HAZARDOUS WASTE, DECONTAMINATION AND DECOMMISSIONING AND CLEAN-UP WORKERS' EXPOSURE ASSESSMENT FEASIBILITY STUDY AT THE DEPARTMENT OF ENERGY'S FERNALD SITE PHASE I

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Hazardous Waste, Decontamination and Decommissioning and Clean Up Workers Exposure Assessment Feasibility Study at the Department of Energy's Fernald Site

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PREFACE

The Department of Health and Human Services (DHHS), subsequent to the implementation of a Memorandum of Understanding (MOU) between the Departments of Energy (DOE) and Health and Human Services, conducts a program of independent occupational and environmental research studies with funding from DOE. Research conducted under this MOU focuses on the examination of health effects that may have resulted from past or current DOE operations. The National Institute for Occupational Safety and Health (NIOSH) within the Centers for Disease Control and Prevention, DHHS is charged with the conduct of the occupational health research component of this MOU. This document on the DOE Fernald site represents the first background site document prepared for the development of the NIOSH project entitled: Exposure Assessment of Hazardous Waste (HW), Decontamination and Decommissioning (D&D), and Clean Up Workers (CW).

The purpose of this document is to assemble information relevant to HW, D&D, and CW activities at the DOE Fernald site addressing four primary objectives. The objectives are: identification of HW, D&D, and CW activities anticipated or in progress from the recent past through the next five to 10 years; demographic definition of the workforce performing these activities; identification of the technologies in use or proposed to be used (including considerations regarding health and safety impact upon the workforce); and assembly of summary information for potential chemical, mixed, and radiological contaminant exposures that may be encountered during these processes. The information is drawn predominantly from existing DOE and contractor documents or reports. Other source documents may include those assembled for compliance purposes or to define activities dictated by site D&D, restoration, transition, and cleanup agreements with local, state, and federal authorities or as mandated by DOE. This assembly of information is to support research hypothesis development in the next phase of this project. It will also provide insight and initial data for study feasibility and planning considerations.

The depth and scope of the information assembled provides a midrange presentation of data. Grapling with the needs for substantive information while avoiding premature detail and acknowledging changes in data relevance as time elapses influenced both the character and decisions that went into the assembly of this document. The data collection process limited the need for intensive site involvement. This document is descriptive in nature. The resource documents used to assemble the information are referenced. Information that could not be obtained or which did not exist in an accessible form is also identified.

The intended application of this document is to provide an overview of HW, D&D, and CW activities at the DOE Fernald site. The information is presented in two ways, a text assembly of information with references and a tablular presentation. The intent of this approach is to permit disassembly of the document to facilitate combining similar information for different sites, ideally facilitating an assessment of the feasibility of involving multiple sites in a research study.

The limitations of this document should be recognized. The rate of change in organizational structure, workforce composition, and site activities at the DOE sites involving HW, D&D, and

CW appears to be increasing in frequency and complexity. This coincides with a compression of the time frame committed to cleaning up sites by DOE, resource reductions, and an increase in the use of autonomous multitiered subcontracting. Numerical data is presented as found in the cited references. No verification of summary data provided by the sites or obtained from pre-existing documents has been performed. Obstacles that may become substantial regarding exposure characterization of workforces on site include cessation of centralized data collection systems; introduction of "just in time" contaminant characterization on an as-justified basis; modification of site programs documenting worker exposures; shifts away from a stable, long-term workforce; and changes in the structure of site management. The information presented may also constitute tangential information related to the objectives specified for this phase of the project.

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HAZARDOUS WASTE, DECONTAMINATION AND DECOMMISSIONING AND CLEAN UP WORKERS EXPOSURE ASSESSMENT FEASIBILITY STUDY

1.0 ABSTRACT

The focus of this study is on Hazardous Waste (HW), Decontamination and Decommissioning (D&D) and Clean Up (CW) workers at the United States Department of Energy's (DOE) Fernald site with regard to past, present and proposed future worker group activities, exposures, demographics and technologies.

Unlike most previous DOE related epidemiological studies which have focused on historical worker exposure data, this study addresses historic (July 1989 to present), present (June-October, 1996) and proposed (October 1996 and beyond) HW, D&D and CW worker group exposure data. In many cases, accelerated clean up schedules are planned for DOE sites across the country with the intention of site remediation within the scope of a ten year period. These worker groups, which might encounter hazards that their predessors (i.e., production workers) were not exposed to, may vanish upon completion of these tasks. The first phase of this study will address, identify and summarize documentation regarding this work force for use as a foundation upon which further studies will be built.

During the course of this study the partnership agreement between the DOE and the Department of Health and Human Services (DHHS), as described in the December 24, 1990 Memorandum of Understanding (MOU) between these two agencies, has been tested in terms of gathering the necessary worker group data for this study.

2.0 PURPOSE

This study involves the assembly of background information necessary to address health hazards to HW, D&D and CW's involved with waste streams at the Fernald site. The objectives of this study are:

1. Identify and catalog historic, in progress and anticipated HW, D&D and CW activities at the site.

2. Define and characterize the HW, D&D and CW workforce demographically.

3. Identify the past, present and proposed future technologies DOE will use for the work categories.

4. Determine if exposure characterization data exists and categorize the available exposure information into the following groups: chemical, mixed and radiological.

Information assembled as a result of this study will serve as a catalyst for subsequent exposure assessment and epidemiological studies of this work force.

3.0 METHODOLOGY

Information Resources

Information utilized to fulfill the objectives stated earlier was collected primarily from publicly available documents and Fernald site contacts.

Publicly available documents were obtained from Internet sites, the NIOSH (National Institute of Occupational Safety and Health) Health-related Energy Research Branch (HERB) Library and from the Fernald Public Environmental Information Center (PEIC).

The PEIC serves as a repository for the Administrative Record which was established under Section 113 (k) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The administrative record is the body of documents that "forms the basis" for the selection of a particular response (remedial response action) at a site. Section 113 (k) requires that the administrative record act as a vehicle for public participation in selecting a remedial response action. All DOE Superfund sites must maintain a PEIC. Information available at the PEIC includes documents pertaining to past, present and proposed future HW, D&D and CW activities and technologies(1). Data concerning worker activities and technologies were obtained primarily from the PEIC, HERB Library and from Internet sites.

A NIOSH identified DOE site contact acted as a liaison between NIOSH contracted study personnel and Fluor-Daniel, Inc., the Fernald site operations contractor. The DOE site contact then identified key staff personnel responsible for the particular information requested. These contacts provided information not available from public information sources, i.e., documents pertaining to past, present and proposed future HW, D&D and CW demographics and exposures. The DOE contact at the Fernald site requested that worker exposure and demographic data be collected from on-site points of contact using a questionnaire format. Questionnaires were developed and utilized as requested. Examples of questionnaires utilized for this study are presented in Section 15.0, page 157.

Format considerations

Information gathered to fulfill the objectives stated earlier is presented using two complimentary approaches. These are descriptive "fact or information sheets" and "tables" which present in an overview fashion the categories and type of information necessary to address each objective.

Site Information

A general description of the site was developed to include site facts, years of operation, site activity during production, process description, current mission and future disposition of the site.

Regulatory Drivers

An overview of driving forces (legal) behind the project is presented which includes regulatory agencies and applicable legislation governing site remediation. Regulatory drivers specific to each worker group and associated activities are also presented.

Definition of Worker Groups

HW, D&D and CW group definitions are based on worker functions and the types of waste streams handled and may vary from site to site. Fernald site HW, D&D and CW group definitions were based on worker functions and the types of waste streams handled. The definitions were developed by the Authors using a combination of personal process knowledge, information gleaned from publicly available documents, and site contacts. Definition of and general management practice for each type of waste generated at the site is also presented.

Identification of Historic, In-progress and Anticipated HW, D&D and CW Activities

This section presents historic, in-progress and anticipated HW, D&D and CW activities which are described and defined in relationship to the physical location of those activities. Also included are the waste categories associated with with each activity. To further illustrate the types of activities performed by the HW, D&D and CW groups, three job task Case Studies per worker group are presented as an addendum to this document. These Case Studies present a detailed overview of the types of HW, D&D and CW group activities performed at the site.

HW, D&D and CW Group Demographics

This section provides a demographic description of the HW, D&D and CW groups at the facility and includes: overall numbers of HW, D&D and CW's, union information, personnel records, numbers of workers per contractor, turnover rates, job titles, tasks or categories, number of workers per job task or category, indication of where workers came from [e.g., former site workers, young unskilled laborers, etc.], industry profiles, construction trades, equipment operators, health and safety support and any unconventional work groups, location of worker activity on site, tracking mechanisms/availability of past, present and proposed future information on these workers, worker pools, primary site location of activity, generic job title groups, etc.

HW, D&D and CW Group Technologies

Provided is a listing of past, present and proposed future technologies for HW, D&D and CW's. Each list was indexed according to worker classification (i.e., HW, D&D and CW) and site. Also included is a brief description of technologies used, the number of workers required/proposed to use the technology, exposure risks (remote versus hands-on, Personal Protective Equipment (PPE) requirements, etc) and perceived advantages and disadvantages of each technology.

HW, D&D and CW Group Exposures

A listing of available HW, D&D and CW exposure information for the site is presented. This information is indexed by chemical, radiological and mixed exposures for each worker classification. Sources for this information included DOE contact identified exposure data sources and data repositories, Remedial Investigation and Feasibility Studies (RI/FS), Resource Conservation and Recovery Act (RCRA) facility investigations, resources identified by the Agency for Toxic Substances and Disease Registry (ATSDR), Internet addresses, site documents, as well as others. Historic and current HW, D&D and CW exposure data was accessed, defined and delineated into the following groups: chemical (i.e. hazardous), mixed and radiological.

Tables

The tabular presentation of the data accompanies and summarizes in an overview fashion the material presented in the written text which is written with greater detail, explanatory information, sources, limitations, etc.

Case Studies

As an addendum to this study, three select HW, D&D and CW activities per group are presented. These Case Studies, based on actual historic HW, D&D and CW group activities at the Fernald Site, will further illustrate the function/responsibilities of these worker groups. These activities include, when available, information regarding contaminants of concern, duration of the activity and worker exposures associated with the specific activity.

Case Study Tables

Presents, in a table format, exposure and other data relative to the Case Studies.

Exhibits

Presents, in a table format, information relative to worker exposures.

In late 1988, as the cold war drew to a close, the demand for uranium metal dropped sharply. On July 10, 1989, after more than 36 years of manufacturing uranium metal products for U.S. defense programs, production operations at the FMPC came to a close. Management and financial responsibility for the FMPC was transferred from the DOE defense program to the DOE Office of Environmental Restoration and Waste Management in October of 1990 as the focus of the facility shifted from production to environmental restoration.

Contaminants of Concern at the Fernald Site

Some of the major contaminants of concern at the Fernald site include: uranium-238 in various solubility classes, uranium daughter products, thorium, radium/radon, magnesium, zirconium, mercury, lead, cadmium, chromium, barium, lithium, arsenic, nickel, asbestos, benzene, acetone, toluene, methylene chloride, methyl ethyl ketone, xylene, PCB's, ammonia, potassium carbonate, potassium chloride, sodium hydroxide, 1,1,1-trichloroethane and hydrofluoric, sulfuric and nitric acids.

Current Mission

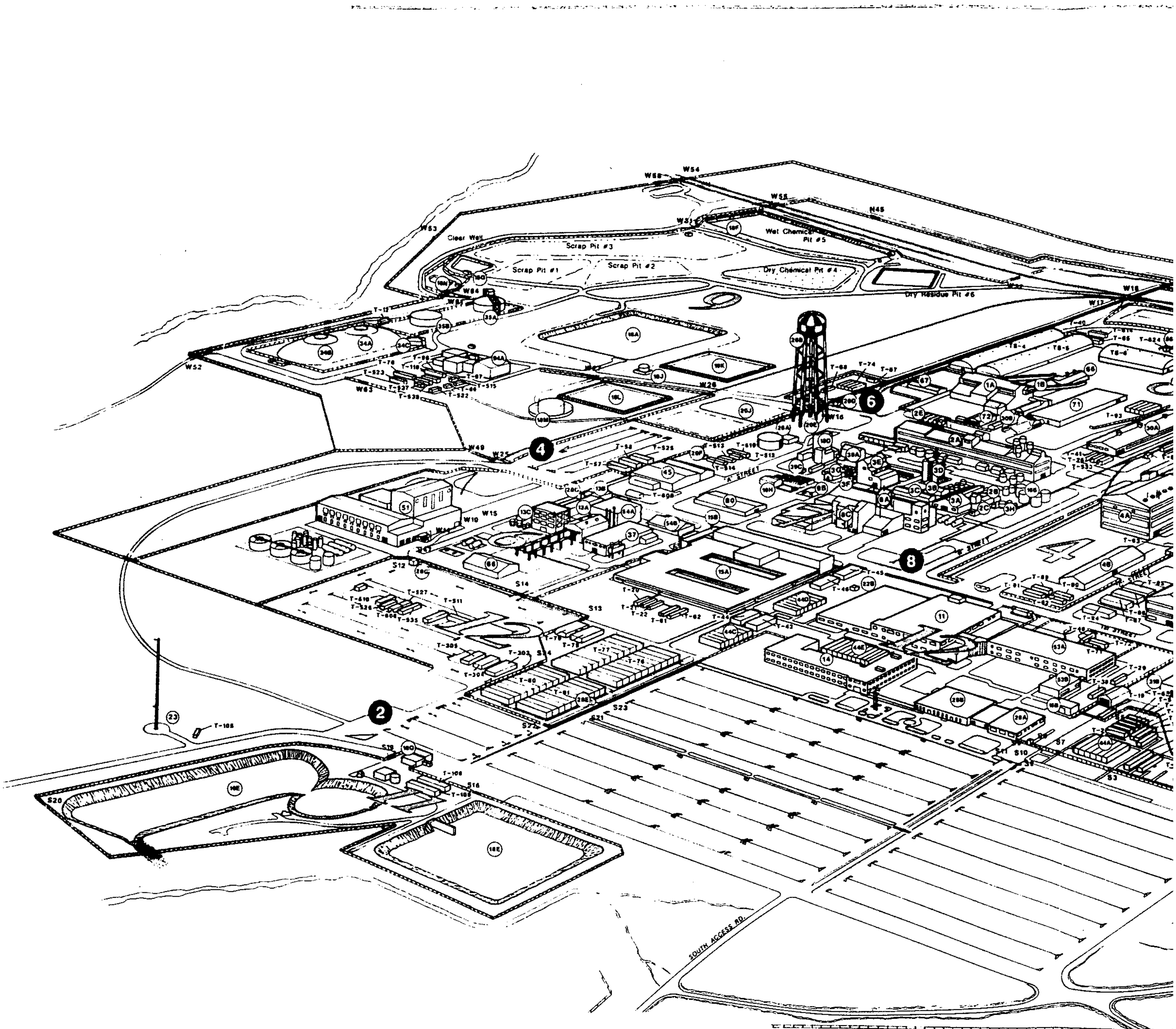
The current mission at the FEMP is one of environmental compliance and restoration. The goal of environmental restoration is to protect human health and the environment by limiting potential exposures to radioactive and hazardous materials. This commitment to protect human health and the environment is reflected in FERMCO's mission statement: "Together DOE and FERMCO are committed to the safe, least-cost, earliest, final cleanup of the Fernald site, within applicable DOE orders, regulations and commitments and in a manner which addresses stakeholder concerns"(2). In fulfillment of it's current mission, the site continues to strive for compliance with all environmental regulations working toward site restoration.

Future Disposition of the Site

Some of the more popular suggestions for future land use at Fernald have been to provide a nature or wildlife preserve; to maintain open green space; to construct a technology center and/or museum; to maintain light industrial activity; to provide a low-level radioactive waste repository; or to use the land for agriculture, recreation, residences, or yard waste or recycling.

Specific future use or uses for which the site is best suited are not yet determined. However, DOE has recommended that some portion of the site be dedicated to the long-term disposal of the contaminated materials present at Fernald(3). At the time of this study, a long-term disposal cell was under construction at the Fernald site.

Figure 1 - Site Map



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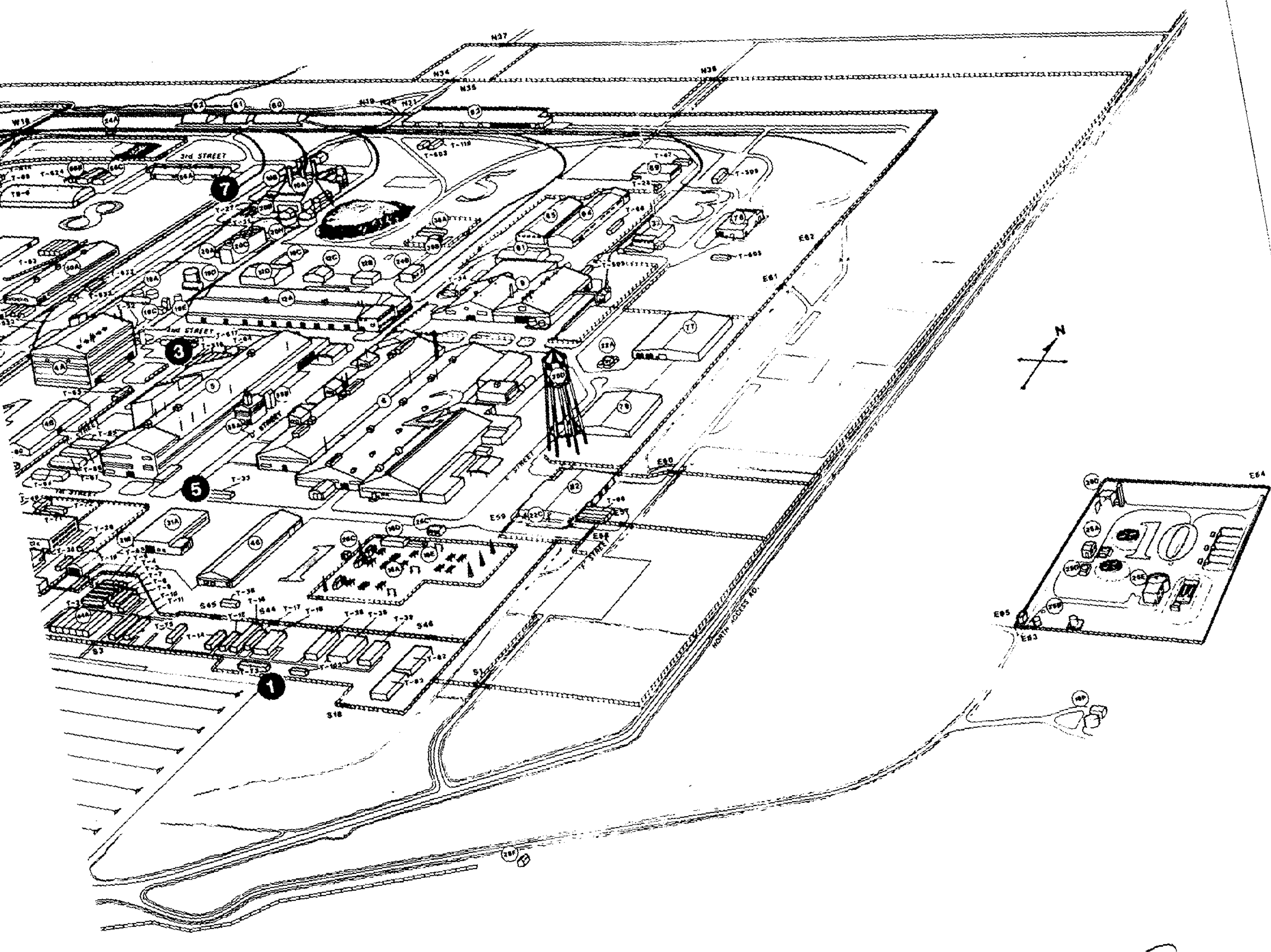


B

Map Key

Building ID No.	Grid Coordinates	Title
00	**	General
1a	C-3	Preparation Plant
1b	C-3	Plant 1 Storage Building
2a	B-3	Ore Refinery Plant
2b	B-3	Lime Handling Building
2c	B-3	Bulk Lime Handling Building
2d	B-3	Metal Dissolver Building
2e	C-3	NFS Storage and Pump House
3a	B-3	Maintenance Building
3b	B-3	Ozone Building
3c	B-3	Control House
3d	B-3	NAR Towers
3e	B-3	Hot Raffinate Building
3f	B-3	Digestion Fume Recovery
3g	B-3	Refrigeration Building
3h	B-3	Refinery Sump
4a	B-4	Green Salt Plant
4b	B-4	Plant 4 Warehouse
4c	B-4	Plant 4 Maintenance Building
5	B-4	Metals Production Plant
6	B-5	Metals Fabrication Plant
8a	B-3	Recovery Plant
8b	B-3	Maintenance Building
8c	B-3	Rotary Kiln/Drum Reconditioning
9	C-5	Special Products Plant
10a	D-4	Boiler Plant
10b	D-4	Boiler Plant Maintenance Building
11	A-4	Service Building
12a	C-4	Maintenance Building (Main)
12b	C-4	Cylinder Storage Building
12c	C-4	Lumber Storage Building
13a	A-3	Pilot Plant Wet Side
13b	A-3	Pilot Plant Maintenance Building
13c	A-3	Sump Pump House
14	A-4	Administration Building
15	A-3	Laboratories
16a	A-5	Main Electrical Station
16b	A-4	Electrical Substation
18a	C-2	Biodenitrification Surge Lagoon
18b	B-3	General Sump
18c	C-4	Coal Pile Runoff Basin
18d	B-3	Biodenitrification Towers
18e	*	Stormwater Retention Basin
18f	D-1	Pit 5 Sluice Gate
18g	C-1	Clearwell Pump House
18h	B-3	BDN Effluent Treatment Facility
18k	B-2	Methanol Tank
18l	C-2	Low Nitrate Tank
18m	B-2	High Nitrate Tank
18n	B-2	High Nitrate Storage Tank
19a	C-4	Main Metal Tank Farm
19b	A-3	Pilot Plant Ammonia Tank Farm
20a	C-4	Pump Station and Power Center
20b	D-4	Water Plant
20c	C-4	Cooling Towers
20d	B-5	Elevated Storage Tank (Potable H_20)
20e	B-3	Well House #1
20f	B-3	Well House #2
20g	A-3	Well House #3
20h	D-4	Process Water Storage Tank
20j	B-2	Lime Slurry Pits
22a	B-5	Gas Meter Building
22b	A-3	Storm Sewer Lift Station

Building ID No.	Grid Coordinates	Title
22c	A-5	Truck Scale
23	*	Meteorological Tower
24a	D-3	Railroad Scale House
24b	C-4	Railroad Engine Building
25a	*	Chlorination Building
25b	*	Manhole–175
25c	A-5	Sewage Lift Station Building
25d	*	U.V. Disinfection Building
25e	*	Digester Control Building
26a	B-3	Pump House – H.P. Fire Protection
26b	B-3	Elevated Water Storage Tank
28a	A-4	Security Building
28b	A-4	Human Resources Building
30a	C-3	Chemical Warehouse
30b	C-3	Drum Storage Warehouse
31	A-5	Engine House – Garage
32	D-5	Magnesium Storage
34a	B-1	K–65 Storage Tank – North
34b	B-1	K–65 Storage Tank – South
35a	C-1	Metal Oxide Storage Tank – North
35b	B-1	Metal Oxide Storage Tank – South
37	A-3	Pilot Plant Annex
38	D-4	Propane Storage
39a	B-3	Incinerator Building
39b	B-3	Shelter Storage Building
39c	B-3	Incinerator Building Sprinkler Riser House
44a	A-5	Trailer Complex — 6–Plex (East)
44c	A-3	Trailer Complex — 7–Plex (South)
44d	A-3	Trailer Complex — 7–Plex (North)
44e	A-4	Trailer Complex — 10–Plex
45	B-3	Rust Engineering Building
46	A-5	Heavy Equipment Garage
51	A-2	UF_6 to UF_4 Reduction Facility 11
53a	A-4	Occupational Safety & Health
53b	A-4	In-Vivo Building
54a	A-3	UF_6 to UF_4 Reduction Facility I
54b	A-3	Pilot Plant Warehouse
55a	B-4	Slag Recycling Plant
55b	B-4	Slag Recycling Pit/Elevator
56	D-3	CP Storage Warehouse
60	D-3	Quonset Hut #1
61	D-3	Quonset Hut #2
62	D-3	Quonset Hut #3
63	D-4	KC–2 Warehouse
64	D-5	Thorium Warehouse
65	D-5	(Old) Plant 5 Warehouse
66	C-3	Drum Reconditioning Building
67	C-3	Plant 1 Thorium Warehouse
68	A-3	Pilot Plant Warehouse
69	D-5	Decontamination Building
71	C-3	General In-Process Storage Warehouse
72	C-3	Drum Storage Building
73	*	Fire Brigade Training Center Building
77	C-5	Finished Products Warehouse
78	*	New D&D Facility
79	B-5	Plant 6 Warehouse
80	B-3	Plant 8 Warehouse
81	C-5	Plant 9 Warehouse
82	B-5	Receiving & Incoming Materials Inspection Area

* Outside of Perimeter Security Fence

** NOTE: Any Unidentified Area is Referred to as 00 General

Process Description

The uranium metal production process and production plants associated with these processes are depicted in Figure 2, page 10 and are described as follows:

1. Processing began at the sampling and preparation plant (Buildings 1A and 1B in Plant 1) where depleted, normal and enriched uranium metals were received, sampled, milled, stored and then shipped.

2. The refinery area (Plants 2 and 3) purified uranium by dissolving uranium ores, oxides, metal and residues into solution as uranyl nitrate through a nitric acid digestion process. Uranium enrichment was also adjusted in Plants 2 and 3 by blending appropriate materials. The uranyl nitrate solution was purified through a liquid-liquid extraction process using tri-butyl phosphate (TBP) as the extracting media. The purified uranyl nitrate was concentrated through evaporation and boil down and then converted to uranium trioxide (UO_3, or "orange oxide") by denitration.

3. The hydrofluorination plant (Plant 4A) process included reducing UO_3 to uranium dioxide (UO_2, or "brown salt") with hydrogen. The UO_2 was then converted to uranium tetrafluoride (UF_4, or "green salt") by reaction with anhydrous hydrogen fluoride (AHF).

4. Incoming UF_6 was also converted to UF_4 in Plant 7 and the Pilot Plant.

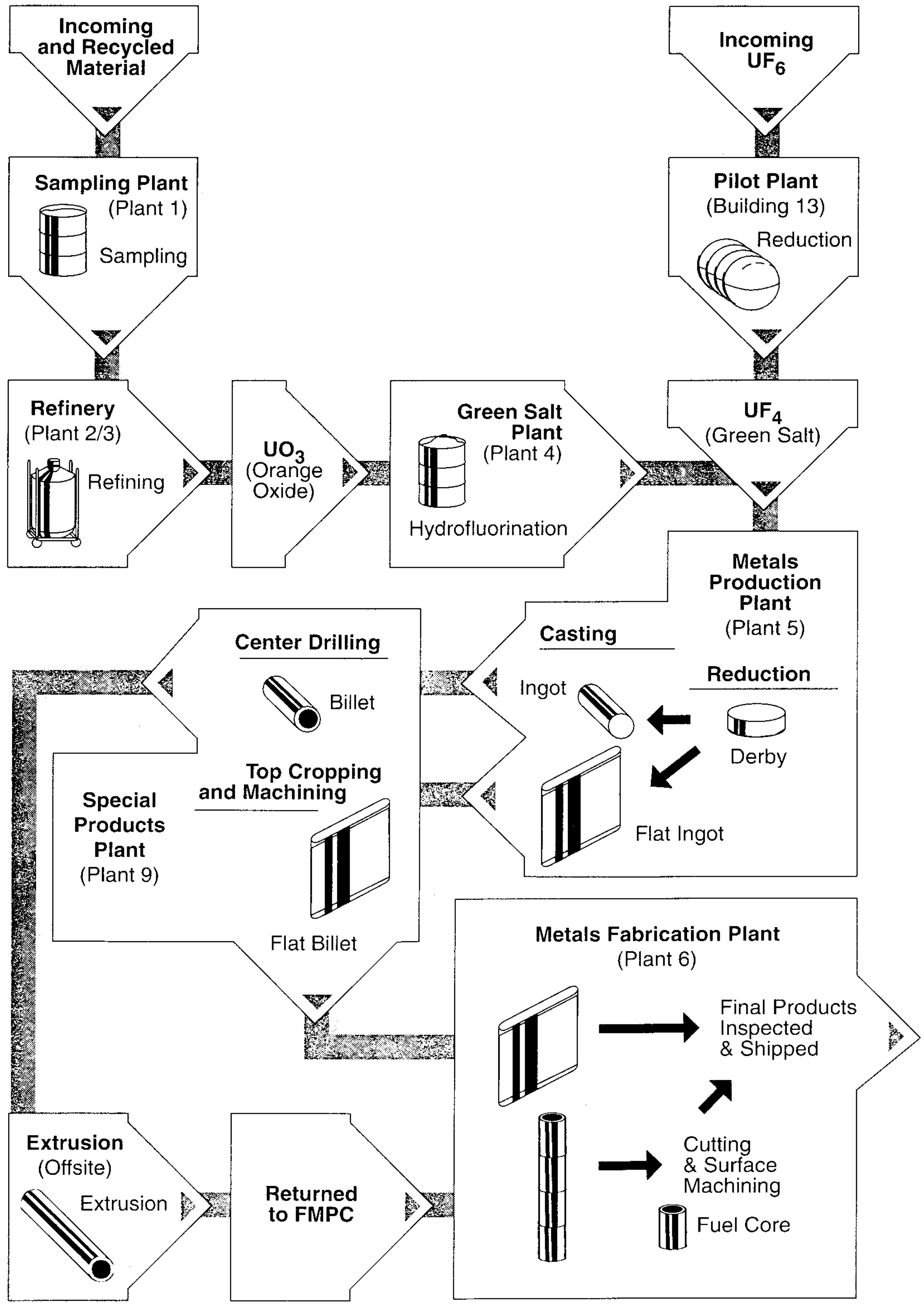
5. Metal processing began in the metals production plant (Plant 5). UF_4 and magnesium metal were combined in a refractory-lined reduction furnace pot to produce uranium "derby" metal via a thermite reaction. Derbies are relatively pure blocks of uranium metal and weigh an average of 300 pounds. Uranium metal derbies and recyclable metals were remelted and formed into uranium ingots in Plant 5.

6. Plant 9, the special products plant, produced fuel rods for the nuclear reactor program located in Hanford, Washington. Machining operations prepared ingots produced in Plant's 9 and 5 for extrusion.

7. Depleted uranium billets were sent for further processing and extrusion into rods at Reactive Metals, Inc. (RMI), a DOE-contracted facility located in Ashtabula, Ohio. The extrusions were returned to the FMPC for heat treating and fabrication into target element cores for DOE reactors.

8. Plant 6 machining and shipping operations included the blanking of extruded ingots or tubes, heat treating the blank core and performing a final machining operation to produce target elements for various DOE sites including Savannah River and Hanford reactors(4).

Figure 2: Former Site Production Process



5.0 REGULATORY DRIVERS

Overview

Hazards across the FEMP fall under a complex regulatory and administrative framework that differs depending on how these hazards occur (e.g., in media or as stored materials), or whether the hazard is chemical, radiological, physical, or a mixture of these aforementioned hazards when they occur in combination. The FEMP must comply with environmental requirements established by a number of agencies governing daily operations at the site. These requirements fall into four general categories:

1) Requirements imposed by applicable Federal statutes and regulations.

2) Requirements imposed by applicable State and local statutes and regulations.

3) Guidelines imposed by DOE Orders and directives.

4) Site-specific requirements imposed through agreements with regulatory agencies.

Since these requirements are initiated by several different sources, enforcement likewise falls under several Federal, State and local agencies. The OEPA is the primary State environmental regulatory agency at the FEMP that issues permits, reviews compliance reports, inspects facilities and operations and oversees compliance with State-issued or State-administered environmental regulations. The USEPA Region V oversees the CERCLA process at the FEMP with the cooperation and active participation of the DOE. Table 10.1, page 62 , presents the Primary Statutory Authorities for the DOE's Fernald Facility.

CERCLA Process

In 1986, the DOE and the USEPA entered into a Federal Facilities Compliance Agreement in which the DOE agreed to comply with various Federal and State pollution control regulations, including those under CERCLA. The Federal Facilities Compliance Agreement addresses remediation as well as compliance with environmental laws and regulations. On November 21, 1989, the FEMP was included on the National Priorities List of sites requiring environmental cleanup. Consistent with the requirements of Section 120 of CERCLA, the 1986 Federal Facilities Compliance Agreement was amended in April 1990. Under the 1990 Consent Agreement, the FEMP was divided into five Operable Units (OU's) to facilitate cleanup. An OU is "a discrete action that comprises an incremental step toward comprehensively addressing site problems. OU's may address geographical portions of a site, specific site problems, or initial phases of an action performed over time, or any actions that are concurrent but located in different parts of the site"(5). OU's 1-4 are depicted in Figure 3 on page 13; OU 5 is composed of all environmental media including that which lies within OU's 1-4.

In September 1991, the DOE and the USEPA jointly signed an amended Consent Agreement. This Consent Agreement identified a series of new, near term corrective actions called "Removal Actions" for implementation by DOE and established revised milestones for the completion of the required feasibility studies within each OU. A Removal Action (RA) is "any necessary action to abate an immediate threat to health and the environment, including actions necessary to monitor, assess, or evaluate the threat"(6). Table 10.3, page 64, provides the FEMP Removal Action Documentation List.

Due to potential delays, it became necessary to re-evaluate the agreement driving these activities. Consequently, in September 1991, an Amended Consent Agreement (ACA) was signed by the DOE and the USEPA which again amended the Federal Facilities Compliance Agreement. The ACA:

1) Established new schedules for the completion of the ongoing RI/FS.

2) Identified 14 new RA's and allowed for the identification of new RAs on an annual basis.

