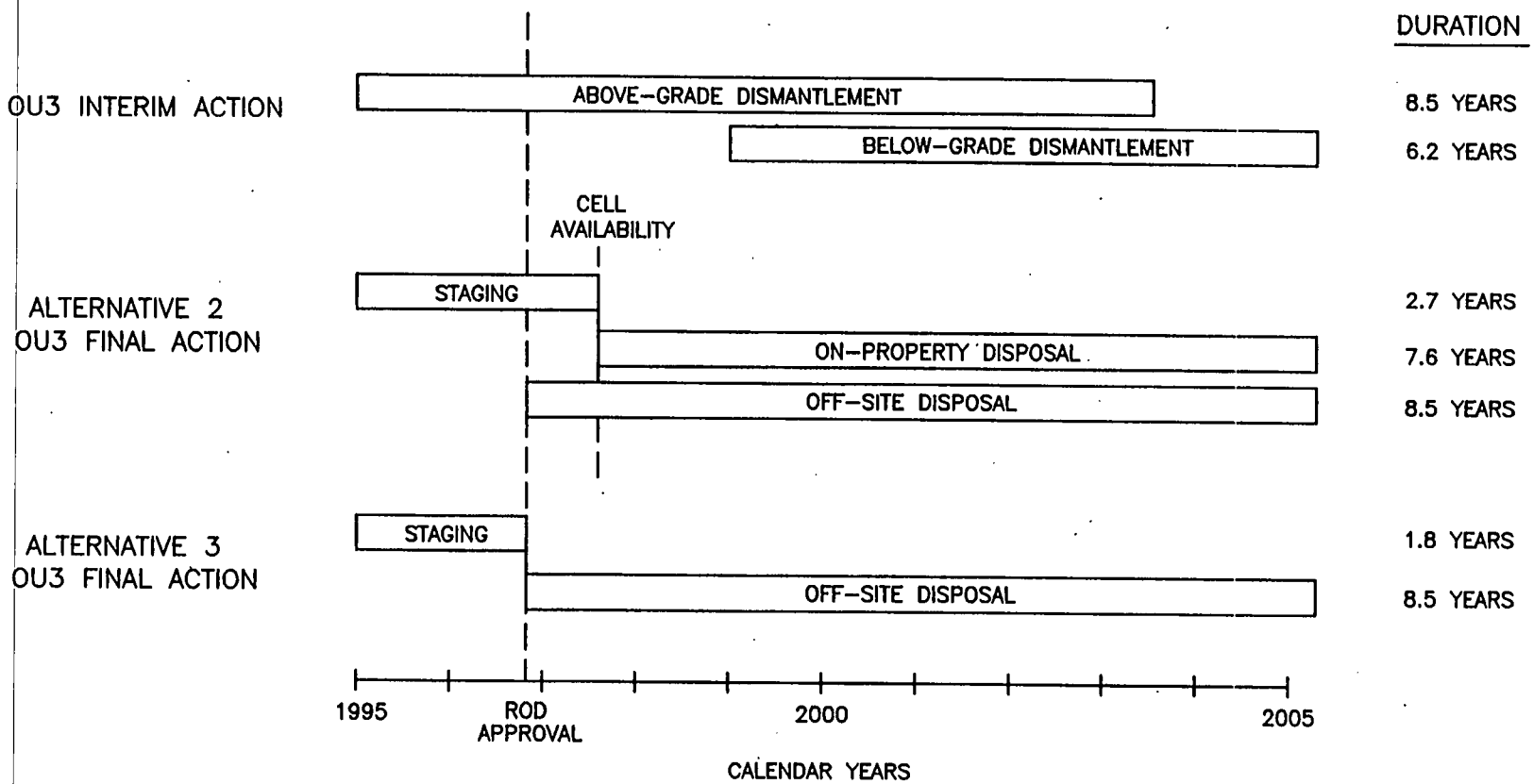

FIGURE 5-1 COMPARISON OF SCHEDULES FOR ALTERNATIVES 2 AND 3

Note: For Alternative 2, no one item will be staged for 7.6 years. Materials that are staged prior to on-property disposal facility completion will be placed in the facility upon achieving operational status.

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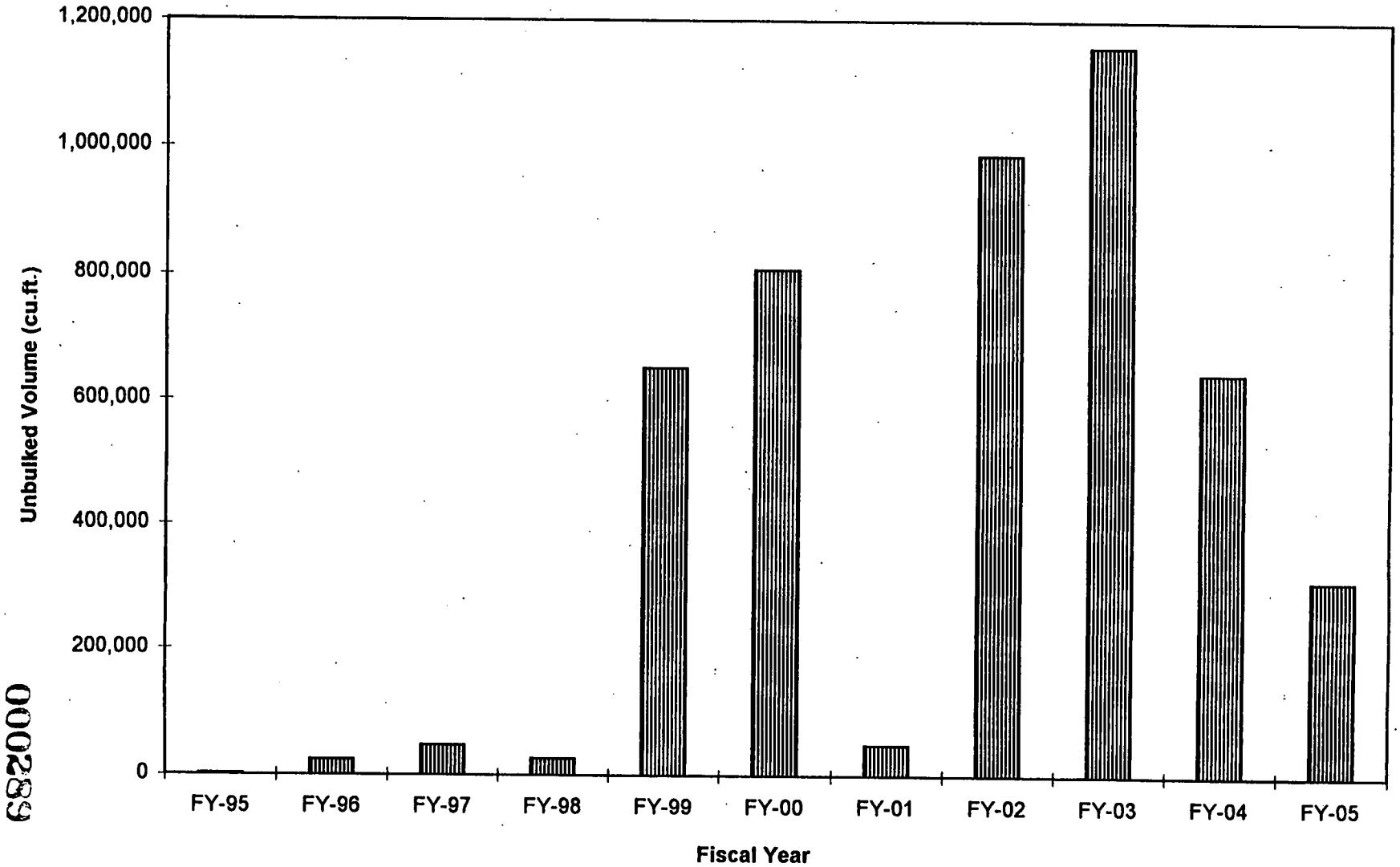

FIGURE 5-2
Yearly Generation of Category E (Concrete) Materials

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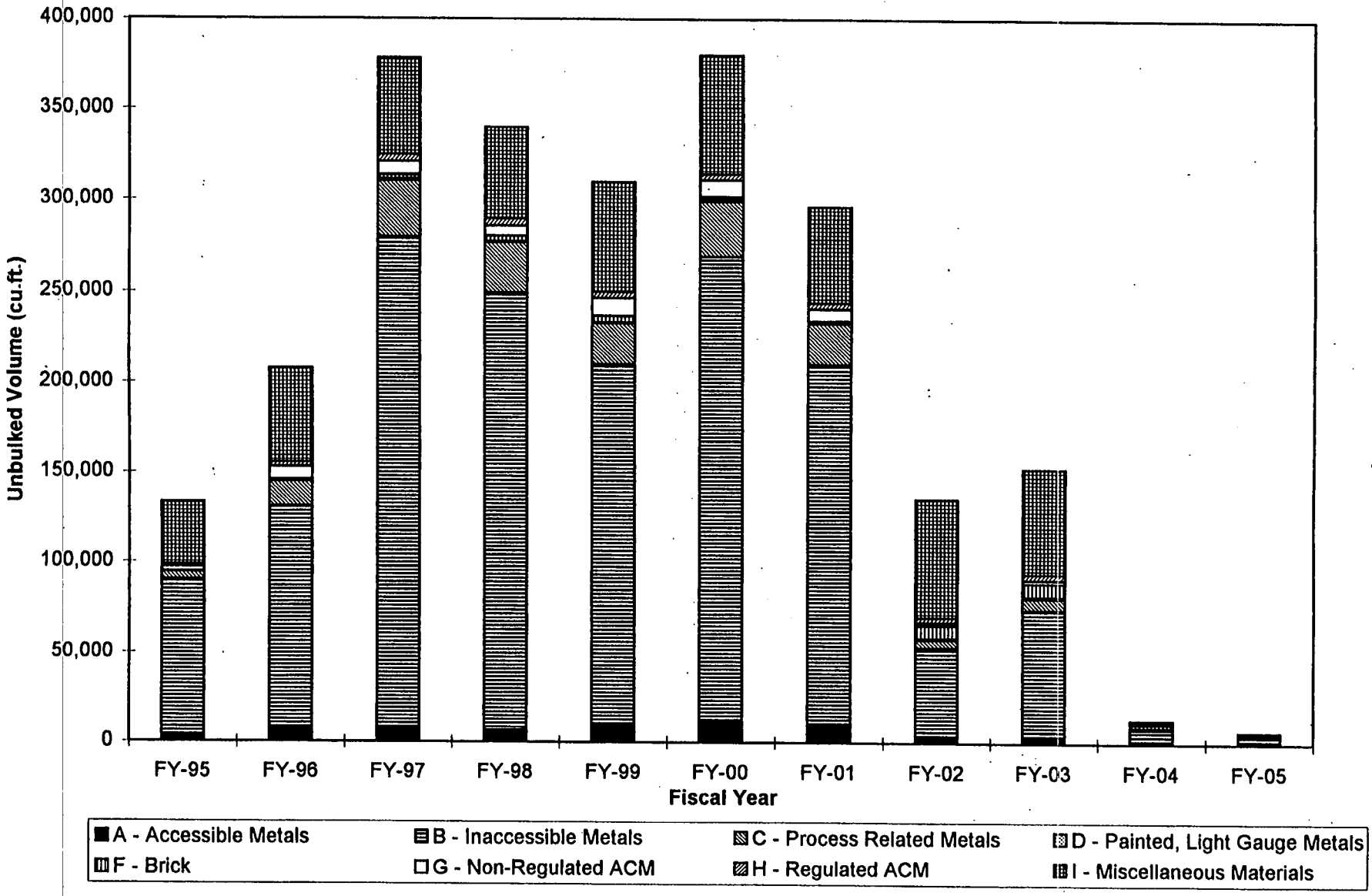

FIGURE 5-3
Yearly Generation of OU3 Material Categories [Excluding Category E - (Concrete) Materials]