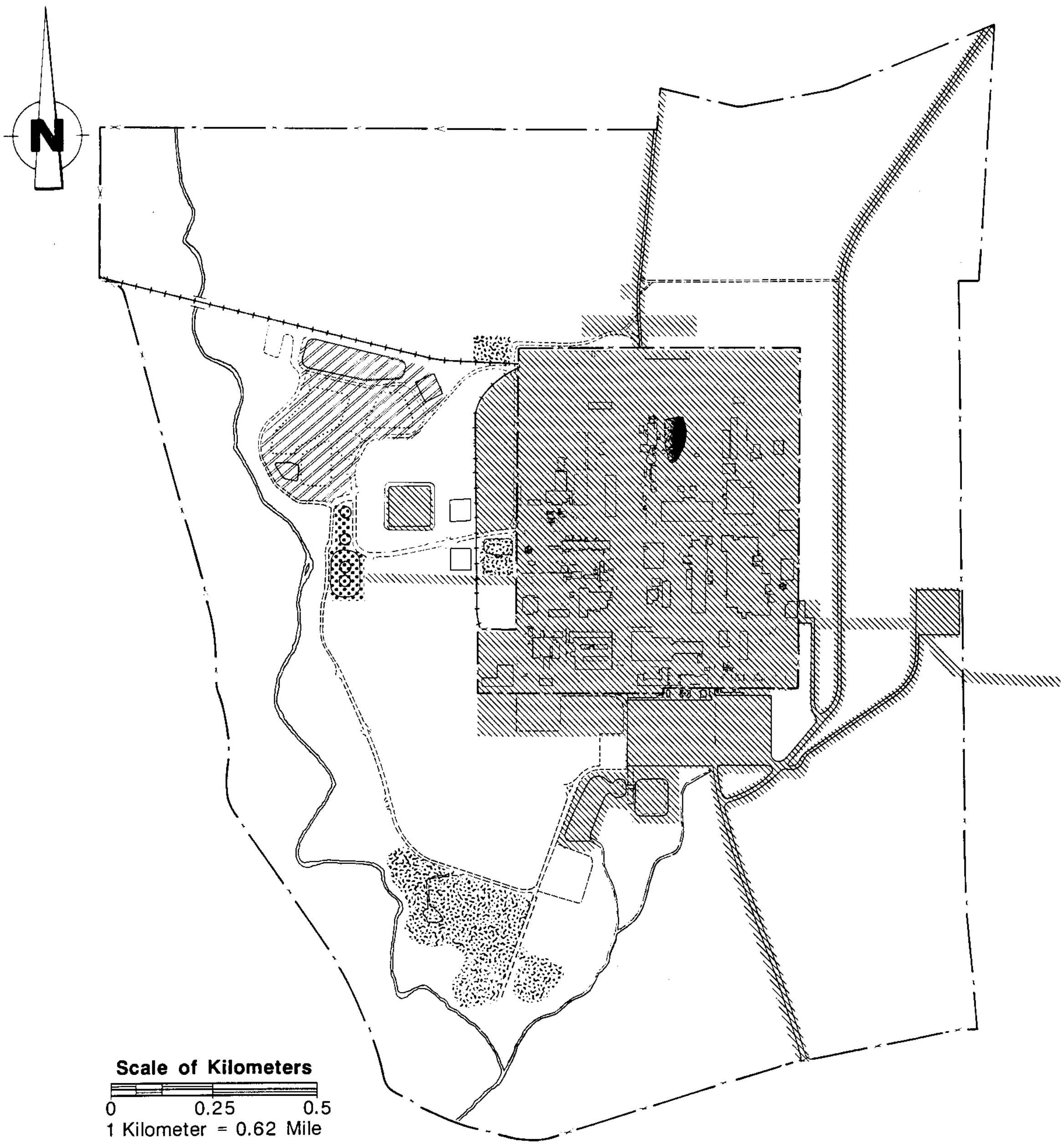
3) Established a Sitewide OU (encompassing OUs 1 through 5) to ensure that actions taken under the individual OUs will protect human health and the environment on a sitewide basis.

Under CERCLA, many Federal and State environmental regulations would constitute Applicable or Relevant and Appropriate Requirements (ARAR's) for CERCLA response actions at the FEMP. This includes many, if not most, of the laws and regulations cited in Appendix 13 of CERCLA. On-site response actions are exempt from environmental permitting, however, response actions must comply with substantive requirements of permits that otherwise would have been required in the absence of this exemption. The CERCLA regulated RI/FS process along with the FEMP Waste Management Program are the two main regulatory drivers involved in site cleanup. Table 10.2, page 63, presents the FEMP Major Activity Milestones.

RCRA Process

RCRA governs the generation, transportation, treatment and disposal of hazardous and mixed waste at the site. In December 1988, the State of Ohio and the DOE signed a Consent Decree establishing milestones to bring the FEMP into full compliance with RCRA and other regulatory requirements. The Stipulated Amended Consent Decree (ACD), which was signed and approved on January 22, 1993, revised the portions of the Consent Decree dealing with hazardous waste evaluations, the Plant 1 pad, Pit 5, Underground Storage Tank 5 and Part A and Part B permit applications(7).

Figure 3 - OU Map



LEGEND

Operable Unit 1
Operable Unit 2
Operable Unit 3
Operable Unit 4
Operable Unit 5 (Not Shown)

Amended Consent Decree

- The FEMP has essentially completed the RI/FS process and has three Records of Decision (RODs) with two others basically agreed upon. A ROD establishes the length of time (deliverable dates) for remediation.

- OU 4 (K-65 Silos) and OU 1 (waste pits) are to be removed, treated and disposed of off-site. RODs have been signed.

- OU 2 (other disposal areas) and OU 5 (environmental media) contain low-level radioactive waste materials and are to be removed, treated and contained on site in an engineered disposal cell (draft RODs and/or proposed plans essentially approved).

- OU 3 (buildings and facilities) has been determined to have no future use. An Interim Record of Decision (IROD) to bring all the buildings and facilities down has been reached. Final RI/FS, Proposed Plan and ROD are being prepared for approval.

The FEMP is actively pursuing full implementation of the actions identified in the Stipulated ACD. OEPA regulations and statutes and RCRA regulations are ARAR's for the FEMP(8).

FEMP Waste Management Program:

The management of hazardous and mixed waste on site is regulated by the OEPA. In December 1988 a consent decree signed by the OEPA and the DOE established milestones to bring the FEMP into full compliance with RCRA and other regulatory requirements. The FEMP is currently working under a RCRA Part B on-site treatment/storage permit for hazardous waste.

In general, the FEMP Waste Management Program encompasses the handling of inventory waste which was generated by past production operations, waste resulting from remedial activities and waste generated by on-going support operations, as well as waste generated from the construction of new treatment facilities. These waste streams will include radioactive, hazardous, mixed and other regulated waste forms. Presented in the paragraphs that follow are the definitions of and the general management practices for each type of waste generated.

Hazardous Waste

Hazardous wastes are any solid, liquid, or gaseous materials that are either specifically listed in 40 "Code of Federal Regulations" (CFR) 261, Subpart D, or exhibit one of the characteristics (e. g. ignitability, corrosivity, reactivity or toxicity) identified in 40 CFR 261, Subpart C. The use of the word "hazardous" in this document means hazardous only in the sense that the waste/residue is subject to RCRA hazardous waste regulations. At the FEMP, the preferred on-site management practice for hazardous waste is treatment to remove or eliminate the listed/characteristic components of the waste before shipment to an off-site Treatment, Storage and Disposal Facility (TSDF).

NOTE: Certain hazardous (chemical) substances are used in the day to day operations of the FEMP. Examples include the use of chlorine as a disinfectant in the waste water treatment process and diesel fuel used in motor vehicle operations. Table 10.4, page 66, presents a List of Chemicals Reported on the Superfund Amendment and Reauthorization Act (SARA) Title III, 312 Report for 1995 for the DOE's Fernald Facility(9).

Mixed Waste

Mixed waste is waste that contains both hazardous waste under RCRA and source, special nuclear, or byproduct material subject to the Atomic Energy Act (AEA). Because of the dual regulations mixed waste is subject to, additional administrative and management controls are required. In addition to the RCRA and the AEA, hazardous and mixed waste need to be managed to ensure compliance with the Proposed Amended Consent Decree (Civil No. C-186-0217). "The DOE is required to conduct its current and future treatment, storage and disposal of hazardous and mixed waste at the FEMP in accordance with Federal and Ohio hazardous waste laws and regulations....DOE is not required to comply with the above requirements, with regard to mixed waste, where compliance will increase the risk to human safety and health or the environment, or, with respect to hazardous or mixed waste, where the requirements would be inapplicable"(10). The Proposed Amended Consent Decree also outlines activities and schedules to be performed in order to remedy site conditions. The management of these wastes are addressed in procedure FMPC-0519. The provisions contained in 40 CFR 261 and FMPC-0519 are followed to ensure that waste is properly packaged and incompatible waste is segregated. Both off-site permitted treatment/disposal facilities and on-site remediation is utilized at the FEMP to manage mixed and hazardous waste.

Radioactive Waste

Radioactive wastes are any solid, liquid, or gaseous materials that contains radionuclides regulated under the AEA and are of negligible economic value considering recovery cost. At the FEMP, radioactive wastes must be managed in accordance with DOE Order 5820.2A. As required in this order, a site radioactive waste management plan (FMPC-2040) has been developed to ensure compliance with appropriate handling practices. Since the majority of the wastes at the FEMP are classified as Low Level Radioactive Wastes (LLRW), compliance with DOE Order 5820.2A is the primary goal of the waste management plan. LLRW consists of processing residues and wastes, contaminated construction rubble (wood, metal, concrete, asphalt, debris) and miscellaneous contaminated materials. In addition to the waste management plan, the FEMP utilizes two site-wide procedures to address LLRW issues (PP-FMPC-5010 and SSOP-044). LLRW will be shipped to the Nevada Test Site (NTS) until the completion of the On-Site Disposal Facility (OSDF).

Asbestos Waste

In response to the Asbestos Hazard Emergency Response Act (AHERA) and Toxic Substances Control Act (TSCA), the FEMP has developed a management plan (PL-FMPC-3002) for operations and projects involving Asbestos Containing Material (ACM). Since there can be health problems associated with exposure to asbestos fibers, special precautions and procedures are required. Construction, maintenance and building decommissioning activities will generate ACM; some of these materials may also be contaminated with radiological and/or hazardous components. ACM represents a small portion of the overall site waste stream. ACM including only LLRW will be shipped to NTS until the completion of the OSDF. ACM which does not include radioactive, hazardous or mixed wastes is shipped to an approved disposal facility. ACM which contains hazardous or mixed waste will be treated on-site or sent to an approved TSDF.

Polychlorinated Biphenyl (PCB)-Contaminated Waste

PCB contaminated materials contain PCB's in concentrations in excess of the regulatory limits as identified in 40 CFR 761. The primary site sources of PCB's are electrical equipment and hydraulic fluids. PCB-contaminated waste at the FEMP is managed in accordance with TSCA as specified in 40 CFR 761. PCB contaminated materials which do not contain radioactive, hazardous or mixed wastes are shipped to an approved disposal facility. At the present time no TSDF can accept PCB contaminated materials containing radioactive, hazardous or mixed wastes. These materials are stored on-site until technology is developed to mitigate the hazards.

Major objectives of the FEMP Waste Management Program

1. Reduce the inventory of low-level radioactive, hazardous and mixed waste stored on-site.

2. Establish cost-effective mechanisms to process waste for disposal.

3. Implement actions to maintain the sites compliance with RCRA, CERCLA and TSCA requirements as specified in the ACD.

4. Facilitate the site comprehensive waste minimization and avoidance program.

5. Provide waste management operations for proper disposition of waste in support of the site cleanup activities, including Safe Shutdown (SS), past production waste resulting from remediation of the OU's, building/equipment decontamination and decommissioning, other contaminated environmental media and remedial facility construction waste.

6. Continuation of waste characterization process including sampling and analysis to insure that treatment, storage or disposal facility waste meets all applicable Waste Acceptance Criteria (WAC)(11).

6.0 DEFINITION OF HW, D&D AND CW GROUPS

Hazardous Waste Worker (HW)

That portion of the FEMP wage workforce involved with the sampling, surveying, containerization, treatment, transportation, storage and disposal of hazardous waste (i.e., chemically contaminated wood, metal, concrete, asphalt, debris, process residues, discarded product, contact waste, etc.) associated with Hazardous Waste Management Units (HWMU's) and the population of SS workers dealing with hazardous and mixed waste. HWMU's encompass a contiguous area of land on or in which hazardous waste has been placed, or the largest area in which there is significant likelihood of mixing hazardous waste constituents in the same area. Examples of HWMU's include surface impoundments, waste piles, land treatment areas, landfill cells, incinerators, tanks and associated piping and container storage areas (40 CFR, Part 260.10, Subpart B definitions).

The HW worker may also deal with hazardous waste with a radiological component. If a radiological component exists above the DOE action level the waste will be construed as mixed waste (many FEMP wastes are mixed waste). In this case, efforts are made to remove or treat either the radiological or hazardous component to allow for disposal options (most mixed waste at this time is stored on-site due to a lack of approved storage facilities). If the radiological component is removed successfully then the hazardous waste that remains can be safely treated on or off-site to render it non-hazardous. Conversely, if the hazardous component can be treated on-site the remaining radiological waste can be shipped to the LLRW storage facility.

Decontamination and Decommissioning Worker (D&D)

Those FEMP workers (primarily subcontractors) who are involved with the decontamination and decommissioning of structures and associated equipment primarily located in OU3. D&D workers remove asbestos, process equipment and internal and external building components after encapsulation of loose radiological material and then transfer this LLRW to CWs for shipping, storage, etc.

Hazardous waste exposures for these workers will be determined by the particular decontamination and decommissioning technology utilized, i.e., removing metal with a cutting torch, hand removal of asbestos panels, removal of lead based paint, etc.

Cleanup Worker (CW)

Those wage workers who are involved with systems operation and maintenance (treatment, transportation, storage and disposal of LLRW generated during day-to-day activities at the FEMP) and the population of SS workers not dealing with hazardous waste. Worker crossover sometimes occurs between worker groups at the FEMP. As a rule, SS workers (a sub-group within the CW group) deal with LLRW removal, storage and shipping but in some cases hazardous and mixed waste removal, storage and shipping is performed by SS workers. The CW identifies, weighs, samples, surveys, containerizes, stores and prepares LLRW for shipment to NTS. The shipment of LLRW to NTS is the primary objective of the FEMP at present. As of July 1995, approximately 589,000 drum equivalents (DE) had been shipped to the NTS for final disposition. These waste shipments include legacy (production era) wastes as well as wastes generated through cleanup activities. LLRW that is currently going to NTS will be stored in an on-site storage cell at the FEMP which is scheduled for completion sometime around the turn of the century. Mirroring the pollution prevention and waste minimization efforts occurring in the private sector, the FEMP sold 1,047,759 pounds of normal and depleted uranium salts, oxides and metals to private industry in 1995(12). CW's are usually not associated with hazardous or mixed waste; this is the domain of the HW worker.

HW, D&D and CW Hierarchy

As stated earlier, the sole mission of the FEMP prior to July 10, 1989 (production era) was the processing of uranium ore concentrates into high purity uranium metal products. After this date, regulatory statutes came into effect at the FEMP and select process materials were redefined as hazardous wastes. Therefore, production era workers who were associated with hazardous materials typically do not fall under HW, D&D and CW classifications for site waste.

Large scale decontamination and decommissioning activities began in earnest at the FEMP in 1990 and a specific worker hierarchy has been utilized to complete the activities to date. That hierarchy plays out as follows:

6.1 ADDENDUM: MODIFICATION OF WORKER GROUP DEFINITIONS. JUNE, 1997

Subsequent to the final Fernald Site Exposure Assessment Feasibility Study oral presentation delivered to NIOSH technical monitors by DSI technical staff on March 30, 1997, modifications to the grouping of workers at the site were introduced. These modifications arose out of a discussion between NIOSH technical monitors and DSI technical staff concerning the definition of the Decontamination and Decommissioning (D&D) worker group associated with clean up activities at the Fernald Site.

Page 18 of the original Fernald Site Exposure Assessment Feasibility Study final report defines D&D workers as "those workers (primarily subcontractors) who are involved with the removal of asbestos, process equipment and internal and external (superstructure) building components after encapsulation of loose radiological material".

After further review of DOE definitions for deactivation, decommissioning, decontamination and dismantlement activities, it was agreed that a more concise definition for the Fernald Study D&D worker group was needed, one that would better reflect DOE's definitions and would be more relevant "across the board" for all DOE sites. The revision of this worker group definition reflects exposure assessment requirements grouping workers into more uniform categories based upon work activities, job functions, or potential exposures. Based on this review, the worker group formerly known as the D&D worker group will herein after be referred to as the **Dismantlement** worker group. The Dismantlement worker group performs final large-scale (superstructure) dismantlement, disassembly and/or demolition of the facility subsequent to facility deactivation. Also based on this review, Safe Shutdown (SS) workers, represented as a sub-population of the Cleanup Worker (CW) group in the Fernald Study, will be placed into their own worker group, herein after referred to as the **Deactivation** worker group. The Deactivation worker group performs deactivation, decommissioning, decontamination and small-scale dismantlement of process lines, tanks, equipment, etc., prior to facility dispositioning.

In the Fernald Study, SS dealt primarily with Low Level Radioactive Wastes (LLRW). But because some deactivation activities involve hazardous and mixed wastes, crossover of SS into the Hazardous Waste (HW) worker group occurred. Placing SS into it's own category, the Deactivation worker group, and redefining D&D workers as the Dismantlement worker group, will resolve the ambiguity of the D&D category of workers originally encountered during the assembly of site information regarding site cleanup.

Previous Fernald Site study worker group definitions:

1. Hazardous Waste Workers (HW)

"That portion of the FEMP wage workforce involved with the sampling, surveying, containerization, treatment, transportation, storage and disposal of hazardous waste (i.e., chemically contaminated wood, metal, concrete, asphalt, debris, process residues, discarded product, contact waste, etc.) associated with Hazardous Waste Management Units (HWMU's) and the population of Safe Shutdown (SS) workers dealing with hazardous and mixed waste. The HW worker may also deal with hazardous waste with a radiological component. If a radiological component exists above the DOE action level the waste will be construed as mixed waste (many FEMP wastes are mixed waste). In this case, efforts are made to remove or treat either the radiological or hazardous component to allow for disposal options (most mixed waste at this time is stored on-site due to a lack of approved storage facilities). If the radiological component is removed successfully then the hazardous waste that remains can be safely treated on or off-site to render it non-hazardous. Conversely, if the hazardous component can be treated on-site the remaining radiological waste can be shipped to the LLRW storage facility."

2. Decontamination and Decommissioning Worker (D&D)

"Those FEMP workers (primarily subcontractors) who are involved with the decontamination and decommissioning of structures and associated equipment primarily located in OU3. D&D workers remove asbestos, process equipment and internal and external building components after encapsulation of loose radiological material and then transfer this LLRW to CW's for shipping, storage, etc. Hazardous waste exposures for these workers will be determined by the particular decontamination and decommissioning technology utilized, i.e., removing metal with a cutting torch, hand removal of asbestos panels, removal of lead based paint, etc."

3. Cleanup Worker (CW)

"Those wage workers who are involved with systems operation and maintenance (treatment, transportation, storage and disposal of LLRW generated during day-to-day activities at the FEMP) and the population of SS workers not dealing with hazardous waste. Worker crossover sometimes occurs between worker groups at the FEMP. As a rule, SS workers (a sub-group within the CW group) deal with LLRW removal, storage and shipping but in some cases hazardous and mixed waste removal, storage and shipping is performed by SS workers. The CW identifies, weighs, samples, surveys, containerizes, stores and prepares LLRW for shipment to NTS. CW's are usually not associated with hazardous or mixed waste; this is the domain of the HW worker."

Based on further review of DOE definitions and modifications to the grouping of workers at the site, the Fernald Site study worker groups are now redefined as follows:

1. Hazardous Waste Workers (HW)

That portion of the FEMP wage workforce involved with the sampling, surveying, containerization, treatment, transportation, storage and disposal of hazardous waste (i.e., chemically contaminated wood, metal, concrete, asphalt, debris, process residues, discarded product, contact waste, etc.) associated with Hazardous Waste Management Units (HWMU's). The HW worker may also deal with hazardous waste with a radiological component. If a radiological component exists above the DOE action level the waste will be construed as mixed waste (many FEMP wastes are mixed waste). In this case, efforts are made to remove or treat either the radiological or hazardous component to allow for disposal options (most mixed waste at this time is stored on-site due to a lack of approved storage facilities). If the radiological component is removed successfully then the hazardous waste that remains can be safely treated on or off-site to render it non-hazardous. Conversely, if the hazardous component can be treated on-site the remaining radiological waste can be shipped to the LLRW storage facility.

2. Cleanup Workers (CW)

Those FEMP wage workers who are involved with systems operation and maintenance (treatment, transportation, storage and disposal of LLRW generated during day-to-day activities at the Fernald site). The CW identifies, weighs, samples, surveys, containerizes, stores and prepares LLRW for shipment to the Nevada Test Site (NTS). CW's are usually not associated with hazardous or mixed waste; this is the domain of the HW worker.

3. Deactivation Workers

Those workers, primarily Safe Shutdown (SS) workers, responsible for placing a facility in a safe and stable condition to minimize the long-term cost of a surveillance and maintenance program that is protective of workers, the public, and the environment until decommissioning is complete. Actions include the removal of fuel, draining and/or de-energizing of non-essential systems, removal of stored radioactive, mixed, and hazardous waste materials, and related actions. As a bridge between operations and decommissioning, based on facility-specific conditions and final disposition plans, deactivation can accomplish operations such as final process runs and decontamination activities aimed at placing the facility in a safe and stable condition. Decommissioning takes place after deactivation and includes surveillance and maintenance, decontamination, and/or small-scale dismantlement of process lines, tanks, and equipment. These actions are taken at the end of the life of the facility to retire it from service with adequate regard for the health and safety of the workers, the public, and protection of the environment. The ultimate goal of decommissioning is the unrestricted release or restricted use of the site.

4. Dismantlement Workers

Those workers, primarily subcontractors, responsible for the disassembly or demolition and removal of any structure, system, or component and satisfactory interim or long-term disposal of the residue from all portions of the facility. The Dismantlement worker group performs final large-scale (superstructure) dismantlement, disassembly and/or demolition of the facility subsequent to facility deactivation. Exposure type for these workers will be primarily radioactive due to fixed radiological contamination associated with superstructure and related components.

DOE has defined the deactivation, decommissioning, decontamination and dismantlement activities as follows:

Deactivation: The process of placing a facility in a safe and stable condition to minimize the long-term cost of a surveillance and maintenance program that is protective of workers, the public and the environment until decommissioning is complete. Actions include the removal of fuel, draining and/or de-energizing of non-essential systems, removal of stored radioactive and hazardous materials and related actions. As a bridge between operations and decommissioning, based on facility-specific conditions and final disposition plans, deactivation can accomplish operations such as final process runs, and decontamination activities aimed at placing the facility in a safe and stable condition.

Decommissioning: Takes place after deactivation and includes surveillance and maintenance, decontamination, and/or dismantlement. These actions are taken at the end of the life of the facility to retire it from service with adequate regard for the health and safety of the workers, the public and protection of the environment. The ultimate goal of decommissioning is the unrestricted release or restricted use of the site.

Decontamination: The removal or reduction of radioactive or hazardous contamination from facilities, equipment, or environmental media by washing, heating, chemical or electrochemical action, mechanical cleaning, or other techniques to achieve a stated objective or end condition.

Dismantlement: The disassembly or demolition and removal of any structure, system, or component during decommissioning and satisfactory interim or long-term disposal of the residue from all portions of the facility.

Source: U.S. DOE [1996]. Integrating Safety and Health During Decommissioning with Lessons Learned from INEL. Germantown, MD: U.S. Department of Energy. DOE/EH-0546, p. v.

Any HWMU's within the area or building to be decontaminated and decommissioned are mitigated under a RA or closure action, (this is the domain of the HW worker). Upon completion of this task and disposition of the removed hazardous waste, a sub-population of the CW group known as SS enters the area or building to be decontaminated and decommissioned and removes any salvageable equipment, loose radiological gross contamination, or "holdup material" (material left in process lines, machinery, equipment etc.) and performs general clean-up activities. At this point a contract is let to a decontamination and decommissioning company for the final phase of the process. The D&D workers working under the decontamination and decommissioning contract perform activities such as removing asbestos and ACM, encapsulation of fixed radiologically contaminated surfaces using latex paint, removal and staging for proper disposal of structural components and ensuring that materials are containerized where applicable and staged for shipment to the proper storage/disposal area.

7.0 HAZARDOUS WASTE WORKERS

7.1 Identification of Historic, In-Progress and Anticipated HW Activities at the FEMP

This section will define HW activities, waste categories, contacts, exposure types, regulatory drivers, time line and number of workers per activity. Table 10.5, page 67, presents HW Worker Contacts, Activity Descriptions and Exposure Types.

OU 1 HW Worker Activities

OU 1 encompasses Waste Pits 1 through 6, the Burn Pit, the Clearwell, the Pit 5 Experimental Treatment Facility, water incidental to the pit area and all berms, liners and soil within the OU boundary. This 37.7 acre area located west of the process area (OU 3) and south of the main rail spur was used during the operation of the plant for disposal of low-level process and mixed waste(13).

Activity 1: HWMU 51- Pit 5 Experimental Treatment Facility

The Pit 5 Experimental Treatment Facility (HWMU 51) was built in 1984 to test the feasibility of solar drying sludge material from Waste Pit 5. Field activities for the dismantling of the the facility (RA 11), removal of the surrounding soils and packaging of the waste materials generated during the RA for storage began in December 1991 and were completed in March of 1992(14). Contaminants of concern associated with this RA include, but are not limited to, uranium, radium and thorium (all of which are LLRWs), arsenic, mercury and PCB's. No measurable amounts of volatile or semi-volatile organics were detected. The types of HW worker activities associated with this RA were containerization, transportation and storage of mixed waste(15). A Consent Agreement was the regulatory driver behind this activity.

Activity 2: HWMU 27 - Waste Pit 4

Waste Pit 4 was a repository for a variety of liquid and solid wastes that were generated by the eight separate operations plants at the site(16). Field activities for the application of a cap to mitigate contaminant migration in Waste Pit 4 (RA 22) began in July 1989 and were completed in September of 1989. The type of HW worker activity associated with this RA was containerization of mixed waste. Contaminants of concern associated with this RA include, but are not limited to, uranium, radium, thorium (all of which are LLRWs), acetone, 2-butanone, methylene chloride, di-n-octyl phthalate, barium, beryllium, cadmium, lead and manganese(17). A Consent Agreement was the regulatory driver behind this activity.

Final closure of Waste Pit 4 will involve the removal of a variety of liquid and solid wastes that were generated by the eight separate operations plants at the site and also excavation of contaminated soils. The proposed time line for the final closure of Waste Pit 4 is projected to be somewhere between 1996 and 2004. Contaminants of concern associated with this closure are the same as those listed above. The types of HW worker activities associated with this final closure will be containerization, transportation, treatment and storage of mixed waste. CERCLA will be the regulatory driver behind this activity.

Activity 3: HWMU 42 - Waste Pit 5

Waste Pit 5 was a repository for a variety of liquid and solid wastes that were generated by the eight separate operations plants at the site(16). Field activities for the Waste Pit 5 RA (RA 18) involved the redistribution of 2,517 cu. yds. of material from the east end to the west end of Pit 5, thereby reducing the potential for wind erosion of the pit material. Field activities began in September 1992 and were completed in December of 1992. Contaminants of concern associated with this RA include, but are not limited to, uranium, radium, thorium (all of which are LLRWs), Aroclor-1254, Aroclor-1248, acetone, methylene chloride, di-n-butyl phthalate, barium, beryllium, lead and manganese(18). The type of HW worker activity associated with this RA was transportation of mixed waste. A Consent Agreement was the regulatory driver behind this activity.

Final closure of Waste Pit 5 will involve the removal of a variety of liquid and solid wastes that were generated by the eight separate operations plants at the site and also excavation of contaminated soils. The proposed time line for the final closure of Waste Pit 5 is projected to occur between 1996 and 2004. Contaminants of concern associated with this closure are the same as those listed above. The types of HW worker activities associated with this final closure will be containerization, transportation, treatment and storage of mixed waste. CERCLA will be the regulatory driver behind this activity.

OU 2 HW Worker Activities

OU 2 encompasses the Solid Waste Landfill, Lime Sludge Ponds, Active and Inactive Fly Ash Piles, other South Field Disposal Areas and all berms, liners and soil within the OU boundary. There are no HWMU's located in OU 2(19).

OU 3 HW Worker Activities

OU 3, the former production area, occupies about 136 acres near the center of the FEMP site and contains many buildings, scrap metal and soil piles, containerized materials, storage pads, a parking lot, roads, railroads, above and underground tanks, utilities and equipment. Several impoundments, ponds and basins are also included(20).

Activity 4: HWMU 13 - Wheelabrator Dust Collector

The Wheelabrator Dust Collector collected dusts and residues generated by the drum reconditioning unit in Building 66. Final closure of this HWMU occurred between July of 1994 and 1995 and involved the removal of process residues generated by the drum reconditioning unit and decontamination of the unit. Contaminants of concern associated with this closure include, but are not limited to, uranium (LLRW), cadmium and lead residues. The types of HW worker activities associated with this final closure were containerization, transportation and storage of mixed waste. RCRA was the regulatory driver behind this activity.

Activity 5: HWMU 20 - Plant 1 Storage Pad

The Plant 1 Storage Pad was used as a drum storage location to support sampling operations from 1952 to 1989. Field activities for the Plant 1 Storage Pad RA (RA 7) involved membrane installation, soil removal, construction of a new concrete pad and upgrading of the existing pad in order to mitigate the continuing release of contaminants from the Pad(21). Field activities began in July 1991 and were completed in September of 1994. Contaminants of concern associated with this RA include, but are not limited to, uranium, thorium (all of which are LLRWs), barium salts and waste oils containing 1, 1, 1 - trichloroethane and lead(22). The type of HW worker activities associated with this RA were containerization, transportation and storage of mixed waste. A Consent Agreement was the regulatory driver behind this activity.

Final closure of this HWMU will involve removal of stored waste on the Pad. The proposed time line for the final closure of this HWMU will be in conjunction with the final closure of the Plant 1 Storage Pad and is projected to occur between 1996 and 2014 (All Pads and foundations are being closed in conjunction with the OU 5 soils remediation activities. 2014 is the projected completion date for all OU 5 soils remediation activities). Contaminants of concern associated with this closure are the same as those listed above. The types of HW worker activities associated with this final closure will be containerization, transportation, treatment, storage and disposal of mixed waste. CERCLA will be the regulatory driver behind this activity.

Activity 6: HWMU 26 - Detrex ® Still

This closure activity involved the removal of the Detrex still and associated equipment which was used for the reclamation of chlorinated solvents laden with PCBs. Final closure occurred between November of 1993 and November of 1995 and involved the removal of residues containing chlorinated solvents laden with PCBs. Contaminants of concern associated with this closure include, but are not limited to, uranium (LLRW), 1, 1, 1 - trichloroethane, perchloroethane, methyl ethyl ketone (MEK) and xylene. The types of HW worker activities associated with this final closure were containerization, transportation and storage of hazardous waste. RCRA was the regulatory driver behind this activity.

Activity 7: HWMU 53 - Safe Geometry Sump

This closure activity involved the removal of the Plant 1 Safe Geometry Sump contents and isolation of associated equipment. The Safe Geometry Sump was used for the safe enrichment of criticality susceptible uranyl nitrate solutions. Final closure occurred between August and September of 1994 and involved the removal of sump contents and the application of a cap. Removal of the sump will occur during the final Plant 1 D&D. Contaminants of concern associated with this closure were uranium (LLRW), hydrofluoric acid (HF) and chromium/cadmium wastes. The types of HW worker activities associated with this final closure were containerization, transportation and storage of mixed waste. RCRA was the regulatory driver behind this activity.

Activity 8: HWMU 19 - C. P. Storage Warehouse

This closure activity will involve the removal of stored waste located within the Warehouse. The proposed time line for the final closure of this HWMU is projected to occur between 1996 and 1999(23). Contaminants of concern associated with this closure include, but are not limited to, waste photo developer (silver). The type of HW worker activity associated with this final closure will be transportation of hazardous waste. CERCLA will be the regulatory driver behind this activity.

Activity 9: HWMU 25 - Plant 1 Storage Building

This closure activity will involve the excavation of associated soils. There is no waste stored within the building. The proposed time line for the final closure of the Plant 1 Storage Building is projected to occur between 1996 and 1999(23). Contaminants of concern associated with this closure include, but are not limited to, thorium wastes (LLRWs) that have not yet been characterized analytically. The type of HW worker activity associated with this final closure will be transportation of mixed waste. CERCLA will be the regulatory driver behind this activity.

Activity 10: HWMU's 46 through 50 - Uranyl Nitrate Hexahydrate (UNH) Tanks

HWMU's 46 through 50 are composed of eighteen stainless steel tanks that were used to store UNH. This RA (RA 20), which began in 1992 and was completed in June of 1996, involved the neutralization and disposal of approximately 200,000 gallons of uranium dissolved in nitric acid(24). Contaminants of concern associated with this RA include, but are not limited to, uranium (LLRW), mercury, barium, chromium, lead and low pH (corrosivity) due to the presence of nitric acid (HNO_3). The type of HW worker activities associated with this RA were treatment, containerization, transportation and storage of mixed waste. A Consent Agreement was the regulatory driver behind this activity.

Final closure will involve the removal of the UNH Tanks and associated equipment. The proposed time line for the final closure of the UNH Tanks is projected to occur between 1996 and 1999(25). Contaminants of concern associated with this closure include, but are not limited to, uranium (LLRW). The type of HW worker activity associated with this final closure will be transportation of LLRW waste. CERCLA will be the regulatory driver behind this activity.

Activity 11: HWMU 10 - Nitric Acid Recovery (NAR) System

HWMU 10 was a stainless steel tank that was used to store UNH. The NAR System RA (RA 20) began in mid-1995 and was completed in April of 1996. This RA involved the neutralization and disposal of uranium dissolved in nitric acid(25). Contaminants of concern associated with this RA include, but are not limited to, uranium (LLRW), mercury, barium, chromium, lead and low pH (corrosivity) due to the presence of HNO_3. The type of HW worker activities associated with this RA were treatment, containerization, transportation and storage of mixed waste. A Consent Agreement was the regulatory driver behind this activity.

Final closure will involve the removal of the NAR System and associated equipment and excavation of associated soils. The proposed time line for the final closure of the NAR System is projected to occur between March, 1998 and December 1999(23). Contaminants of concern associated with this closure include, but are not limited to, uranium (LLRW). The type of HW worker activity associated with this final closure will be transportation of LLRW. CERCLA will be the regulatory driver behind this activity.

Activity 12: HWMU 28 - Trane® Incinerator

This closure activity will involve the removal of the Trane® Incinerator and associated equipment. The Trane® Thermal Liquid Incinerator is located in Building 39B and was used to burn waste oils generated at the FEMP. Final closure of this HWMU is projected to occur between 1998 and 1999. The contaminants of concern were based on analysis of the waste oil waste stream and indicated the oils are RCRA hazardous for lead and 1,1,1-trichloroethane as well as being uranium (LLRW) contaminated. The type of HW worker activities associated with this final closure will be treatment, storage, transportation and disposal of mixed waste (i.e., incinerator contents). CERCLA will be the regulatory driver behind this activity.

Activity 13: HWMU 6 - HF Drum Storage Area: Plant 4

This HWMU served as a storage area for drummed Hydrofluoric Acid. Final closure of this HWMU occurred from April 1994 to April 1995 and involved washing of the floor and the removal of stored waste located in the HF Drum Storage Area: Plant 4. Contaminants of concern associated with this closure included, but were not limited to, uranium (LLRW) and HF residues that were considered corrosive (low pH). The type of HW worker activities associated with this closure were transportation and storage of mixed waste. CERCLA was the regulatory driver behind this activity.

Activity 14: HWMU 7 - HF Drum Storage Area: NW of Plant 4

This HWMU served as a storage area for drummed Hydrofluoric Acid. Final closure of this HWMU occurred from April 1994 to April 1995 and involved the removal of stored waste located in the HF Drum Storage Area: NW of Plant 4. Contaminants of concern associated with this closure included, but were not limited to, uranium (LLRW) and HF residues that were considered corrosive (low pH). The type of HW worker activities associated with this closure were transportation and storage of mixed waste. CERCLA was the regulatory driver behind this activity.

Activity 15: HWMU 8 - HF Drum Storage Area: South of the Cooling Towers

This HWMU served as a storage area for drummed Hydrofluoric Acid. Final closure of this HWMU is projected to occur between 1996 and 1999(23) and will involve the removal of stored waste located in the HF Drum Storage Area: South of the Cooling Towers. Contaminants of concern associated with this closure include, but are not limited to, uranium (LLRW) and HF residues that were considered corrosive (low pH). The type of HW worker activities associated with this closure will be transportation and storage of mixed waste. CERCLA will be the regulatory driver behind this activity.

Activity 16: HWMU 8 - HF Tank Farm Sump

Final closure closure of this HWMU is projected to occur between 1996 and 1999 and will involve the removal of the Tank Farm Sump and associated equipment. Contaminants of concern associated with this closure include, but are not limited to, uranium (LLRW) and HF residues that were considered corrosive (low pH). The type of HW worker activities associated with this closure will be transportation and storage of mixed waste. CERCLA will be the regulatory driver behind this activity.

Activity 17: HWMU 38 - HF Tank Car

This HWMU served as a storage area for waste Hydrofluoric Acid. Final closure of this HWMU occurred from March 1995 to September 1995 and involved the removal and treatment of the HF Tank Car contents. Contaminants of concern associated with this closure included, but were not limited to, uranium (LLRW) and HF residues that were considered corrosive (low pH). The type of HW worker activities associated with this closure were treatment, transportation, storage and disposal of mixed waste. RCRA was the regulatory driver behind this activity.

Activity 18: HWMU 21 - Hilco® Oil Recovery Unit

This HWMU served as an oil recycling system for the Plant 5 furnaces and associated equipment. The Hilco® Oil Recovery Unit has been delisted as an HWMU and is now classified as a Solid Waste Management Unit (SWMU). Final closure of this SWMU is projected to occur somewhere between 1996 and 1999 and will involve the removal of the Hilco® Oil Recovery Unit and associated equipment. Contaminants of concern associated with this closure will include, but are not limited to, uranium (LLRW). The type of HW worker activities associated with this closure were transportation and storage of LLRW waste. CERCLA will be the regulatory driver behind this activity.

Activity 19: HWMU 36 - Plant 6 North Storage Pad

This HWMU served as a storage area for drummed waste. Final closure of this HWMU occurred from December 1993 to 1995 and involved the removal of stored wastes located on the Pad and high pressure water rinsing of the Pad. Contaminants of concern associated with this closure included, but were not limited to, uranium (LLRW), 1, 1, 1 - trichloroethane and lead. The type of HW worker activities associated with this closure were transportation and storage of mixed waste. CERCLA was the regulatory driver behind this activity.

Activity 20: HWMU 37 - Plant 6 Warehouses

This HWMU serves as a storage area for drummed waste. Final closure of this HWMU is projected to occur between 1996 and 1999(23). Contaminants of concern associated with this closure include, but are not limited to, various RCRA wastes (yet to be determined). The type of HW worker activities associated with this closure will be transportation and storage of hazardous and mixed wastes. CERCLA will be the regulatory driver behind this activity.

Activity 21: HWMU 14 - Plant 8 Box Furnace

This HWMU closure activity will involve the removal of the Plant 8 Box Furnace contents and is projected to occur between 1996 and 2000(23). Contaminants of concern associated with this closure include, but are not limited to, uranium (LLRW) and 1, 1, 1 - trichloroethane, perchloroethane, trichloroethylene, barium, chromium, lead and silver. The type of HW worker activities associated with this closure will be transportation, storage and disposal of mixed waste. CERCLA will be the regulatory driver behind this activity.

Activity 22: HWMU 15 - Plant 8 Oxidation Furnace

This HWMU closure activity will involve the removal of the Plant 8 Oxidation Furnace contents and is projected to occur between 1996 and 2000(23). Contaminants of concern associated with this closure include, but are not limited to, uranium (LLRW) and 1, 1, 1 - trichloroethane. The type of HW worker activities associated with this closure will be transportation, storage and disposal of mixed waste. CERCLA will be the regulatory driver behind this activity.

Activity 23: HWMU 17 - Plant 8 East Drum Storage Pad

This HWMU closure activity will involve the removal of stored waste located on the Plant 8 East Drum Storage Pad and is projected to occur between 1996 and 2014 in conjunction with soils remediation. Contaminants of concern associated with this closure include, but are not limited to, uranium (LLRW), lead and MEK. The type of HW worker activities associated with this closure will be transportation and storage of mixed waste. CERCLA will be the regulatory driver behind this activity.

Activity 24: HWMU 18 - Plant 8 West Drum Storage Pad

This HWMU closure activity will involve the removal of stored waste located on the Plant 8 West Drum Storage Pad and is projected to occur between 1996 and 2014 in conjunction with soils remediation. Contaminants of concern associated with this closure include, but are not limited to, uranium (LLRW), lead and MEK. The type of HW worker activities associated with this closure will be transportation and storage of mixed waste. CERCLA will be the regulatory driver behind this activity.

Activity 25: HWMU 29 - Plant 8 Warehouse

This HWMU closure activity will involve the removal of stored waste located in the Plant 8 Warehouse and is projected to occur between 1996 and 2000(23). Contaminants of concern associated with this closure include, but are not limited to, uranium (LLRW) and barium chloride wastes. The type of HW worker activities associated with this closure will be transportation and storage of mixed waste. CERCLA will be the regulatory driver behind this activity.

Activity 26: HWMU 35 - Plant 9 Warehouse

This HWMU closure activity will involve the removal of stored waste located in the Plant 9 Warehouse and is projected to occur between 1997 and 1999(23). Contaminants of concern associated with this closure include, but are not limited to, various RCRA wastes (yet to be determined). The type of HW worker activities associated with this closure will be transportation and storage of mixed and hazardous waste. CERCLA will be the regulatory driver behind this activity.

Activity 27: HWMU 34 - KC 2 Warehouse/Well No 67

The KC 2 Warehouse/Well No 67 RA (RA "G") will involve the removal of the well and it's contents, removal of contaminated soils immediately surrounding the well and containerization and disposal of associated wastes. RA G will be performed in conjunction with the final closure of the KC - 2 Warehouse(26). Final closure is projected to occur between 1996 and 2010(23). Contaminants of concern associated with this closure include, but are not limited to, uranium (LLRW), arsenic, barium, lead, acetone, cadmium, chromium, xylene, zinc and sulfides(27). The type of HW worker activities associated with this closure will be transportation, storage and disposal of mixed waste. A Consent Agreement will be the regulatory driver behind this activity.

Activity 28: HWMU 22 - Pilot Plant West Sump

This RA (RA 24) involved the removal of the sump and it's contents, removal of contaminated soils immediately surrounding the sump and containerization of each waste(28). Field activities for this RA occurred between August and October of 1993. Contaminants of concern associated with this closure include, but are not limited to, uranium, thorium (all of which are LLRWs), barium, benzene, mercury, carbon tetrachloride, 1, 1, 1 - trichloroethane and o-xylene. The types of HW worker activities associated with this RA were containerization, transportation and storage of mixed waste. A Consent Agreement was the regulatory driver behind this activity.

Activity 29: HWMU 31 - Solvent Storage Tank T-5

This HWMU served as a holding tank for mixed waste. Final closure of this HWMU occurred from November 1993 to 1994 and involved the removal of the tank contents and decontamination of the Tank. Contaminants of concern associated with this closure included, but were not limited to, uranium, thorium (all of which are LLRWs), 1,1,1- trichloroethane, mineral spirits, benzene and carbon tetrachloride. The type of HW worker activities associated with this closure were containerization, transportation and storage of mixed waste. RCRA was the regulatory driver behind this activity.

Activity 30: HWMU 32 - Solvent Storage Tank T-6

This HWMU served as a holding tank for mixed waste. Final closure of this HWMU occurred from November 1993 to 1994 and involved the removal of the tank contents and decontamination of the Tank. Contaminants of concern associated with this closure included, but were not limited to, uranium, thorium (all of which are LLRWs), 1,1,1- trichloroethane, mineral spirits, benzene and carbon tetrachloride. The type of HW worker activities associated with this closure were containerization, transportation and storage of mixed waste. RCRA was the regulatory driver behind this activity.

Activity 31: HWMU 33 - North and South Solvent Tanks

This HWMU closure activity occurred from June of 1994 to December of 1994 and involved the removal of the North and South Solvent Tanks' contents and decontamination of the Tanks. Contaminants of concern associated with this closure included, but were not limited to, uranium (LLRW), diamyl-amyl phosphate, 1,2,4- trimethylpentane, cumene, xylene, ethyl benzene, tri-butyl phosphate and kerosene. The type of HW worker activities associated with this closure were containerization, transportation, storage and disposal of mixed waste. RCRA was the regulatory driver behind this activity. A full description of the processes concerning the remediation of this facility is detailed in HW Worker Case Study 1: Decontamination of North and South Solvent Tanks, Section 11.1, page 120.

Activity 32: HWMU 54 - Tank T-2

This HWMU closure activity occurred from June of 1994 to November of 1995 and involved the removal of the Tank T-2 contents and decontamination of the Tank. Contaminants of concern associated with this closure included, but were not limited to thorium (LLRW), cadmium, chromium and corrosivity (low pH) due to the presence of nitric acid. The type of HW worker activities associated with this closure were treatment, containerization, transportation, storage and disposal of mixed waste. CERCLA was the regulatory driver behind this activity. A full description of the processes concerning the remediation of this facility is detailed in HW Worker Case Study 2: Decontamination of Tank T-2, Section 11.2, page 123.

Activity 33: HWMU 33 - Pilot Plant Warehouse

This HWMU closure is projected to occur between 1996 and 2010 and will involve the removal of stored waste located in the Warehouse. Contaminants of concern associated with this closure will include, but are not limited to, various RCRA wastes (yet to be determined). The type of HW worker activities associated with this closure will be containerization, transportation and storage of hazardous and mixed waste. CERCLA will be the regulatory driver behind this activity.

Activity 34: HWMU 9 - Nitric Acid Rail Car

This RA (RA 25) occurred between March and October of 1993 and involved the removal of the Nitric Acid Rail Car contents, decontamination and disposal of the Tank Car, removal of surrounding soils and containerization and disposal of each waste(29). Contaminants of concern associated with this RA included, but were not limited to, uranium (LLRW), chromium and corrosivity (due to low pH)(30). The type of HW worker activities associated with this closure will be containerization, transportation, storage and disposal of mixed waste. A Consent Agreement was the regulatory driver behind this activity.

Activity 35: HWMU 41 - Sludge Drying Beds

Final closure of this HWMU is projected to occur between 1996 and 2010 and will involve the removal of sludge generated by the Sewage Treatment Plant and Sewage Treatment Plant Incinerator and excavation/removal of surrounding soils. Contaminants of concern associated with this closure will include, but are not limited to, uranium (LLRW) and perchloroethylene. The type of HW worker activities associated with this closure will be containerization, transportation and storage of mixed waste. CERCLA will be the regulatory driver behind this activity.

Activity 36: HWMU 1 - Fire Training Facility (FTF)

This RA (RA 28) occurred between July of 1994 and April of 1995 and involved the removal of each structure at the FTF, removal of surrounding soils and containerization of each waste(31). Contaminants of concern associated with this RA included, but were not limited to uranium (LLRW), 1, 1, 1, - trichloroethane, PCB's, benzene, gasoline and toluene. The type of HW worker activities associated with this RA were containerization, transportation and storage of mixed waste. A Consent Agreement was the regulatory driver behind this activity. A full description of the processes concerning the remediation of this facility is detailed in HW Worker Case Study 3: Decontamination of an Open Top Tank at the Fire Training Facility, Section 11.3, page 125.

Activity 37: HWMU 30 - Barium Chloride Salt Treatment Facility

This HWMU closure activity began in July of 1987 and was completed in February of 1990 and involved the removal of the Barium Chloride Salt Treatment Facility contents, final disposal of the Facility and washing of the concrete floor. Contaminants of concern associated with this closure included, but were not limited to, uranium (LLRW), barium chloride and sulfate. The type of HW worker activities associated with this HWMU closure were transportation, storage and disposal of mixed waste. RCRA was the regulatory driver behind this activity.

Activity 38: HWMU 3 - Waste Oil Storage in Garage

This HWMU closure activity occurred between February of 1995 and June of 1996 and involved the removal of waste oil stored in the Garage and final disposal of the oil. Contaminants of concern associated with this closure included, but were not limited to, uranium (LLRW), lead and 1,1,1-trichloroethane. The type of HW worker activities associated with this HWMU closure were transportation, storage and disposal of mixed waste. RCRA was the regulatory driver behind this activity.

Activity 39: HWMU 4 - Drum Storage Area near Loading Dock

This RA (RA B) occurred in 1995 and involved the removal of contaminated soils immediately surrounding the dock and containerization and disposal of associated wastes(32). Contaminants of concern associated with this closure included, but were not limited to, uranium, thorium, radium, plutonium (all of which are LLRWs), perchloroethylene, benzene and toluene. The type of HW worker activities associated with this RA were containerization, transportation, storage and disposal of mixed waste. A Consent Agreement was the regulatory driver behind this activity.

Activity 40: HWMU 5 - Drum Storage Area South of Lab

This HWMU closure activity occurred in 1995 and involved the removal of surrounding soils and containerization and disposal of each waste. Contaminants of concern associated with this closure included, but were not limited to, uranium (LLRW), lead and mercury. The type of HW worker activities associated with this closure activity were containerization, transportation, storage and disposal of mixed waste. CERCLA was the regulatory driver behind this activity.

OU 4 HW Worker Activities

OU 4 is located south of the waste pit area on the west side of the FEMP. The primary components of OU 4 are four concrete silos. Silos 1, 2 and 3 contain RCRA exempt mixed waste and therefore are not technically HWMU's. However, remediation of these Silos will be accomplished using HW workers. Silo 4 was never used and remains empty. It will likely be removed using D&D workers. There are no HWMU's located in OU 4(33).

OU 5 HW Worker Activities

OU 5 consists of the groundwater (perched and regional aquifer, surface water), surface soils and sediments, subsurface soils and flora and fauna not included in OU's 1-4. There are no HWMU's located in OU 5(33).

7.2 HW WORKER GROUP DEMOGRAPHICS

According to the FERMCO Human Resources Department, the FEMP HW workforce, which has fluctuated in number over the years, peaked in 1995 at 222 workers. The post-production HW workforce at the FEMP has undergone a change of job title and job code categories. HW workers in 1989-1992 carried the title "Chemical Operator", code 0009. In late 1992, new health and safety training regulations (29 CFR 1910.120e) were imposed which lead to the creation of the Hazardous Waste Operations and Emergency Response (HAZWOPER) job title (job code 0010). At this time there were only 45 HAZWOPERs. In 1993 all chemical operators were trained to the new regulatory requirements and the title of chemical operator (job code 0009) was replaced by the HAZWOPER title. The normal operating shift of these workers is 5 days a week, 8 hours a day with "skeleton crews" performing second and third shift activities. HW workers are required to change into company issued clothing prior to reporting to their work station and must doff company issued clothing and shower prior to exiting. Due to potential contact with chemical and radiological contaminants, the donning of PPE specified by the Industrial Hygiene and Radiological Engineering departments is required prior to entry into the HWMU where work is being performed. Table 10.16, page 117, identifies Fernald site-specific PPE levels and the types of protective clothing and equipment associated with each level.

In October 1996, FERMCO employed approximately 652 CW and HW workers. The function of these worker groups involves the treatment, storage, transportation and disposal of hazardous, mixed and LLRW waste. The top five job titles associated with these worker group activities are HAZWOPER (222 workers), Motor Vehicle Operator (59 workers), Laborer (40 workers), Millwright (38 workers) and Pipefitter (32 workers). Table 10.6, page 81, identifies the specific unions associated with the HW workforce. Industry profiles (comparable worker groups in the private sector) include, but are not limited to, solid, hazardous and mixed waste treatment storage and disposal workers. Table 10.17, page 118, identifies contractors, numbers of workers associated with each worker group, industry profiles, the top five job titles and the primary activity titles.

Turnover rates for the HW worker group are as follows: no rate is available for 1989, 1990 = 15.0%, 1991 = 7.0%, 1992 = 5.3%, 1993 = 7.3%, 1994 = 5.5%, 1995 = 5.0% and the first half of 1996 = 6.1%. Table 10.7, page 83, provides the HW and CW Annual Turnover Rates.

Description of FEMP Records Systems

A. Medical /Radiological Records

The FEMP maintains personnel medical records in individual file folders by employee social security number as well as a Flo Gemini® database format entitled "Medical Records Data Entry Program" (MRDEP). The information contained in these records include pre-employment and annual physicals and accident reports. Annual physicals include chest X-rays, drug screen, audiogram, vision test, blood test, baseline urinalysis, blood workup and spirometry. Thermoluminescent Dosimetry (TLD) information, urine, fecal and blood sampling results and Invivo ("in the body") dosimetry information are kept in an Oracle® database and in hard copy which is reported to the DOE annually. Table 10.8, page 84, presents 1990-1994 WEMCO/FERMCO Dosimetry Rates among HW, D&D and CW Workers.

B. Personnel Training Records

The FEMP maintains personnel training records in individual file folders by employee name as well as a Collier Jackson® database format entitled: "Training Records Information Management System" (TRIMS). The information contained in these records includes site and job specific training as identified in applicable DOE, Occupational Safety and Health Administration (OSHA), Department of Transportation (DOT) and EPA regulations.

C. Personnel Employment Records

The FEMP maintains personnel employment records in individual file folders by employee name as well as a Collier Jackson® database format entitled "Employee Records Information Management System" (ERIMS). The information contained in these records includes employees name, address, date of birth, hire and termination dates, social security number, job status, payroll changes and job codes/title.

D. Industrial Hygiene Records

The FEMP Industrial Hygiene Department maintains chemical and physical agent exposure records in a Paradox 3.5® DOS database format entitled, "HWMU Closure Worker ID and Process Flow" and "RCRA/CERCLA Closure Files". Industrial Hygiene chemical and physical agent exposure records are also available in paper file folders by program and project. These industrial hygiene records include information concerning asbestos, nuisance dust, PCB's and various chemicals used on-site.

E. Waste Generation, Characterization, Tracking and Shipping Records

The FEMP Waste Management Department maintains an Oracle® database application known as the Sitewide Waste Information, Forecasting and Tracking System (SWIFTS) to assist in the forecasting, characterizing, tracking and shipping of waste generated at the Fernald site(34). SWIFTS has effectively merged several databases which in the past controlled the processes listed above separately and had no interaction, this lead to confusion about the types and amounts of waste at the FEMP. With the addition of this system a true RCRA cradle to grave tracking can occur.

F. FERMCO Records Center

Data concerning production era worker activities, demographics, technologies and exposures at the FEMP exists in the archives of the FERMCO Records Center (P.O. Box 538704, Cincinnati, OH. 45253-8704). Prior to 1985, records retention practices were employed whereby select FEMP related records were retained for specified periods of time and then destroyed. Beginning in 1985, the DOE placed a moratorium on the practice of destroying documents at the FEMP. All records generated at the FEMP are now permanently retained at the FERMCO Records Center(35).

Records available at the FERMCO Records Center include, but are not limited to:

- General Administrative files
- Acquisition and Controller files
- Personnel, Medical and Training files
- Health and Safety Department records
- Security records
- Industrial Hygiene and Radiological Department records
- Fire and Safety Department records
- Old Standard Operating Procedures (SOP's)
- Old Production records

7.3 HW WORKER GROUP TECHNOLOGIES

The basis for the use of advancing technologies at the FEMP is to reduce or eliminate worker radiological and chemical exposure, as well as facilitating the proper disposition of waste from the site. The FEMP is driven by the DOE to develop and utilize a Site Treatment Plan (STP). This living document is designed to identify developing technologies and allow them to be assessed in terms of applicability for the accelerated site clean-up(36).

OU 1 HW Worker Past, Present and Proposed Future Technologies:

Table 10.9, page 94, presents OU 1 Past, Present and Proposed Future Technologies.

Activity 1: Hazardous and Mixed Waste Treatment - Minimum Additive Waste Stabilization (MAWS)

MAWS technology remediates hazardous, mixed and low-level radioactive waste in multiple waste streams through one vitrification treatment train. Exposure potential using this technology involves limited contact with the waste, the use of indoor facility High Efficiency Particulate Air Filter (HEPA) ventilation for worker and environmental protection and "Level B" PPE. Advantages of using MAWS technology include reduced potential for skin contact with hazardous/mixed waste sludges and a the utilization of a closed treatment system. No disadvantages are noted. The number of workers necessary to utilize this technology are between 10-20. Past uses of this technology include a 1993-1994 pilot study. Future use of MAWS technology is expected to occur from 1999-2004(37),(38).

Activity 2: Hazardous and Mixed Waste Storage

Hazardous and mixed waste storage does not occur within the OU 1 confines.

Activity 3: Hazardous and Mixed Waste Disposal and Transportation - Waste Pits 4 and 5 Area Drying Technology

Waste Pits 4 and 5 Area Drying Technology remediates hazardous and mixed wastes by dewatering, excavation and drying of excavated hazardous waste sludges. Waste Pit Area Drying involves de-watering, excavation and drying wastes that are classified as HWMU's (i.e., Waste Pits 4 and 5 and the Clearwell). The water condensed in this process will be run through the Advanced Wastewater Treatment System (AWWT) to remove chemical and radiological contaminants in compliance with the site's National Pollutant Discharge and Elimination System (NPDES) permit. The rotary kiln dried wastes will be loaded into rail cars for shipment to NTS for disposal as LLRW.

Exposure potential using this technology involves limited contact with the waste, handling of the waste outdoors and "Level B" PPE. Advantages of using Waste Pits 4 and 5 Area Drying Technology include reduced potential for skin contact with hazardous waste sludges and volume reduction of the waste. No disadvantages are noted. The number of workers necessary to utilize this technology is between 20 and 50. The use of Waste Pits 4 and 5 Area Drying Technology is expected to occur from 1996-2004(37),(38).

OU 2 HW Worker Past, Present and Proposed Future Technologies:

Table 10.10, page 96, presents OU 2 Past, Present and Proposed Future Technologies.

Activity 1: Hazardous and Mixed Waste Treatment - MAWS

See OU 1 HW Worker Past, Present and Proposed Future Technologies: Activity 1.

Activity 2: Hazardous and Mixed Waste Storage

Hazardous and mixed waste storage does not occur within the OU 2 confines.

Activity 3: Hazardous and Mixed Waste Disposal and Transportation - Standard Excavation Technology

Standard Excavation Technology remediates hazardous and mixed wastes by excavation and removal of hazardous waste solids. Exposure potential using this technology involves limited contact with the waste, outdoor contact with the waste and "Level B" PPE. Advantages of using Standard Excavation Technology include reduced potential for skin contact with hazardous waste solids. No disadvantages are noted. The number of workers necessary to utilize this technology will be between 20 and 50. The use of Standard Excavation Technology is expected to occur from 1996-2001(37).

OU 3 HW Worker Past, Present and Proposed Future Technologies

Table 10.11, page 98, presents OU 3 Past, Present and Proposed Future Technologies.

Activity 1: Hazardous and Mixed Waste Treatment - Mobile Stabilization

Mobile Stabilization involved the treatment of characteristic and listed inorganic hazardous, mixed and low level radioactive waste using low strength cement stabilization or macro encapsulation. Exposure potential using this technology involved a high level of contact while opening and dumping containers, sizing, crushing, shredding and mixing hazardous and mixed waste while indoors using facility HEPA air filtration and wearing "Level B" PPE. The advantage of using Mobile Stabilization is that the final product can be shipped off-site for disposal, reducing exposure potential. Untreated, these hazardous and mixed wastes would require on-site storage which would require frequent inspection adding to exposure potential.

Disadvantages of using Mobile Stabilization include a potential for skin contact with hazardous waste sludges and solids during processing and the high amount of dust generated which causes housekeeping concerns. The number of workers necessary to utilize this technology are between 12-16 daily. This technology was used at the FEMP from 11/1995 to 10/1996(37),(39).

Activity 2: Hazardous and Mixed Waste Treatment - Mobile Chemical Treatment

Mobile Chemical Treatment involves the treatment of characteristic and listed hazardous and mixed wastes by means of a chemical treatment process which may include biodegradation, chemical or electrolytic oxidation, chemical reduction, chemical precipitation, recovery of organics, steam stripping, water wash/separation of contaminants, wet air oxidation, neutralization and amalgamation. Exposure potential using this technology involves a high level of contact while opening and dumping containers, sizing, crushing, shredding and mixing hazardous and mixed waste while indoors using facility HEPA air filtration and wearing "Level B" PPE. The advantage of using Mobile Chemical Treatment is that the final product can be shipped off-site for disposal, reducing exposure potential. Untreated, these hazardous and mixed wastes would require on-site storage which would require frequent inspection adding to exposure potential. Disadvantages of using Mobile Chemical Treatment include a potential for skin contact with hazardous waste and mixed wastes during processing. The number of workers necessary to utilize this technology has been between 5 and 20 in the past (11/95-10/96). The number of workers necessary to utilize this technology in the future (1997-2003) has not yet been determined(37),(39).

Activity 3: Hazardous and Mixed Waste Storage - Drum Inspection Robotics

The three types of Drum Inspection Robots robotics developed for use at the FEMP include: Intelligent Mobile Sensing System, Automated Research/Investigation Energy System (ARIES) and Stored Waste Autonómous Mobile Inspector (SWAMI). These self-navigating robot bases have been fitted with Charge Coupled Device (CCD) cameras, software and bar code readers to read drum ID's and find rust spots and other defective features in waste storage drums. These robots are equipped with detectors capable of detecting elevated radiation levels.

These units are being tested in an effort to replace the HW and CW's who currently perform these regulatory mandated inspections thus reducing HW worker chemical and radiological (mixed) exposures and CW radiological exposures. Exposure potential using this technology is zero because the work is done remotely. The advantage of using Drum Inspection Robotics is that it eliminates the potential for contact with hazardous and mixed waste. No disadvantages are noted. The number of workers necessary to utilize this technology are between 1 and 3. The use of Drum Inspection Robotics is expected to occur from 1996-2001(37).

Activity 4: Hazardous and Mixed Waste Disposal and Transportation - Incinerator Technology

Incinerator Technology involves the incineration of liquid and sludge mixed wastes and is performed off-site at a TSCA approved incinerator. This process eliminates mixed wastes by exposing the waste to extreme heat in a rotary kiln with a secondary combustion chamber. Incineration is the preferred Land Disposal Restriction (LDR)treatment method for destroying organic-laden hazardous waste (i.e., low level radiological spent solvents and PCB wastes). Activities associated with this technology include bulking (mixing contents of different on-site tanks), sampling and shipping of mixed waste. Exposure potential encountered during the bulking, sampling and shipping process involves limited contact and is performed outdoors while wearing "Level B" PPE. Exposure potential encountered during the incineration process involves limited contact using a closed loop system with a scrubber and facility HEPA filtration. Advantages of bulking include reduced potential for contact with hazardous waste sludges and solids due to a reduction in the amount of sampling needed. No disadvantages are noted. The number of workers necessary to utilize this technology are between 30 and 40. The use of Incinerator Technology occurred between 1990 and 1992 and is expected to occur from 1996-2001(37),(40).

OU 4 HW Worker Past, Present and Proposed Future Technologies

Table 10.12, page 103, presents OU 4 Past, Present and Proposed Future Technologies.

Activity 1: Hazardous and Mixed Waste Treatment - Vitrification Plant

Vitrification technology utilizes glass forming processes into which K-65 material (RCRA exempt mixed waste) is added to form a glass-like waste which retains 99% of the hazardous chemicals and radionuclides in a stabilized form.

This glass-like non-hazardous end product is suitable for disposal at the Nevada Test Site (NTS). Robotics will be used to remove the waste from Silos 1 and 2 to reduce worker exposure. Radon gas emitted during the vitrification process will be treated in the off-gas treatment system. Vitrification is the preferred international treatment method for high-level radioactive waste and was the chosen treatment method in the OU 4 ROD.

Exposure potential encountered during the vitrification process involves limited contact due to a closed loop system. Work is performed indoors using facility HEPA ventilation and off-gas scrubbers. "Level B" PPE is worn. Radon is a concern.. Advantages of vitrification include reduced potential for skin contact with RCRA exempt mixed waste in a closed loop treatment system. Disadvantages of vitrification technology include the utilization of phosphates and sulfates as additives. Radon control issues are noted. The number of workers necessary to utilize this technology are between 50 and 100, 24 hours a day, seven days a week. Vitrification Plant technology was tested for a short time in 1995 as a pilot program. In 1996 the Vitrification Plant was processing non-radiological and non-hazardous surrogate material. The use of Vitrification Plant technology is expected to continue from 1998-2004(37).

Activity 2: Hazardous and Mixed Waste Storage

Hazardous and mixed waste storage does not occur within the OU 4 confines.

Activity 3: Hazardous and Mixed Waste Disposal and Transportation - Houdini® Waste-dislodging Robot

The Houdini® Waste-dislodging Robot is a remote operated, tracked vehicle that will aid in the retrieval of the waste (RCRA exempt mixed waste) contained in the K-65 silos and Silo 3. The robot will aid in the remediation by performing tasks which include dislodging waste, pumping/vacuuming out solids, semisolids and liquids. The robot will also be utilized to decontaminate silo walls and floors, thus reducing HW worker chemical and radiological (mixed) exposures and CW radiological exposures. Exposure potential encountered using the Houdini® Waste-dislodging Robot is limited to support operations and involves limited contact with waste materials, outdoor operations and "Level B" PPE with supplied air respirator (radon issues). Advantages of the Houdini® Waste-dislodging Robot include reduced potential for skin contact with RCRA exempt mixed waste. The Houdini® Waste-dislodging Robot eliminates the need to enter a confined space (high radiation /radon area). No disadvantages are noted. The number of workers necessary to utilize this technology are between 1 and 5. Houdini® Waste-dislodging Robot technology was tested for a short time in 1996 as a pilot program. The use of Houdini® Waste-dislodging Robot technology is expected to continue from 1998-2004(37).

OU 5 HW Worker Past, Present and Proposed Future Technologies

Table 10.13, page 105, presents OU 5 Past, Present and Proposed Future Technologies.

Activity 1: Hazardous and Mixed Waste Treatment - Soil Separation/Treatment

Soil Separation/Treatment is an ex-situ, physical extraction/separation process for the removal of organic, inorganic and radiologically contaminated soil by physical means (mass action) or chemically by complexing, chelating, reducing, oxidizing or ion-exchange. Exposure potential encountered during the Soil Separation/Treatment process involves limited contact due to a closed loop system. Work is performed indoors using facility HEPA ventilation and off-gas scrubbers. "Level B" PPE is worn. Advantages of Soil Separation/Treatment technology include reduced potential for skin contact with hazardous or mixed waste in a closed loop treatment system. Disadvantages of Soil Separation/Treatment technology include the utilization of phosphates and sulfates as additives. Radon control issues are noted. The number of workers necessary to utilize this technology are between 50 and 100 total. Soil Separation/Treatment technology was tested for a short time in 1996 as a pilot program. In 1996 Soil Separation/Treatment technology was also utilized. The use of Soil Separation/Treatment technology is expected to continue from 1998-2014(37).

Activity 2: Hazardous and Mixed Waste Treatment - MAWS

See OU 1 HW Worker Past, Present and Proposed Future Technologies: Activity 1. Future use of MAWS technology is expected to occur from 1998-2014.

Activity 3: Hazardous and Mixed Waste Storage

Hazardous and mixed waste storage does not occur within the OU 5 confines.

Activity 4: Hazardous and Mixed Waste Disposal and Transportation

Hazardous and mixed waste disposal and transportation does not occur within the OU 5 confines.

Many other technologies dealing with water treatment, radiological monitoring, soil contamination treatment and containment exist(37). At the time of this study, the OU 5 groundwater/soils remediation ROD had not been identified. Therefore, these technologies are not being utilized at the FEMP at present.

7.4 HW WORKER GROUP EXPOSURES

The HW worker group is the most likely of the three worker groups to experience both chemical and radiological or a combination (mixed) exposure because these workers are dealing with mixed waste the majority of the time. Many of the mixed wastes encountered by HW's are liquids which pose a skin exposure (absorption) threat, as well as residues and gasses which pose an inhalation hazard. The FEMP maintains an Industrial Hygiene / Radiological Safety program which addresses these issues through the implementation of Project, Task and Job Specific Training, PPE requirements and Engineering /Administrative Controls. Table 10.8, page 84, presents 1990-1994 WEMCO/FERMCO Dosimetry Rates among HW, D&D and CW Workers.

Engineering and Administrative Controls

The FEMP defines an engineering control as those controls which eliminate hazards by mechanical means or by process design, including apparatus and mechanisms which physically prevent entry, minimize hazards, or create some kind of physical barrier.

The FEMP defines an administrative control as those controls which eliminate hazards by altering work habits such as SOP's, management directives, exposure tracking and limitations on actual exposure.

Both engineering and administrative controls are in place with regard to the work at the FEMP. In most cases regarding chemical and radiological exposures, the administrative controls utilized by the FEMP Contractor are more restrictive than exposure limits implemented by the DOE. Because of these controls, actual personal exposures are expected to be conservative relative to general area survey results.

8.0 DECONTAMINATION AND DECOMMISSIONING WORKERS

8.1 Identification of Historic, In-Progress and Anticipated D&D Worker Activities at the FEMP

Since July 10, 1989, five buildings and associated structures/tanks located within the various OUs have undergone decontamination and decommissioning by D&D workers. At the time of this study several buildings were in the process of being placed in a safe configuration in anticipation of the final decontamination and decommissioning.

As stated earlier in the "Worker Definitions" section of this document, D&D workers are associated with the disposition of LLRW. Therefore, the contaminant of concern associated with each historic, in-progress and anticipated D&D worker activity listed below will be primarily radiological.

This section will define D&D activities, waste categories, contacts, exposure types, regulatory drivers and time line. Also, a qualitative indicator of the number of workers per category of activity (LOW: <10; MED: 11-75, HIGH: >75), are presented. Table 10.14, page 109, presents D&D Worker Contacts, Activity Descriptions and Exposure Types.

OU 1 D&D Worker Activities

OU 1 encompasses Waste Pits 1 through 6, the Burn Pit, the Clearwell, the Pit 5 Experimental Treatment Facility, water incidental to the pit area and all berms, liners and soil within the OU boundary. This 37.7 acre area located west of the process area (OU 3) and south of the main rail spur was used during the operation of the plant for disposal of low-level radiological process and mixed waste(13). Structures located within OU 1 consist mainly of smaller out-buildings and storage sheds. The removal of these structures is relatively simple and does not require the manpower and equipment resources associated with the dismantling and demolition of the much larger steel-beam structures found in OU 3. Therefore, the removal of these structures is considered more of a clean-up activity and falls under the domain of the CW worker. As stated earlier in the "Worker Definitions" section of this document, D&D workers are associated with the disposition of LLRW. Therefore, the contaminant of concern associated with each historic, in-progress and anticipated D&D worker activity listed below will be primarily radiological with lead from lead based paint and asbestos as the exceptions.

Activity 1: There are no large buildings or structures within this OU requiring the services of a D&D contractor.