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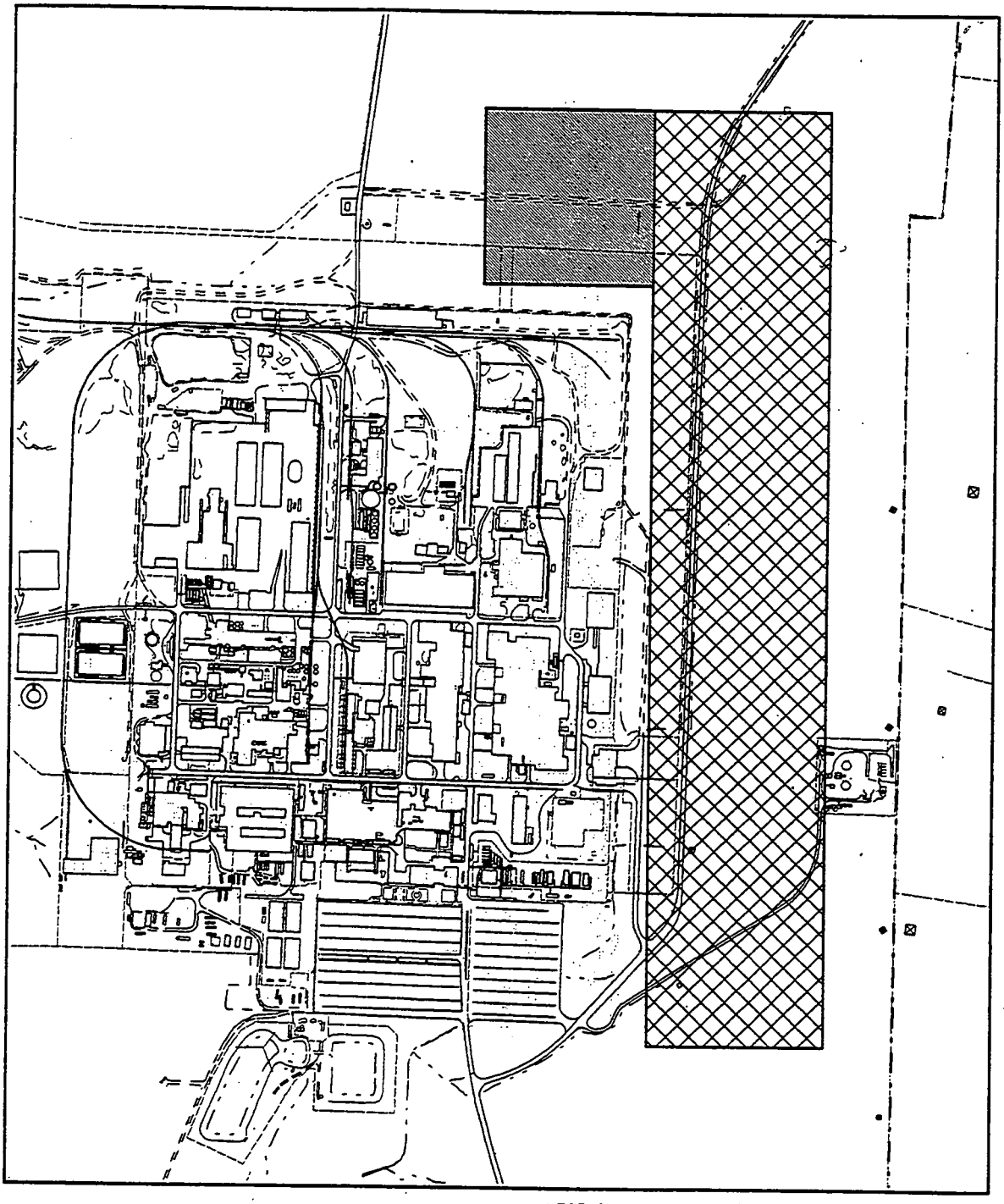

LEGEND

SCALE

0 375' 750' 1500'

CONTINGENCY EXPANSION AREA

ON-PROPERTY DISPOSAL FACILITY 2.5 MCY

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FIGURE 5-4 SELECTED LOCATION FOR THE ON-PROPERTY DISPOSAL FACILITY

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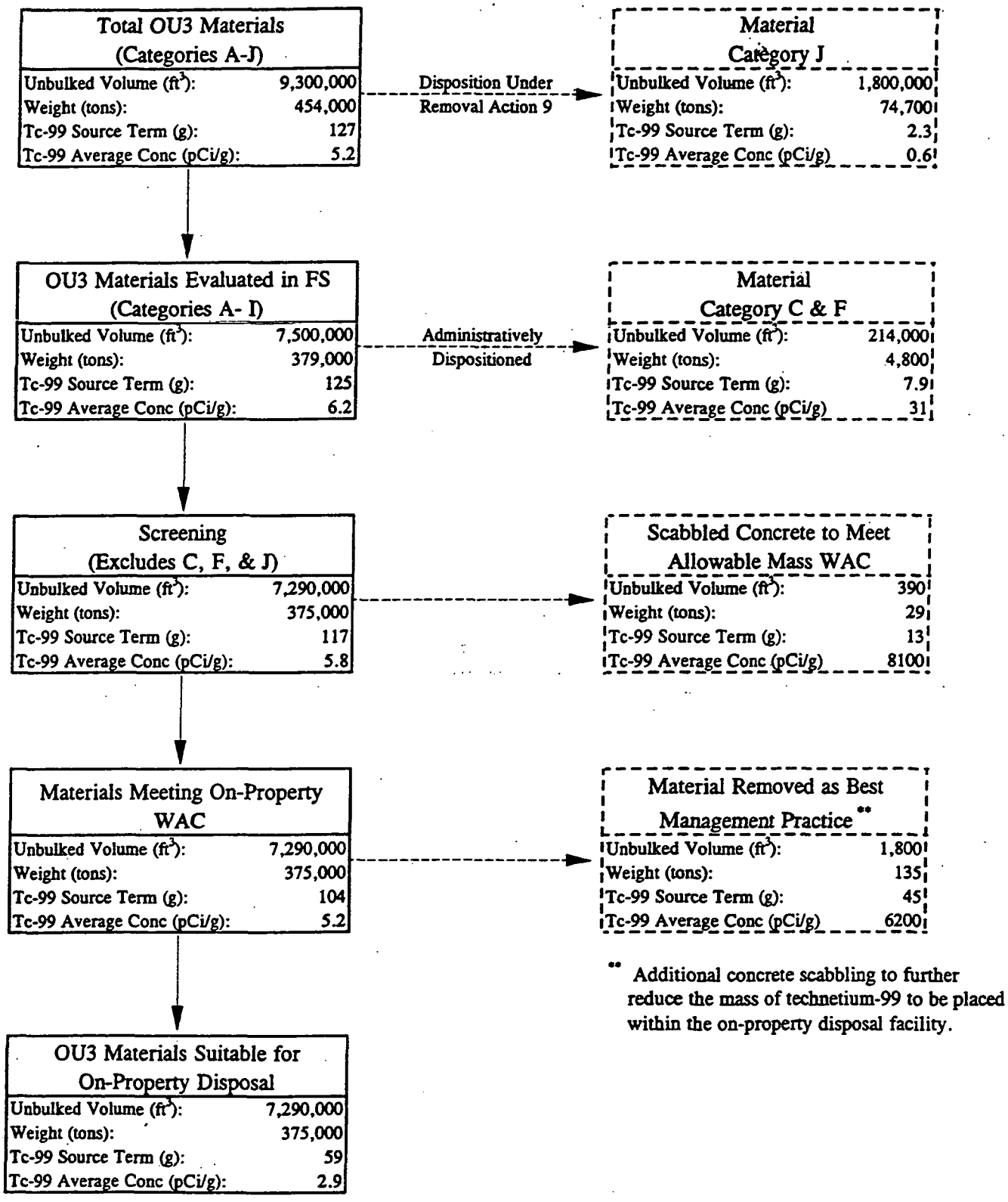

FIGURE 5-5

SUMMARY OF ON-PROPERTY DISPOSAL FACILITY WAC IMPLEMENTATION

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6.0 DETAILED ANALYSIS OF ALTERNATIVES

This section presents the detailed analysis of the remedial action alternatives that were identified in Section 5 of this report. The detailed analysis consists of six subsections. Section 6.1 describes the purpose of the detailed analysis and its importance to the CERCLA FS process. Section 6.2 provides an overview of the remedial alternatives by summarizing each one and identifying the elements that are common among all alternatives. Section 6.3 identifies and describes the NCP-required criteria used for evaluating the alternatives. The evaluation of the alternatives is conducted in Section 6.4. Section 6.5 offers a comparative analysis of the alternatives to identify the tradeoffs inherent in employing one alternative in favor of the others. Finally, Section 6.6 describes the irreversible and irretrievable commitment of resources inherent in implementing each of the alternatives.

6.1 PURPOSE OF DETAILED ANALYSIS

The detailed analysis includes a presentation and assessment of relevant information that provides the basis for selecting an alternative and preparing a ROD. By assessing each alternative according to the criteria required by the NCP, the detailed analysis identifies and emphasizes the information necessary for the remedy selection process. Careful examination of each alternative's relative advantages and disadvantages facilitates identification of a preferred remedial alternative in the OU3 PP.

6.2 NCP CRITERIA FOR EVALUATING REMEDIAL ALTERNATIVES

Specific statutory requirements for remedial actions are specified under CERCLA. These requirements include protection of human health and the environment, compliance with ARARs not excluded by the granting of a US EPA waiver, a preference for permanent solutions which incorporate treatment as a principal element (to the maximum extent practicable) or a justification for not meeting the preference, and cost-effectiveness. The nine criteria for evaluating remedial alternatives in feasibility studies are identified in the NCP [40 CFR 300.430(e)(9)(iii)] and establish the framework for assessing whether remedial alternatives meet the necessary requirements. This section provides a summary of the nine criteria and an overview of the approach taken by this RI/FS to address them.

The first two criteria, overall protection of human health and the environment and compliance with ARARs, are known as threshold criteria. Assessments against these two criteria relate directly to statutory findings that must ultimately be made in the ROD. If a remedial alternative does not meet either of the two threshold criteria, it cannot be considered a viable option unless a waiver is granted

by the US EPA. The next five criteria are known as "balancing factors." They are grouped together because they represent the primary criteria upon which the detailed analysis is based. Two additional criteria, state acceptance and community acceptance, are addressed in the ROD as part of the responsiveness summary following comment on the RI/FS Report and the PP by the public and other stakeholders. Figure 6-1 shows the relationship between the screening and the seven evaluation criteria used in this section for the detailed analysis of the remedial alternatives.

6.2.1 Overall Protection of Human Health and the Environment

This evaluation criterion provides an assessment of whether an alternative achieves and maintains adequate protection of human health and the environment against unacceptable short-term and long-term risks in accordance with the remedial action objectives established in Section 4. The discussion of overall protection draws from assessments conducted under other assessment criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs not excluded by the granting of a US EPA waiver. The discussion focuses on the manner in which identified site risks are eliminated, reduced, or controlled through treatment, engineering, or institutional controls.

The acceptable risk levels, under CERCLA, for members of the public for known or suspected carcinogens are generally concentration levels in the environmental media that represent an upper bound of the ILCR to an individual between 10^{-4} to 10^{-6}. The RAOs previously identified in Section 4.1 were developed consistent with this criterion.

The identified RAOs account for the fact that potential OU3 contaminant sources would be reduced from current levels by the interim remedial action. The RAOs also reflect the rationale that the OU3 materials in interim storage would be permanently dispositioned, which is a primary premise of this RI/FS and requirement of the IROD.

6.2.2 Compliance with ARARs

This criterion addresses the attainment of promulgated federal and state requirements. A requirement is applicable if it is a substantive federal or state environmental protection requirement that specifically addresses a hazardous substance, pollutant, contaminant, remedial action location, or other circumstances at the site. Even if a requirement is not directly applicable, it may be considered relevant and appropriate because the situation at the site is similar to those addressed in the promulgated federal or state law. "To Be Considered" (TBC) criteria are nonpromulgated advisories

or guidance that may be used to determine the necessary level of cleanup or technology required. If a TBC criterion is incorporated into the final ROD, it becomes enforceable, and compliance must be achieved.

If an alternative cannot meet an ARAR, a determination can be made that a waiver under CERCLA may be appropriate if it is adequately justified. An ARAR can only be waived with approval from the US EPA. ARARs affecting remedial actions under consideration may be categorized according to: 1) the location of the action, 2) the contaminants requiring remediation, and 3) the specific activities necessary to execute the action. Therefore, the corresponding ARARs and TBCs are termed location-specific, chemical-specific, and action-specific. The specific ARARs that apply to the three alternatives are described in greater detail in Appendix C of this report. Tables C-1 through C-3 identify the location-, chemical-, and action-specific ARARs and TBCs for other FEMP OUs, the OU3 interim remedial action, and the proposed OU3 remedial action alternatives. Table C-4 identifies other germane requirements, and Table C-5 provides an expanded discussion of ARARs and TBCs associated with the major issues for OU3.

6.2.3 Long-Term Effectiveness and Permanence

This criterion evaluates the residual risk to human health and the environment after completion of the final remedial actions. It is concerned with the degree to which a remedial alternative is capable of providing long-term reliability and controls sufficient to confine exposures to human and environmental receptors within protective levels. The principal factors addressed include the magnitude of residual risk and the adequacy and reliability of controls. Additionally, long-term environmental impacts as defined by the NEPA are addressed. The evaluation also includes consideration of the degree of uncertainty associated with the ability of the alternative to establish long-term effectiveness and permanence.

The OU3 IROD committed that contaminant sources would be reduced and contained prior to the implementation of the OU3 final remedial action. This reduction and containment would be accomplished through completion of OU3 removal actions, including Safe Shutdown activities, and the actions defined in the OU3 interim remedial action scope of work. The potential health risks associated with any residual contaminants remaining after the completion of these activities would be the focus of the remedial alternative analysis under this criterion.

6.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

This criterion reflects the statutory preference for remedial action alternatives containing a principal component that further reduces toxicity, mobility, and/or volume of radiological and hazardous constituents. The evaluation considers the extent to which final remedial action process technologies may effectively and irreversibly fix, transform, immobilize, and/or reduce the volume of waste materials and contaminated media.

The potential use of representative technologies, identified in Section 4, during the final remedial action would be based on the feasibility and the desired decontamination goals that would be attained by implementing one of these technologies. Because of the initial treatment of materials under the interim remedial action, treatment as proposed within the alternatives will be limited to materials that exceed WAC for off-site disposal facilities.

Each of the action alternatives defined by Section 5 retains an option to use any of the variety of available process options in Section 4 to facilitate treatment actions. The decision to utilize a representative process option during the final remedial action would be based on the type of contaminant and material to be treated, the volume of the material, the required level of treatment, and the cost-effectiveness of the potential process option.

6.2.5 Short-Term Effectiveness

This criterion addresses the potential short-term effects on human health and the environment resulting from conducting the activities necessary to implement the final remedial action. This short-term risk assessment, presented in detail in Appendix H, evaluates the potential risk to remediation and nonremediation workers, as well as the public, from initial preparation for the final remedial action through completion of the remedial activities.

Potential short-term risks to workers include inhalation and direct radiation exposure during packaging treatment, transportation, and disposal of OU3 materials. Potential short-term risks to the public include exposure to fugitive dust and radiation emissions during material treatment, off-site transportation, and disposal operations. The parameters examined in the short-term risk assessment for each receptor group (i.e., workers and the public) include cumulative noncarcinogenic hazard index (HI), the ILCR, physical injury, and death. The alternative analysis also includes the impacts of mitigative measures, such as engineering and institutional controls, that are expected to lessen potential risks to workers and the public.

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The potential short-term impacts to the environment are also presented. Discussions concerning the specific environmental elements that may be adversely affected during the proposed remedial activities generally include soil and geology, water quality and hydrology, air quality, biotic resources, wetlands and floodplains, socioeconomics, and land use.

6.2.6 Implementability

This criterion examines the technical and administrative factors affecting implementation of an alternative and considers the availability of services and materials required during implementation. Technical factors to be assessed include the ease and reliability of initiating construction and facility/equipment operations, as well as the prospects for implementing any needed future actions. Administrative factors examined include permitting and coordination requirements among the lead agency and regulatory agencies. Service and material considerations include further treatment, storage, and disposal capacities; equipment and operator availability; and prospective technology applicability or development requirements.

Where proven technologies are proposed, an assessment of technical feasibility examines the performance history of the technologies in direct applications, or considers the expected performance based on similar applications. Uncertainties associated with construction, operation, and performance monitoring are also addressed.

The evaluation of administrative feasibility includes a discussion of those actions required to coordinate with regulatory agencies and establish the framework for obtaining necessary approvals and permits from other agencies (for off-site locations). Additionally, alternatives involving off-site transportation are reviewed to assess the technical and administrative feasibility of implementing interstate transportation and disposal.

The availability of services and materials is addressed by analyzing the material components of the proposed technologies to determine the locations and quantities of those materials and by reviewing process operations to identify special services, operator skills, or training required to readily implement the process.

6.2.7 Cost

This evaluation criterion includes a presentation of costs developed for Alternatives 2 and 3 in Tables 6-2 and 6-4, respectively. No costs are associated with Alternative 1 since no further action would be

taken. The cost estimates include capital costs, staffing and management, operation and maintenance (O&M) costs, risk budget costs, and the total project cost (see Appendix E for details). Capital costs include expenditures for equipment, labor, material, and indirect costs necessary to complete the final remedial action. O&M costs include administrative, personnel, and post-remediation costs necessary to maintain any treatment facilities necessary for the final remedial action. The total cost (nonescalated) is the sum of the capital, staffing, management, O&M, and risk budget costs for each alternative (in 1995 dollars).

Once the total cost is established, the anticipated annual costs over the established duration are summarized for each alternative, and a present-worth analysis is conducted on the annual cash flow of each alternative. The present-worth analysis uses the real discount rates established by the Office of Management and Budget, which include adjustments for varying interest rates and effects of inflation on annual constant-worth cash flows, to reflect a lump-sum payment today that would finance the entire operation. Net present-worth costs are presented at the alternative cost summary level adjacent to the total costs for each alternative. An average discount rate of 4.8 percent has been used for the alternative present-worth analysis.

Key assumptions were made to establish a consistent approach to developing the alternative cost estimates. These assumptions, along with the cost estimating methods, are described in Appendix E.

6.2.8 State Acceptance

This criterion addresses the key concerns related to the potential remedial alternatives expressed by the State of Ohio through the OEPA. A discussion of those concerns are not presented in this report but will be incorporated into the ROD following receipt of OEPA comments on the RI/FS Report and the PP.

6.2.9 Community Acceptance

This criterion evaluates issues and concerns the public may have regarding the proposed remedial alternatives. As with State acceptance, this criterion will be addressed within the responsiveness summary of the ROD, once comments on the RI/FS Report and the PP have been received.

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6.3 INDIVIDUAL ANALYSIS OF ALTERNATIVES

6.3.1 Alternative 1 - No Further Action

The No Further Action alternative is included, as required by the NCP [40CFR 300.430(e))(6)], to serve as a baseline for comparison with Alternatives 2 and 3. The No Further Action alternative assumes that no further OU3 remedial activity occurs after the completion of the interim remedial action. Under this alternative, the OU3 materials would remain in an "as is" condition, based upon the interim material storage scenarios detailed Section 5.5.1 of this report. This condition would consist of a majority of OU3 interim-remedial-action-generated materials remaining in indefinite storage on FEMP property. Under this alternative, no further implementation of any additional OU3 material containment, removal, treatment, or disposition actions would be initiated.

This alternative would not provide for ongoing environmental monitoring or for passive institutional controls to reduce the potential for exposure to the public and the environment (e.g., fencing, deed restrictions, etc.). However, monitoring and institutional controls implemented under the OU2 ROD and proposed in the draft OU5 ROD would be implemented.

As indicated in the IROD, the DOE and EPA have agreed that OU3 materials generated during the interim remedial action would not remain in interim storage for an indefinite time period. This agreement requires action to safely and permanently dispose OU3 materials under the ROD for final remedial action. Thus, the No Further Action alternative cannot be selected as the appropriate final remedial alternative. However, this alternative will be retained throughout the detailed analysis of alternatives to establish a baseline for evaluation of the other proposed alternatives.

6.3.1.1 Overall Protection of Human Health and the Environment

The No Further Action alternative would not be protective of human health and the environment. Although a long-term human health risk assessment was not performed for this alternative, it is anticipated that the potential risk levels from leaving the materials in place would exceed the generally accepted ILCR range of 10^{-4} to 10^{-6} for carcinogens. Based upon the modeled gamma dose rates for the various containers and piles provided in Table H.3-11 of this report, a trespasser, who would spend four hours per week over 30 years scavaging from the piles and containers, could receive an estimated external radiation dose of approximately 3,000 mrem. Using the EPA risk coefficient of 7.6×10^{-7} risk/mrem, this would result in a carcinogenic risk in the 10^{-3} range.

In addition, the No Further Action alternative would not be protective of the environment. Potential residual contamination could become mobile due to mechanical actions resulting from the natural elements. Residual contaminants could enter the local environment via stormwater runoff or by becoming airborne due to the deterioration of the OU3 materials stored outdoors for an extended period of time.

6.3.1.2 Compliance with ARARs

The No Further Action alternative is not expected to meet certain ARARs for OU3. With no further action, potential further release of contaminants could result in exceedance of airborne emissions limits for radionuclides under 40 CFR 61, Subparts H and Q, and exposure limits to the public established under DOE Order 5400.5. Release of residual radiological, organic, and inorganic contaminants could also violate the State of Ohio water quality standards (OAC 3745-1) for receiving surface waters. Drinking water Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs) could also be exceeded in the long term if the released material were to continue to migrate into the Great Miami Aquifer. The potential continued presence of organic and inorganic contaminants could also violate storage and disposal requirements as set forth in RCRA and Toxic Substances Control Act (TSCA) regulations (40 CFR 268.41 and 40 CFR 761.125, respectively).

6.3.1.3 Long-Term Effectiveness and Permanence

The long-term presence of the materials generated during the OU3 interim remedial action could pose risks to the environment and the public. The risks could derive from residual contamination becoming mobile due to the deterioration of the OU3 materials. The deterioration would be caused by mechanical actions generated by the natural elements. Mobile residual contaminants could then migrate to the surrounding environment.

Risks to the public could be generated by direct exposure of a trespasser to radiological contaminants. The trespasser could gain access to the materials after all institutional measures have been removed upon completion of the OU5 remedial action.

Adequacy and Reliability of Controls

The No Further Action alternative would provide no additional controls for residual contamination. Therefore, the No Further Action alternative would not reduce residual risks. Deterioration of

proposed storage configurations (i.e., piles) would be expected to increase the concentration of residual contaminants in surface water and soils, thereby affecting adjacent biotic resources.

Long-Term Environmental Impacts

It is expected that the No Further Action alternative would not be protective of the environment in the long-term, since it is not protective against potential exposure to the OU3 materials. The long-term deterioration of the storage containers, piles, and the contaminated media, could increase contaminant levels in the Great Miami Aquifer, the on-property perched groundwater zone, the surface water and sediment, the 100- and 500-year floodplain of Paddys Run, and wetland areas within OU3. Sloan's crayfish (*Orconectes sloanii*), a species included on the state's list of threatened species, is found to inhabit Paddys Run, and may be adversely affected by conditions within the study area under the No Further Action alternative.

6.3.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Since no treatment would occur subsequent to the interim remedial action, no additional reduction of toxicity, mobility, or volume through treatment would be achieved.

6.3.1.5 Short-Term Effectiveness

Because no action would occur under this alternative, there is no action period to assess potential impacts to human health and the environment. It is expected that there would be no short-term impact.

6.3.1.6 Implementability

Since no final remediation would take place under the No Further Action alternative, no difficulties or uncertainties associated with technical feasibility are expected to exist. Administrative, materials, and services implementability do not require examination.

6.3.1.7 Cost

There would be no costs associated with implementation of the No Further Action alternative.

6.3.2 Alternative 2 - Selected Material Treatment, On-Property Disposal, and Off-Site Disposition

Alternative 2 is the only remedial action alternative considered under this RI/FS that contemplates placement of OU3 remediation materials into an on-property disposal facility. This alternative would

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result in a majority of OU3 materials generated during the interim remedial action being dispositioned in the on-property facility, provided WAC are met.

Materials that have been classified as Category C (Process-Related Metals) and Category F (Brick) materials would be administratively dispositioned off-site under this alternative. Category F (Brick) materials would be dispositioned at the representative commercial disposal facility. A portion of these materials have been identified as mixed waste, and would require treatment (i.e., encapsulation or solidification) to meet LDR requirements. Category C (Process-Related Metals) materials are expected to exceed WAC at the representative commercial disposal facility because of anticipated uranium and thorium compounds contained within the Category C materials. Thus, these materials will be dispositioned at the NTS.

Furthermore, a portion of Category E (Concrete) materials will be removed so that the allowable mass of technetium-99 will be met (see Section 5.5.2.1). This material will be transported to the representative commercial disposal facility for final disposition. All remaining remediation OU3 materials will be placed in the on-property disposal facility.

Alternative 2 material volume projections presented in Table 6-1 were based upon an evaluation of available data that were compiled and evaluated in Sections 2 and 3 of this report.

6.3.2.1 Overall Protection of Human Health and the Environment

Alternative 2 would meet the RAOs for OU3 and would be protective of human health and the environment. Implementation of this alternative would prevent direct access to potentially contaminated OU3 materials by either placing the materials in an on-property disposal facility or removing the materials from the site. Implementation of Alternative 2 would mitigate the potential migration of contaminants from the OU3 materials to the surrounding environmental media. Additionally, worker exposure to direct radiation above protective levels would be prevented throughout the final disposition activities through the use of personal protective equipment and personnel monitoring.

The OU3 materials that meet the on-property WAC would be covered with excavated soil and sediments from the OU5 and OU2 remedial actions to reduce risks to off-site residents. This alternative would employ conservative design considerations from other engineered disposal facilities including Uranium Mill Tailing Remediation Control Act standards and RCRA regulations to ensure

the long-term performance of the disposal facility. These standards would require the use of multilayered capping and lining systems, the development of contaminant- and material-specific WAC, and use of a design which ensures protectiveness for a minimum of 200 years to a maximum of 1,000 years. These design considerations would supplement the natural containment capabilities of the existing site geology to ensure the long-term performance of the disposal system. Further detailed discussions using the on-property disposal facility for the disposition of OU3 materials can be found in Appendix G.

Following implementation of Alternative 2, institutional controls would be maintained by OU2 and OU5 for the disposal facility to ensure continued protection of human health and the environment. Institutional controls maintained for the disposal facility area would include continued federal ownership of that portion of the FEMP to preclude homesteading, intrusive actions, or facility degradation; deed restrictions; and passive access controls (e.g., fencing) around the facility to prevent unauthorized access or use of the land.

6.3.2.2 Compliance with ARARs

Alternative 2 would comply with all ARARs except those excluded upon receipt of a waiver from the US EPA for State of Ohio solid waste disposal facility siting requirements. To be granted the waivers, the FEMP would be required to adopt an engineering design for the facility which would, when coupled with existing site geologic conditions, attain a standard of performance that is equivalent to that required under State of Ohio solid waste disposal facility siting requirements.