OU 2 D&D Worker Activities

OU 2 encompasses the Solid Waste Landfill, Lime Sludge Ponds, Active and Inactive Fly Ash Piles, other South Field Disposal Areas and all berms, liners and soil within the OU boundary. There are no HWMU's located in OU 2(19). Structures located within OU 2 consist mainly of smaller out-buildings and storage sheds. The removal of these structures is relatively simple and does not require the manpower and equipment resources associated with the dismantling and demolition of the much larger steel-beam structures found in OU 3. Therefore, the removal of these structures is considered more of a clean-up activity and falls under the domain of the CW worker.

Activity 2: There are no large buildings or structures within this OU requiring the services of a D&D contractor.

OU 3 D&D Worker Activities

OU 3, the former production area, occupies about 136 acres near the center of the FEMP site and contains many buildings, scrap metal and soil piles, containerized materials, storage pads, a parking lot, roads, railroads, above and underground tanks, utilities and equipment. Several impoundments, ponds and basins are also included(20).

Activity 3: Thorium Bins and Silo

The Thorium Bins and Silo D&D effort involved the removal of thorium (LLRW), encapsulation of removed equipment using tape and Herculite® and removal of the Thorium Bins and Silo external structure. This project, part of the Plant 8 thorium silo decontamination and decommissioning and building repair efforts, involved the removal of thorium residues (LLRW) from two bins and one silo located on the southeast corner of Plant 8. This project was completed in three phases:

Phase I: Removal of thorium residues from the large bin.

Phase II: Removal of thorium residues from the small bin.

Phase III: Removal of thorium residues from the silo.

Phases I, II and III of this project, removal of thorium residues, were completed on March 31, 1989. The International Technologies Corporation performed the work under a contract to WEMCO, the FEMP prime contractor at the time. The work was performed by a crew of 35 individuals. The project exposure levels are based on actual TLD readings, which were logged on a monthly basis. Total exposure levels per project phase were prorated based on the amount of time spent on each phase versus the amount of time spent on other, overall, exposure generating activities not assignable to a particular phase. The proration performed was based on actual Self Reading Pocket Dosimeter (SRPD) which were read and logged daily. Peak dose rates are from the actual readings of the repackaged thorium containers, taken with a Ludlum® Model 3 with a 44-6 detector. Exhibit 13.1, page 148, presents dose rates associated with the thorium repackaging activity. The time line associated with the entire Thorium Bins and Silo D&D effort was from 12/89 to 11/90. The number of workers necessary to perform this effort was medium at approximately 35. CERCLA was the regulatory driver behind this D&D effort(41).

Activity 4: Plant 1 Ore Silos

The Plant 1 Ore Silos D&D effort involved the removal of thorium (LLRW), removal and size reduction of the Plant 1 Ore Silos external structure and encapsulation of structural components using tape and Herculite® or by the application of latex paint. The time line associated with this effort was from 12/92 to 12/94. The number of workers necessary to perform this effort was > 75. CERCLA was the regulatory driver behind this D&D effort(42). A full description of the processes concerning the decontamination and decommissioning of this facility is detailed in D&D Worker Case Study 1: Decontamination and Decommissioning of the Plant 1 Ore Silos, Section 11.4, page 127.

Activity 5: Plant 7 Removal

The Plant 7 Removal D&D effort involved the removal of equipment and internal building components, removal and size reduction of the Plant 7 external structure and encapsulation of structural components. The major contaminates of concern in Plant 7 were uranium compounds (i.e., UF_4, UF_6, UO_2 and UO_2F_2, all of which were LLRWs), asbestos, biological hazards (i.e., pigeon droppings), ammonia and nickel. The time line associated with this effort was from 12/3/93 to 11/16/94. The number of workers necessary to perform this effort was medium at between 11 and 75 workers. CERCLA was the regulatory driver behind this D&D effort(43). A full description of the processes concerning the decontamination and decommissioning of this facility is detailed in D&D Worker Case Study 2: Decontamination and Decommissioning of Plant 7 (Removal Action No. 19), Section 11.5, page 129.

Activity 6: Plant 4 Removal

The Plant 4 Removal D&D effort involved the removal of equipment and internal building components, removal and size reduction of the Plant 4 external structure and encapsulation of structural components. The contaminates of concern in Plant 4a were uranium compounds (i.e., UF_4, UF_6, UO_2 and UO_2F_2, all of which were LLRWs) asbestos, silica, acids (i.e., HF), caustics (i.e., sodium hydroxide, calcium hydroxide, calcium oxide), ammonia, heavy metals (i.e., mercury and lead) and PCB's. The time line associated with this effort was from 12/7/94 to 9/25/96. The number of workers necessary to perform this effort was medium at between 11 and 75 workers. CERCLA was the regulatory driver behind this D&D effort(44). A full description of the processes concerning the decontamination and decommissioning of this facility is detailed in D&D Worker Case Study 3: Decontamination and Decommissioning of Plant 4a, Section 11.6, page 131.

Activity 7: Plant 1 Removal

The Plant 1 Removal D&D effort will involve the removal of equipment and internal building components, removal and size reduction of the Plant 1 external structure and encapsulation of structural components. Exposure type associated with this removal will be LLRW. The time line associated with this effort will be from 2/5/96 to 11/22/97. The number of workers necessary to perform this effort is anticipated to be medium at between 11 and 75 workers. CERCLA is the regulatory driver behind this D&D effort(23).

Activity 8: Plant 10 and 20 and Associated Structures Removal

The Plant 10 and 20 and Associated Structures Removal D&D effort will involve the removal of equipment and internal building components, removal and size reduction of external structures and encapsulation of structural components. Exposure type associated with this removal will be LLRW. The time line associated with this effort will be from 2/97 to 2/98. The number of of workers necessary to perform this effort is anticipated to be medium at between 11 and 75 workers. CERCLA will be the regulatory driver behind this D&D effort(23).

Activity 9: Plant 9 and Associated Structures Removal

The Plant 9 and Associated Structures Removal D&D effort will involve the removal of equipment and internal building components, removal and size reduction of external structures and encapsulation of structural components. Exposure type associated with this removal will be LLRW. The time line associated with this effort will be from 2/97 to 2/98. The number of workers necessary to perform this effort is anticipated to be medium at between 11 and 75 workers. CERCLA will be the regulatory driver behind this D&D effort(23).

Activity 10: Building 69 and Associated Structures Removal

The Building 69 and Associated Structures Removal D&D effort will involve the removal of equipment and internal building components, removal and size reduction of external structures and encapsulation of structural components. Exposure type associated with this removal will be LLRW. The time line associated with this effort will be from 2/97 to 2/98. The number of workers necessary to perform this effort is anticipated to be medium at between 11 and 75 workers. CERCLA will be the regulatory driver behind this D&D effort(23).

Activity 11: Building 64/65 and Associated Structures Removal

The Building 64/65 and Associated Structures Removal D&D effort will involve the removal of equipment and internal building components, removal and size reduction of external structures and encapsulation of structural components. Exposure type associated with this removal will be LLRW. The time line associated with this effort will be from 2/97 to 2/98. The number of workers necessary to perform this effort is anticipated to be medium at between 11 and 75 workers. CERCLA will be the regulatory driver behind this D&D effort(23).

Activity 12: Plant 12 and Associated Structures Removal

The Plant 12 and Associated Structures Removal D&D effort will involve the removal of equipment and internal building components, removal and size reduction of external structures and encapsulation of structural components. Exposure type associated with this removal will be LLRW. The time line associated with this effort will be from 2/98 to 2/99. The number of workers necessary to perform this effort is anticipated to be medium at between 11 and 75 workers. CERCLA will be the regulatory driver behind this D&D effort(23).

Activity 13: Plants 5 and 3 and Associated Structures Removal

The Plants 5 and 3 and Associated Structures Removal D&D effort will involve the removal of equipment and internal building components, removal and size reduction of external structures and encapsulation of structural components. The SS group is currently placing abandoned equipment in Plant 5 into a safe configuration. Safe configuration involves cleaning and removal of hazardous constituents from abandoned process equipment. Equipment in a safe configuration mode will be dealt with during the Plants 5 and 3 final dismantling and demolition scheduled to begin in 2001. Exposure type associated with both of these removals will be LLRW. The time line associated with these efforts will be from 2/98 to 2/99. The number of workers necessary to perform these efforts is anticipated to be medium at between 11 and 75 workers each. CERCLA will be the regulatory driver behind these D&D efforts(23).

Activity 14: Plants 2, 6 and 8 and Associated Structures Removal

The Plants 2, 6 and 8 and Associated Structures Removal D&D effort will involve the removal of equipment and internal building components, removal and size reduction of external structures and encapsulation of structural components. Exposure type associated with this removal will be LLRW. The time line associated with this effort will be from 1999 to 2000. The number of workers necessary to perform this effort is anticipated to be medium at between 11 and 75 workers. CERCLA will be the regulatory driver behind this D&D effort(23).

Activity 15: Plant 1 Pad and Associated Structures (Buildings 30, 82, 71, KC-2 Warehouse, Quonset Huts 1, 2 and 3) Removal

The Plant 1 Pad and Associated Structures (Buildings 30, 82, 71, KC-2 Warehouse, Quonset Huts 1, 2 and 3) Removal D&D effort will involve the removal of equipment and internal building components, removal and size reduction of external structures and encapsulation of structural components. Exposure type associated with this removal will be LLRW. The time line associated with this effort will be from 1999 to 2000. The number of workers necessary to perform this effort is anticipated to be medium at between 11 and 75 workers. CERCLA will be the regulatory driver behind this D&D effort(23).

Activity 16: Pilot Plant and Associated Structures Removal

The Pilot Plant and Associated Structures Removal D&D effort will involve the removal of equipment and internal building components, removal and size reduction of external structures and encapsulation of structural components. Exposure type associated with this removal will be LLRW. The time line associated with this effort will be from 1999 to 2000. The number of workers necessary to perform this effort is anticipated to be medium at between 11 and 75 workers. CERCLA will be the regulatory driver behind this D&D effort(23).

Activity 17: Remaining Administrative Support Buildings Including Lab Building, Services Building, Administration Building and Associated Structures Removal:

The Remaining Administrative Support Buildings Including Lab Building, Services Building, Administration Building and Associated Structures Removal D&D effort will involve the removal of equipment and internal building components, removal and size reduction of external structures and encapsulation of structural components. Exposure type associated with this removal will be LLRW and mixed solid waste. The time line associated with this effort will be from 2000 to 2001. The number of workers necessary to perform this effort is anticipated to be medium at between 11 and 75 workers. CERCLA will be the regulatory driver behind this D&D effort(23).

OU 4 D&D Worker Activities

OU 4 is located south of the waste pit area on the west side of the FEMP. The primary components of OU 4 are four concrete silos. Silo's 1 and 2 contain uranium, radium, thorium, radon, other decay products and other metals. Silo 3 contains metal oxides. Silo 4 was never used(33).

Activity 18: K-65 Silos and Associated Structures Removal

The K-65 Silos and Associated Structures Removal D&D effort will involve the encapsulation, removal and size reduction of the silo external structures. Exposure type associated with this removal will be LLRW. The time line associated with this effort will be from 2003 to 2005. The number of workers necessary to perform this effort is anticipated to be medium at between 11 and 75 workers. CERCLA will be the regulatory driver behind this D&D effort.

OU 5 D&D Worker Activities

OU 5 consists of the groundwater (perched and regional aquifer, surface water), surface soils and sediments, subsurface soils and flora and fauna not included in OU's 1-4(44). Structures located within OU 5 consist mainly of smaller out-buildings and storage sheds. The removal of these structures is relatively simple and does not require the manpower and equipment resources associated with the dismantling and demolition of the much larger steel-beam structures found in OU 3. Therefore, the removal of these structures is considered more of a clean-up activity and falls under the domain of the CW worker.

Activity 19: There are no large buildings or structures within this OU requiring the services of a D&D contractor

8.2 D&D WORKER GROUP DEMOGRAPHICS

The D&D workforce size at the FEMP has fluctuated greatly from 1989 thru 1996 due to the sub-contractor nature of the work. The majority of this work force is union or "craft" labor which is drawn from local union halls in much the same way normal construction work forces are assembled. Workers drawn from union labor pools must receive FEMP site specific training prior to accessing the facility. In order to avoid the high cost of continuously training new workers for FEMP-related projects, sub-contractors routinely utilize union labor pools containing workers that have already received FEMP site specific training. A search of the certified payroll of each sub-contractor at the FEMP would be required to identify the frequency of utilization of workers drawn from union labor pools. The normal operating shift of these workers is 10 hours a day, 4 days a week. Daily starting and quitting times are based on considerations given to temperature extremes (i.e., work starting at 9 pm during the hottest part of the summer). This deadline oriented work may also require the need for overtime and extended work days when work is not accomplished as scheduled. D&D workers are required to change into company issued clothing prior to reporting to their work station and must doff company issued clothing and shower prior to exiting. Due to potential contact with radiological contaminants, the donning of PPE specified by the Industrial Hygiene and Radiological Engineering departments is required prior to entry into areas where work is being performed. The types of PPE required depend upon the level of radiological contamination present in the work area. Table 10.17, page 118, identifies contractors, numbers of workers associated with each worker group, industry profiles, the top five job titles and the primary activity titles.

D&D Contractors

The following sub-contractors supplied general demographic information for D&D workers.

Babcox & Wilcox

Babcox & Wilcox employs approximately 15 to 50 D&D workers. The function of this worker group involves equipment and internal/external building component removal and encapsulation. The top five job titles associated with these worker group activities are Asbestos and Lead Abatement workers, Demolition (Construction) workers, Laborer, Painters and Millwrights. Industry profiles (comparable worker groups in the private sector) include, but are not limited to, construction, demolition, asbestos and lead abatement and nuclear power plant maintenance workers.

Babcox & Wilcox
NESI 2200 Langhorne Road, Lynchburg, VA 24506
(804) 948-4600
Point of Contact (POC): James D. Phinney

International Technology Corporation (IT)

International Technology Corporation (IT) employed approximately 35 D&D workers. The function of this worker group involved equipment and internal/external structure component removal and encapsulation. The top five job titles associated with these worker group activities are Nuclear Material Handler, Demolition (Construction) worker, Laborer, Millwright and Electrician. Industry profiles (comparable worker groups in the private sector) include, but are not limited to, construction, demolition and nuclear power plant maintenance workers.

International Technology Corporation (IT)
312 Directors Drive, Knoxville, TN 37923
(423) 690-3211
(POC): John Rizor

Wise Construction

Wise Construction employs approximately 93 D&D workers. The function of this worker group involves equipment and internal/external building component removal and encapsulation. The top five job titles associated with these worker group activities are Asbestos and Lead Abatement worker, Demolition (Construction) worker, Laborer, Heavy Equipment Operator and Trades (Pipefitters, Electricians, etc.). Industry profiles (comparable worker groups in the private sector) include, but are not limited to, construction, demolition and asbestos/ lead abatement workers.

Wise Construction
1705 Guenther Road, Dayton, OH 45471
(513) 854-0281
(POC): David Abney

Martech Construction

Martech Construction employed approximately 93 D&D workers. The function of this worker group involved equipment and internal/external structure component removal and encapsulation. The top five job titles associated with these worker group activities are Asbestos and Lead Abatement worker, Demolition (Construction) worker, Laborer, Heavy Equipment Operator and Trades (Pipefitters, Electricians, etc.). Industry profiles (comparable worker groups in the private sector) include, but are not limited to, construction, demolition and asbestos/lead abatement workers(45).

Martech Construction
(Out of business, no known address.)

8.3 D&D WORKER GROUP TECHNOLOGIES

The basis for the use of advancing technologies at the FEMP is to reduce or eliminate worker radiological and chemical exposure, as well as facilitating the proper disposition of waste from the site. The FEMP is driven by the DOE to develop and utilize a STP. This living document is designed to identify developing technologies and allow them to be assessed in terms of applicability for the accelerated site clean-up(36).

OU 1 D&D Worker Past, Present and Proposed Future Technologies

Table 10.9, page 94, presents OU 1 Past, Present and Proposed Future Technologies.

Activity 1: Equipment and Internal Building Component Removal

Equipment and Internal Building Component Removal does not occur within the OU 1 confines.

Activity 2: Encapsulation

Encapsulation does not occur within the OU 1 confines.

Activity 3: External (Superstructure) Building Component Removal

External (Superstructure) Building Component Removal does not occur within the OU 1 confines.

OU 2 D&D Worker Past, Present and Proposed Future Technologies

Table 10.10, page 96, presents OU 2 Past, Present and Proposed Future Technologies.

Activity 1: Equipment and Internal Building Component Removal

Equipment and Internal Building Component Removal does not occur within the OU 2 confines.

Activity 2: Encapsulation

Encapsulation does not occur within the OU 2 confines.

Activity 3: External (Superstructure) Building Component Removal

External (Superstructure) Building Component Removal does not occur within the OU 2 confines.

OU 3 D&D Worker Past, Present and Proposed Future Technologies

Table 10.11, page 98, presents OU 3 Past, Present and Proposed Future Technologies.

Activity 1: Equipment and Internal Building Component Removal - Seamist® Method for Stabilization of Hazardous and LLRW in Piping, Ducts and Vent Lines.

This technology utilizes an adhesive fabric liner which is placed on the equipment, trapping the hazardous and LLRW in-place. The trapped contamination can then be removed or left in-place. Exposure potential involves limited contact with the waste, indoor contact and "Level B" PPE. Advantages of this technology include reduction of worker exposure to airborne chemical or radiological contaminants. A disadvantage of this technology is that it cannot be utilized in ducts and pipes that step down or contain baffles. The number of workers necessary to utilize this technology is low at 4(46).

Activity 2: Encapsulation - Standard Application of Latex Paint to Contaminated Surfaces (Fixed Radiological).

This technology involves the application of latex paint to encapsulate fixed radiological contamination. Exposure potential involves limited contact and is performed indoors while using "Level B" PPE. Advantages of encapsulation include reduced worker exposure to airborne chemical or radiological contaminants. No disadvantages are noted. The number of workers necessary to utilize this technology is low at 5 to 10.

Activity 3: External (Superstructure) Building Component Removal - Controlled Detonation.

Controlled Detonation technology involves the use of steel cutting shape charges to fell the superstructure of former production buildings or plants. Plates and flanges are cut for the placement of charges, the detonator is wired to the charges and then covered with material to reduce flying debris. Exposure potential involves limited contact with contaminated surfaces and work is performed within the open air building superstructure. PPE ranges from process clothing to PPE-Level B and is dependent upon site conditions. Advantages of this technology include a reduction in the number of column torch cuts required, elimination of the need to torch cut decking, elimination of the need for heavy lifts and a ten fold reduction in the time necessary to bring down the superstructure thereby decreasing potential lead paint and radiation exposure. Disadvantages involve the use of explosive poses which raises worker safety concerns. The number of workers necessary to utilize this technology are between 5 and 50(43).

OU 4 D&D Worker Past, Present and Proposed Future Technologies

Table 10.12, page 103, presents OU 4 Past, Present and Proposed Future Technologies.

Activity 1: Equipment and Internal Building Component Removal

Equipment and Internal Building Component Removal does not occur within the OU 4 confines.

Activity 2: Encapsulation

Encapsulation does not occur within the OU 4 confines.

Activity 3: External (Superstructure) Building Component Removal

External (Superstructure) Building Component Removal does not occur within the OU 4 confines.

OU 5 D&D Worker Past, Present and Proposed Future Technologies

Table 10.13, page 105, presents OU 5 Past, Present and Proposed Future Technologies.

Activity 1: Equipment and Internal Building Component Removal

Equipment and Internal Building Component Removal does not occur within the OU 5 confines.

Activity 2: Encapsulation

Encapsulation does not occur within the OU 5 confines.

Activity 3: External (Superstructure) Building Component Removal

External (Superstructure) Building Component Removal does not occur within the OU 5 confines.

8.4 D&D WORKER GROUP EXPOSURES

The D&D worker group is the least likely of the three worker groups to experience either chemical or radiological exposure due to the fact that these workers are dealing with buildings and plants where the majority of the waste (hazards) have been mitigated by HW workers and/or CW's. The major threats to this worker class are those common to the construction industry (i.e., overhead work, elevated work, etc.) coupled with the dangers of using explosives to fell the building superstructures. The FEMP maintains Construction, Industrial Hygiene/Radiological Safety programs which address these issues through the implementation of Project, Task and Job Specific Training, PPE requirements and Engineering/Administrative Controls. Table 10.8, page 84, provides the 1990-1994 WEMCO/FERMCO Dosimetry Rates among HW, D&D and CW Workers.

A Remediation Worker Radiological Exposure Study

Described below is a previous remediation worker radiological exposure study.

A study (FEMP PAPER #2354) was performed by FERMCO and Environmental Dimensions, Inc. to determine the extent of exposure that would be associated with the controlled decontamination and decommissioning of Fernald facilities by remediation workers, other on-site workers and off-site public(47). Exhibit 13.2, page 149, presents remediation worker radiological exposure information as presented in this study. FEMP PAPER #2354 sought to justify the removal of buildings at the FEMP by assessing Effective Dose Equivalents of worker groups preforming D&D activities. A conceptual risk assessment model was developed, with exposure mechanisms and associated pathways for each potential receptor. For use in the conceptual model, an airborne source term was developed through process knowledge, other historical information and data and air sample data from within the facility. The risk assessment demonstrated that all exposures resulting from the action would be within the acceptable DOE administrative control level of 2.0 rem per year for occupational workers.

The defined groups identified in FEMP PAPER #2354 differ from those in this Fernald site study due to the fact that the FEMP PAPER #2354 D&D worker group includes SS workers while this study places them in the CW category. The FEMP PAPER #2354 study was based on a conservative assessment of potential radiological exposures and was utilized in ROD decision making for OU3. This Fernald exposure assessment feasibility study is based on actual exposure data. Table 10.8, page 84, presents 1990-1994 WEMCO/FERMCO Dosimetry Rates among HW, D&D and CW Workers.

9.0 CLEAN UP WORKERS

9.1 Identification of Historic, In-Progress and Anticipated CW Activities at the FEMP

As stated earlier, CW's are responsible for the day-to-day activities associated with the maintenance and operation of facilities located within the various OU's and shipment of LLRW generated by HW and D&D worker activities. One example of CW historic, in-progress and anticipated activities is routine facilities maintenance (painting, utilities, structural integrity, sanitation, etc.).

OU 1, OU 2 and OU 5 consist mainly of smaller out-buildings and storage sheds. The removal of these structures is relatively simple and does not require the manpower and equipment resources associated with the dismantling and demolition of the much larger steel-beam structures found in OU 3. Therefore, the final disposition of these structures is considered more of a clean-up activity and falls under the domain of the CW.

This section will define CW activities, waste categories, contacts, exposure types, regulatory drivers, time line and number of workers per activity. Table 10.15, page 114, presents CW Contacts, Activity Descriptions and Exposure Types. CW Case Studies 1-3 present specific activity descriptions for CW's; CW Case Study 1: Contaminated Trash Waste Stream, Section 11.7, page 134; CW Case Study 2: Plant 5 East Derby Breakout, Section 11.8, page 135; CW Case Study 3: Pilot Plant Tank D13A-111, Section 11.9, page 138.

OU 1 CW Activities

OU 1 encompasses Waste Pits 1 through 6, the Burn Pit, the Clearwell, the Pit 5 Experimental Treatment Facility, water incidental to the pit area and all berms, liners and soil within the OU boundary. This 37.7 acre area located west of the process area (OU 3) and south of the main rail spur was used during the operation of the plant for disposal of low-level process and mixed waste(13).

Activity 1: Treatment, Storage, Transportation/Disposal, Systems Operation/Maintenance.

LLRW treatment utilizes remediation methods such as vitrification, sludge dewatering, excavating and drying. Storage of LLRW involves inspection, container maintenance and tracking. Transportation/disposal of LLRW involves container handling and shipping to storage or final disposition. Systems operation/maintenance of LLRW involves the operation of the Automated Grounds Maintenance Device. The regulatory driver behind these activities is/will be CERCLA. The time line associated with these activities is 1996 to 2004. The number of workers necessary to accomplish these activities is medium at 11-75.

OU 2 CW Activities

OU 2 encompasses the Solid Waste Landfill, Lime Sludge Ponds, Active and Inactive Fly Ash Piles, other South Field Disposal Areas and all berms, liners and soil within the OU boundary(19).

Activity 2: Treatment, Storage, Transportation/Disposal, Systems Operation/Maintenance.

LLRW treatment utilizes remediation methods such as vitrification, excavation and drying. Storage of LLRW involves inspection, container maintenance and tracking. Transportation/disposal of LLRW involves container handling and shipping to storage or final disposition. Systems operation/maintenance of LLRW involves the operation of the Automated Grounds Maintenance Device. The regulatory driver behind these activities is/will be CERCLA. The time line associated with activities in the waste areas is 1996 to 2001. The number of workers necessary to accomplish these activities in the waste areas is medium at 11-75. The time line associated with activities at the On-Site Disposal Cell is 1996 to 2014.

OU 3 CW Activities

OU 3, the former production area, occupies about 136 acres near the center of the FEMP site and contains many buildings, scrap metal and soil piles, containerized materials, storage pads, a parking lot, roads, railroads, above and underground tanks, utilities and equipment. Several impoundments, ponds and basins are also included(20).

Activity 3: Treatment

LLRW treatment is accomplished utilizing remediation methods such as vitrification, dewatering, stabilization and chemical treatment. These types of treatments have occured or will occur in Plants 6, 9, 13a and Buildings 64 and 65. The regulatory driver behind these activities is/will be CERCLA. The time line associated with these activities is 1996 to 2010. The number of workers necessary to accomplish these activities is high, > 75.

Activity 4: Storage

LLRW storage involves inspection, container maintenance and tracking. Transportation/disposal of LLRW involves container handling and shipping to storage or final disposition. These types of treatments have occured or will occur in Plants 6, 9, 13a and Buildings 64 and 65. The regulatory driver behind these activities is/will be CERCLA. The time line associated with these activities is 1996 to 2010. The number of workers necessary to accomplish these activities is high, > 75.

Activity 5: Transportation/Disposal

Transportation/disposal of LLRW involves container handling and shipping to storage or final disposition. The regulatory driver behind these activities is/will be CERCLA. The time line associated with activities in the waste areas is 1996 to 2010. The number of workers necessary to accomplish these activities in the waste areas is high, > 75.

Activity 6: Systems Operation/Maintenance

Systems operation/maintenance of LLRW involves the operation of the Automated Grounds Maintenance Device, operation/maintenance of all utilities, process, shipping and vehicular systems or equipment. The regulatory driver behind these activities is/will be CERCLA. The time line associated with activities in the waste areas is 1996 to 2010. The number of workers necessary to accomplish these activities in the waste areas is high, > 75.

OU 4 CW Activities

OU 4 is located south of the waste pit area on the west side of the FEMP. The primary components of OU 4 are four concrete silos. Silo's 1 and 2 contain uranium, radium, thorium, radon, other decay products and other metals. Silo 3 contains metal oxides. Silo 4 was never used(33).

Activity 7: Treatment, Storage, Transportation/Disposal, Systems Operation/Maintenance

LLRW treatment utilizes remediation methods such as vitrification. Storage of LLRW involves inspection, container maintenance and tracking. Transportation/disposal of LLRW involves container handling and shipping to storage or final disposition. Systems operation/maintenance of LLRW involves the operation of the Automated Grounds Maintenance Device or operation of the Advanced Wastewater Treatment System. The regulatory driver behind these activities is/will be CERCLA. The time line associated with these activities is 1994 to 2010. The number of workers necessary to accomplish these activities is high, > 75.

OU 5 CW Activities

OU 5 consists of the groundwater (perched and regional aquifer, surface water), surface soils and sediments, subsurface soils and flora and fauna not included in OU's 1-4(44).

Activity 8: Treatment, Storage, Transportation/Disposal, Systems Operation/Maintenance

LLRW treatment utilizes remediation methods such as Advanced Wastewater Treatment and excavation. Storage of LLRW involves inspection, container maintenance and tracking. Transportation/disposal of LLRW involves container handling and shipping to storage or final disposition. Systems operation/maintenance of LLRW involves the operation of the Automated Grounds Maintenance Device or operation of the Advanced Wastewater Treatment System. The regulatory driver behind these activities is/will be CERCLA. The time line associated with activities involving soils is 1997 to 2014. The time line associated with activities involving groundwater is 1997 to 2028. The number of workers necessary to accomplish these activities is high, > 75(37).

9.2 CW GROUP DEMOGRAPHICS

The CW workforce total population is a product of several job titles/codes.

The CW workforce at the FEMP has increased from 321 workers in 1989 to 639 workers in 1996. This increase is in response to the accelerated clean-up schedule adopted by the site prime contractor (FERMCO). The normal operating shift of these workers is 5 days a week, 8 hours a day with "skeleton crews" performing second and third shift activities. CW's are required to don company issued clothing prior to reporting to their work station and must doff company issued clothing and shower prior to exiting. Due to potential contact with radiological contaminants, the donning of PPE specified by the Industrial Hygiene and Radiological Engineering departments is required prior to entry into areas where work is being performed. The types of PPE required depend upon the level of radiological contamination present in the work area. Table 10.17, page 118, identifies contractors, numbers of workers associated with each worker group, industry profiles, the top five job titles and the primary activity titles.

Turnover rates for this worker group and the associated group of hazardous waste workers (Safe Shutdown) are as follows according to FERMCO Human Resources Department: no rate is available for 1989, 1990 = 15.0%, 1991 = 7.0%, 1992 = 5.3%, 1993 = 7.3%, 1994 = 5.5%, 1995 = 5.0% and the first half of 1996 = 6.1%. Table 10.7, page 83, provides the HW and CW Worker Annual Turnover Rates.

Ten percent of today's local employees (the CW group and the associated group of HW workers) have worked at the site for more than sixteen years and nearly fifty percent worked at the site at some point during production years(48). No other indication of where these groups originated in terms of previous work history was given.

9.3 CW GROUP TECHNOLOGIES

The basis for the use of advancing technologies at the FEMP is to reduce or eliminate worker radiological and chemical exposure, as well as facilitating the proper disposition of waste from the site. The FEMP is driven by the DOE to develop and utilize a STP. This living document is designed to identify developing technologies and allow them to be assessed in terms of applicability for the accelerated site clean-up(36).

OU 1 CW Past, Present and Proposed Future Technologies:

Table 10.9, page 94, presents OU 1 Past, Present and Proposed Future Technologies.

Activity 1: LLRW Treatment - MAWS.

See OU 1 HW Worker Past, Present and Proposed Future Technologies: Activity 1. Future use of this technology is expected occur from 1996 to 2004(37).

Activity 2: LLRW Systems Maintenance - Automated Grounds Maintenance Device.

The Automated Grounds Maintenance Device is a hydraulically powered, self-propelled lawn mower outfitted with remote controls. Exposure potential is reduced because the unit is outdoors and controlled from remote distances which lessens effects from heat stress and eliminates the need for PPE. Advantages of this technology include remote operation which eliminates the need for PPE. No disadvantages are noted. The number of workers necessary to utilize this technology is 1. The use of this technology is expected occur from 1996 and beyond(37).

Activity 3: LLRW Disposal and Transportation - Waste Pits 1, 2, 3 and 6 Area Drying Technology.

Waste Pits 1, 2, 3 and 6 Area Drying Technology involves dewatering, excavation and drying of excavated LLRW sludges. Exposure potential using this technology involves limited contact with the waste and outdoor contact with the waste. "Level B" PPE is required. Advantages of using Waste Pits 1, 2, 3 and 6 Area Drying Technology include reduced potential for skin contact with LLRW sludges and volume reduction of the waste. No disadvantages are noted. The number of workers necessary to utilize this technology is between is medium at 20-50. The use of Waste Pits 1, 2, 3 and 6 Area Drying Technology is expected to occur from 1996-2004(38).

OU 2 CW Past, Present and Proposed Future Technologies

Table 10.10, page 96, presents OU 2 Past, Present and Proposed Future Technologies.

Activity 1: LLRW Treatment - MAWS

See OU 1 HW Worker Past, Present and Proposed Future Technologies: Activity 1. Future use of this technology is expected occur from 1996 to 2004(37).

Activity 2: LLRW Systems Maintenance - Automated Grounds Maintenance Device

See OU 1 CW Past, Present and Proposed Future Technologies: Activity 2. The use of this technology is expected occur in 1996 and beyond(37).

Activity 3: LLRW Disposal and Transportation - Standard Excavation Technology

See OU 2 HW Worker Past, Present and Proposed Future Technologies: Activity 3. The use of Standard Excavation Technology is expected to occur from 1996-1997(38).

OU 3 CW Past, Present and Proposed Future Technologies

Table 10.11, page 98, presents OU 3 Past, Present and Proposed Future Technologies.

Activity 1: LLRW Treatment - Drum Inspection Robotics

See OU 3 HW Worker Past, Present and Proposed Future Technologies: Activity 3. Drum Inspection Robotics were used in a 1991 pilot program and future use of this technology is expected to occur from 1996-2001(37).

Activity 2: LLRW Systems Maintenance - Automated Grounds Maintenance Device

See OU 1 CW Past, Present and Proposed Future Technologies: Activity 2. The use of this technology is expected occur in 1996 and beyond(37).

Activity 3: LLRW Disposal and Transportation

LLRW Disposal and Transportation does not occur within the OU 3 confines.

OU 4 CW Past, Present and Proposed Future Technologies

Table 10.12, page 103, presents OU 4 Past, Present and Proposed Future Technologies.

Activity 1: LLRW Treatment

LLRW Treatment does not occur within the OU 4 confines.

Activity 2: LLRW Systems Maintenance - Automated Grounds Maintenance Device

See OU 1 CW Past, Present and Proposed Future Technologies: Activity 2. The use of this technology is expected occur in 1996 and beyond(37).

Activity 3: LLRW Disposal and Transportation

LLRW Disposal and Transportation does not occur within the OU 4 confines.

OU 5 CW Past, Present and Proposed Future Technologies

Table 10.13, page 105, presents OU 5 Past, Present and Proposed Future Technologies.

Activity 1: LLRW Treatment - Electro Hydraulic Scabbling

Electro Hydraulic Scabbling utilizes an electrical discharge in a water bath to remove contaminated concrete pads foundations, etc. after the D&D of buildings and plants. This technology can remove .07" of concrete comparatively dust free. Exposure potential utilizing this technology involves limited contact with the waste, is performed outdoors after the D&D of buildings and plants and is done while wearing "Level B" PPE. Advantages of this technology include a reduced potential for contact with fixed radiological contamination and the feed water can be treated and reused. No disadvantages are noted. The number of workers necessary to utilize this technology is 2-5. The use of this technology is expected to occur in 1996 and from 1998 to 2028(37).

Activity 2: LLRW Treatment - Enhanced Groundwater Remediation (In situ Leaching)

This uranium mining industry technology utilizes a geometric pattern of extraction, injection and monitoring wells and is based on aquifer hydro geology. Exposure potential involves zero contact and is performed outdoors. No advantages or disadvantages are noted. The number of workers necessary to utilize this technology is 5-8. The use of this technology is expected to occur in 1996 and from 1998 to 2028(37),(46).

Activity 3: LLRW Treatment - Advanced Waste Water Treatment Facility

The Advanced Waste Water Treatment Facility treats existing uranium contaminated wastewater and certain storm water runoff to less than 20 ppb at a rate of 1,100 gallons per minute, utilizing chemical precipitation/clarification to remove suspended solids containing radionuclides and carbon filters to remove volatile organic compounds. Exposure potential involves a limited contact closed loop system and is performed indoors using facility HEPA ventilation. Sulfuric acid is used to regenerate ion exchange resin. Advantages of using this technology include reduced potential for ingestion of radiological contaminated water supplies. No disadvantages are noted. The number of workers necessary to utilize this technology is 10-20.