Chemical-Specific ARARs

Alternative 2 would comply with all chemical-specific ARARs and TBCs (Appendix C, Table C-1). Contaminated material meeting the on-property disposal facility WAC would be disposed of in a manner that minimizes the potential release of contaminants to the environment. The facility's liner and cap design (see Appendix G) would minimize infiltration of water into the waste materials and minimize any radon and penetrating radiation emissions. Materials exceeding the on-property disposal facility WAC would be dispositioned at the representative commercial disposal facility or at the NTS.

Fugitive airborne emissions would be minimized for remedial actions by using covered trucks, tarps, and/or dust suppression, as necessary, during OU3 material transportation to, and placement in, the on-property facility.

Any storm runoff waters associated with the final remediation action would be treated at the on-property AWWT facility to meet the Ohio Water Quality Standards ARARs (Appendix C, Table C-1), as described in the draft OU5 ROD.

Location-Specific ARARs

Alternative 2 would meet all principal location-specific ARARs discussed in Table C-2 of Appendix C, except those excluded by US EPA waivers for two State of Ohio solid waste disposal facility siting restrictions. These restrictions prohibit the siting of disposal facilities over: 1) sole-source aquifers designated under the Safe Drinking Water Act; and 2) aquifers capable of providing 100 gallons per minute (gpm) or more of sustained yield for consumptive use. Since the hydrogeologic conditions at the FEMP described in the draft OU5 ROD indicate that the exemption criteria for both the sole-source aquifer and the 100-gpm aquifer siting restrictions cannot be met based on the protective properties of the native geologic materials alone, waivers are required for the disposal of OU3 materials in the on-property disposal facility in consideration of engineering controls to be employed. Appendix C of this report provides details for the request of the required waivers.

Alternative 2 would comply with all location-specific ARARs for floodplains, wetlands, endangered species, and historical preservation. These ARARs would be met since the scope of Alternative 2 activities does not include the construction of new, or the expansion of current, on-property interim storage facilities.

Action-Specific ARARs

Alternative 2 would meet the action-specific ARARs (Appendix C, Table C-3). Since remediation of the FEMP will generate LLW, solid waste, hazardous waste, and PCB waste, the on-property disposal facility would be designed and constructed to accommodate this range of waste types. The action-specific ARARs listed in Appendix B of the OU2 FS identified the requirements for the design of the on-property disposal facility (DOE 1995f). These requirements were incorporated into the Alternative 2 definition discussed in Section 5 of this report. ARARs that would be met by OU3 include EPA requirements in 40 CFR 192.02(a). These requirements stipulate that a disposal facility for uranium mill tailings must be designed to protect groundwater and be effective for up to 1,000 years, to the extent reasonably achievable, and in any case, for at least 200 years.

DOE Order 5820.2A sets performance objectives stating that a LLW disposal site must be protective of public health and safety, protective of the environment and protective of groundwater resources

from releases of radioactivity. By meeting the DOE requirements, this disposal facility would also satisfy the less-stringent Ohio Revised Code (ORC), RCRA, and TSCA engineering design criteria for the disposal of solid and hazardous wastes.

To accommodate potential on-property disposal of RCRA wastes, the FEMP would utilize the RCRA Subtitle C CAMU provisions for on-property disposal of OU3 materials as remediation waste. Under this strategy, the on-property WAC would have to be met so that the waste could be placed in an on-property disposal facility in lieu of meeting LDRs. All storage, management, and manifesting requirements for listed and characteristic waste would comply with RCRA requirements found in 40 CFR Parts 261, 262, and 265, and in the Ohio authorized hazardous waste program.

6.3.2.3 Long-Term Effectiveness and Permanence

The long-term effectiveness and permanence of Alternative 2 for containing the residual contamination remaining on OU3 materials after the interim remedial action would depend primarily on the physical integrity of the on-property disposal facility. The facility will be designed to ensure protectiveness for a minimum of 200 years to a maximum goal of 1,000 years. However, some degree of uncertainty concerning the ability of the federal government to maintain long-term (i.e., up to 1,000 years) institutional controls and the long-term performance of the engineered system does exist. However, based on available engineering data and computer modeling, the long-term effectiveness and permanence of the disposal facility would be supported.

Adequacy and Reliability of Controls

Based on current OU2 designs, the on-property disposal facility would use proven technologies and construction materials to provide protection to the public and the environment from residual contamination on materials and soils placed in the facility. Similarly designed systems are currently used for LLW disposal under DOE and Nuclear Regulatory Commission programs at other sites. As discussed in the OU2 Pre-Design Investigation Report, the disposal facility will be located at a minimum of 300 feet from the FEMP property boundary in the northeast corner of the site. The disposal facility would extend to the south for approximately 4,300 feet, and would be approximately 800 feet wide. This area is located away from Paddys Run and the floodplain to minimize the potential for erosion induced by surface water. The bottom of the facility liner would be, on average, five feet below existing grade, which is well above the Great Miami Aquifer water table at this location. OU3 materials and contaminated soils from OU5 and OU2 would be placed at or above

existing grade to preclude the potential for the material to come into contact with the perched water system. See Figure 6-2 for a conceptual schematic drawing of the facility cap and liner.

Once all remediation materials and soils have been placed into the disposal facility, active maintenance and monitoring of the disposal facility would be performed according to the OU2 ROD and the draft OU5 ROD. The monitoring, which is anticipated to include groundwater monitoring and engineering inspections of the facility, would last for 30 years past the completion date of the OU5 groundwater extraction and treatment phase.

The potential for loss of facility integrity at a future point in time following this active maintenance period was incorporated into the conservativeness of the facility design and the WAC. Modeling runs completed for the OU5 FS on the performance of the disposal facility demonstrated that even in the presence of hypothetical failure modes considered through Monte Carlo simulations, there is an 80 percent likelihood that the disposal facility could protect the Great Miami Aquifer for a 1,000 year performance period.

The disposal facility boundaries would be delineated with fencing, signs, and markers. Deed restrictions would be implemented to restrict potential future use of the disposal area. However, the long-term reliability of deed restrictions is uncertain. For this reason, the current disposal facility design incorporates features that would mitigate the impacts of potential future intrusion by the public. These features include a stone layer to prevent erosion. This layer would also minimize the potential for intrusion through excavation. Furthermore, the entire cap design includes a 36-inch cobble biotic barrier followed by a 12-inch layer of pea gravel (see Figure 6-2 for a schematic of the cap). These layers would discourage the potential installation of wells. The cover over the cobbles (6 inches of sand, 21 inches of common soil, and 6 inches of topsoil) would support the growth of indigenous grasses but is insufficient to support farming for an extended period. Potential exposure to a hypothetical future intruder would result in a risk potential comparable to that already considered for a trespasser.

The OU3 materials that exceed the WAC for the on-property disposal facility would be transported to a representative commercial disposal facility or to the NTS. The off-site facilities would be responsible for the adequacy and reliability of the long-term monitoring and maintenance activities for these materials.

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Soil and Geology The FEMP soil and geology would not be disrupted by the implementation of Alternative 2 for the on-property disposal of OU3 materials.

Up to approximately 0.4 acres of soil at the representative commercial disposal facility would be permanently disturbed for disposal of OU3 materials.

Up to approximately 2.5 acres of soil at the NTS would be permanently disturbed for the disposal of Category C (Process Related Metals) materials. Borrow material may be required for shallow land disposal. The geology of the NTS has been determined suitable for the disposal of LLW (DOE 1991).

The disposition of unrestricted release materials would affect up to 13 acres of soil at a commercial sanitary landfill.

Water Quality and Hydrology The disposition of OU3 materials in the on-property facility is not expected to adversely affect water quality at the FEMP. A long-term groundwater monitoring plan would be implemented by OU5 to ensure the performance of the on-property disposal facility. The on-property disposal facility would be actively monitored and maintained for 30 years past the closure of the disposal facility.

The disposal of OU3 materials at the representative commercial disposal facility is not expected to affect water quality or hydrology. The prevailing arid climate affects the surface water regime. The facility lies within the Great Salt Lake Drainage Basin, with the closest perennial water body 23 miles away. Any long-term impacts to nearby surface water bodies are expected to be minimal. Depths to groundwater beneath the disposal facility vary from 20 to 30 feet. This groundwater aquifer is a Class III aquifer due to extremely high total dissolved solids. Because the hydraulic gradient in the groundwater is small, the velocity of groundwater movement away from the site is limited to a maximum of 0.6 feet per year (DOE 1984). The design of the disposal facility and the high evapotranspiration rate characterized in the area would also reduce the potential for contaminant transport.

No impacts to the water quality or hydrology due to the disposal of OU3 materials at the NTS is expected. The NTS characterization indicates that groundwater depths vary from 515 feet to more than 2,000 ft. Groundwater movement in the saturated and unsaturated zones is slow, and thus

creates a low potential for radiological transport to off-site areas. No continuously flowing streams are present at the NTS. Stream beds carry water only during unusually intense or persistent rains. Rainfall, averaging six inches per year, infiltrates quickly into the moisture-deficient soil. Evaporation rates are many times higher than precipitation rates. These parameters, coupled with suitable geology, would minimize long-term impacts to water quality.

No impacts to water quality or hydrology are expected at the commercial sanitary landfill. Groundwater monitoring plans would be implemented, by the facility, to ensure the containment performance.

Air Quality The long-term impacts on air quality at all disposal facilities would be minor, since the source of potential airborne releases from OU3 would be contained within the on-property disposal facility.

Biotic Resources Long-term impacts to biotic resources at the FEMP would be positive as a result of contaminant removal and disposition, and would thus result in reduced exposure to FEMP contaminants.

Up to approximately 0.4 acres of the existing plant community (Shadscale-Gray Molly) and its attendant habitat at the representative commercial disposal facility would be displaced or disturbed as a result of the implementation of Alternative 2. This type of plant community is neither unique or particularly valuable as a biotic resource. The flora or fauna in the potentially disturbed area are neither endangered nor threatened.

The NTS is sparsely vegetated with various desert shrubs. There are approximately 711 types of vascular plants within or near the boundaries of the NTS (DOE 1990). Several mammal species on the NTS (e.g., feral horses, burros, mountain lions, and kit foxes) have been placed on the protected classification list by the State of Nevada. The desert tortoise (*Gopherus agassizii*) is federally listed as a threatened species and is present in some areas of the NTS. Disposal activities, however, are not expected to adversely affect the habitat of the desert tortoise or displace any other species at the NTS.

Biotic resources are not expected to be affected at the commercial sanitary landfill.

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Wetlands and Floodplains A wetlands delineation for the FEMP was conducted in December 1992 (Ebasco Environmental 1993) and approved by the U.S. Army Corps of Engineers, Louisville District, in August 1993. The delineation identified 27 acres of palustrine forested wetlands, seven acres of drainage ditch/swales, and two acres of isolated persistent emergent and scrub/shrub wetlands. On-property wetland areas would not be affected by the Alternative 2 activities. Impacts to the 100- and 500-year floodplain of Paddys Run are not expected.

No wetlands or floodplains exist within the disposal areas of either the representative commercial disposal facility, the NTS, or the commercial sanitary landfill.

Socioeconomics and Land Use Minor long-term social and economic impacts would be expected with the implementation of Alternative 2. The counties within proximity to the FEMP, and those most likely to be affected by remedial activity decisions, have been grouped into a 13-county region referred to as the Consolidated Metropolitan Statistical Area (CMSA). The CMSA consists of Brown, Butler, Clermont, Hamilton, and Warren counties in Ohio; Boone, Campbell, Gallatin, Grant, Kenton, and Pendleton counties in Kentucky; and Dearborn and Ohio counties in Indiana. Excluding public perception concerning the disposal of remediation wastes on-property, impacts resulting from the implementation of Alternative 2 would result from the purchase of materials for remedial activities and fluctuations in the work force population. Assuming all resources were purchased within the 13-county region, excluding off-site transportation and disposal costs, minor increases to the collective wealth of the CMSA would be expected.

Land use would consist of restricted on-property recreational use (undeveloped park) with provisions of long-term protection of water quality in the Great Miami Aquifer.

Long-term social and economic impacts occurring at all off-site disposal facilities from the implementation of Alternative 2 would be minor. Due to the limited quantity of materials to be dispositioned off-site, limited economic impacts are expected from disposal costs paid by the FEMP at any locations. Minimal land use impacts are expected from either the representative commercial disposal facility or the NTS, due to their remote locations in rural areas. The representative commercial disposal facility is located within a 10-square-mile area designated as a hazardous waste zone and the NTS is located within a 1,350 square mile area with a primary land used of nuclear weapons testing (since 1951) and LLW disposal. The commercial sanitary landfill would have minimal land use impacts due to its current use as the local landfill for the Greater Cincinnati area.

Cultural Resources Cultural resources at or near the FEMP are not expected to be adversely affected due to remedial activities associated with Alternative 2. However, if cultural resources at or near the FEMP are affected by the remedial activities, then the resources will be managed under one of two programmatic agreements between DOE, the Advisory Council on Historic Preservation, and the Ohio Historic Preservation Office (OHPO). These agreements will provide an alternative means of compliance with Sections 106 and 110 of the National Historic Preservation Act (NHPA) so that impacts to cultural resources due to response actions and/or associated activities performed at the FEMP may be mitigated appropriately.