The use of this technology occurred in 1991 as a pilot project, limited use in 1996 and proposed extended use from 1999 to 2028(37).

Activity 4: LLRW Systems Maintenance - Automated Grounds Maintenance Device

See OU 1 CW Past, Present and Proposed Future Technologies: Activity 2. The use of this technology is expected occur in 1996 and beyond(37).

Activity 5: LLRW Disposal and Transportation

LLRW Disposal and Transportation does not occur within the OU 5 confines.

9.4 CW GROUP EXPOSURES

Radiological exposure would likely be highest among the CW group because these workers generally deal with LLRW the majority of the time.
Many of the wastes encountered by CW's are liquids which pose a skin exposure (contamination/ absorption) threat, as well as residues and gasses which pose an inhalation hazard. The FEMP maintains an Industrial Hygiene / Radiological Safety program which addresses these issues through the implementation of Project, Task and Job Specific Training, PPE requirements and Engineering/Administrative Controls. Table 10.8, page 84, presents 1990-1994 WEMCO/FERMCO Dosimetry Rates among HW, D&D and CW Workers.

10.0 - TABLES

Table 10.1: Primary Statutory Authorities which Enforce or Mandate Compliance at the DOE's Fernald Facility As Reported October, 1996

Statutes	Environmental Protection Agency	State of Ohio	Nuclear Regulatory Commission	DOE Orders	Department of Transportation	Citizens Action Suits
Atomic Energy Act	X			X		
Clean Air Act	X	X				X
Comprehensive Environmental Response Compensation and Liability Act	X	X				X
Clean Water Act	X	X				
Energy Policy Act	X					
Hazardous Material Transportation Act				X	X	
National Environmental Policy Act				X		
Nuclear Waste Policy Act	X		X	X	X	
Occupational Safety and Health Act				X		
Resource Conservation and Recovery Act	X	X				X
Safe Drinking Water Act	X	X				X
Toxic Substances Control Act	X					
Uranium Mill Tailings Remediation Control Act	X		X	X		

Table 10.2: FEMP Major Activity Milestones for the DOE's Fernald Facility As Reported October, 1996

ACTIVITY	TASK	COMPLETION DATE
Operable Unit 1 - (Waste Pit Area)	Final Record of Decision Signed by EPA Remedial Action Starts Remedial Action Ends	1995 1996 2004
Operable Unit 2 - (Other Waste Areas)	Final Record of Decision Signed by EPA Remedial Action Starts Remedial Action Ends: Waste Areas Remedial Action Ends: Onsite Disposal Facility	1995 1996 2001 2014
Operable Unit 3 - (Former Production Area)	Interim Remedial Action Starts Final Remedial Investigation Report Submitted to EPA Final Feasibility Study Report Submitted to EPA Final Record of Decision Signed by EPA Final Remedial Action Ends	1995 1996 1996 1996 2010
Operable Unit 4 - (Silos 1 through 4)	Vitrification Pilot Plant Started Final Record of Decision Signed by EPA Remedial Action Starts Remedial Action Ends on Ends	1994 1994 1995 2010
Operable Unit 5 - (Environmental Media)	Final Record of Decision Signed by EPA Remedial Action Starts Remedial Action Ends: Soils Remedial Action Ends: Groundwater	1996 1997 2014 2028
Legacy Waste	Site Treatment Plan Submitted to Ohio EPA Remedial Action Ends: Low-Level Radiological Waste Remedial Action Ends: Low-Level Mixed Waste	1995 1996 1997

Table 10.3: FEMP Removal Action (RA) Documentation List for the DOE's Fernald Facility As Reported October, 1996

RA#	RA Title	PEIC ① Indexed Document #
1	Perched Water	R-002-101.1 thru 1003
2	Waste Pit Runoff	R-010-107.1 thru 1003
3	South Groundwater Plume	R-009-101.1 thru 1004
4	K-65 Silos 1 & 2	R-008-101.1 thru 1004
5	K-65 Decant Sump	R-014-108.1 thru 1003
6	Waste Pit 6 Exposed Material	R-016-201.1 thru 209.1
7	Plant 1 Pad	R-012-101.1 thru 1106.1
8	Flyash Pile (Inactive)	R-018-201.1 thru 1003.3
9	Thorium Waste Management	R-020-101.1 thru 1002.1
10	Flyash Pile (Active)	R-024-108.1 thru 1003.2
11	Experimental Treatment Facility	R-021-101.1 thru 1003.1
12	Safe Shutdown	R-022-104.1 thru 1002.1
13	Plant 1 Ore Silos	R-019-101.1 thru 1003.1
14	Soils at Sewage Treatment Plant	R-015-108.1 thru 1002.1
15	Scrap Metal Piles	R-026-101.1 thru 1003.1
16	Production Area Runoff	R-027-104.1 thru 1007.1
17	Soil/Debris Piles	R-028-201.1 thru 1003.3
18	Caps for Waste Pit 5	R-029-201.1 thru 1003.3
19	Plant 7 D&D	R-037-108.1 thru 1003.2
20	UNH Neutralization	R-023-101.1 thru 1003.1
21	K-65 Silo 3	R-025-104.1 thru 1003.2
22	Waste Pit Containment	R-033-107.1 thru 1003.2
23	South Field Inactive Flyash (Soils)	R-033-301.1 thru 204.2
24	Pilot Plant Sump	R-031-108.1 thru 1003.2
25	Nitric Acid RR Car	R-035-108.1 thru 1003.1
26	Site Wide Asbestos Removal	R-030-101.1 thru 1003.2
27	Contaminated Structures	R-036-203.1 thru 1005.3

Table 10.3, Continued: FEMP Removal Action (RA) Documentation List for the DOE's Fernald Facility As Reported October, 1996

RA#	RA Title	PEIC ① Indexed Document #
28	Fire Training Facility	R-032-108.1 thru 1003.1
29	Erosion Control for South Field	R-032-104.1 thru 1003.1
30	Canceled	None
31	South Field Seepage	R-041-108.1 thru 1003.1
A	Uranium Contamination Offsite	R-001-101.1 thru 1003.1
B	Lab Soils	R-011-209.1 thru 1003.1
C	Stockpile at Plant 1	R-013-101.1 thru 203.1
D	Main Outfall Line	R-017-201.1 thru 209.1
E	Fire Training Facility (Final Report)	R-032-201.1 thru 1003.1
F	Erosion Control South Field (Final Report)	R-038-104.1 thru 202.1
G	KC-2 Warehouse Well	R-039-106.1 thru 1003.1

① PEIC=Public Environmental Information Center. The PEIC houses the Fernald administrative record which is the "body of documents" used to form the basis for site response selection. All documents included in the administrative record are assigned an index number. The first part of the index number is an alphabetical identifier which indicates the document's contents (i.e., R= removal action, U= operable unit and G= general). The second part of the index number is the file number for a particular removal action or operable unit. The third part of the index number is the classification code which breaks the information down by it's intended usage (i.e., feasibility studies = 400 code, site identification = 100 code, etc.). The fourth and final part of the index number is a unique sequential identifier, (i.e., .1= initial action to 1003.1 final report). This information was provided by employees of the PEIC on 02/21/97.

Table 10.4: List of Chemicals Reported on SARA Title III, 312 Report for 1995 for the DOE's Fernald Facility As Reported October, 1996

CHEMICAL NAME	CAS #	Extremely Hazardous Substance (EHS) & Non-EHS (CERCLA) Threshold Planning Quantity (pounds)
Aluminum Sulfate (Alum)	10043-01-3	①
Argon	7440-37-1	①
Barium Carbonate	513-77-9	①
Calcium Oxide	1305-78-8	①
Carbon (Activated)	7440-44-0	①
Chlorine	7782-50-5	EHS= 100
Diatomaceous Earth	61790-53-2	①
Diatomaceous Earth	68855-54-9	①
Diesel Fuel #2	68476-34-6	①
Ferrous Sulfamate	14017-39-1	①
Hydrated Alumina	21645-51-2	①
Hydrogen Fluoride	7664-39-3	EHS= 100
Lithium Carbonate	554-13-2	①
Magnesium Oxide	1309-48-4	①
Methanol	67-56-1	①
Nitric Acid	7697-37-2	EHS= 500
Nitrogen	7727-37-9	①
Portland Cement	65997-15-1	①
Potassium Carbonate	584-08-7	①
Sodium Carbonate	497-19-8	①
Sodium Hydroxide	1310-73-2	①
Sodium Sulfide	1313-82-2	①
Sulfuric Acid	7664-93-9	EHS= 500
Unleaded Gasoline (Gasohol)	86290-81-5	①
Uranium Metal	7440-61-1	①
Uranium Dioxide	1344-57-6	①
Uranium Octaoxide	1317-99-3	①
Uranium Tetrafluoride	10049-14-6	①
Uranium Trioxide	1344-58-7	①

①The reportable quantity for all non-EHS chemicals is 10,000 pounds, the Fernald site retains less than that amount.

Table 10.5: Fernald HW Worker Contacts, Activity Descriptions and Exposure Types As Reported October, 1996

Facility	Category	Contact(s)	Activities Title and Brief Description	Exposure Type	Driver	Time line	Duration	Workers per Activity
Fernald OU 1	Hazardous Waste	Information gathered from reference material	Act 1: Containerization, Transportation, Storage HWMU # 51 - Pit 5 Experimental Treatment Facility This removal action (RA # 11) involved the dismantling of the the facility, removal of the surrounding soils, and packaging of the waste materials generated during the removal action	Mixed	Consent Agreement	RA # 11: 12/91 - 3/92	15 months	MED: 11 - 75
Fernald OU 1	Hazardous Waste	Information gathered from reference material	Act 2: Containerization, Transportation,, Treatment, Storage, Disposal HWMU # 27 - Waste Pit 4 This removal action (RA # 22) involved the application of a cap to mitigate contaminant migration	Mixed	Consent Agreement	RA# 27: 7/89 - 9/89	2 months	MED: 11 - 75
			Final closure will involve removal of a variety of liquid and solid wastes that were generated by the eight separate operations plants at the site and also excavation of contaminated soils	Mixed	CERCLA	Final Closure: 1996 - 2004	8 years	HIGH: > 75

Table 10.5, Continued: Fernald HW Worker Contacts, Activity Descriptions and Exposure Types As Reported October, 1996

Facility	Category	Contact(s)	Activities Title and Brief Description	Exposure Type	Driver	Time line	Duration	Workers per Activity
Fernald OU 1	Hazardous Waste	Information gathered from reference material	Act 3: Containerization, Transportation, Treatment, Storage, Disposal HWMU # 42 - Waste Pit 5 This removal action (RA # 18) involved the redistribution of 2,517 cu. yds. of material from the east end to the west end of Pit 5, thereby reducing the potential for wind erosion of the pit material	Mixed	Consent Agreement	RA # 18: 9/92 - 12/92	3 months	MED: 11 - 75
			Final closure will involve removal of a variety of liquid and solid wastes that were generated by the eight separate operations plants at the site and also excavation of contaminated soils	Mixed	CERCLA	Final Closure: 1996 - 2004	8 years	HIGH: > 75
Fernald OU 3	Hazardous Waste	Information gathered from reference material	Act 4: Containerization, Transportation, Storage HWMU # 13 - Wheelabrator Dust Collector This closure activity involved the removal of process residues generated by the drum reconditioning unit in Building 66 and decontamination of the Unit.	Mixed	RCRA	7/94 - 95	17 months	MED: 11 - 75

Table 10.5, Continued: Fernald HW Worker Contacts, Activity Descriptions and Exposure Types As Reported October, 1996

Facility	Category	Contact(s)	Activities Title and Brief Description	Exposure Type	Driver	Time line	Duration	Workers per Activity
Fernald OU 3	Hazardous Waste	Information gathered from reference material	Act 5: Containerization, Transportation, Treatment, Storage, Disposal					
			HWMU # 20 - Plant 1 Storage Pad This removal action (RA # 7) involved membrane installation, soil removal, construction of a new concrete pad, and upgrading the existing pad	Mixed	Consent Agreement	7/91 - 9/94	38 months	MED: 11 - 75
			Final closure will involve removal of stored waste on the Pad and excavation of the soils under and around the Pad.	Mixed	CERCLA	1996 - 2010	14 years	HIGH: > 75
Fernald OU 3	Hazardous Waste	Information gathered from reference material	Act 6: Containerization, Transportation, Storage					
			HWMU # 26 - Detrex Still This closure activity involved the removal of the Detrex still and associated equipment which was used for the reclamation of chlorinated solvents laden with PCBs.	Mixed	RCRA	11/5/93 - 11/7/95	2 years	MED: 11 - 7
Fernald OU 3	Hazardous Waste	Information gathered from reference material	Act 7: Containerization, Transportation, Storage					
			HWMU # 53 - Safe Geometry Sump This closure activity involved the removal of the Safe Geometry Sump contents and isolation of associated equipment.	Mixed	RCRA	8/31/94 - 9/27/94	1 month	MED: 11 - 75

Table 10.5, Continued: Fernald HW Worker Contacts, Activity Descriptions and Exposure Types As Reported October, 1996

Facility	Category	Contact(s)	Activities Title and Brief Description	Exposure Type	Driver	Time line	Duration	Workers per Activity
Fernald OU 3	Hazardous Waste	Information gathered from reference material	Act 8: Transportation HWMU # 19 - C. P. Storage Warehouse Final closure will involve the removal of stored waste located in the Warehouse.	Hazardous	CERCLA	1996 - 1999	3 years	MED: 11 - 75
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 9: Transportation HWMU # 25 - Plant 1 Storage Building Final closure will involve the excavation of associated soils. There is no waste stored in this Building.	Mixed	CERCLA	1996 - 1999	3 years	MED: 11 - 75
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 10: Treatment, Transportation, Containerization, Storage HWMU's # 46 through 50 - UNH Tanks This removal action (RA # 20) involved the neutralization and disposal of approximately 200,000 gallons of uranium dissolved in nitric acid. Final closure will involve the removal of the UNH Tanks and associated equipment.	Mixed LLRW	Consent Agreement CERCLA	RA # 20: 1992 - 6/96 1996 - 1999	4.5 years 3 years	MED: 11 - 75 MED: 11 - 75

Table 10.5, Continued: Fernald HW Worker Contacts, Activity Descriptions and Exposure Types As Reported October, 1996

Facility	Category	Contact(s)	Activities Title and Brief Description	Exposure Type	Driver	Time line	Duration	Workers per Activity
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 11: Treatment, Transportation, Containerization, Storage HWMU # 10 - Nitric Acid Recovery (NAR) System This removal action (RA # 20) involved the neutralization and disposal of uranium dissolved in nitric acid.	Mixed	Consent Agreement	RA # 20: mid 1995 - 4/96	1 year	MED: 11 - 75
			Final closure will involve the removal of the Nitric Acid Recovery (NAR) System and associated equipment and excavation of associated soils.	Mixed	CERCLA	3/98 - 12/99	21 months	MED: 11 - 75
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 12: Treatment, Storage, Transportation HWMU # 28 - Trane Incinerator This closure activity will involve the removal of the Trane Incinerator and associated equipment.	Mixed	CERCLA	1998 - 1999	1 year	MED: 11 - 75
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 13: Transportation, Storage HWMU # 6 - Hydrofluoric Acid (HF) Drum Storage Area: Plant # 4 Final closure of this HWMU involved washing of the floor and the removal of stored waste located in the Hydrofluoric Acid (HF) Drum Storage Area: Plant # 4	Mixed	CERCLA	4/94 - 4/95	1 year	MED: 11 - 75

Table 10.5, Continued: Fernald HW Worker Contacts, Activity Descriptions and Exposure Types As Reported October, 1996

Facility	Category	Contact(s)	Activities Title and Brief Description	Exposure Type	Driver	Time line	Duration	Workers per Activity
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 14: Transportation, Storage HWMU # 7 - Hydrofluoric Acid (HF) Drum Storage Area: NW of Plant # 4 Final closure of this HWMU involved the removal of stored waste located in the Hydrofluoric Acid (HF) Drum Storage Area: NW of Plant # 4	Mixed	CERCLA	4/94 - 4/95	1 year	MED: 11 - 75
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 15: Treatment, Storage, Disposal HWMU # 8 - Hydrofluoric Acid (HF) Drum Storage Area: South of cooling towers Final closure of this HWMU will involve the removal of stored waste located in the Hydrofluoric Acid (HF) Drum Storage Area: South of cooling towers	Mixed	CERCLA	1996 - 1999	3 years	MED: 11 - 75
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 16: Treatment, Storage, Disposal HWMU # 11 - Hydrofluoric Acid (HF) Tank Farm Sump This closure activity will involve the removal of the Hydrofluoric Acid (HF) Tank Farm Sump and associated equipment	Mixed	CERCLA	1996 - 1999	3 yrs	MED: 11 - 75

Table 10.5, Continued: Fernald HW Worker Contacts, Activity Descriptions and Exposure Types As Reported October, 1996

Facility	Category	Contact(s)	Activities Title and Brief Description	Exposure Type	Driver	Time line	Duration	Workers per Activity
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 17: Treatment, Transportation, Storage, Disposal HWMU # 38 - Hydrofluoric Acid (HF) Tank Car This HWMU closure activity involved the removal and treatment of the Hydrofluoric Acid (HF) Tank Car contents.	Mixed	RCRA	3/95 - 9/95	6 months	MED: 11 - 75
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 18: Transportation, Storage HWMU # 21 - Hilco Oil Recovery Unit This Unit has been delisted as an HWMU and is now classified as a SWMU (Solid Waste Management Unit). Closure activity will involve disposal of the unit as LLRW.	LLRW	CERCLA	1996 - 1999	3 years	MED: 11 - 75
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 19: Transportation, Storage HWMU # 36 - Plant 6 North Storage Pad Final closure of this HWMU involved the removal of stored waste located on the Pad and high pressure water rinsing of the Pad.	Mixed	CERCLA	12/93 - 1995	2 years	MED: 11 - 75
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 20: Transportation, Storage HWMU # 37 - Plant 6 Warehouses Final closure of this HWMU will involve the removal of stored waste located in the Plant 6 Warehouses	Hazardous/ Mixed	CERCLA	1996 - 1999	3 years	MED: 11 - 75

Table 10.5, Continued: Fernald HW Worker Contacts, Activity Descriptions and Exposure Types As Reported October, 1996

Facility	Category	Contact(s)	Activities Title and Brief Description	Exposure Type	Driver	Time line	Duration	Workers per Activity
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 21: Transportation, Storage, Disposal HWMU # 14 - Plant 8 Box Furnace This HWMU closure activity will involve the removal of the Plant 8 Box Furnace contents, final disposal of the Unit and excavation of surrounding soils.	Mixed	CERCLA	1996 - 2000	4 years	MED: 11 - 75
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 22: Transportation, Storage, Disposal HWMU # 15 - Plant 8 Oxidation Furnace This HWMU closure activity will involve the removal of the Plant 8 Oxidation contents and final disposal of the Unit.	Mixed	CERCLA	1996 - 2000	4 years	MED: 11 - 75
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 23: Transportation, Storage HWMU # 17 - Plant 8 East Drum Storage Pad Final closure of this HWMU will involve the removal of stored waste located on the Plant 8 East Drum Storage Pad	Mixed	CERCLA	1996 - 2014	18 years	MED: 11 - 75
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 24: Transportation, Storage HWMU # 18 - Plant 8 West Drum Storage Pad Final closure of this HWMU will involve the removal of stored waste located on the Plant 8 West Drum Storage Pad	Mixed	CERCLA	1996 - 2014	18 years	MED: 11 - 75

Table 10.5, Continued: Fernald HW Worker Contacts, Activity Descriptions and Exposure Types As Reported October, 1996

Facility	Category	Contact(s)	Activities Title and Brief Description	Exposure Type	Driver	Time line	Duration	Workers per Activity
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 25: Transportation, Storage HWMU # 29 - Plant 8 Warehouse Final closure of this HWMU will involve the removal of stored waste located in the Plant 8 Warehouse	Mixed	CERCLA	1996 - 2000	4 years	MED: 11 - 75
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 26: Transportation, Storage HWMU # 35 - Plant 9 Warehouse Final closure of this HWMU will involve the removal of stored waste located in the Plant 9 Warehouse	Hazardous/ Mixed	CERCLA	1997 - 1999	2 years	MED: 11 - 75
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 27: Transportation, Storage, Disposal HWMU # 34 - KC - 2 Warehouse/Well This removal action (RA G) will involve the removal of the well and it's contents, removal of contaminated soils immediately surrounding the well, and containerization and dispositioning of associated wastes. Removal Action G will be performed in conjunction with the final closure of the KC - 2 Warehouse	Mixed	Consent Agreement	1996 - 2010	14 years	MED: 11 - 75

Table 10.5, Continued: Fernald HW Worker Contacts, Activity Descriptions and Exposure Types As Reported October, 1996

Facility	Category	Contact(s)	Activities Title and Brief Description	Exposure Type	Driver	Time line	Duration	Workers per Activity
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 28: Containerization, Transportation, Storage HWMU # 22 - Pilot Plant West Sump This removal action (RA # 24) involved the removal of the sump and it's contents, removal of contaminated soils immediately surrounding the sump, and containerization and dispositioning of each waste.	Mixed	Consent Agreement	8/93 - 10/93	2 mos.	MED: 11 - 75
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 29: Containerization, Transportation, Storage HWMU # 31 - Solvent Storage Tank T - 5 This HWMU closure activity involved the removal of the Solvent Storage Tank T - 5 contents and decontamination of the Tank	Mixed	RCRA	11/93 - 1994	1 year	MED: 11 - 75
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 30: Containerization, Transportation, Storage HWMU # 32 - Solvent Storage Tank T - 6 This HWMU closure activity involved the removal of the Solvent Storage Tank T - 6 contents and decontamination of the Tank	Mixed	RCRA	11/93 - 1994	1 year	MED: 11 - 75

Table 10.5, Continued: Fernald HW Worker Contacts, Activity Descriptions and Exposure Types As Reported October, 1996

Facility	Category	Contact(s)	Activities Title and Brief Description	Exposure Type	Driver	Time line	Duration	Workers per Activity
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 31: Containerization, Transportation, Storage, Disposal HWMU # 52 - North and South Solvent Tanks This HWMU closure activity involved the removal of the North and South Solvent Tanks contents and decontamination of the Tank.	Mixed	RCRA	6/94 - 12/94	6 months	MED: 11 - 75
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material:	Act 32: Treatment, Containerization, Transportation, Storage, Disposal HWMU # 54 - Tank T - 2 This HWMU closure activity involved the removal of the Tank T - 2 contents and decontamination of the Tank.	Mixed	CERCLA	6/94 - 11/95	17 months	MED: 11 - 75
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 33: Containerization, Transportation, Storage HWMU # 33 - Pilot Plant Warehouse Final closure of this HWMU will involve the removal of stored waste located in the Warehouse	Hazardous/ Mixed	CERCLA	1996 - 2010	14 years	MED: 11 - 75

Table 10.5, Continued: Fernald HW Worker Contacts, Activity Descriptions and Exposure Types As Reported October, 1996

Facility	Category	Contact(s)	Activities Title and Brief Description	Exposure Type	Driver	Time line	Duration	Workers per Activity
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 34: Containerization, Transportation, Storage, Disposal HWMU # 9 - Nitric Acid Rail Car This removal action (RA # 25) involved the removal of the Nitric Acid Rail Car contents, decontamination and disposal of the Tank Car, removal of surrounding soils, and containerization and dispositioning of each waste. (30)	Mixed	Consent Agreement	3/93 - 10/93 (31)	7 months	MED: 11 - 75 (estimated)
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 35: Containerization, Transportation, Storage HWMU # 41 - Sludge Drying Beds This HWMU closure activity will involve the removal of sludge generated by the Sewage Treatment Plant and Sewage Treatment Plant Incinerator and excavation/removal of surrounding soils.	Mixed	CERCLA	1996 - 2010	14 years	MED: 11 - 75
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 36: Containerization, Transportation, Storage HWMU # 1 - Fire Training Facility (FTF) This removal action (RA # 28) involved the removal of each structure at the FTF, removal of surrounding soils, and containerization and dispositioning of each waste.	Mixed	Consent Agreement	7/94 - 4/95	9 months	MED: 11 - 75

Table 10.5, Continued: Fernald HW Worker Contacts, Activity Descriptions and Exposure Types As Reported October, 1996

Facility	Category	Contact(s)	Activities Title and Brief Description	Exposure Type	Driver	Time line	Duration	Workers per Activity
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 37: Transportation, Storage, Disposal HWMU # 30 - Barium Chloride Salt Treatment Facility This HWMU closure activity involved the removal of the Barium Chloride Salt Treatment Facility contents and final disposal of the Facility	Mixed	RCRA	7/87 - 2/90	31 months	MED: 11 - 75
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 38: Transportation, Storage, Disposal HWMU # 3 - Waste Oil Storage in Garage This HWMU closure activity involved the removal of waste oil stored in the Garage and final disposal of the oil	Mixed	RCRA	2/95 - 6/96	14 months	MED: 11 - 75
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 39: Containerization, Transportation, Storage, Disposal HWMU # 4 - Drum Storage Area near Loading Dock This removal action (RA B) involved the removal of contaminated soils immediately surrounding the dock, and containerization and dispositioning of associated wastes.	Mixed	Consent Agreement	2/1/94 - 1995	18 months	MED: 11 - 75

Table 10.5, Continued: Fernald HW Worker Contacts, Activity Descriptions and Exposure Types As Reported October, 1996

Facility	Category	Contact(s)	Activities Title and Brief Description	Exposure Type	Driver	Time line	Duration	Workers per Activity
Fernald OU 3	Hazardous Waste Worker	Information gathered from reference material	Act 40: Containerization, Transportation, Storage, Disposal HWMU # 5 - Drum Storage Area South of Lab This closure involved the removal of surrounding soils, and containerization and dispositioning of each waste.	Mixed	CERCLA	95 - 12/95	6 months	MED: 11 - 75
Fernald OU 4	Hazardous Waste Worker	Information gathered from reference material	N/A	N/A	N/A	N/A	N/A	N/A
Fernald OU 5	Hazardous Waste Worker	Information gathered from reference material	N/A	N/A	N/A	N/A	N/A	N/A

Table 10.6: FEMP UNION INFORMATION as of October 1996

FEMP Union Representing Hazardous Waste Workers (HW's)

Local#	Name / Address	Represented Group
501	International Chemical Workers Union, P.O. Box 279 Lawrenceburg, IN 47025	HAZWOPERS

FEMP Unions Representing Cleanup Workers (CW's)

Local#	Name / Address	Represented Group
7	Firemen & Oilers Union, 134 North Lasalle Street Chicago, IL 60602	Boiler Plant Operators
18	Brick Layers & Masons Union, 1550 Chase Ave. Cincinnati, OH 45223	Brick Layers & Masons
20	Operators & Engineers Union, 1216 East McMillan St., Rm 202 Cinti., OH 45206	Heavy Equip., Wastewater Treatment Plant (WWT) Operators, & Boiler Plant Engineers
44	Ironworkers Union, 4850 Madison Road, Cincinnati, OH 45227	Riggers
59	Pipefitters & Welders Union, 9 Knollcrest Drive, Cincinnati, OH 45237	Pipefitters, Welders, & Plumbers
100	Teamsters Union, 2100 Oak Road Cincinnati, OH 45241	Transportation, Laborers, Store Attendants
248	Laundry Workers Union, P.O. Box 338 Williamstown, KY 41097	Laundry & Respirator Cleaning Facility Workers
308	Painters Union, 1216 East McMillan St., Rm 108 Cinti., OH 45206	Painters
1199	Service Workers Union, 1579 Summit Rd. Rm 124 Cincinnati, OH 45237	Porters & Maintenance Workers
1825	Intl. Brotherhood of Electrical Workers Union, P.O. Box 273 Ross, OH 45061	Electrical Workers & Instrument Mechanics
1901	Intl. Association of Machinists, 2928 Colrain Ave. Cincinnati, OH 45225	Machinists & Garage Personnel
2380	Carpenters & Jointers Union, 633 Morgan Rd.. West Harrison, IN 47060	Millwrights&Carpenters

Table 10.6, Continued: FEMP UNION INFORMATION as of October 1996

FEMP Union Representing Decontamination and Decommissioning Workers (D&D)

Local#	Name / Address	Represented Group
N/A	Greater Cincinnati Building and Trades Council, 1550 Chase Ave. Cincinnati, OH 45223	Carpenters, Iron Workers, Plumbers, Operating Engineers, Etc.

In 1995 a total of 600 FEMP (Hourly) Wage employees (HW & CW workers) and 50 D&D workers were represented. The Fernald Atomic Trade and Labor Council (FATLC) is in place at the FEMP to resolve labor issues between management and the 14 unions. Mr. Jim Ball with this council provided the above information. FATLC: (513) 648-5075, P.O. Box 126, Ross, OH 45061

Table 10.7: HW & CW Annual Turnover Rate As Reported October 1996

YEAR	ANNUAL TURNOVER RATE (%)
1989	Data Not Available
1990	15.0
1991	7.0
1992	5.3
1993	7.3
1994	5.5
1995	5.0
thru 7/1996	6.1

Table 10.8: 1990 WEMCO/FERMCO Dosimetry rates among HW, D&D, and CW's. As Reported October, 1996

Occ. Code	Occupation	# w/none detected	# w / <100 mrem	100-250 mrem	250-500 mrem	500-750 mrem	750-1000 mrem	1000-2000 mrem	total # monitored	Avg. Meas.TEDE (mrem) * TEDE = Total Effective Dose Equivalent
0524	Janitors (CW)	6	1						7	15
0525	Misc. Service (CW)	43	39	24	7				113	109
0610	Mechanics/Repairers(CW)	22	2						24	28
0641	Masons (CW)	40	2						42	24
0642	Carpenters (CW)	53	3						56	20
0643	Electricians (CW)	95	16	2					113	45
0644	Painters (CW)	29	5						34	30
0645	Pipe Fitters (CW)	196	34	3	1				234	39
0646	Miners/Drillers (CW)	10	8						18	19
0681	Machinists (CW)	5		2	1				8	208
0690	Operators, Plt., Syst, Util. (CW)	9	25	3					37	56
0710	Machine Setup/Operators (CW)	1							1	0
0771	Welders/Solderers (CW)	2	2						4	9
0780	Misc. Precision/Product. (CW)	22	7	2					31	56
0820	Truck Drivers (CW)	1	3	1					5	91
0821	Bus Drivers (CW)	3	12	2	2				19	100

* TEDE = Total Effective Dose Equivalent

Table 10.8, Continued: 1990 WEMCO/FERMCO Dosimetry rates among HW, D&D, and CW's. As Reported October, 1996

Occ. Code	Occupation	# w/none detected	# w / <100 mrem	100-250 mrem	250-500 mrem	500-750 mrem	750-1000 mrem	1000-2000 mrem	total # monitored	Avg. Meas.TEDE (mrem) * TEDE = Total Effective Dose Equivalent
0830	Equipment Operators (CW)	2	2	1					5	77
0840	Misc. Transportation (CW)	5	10						15	24
0850	Handles/Laborers/Helpers (CW)	81	21	2					104	33
0840	Chem. Oper. Technicians (HW)	87	15	1	2	2		1	108	192
0850	Demo./Construction (D&D)	259	35						294	23

* TEDE = Total Effective Dose Equivalent

Table 10.8, Continued: 1991 WEMCO/FERMCO Dosimetry rates among HW, D&D, and CW's. As Reported October, 1996

Occ. Code	Occupation	# w/none detected	# w / <100 mrem	100-250 mrem	250-500 mrem	500-750 mrem	750-1000 mrem	1000-2000 mrem	total # monitored	Avg. Meas. TEDE (mrem)* TEDE = Total Effective Dose Equivalent
0524	Janitors (CW)	14	2	1					17	93
0525	Misc. Service (CW)	29	31	18	3	1			82	108
0610	Mechanics/Repairers(CW)	20	2						22	78
0641	Masons (CW)	10	2						12	7
0642	Carpenters (CW)	31	16	2	3				52	82
0643	Electricians (CW)	31	16	3	2	1	2	1	56	194
0644	Painters (CW)	20	4						24	38
0645	Pipe Fitters (CW)	68	18	8					95	110
0646	Miners/Drillers (CW)	15	5	1					21	36
0681	Machinists (CW)	1	2	1	2				6	181
0690	Operators, Plt., Syst, Util. (CW)	25	22	14	1				62	87
0710	Machine Setup/Operators (CW)	2	1						3	6
0771	Welders/Solderers (CW)	1	1						2	11
0780	Misc. Precision/Product. (CW)	15	6	2					23	41
0820	Truck Drivers (CW)	5	1	3					9	146
0821	Bus Drivers (CW)	3	6	3					12	78

* TEDE = Total Effective Dose Equivalent

Table 10.8, Continued: 1991 WEMCO/FERMCO Dosimetry rates among HW, D&D, and CW's. As Reported October, 1996

Occ. Code	Occupation	# w/none detected	# w / <100 mrem	100-250 mrem	250-500 mrem	500-750 mrem	750-1000 mrem	1000-2000 mrem	total # monitored	Avg. Meas. TEDE (mrem) * TEDE = Total Effective Dose Equivalent
0830	Equipment Operators (CW)	7	4		1				12	93
0840	Misc. Transport (CW)	17	8	1					26	49
0850	Handles/Laborers/Helpers (CW)	63	25	4	5	1		1	99	137
0840	Chem. Oper. Technicians (HW)	74	19	5	3			1	102	147
0850	Demo./Construction (D&D)	109	24	1	1				135	33

* TEDE = Total Effective Dose Equivalent

Table 10.8, Continued: 1992 WEMCO/FERMCO Dosimetry rates among HW, D&D, and CW's. As Reported October, 1996

Occ. Code	Occupation	# w/ none detected	# w / <100 mrem	100-250 mrem	250-500 mrem	500-750 mrem	750-1000 mrem	1000-2000mrem	total # monitored	Avg. Meas. TEDE (mrem) * TEDE = Total Effective Dose Equivalent
0524	Janitors (CW)	23	9						32	36
0525	Misc. Service (CW)	24	32	6	8				70	101
0610	Mechanics/Repairers(CW)	19	3						22	10
0641	Masons (CW)	19	10						29	19
0642	Carpenters (CW)	42	13						55	16
0643	Electricians (CW)	46	27						73	18
0644	Painters (CW)	9	11						20	23
0645	Pipe Fitters (CW)	69	20						89	21
0646	Miners/Drillers (CW)	21	1						21	5
0681	Machinists (CW)	2		1	2				5	219
0690	Operators, Plt., Syst, Util. (CW)	50	67	26	5	1			149	86
0710	Machine Setup/Operators (CW)	1	5						6	26
0771	Welders/Solderers (CW)	2							2	0
0780	Misc. Precision/Product. (CW)	18	11	1					30	28
0820	Truck Drivers (CW)	4	24	2		1			31	44
0821	Bus Drivers (CW)	3	3	1	2				9	130
0830	Equipment Operators (CW)	26	2	1					29	41

* TEDE = Total Effective Dose Equivalent

Table 10.8, Continued: 1992 WEMCO/FERMCO Dosimetry rates among HW, D&D, and CW's. As Reported October, 1996

Occ. Code	Occupation	# w/none detected	# w / <100 mrem	100-250 mrem	250-500 mrem	500-750 mrem	750-1000 mrem	1000-2000 mrem	total # monitored	Avg. Meas. TEDE (mrem) * TEDE = Total Effective Dose Equivalent
0840	Misc. Transport (CW)	7	16	5					28	62
0850	Handles/Laborers/Helpers (CW)	128	60	5	1				194	42
0840	Chem. Oper. Technicians (HW)	71	19	2					92	37
0850	Demo./Construction (D&D)	114	24	1					139	22

* TEDE = Total Effective Dose Equivalent

Table 10.8, Continued: 1993 WEMCO/FERMCO Dosimetry rates among HW, D&D, and CW's. As Reported October, 1996

Occ. Code	Occupation	# w/none detected	# w / <100 mrem	100-250 mrem	250-500 mrem	500-750 mrem	750-1000 mrem	1000-2000 mrem	total # monitored	Avg. Meas. TEDE (mrem) * TEDE = Total Effective Dose Equivalent
0524	Janitors (CW)	21	2						23	11
0525	Misc. Service (CW)	17	13						30	16
0610	Mechanics/Repairers(CW)	25	5						30	8
0641	Masons (CW)	4	3						7	6
0642	Carpenters (CW)	24	20	1					45	21
0643	Electricians (CW)	34	49						83	15
0644	Painters (CW)	22	9						31	19
0645	Pipe Fitters (CW)	41	44						85	14
0646	Miners/Drillers (CW)	30	9						39	9
0681	Machinists (CW)	14	4						18	8
0690	Operators, Plt., Syst, Util. (CW)	62	192	29	2				285	52
0710	Machine Setup/Operators (CW)	2	1						3	5
0771	Welders/Solderers (CW)	7	5						12	13
0780	Misc. Precision/Product. (CW)	22	16						38	20
0820	Truck Drivers (CW)	3	15	1					19	24
0821	Bus Drivers (CW)		1						1	24
0830	Equipment Operators (CW)	13	28	1					41	36

* TEDE = Total Effective Dose Equivalent

Table 10.8, Continued: 1993 WEMCO/FERMCO Dosimetry rates among HW, D&D, and CW's. As Reported October, 1996

Occ. Code	Occupation	# w/none detected	# w / <100 mrem	100-250 mrem	250-500 mrem	500-750 mrem	750-1000 mrem	1000-2000 mrem	total # monitored	Avg. Meas. TEDE (mrem) * TEDE = Total Effective Dose Equivalent
0840	Misc. Transport (CW)	3	8	1					12	45
0850	Handles/Laborers/Helpers (CW)	121	65		1				187	21
0840	Chem. Oper. Technicians (HW)	37	9						46	8
0850	Demo./Construction (D&D)	57	28						85	11

* TEDE = Total Effective Dose Equivalent

Table 10.8, Continued: 1994 WEMCO/FERMCO Dosimetry rates among HW, D&D, and CW's. As Reported October, 1996

Occ. Code	Occupation	# w/none detected	# w / <100 mrem	100-250 mrem	250-500 mrem	500-750 mrem	750-1000 mrem	1000-2000 mrem	total # monitored	Avg. Meas. TEDE (mrem) * TEDE = Total Effective Dose Equivalent
0524	Janitors (CW)	23	6						29	14
0525	Misc. Service (CW)	24	8						32	7
0610	Mechanics/Repairers(CW)	29	4						33	7
0641	Masons (CW)	8	2						10	12
0642	Carpenters (CW)	35	24						59	9
0643	Electricians (CW)	39	45						84	17
0644	Painters (CW)	19	5	1					25	23
0645	Pipe Fitters (CW)	56	43						99	16
0646	Miners/Drillers (CW)	11	2						13	19

* TEDE = Total Effective Dose Equivalent

Table 10.8, Continued: 1994 WEMCO/FERMCO Dosimetry rates among HW, D&D, and CW's. As Reported October, 1996

Occ. Code	Occupation	# w/none detected	# w / <100 mrem	100-250 mrem	250-500 mrem	500-750 mrem	750-1000 mrem	1000-2000 mrem	total # monitoried	Avg. Meas. TEDE (mrem) * TEDE = Total Effective Dose Equivalent
0681	Machinistis (CW)	4	8						12	9
0690	Operators, Plt., Syst, Util. (CW)	70	187	29					286	52
0710	Machine Setup/Operators (CW)		1						1	17
0771	Welders/Solderers (CW)	7	2						9	12
0780	Misc. Percision/Product. (CW)	12	19						31	23
0820	Truck Drivers (CW)	4	18						22	12
0821	Bus Drivers (CW)	1							1	
0830	Equipment Operators (CW)	13	24						37	33
0840	Misc. Transportion (CW)	3	9	1					13	44
0850	Handles/Laborers/Helpers (CW)	103	82						185	15
0840	Chem. Oper. Technicians (HW)	19	1						20	33
0850	Demo./Construction (D&D)	84	19						103	12

* TEDE = Total Effective Dose Equivalent
No Data Is Availibile at this time (October 1996) for 1995 or 1996

Table 10.9: Fernald Environmental Management Project - Operable Unit 1 Past, Present and Proposed Future Technologies. As Reported October, 1996

FEMP/OU #	Category	Activity Title	Technology and Brief Description	# of Workers per technology	Descriptive Exposure Potential	Advantages	Disadvantages
FEMP/OU 1	Hazardous Waste	HW/MW Treatment (Past-1993-1994 pilot) (Future-1999-2004)	Minimum Additive Waste Stabilization (MAWS): remediates HW/MW/LLRW in multiple waste streams through one vitrification treatment train	10 - 20	Limited contact, indoors w/HEPA, ①PPE-Level B	Reduced potential for skin contact w/HW sludges & Closed Treatment System	None Noted
FEMP/OU 1	Hazardous Waste	HW/MW Storage	None in OU1	None in OU1	None in OU1	N/A	N/A
FEMP/OU 1	Hazardous Waste	HW/MW Disposal & Transportation (Future-1996-2004)	Waste Pits (4&5) Area Drying Technology: dewatering, excavation, drying excavated HW sludges.	20 - 50 overall drying	Limited contact, outdoors, ①PPE-Level B	Reduced potential for skin contact w/HW sludges, volume reduction	None Noted
FEMP/OU 1	D&D	Equipment & Internal Bld. Component Removal Personnel	None in OU1	None in OU1	None in OU1	N/A	N/A
FEMP/OU 1	D&D	Encapsulation Personnel	None in OU1	None in OU1	None in OU1	N/A	N/A
FEMP/OU 1	D&D	(Superstructure) External Bld. Component Removal Personnel	None in OU1	None in OU1	None in OU1	N/A	N/A

① PPE-Level B included: double/single Saranex®, Latex Gloves & Boot covers, as well as Full Face Respirators w/ organic vapor/acid gasses/HEPA cartridges

Table 10.9, Continued: Fernald Environmental Management Project - Operable Unit 1 -Past, Present and Proposed Future Technologies. As Reported October, 1996

FEMP/OU #	Category	Activity Title	Technology and Brief Description	# of Workers per technology	Descriptive Exposure Potential	Advantages	Disadvantages
FEMP/OU 1	Clean-up	LLRW Treatment (Past-1991 pilot) (Future-1996-2004)	Minimum Additive Waste Stabilization (MAWS): remediates multiple HW/MW/LLRW waste streams in one vitrification treatment train	10 - 20	Limited contact, indoors w/HEPA, ①PPE-Level B	Reduced potential for skin contact w/LLRW sludges & Closed Treatment System	None Noted
FEMP/OU 1	Clean-up	LLRW Systems Maintenance (Present-1996)	Automated Grounds Maintenance Device: Hydraulically powered, self-propelled lawn mower outfitted w/remote controls.	1/unit	No contact, outdoors from remote distances, lessen effects from heat stress, eliminates need for PPE	Operated from remote distances eliminates need for PPE	None Noted
FEMP/OU 1	Clean-up	LLRW Disposal & Transportation (Future-1999-2004)	Waste Pits (1, 2, 3 & 6) Area Drying Technology: dewatering, excavation, drying excavated LLRW sludges.	20 - 50 overall drying	Limited contact, outdoors, ①PPE-Level B	Reduced potential for skin contact w/LLRW sludges, volume reduction	None Noted

① PPE-Level B included: double/single Saranex®, Latex Gloves & Boot covers, as well as Full Face Respirators w/ organic vapor/acid gasses/HEPA cartridges

Table 10.10: Fernald Environmental Management Project Operable Unit 2 - Past, Present and Proposed Future Technologies As Reported October, 1996

FEMP/OU#	Category	Activity Title	Technology and Brief Description	# of Workers per Technology	Descriptive Exposure Potential	Advantages	Disadvantages
FEMP/OU2	Hazardous Waste	HW/MW Treatment (Past -1991 pilot) (Future-1996-2001)	Minimum Additive Waste Stabilization (MAWS): remediates HW/MW/LLRW in multiple waste streams through one vitrification treatment train	10 - 20	Limited contact, indoors w/HEPA, ①PPE-Level B	Reduced potential for skin contact w/HW sludges & Closed Treatment System	None Noted
FEMP/OU2	Hazardous Waste	HW/MW Storage	None in OU2	None in OU2	None in OU2	N/A	N/A
FEMP/OU2	Hazardous Waste	HW/MW Disposal & Transportation (Future-1996-2001)	Standard Excavation Technology: Excavation and removal of HW sludges.	20 - 50 overall	Excavation: limited contact, outdoors, ①PPE-Level B	Reduced potential for skin contact w/HW solids	None Noted
FEMP/OU2	D&D	Equipment & Internal Bld. Component Removal Personnel	None in OU2	None in OU2	None in OU2	N/A	N/A
FEMP/OU2	D&D	Encapsulation Personnel	None in OU2	None in OU2	None in OU2	N/A	N/A
FEMP/OU2	D&D	(Super-structure) External Bld. Component Removal Personnel	None in OU2	None in OU2	None in OU2	N/A	N/A

①PPE-Level B included: double/single Saranex® coveralls, Latex Gloves & Boot covers, as well as Full Face Respirators w/ organic vapor/acid gasses/HEPA cartridges.

Table 10.10, Continued: Fernald Environmental Management Project Operable Unit 2 - Past, Present and Proposed Future Technologies As Reported October, 1996

FEMP/OU#	Category	Activity Title	Technology and Brief Description	# of Workers per Technology	Descriptive Exposure Potential	Advantages	Disadvantages
FEMP/OU2	Clean-up	LLRW Treatment (Past-1991 pilot) (Future-1996-2001)	Minimum Additive Waste Stabilization (MAWS): remediates multiple HW/MW/LLRW waste streams in one vitrification treatment train	10 - 20	Limited contact, indoors w/HEPA, ①PPE-Level B	Reduced potential for skin contact w/LLRW sludges & Closed Treatment System	None Noted
FEMP/OU2	Clean-up	LLRW Systems Maintenance (Present-1996)	Automated Grounds Maintenance Device: Hydraulically powered, self-propelled lawn mower outfitted w/remote controls.	1/unit	No contact, outdoors from remote distances, lessen effects from heat stress, eliminates need for PPE	operated from remote distances eliminates need for PPE	None Noted
FEMP/OU2	Clean-up	LLRW Disposal & Transportation (Future-1996-97)	Standard Excavation Technology: excavating LLRW solids.	20 - 50 overall	Excavation: limited contact, outdoors, ①PPE-Level B	None Noted	None Noted

①PPE-Level B included: double/single Saranex® coveralls, Latex Gloves & Boot covers, as well as Full Face Respirators w/ organic vapor/acid gasses/HEPA cartridges.

Table 10.11: Fernald Environmental Management Project Operable Unit 3 - Past, Present and Proposed Future Technologies As Reported October, 1996

FEMP/OU#	Category	Activity Title	Technology and Brief Description	# of Workers per Technology	Descriptive Exposure Potential	Advantages	Disadvantages
FEMP/OU3	Hazardous Waste	HW/MW Treatment (Past-11/1995-10/1996)	Mobile Stabilization: treatment of characteristic & listed inorganic HW/MW/LLRW by low strength cement stabilization or macro encapsulation	12 - 16 daily	High level of contact while opening & dumping containers, sizing, crushing, shredding and mixing HW/MW indoors w/HEPA, PPE-Level B①	Final product could be shipped offsite for disposal, reducing exposure potential. Untreated these HW/MW's would require onsite storage which would require frequent inspection adding to exposure potential	Potential for skin contact w/HW sludge& solids during process. High degree of dust causing house-keeping issues.
FEMP/OU3	Hazardous Waste	HW/MW Storage (Future-1996-2016)	Drum Inspection Robotics (RCRA Warehouses): self-navigating robots outfitted w/cameras, software, and bar code readers to read container ID #'s and spot rust and other defective features.	1-3	None	Eliminates the potential for in contact w/HW or MW	None Noted

①PPE-Level B included: double/single Saranex® coveralls, Latex Gloves & Boot covers, and Full Face Respirators w/organic vapor/acid gasses/HEPA cartridges.

Table 10.11, Continued: Fernald Environmental Management Project Operable Unit 3 - Past, Present and Proposed Future Technologies As Reported October, 1996

FEMP/OU#	Category	Activity Title	Technology and Brief Description	# of Workers per Technology	Descriptive Exposure Potential	Advantages	Disadvantages
FEMP/OU3	Hazardous Waste	HW/MW Disposal & Transportation (Past-1990-92) (Present-1996) (Future-1996-97)	Incineration Technology: Liquid/Sludge Mixed Waste (offsite @ TSCA incinerator): involved bulking (mixing contents of different on-site tanks), sampling, and shipping mixed waste. This process destroys MW by excessive heat in a rotary kiln w/a secondary combustion chamber	30 - 40	Bulking, sampling and shipping: limited contact, outdoors, PPE-Level B ① Incineration: limited contact closed loop system w/scrubber & HEPA filtration	Bulking Reduces the potential for contact w/HW sludge & solids due to fewer sampling events.	None Noted
FEMP/OU3	Hazardous Waste	HW/MW Treatment (Past-11/1995-10/1996) (Future-1997-2003	Mobile Chemical Treatment: treatment of characteristic & listed HW/MW by means of a chemical treatment process which may include biodegradation, chemical or electrolytic oxidation, chemical reduction, chemical precipitation, recovery of organics, steam stripping, water wash/separating contaminants, wet air oxidation, neutralization, & amalgamation	Past: 5-20 Future: Not yet Available	High level of contact while opening & dumping containers, sizing, crushing, shredding and mixing HW/MW indoors w/HEPA , PPE-Level B①	Final product could be shipped offsite for disposal, reducing exposure potential. Untreated these HW/MW's would require onsite storage which would require frequent inspection adding to exposure potential	Potential for skin contact w/HW/MW during process.

①PPE-Level B included: double/single Saranex® coveralls, Latex Gloves & Boot covers, and Full Face Respirators w/organic vapor/acid gasses/HEPA cartridges.

Table 10.11, Continued: Fernald Environmental Management Project Operable Unit 3 - Past, Present and Proposed Future Technologies As Reported October, 1996

FEMP/OU#	Category	Activity Title	Technology and Brief Description	# of Workers per Technology	Descriptive Exposure Potential	Advantages	Disadvantages
FEMP/OU3	D&D	Equipment & Internal Bld. Component Removal Personnel	Seamist® Method for Stabilization of HW/LLRW in Piping, Ducts and Vent Lines: Places an adhesive fabric liner into place trapping HW/LLRW. The trapped contamination can be removed or left in place	4 per application	Limited contact, indoors, PPE-Level B ① encapsulation of the waste reduces airborne potential	Encapsulation of the waste reduces worker exposure to airborne chemical or radiological contaminants	Cannot be utilized in ducts and pipes that step down or contain baffles
FEMP/OU3	D&D	Encapsulation Personnel	Standard application of latex paint to contaminated surfaces (fixed radiological)	5 - 10	Limited contact, indoors, PPE-Level B ① encapsulation of the contaminated surfaces reduces airborne potential	Encapsulation of the waste reduces worker exposure to airborne chemical or radiological contaminants	None Noted

①PPE-Level B included: double/single Saranex® coveralls, Latex Gloves & Boot covers, as well as Full Face Respirators w/ organic vapor/acid gasses/HEPA cartridges.

Table 10.11, Continued: Fernald Environmental Management Project Operable Unit 3 - Past, Present and Proposed Future Technologies As Reported October, 1996

FEMP/OU#	Category	Activity Title	Technology and Brief Description	# of Workers per Technology	Descriptive Exposure Potential	Advantages	Disadvantages
FEMP/OU3	D&D	External Bld. Component (Superstructure) Removal Personnel	Controlled Detonation: Implosion utilizing steel-cutting shape charges to fell the superstructure of former production buildings or plants: cutting plates and flanges for placement of charges, placing charge, covering with material to reduce flying debris, wiring of charge to detonator	5-50 dependent upon project scope	Limited contact w/contaminated surfaces, open air building superstructure, from process clothing to PPE-Level B ① dependent upon site conditions	Reduces the number of column torch cuts required. Eliminates the need to torch cut decking. Eliminates the need for heavy lifts. Reduces duration ten fold, positively influencing potential lead paint & radiation exposure	The use of explosives pose worker safety concerns
FEMP/OU3	Clean-up	LLRW Treatment/Storage (Past-1991 pilot) (Future-1996-2016)	Drum Inspection Robotics (LLRW Pads & Warehouses): sel-navigating robots outfitted w/cameras, software, and bar code readers to read container ID #'s and spot rust and other defective features.	1-3	None	Eliminates the potential for radiological contamination	None Noted

①PPE-Level B included: double/single Saranex® coveralls, Latex Gloves & Boot covers, as well as Full Face Respirators w/ organic vapor/acid gasses/HEPA cartridges.

Table 10.11, Continued: Fernald Environmental Management Project Operable Unit 3 - Past, Present and Proposed Future Technologies As Reported October, 1996

FEMP/OU#	Category	Activity Title	Technology and Brief Description	# of Workers per Technology	Descriptive Exposure Potential	Advantages	Disadvantages
FEMP/OU3	Clean-up	LLRW Systems maintenance (Present-1996) (Future-1996-?)	Automated Grounds Maintenance Device: Hydraulically powered, self-propelled lawn mower outfitted w/remote controls.	1/unit	No contact, outdoors from remote distances, lessen effects from heat stress, eliminates need for PPE	Operated from remote distances eliminates need for PPE	None Noted
FEMP/OU3	Clean-up	LLRW Disposal & Transportation (Future-1996-97)	N/A	N/A	N/A	N/A	N/A

①PPE-Level B included: double/single Saranex® coveralls, Latex Gloves & Boot covers, as well as Full Face Respirators w/ organic vapor/acid gasses/HEPA cartridges.

Table 10.12: Fernald Environmental Management Project Operable Unit 4 - Past, Present and Proposed Future Technologies As Reported October, 1996

FEMP/OU#	Category	Activity Title	Technology and Brief Description	# of Workers per Technology	Descriptive Exposure Potential	Advantages	Disadvantages
FEMP/OU4	Hazardous Waste	HW/MW Treatment (Past-1995 pilot) (Present-1996 non-radiological/ hazardous surrogate material) (Future-1998-2004)	Vitrification Plant: remediates K-65 waste streams (RCRA exempt MW) through a vitrification treatment train resulting in a glass-like non-hazardous end product suitable for disposal at NTS	50 - 100 total 24 hours/day 7 days a week	Limited contact, closed loop system indoors w/HEPA and off-gas scrubbers, ①PPE-Level B. Radon is a concern	Reduced potential for skin contact w/RCRA exempt MW in a Closed Treatment System	The technology utilizes phosphates & sulfates as additives. Radon control issues
FEMP/OU4	Hazardous Waste	HW/MW Storage	None in OU4	None in OU4	None in OU4	N/A	N/A
FEMP/OU4	Hazardous Waste	HW/MW Transportation (Present-1996 pilot) (Future-1998-2004)	Houdini® Waste-dislodging Robot enters the confined high radiation/radon areas of the K-65 silos and aids in the removal of K-65 waste (RCRA exempt MW) utilizing remote control, robot decontamination, and waste pumping technology.	1-5	Support: limited contact, outdoors, PPE-level B w/ supplied air respirator (radon issues)	Reduced potential for contact w/ RCRA exempt MW. Eliminates the need to enter a confined space (high radiation /radon area)	None Noted
FEMP/OU4	D&D	Equipment & Internal Bld. Component Removal Personnel	None in OU4	None in OU4	None in OU4	N/A	N/A
FEMP/OU4	D&D	Encapsulation Personnel	None in OU4	None in OU4	None in OU4	N/A	N/A

①PPE-Level B included: double/single Saranex® coveralls, Latex Gloves & Boot covers, and Full Face Respirators w/ organic vapor/acid gasses/HEPA cartridges.

Table 10.12, Continued: Fernald Environmental Management Project Operable Unit 4 - Past, Present and Proposed Future Technologies As Reported October, 1996

FEMP/OU#	Category	Activity Title	Technology and Brief Description	# of Workers per Technology	Descriptive Exposure Potential	Advantages	Disadvantages
FEMP/OU4	D&D	(Superstructure) External Bld. Component Removal Personnel	None in OU4	None in OU4	None in OU4	N/A	N/A
FEMP/OU4	Clean-up	LLRW Treatment (Past-1991 pilot) (Future-1996-2004)	None in OU4	None in OU4	None in OU4	N/A	N/A
FEMP/OU4	Clean-up	LLRW Systems Maintenance (Present-1996)	Automated Grounds Maintenance Device	1/unit	No contact, outdoors from remote distances, lessen effects from heat stress, eliminates need for PPE	Operated from remote distances, eliminates need for PPE	None Noted
FEMP/OU4	Clean-up	LLRW Disposal & Transportation (Future-1999-2004)	None in OU4	None in OU4	None in OU4	N/A	N/A

①PPE-Level B included: double/single Saranex® coveralls, Latex Gloves & Boot covers, as well as Full Face Respirators w/ organic vapor/acid gasses/HEPA cartridges.

Table 10.13: Fernald Environmental Management Project Operable Unit 5 - Past, Present and Proposed Future Technologies As Reported October, 1996

FEMP/OU#	Category	Activity Title	Technology and Brief Description	# of Workers per Technology	Descriptive Exposure Potential	Advantages	Disadvantages
FEMP/OU5	Hazardous Waste	HW/MW Treatment (Past-1996 pilot) (Present-1996 (Future-1998-2014)	Soil Separation/Treatment: An ex-situ, physical extraction/separation process for the removal of organic, in-organic, and radiologically contaminated soil by physical means (mass action) or chemically by complexing, chelating, reducing, oxidizing, or ion-exchange.	50 - 100 total	Limited contact, closed loop system indoors w/HEPA and off-gas scrubbers. ①PPE-Level B	Reduced potential for contact w/HW or MW in a Closed Treatment System	The technology utilizes phosphates & sulfates as additives. Radon control issues
FEMP/OU5	Hazardous Waste	HW/MW Treatment (Future-1998-2014)	Minimum Additive Waste Stabilization(MAWS): remediates HW/MW/LLRW in multiple waste streams through one vitrification treatment train	10 - 20	Limited contact, indoors w/HEPA, ①PPE-Level B	Reduced potential for skin contact w/HW sludges & Closed Treatment System	None Noted
FEMP/OU5	Hazardous Waste	HW/MW Storage	None in OU5	None in OU5	None in OU5	N/A	N/A
FEMP/OU5	Hazardous Waste	HW/MW Transportation	None in OU5	None in OU5	None in OU5	N/A	N/A

①PPE-Level B included: double/single Saranex® coveralls, Latex Gloves & Boot covers, as well as Full Face Respirators w/ organic vapor/acid gasses/HEPA cartridges.

Table 10.13, Continued: Fernald Environmental Management Project Operable Unit 5 - Past, Present and Proposed Future Technologies As Reported October, 1996

FEMP/OU#	Category	Activity Title	Technology and Brief Description	# of Workers per Technology	Descriptive Exposure Potential	Advantages	Disadvantages
FEMP/OU5	D&D	Equipment & Internal Bld. Component Removal Personnel	None in OU5	None in OU5	None in OU5	N/A	N/A
FEMP/OU5	D&D	Encapsulation Personnel	None in OU5	None in OU5	None in OU5	N/A	N/A
FEMP/OU5	D&D	(Superstructure) External Bld. Component Removal Personnel	None in OU5	None in OU5	None in OU5	N/A	N/A
FEMP/OU5	Clean-up	LLRW Treatment Present-1996 pilot) (Future-1998-2014)	Electro Hydraulic Scabbling: Utilizes an electrical discharge in a water bath to remove contaminated concrete pads, foundations, etc. (after D&D of buildings & plants). Can remove .07" of concrete comparatively dust free.	2-5	Limited contact, outdoors (after D&D of buildings & Plants). PPE-level B	Reduced potential for contact. Fixed radiological contamination. Feed water can be treated and reused	None Noted

①PPE-Level B included: double/single Saranex® coveralls, Latex Gloves & Boot covers, as well as Full Face Respirators w/ organic vapor/acid gasses/HEPA cartridges.

Table 10.13, Continued: Fernald Environmental Management Project Operable Unit 5 - Past, Present and Proposed Future Technologies As Reported October, 1996

FEMP/OU#	Category	Activity Title	Technology and Brief Description	# of Workers per Technology	Descriptive Exposure Potential	Advantages	Disadvantages
FEMP/OU5	Clean-up	LLRW Treatment (Present-1996) (Future-1998-2028)	Enhanced Groundwater Remediation (In situ Leaching): This uranium mining industry technology utilizes a geometric pattern of extraction, injection and monitoring wells based on aquifer hydro geology.	5-8	No contact & outdoors	None Noted	None Noted
FEMP/OU5	Clean-up	LLRW Treatment (Past-1991 pilot) (Present - 1996) (Future-1999-2028)	Advanced Waste Water Treatment Facility: Treats existing uranium contaminated wastewater and certain storm water runoff to less than 20 ppb at a rate of 1,100 gallons per minute by utilizing chemical precipitation/clarification process to remove suspended solids containing radio nuclides & carbon filters to remove volatile organic compounds	10-20	Limited contact closed loop system, indoors w/HEPA ventilation. Sulfuric acid used to regenerate ion exchange resin	Reduced potential for ingestion of radiologically contaminated water supplies	None Noted

①PPE-Level B included: double/single Saranex® coveralls, Latex Gloves & Boot covers, as well as Full Face Respirators w/ organic vapor/acid gasses/HEPA cartridges.

Table 10.13, Continued: Fernald Environmental Management Project Operable Unit 5 - Past, Present and Proposed Future Technologies As Reported October, 1996

FEMP/OU#	Category	Activity Title	Technology and Brief Description	# of Workers per Technology	Descriptive Exposure Potential	Advantages	Disadvantages
FEMP/OU5	Clean-up	LLRW Systems Maintenance (Present-1996) (Future-1996-2014)	Automated Grounds Maintenance Device: Hydraulically powered, self-propelled lawn mower outfitted w/remote controls.	1/unit	No contact, outdoors from remote distances, lessen effects from heat stress, eliminates need for PPE	Operated from remote distances eliminates need for PPE	None Noted
FEMP/OU5	Clean-up	LLRW Disposal & Transportation	None in OU5	None in OU5	None in OU5	N/A	N/A

①PPE-Level B included: double/single Saranex® coveralls, Latex Gloves & Boot covers, as well as Full Face Respirators w/ organic vapor/acid gasses/HEPA cartridges.

Table 10.14: Fernald D&D Worker Contacts, Activity Descriptions and Exposure Types As Reported October, 1996

Facility	Category	Contact(s)	Activities Title and Brief Description	Exposure Type	Driver	Timeline	Duration	Workers per Activity
Fernald OU 1	D&D	Information gathered from reference material	Act 1: None Applicable. There are no large buildings or structures within this Operable Unit requiring the services of a D&D contractor	N/A	N/A	N/A	N/A	N/A
Fernald OU 2	D&D	Information gathered from reference material	Act 2: None Applicable. There are no large buildings or structures within this Operable Unit requiring the services of a D&D contractor	N/A	N/A	N/A	N/A	N/A
Fernald OU 3	D&D	Information gathered from reference material	Act 3: Plant 8 Thorium Bins and Silo: Low Level Radiological Waste (Thorium) Removal, External Structure Component (Superstructure) Removal, Encapsulation (tape &herculite) of removed Equipment	LLRW	CERCLA	12/89 - 11/90	348 Calendar Days	MED: 35
Fernald OU 3	D&D	Information gathered from reference material	Act 4: Plant 1 Ore Silos: Low Level Radiological Waste (Thorium) Removal, External Structure Component (Superstructure) Removal & Size Reduction, Encapsulation of Structural Components (tape & herculite or application of latex paint).	LLRW	CERCLA	12/92 - 12/94	24 months	HIGH:>75

Table 10.14, Continued: Fernald D&D Worker Contacts, Activity Descriptions and Exposure Types As Reported October, 1996

Facility	Category	Contact(s)	Activities Title and Brief Description	Exposure Type	Driver	Timeline	Duration	Workers per Activity
Fernald OU 3	D&D	Information gathered from reference material	Act 5: Plant 7 Removal: Equipment & Internal Bld. Component Removal, Encapsulation, External Bld. Component (Superstructure) Removal & Size Reduction	LLRW	CERCLA	12/3/93 -11/16/94	348 calendar days	MED: 11 - 75
Fernald OU 3	D&D	Information gathered from reference material	Act 6: Plant 4 Removal: Equipment & Internal Bld. Component Removal, Encapsulation, External Bld. Component (Superstructure) Removal & Size Reduction	LLRW	CERCLA	12/7/94 -9/25/96	656 calendar days	MED: 11 - 75
Fernald OU 3	D&D	Information gathered from reference material	Act 7: Plant 1 Removal: Equipment & Internal Bld. Component Removal, Encapsulation, External Bld. Component (Superstructure) Removal & Size Reduction	LLRW	CERCLA	2/5/96 -11/22/97	658 calendar days	MED: 11 - 75
Fernald OU 3	D&D	Information gathered from reference material	Act 8: Plants 10 & 20 and associated structures Removal: Equipment & Internal Bld. Component Removal, Encapsulation, External Bld. Component (Superstructure) Removal & Size Reduction	LLRW	CERCLA	2/97 -2/98	1 year	MED: 11 - 75
Fernald OU 3	D&D	Information gathered from reference material	Act 9: Plants 9 and associated structures Removal: Equipment & Internal Bld. Component Removal, Encapsulation, External Bld. Component (Superstructure) Removal & Size Reduction	LLRW	CERCLA	2/97 -2/98	1 year	MED: 11 - 75

Table 10.14, Continued: Fernald D&D Worker Contacts, Activity Descriptions and Exposure Types As Reported October, 1996

Facility	Category	Contact(s)	Activities Title and Brief Description	Exposure Type	Driver	Timeline	Duration	Workers per Activity
Fernald OU3	D&D	Information gathered from reference material	Act 10: Building 69 and associated structures Removal: Equipment & Internal Bld. Component Removal, Encapsulation, External Bld. Component (Superstructure) Removal & Size Reduction	LLRW	CERCLA	2/97 -2/98	1 year	MED: 11 - 75
Fernald OU 3	D&D	Information gathered from reference material	Act 11: Building 64/65 and associated structures Removal: Equipment & Internal Bld. Component Removal, Encapsulation, External Bld. Component (Superstructure) Removal & Size Reduction	LLRW	CERCLA	2/97 -2/98	1 year	MED: 11 - 75
Fernald OU 3	D&D	Information gathered from reference material	Act 12: Plants 12 and associated structures Removal: Equipment & Internal Bld. Component Removal, Encapsulation, External Bld. Component (Superstructure) Removal & Size Reduction	LLRW	CERCLA	2/98 -2/99	1 year	MED: 11 - 75
Fernald OU 3	D&D	Information gathered from reference material	Act 13: Plants 5 & 3 and associated structures Removal: Equipment & Internal Bld. Component Removal, Encapsulation, External Bld. Component (Superstructure) Removal & Size Reduction	LLRW	CERCLA	2/98 -2/99	1 year	MED: 11 - 75

Table 10.14, Continued: Fernald D&D Worker Contacts, Activity Descriptions and Exposure Types As Reported October, 1996

Facility	Category	Contact(s)	Activities Title and Brief Description	Exposure Type	Driver	Timeline	Duration	Workers per Activity
Fernald OU 3	D&D	Information gathered from reference material	Act 14: Plants 2, 6 & 8 plus associated structures Removal: Equipment & Internal Bld. Component Removal, Encapsulation, External Bld. Component (Superstructure) Removal & Size Reduction	LLRW	CERCLA	1999 -2000	1 year	MED: 11 - 75
Fernald OU 3	D&D	Information gathered from reference material	Act 15: Plant 1 Pad and associated structures (Buildings 30, 82, 71, KC2 Warehouse, Quonset huts 1, 2 & 3) Removal: Equipment & Internal Bld. Component Removal, Encapsulation, External Bld. Component (Superstructure) Removal & Size Reduction	LLRW	CERCLA	1999 -2000	1 year	MED: 11 - 75
Fernald OU 3	D&D	Information gathered from reference material	Act 16: Pilot Plant and associated structures Removal: Equipment & Internal Bld. Component Removal, Encapsulation, External Bld. Component (Superstructure) Removal & Size Reduction	LLRW	CERCLA	1999 -2000	1 year	MED: 11 - 75
Fernald OU 3	D&D	Information gathered from reference material	Act 17: Remaining Administrative support buildings including Lab building, Services building, Administration building, and associated structures Removal: Equipment & Internal Bld. Component Removal, Encapsulation, External Bld. Component (Superstructure) Removal & Size Reduction	LLRW to MSW	CERCLA	2000-2001	1 year	MED: 11 - 75

Table 10.14, Continued: Fernald D&D Worker Contacts, Activity Descriptions and Exposure Types As Reported October, 1996

Facility	Category	Contact(s)	Activities Title and Brief Description	Exposure Type	Driver	Timeline	Duration	Workers per Activity
Fernald OU 4	D&D	Information gathered from reference material	Act 18: K-65 silos and associated structures Removal: Encapsulation, External Silo Component Removal & Size Reduction	LLRW	CERCLA	2003-2005	2 year	MED: 11 - 75
Fernald OU 5	D&D	Information gathered from reference material	Act 1: None applicable. There are no large buildings or structures within this Operable Unit requiring the services of a D&D contractor.	N/A	N/A	N/A	N/A	N/A

Table 10.15: Fernald CW Worker Contacts, Activity Descriptions and Exposure Types As Reported October, 1996

Facility	Category	Contact(s)	Activities Title and Brief Description	Exposure Type	Driver	Timeline	Duration	Workers per Activity
Fernald OU 1	CW	Information gathered from reference material	Act 1: LLRW **Treatment** (utilizing remediation methods such as vitrification, sludge dewatering, excavating & drying). **Storage** (inspection, container maintenance and tracking). **Transportation/Disposal** (container handling and shipping to storage or final disposition). **Systems Operation/Maintenance** (i.e. operation of Automated Grounds Maintenance Device)	LLRW	CERCLA	1996-2004	8 years	MED: 11-75
Fernald OU 2	CW	Information gathered from reference material	Act 2: LLRW **Treatment** (utilizing remediation methods such as vitrification & excavating). **Storage** (inspection, container maintenance and tracking). **Transportation/Disposal** (container handling and shipping to storage or final disposition). **Systems Operation/Maintenance** (i.e. operation of Automated Grounds Maintenance Device)	LLRW	CERCLA	1996-2001 (Waste Areas) 1996-2014 (Onsite Disposal Cell)	6 years 18 years	MED: 11-75 HIGH: >76
Fernald OU 3	CW	Information gathered from reference material	Act 3: LLRW **Treatment** (utilizing remediation methods such as vitrification, Dewatering, Stabilization & Chemical Treatment). To occur or has occurred in Plants: 6, 9, 13a & Buildings 64/ 65	LLRW	CERCLA	1996-2010	14 years	HIGH: >76

Table 10.15, Continued: Fernald CW Worker Contacts, Activity Descriptions and Exposure Types As Reported October, 1996

Facility	Category	Contact(s)	Activities Title and Brief Description	Exposure Type	Driver	Timeline	Duration	Workers per Activity
Fernald OU3	CW	Information gathered from reference material	Act 4: LLRW **Storage** (inspection, container maintenance and tracking) To occur or has occurred in Plants: 6, 9, 13a & Buildings 64/ 65	LLRW	CERCLA	1996-2010	14 years	HIGH: >75
Fernald OU3	CW	Information gathered from reference material	Act 5: LLRW **Transportation/Disposal** (container handling and shipping to storage or final disposition)	LLRW	CERCLA	1996-2010	14 years	HIGH: >75
Fernald OU3	CW	Information gathered from reference material	Act 6: LLRW **Systems Operation/ Maintenance**: Operation of Automated Grounds Maintenance Device or Operation/Maintenance of all Utilities, Process, Shipping & Vehicular Systems or Equipment	LLRW	CERCLA	1996-2010	14 years	HIGH: >75

Table 10.15, Continued: Fernald CW Worker Contacts, Activity Descriptions and Exposure Types As Reported October, 1996

Facility	Category	Contact(s)	Activities Title and Brief Description	Exposure Type	Driver	Timeline	Duration	Workers per Activity
Fernald OU 4	CW	Information gathered from reference material	Act 7: LLRW **Treatment** (utilizing remediation methods such as vitrification). **Storage** (inspection, container maintenance and tracking). **Transportation/Disposal** (container handling and shipping to storage or final disposition). **Systems Operation/ Maintenance** (i.e. operation of Automated Grounds Maintenance Device or Operation/Maintenance of all Utilities, Process, Shipping & Vehicular Systems or Equipment	LLRW	CERCLA	1994-2010	16 years	HIGH: >75
Fernald OU 5	CW	Information gathered from reference material	Act 8: LLRW **Treatment** (utilizing remediation methods such as Advanced Wastewater Treatment, & excavating). **Storage** (inspection, container maintenance and tracking). **Transportation/Disposal** (container handling and shipping to storage or final disposition). **Systems Operation/ Maintenance** (i.e. operation of Automated Grounds Maintenance Device or Operation of the Advanced Wastewater Treatment System)	LLRW	CERCLA	1997-2014 (Soils) 1997-2028 (Groundwater)	17 years 31 years	HIGH: >75 HIGH: >75

Table 10.16: Fernald Site-Specific PPE Levels as of 10/96

PPE Level	Equipment Description
Level D	Company issued cloth coveralls, steel toed work boots and safety glasses.
Level C	Company issued cloth coveralls, steel toed work boots, safety glasses, protective disposable or washable coveralls and gloves.
Level B	Company issued cloth coveralls, steel toed work boots, safety glasses, protective disposable or washable coveralls, gloves and air purifying respiratory protection
Level A	Company issued cloth coveralls, steel toed work boots, safety glasses, protective disposable or washable coveralls, gloves, a fully encapsulating suit and supplied air respiratory protection.