No events of historical significance have occurred at the representative commercial disposal facility. A cultural resource survey for the facility was performed in August 1981 by the Archaeological Environmental Research Corporation (DOE 1984). No cultural or historical resource sites were identified at the facility. Cultural resources at the NTS would be managed consistently with the requirements of the NHPA, the American Indian Religious Freedom Act (AIRFA), and the Native American Grave Protection and Repatriation Act (NAGPRA). No cultural resources would be affected at the commercial sanitary landfill.

6.3.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternative 2 would provide limited, additional reduction of residual toxicity, mobility, or volume of contaminated OU3 materials through treatment. The limited scope of additional treatment of OU3 materials and the preference for using engineering and institutional controls was discussed in Section 4 of this report. As discussed in Section 4, the majority of treatment of OU3 materials will occur during the interim remedial action. It is anticipated that the majority of OU3 materials would be dispositioned in the on-property disposal facility by meeting the established WAC. However, those materials that would not meet WAC for the on-property disposal facility would be shipped off-site to the representative commercial disposal facility or the NTS. If these materials do not meet the commercial facility WAC, treatment to meet the WAC would be applied to allow disposal. Approximately 11,600 ft^3 of material is classified as potential mixed wastes would require treatment (solidification or encapsulation) to meet LDR requirements.

6.3.2.5 Short-Term Effectiveness

The short-term risks associated with Alternative 2 to members of the community would be minimized through a combination of engineering (e.g., dust suppression and physical barriers) and administrative controls (e.g., fencing and security). A remedial action risk assessment was conducted to assess the

potential short-term risks associated with the implementation of Alternative 2 and is included in Appendix H.

Protection of the Community During Remedial Actions

The estimated ILCR to a hypothetical receptor, representing an adult member of the public near the FEMP, due to inhalation associated with airborne releases during remedial actions, is 1.9 x 10^{-6} for radionuclides and 5.8 x 10^{-8} for chemicals. A hypothetical noncarcinogenic hazard index for an off-site child from inhalation of resuspended toxicants is 0.02. This receptor is assumed to be located at the FEMP fenceline downwind from the on-property disposal facility. Carcinogenic risks to this receptor from external radiation were screened out as insignificant because the dose rates received off-site would be lower than that received by a receptor in the Administrative Area of the site, which is estimated in the 10^{-8} risk range during remediation. The risk from inhalation of radionuclides may be overestimated by approximately two orders of magnitude because of the assumption that all concrete materials would be subject to resuspension, when actually dust suppression measures would be used.

Risk to the public along the transportation route to the off-site facilities are expected to be minimal. The ILCR calculated for an individual along the route during incident-free transportation from direct radiation is 3.1 x 10^{-9}. Because none of the materials being shipped off-site are liquid, it is expected that in the event of an accident, clean-up would be quick and efficient, and minimal exposure other than direct radiation would result.

Protection of Workers During Remedial Actions

This alternative is expected to be protective of human health based on calculations using the maximum contaminant concentrations and maximum transportation scenario volumes. Based on a conservative bounding estimate, it is estimated that a remediation worker would receive annual doses of 360 mrem from direct radiation, which is less than the annual routine condition limit of 5,000 mrem and administrative control limit of 2,000 mrem as stipulated in DOE Order 5480.4. The total ILCRs for the remediation worker are estimated at 2.8 x 10^{-3} for radionuclides and 9.8 x 10^{-7} for chemicals. Noncarcinogenic effects are estimated to result in an HI of 0.14. These estimates do not consider protective administrative and engineering controls that will be utilized during remediation activities.

The annual dose to a nonremediation worker is considerably lower, 0.011 mrem, due to a distance of approximately 300 meters from the remedial activities. The total ILCRs for a nonremediation worker

are estimated at 6.6 x 10^{-7} for radionuclides and 6.0 x 10^{-7} for chemicals. The cumulative noncarcinogenic effect (HI) is 0.0025 for a nonremediation worker. Carcinogenic and noncarcinogenic risks for remediation workers are within Occupational Safety and Health Administration (OSHA) and DOE regulatory guidelines for occupational exposures. Through the use of engineering controls, health and safety procedures, and the standard practice of keeping exposures as low as reasonably achievable (ALARA), worker doses would be maintained at or below the DOE administrative control level of 2,000 mrem/year.

The cumulative dose for a maximally exposed individual transportation worker is estimated at 2,200 mrem over the duration of the ten-year project. This estimate is based on the maximum exposure received while transporting materials to an off-site disposal facility. Using the EPA risk coefficient, this cumulative individual dose results in an ILCR of 1.7 x 10^{-3} for a transportation worker. This level of risk is within the Department of Transportation (DOT) guidelines for transportation workers.

The cumulative dose for a maximally exposed individual material handler at an off-site disposal facility is estimated at 2,300 mrem over the duration of the project. This estimate is based on the maximum exposure received by off-loading OU3 materials at an off-site facility. An ILCR of 1.8 x 10^{-4} has been estimated for an individual material handler.

Mechanical hazards (industrial accidents) from on-property activities for Alternative 2 may result in less than one fatality and approximately 15 injuries. Mechanical hazards during transportation are expected to result in no injuries and no fatalities to both members of the public and transportation workers combined. This is based upon the estimated number of injuries and fatalities from transportation which fall below 0.17.

Short-Term Environmental Impacts

The following subsections identify the short-term environmental impacts that are associated with implementing Alternative 2.

Soil and Geology Soil and geology are not expected to be disturbed since construction and excavation activities are outside the scope of the OU3 FS. These activities will be facilitated under the scope of the draft OU5 ROD (DOE 1995b).

No short-term impacts to soil and geology are expected at the representative commercial disposal facility the NTS, and the commercial sanitary landfill. It is anticipated that OU3 materials would be dispositioned in existing disposal cells at these facilities.

Water Quality and Hydrology No impacts to the FEMP water quality and hydrology are expected. The current stormwater collection and treatment system would address any waters that came in contact with OU3 materials during the final remedial action.

Impacts to water quality and hydrology at the representative commercial disposal facility would be minor. No surface water exists within 23 miles of the representative commercial facility; thus, no impact to surface water is expected. The groundwater is unsuitable for human consumption or domestic use because of natural salienation.

No short-term impacts to the water quality or hydrology at the NTS due to the disposal of OU3 materials is expected. No continuously flowing streams are present at the NTS. Stream beds carry water only during unusually intense or persistent rains.

No short-term impacts to water quality or hydrology are expected at the commercial sanitary landfill due to appropriate leachate collection and water treatment systems.

Air Quality Activities that could affect air quality include on-property transport of waste materials and operation of heavy equipment. With appropriate material handling methods and dust suppression and containment contingencies, impacts to air quality would be minimal. Gaseous emissions from equipment operation would also be minimal. The current FEMP air monitoring plus supplemental monitoring that is specific to the final remedial action would be used to detect any airborne emissions that may result from the remedial activities.

Disposal of materials at the representative commercial disposal facility, the NTS, and the commercial sanitary landfill would not result in major air quality impacts. Minor increases in fugitive dust due to equipment operation may be experienced. Engineering controls and ongoing monitoring activities would be used to control air quality impacts.

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Biotic Resources Limited short-term impacts to biotic resources could occur from airborne deposition of contaminants, but are expected to be minimized through the use of engineering controls. Displacement of wildlife resulting from noise related activities would also be minimal.

No short-term impacts to biotic resources are expected at the representative commercial disposal facility, the NTS, and at the commercial sanitary landfill.

Wetlands and Floodplains No short-term impacts to the wetlands and floodplains at or near the FEMP are anticipated. No short-term impacts would occur to the wetlands and floodplains surrounding the off-site facilities since no wetland or floodplain areas exist at the representative commercial disposal facility, the NTS, or the commercial sanitary landfill.

Socioeconomics and Land Use Minor socioeconomic impacts would be expected with the implementation of Alternative 2. To better assess short-term impacts, it is assumed all resources needed to implement Alternative 2, excluding off-site transportation and off-site disposal costs, would be purchased within the CMSA. Rather than addressing each individual county and the resources they are capable of supplying, each county's public and private expenditures were combined, for a collective wealth for the CMSA of approximately $805,000,000 for fiscal year 1993 to 1994. The estimated total cost benefit to the CMSA of implementing Alternative 2 would be $77,000,000. The collective wealth of the CMSA would increase less than one percent annually over ten years, excluding the cost of off-site disposal and assuming the 1995 value of the dollar. Consequently, positive economic impacts would result from the implementation of Alternative 2.

Other issues that merit discussion related to socioeconomic impacts are noise and transportation (see Appendix J). Because of the extensive nature of on-property transportation, some increase in noise levels in areas immediately adjacent to the FEMP may occur. In addition, traffic levels are expected to remain constant on local roads.

Short-term noise and land-use impacts to the representative commercial disposal facility, the NTS and the commercial sanitary landfill are expected to be minor. Because of these areas' population density and limited recreational and industrial use, the area will not be affected by the implementation of Alternative 2.

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The impacts on workforce population due to the implementation of Alternative 2 at the FEMP, the representative commercial facility, the NTS, and the commercial sanitary landfill will be minimal.

Cultural Resources Cultural resources will be managed pursuant to a programmatic agreement between the DOE, the Advisory Council on Historic Preservation, and the OHPO. The agreement indicates that literature review, investigation of aerial photographs, and application of a predictive model revealed that the area to be affected by the implementation of Alternative 2 exhibits surface contamination greater than (disintegrations per minute/centimeter squared) 1,000 dpm/100cm^2 or contains soil disturbance beyond the sterile layer. Consequently, it is assumed that no historic properties would be adversely affected by the implementation of Alternative 2. In the event an unexpected discovery of historic properties occurs during remedial activities, the protection of sensitive cultural resources would be implemented pursuant to Section 106 of the NHPA (National Historical Preservation Act), and Section 110(f) of the same act.

No impacts to cultural or historic resources at the representative off-site disposal facility are expected because no cultural or historical resources have been identified at or near the facility. Cultural resources at the NTS will be managed in accordance with NHPA, AIRFA, and NAGPRA requirements. No cultural resources at the commercial sanitary landfill will be affected.

6.3.2.6 Implementability

This alternative would be implementable. The design for the on-property disposal facility has been initiated under the OU2 ROD (DOE 1995a), which allows for construction to begin in 1996. Material placement in the facility is estimated to begin after August 1997. The following sections detail specific implementability issues.

Time Period to Achieve Remedial Action Objectives

The estimated time period to achieve the objectives under Alternative 2 is ten years. This schedule parallels the time frame that would be required for the interim remedial action completion.

Technical Feasibility

Placement of OU3 materials in the on-property disposal facility would use standard construction equipment. A variety of equipment such as trucks, forklifts or equivalent, and steel hoppers, may be used and are expected to be readily available. It is expected that interim remedial action materials would be placed in ROBs and transported by truck to the disposal facility. Trained equipment

operators, drivers, and maintenance personnel would be required. These personnel are currently available at the FEMP.

Materials exceeding the WAC for the on-property disposal facility would be transported to the representative commercial disposal facility or to the NTS by truck. The technical feasibility of implementing this alternative depends on the implementability of transportation of the materials to the off-site facilities and on compliance with the respective facilities' WAC. Based on evaluation of the OU3 materials and the relatively small volume of materials anticipated to require off-site disposal over a ten-year period, it is expected that the materials would be accepted at the representative commercial disposal facility or the NTS. The packaging and transportation personnel required to facilitate this action would be available.

The transportation of OU3 materials to the representative commercial facility and the NTS under Alternative 2 was costed assuming truck transportation. However, the potential to use rail transport to the representative commercial facility does exist. The materials generated during the OU1 remedial action will be shipped to the representative commercial facility via rail per the OU1 ROD (DOE 1994d). Coordinated efforts between OU3 and OU1 could result in the shipment of OU3 materials in conjunction with OU1 materials.

Any delays in the construction of the on-property disposal facility could delay implementation of this alternative. The OU3 final remedial activities will be coordinated with the remediation schedules of other FEMP OUs, particularly OU5. Coordination with OU5 would be required to ensure that a sufficient volume of soils and sediment excavated during the OU5 final remedial action would be available to provide cover of the OU3 materials subsequent to placement into the on-property facility.

Administrative Feasibility

The implementability of this alternative would be feasible once the US EPA grants a waiver to the on-property disposal facility at the FEMP. Since a waiver has already been issued for OU2 materials, a waiver for OU3 materials to be placed in the on-property disposal facility should be feasible. Once the waiver is received, this alternative would meet all ARARs not excluded by the granting of the waiver, as previously discussed.

Implementability of the off-site disposal options would be based upon administrative agreements between the DOE and the representative commercial disposal facility and the NTS for shipment and

disposal of OU3 materials. The OU3 materials would have to meet the respective WAC for the off-site facilities. Coordination with regulatory agencies and the local community before and during remedial actions would be necessary for successful implementation.