Table 10.17: Demographic Description of HW, D&D, and CW Workers at the Fernald Environmental Management Project (FEMP) As Reported October, 1996

Facility	Category	Contractor	# Workers	Industry Profile	Top 5 Job Titles	Primary Activity Titles	No. Workers
FEMP	D & D	Babcox and Wilcox NESI 2200 Langhorne Road Lynchburg, VA 24506 (804) 948-4600 (POC): James D. Phinney⑤	15-50 ④	1. Construction 2. Demolition 3. Asbestos and Lead Abatement 4. Nuclear Power Plant Maintenance	1. Asbestos and Lead Abatement Workers 2. Demolition/ Construction Workers 3. Laborers 4. Painters 5. Millwrights	Equipment and Internal Bld. Component Removal Personnel, Encapsulation Personnel and External Bld.. Component Removal Personnel	1. N/A* 2. N/A 3. N/A 4. N/A 5. N/A
	D & D	International Technology Corporation (IT) 312 Directors Drive Knoxville, TN 37923 (423) 690-3211 (POC): John Rizor	35	1. Construction 2. Demolition 3. Nuclear Power Plant Maintenance	1. Nuclear Material Handlers 2. Demolition/ Construction Workers 3. Laborers 4. Millwright 5. Electricians	Equipment and Internal Bld.. Component Removal Personnel, Encapsulation Personnel and External Bld.. Component Removal Personnel	1. N/A 2. N/A 3. N/A 4. N/A 5. N/A
	D & D	Wise Construction 1705 Guenther Road Dayton, OH 45471 (513) 854-0281 (POC): David Abney	93	1. Construction 2. Demolition 3. Asbestos and Lead Abatement	1. Asbestos and Lead Abatement Workers 2. Demolition/ Construction Workers 3. Laborers 4. Heavy Equipment Operators 5. Trades: Pipe fitters, Electricians, etc.	Equipment and Internal Bldg. Component Removal Personnel, Encapsulation Personnel and External Bldg. Component Removal Personnel	1. N/A 2. N/A 3. N/A 4. N/A 5. N/A

Table 10.17, Continued: Demographic Description of HW, D&D, and CW Workers at the Fernald Environmental Management Project (FEMP) As Reported October, 1996

Facility	Category	Contractor	# Workers	Industry Profile	Top 5 Job Titles	Primary Activity Titles	No. Workers
FEMP	D & D	Martech Construction (Out of business, no known address)③	Not Known	1. Construction 2. Demolition 3. Asbestos and Lead Abatement	1. Demolition/ Construction Workers 2. Laborers 3. Heavy Equipment Operators 4. Heavy Equipment Operators 5. Trades: Pipe fitters, Electricians, etc.	Equipment and Internal Bldg. Component Removal Personnel, Encapsulation Personnel and External Bldg. Component Removal Personnel	1. N/A 2. N/A 3. N/A 4. N/A 5. N/A
	CW HW	FERMCO (a subsidiary of Fluor Daniel, Inc.) P.O. Box 538705 (MS-SDC3/005) Cincinnati, OH 45253-8705 (513) 648-6415 Demographics (POC): Darlene Gill	652 ①	Solid, Hazardous and Mixed Waste Treatment, Storage and Disposal Workers	1. Hazwoper 2. Motor Vehicle Oper. 3. Laborer 4. Millwright 5. Pipe fitter	HW/MW/LLRW Treatment, Storage, Disposal, Transportation and Systems Maintenance	1. 222 ① 2. 59 3. 40 4. 38 5. 32
	HW, D&D and CW Combined	All of Above 1989-1996	Total ②: 820				

* N/A - Not Available

① Numbers represent peak numbers of employees 1995-1996.

② Total represents the number of study specific workers only (administrative support and other non-exposed workers are excluded).

③ Information unavailable in print, See Conversation Report w/ Francis Maranda (FERMCO Contracts Administration)(45)

④ Utilized the highest number in total

⑤ Information unavailable in print, See Conversation Report w/ J. Phinney (B&W)(63)

11.0 - FERNALD SITE CASE STUDIES

As an addendum to this study, three select HW, D&D and CW activities per group are presented. These Case Studies, based on actual historic HW, D&D and CW group activities at the Fernald Site, will further illustrate the function/responsibilities of these worker groups. These activities include, when available, information regarding contaminants of concern, duration of the activity and worker exposures associated with the specific activity.

Note: All numerical data reported as taken from reference material.

HW WORKER CASE STUDIES

11.1 HW Worker Case Study 1: Decontamination of North and South Solvent Tanks.

Description of Tanks:

The North (T-1S) and South (T-2S) Solvent Tanks were determined to be HWMU's because they stored wastes which were characteristically hazardous for ignitability. (RCRA - EPA HW No. D001 drivers). They were operated as part of a recovery system for contaminated extraction solvents. The solvent mixture was used as an extractant in the uranium and thorium refining processes. These solvents were stored in Tanks T-1S and T-2S before being reprocessed through other systems for recovery or reuse of solvent ingredients. Both tanks have a maximum capacity of 2200 gallons.

Contaminants of Concern:

The solvent mixture stored in the tanks consisted of :

1. Diamyl-amyl phosphonate (DAAP), 1,2,4-trimethylpentane, cumene, xylene, ethlybenzene (Solvesso® 100), tributyl phosphate and/or kerosene.

2. Uranium

Solvesso® 100 and kerosene were the main contributors to the tank contents.

Tank Decontamination Process:

The tanks were emptied by blanking off the process lines and pumping the contents out of the bottom of the tanks utilizing the existing pump and drain lines. Inspection of the tanks at this time revealed that no solvent material existed in the process lines, no residues (e.g., tar, oils, resins, waxes, greases, etc.) appeared on the walls and bottoms of the tanks and little or no solvent remained in the tanks.

1. All process piping connected to the tanks were disconnected from the tank flanges and blanked off to prevent steam cleaning and rinse waters from escaping. All electrical connections to equipment were disconnected, tagged and locked out. When removing the first flange, the Industrial Hygiene Department, using a Photo Ionizing Detector (PID), recorded worker breathing space total volatile organic compounds at 74 - 280 ppm. This prompted a project work stoppage and an upgrade in respiratory protection whereby organic vapor combo cartridges were substituted with supplied air (air line) respirators.

2. Each tank was then rinsed with approximately 100 gallons of pressurized water. The rinseate was then drained and treated on site. Industrial Hygiene, using a Photo Ionizing Detector (PID), recorded worker breathing space volatile organic compounds at <2 ppm while rinsing the tanks.

3. After each tank was rinsed and the bottom of the drain valve closed, a steam line was inserted into the man way of each tank to remove residues adhering to the side walls and bottom. After the steam was removed, the drain valve underneath was opened to release the accumulated water into an approved storage container. The drain valve was then closed.

4. Each tank was then rinsed again with approximately 100 gallons of pressurized water. The rinseate was then drained and containerized in an approved storage container(s).

5. The drain valve was then closed again prior to performance of a final verification rinse. The verification rinse used an additional 100 gallons of clean water per tank. Each tank was then drained once more and the rinseate containerized, sampled and analyzed for BETX (benzene, ethylene, toluene, xylene) and flashpoint.

6. The interior of the tanks were then visually inspected.

Ancillary Equipment Decontamination Process:

1. As the ancillary equipment was dismantled from the HWMU, it was flushed with water to clean off any residuals. The rinseate generated by this process was then pumped into an appropriate container.

2. The ancillary equipment was managed as solid waste after it was removed from the HWMU. In order to characterize the debris, the rinseate from the equipment was sampled and analyzed for flashpoint and TCLP (Toxicity Characteristic Leaching Procedure) benzene. Equipment was then disposed of.

Project Personal Protective Equipment Requirements:

At the onset of this project HW workers wore Saranex® suits, nitrile and surgical gloves and full face respirators fitted with HEPA organic vapor combo cartridges. As stated above, when IH field instruments indicated elevated levels of Volatile Organic Compounds (VOC's), the HEPA organic vapor combo cartridges were substituted with supplied air (air line) respirators.

Sampling Information:

Industrial Hygiene used PID's to record worker breathing space total volatile organic compounds. If/when a reading of greater than 50 ppm was encountered, specific chemical compound indicators in the form of Draeger® tubes were utilized. FEMP Standard Operating Procedure mandates that Industrial Hygiene monitor the work environment for worker breathing space total volatile organic compounds before work is begun.

Project Specific Chemical Exposure Data:

Table 12.1, HW Worker Case Study 1, page 140, presents Project Specific Chemical Exposure Data for the Decontamination of the North and South Solvent Tanks.

Twelve personal samples were collected by FERMCO Industrial Hygiene for methylene chloride and tributyl phosphate (TBP) during the rinsing and demolition of these solvent tanks which allowed the calculation of an 8-hour Time Weighted Average (TWA) for personal exposures. These results, <0.006 ppm for TBP and <0.12 ppm for methylene chloride, were less than one percent of the current OSHA Permissible Exposure Limits (PEL) of 0.2 ppm for TBP and 25 ppm for methylene chloride(28). Table 12.2, HW Worker Case Study 1, page 141, provides additional chemical exposure data gathered during the course of this activity.

Project Specific Radiological Exposure Data:

The FEMP Radiological control group oversees the HW, D&D and CW work at the FEMP from a radiological perspective. This group has implemented a DOE driven administrative control which calls for twenty-five percent of the HW, D&D and CW's working on projects where uranium is the prime contaminate of concern (COC) to wear Personal Air Samplers (PAS). One hundred percent of the HW, D&D and CW's working on projects where thorium is the prime COC are required to wear PAS's. It should be noted that the reported PAS data reflects the use of the solubility class "W" Derived Air Concentration (DAC) value for uranium (as cited in 10 CFR section 835), which has been confirmed by comparison to bioassay sampling programs and the solubility class "W" DAC value for thorium-232. Therefore, the use of these conservative DAC values means that 1 DAC-hour (hr) represents a 1.0 mrem exposure to solubility class "W" thorium-232 and a 0.19 mrem exposure to solubility class "W" uranium. Also, the corrected DAC-hr values take into account respiratory protection factors, as prescribed by ANSI Z88.2. Lastly, it is important to convey that these values do not necessarily mean that a worker had confirmed intake(49),(50),(51).

This data is stored by building or plant number. Table 12.3, HW Worker Case Study 1, page 142, presents the results from the sampling for Building 13A (3/94 to 4/96) where the North/South Solvent Tanks are located.

11.2 HW Worker Case Study 2: Decontamination of Tank T-2

Description of Tank:

Tank T-2 was an 8,000 gallon capacity tank that was used to store purified thorium nitrate solution generated at the DOE's Hanford facility as part of the DOE-wide research program with Thorium Breeder Reactors. When this program was terminated in the early 1970's the material was sent to Fernald, the United States thorium repository. Nitric acid was used to keep the thorium in solution. Tank T-2 was located in a diked tank farm area on the west side exterior of the Pilot Plant and contained approximately 5,300 gallons of thorium nitrate solution at the time of decontamination.

Contaminants of Concern:

Radiological analysis indicated a total thorium mean concentration of 408 g/L and a cadmium TCLP metal concentration of 1.9 ppm, which is above the RCRA regulatory level of 1.0 ppm. Chromium TCLP metal analysis indicated a concentration of 5.27 ppm which is above the RCRA regulatory level of 5.0 ppm.

The excess nitric acid (1 to 3 Normal) used to keep thorium nitrate in solution is known to exhibit the hazardous characteristic of corrosivity (RCRA-EPA HW No. D002 radioactive waste).

The thorium nitrate waste, based upon the above, is characterized as RCRA-EPA HW No. D002, D006 and D007 radioactive waste.

Tank Decontamination Process:

As an engineering control, a HEPA ventilated solidification tent was erected around tank T-2 prior to solidification of the thorium nitrate solution. The tent was utilized as a means of preventing the release of radiological particulate contamination to the environment. At times workers worked inside the tent.

The tank's contents underwent neutralization/solidification in-place by gradually adding sodium hydroxide, cement and flyash through a closed loop system engineered to reduce worker chemical and radiological exposure. The resulting slurry was filtered and de-watered at the on-site Waste Water Treatment Facility (WWTF). The solidified waste was placed in drums for shipment to the NTS(77). According to the Final Report, no process piping, electrical connections or ancillary equipment was associated with T-2 because it had been previously isolated. The emptied tank (post solidification) was blanked off and the following steps were taken:

1. The tank was rinsed with approximately 100 gallons of pressurized water. The rinse was then drained and containerized in an approved storage container(s).

2. After the tank was rinsed and the bottom of the drain valve closed, a steam line was inserted into the man way of the tank to remove residues adhering to the side walls and bottom. After the steam was removed, the drain valve underneath was opened to release the accumulated water into an approved storage container. The drain valve was then closed.

3. The tank was then rinsed three more times with approximately 100 gallons of pressurized water to reduce radiological contamination levels from thorium residues. The rinse was then drained and containerized in an approved storage container(s) for treatment at the WWTF.

4. The drain valve was then closed again prior to performance of a final verification rinse. The verification rinse used an additional 100 gallons of clean water. The tank was then drained once more and the rinseate containerized, sampled and analyzed for corrosivity. TCLP Cadmium results were less than 190 μg/L and Chromium results less than 860 μg/L.

5. The interior of the tank was then visually inspected.

6. The cleaned tank was abandoned in place awaiting the decontamination and decommissioning of the Pilot Plant.

Project Personal Protective Equipment Requirements:

During this project the HW workers wore double Saranex® suits, surgical inner gloves, nitrile outer gloves, nitrile boot covers and full face supplied air (airline) respirators.

Sampling Information:

Industrial Hygiene used PID's to record worker breathing space total volatile organic compounds. If/when a reading of greater than 50 ppm was encountered, specific chemical compound indicators in the form of Draeger® tubes were utilized.

Project Specific Chemical Exposure Data:

Table 12.4, HW Worker Case Study 2, page 142, presents Project Specific Chemical Exposure Data for the Decontamination of Tank T-2.

Project Specific Radiological Exposure Data:

Radiological air and dosimetry monitoring throughout the duration of this project indicated cumulative exposures received by project personnel were below the project goal of 1.9 man-rems. "Radiation Area" (work zone) dose-rates were between 10-15 mrem/hour. General area dose-rates in the project area were less than 5 mrem/hour. The DAC for Thorium - 232 (Class W soluble) and thoron progeny with a DAC of 1.0 working levels (WL) were monitored throughout the project; average concentrations on the project perimeter were less than ten percent of each DAC(52),(53).

11.3 HW Worker Case Study 3: Decontamination of an Open Top Tank at the Fire Training Facility

Description of Tank:

The Open Top Tank, located at the Fernald site Fire Training Facility (FTF), was filled with waste solvents or fuel oil that was ignited and then extinguished for the purpose of practicing fire fighting techniques. Sediments/sludges had collected in the tank and were removed as part of Removal Action # 28.

Contaminants of Concern:

Flammable liquids burned in the tank included kerosene, gasoline, diesel fuel and waste oils from the maintenance building which contained spent 1,1,1- trichloroethane from de-greasing operations. Off site solvents brought to the FTF by a local fire department included waste thinners, waste paint solvents and waste toluene. Spent 1,1,1- trichloroethane and spent toluene are RCRA listed hazardous wastes (RCRA-EPA HW No. F002 and F005, respectively).

Tank Decontamination Process:

The tank's contents were pumped out and the following steps were taken:

1. The tank's drain valve was blanked off to prevent steam cleaning and rinse waters from escaping.

2. The tank was then rinsed with approximately 100 gallons of pressurized water. The rinse was then drained and containerized in an approved storage container(s).

3. After the tank was rinsed and the bottom of the drain valve closed, a steam line was utilized to remove residues adhering to the side walls and bottom. After the steam was removed, the drain valve underneath was opened to release the accumulated water into an approved storage container. The drain valve was then closed.

4. The tank was then rinsed again with approximately 100 gallons of pressurized water. The rinse was then drained and containerized in an approved storage container(s).

5. The drain valve was then closed again prior to performance of a final verification rinse. The verification rinse used an additional 100 gallons of clean water. The tank was then drained once more and the rinseate containerized, sampled and analyzed for spent 1,1,1-trichloroethane and toluene.

6. The interior of the tank was then visually inspected.

Project Personal Protective Equipment Requirements:

During this project the HW workers wore double Saranex® suits, surgical inner gloves, nitrile outer gloves, nitrile boot covers and full face respirators fitted with HEPA organic vapor combo cartridges.

Sampling Information:

Industrial Hygiene used PID's to record worker breathing space total volatile organic compounds. If/when a reading of greater than 50 ppm was encountered, specific chemical compound indicators in the form of Draeger® tubes were utilized.

Project Specific Chemical Exposure Data:

Table 12.5, HW Worker Case Study 3, page 143, presents Project Specific Chemical Exposure Data for the Decontamination of an Open Top Tank at the Fire Training Facility(31).

Project Specific Radiological Exposure Data:

Table 12.6, HW Worker Case Study 3, page 143, presents FEMP Radiological Control Group Sampling Results Reported for Building 73 (3/94 to 4/96), FTF Open Top Tanks. Results ranged from an average DAC-hr corrected of 0.001 ± 0.001 to an uncorrected of 0.026 ± 0.073 and a maximum DAC-hr corrected of 0.001 to an uncorrected of 0.051 (ranges derived from a total of two samples)(54),(55) (31).

D&D WORKER CASE STUDIES

In order to fully illustrate the function/responsibilities of D&D workers at the FEMP, three select historic D&D worker activities have been described below. These activities include, when available, information regarding contaminants of concern, duration of the activity and worker exposures associated with the specific activity.

11.4 D&D Worker Case Study 1: Decontamination and Decommissioning of the Plant 1 Ore Silos.

Description of Silos:

The Plant 1 Ore Silos, located directly south of Plant 1a, consisted of fourteen storage silos that were used to store uranium ore and raffinate (a by-product of the uranium extraction process). Raffinate has thorium-230 (Th-230) as a primary component and ninety-five percent of the Curie inventory in raffinate is attributable to Th-230.

Two different types of storage silos were utilized; a cylindrical concrete type (total of six silos) and a cylindrical glazed ceramic tile type (total of eight silos). In 1962 the use of the Silos in the FEMP production process was discontinued due to structural deficiencies. Each silo had a conical or funnel type bottom which allowed the stored ores/raffinates to be easily removed for transfer back to the extraction plant (Plant 2/3).

Prior to decontamination and decommissioning, one to six feet of residual uranium ore/raffinate was removed from these silos. Approximately two to three feet of bird droppings was removed from the concrete type silo.

Contaminants of Concern:

The contaminants of concern are uranium ore and raffinate which contains thorium-230 (Th-230) as a primary component.

Additional hazardous wastes associated with the decontamination and decommissioning of the Plant 1 Ore Silos include asbestos, organic residuals from the solvent extraction process, cadmium dusts/salts and lead-based paint.

Decontamination Process:

1. All process piping, electrical runs and product feed tubes associated with the silos were disconnected utilizing the lock-out, tag-out system.

2. A HEPA ventilated pipe scaffold containment device, utilized to enclose the work area, was erected around each silo.

3. Each of the fourteen silos and their support structures were removed in pieces using water saws, cutting torches, hydraulic shears and hand tools.

4. Large pieces were transported to the HEPA ventilated Size Reduction Facility (SRF) for further size reduction, decontamination and containerization.

5. The spent decontamination water detergent solution and other waste waters used in the SERF were then drained and treated through the on site WWTF.

Project Personal Protective Equipment Requirements:

During this project the D&D workers wore various levels of PPE ranging from Level D (company issued clothing, hard hats and work boots), to Level B (double Saranex® suits, hard hats, surgical inner gloves, nitrile outer gloves, nitrile boot covers and full face respirators fitted with either airline (supplied air) or HEPA organic vapor combo cartridges).

Sampling Information:

Industrial Hygiene utilized personal breathing zone (BZ) monitors to determine D&D worker exposure to asbestos fibers, cadmium dusts and salts and lead. Results of this sampling effort are as follows: asbestos fibers at a range of 0.0122 f/cc TWA to 0.1120 f/cc TWA, cadmium dust and salts at a range of 0.0000 mg/m^3 in air TWA to 0.0009 mg/m^3 in air TWA and lead at a range of 0.0 μg/m^3 in air TWA to 450.0 μg/m^3 in air TWA(56).

Project Specific Chemical Exposure Data:

Table 12.7, D&D Worker Case Study 1, page 144, presents Project Specific Chemical Exposure Data for the Decontamination and Decommissioning of the Plant 1 Ore Silos

Project Specific Radiological Exposure Data:

Table 12.8, D&D Worker Case Study 1, page 144, presents the FEMP Radiological Control Group Project Specific Radiological Exposure Data from the PAS for Plt 1 Ore Silos (7/93 to 12/94). Results ranged from an average DAC-hr corrected of 0.507 ± 2.186 to an uncorrected of 21.025 ± 107.829 and a maximum DAC-hr corrected of to 13.85 an uncorrected of 692.50 (ranges derived from a total of 295 samples)(42).

11.5 D&D Worker Case Study 2: Decontamination and Decommissioning of Plant 7 (Removal Action No. 19)

Description of Plant 7:

This seven story plant was designed for the gravity gaseous reduction of uranium hexafluoride (UF_6) with hydrogen to produce green salt (UF_4). In 1967 this type of UF_6 reduction process was deemed obsolete and the majority of the equipment and process piping were dismantled and removed. In 1975 all utilities were disconnected at the exterior walls of the plant and capped off. The remaining process equipment and piping were abandoned in place.

Contaminants of Concern:

The major contaminates of concern in Plant 7 were asbestos, biological hazards (i.e., pigeon droppings), uranium compounds (i.e., UF_4, UF_6, UO_2 and UO_2F_2, all of which were LLRWs), ammonia and nickel. Monitoring for airborne uranium radiological contamination in and around Plant 7 during the decontamination and decommissioning activities ranged from 0.0002 pCi/m^3 to 0.0448 pCi/m^3 with an average of 0.0081 pCi/m^3. It should be noted that all workers on this project were required to wear PPE which included respiratory protection when necessary.

Technologies:

The Plant 7 decontamination and decommissioning marked the first use of controlled detonation at the FEMP. Controlled detonation is a new D&D technology that utilizes steel cutting explosive charges to demolish a superstructure. The decision to use this type of demolition was based on the expected abatement of exposure and physical hazard risks to workers(43). Table 12.9, D&D Worker Case Study 2, page 145, compares and contrasts the amount of effort necessary to achieve demolition using modular dismantlement, a traditional D&D technique and controlled detonation.

Decontamination Process:

1. All utilities and electrical runs associated with Plant 7 were disconnected utilizing lock-out, tag-out protocol.

2. All loose contamination (i.e., radiological components), ductwork, piping, conduit, equipment, interior asbestos and non-asbestos material was removed.

3. All exposed surfaces were decontaminated using detergent solution. The spent decontamination water detergent solution and other waste waters used on this project were then drained and treated through the onsite WWTF.

4. Residual contaminates were encapsulated using latex paint on all exposed surfaces.

5. Exterior transite panels (asbestos), windows and doors were removed.

6. Structural steel skeleton was felled using steel cutting explosive charges.

7. The downed structural steel skeleton sheared using mechanical shears and cutting torches.

8. Scrap steel was placed into roll-off containers for shipment to recycling vendor.

Project Personal Protective Equipment Requirements:

During this project the D&D workers wore various levels of PPE ranging from Level D (company issued clothing and work boots), to Level B (double Saranex® suits, surgical inner gloves, nitrile outer gloves, nitrile boot covers and full face respirators fitted with either airline (supplied air) or HEPA organic vapor combo cartridges).

Sampling Information:

Industrial Hygiene used PID's to record worker breathing space total volatile organic compounds. If/when a reading of greater than 50 ppm was encountered, specific chemical compound indicators in the form of Draeger® tubes were utilized.

Project Specific Chemical Exposure Data:

Not available at the time of this study.

Project Specific Radiological Exposure Data:

Table 12.10, D&D Worker Case Study 2, page 145, presents Project Specific Radiological Exposure Data from the PAS for the Plant 7 Decontamination and Decommissioning (12/93 to 11/94). Results ranged from an average DAC-hr corrected of 0.055 ± 0.230 to an uncorrected of 1.496 ± 7.561 and a maximum DAC-hr corrected of to 1.410 an uncorrected of 90.00 (ranges derived from a total of 967 samples)(57),(43).

11.6 D&D Worker Case Study 3: Decontamination and Decommissioning of Plant 4a

Description of Plant 4a:

This four story plant, utilized until 1988, was designed to facilitate the hydro fluorination process. In this process, twelve reactor banks were used for the conversion of uranium trioxide (UO_3) to uranium dioxide (UO_2) or to triuranium dioxide (U_3O_8) using anhydrous hydrofluoric acid (AHF) to create the plant's final product; uranium tetrafluoride (UF_4, or "green salt"). During 1954, experimental batches of thorium oxides were hydro fluorinated in bank 7, after which this bank resumed uranium production. Plant 4a also housed ten other operations, the majority of which operated only a short time. Long term operations at Plant 4a included uranium tetra fluoride packaging stations, a wastewater treatment system, ammonia dissociation and generation operation, AHF vaporization system and several dust collectors.

Contaminants of Concern:

The contaminates of concern in Plant 4a were asbestos, silica, uranium compounds (i.e., UF_4, U_3O_8, UO_2, UO_3, UO_2F_2,), acids (i.e., HF), caustics (i.e., sodium hydroxide, calcium hydroxide, calcium oxide), ammonia, heavy metals (i.e., mercury & lead) and PCB's. Exposure of the D& D workers to the above listed contaminates of concern is unlikely due to Safe Shutdown activities which superseded the D&D process. An exception to these exposures is uranium compounds (i.e., UF_4, U_3O_8, UO_2, UO_3, UO_2F_2,). Air sampling for uranium ranged from 0.01 pCi/m^3 to 0.095 pCi/m^3.

Airborne Lead:

Seven high volume air samplers were placed around the Plant 4 project site to evaluate airborne lead levels. The day prior to the implosion, samples were collected to establish a background lead level. Samples were collected on the day of the implosion as well. All of these samples were analyzed using NIOSH analytical methodology. The results of this sampling effort were as follows: Six of the pre-implosion samples read less than the 0.30 $\mu g/m^3$ detection limit and the seventh read 1.10 $\mu g/m^3$. Six of the post-implosion samples read less than the 0.20 $\mu g/m^3$ detection limit (lower detection limit due to greater sample volume), the seventh read 0.65 $\mu g/m^3$.

Airborne Asbestos:

Six asbestos air samplers were placed around the Plant 4 project site (800-1500 feet from Plant 4) to evaluate airborne asbestos levels. The day prior to the implosion, samples were collected to establish a background lead level. Samples were collected during the implosion as well. All of these samples were analyzed using NIOSH analytical fiber loading methodology. The results of this sampling effort were as follows: The pre-implosion and post-implosion samples read less than the 0.002 f/cc detection limit to 0.004 f/cc.

Nuisance Dust:

Real-time sampling data revealed a pre-implosion baseline reading of 0.04 mg/m³. During the implosion, dust levels reached a maximum of 0.64 mg/m³, the level returned to background five minutes after the implosion.

Technologies:

The Plant 4a decontamination and decommissioning is being performed by Babcock & Wilcox Company - Nuclear Environmental Services, Inc. (B&W- NESI) of Lynchburg, Virginia. B&W- NESI has subcontracted Controlled Demolition, Inc. to utilize steel cutting explosive charges on the FEMP Plant 4a superstructure. Table 12.11, D&D Worker Case Study 3, page 146, compares and contrasts the amount of effort necessary to achieve demolition using modular dismantlement, a traditional D&D technique and controlled detonation.

Decontamination Process:

1. All utilities and electrical runs associated with Plant 4a were disconnected utilizing lock-out, tag-out protocol.
2. All loose contamination (i.e., radiological components), reactor banks, ductwork, piping, conduit, equipment, interior asbestos and non-asbestos material was removed.
3. All exposed surfaces were decontaminated using detergent solution. The spent decontamination water detergent solution and other waste waters used on this project were then drained and treated through the onsite WWTF.
4. Residual contaminates were encapsulated using latex paint on all exposed surfaces.
5. Exterior transite panels (asbestos), windows and doors were removed.
6. Structural steel skeleton was felled using steel cutting explosive charges.

7. The downed structural steel skeleton was sheared using mechanical shears and cutting torches.

8. Scrap steel was placed into roll-off containers for shipment to a recycling vendor.

Project Personal Protective Equipment Requirements:

During this project the D&D workers wore various levels of PPE ranging from Level D (company issued clothing, hard hats and work boots), to Level B (double Saranex® suits, hard hats, surgical inner gloves, nitrile outer gloves, nitrile boot covers and full face respirators fitted with either airline (supplied air) or HEPA organic vapor combo cartridges).

Sampling Information:

Industrial Hygiene used PID's to record worker breathing space total volatile organic compounds. If/when a reading of greater than 50 ppm was encountered, specific chemical compound indicators in the form of Draeger® tubes were utilized.

Project Specific Chemical Exposure Data:

Not available at the time of this study.

Project Specific Radiological Exposure Data:

Table 12.12, D&D Worker Case Study 3, page 146, presents FEMP Radiological Control Group Reported Results from the PAS for Plant 4a Decontamination and Decommissioning (12/95 to 8/96). Results ranged from an average DAC-hr corrected of 0.243 ± 1.340 to an uncorrected of 15.129 ± 54.535 and a maximum DAC-hr corrected of to 10.448 an uncorrected of 404.00 (ranges derived from a total of 4398 samples).
General Area air sampling for UF_4, U_3O_8, UO_2, UO_3, UO_2F_2, ranged from 1.05 pCi/m^3 to 9.45 pCi/m^3(58),(59),(23).

CW CASE STUDIES

In order to fully illustrate the function/responsibilities of CW's at the FEMP, three select historic CW activities have been described below. These activities include, when available, information regarding contaminants of concern, duration of the activity and worker exposures associated with the specific activity.

11.7 CW Case Study 1: Contaminated Trash Waste Stream

Description of Contaminated Trash Waste Stream:

The Contaminated Trash Baler, located at Bldg. 39A, is used to compact radioactively contaminated trash generated within radiologically controlled areas of the FEMP. Contaminated trash generally consists of radiologically contaminated paper, plastic, non-asbestos insulation and PPE(42). The baled trash is then shipped for off-site disposal.

Contaminants of Concern:

Uranium

Baled Waste Stream Process:

1. Dumpster containing contaminated trash is transported to the Baler.

2. Transportation Driver empties material from dumpster into baler.

3. Baler operator inspects trash for prohibited waste.

4. Baler operator compacts trash.

5. Baler operator moves compacted bale to designated storage area.

6. Operator places bale(s) in sea land container for off-site disposal.

Project Personal Protective Equipment Requirements:

During normal Baler operation the CW's wear PPE consisting of company issued clothes and work boots (Level D). When conditions warrant, PPE can be upgraded to include respiratory protection, etc.

Sampling Information:

Industrial Hygiene used cassette type air sampling devices to record worker breathing zone nuisance dust levels.

Project Specific Chemical Exposure Data:

Not available at the time of this study.

Project Specific Radiological Exposure Data:

The FEMP Radiological control group reported no results from the PAS for Building 39a processes(59).

11.8 CW Case Study 2: Plant 5 East Derby Breakout

Description of Plant 5 East Derby Breakout:

The primary function of Plant 5 was the reduction of UF4 to produce high purity uranium metal "derbies". Derbies are relatively pure blocks of uranium metal and weigh on average around 300 pounds. Derbies and recycled uranium metal were then remelted in vacuum induction furnaces for casting into ingots. The Plant 5 East Derby Breakout area, located on the East side of Plant 5 on the first and second floors, contains 11 pieces of equipment utilized to remove or "breakout" the cooled derbies from the reduction pots in which they were formed. The 11 pieces of equipment associated with the East Derby Breakout include a derby manipulator, vibrating feeder, jaw crusher, lid cleaning station, drum filling station, lid return chute, elevator and associated utilities, hydraulic lines, ductwork and conveyors.