Availability of Services and Materials

The material requirements for implementing Alternative 2 would include ROBs, flatbed trucks to haul the OU3 materials to the on-property facility, front-end loaders to fill the ROBs, and tarpaulins to cover the interim-stored OU3 materials. It is anticipated that these materials would be available to implement Alternative 2. The NTS currently accepts shipments of LLW from the FEMP. It is anticipated that the NTS would continue to accept FEMP wastes during the OU3 final remedial action. The services of a representative commercial disposal facility would also be arranged as required to accept material that may be determined to exceed the on-property WAC.

Staffing needed to successfully implement this alternative includes field personnel to conduct contamination surveys and prepare materials for off-site disposal, heavy equipment operators, laborers, and administrative personnel, all of whom are expected to be available locally.

6.3.2.7 Cost

The cost to implement Alternative 2 would include the cost to place OU3 materials in the on-property disposal facility and to ship materials to the representative commercial disposal facility and the NTS, when necessary. Table 6-2 summarizes the costs (in 1995 dollars) of Alternative 2. It also contains the corresponding present-worth cost. The present-worth cost has been calculated using a discount rate of 4.8 percent.

The capital costs portion of Alternative 2 would include material containers, forklifts, trucks, portable scales, steel hoppers, portable light plants, and a concrete crusher. Additional capital costs would include labor, materials, fuel, utilities, chemicals, parts required to operate and maintain remediation actions, sampling and analysis, and transportation and disposal of contaminated material.
The O&M costs for Alternative 2 would include costs for the long-term maintenance and monitoring of the on-property disposal facility. These costs will be shared with the other OUs utilizing the facility.

6.3.3 Alternative 3 - Selected Material Treatment and Off-Site Disposition

Alternative 3 considers the off-site disposition of all OU3 materials. The achievement of this objective would require that the OU3 materials treated during the interim remedial action meet WAC for the representative off-site disposal facility and/or the NTS. Alternative 3 material volume projections are presented in Table 6-3.

Under Alternative 3, all OU3 materials that would not meet the criteria for unrestricted release or would be permanently dipositioned either at the representative off-site disposal facility or at the NTS. The representative commercial disposal facility is licensed to accept LLW and most mixed waste for disposal. As currently estimated, Category C (Process-Related Metals) materials are expected to exceed WAC at the representative commercial disposal facility because of anticipated uranium and thorium compounds contained within these materials. Because the materials would exceed the representative commercial disposal facility WAC, they would be transported by truck and dispositioned at the NTS. Of the remaining materials, it is expected that all would meet the representative commercial disposal facility WAC; however, any materials that would not meet WAC may be treated to meet the criteria. OU3 materials to be dispositioned at the representative commercial disposal facility would be transported by rail in conjunction with OU1 remediation wastes.

Approximately 150 rail shipments of OU3 materials to the representative commercial disposal facility would be required. Under a unit train concept, with the train designed for FEMP waste only, each shipment would be made including OU1 wastes and OU3 wastes. This estimate is based on placing the total bulked OU3 materials into intermodal transport containers (ITCs). Each ITC has an internal volume of 675 ft^3 and would be reused 50 times. The number of trips is based on the expectation that a unit train will leave the FEMP approximately every three weeks; with a total of 18 shipments per year. Based on the ten-year remediation schedule (see Figure 5-1), shipments would occur for approximately 8.5 years. Each railcar to be shipped could carry six ITCs. Approximately 28 rails cars would be used for each of the estimated 150 shipments. The number of rail cars was estimated by determining that approximately 25,000 ITC containers would be required to ship OU3 materials, on approximately 18 rail shipments per year, for 8.5 years (see Appendix E).

Approximately 650 truck shipments of OU3 materials to the NTS would be required during the ten-year remediation efforts. This estimate is based on shipping 191,000 unbulked ft^3 (649,000

bulked ft^3) of Category C (Process-Related Metals) materials in large metal boxes (LMBs). An LMB has an internal volume of 1,025 ft^3. One loaded LMB would be shipped per trip.

6.3.3.1 Overall Protection of Human Health and the Environment

It is expected that Alternative 3 would meet the RAOs for OU3 and would be protective of human health and the environment. Implementation of this alternative would prevent direct access to OU3 materials since the materials would be dispositioned at off-site disposal facilities. Implementation of Alternative 3 would also prevent any additional migration of contaminants from the OU3 materials to the surrounding environment.

The most significant short-term risks associated with the implementation of Alternative 3 would be the risks associated with the transport of contaminated material to one of the off-site facilities. In addition, direct radiation exposure to remediation workers and transportation workers would be expected throughout implementation of this alternative because of labor intensive handling of containers. The handling activities would include weighing, certifying, and loading ITCs onto rail cars. However, through the implementation of a worker health and safety plan in compliance with 29 CFR 1910.120, exposures would be kept to below regulatory limits and would be expected to comply with DOE Orders.

6.3.3.2 Compliance with ARARs

A listing of the principal ARARs and TBCs for this alternative is presented in Appendix C.

Chemical-Specific ARARs

Alternative 3 would comply with the chemical-specific ARARs in Appendix C, Table C-1. ARARs would be met for penetrating radiation and potential releases of contaminants to air, surface water, and groundwater.

Location-Specific ARARs

Alternative 3 would meet the principal, location-specific ARARs identified for the FEMP, as discussed in Appendix C, Table C-2. Compliance with location-specific ARARs for FEMP floodplains and wetlands would be attained, since Alternative 3 activities would remove all OU3 remediation materials to off-site locations.

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Action-Specific ARARs

Alternative 3 would comply with action-specific ARARs identified in Appendix C, Table C-3. These ARARs would address OU3 material interim storage, additional treatment, and transport to an off-site disposal facility.

During implementation of the final remedial action, appropriate engineering controls would be implemented to comply with the requirements of the State of Ohio's fugitive dust control regulations, OAC 3745-17-08.

Any listed or characteristic hazardous wastes to be disposed would be required to meet the disposal facility WAC, including the treatment standards appropriate for LDRs under RCRA (40 CFR 268.40 through 268.44). All storage, containment, management, and manifesting requirements for listed and characteristic hazardous waste would be compliant with RCRA requirements found in 40 CFR Sections 261, 262, and 265.

6.3.3.3 Long-Term Effectiveness and Permanence

It is anticipated that Alternative 3 would provide long-term effectiveness, since the scope of the alternative involves the disposal of all OU3 material at off-site disposal facilities. By removing all OU3 materials from the site, all potential residual contamination sources would be eliminated. The permanence of Alternative 3 would be assured, since the materials would not be transported back to the FEMP in the future and since the off-site facilities would be required to comply with all appropriate federal, state, and local requirements in order to receive the materials.

Adequacy and Reliability of Controls

In Alternative 3, OU3 materials would be packaged and transported to off-site disposal facilities. These facilities would be responsible for their respective long-term monitoring and maintenance activities. As a result, no long-term management of OU3 materials would be required at the FEMP.

Long-Term Environmental Impacts

Long-term impacts to the environment at the off-site facilities for Alternative 3 are similar to those previously identified in Alternative 2, except that up to approximately 96 acres of soil and the vegetation at the representative commercial disposal facility under Alternative 3 would be permanently disturbed for disposal of FEMP materials. Long-term effects to the NTS and the commercial sanitary landfill would be similar to those in Alternative 3.

6.3.3.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

This alternative would provide limited, further reduction of toxicity, mobility or volume of material contaminants through additional treatment. The additional treatment would generally be applied at the representative commercial facility prior to disposal, since the facility is licensed and equipped to perform the treatment.

6.3.3.5 Short-Term Effectiveness

The short-term risks associated with Alternative 3 to members of the community would be minimized through a combination of engineering (e.g., dust suppression) and administrative controls (e.g., fencing and security). A remedial action risk assessment was conducted to assess the potential short-term risks associated with the implementation of this remedial action and is included in Appendix H.

Protection of the Community during the Remedial Actions

The potential risks to hypothetical receptors (representing members of the public near the FEMP), are expected to be insignificant because all materials will be containerized for off-site shipment during the interim remedial action, and therefore no airborne contaminants would be generated. Due to the distance to the site fenceline, dose rates to the public from OU3 materials are also minimal.

Risk to the public along the transportation route are expected to be minimal. The ILCR calculated for an individual along the route during incident-free transportation from direct radiation is 2.7×10^{-9}. Because none of the materials being shipped off-site are liquid, it is expected that in the event of an accident, clean-up would be quick and efficient and minimal exposure other than direct radiation would result.

Protection of Workers During Remedial Actions

It is estimated that an individual remediation worker would receive annual doses of 88 mrem from direct radiation, which is less than the annual routine condition limit of 5,000 mrem and administrative control limit of 2,000 mrem as stipulated in DOE Order 5480.4. Based upon the EPA risk coefficient, this dose would result in a total ILCR of 6.7×10^{-4}. It is estimated that an individual nonremediation worker could receive an annual dose of 0.11 mrem from direct radiation during the ten-year remediation. A total ILCR of 8.4×10^{-8} has been estimated for nonremediation workers.

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The cumulative dose for a maximally exposed individual transportation worker is 1,800 mrem over the ten-year remediation. A total ILCR of 1.4×10^{-3} has been estimated for a transportation worker.

The cumulative dose for a maximally exposed individual material handler at an off-site disposal facility is 1,700 mrem over the ten-year remediation. A total ILCR of 1.3×10^{-3} has been estimated for a material handler.

Mechanical hazards (industrial accidents) from on-site activities may result in approximately 32 injuries and less than one fatality. These injuries would be predominantly related to person hours necessary to more ITCs to the rail line and weigh and certify the ITCs for shipment. Mechanical hazards during transportation may result in approximately two injuries and less than one fatality for transportation workers, and two injuries and less than one fatality to the public.

Short-Term Environmental Impacts

Short-term impacts to the environment for Alternative 3 would be similar to those previously identified in Alternative 2 with the differences outlined below. Discussion regarding socioeconomic impacts is found in Appendix J of this report.

Alternative 3 would increase the wealth of the CMSA by approximately one percent annually for ten years. Traffic volumes on local roads would be expected to remain consistent with current levels.

Both the representative commercial facility and the NTS are located in areas with limited human populations. Both facilities are also located in arid environments. Thus, any short-term effects of the dispositioning of OU3 material would be acceptable.

The commercial sanitary landfill is located near a metropolitan area. The facility is also located in a temperate environment. However, any short-term effects of the dispositioning of OU3 material are also anticipated to be acceptable.

6.3.3.6 Implementability

This alternative is implementable. It is anticipated that the off-site disposal facilities would be able to receive OU3 materials throughout the ten-year remediation period. The following sections detail the implementability of Alternative 3.

Time Period to Achieve Remedial Action Objectives

The estimated time required to complete the objectives under Alternative 3 is ten years. This schedule parallels the time frame that would be required for completing the interim remedial action.

Technical Feasibility

The use of off-site disposition facilities for implementation this alternative would be feasible. Shipment of OU3 materials to the representative commercial disposal facility would use standard construction equipment and rail service. A variety of equipment, such as trucks, forklifts, and reusable transport containers, may be used and would be readily available to transport materials directly from a D&D workzone or from an interim storage area to a rail transport carrier. Upgrades to the FEMP rail system and to the local off-site rail system are scheduled under the OU1 ROD (DOE 1994d).

Shipment of Category C materials to the NTS would use standard construction and trucking equipment. This equipment would be readily available. The representative commercial disposal facility is accessible by rail. Shipping requirements for both facilities, as outlined in 49 CFR 173.425(c), would be met. These requirements include average estimated radioactivity, not to exceed 0.001 millicurie per gram of material, and external radiation levels not to exceed 200 mrem/hour at any point on the external surface.

Materials exceeding the WAC for the representative commercial disposal facility would be either treated on-property or transported to the representative commercial disposal facility, by rail, for further treatment. The technical feasibility of implementing this alternative depends on the implementability of further treating the materials in a cost-effective and safe manner. A relatively small volume of OU3 materials is expected to require additional treatment prior to off-site disposal over a ten-year period. It is expected that the materials could be further treated in a cost-effective and safe manner and would be subsequently accepted at the representative commercial disposal facility (see Appendix F).

Administrative Feasibility

The implementability of this alternative depends on the establishment of a negotiated contract with the representative commercial disposal facility to accept material from the FEMP. Because there is a precedent for the DOE to disposition wastes at non-DOE sites, it is possible for FEMP waste to be disposed of off-site. The FEMP would be required to maintain administrative approval to transport

LLW to the NTS. The FEMP currently transports LLW to the NTS in accordance with Nevada Field Office (NVO)-325 requirements. The administrative personnel required to perform this function would be available during the ten-year final remedial action. The contract with the representative commercial disposal facility would have to contain provisions to ensure continued disposal capacity over the ten-year remediation time period.

Transportation of LLW from the FEMP to off-site disposal facilities invokes several requirements from US EPA, DOT, and DOE. In addition, compliance with the requirements of each state through which the waste would be transported must be achieved. These requirements would include obtaining permits (as required) and notifying the pertinent state agency regarding transportation schedules and routes through that state. FEMP waste has been shipped via truck to disposal sites in the west, and it is assumed that rail transport would also be acceptable. Considerable coordination with regulatory agencies and the local community before and during the final remedial action would also be necessary for successful implementation.

Availability of Services and Materials

The implementability of this alternative would depend on the availability of adequate disposal capacity at the representative commercial disposal facility and the NTS. The representative commercial facility currently has an available permitted capacity of approximately five million yd^3, with the potential to bring under permit approximately 14 million yd^3 in additional capacity. OU3 materials would require approximately 230,000 yd^3 of capacity. However, if the schedule were to be delayed beyond 10 years, there is the potential for the loss of available space within the representative commercial disposal facility.

The NTS currently accepts LLW from the FEMP. The NTS disposal capacity is not expected to be exceeded during the ten-year OU3 remediation period.

Qualified personnel needed to successfully implement this alternative include field personnel to conduct contamination surveys and prepare materials for off-site disposal, heavy equipment operators, laborers, and administrative personnel, all of whom are locally available.

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6.3.3.7 Cost

The cost to implement Alternative 3 includes the cost to containerize and transport OU3 materials to an off-site disposal facility. Table 6-4 summarizes the costs (in 1995 dollars) of Alternative 3. It also contains the corresponding present-worth costs. The present-worth cost is calculated using a discount rate of 4.8 percent.

The capital costs of Alternative 3 include material containers, forklifts, trucks, portable scales, labor, materials, fuel, utilities, and parts required to operate and maintain remediation actions, and transportation and disposal of contaminated material. No post-remediation costs are expected for Alternative 3. Appendix E provides the cost estimates for this alternative.

6.4 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section provides a comparative analysis of the remedial alternatives that were evaluated in Section 6.3. The purpose of the comparative analysis is to identify the advantages and disadvantages of each alternative relative to another, so that key tradeoffs can be identified and considered by project stakeholders and regulatory decision-makers. Highlights of the individual alternative evaluations are provided to assist decision-makers and stakeholders in identifying which alternative best qualifies as the preferred remedy for OU3.

Similar to the detailed analysis conducted in Section 6.3, the comparative analysis is conducted using seven of the nine NCP evaluation criteria as the framework for identifying technical and administrative differences among the alternatives. The remaining two criteria, state and community acceptance, are not included because these criteria cannot be assessed until after the PP has been issued and state and public comments on the preferred alternative have been received. The state and community acceptance considerations will be formally evaluated and documented in the ROD.

To facilitate the comparative analysis process, the key points discussed in this section pertaining to each of the evaluation criteria have been arrayed in tables. Table 6-5 presents a summary of the comparison of the alternatives against each of the seven evaluation criteria, including the present-worth cost and total cost of each alternative. Table 6-6 provides a summary of the projected environmental resource impacts associated with each of the alternatives under consideration.

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6.4.1 Threshold Criteria

The NCP states overall protection of human health and the environment and compliance with ARARs are threshold criteria that must be attained by the selected remedial action.

6.4.1.1 Overall Protection of Human Health and the Environment

Alternative 1 would allow for continued migration of site contaminants and would not provide for protection of human health and the environment.

Alternative 2 would be protective of human health and the environment. Alternative 2 would rely on an engineered disposal facility with conservative design assumptions and the adoption of WAC that would supplement the natural containment capabilities of the existing site geology to ensure the long-term performance of the disposal system. Modeling completed for the OU5 FS on the performance of the disposal facility demonstrated a high certainty (>80 percent) that concentrations in the aquifer underlying the facility would not exceed existing and proposed federal drinking water standards for 1,000 years.

Alternative 3 would also provide protection to human health and the environment. Alternative 3 would provide a high level of certainty for continued, long-term protectiveness and would require no provisions for perpetual institutional controls or five-year CERCLA reviews.

6.4.1.2 Compliance With Applicable or Relevant and Appropriate Requirements

Alternative 1 would not comply with ARARs. Alternative 2 would comply with all identified ARARs, except those precluded by the granting of a waiver from the State of Ohio to allow disposal of OU3 materials in the on-property disposal facility. In general, to be granted the waiver, OU3 would be required to adopt an engineering design for the facility that will, when coupled with existing site geologic conditions, ensure the long-term protection of human health and the environment and attain a standard of permanence that is equivalent to that required order State of Ohio waste disposal facility siting requirements. These measures will be implemented by OU2 for the design and construction of the disposal facility. Alternative 3 would meet all ARARs identified for the OU3 final remedial action, since all materials generated during the interim remedial action would be dispositioned at an off-site facility.

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6.4.2 Primary Balancing Criteria

The NCP establishes five criteria that form the basis for the comparative analysis of viable remedial alternatives. These are the "balancing criteria," as they are used to evaluate the relative tradeoffs among alternatives that meet the threshold criteria. Alternative 1 is carried forward as the baseline alternative for comparison purposes in accordance with the NCP.

6.4.2.1 Long-Term Effectiveness and Permanence

Long-term effectiveness is evaluated through two factors: the magnitude of the residual risk remaining at the site after the cleanup and the adequacy and reliability of any required engineering or institutional controls. Alternative 1 would present an unacceptable magnitude of risk remaining at the site, and would provide the most limited amount of reliability and permanence as compared to Alternatives 2 and 3. Alternative 2 would provide permanent and reliable configuration for the material disposition that is more acceptable than Alternative 1, but not as acceptable as Alternative 3. The implementation of Alternative 2 would include the continuation of institutional controls and long-term monitoring activities. Alternative 3 would include the removal of all contaminated material from the site and thereby provide a greater degree of long-term effectiveness and permanence than Alternatives 1 and 2. No long-term on-property actions for continued institutional controls, surveillance, or maintenance activities would be required for OU3.

6.4.2.2 Reduction of Toxicity, Mobility, or Volume Through Treatment

As presented in Section 6.3.4 of this report, the majority of the OU3 materials to be dispositioned under the final remedial action will undergo treatment during the interim remedial action. The purpose of this treatment is to reduce the levels of removable contamination prior to dismantlement of the OU3 components.

Alternative 1 would provide no additional reduction in contaminant toxicity, mobility, or volume. Furthermore, by placing all OU3 materials into permanent storage without continued maintenance, the mobility of the contaminants would increase over time leading to eventual releases to the environment. For Alternative 2, all mixed wastes to be dispositioned off-site would be treated through solidification or encapsulation to meet LDRs thereby reducing the contaminant mobility. Because Alternative 3 has a greater volume of material being dispositioned off-site, Alternative 3 would provide the greatest reduction of toxicity, mobility, or volume by treating to meet LDRs in comparison to the other alternatives.

6.4.2.3 Short-Term Effectiveness

The evaluation of the alternatives under this criterion addresses effects during the implementation phase of the final remedial action. Short-term effectiveness evaluates the potential impacts to workers, the public, and the environment associated with performing a remedial alternative. Critical considerations in the assessment of the OU3 alternatives are the projected work hours to accomplish a given alternative, the quantity of materials to be dispositioned, the quantity of materials to be treated, the estimated fugitive dust generated by material movements, and the transport time to the on-property disposal facility or the off-site disposal facilities.

Alternative 1 involves no short-term impacts. Alternatives 2 and 3 would involve remedial activities such as loading OU3 materials for disposition, transporting materials for disposition, construction and operation of support facilities, and potentially treating materials. Alternatives 2 would create an impact and pose some risk to the environment, workers, and the public. These impacts could be effectively controlled through the application of mitigative measures such as dust suppression techniques and rigorous worker health and safety programs.

In general, Alternative 2 would present slightly greater risks from radiological and chemical exposure than Alternative 3. This higher risk is attributable to the placement of materials within the on-property disposal facility. Under Alternative 3, all materials are containerized within the D&D work zone, and therefore, no materials are available for resuspension. For both alternatives, risks are below the EPA acceptable range of 10^{-4} to 10^{-6} and worker doses are within DOE administrative control levels.

The most significant element of the short-term effectiveness is the risk associated with projected injuries related to mechanical hazards. These risks are greater for Alternative 3 than Alternative 2 due to the greater number of man hours associated with weighing, certifying, and loading containers for off-site shipment. Such injuries would be minimized at DOE facilities, such as the FEMP, through the adoption of strict health and safety program requirements during the implementation of remedial actions. Additionally, the increased number of shipments off-site associated with Alternative 3 raises the risk for potential accidents. Such injuries would be minimized at DOE facilities, such as the FEMP, through the adoption of strict health and safety program requirements during the implementation of remedial activities.

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6.4.2.4 Implementability

This evaluation criterion addresses the technical and administrative feasibility of implementing the remedial alternatives.

Alternative 1 would be the most technically and administratively implementable action compared to Alternatives 2 and 3, since no further action would take place. The implementability of Alternative 2 would be more challenging than Alternative 1. However, to implement Alternative 2 would require less effort than Alternative 3, because Alternative 2 only requires the placement of OU3 materials into an on-property disposal facility already being constructed for OU2 and OU5 remediation materials.

The administrative implementability of Alternative 2 would be contingent upon OU3 receiving a waiver to disposition interim remedial action materials in the on-property disposal facility. A contractual agreement between the FEMP and the representative commercial disposal facility as well as the continued approval to ship materials to the NTS, would be required. The technical implementability of Alternative 2 would highly be probable, since equipment and personnel required to transport the OU3 materials from either an interim storage facility or directly from the dismantlement work zone are readily available.

The administrative implementability for Alternative 3 would be similar to that of Alternative 2 except that an on-property disposal facility would not be used. The technical implementability of Alternative 3, which would include the packaging and transportation of materials to a representative off-site disposal facility, is probable. The equipment and personnel required to complete these tasks are readily available.

6.4.2.5 Cost

Cost estimates are used in the RI/FS process to provide a basis for comparison among alternatives. Estimates are typically provided to an accuracy range of +50 percent (real cost would be 50 percent higher than the estimate) to -30 percent (real cost would be 30 percent lower than the estimate) because of the uncertainties in the information used to develop them. To provide a fair basis of comparison for alternatives, cost estimates for alternatives are presented in present-worth costs. Present-worth costs reflect the quantity of money which would need to be placed in a bank today at a set interest rate, termed the discount rate, to pay for the remedial action over the life of the project.

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Alternative 1 would not have any associated costs since no additional actions would occur beyond the scope of the interim remedial action.

The costs required to implement Alternative 2 would have an estimated present worth value of $70,000,000 and an estimated total cost value of $93,000,000. These costs represent the disposition of the OU3 materials in the on-property disposal facility and at off-site disposal facilities. The costs also include any treatment required for off-site disposition at the representative commercial disposal facility (see Appendix E for details). Additionally, costs that OU3 would share with the other FEMP OUs for the design, construction, material placement, maintenance, and monitoring associated with the on-property disposal facility are reflected as a unit rate for disposal ($3.05/ft^3) and a unit rate for the operation and maintenance of the cell ($1.12/ft^3).

The costs required to implement Alternative 3 would have an estimated present-worth value of $150,000,000 and an estimated total cost value of $190,000,000. These costs represent the disposition of the OU3 materials at off-site disposal facilities and include treatment required for off-site disposition.

6.5 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Natural resources would be permanently committed as a result of implementing the selected remedial alternative over a period of ten years. The commitment of natural resources and land corresponding to each alternative are addressed below. These commitments not only include the resources and land, but the services they provide as well.

Implementing Alternative 1 would require no further commitment of resources or services other than material storage space. Implementing Alternatives 2 and 3 would result in the permanent commitment of land at the off-site disposal facilities. A summary of resource impacts and associated quantities from implementation of remedial action alternatives is provided in Table 6-7.

Consumptive use of petroleum products (e.g., diesel fuel and gasoline) would be required for construction of final action support facilities, material transport, and on-property disposal activities of action alternatives. These materials would be available at the FEMP. Additional fuel use would result from off-site transport of the materials. However, adequate supplies are available without affecting local requirements for these products.

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Potential additional treatment processes for the selected action alternative would require consumptive use of materials and energy. The vendor-operated solidification of Category E (Concrete) residues would require additives such as cement and flyash.

The land committed at the FEMP site is scheduled to be actively monitored and maintained under the OU5 ROD (DOE 1995b). Periodic monitoring of nearby surface water and groundwater from monitoring wells around the perimeter of the on-property disposal area would be performed, and periodic inspections would identify any damage to the disposal area. Maintenance activities would be performed as necessary. Therefore, no negative impacts to the groundwater are anticipated to occur from OU3 remedial activities.

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TABLE 6-1

MATERIAL VOLUMES[a] FOR ALTERNATIVE 2

Segregation Category	On-Property Disposal Facility	Off-Site Disposal Facilities	Unrestricted Release
Mixed Waste	95,100	11,600	0
TSCA Waste	14,900	0	0
Low Level Waste	2,430,000	202,000	0
At or Below Baseline	3,760,000	0	986,000
Totals	6,300,000	214,000	986,000

[a] All volumes represent unbulked material volumes (ft^3).

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TABLE 6-2

ALTERNATIVE 2 COSTS

Cost Item	($) 1995 Dollars
Capital Costs	59,000,000
Staffing and Management	9,600,000
*O&M	7,100,000
Risk Budget	18,000,000
Total Cost	93,000,000
Present-Worth Cost	70,000,000

*Includes post-remediation cost required under Alternative 2.

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TABLE 6-3

MATERIAL VOLUMES[a] FOR ALTERNATIVE 3

OU3 Material Volumes (ft^3) by Segregation Category	Off-Site Disposal Facilities	Unrestricted Release
Mixed Waste	107,000	0
TSCA Waste	14,900	0
Low Level Waste	2,630,000	0
At or Below Baseline	3,760,0000	986,000
Totals	6,510,000	986,000

[a] All volumes represent unbulked material volumes (ft^3).

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TABLE 6-4

ALTERNATIVE 3 COSTS

Cost Item	($) 1995 Dollars
Capital Costs	140,000,000
Staffing and Management	14,000,000
*O&M	0
Risk Budget	38,000,000
Total Cost	190,000,000
Present-Worth Cost	150,000,000

*No post-remediation cost included under Alternative 3.

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TABLE 6-5

OPERABLE UNIT 3
COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

Evaluation Criteria	Alternative 1 No Further Action	Alternative 2 Selected Material Treatment, On-Property and Off-Site Disposal	Alternative 3 Selected Material Treatment and Off-Site Disposal
Overall protection of human health and the environment	Not protective of human health and the environment.	Provides overall protection of human health and the environment.	Provides overall protection of human health and the environment.
Compliance with ARARs	Not compliant because no further action would likely result in exposures to the public and releases to the environment.	Compliant with all ARARs, except those excluded upon receipt of a waiver from the U.S. EPA for the State of Ohio solid waste disposal facility siting requirements.	Compliant with all ARARs.
Short-term effectiveness	No short-term risks since no action would be taken.	All radiological and chemical exposures are estimated to be within acceptable limits. This alternative presents lower short-term risks associated with mechanical hazards than Alternative 3.	All radiological and chemical exposures are estimated to be within acceptable limits. Greater mechanical hazards than Alternative 2 due to injuries from transporting all materials to off-site disposal facilities.
Long-term effectiveness and permanence	Not protective in the long-term. Would result in unacceptable long-term risks to the public.	Is protective of human health and the environment through site geology, engineering, and administrative controls. However, Alternative 2 is less effective and permanent in the long-term than Alternative 3.	Is the most effective and permanent since all contaminated material would be removed from Fernald with no long-term requirements for continued administrative controls, surveillance, or maintenance activities.
Reduction in toxicity, mobility, or volume through treatment	Due to unmaintained storage of dismantled debris, contaminant mobility is expected to increase.	Potentially treats 11,600 cubic feet of material to meet land disposal restrictions for off-site disposal.	Potentially treats more material (an additional 95,000 cubic feet) than Alternative 2 because of land disposal restrictions for off-site disposal.
Implementability	Easier to implement than Alternatives 2 or 3 because no action occurs.	Easier to implement than Alternative 3 because this alternative only requires placement of OU3 materials into an on-property disposal facility already being constructed for OU2 and OU5 materials.	Hardest alternative to implement because it is dependent on whether agreements are reached with off-site disposal facilities to accept waste. Considerably more coordination would be required with state and local authorities along transportation routes. The volume of material would also require a longer time period to complete shipments.
Current year (1995) cost (in millions)	$0	$93	$190
Present worth cost (in millions)	$0	$70	$150

TABLE 6-6

OPERABLE UNIT 3
COMPARATIVE ANALYSIS OF ENVIRONMENTAL RESOURCES IMPACTS

Alternative	Soil and Geology	Water Quality and Hydrology	Air Quality	Biotic Resources	Wetlands and Floodplains	Socioeconomics and Land Use	Cultural Resources	Transport Impacts
1	No further impacts	Potential for release to surface and groundwater	Potential for release to ambient air	Potential exposure to ecological receptors	Potential for release to on-property wetlands	Restriction of site future use	No impacts	No impacts
2	Up to approximately 16 acres committed to off-site disposal	Minor impacts assuming monitoring and controls	Minor impacts from fugitive dust assuming controls	No impacts	No impacts	Less than one percent annual increase in CMSA over ten years	No impacts because of identification and management	ILCR of 3.1×10^{-9} along the route to the off-site disposal facility
3	Up to approximately 112 acres committed to off-site disposal	Minor impacts assuming monitoring and controls	Minor impacts from fugitive dust assuming controls	No impacts	No impacts	Less than one percent annual increase in CMSA over ten years	No impacts due to identification and management	ILCR of 2.7×10^{-9} along the route to the off-site disposal facility

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TABLE 6-7

QUANTITIES OF NATURAL RESOURCES PERMANENTLY COMMITTED

Alternative	Land[a]	Biotic Resources[a]	Wetlands[a]
1	None Required	None Required	None Required
2	Up to 0.4 acres committed at the representative commercial disposal facility	Up to 0.4 acres of plant community (sandscale-gray molly) at representative disposal commercial facility	None Required
	Up to 2.5 acres commited at the NTS	Up to 2.5 acres of various desert shrubs	
	Up to 13 acres committed at the commercial sanitary landfill	None Required	None Required
3	Up to 96 acres committed at off-site commercial facility	Up to 96 acres of plant community (sandscale-gray molly) at off-site commercial facility	None Required
	Up to 2.5 acres commited at the NTS	Up to 2.5 acres of various desert shrubs	None Required
	Up to 13 acres committed at the commercial sanitary landfill	None Required	None Required

[a] Resource impacts occur at the FEMP unless noted otherwise.

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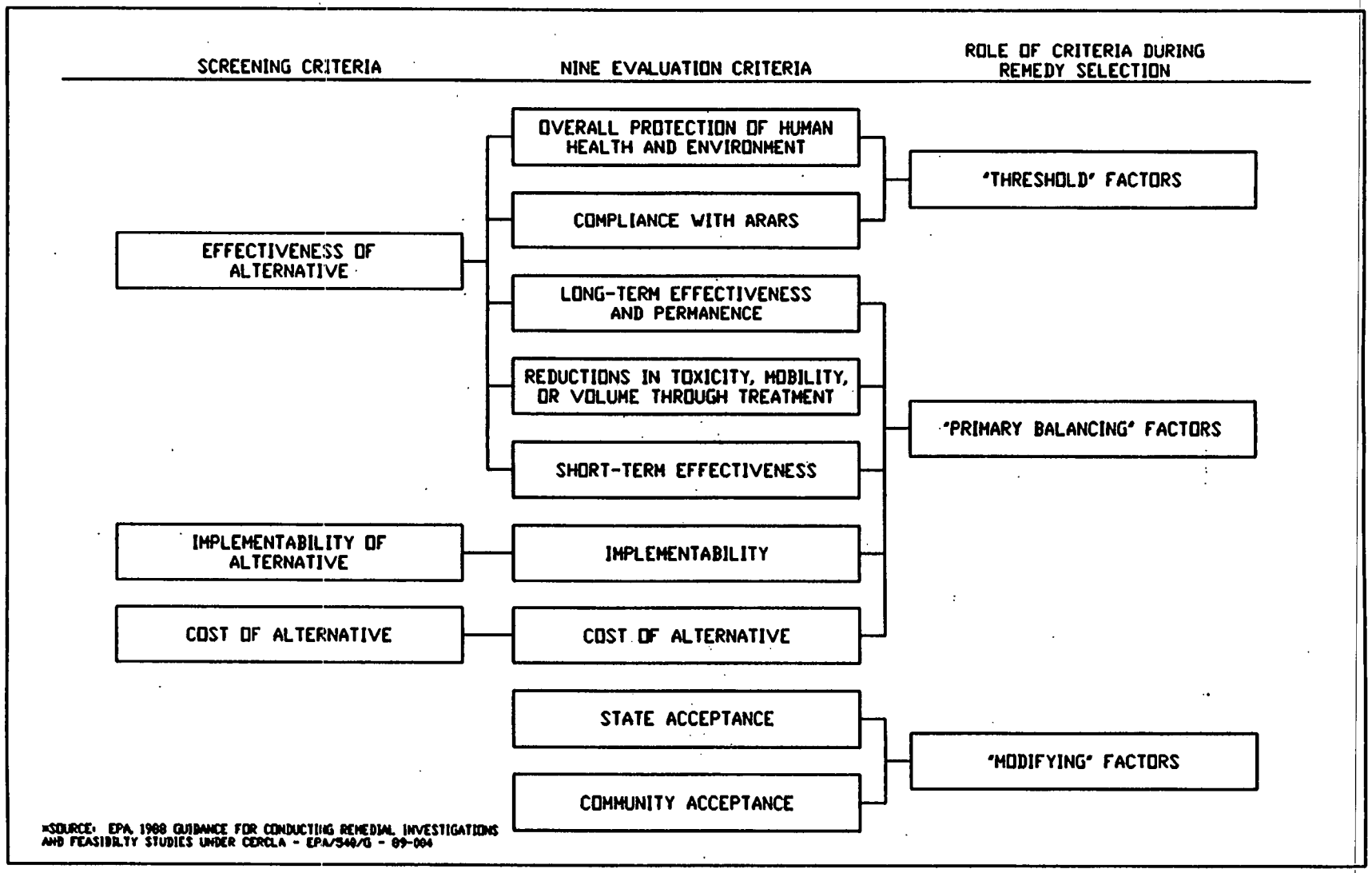

*SOURCE: EPA, 1988 GUIDANCE FOR CONDUCTING REMEDIAL INVESTIGATIONS AND FEASIBILITY STUDIES UNDER CERCLA - EPA/540/G - 89-004

FIGURE 6-1 RELATIONSHIP OF SCREENING CRITERIA TO THE NINE EVALUATING CRITERIA

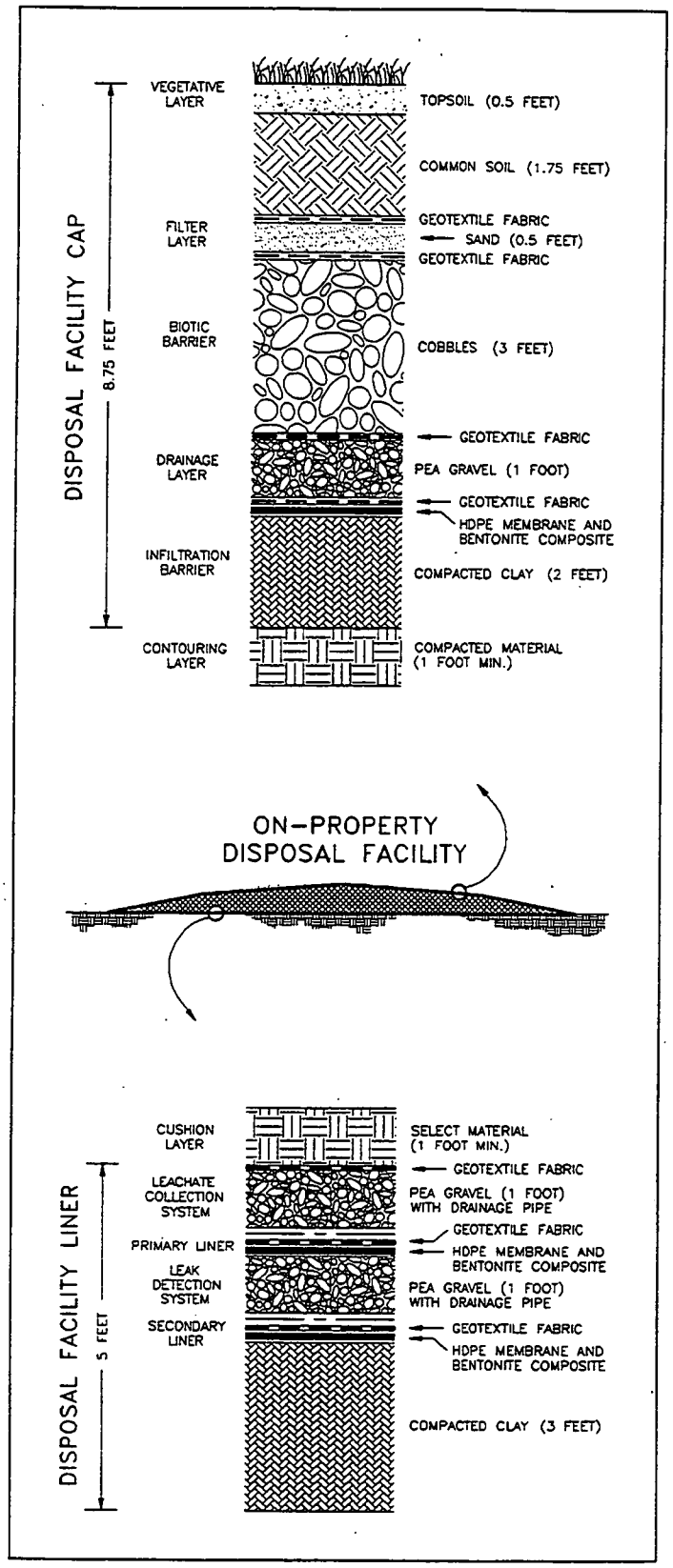

FIGURE 6-2

MULTI-LAYER LINER AND CAPPING SYSTEM FOR THE ON-PROPERTY DISPOSAL FACILITY

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