Contaminants of Concern:

Uranium

Plant 5 East Derby Breakout Process:

Prior to start of task:

1. Work area must be cleaned of debris (i.e., any unfixed items not essential to the task at hand).

2. Decontaminate or cover contaminated surfaces if contact with other than hands or feet is required (examples: kneeling, leaning, lying down, etc.).

3. Establish work boundaries and use Herculite® (a fabric reenforced plastic) as a lay down material and secondary containment in the immediate work areas to contain loose material which may result from removal of contents.

Begin Task:

4. Isolate all utilities.

5. Drain any oil/lubricants remaining in motors and hydraulic lines and transport as directed by Supervisor. When draining components containing gear oil, hydraulic oil and/or lubricants, secondary containment must be provided along with absorbent material.

6. Isolate ductwork by unbolting ductwork at flanges.

7. Inspect ductwork interior for holdup material.

8. If holdup material is encountered, use a scoop or HEPA vacuum to remove holdup from interior of ducts.

9. Secure duct openings with Herculite® and tape.

10. Using a scoop, shovel, or HEPA vacuum, remove holdup material from beneath Breakout Station conveyors.

11. Gain access to Breakout Station interior.

12. Visually inspect Station interior for holdup material.

13. If holdup material is encountered, use a scoop, shovel, or HEPA vacuum to remove holdup from Station interior.

14. Secure Station openings with Herculite® and tape.

Task Completion:

15. Remove lay down covering. Using a HEPA vacuum, vacuum all loose material and protective clothing prior to leaving work area.

The Breakout Station was then abandoned in place to await final disposition by decontamination and decommissioning subcontractors.

Engineering Controls:

HEPA units were used during the following activities....

A. When opening a closed system which has the potential to contain radioactive material. This must be done as close to the opening as possible and must remain positioned at the opening until the system is closed.

B. When burning, welding, or cutting contaminated surfaces. A surface is considered "contaminated" if it exceeds the removable and total (fixed plus removable) values specified in Appendix D of RM-0020, FERMCO Radiological Control Requirements Manual.

Project Personnel Protective Equipment Requirements:

During this project the CW's wore various levels of PPE ranging from Level D (company issued clothing and work boots), to Level B (double Saranex® suits, surgical inner gloves, nitrile outer gloves, nitrile boot covers and full face respirators fitted with either airline (supplied air) or HEPA organic vapor combo cartridges).

Sampling Information:

Not available at the time of this study.

Project Specific Chemical Exposure Data:

Not available at the time of this study.

Project Specific Radiological Exposure Data:

Table 12.13, CW Case Study 2, page 147, presents FEMP Radiological Control Group reported results from the PAS for Plant 5 (4/96 to 6/96). Results ranged from an average DAC-hr corrected of 0.089 ± 0.632 to an uncorrected of 1.584 ± 5.792 and a maximum DAC-hr corrected of 2.946 to an uncorrected of 15.00 (ranges derived from a total of 295 samples)(60).

11.9 CW Case Study 3: Pilot Plant Tank D13A-111

NOTE: Crossover of Cleanup Worker (i.e., Safe Shutdown personnel) to HW Group.

This worker Case Study emphasizes the crossover which sometime occurs between worker groups at the FEMP. As a rule, Safe Shutdown workers are CW's and deal with LLRW removal, storage and shipping. However, in this Case Study mixed (i.e., hazardous and radioactive) waste removal, storage and shipping is performed by Safe Shutdown workers. For this particular Case Study, Safe Shutdown workers would be classified as HW workers.

Description of Pilot Plant Tank D13A-111:

This 500 gallon capacity tank, used to precipitate thorium nitrate solution, is located inside the South central portion of Building 13A (Pilot Plant). The material remaining inside the Tank (approximately 100 gallons) was sampled on 2/22/96 and was found to contain a significant amount of thorium nitrate with a pH of less than 1.

Contaminants of Concern:

Thorium and nitric acid.

Pilot Plant D13A-111 Decontamination Process:

1. Tygon® tubing was attached to the end of the tank effluent pipe.

2. The unattached end of the tubing was placed in an empty 55-gallon polyethylene drum.

3. After a bucket was placed under the tank effluent valve, the valve was opened and the empty 55-gallon polyethylene drum was allowed to fill within 3 inches of the top.

4. This process was repeated until all material remaining in the tank was emptied (a total of 100 gallons of material was collected).

5. The drums were then transferred to Waste Management for storage.

6. After the tank was emptied, the tank effluent pipe was removed, drained into a polyethylene drum and placed into a large metal box.

7. The emptied tank was then abandoned in place to await final disposition by decontamination and decommissioning subcontractors.

Project Personnel Protective Equipment Requirements:

This project required CW's to wear double Saranex® suits, surgical inner gloves, nitrile outer gloves and full face respirators fitted with HEPA organic vapor combo cartridges.

Sampling Information:

Industrial Hygiene used a PID to record worker breathing space total volatile organic compounds. If/when a reading of greater than 50 ppm was encountered, more sophisticated chemical specific quantitative instrumentation in the form of Draeger® tubes were utilized.

Project Specific Chemical Exposure Data:

Not available at the time of this study.

Project Specific Radiological Exposure Data:

Table 12.14, CW Case Study 3, page 147, presents Project Specific Radiological Exposure Data from the sampling of Building 13A (3/94 to 4/96) where Tank D13A-111 is located. Results ranged from an average DAC-hr corrected of 0.235 ± 2.184 to an uncorrected of 38.696 ± 564.450 and a maximum DAC-hr corrected of 2.946 to an uncorrected of 10333.00 (ranges derived from a total of 2530 samples)(61),(62).

12.0 - CASE STUDY TABLES

HW WORKER CASE STUDY TABLES

Table 12.1, HW Worker Case Study 1: Project Specific Chemical Exposure Data for the Decontamination of the North and South Solvent Tanks.

Job Class	Isolate Area	Deenergize Equipment	Open Tank	Decontaminate Tank	Cut Up Tank	Transport To Shipping	Ship/ Store
HAZWOPER	N/A ①	N/A ①	N/A (Worker group not involved)	**VOC's** <0.04 mg/m^3 TBP <0.006 ppm in air	None Detected	N/A ②	N/A ②
Pipefitter	N/A ①	N/A ①	**TBP** <0.06 ppm, **Hydrocarbons** <0.2 mg/m^3 in air	N/A (Worker group not involved)	None Detected	N/A ②	N/A ②

①= No contact with Hazardous/Mixed waste no exposure to worker
②= Hazard contained in drum or container no exposure to worker
mg/m^3=milligrams per cubic meter
ppm=parts per million

Table 12.2, HW Worker Case Study 1: FEMP Industrial Hygiene report # IH-06-0013-01 Spot Check #IH-0050.

Date of Sample	**Contaminant**	**Activity**	**8 Hour TWA**	**OSHA PEL**
03/24/94	Hydrocarbons	Breaking flanges	<0.2 mg/m^3 in air	n/a
03/24/94	TBP	Breaking flanges, west side	<0.06 ppm in air	0.2 ppm
03/30/94	Hydrocarbons	Dismantling above tank pipes	<0.1 mg/m^3 in air	n/a
03/30/94	TBP	Dismantling above tank pipes	<0.05 ppm in air	0.2 ppm
03/26/94	Volatile Compounds	Rinsing T-1	<0.04 mg/m^3 in air	<0.11 mg/m^3
03/26/94	TBP	Rinsing ST-2	<0.006 ppm in air	0.2 ppm

(Data per Industrial Hygiene report # IH-06-0013-01 Spot Check #IH-0050)
mg/m^3 = milligrams per cubic meter
ppm = parts per million

Table 12.3, HW Worker Case Study 1: North/South Solvent Tanks Air Sampling Results (Ranges derived from a total of 2530 samples).

Location	Dates	Total # of Samples	Average DAC-hr (corrected)	Average DAC-hr (uncorrected)	Maximum DAC-hr (corrected)	Maximum DAC-hr (uncorrected)
Bldg. 13A	3/94-4/96	2530	0.235 ± 2.184	38.696 ± 564.450	2.946	10333.00

DAC = Derived Air Concentration

Table 12.4, HW Worker Case Study 2: Project Specific Chemical Exposure Data for the Decontamination of Tank T-2.

Job Class	Isolate Area	Deenergize Equipment	Open Tank	Neutralize by Addition of $CaSO_2$	Decontaminate Tank	Cut Up Tank	Transport To Shipping	Ship/ Store
HAZWOPER	N/A ①	N/A ①	N/A (Worker group not involved)	**Nuisance Dust-** Respirable @1.44 mg/m^3 in air **Silica /Cristobalite-** Respirable @0.035 mg/m^3 in air **Silica /Quartz-** Respirable @0.043 mg/m^3 in air	N/A ①	None Detected	N/A ②	N/A ②
Pipefitters	N/A ①	N/A ①	N/A ①	N/A worker group not involved	N/A (Worker group not involved)	None Detected	N/A ②	N/A ②

① = No contact with Hazardous/Mixed waste (closed system) no exposure to worker
② = Hazard contained in drum or container no exposure to worker
mg/m^3 = milligrams per cubic meter

Table 12.5, HW Worker Case Study 3: Project Specific Chemical Exposure Data for the Decontamination of an Open Top Tank at the Fire Training Facility.

Job Class	Isolate Area	Open Equipment	Decontaminate Equipment	Cut Up Equipment	Transport To Shipping	Ship/ Store
HAZWOPER	N/A①	N/A worker group not involved	**1,1,1 Trichloroethane** 0.13 to 27.20 ppm in air **1,1 Dichloroethane** 0.18 to 1.76 ppm in air **Tetrachloroethylene** 11.5 to 0.45 ppm in air **Trichloroethylene** 0.16 to 3.19 ppm in air	None Detected	N/A ②	N/A ②
Pipefitter	N/A①	**1,1,1 Trichloroethane** 0.13 to 27.2 ppm in air **1,1 Dichloroethane** 0.18 to 1.76 ppm in air **Tetrachloroethylene** 11.5 to 0.45 ppm in air **Trichloroethylene** 0.16 to 3.19 ppm in air	N/A worker group not involved	None Detected	N/A ②	N/A ②

① = No contact with Hazardous/Mixed waste no exposure to worker
② = Hazard contained in drum or container no exposure to worker
ppm = parts per million

Table 12.6, HW Worker Case Study 3: FEMP Radiological Control Group Sampling Results Reported for Building 73 (3/94 to 4/96), FTF Open Top Tanks. (Ranges derived from a total of two samples)

Location	Dates	Total # of Samples	Average DAC-hr (corrected)	Average DAC-hr (uncorrected)	Maximum DAC-hr (corrected)	Maximum DAC-hr (uncorrected)
Bldg. 73	7/94-11/96	2	0.001 ± 0.001	0.026 ± 0.073	0.001	0.051

DAC = Derived Air Concentration

D&D WORKER CASE STUDY TABLES

Table 12.7, D&D Worker Case Study 1: Project Specific Chemical Exposure Data for the Decontamination and Decommissioning of the Plant 1 Ore Silos

Job Class	Isolate Area	Open Equipment	Decontaminate and Decommission Equipment	Cut Up Equipment	Transport To Shipping	Ship/ Store
D&D Worker	N/A①	N/A worker group not involved	**Asbestos** 0.012 to 0.112 f/cc **Cadmium** 0.0 to 0.009 mg/m^3 **Lead** 0.006 to 450.0 ug/m^3	None Detected	N/A ②	N/A ②

① = No contact with Hazardous/Mixed; waste no exposure to worker
② = Hazard contained in drum or container no exposure to worker
f/cc = fibers per cubic centimeter
mg/m^3 = milligrams per cubic meter
ug/m^3 = micrograms per cubic centimeter

Table 12. 8, D&D Worker Case Study 1: FEMP Radiological Control Group Project Specific Radiological Exposure Data from the PAS for Plt 1 Ore Silos (7/93 to 12/94). Ranges are derived from a total of 295 samples.

Location	Dates	Total # of Samples	Average DAC-hr (corrected)	Average DAC-hr (uncorrected)	Maximum DAC-hr (corrected)	Maximum DAC-hr (uncorrected)
Plt 1 Ore Silos	7/93 to 12/94	295	0.507 ± 2.186	21.025 ± 107.829	13.85	692.50

DAC = Derived Air Concentration

Table 12.9, D&D Worker Case Study 2: Comparison Between Modular Dismantlement and Controlled Detonation.

Work Activity	Modular Dismantlement	Controlled Detonation
# of Torch Cuts: Columns	420 linear feet full cuts	90 linear feet flange cuts
# of Torch Cuts: Decking	3,000 linear feet (floor)	0 linear feet
# of Heavy Lifts	80	0
Duration	8 weeks	3 weeks
Possible Lead Exposure	640 hours	25 hours
Possible Radiation Exposure	8 weeks	3 weeks
High Altitude Work	yes	no
Work on open floors	yes	no
Heavy lifts	yes	no
Cutting full columns	yes	no

Table 12.10, D&D Worker Case Study 2: Project Specific Radiological Exposure Data from the PAS for the Plant 7 Decontamination and Decommissioning (12/93 to 11/94). Ranges derived from a total of 967 samples.

Location	Dates	Total # of Samples	Average DAC-hr (corrected)	Average DAC-hr (uncorrected)	Maximum DAC-hr (corrected)	Maximum DAC-hr (uncorrected)
Plant 7 D&D	7/93 to 12/94	967	0.055 ± 0.230	1.496 ± 7.561	1.410	90.00

DAC = Derived Air Concentration

Table 12.11, D&D Worker Case Study 3: Comparison Between Modular Dismantlement and Controlled Detonation.

Work Activity	Modular Dismantlement	Controlled Detonation
# of Torch Cuts: Columns	4,200 linear feet full cuts	420 linear feet flange cuts
# of Torch Cuts: Decking	25,200 linear feet (floor)	0 linear feet
# of Heavy Lifts	To be Determined	0
Duration	43 weeks	4 weeks
Possible Lead Exposure	29,400 hours	495 hours
Possible Radiation Exposure	43 weeks	4 weeks
High Altitude Work	yes	no
Work on open floors	yes	no
Heavy lifts	yes	no
Cutting full columns	yes	no

Table 12.12, D&D Worker Case Study 3: FEMP Radiological Control Group Reported Results from the PAS for Plant 4a Decontamination and Decommissioning (12/95 to 8/96). Ranges derived from a total of 4398 samples.

Location	Dates	Total # of Samples	Average DAC-hr (corrected)	Average DAC-hr (uncorrected)	Maximum DAC-hr (corrected)	Maximum DAC-hr (uncorrected)
Plant 4a D&D	12/95 to 8/96	4398	0.243 ± 1.340	15.129 ± 54.535	10.448	404.00

DAC = Derived Air Concentration

CW CASE STUDY TABLES

Table 12.13, CW Case Study 2: FEMP Radiological Control Group Reported Results from the PAS for Plant 5 (4/96 to 6/96). Ranges derived from a total of 295 samples.

Location	Dates	Total # of Samples	Average DAC-hr (corrected)	Average DAC-hr (uncorrected)	Maximum DAC-hr (corrected)	Maximum DAC-hr (uncorrected)
Plant 5	4/96 to 6/96	295	0.089 ± 0.632	1.584 ± 5.792	2.946	15.00

DAC = Derived Air Concentration

Table 12.14, CW Case Study 3: Project Specific Radiological Exposure Data from the Sampling of Building 13A (3/94 to 4/96) Where Tank D13A-111 is Located. Ranges derived from a total of 2530 samples.

Location	Dates	Total # of Samples	Average DAC-hr (corrected)	Average DAC-hr (uncorrected)	Maximum DAC-hr (corrected)	Maximum DAC-hr (uncorrected)
Bldg. 13A	3/94-4/96	2530	0.235 ± 2.184	38.696 ± 564.450	2.946	10333.00

DAC = Derived Air Concentration

13.0 - EXHIBITS

Exhibit 13.1: OU3 D&D Worker Skin, Whole Body and Peak Dose Rates Associated with the Thorium Repackaging Effort

Repackaging Activity	Prorated Skin Dose (in person-mRem)	Prorated Whole Body Dose (in person-mRem)
Phase I - Large Bin	2,941	2,593
Phase II - Small Bin	2,754	2,369
Phase III - Silo	4,869	4,741
Project Total (sum I, II & III)	10,564	9,703

Total Project	Skin Dose (in person-mRem)	Whole Body Dose (in person-mRem)
Actual TLD Reading	16,379	15,618

Peak Does Rates	(in person-mRem)
Phase I - Large Bin	2,593
Phase II - Small Bin	2,369
Phase III - Silo	4,741
Project Total (sum I, II & III)	9,703

Exhibit 13.2: Remediation Worker Radiological Exposure Study (FEMP Paper 2354): Radiological Doses and Risks by Receptor Group

Receptor Group	Effective Dose Equivalent (EDE) in rem
Remediation Worker during a D&D Action	3.4 EDE
Remediation Worker during an On-Site Storage Action	3.5 EDE
Remediation Worker during a Safe Shutdown Action	0.95 EDE
Other On-Site Worker during a D&D Action	0.00012 EDE
Other On-Site Worker during an On-Site Storage Action	0.00024 EDE
Other On-Site Worker during a Safe Shutdown	0.000035 EDE

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53. Department of Energy, Fernald Environmental Management Project [1996]. Transmittal of Final Report for Thorium Nitrate Tank T-2 Completed under Removal Action No. 9 Removal of Waste Inventories. 7492 R-020-209.1 DOE-0531-96.

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56. United States Department of Energy, Ohio Field Office, Fernald Area Office [1996] Industrial Hygiene Report IH-0274-01C - Plant 1 Ore Silos.

57. United States Department of Energy, Fernald Environmental Managment Project [1993]. Plant 7 Dismantling Removal Action 19 Work Plan Rev.0. 4305 R-037-204.1 ERAFS1\Vol 1:RSAPPS\RSDATA\OU-3\PO-32\Work plan. pp. E-1 - 3-3.

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59. Fernald Environmental Management Project, Westinghouse Environmental Managment Company of Ohio, Site Services Document Program, Administrative Record [1991]. SOP 2-C-923. pp. 303-313.

60. Fernald Environmental Restoration and Management Corporation [1996]. Safe Shutdown Implementation Plan #05-0008, Plant 5 East Derby Breakout Area, pp. 1-16.

61. Fernald Environmental Restoration and Management Corporation [1996]. Safe Shutdown Implementation Plan #03-0023. p. 1.

62. Fernald Environmental Restoration and Managment Corporation [1996]. Safe Shutdown Implementation Plan #03-0023. p. 2.

63. Phinney J [1996]. Telephone conversation on August 27, 1996 between James Phinney, Babcock & Wilcox (B&W) Nuclear Environmental Services Inc., and David Back, Senior Staff Scientist, Dynamic Science, Inc.

64. The Site Restoration Services Department, Fernald Environmental Restoration Management Corporation [1996]. 1995 Site Environmental Report. DOE contract no. DE-AC24-92OR21972 for United States Department of Energy Fernald Field Office. pp. 5-7.

Internet Sites Identified:

htttp://cedr.ibi.gov/CEDRhomepage.html
U.S. D.O.E., Office of Environmental, Safety and Health
Comprehensive Epidemiologic Data Resource - Primarily geared to offsite exposures, used as background information only (of little benefit to this study).

htttp://atsdr1.atsdr.cdc.gov:8080/gsql/gethc.script?in_site=OH6890008976
Agency for Toxic Substances and Drug Registry (ATSDR) - A Fernald Site Contaminant List was available at this website however more current and comprehensive information was found at the FEMP PEIC.

htttp://www.em.doe.gov/acd/advisfac.html
Advisory Committee on External Regulation of D.O.E. Nuclear Safety
Nuclear Safety through external regulation- Provides background information DOE complex wide radiological exposure & protection (of little benefit to this study). More current and comprehensive site specific information was found at the FEMP PEIC.

htttp://www.em.doe.gov/menu/?techdev.html
U.S. D.O.E., Office of Environmental Management (Office of Technology Development)
Science/Technology Program Description - Provides information regarding DOE complex wide technologies. More current and comprehensive site specific information was found at the FEMP PEIC.

htttp://www.em.doe.gov/dd/decresma.html
U.S. D.O.E., Office of Environmental Restoration
Decommissioning Resource Manual - Provides information regarding DOE complex wide D&D efforts and methods. More current and comprehensive site specific information was found at the FEMP PEIC.

htttp://www.em.doe.gov/rainmxws/intro.html
U.S. D.O.E., Office of Environmental Management / Office of Technology Development
Working Group Program Description - Provides information regarding DOE complex wide technologies. More current and comprehensive site specific information was found at the FEMP PEIC. Useful for identifying POC for FEMP technologies.

15.0 - QUESTIONNAIRES

MEMORANDUM

Date: June 26, 1996

DOE/Fernald Site Contact: Raj Sundram

Contractor: Dynamic Science Inc. (DSI)

Contractor Research Leaders: David A. Back
Gentry Stevens
(513)-821-3773

Request for information and identification of information resources in support of NIOSH/DOE Hazardous Waste, Decontamination and Decommission and Clean-up Workers Exposure Assessment Feasibility Study at the Fernald Site.

Dear Mr. Sundram,

This request is intended as a means of gathering demographic and exposure data on FEMP production area wage workers involved with hazardous, mixed and radiological waste streams from July of 1989 to present.

At this time we are interested only in a broad based inventory of what data is available relative to our worker classifications. Any sensitive information involving Privacy Act or security related issues should be avoided.

We would like to have this request completed, with our assistance and guidance, by key staff members who have both the knowledge and the capability to synthesize the information requested.

For the purposes of this request the laboratory building and administrative support areas of the FEMP will be excluded.

Worker classifications:

For the purpose of this request, worker classifications will be defined as:

HW (Hazardous Waste Workers)

"That portion of the FEMP wage workforce associated with the transportation, storage and disposal of hazardous and mixed waste generally relating to Hazardous Waste Management Unit's (HWMU's) located in OU3".

Types of HW workers include:

1. Union represented crafts personnel: i.e., pipe fitters, ironworkers, etc.
2. HWMU Inspectors
3. Emergency Actions (Containment and Abatement)
4. RCRA Warehouse Worker

D&D (Decontamination & Decommissioning Workers)

"That portion of the FEMP wage workforce (including sub-contractors) involved in the D&D of structures and associated equipment located in OU3".

Types of D&D workers include:

1. Demolition Sub-contractors
2. Union represented crafts personnel: i.e., laborers, drivers, etc.

CW (Cleanup Workers)

"Safe Shutdown and that portion of the FEMP wage workforce involved in the support of low-level waste shipping activities in OU3".

Types of CW workers include:

1. HAZWOPER
2. Laborer
3. Driver
4. Sampler
5. Inspector
6. Scale Operator

To complete this study, the following information is requested; (Note: If this information has been previously compiled in support of other studies, please identify the studies to avoid any redundancy).

1.) A **demographic description** of the HW, D&D and CW wage workers at the Fernald facility. These descriptive demographics should include, if available;

- number of HW, D&D and CW workers
- number of workers per contractor
- turnover rates
- job titles, tasks, or categories
- number of workers per job task or category
- indication of where workers came from (e.g., former site workers, young unskilled laborers, etc.)
- industry profiles, construction trades, equipment operators, health and safety support and any unconventional work groups
- location of worker activity on-site
- tracking mechanisms/availability of past, present and future information on these workers

2.) **Exposure characterization data** and the available *exposure* information indexed into the following groups: hazardous, mixed and radiological. Sources for this type of information will include:

- Exposure data sources and data repositories (e.g., IH Monitoring Results (Personal and Area Air Monitoring data expressed in Time Weighted Averages (TWA), Parts per Million (ppm), Parts per Billion (ppb, Micrograms per Liter (ug/L) or Milligrams per Liter (mg/L).
- Radiological Monitoring Results (Thermoluminescent Dosimeter (TLD) expressed in rem, Personal and Area Air Monitoring expressed in pCi/L, Personal and Area Field Measurements as well as wipe and smear sample data expressed in dpm).
- Remedial Investigation and Feasibility Studies (RIFS).
- RCRA Facility Investigations (RFI).
- Site documents.

It is anticipated that questions will arise from staff members regarding some of the information requested. Please feel free to contact David A. Back or Gentry Stevens if the need arises.

Thank you for any assistance you can supply.

MEMORANDUM

Date:	August 29, 1996
DOE/Fernald Site Contact:	James W. Neton
Contractor:	Dynamic Science Inc. (DSI)
Contractor Research Leaders:	David A. Back (513)-821-3773 Gentry Stevens (513)-821-3773

Data Request in support of NIOSH/DOE Hazardous Waste, Decontamination and Decommission and Clean-up Workers Exposure Assessment Feasibility Study at the Fernald Site.

Dear Mr. Neton:

Per our conversation 8/29/96, the following information is requested;

1.) **Depersonalized Exposure data** *(radiological personal airborne)* information pertaining to:

Plant 4A 12/95 to 08/96
Plant 7 12/93 to 11/94
Plant 1 Ore Silos 07/93 to 12/94
Building 13A North/South Solvent Tanks 03/94 to 03/94
Building 13A Tank T-2 12/94 to ??/95
Building 13A Wet Side 02/96 to 04/96
Plant 5 East Derby Breakout Area 04/96 to 06/96
Building 39A 01/96 to 02/96
Building 73 (Fire Brigade Training Facility) 07/94 to 11/94

Thank you for your assistance,

David A. Back

16.0 - POINTS OF CONTACT

DOE Ohio Field Office, Fernald Area Office, P.O. Box 538704, Cincinnati, Ohio 45253-8704

POC	Location/ Bldg. #/ Mail Stop	Phone #	Fax#	Area of Expertise
David Kozloski	DOE-FN / Bld. B14 /MS 45	513-648-3187	513-648-3077	Overall Support
Rajkumar Sundram	DOE-FN / Bld. B14 /MS 45	513-648-3046	513-648-3077	Overall Support
Arthur Murphy	DOE-FN / Bld. B14 /MS 45	513-648-3132	513-648-3076	Technology Info.
Shannon Kaster	DOE-FN / Bld. B14 /MS 45	513-648-3157	513-648-3077	Health & Safety

Fernald Environmental Management Project, P.O. Box 538704, Cincinnati, Ohio 45253-8704

POC	Location / Mail Stop	Phone #	Fax#	Area of Expertise
John Bradburne (CEO)	B14/001@MS49	513-648-3311	513-648-3601	Overall Support
Darlene Gill①	SDC3/005@MS81-1	513-648-6415	513-648-6905	Demographics (FERMCO)
Mike Tester	Bld. B53@MS51	513-648-4327	513-648-5746	Radiological Safety
Walter Mengel	Bld. B53/243@MS31	513-648-4241	513-648-5747	Chem. Exposure (IH)
Shirley Wendell	Bld. B53@MS30	513-648-4378	513-648-3934	Training Records
Jim Ball	T-84@MS33	513-648-5075	None	Union Information
James Neton	Bld. B53/226@MS31	513-648-4017	513-648-5746	Radiological Exposure
Dennis Klein	T-76@MS52-9	513-648-4078	513-648-3973	OU3 / Safe Shutdown
Carolyn Waugh	T-23/06@MS51	513-648-5674	513-648-5702	HWMU / RCRA
Francis Maranda	Bld. B45@MS44	513-648-5161	513-648-5234	Demographics (Subcontr.)
Derek Hagemeyer②	SAIC@Oakridge	423-481-2330	423-481-8584	DOE-HQ Rad Annual Exposures

① FERMCO Springdale Center, 25 Merchant Street, Cincinnati, OH 45246
② Science Applications International Corporation (SAIC), 301 Laboratory Road, Oakridge, TN 37830

17.0 - GLOSSARY AND ACRONYMS

ACA **Amended Consent Agreement**. Agreement between the US Environmental Protection Agency (US EPA) and the Department of Energy (DOE) driven by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) legislation. The ACA determines Operable Units (OUs) for the Fernald Environmental Management Project (FEMP) and provides general schedules for on-going Remedial Investigation and Feasibility Studies (RI/FS).

ACD **Amended Consent Decree**. Following CERCLA legislation and agreements between USEPA and the DOE, the ACD outlines the FEMP's Operable Units (OU) and declares Records of Decision (ROD) which establish the length of time (deliverable dates) for remediation. Also know as the Amended Consent Agreement-explicit.

ACM **Asbestos Containing Material**. Asbestos fibers that are a portion of the overall site waste stream generated by construction, maintenance and building decommissioning activities.

AEA **Atomic Energy Act**. The Act of 1946 gave responsibility for production and control of nuclear materials with the Atomic Energy Commission. The Act of 1954 allowed the Atomic Energy Commission to license private companies to use nuclear materials, construct and operate nuclear plants.

AEC **Atomic Energy Commission**. The AEC was created by the U.S. Congress in 1946 as the civilian agency responsible for the production of nuclear weapons. The AEC also researched and regulated atomic energy. It's weapons production and research activities were given to the *Energy Research and Development Administration* in 1975, while its regulatory responsibility was given to the new Nuclear Regulatory Commission.

AHERA **Asbestos Hazard Emergency Response Act**

AHF **Anhydrous Hydrogen Fluoride**

ALARA **As Low As Reasonably Achievable**. A phrase and acronym (As Low As Reasonably Achievable) used to describe an approach to radiation exposure and emissions control or management whereby the exposures and resulting doses to the public are maintained as far below the specified limits as economic, technical and practical considerations will permit.

ARAR **Applicable or Relevant and Appropriate Requirement**. Standards, criteria, or limitations established under federal and state environmental regulations. These standards are used in determining treatment of mixed waste that can not be decontaminated under the project.

ARIES **Automated Research/Investigation Energy System**. Self-navigating robot bases that have been outfitted with cameras, software and bar code readers to read drum IDs and find rust spots and other defective features.

ASER **Annual Site Environmental Report**. The site specific report identifies mission statements, site background information, radiological health hazards, compliance summaries, air pathway monitoring, effluent and surface water monitoring, groundwater monitoring, estimated radiation doses for the year, quality assurance procedures and current programs applicable to that year. Its purpose is to show the comparisons between the results of the site's monitoring program to specific standards for various pollutants.

ATSDR **Agency for Toxic Substances and Disease Registry**. The federal agency responsible for reporting and documenting toxic substance information and disease outbreak. Work related exposures must also be reported to ATSDR.

AWWT **Advanced Wastewater Treatment System**. Treats existing uranium-contaminated wastewater streams and reduces the amount of uranium being discharged into local river.

CAA **Clean Air Act**. This Act protects and enhances the quality of air resources. Its primary application is through Prevention of Significant Deterioration (PSD) permits to regulate new potentially polluting facilities. The CAA was passed in 1970 as an amendment to 42 USC 7401. It was also amended in 1977, 1990 and 1992.

CCD **Charged Coupling Device**. A device used with cameras and other sensors within Drum Inspection Robotic technologies.

CERCLA **Comprehensive Environmental Response, Compensation and Liability Act**. A Federal law, enacted in 1980, that governs the cleanup of hazardous, toxic and radioactive substances. The Act and its amendments created a trust fund, commonly known as Superfund, to finance the investigation and cleanup of abandoned and uncontrolled hazardous waste sites.

CFR **Code of Federal Regulations**. The index containing United States law.

Ci **Curie**. The unit of quantity of radioactivity. It requires that in the given sample of any material, 37 billion disintegrations occur each second.

COC **Contaminants of Concern**

CSOU **Comprehensive Sitewide Operable Unit**. An Operable Unit (OU) containing many Hazardous Waste Management Units (HWMU's) and many complex remediation strategies.

CW **Clean Up Worker**. A worker involved with the treatment, transportation, storage and disposal of Low Level Radioactive Waste (LLRW).

CWA **Clean Water Act**. This act amended the Federal Water Pollution Control Act first passed in 1956. Its objective is to restore and maintain the chemical, physical and biological integrity of the nation's waters, including surface waters and navigable streams. It regulates discharges to or dredging of wetlands. Its major enforcement tool is the National Pollutant Discharge Elimination System (NPDES) permit.

DAC **Derived Air Concentration**

D&D **Decontamination and Decommissioning Worker**. A worker involved with the decontamination and decommissioning of structures and associated equipment.

DE **Drum Equivalent**. The number of 55-gallon drums that it would take to contain a given volume of waste.

DHHS **Department of Health and Human Services** The United States Governments's principal agency for protecting the health of all Americans and providing essential human services, especially for those who are least able to help themselves

DOD **Department of Defense**. The federal agency in charge of defense tactics and protective strategies for the nation.

DOE **Department of Energy.** Created from the Energy Research and Development Administration in 1977, the cabinet-level US Government agency is responsible for nuclear weapons production, energy research and the cleanup of hazardous and radioactive waste at its sites.

DOT **Department of Transportation**. The federal agency in charge of national transportation regulations.

DP — **Defense Program**. The program dedicated to National weapons, protection and military tactics headed by the Department of Energy. The DP came to an abrupt weapons production halt in 1989 following the end of the cold war.

EDE — **Effective Dose Equivalent**. The sum of the weighted dose equivalents for all irradiated tissues, using the weighting factors in ICRP Publication 26.

EM — **Environmental Monitoring**. Periodic or continuous measuring of the quantity and type of discharges or migration of radioactive or hazardous waste from a management facility to determine the level of compliance with regulatory requirements and/or pollutant levels in various media.

Environmental Media — Consists of groundwater (perched and regional aquifer, surface water), surface soils and sediments, subsurface soils and flora and fauna.

ERIMS — **Employee Records Information Management System**. An individual record system in database format maintained by the FEMP.

FEMP — **Fernald Environmental Management Project**. Current official name for the uranium foundry located near Fernald Ohio. Formerly known as the Feed Materials Production Center during the Cold War.

FERMCO — **Fernald Environmental Restoration Management Corporation**. Subsidiary to Fluor Daniel Inc. and the DOE prime contractor involved in site remediation from 1992 to the present.

Fixed Radiological Contamination — Any radioactive material that cannot be removed by light to moderate swiping techniques using paper or cloth smears.

FMPC — **Feed Materials Production Center**. The name for the uranium foundry built in the early 1950's during the Cold War.

FS — **Feasibility Study**. An analysis of the practicability of a proposal. The feasibility study emphasizes data analysis and usually recommends selection of a cost effective alternative. Usually performed with data within a remedial investigation and is collectively termed RI/FS.

FTF — **Fire Training Facility** The FEMP facility historically used to train emergency responders in site-specific response drills.

HAZWOPER — **Hazardous Waste Operations and Emergency Response**. The activities associated with specific hazardous waste duties and the emergency response actions taken during hazardous waste accidents. HW workers are specifically trained worker groups required to be certified as such.

HEPA — **High Efficiency Particulate Air (Filtration)** A gas filtration system having a fibrous medium that produces a particle-removal efficiency of at least 99.97% for 0.3-micron-diameter monodisperse dioctylphthalate (DOP).

HERB — **Health-Related Energy Research Branch**. The division within the National Institute for Occupational Safety and Health conducting health research for energy related studies.

Herculite® — A plastic sheeting material.

HF — **Hydrofluoric Acid**

HNO_3 — **Nitric Acid**

HW — **Hazardous Waste Worker**. A worker involved in sampling, surveying, containerization, treatment, transportation, storage and disposal of hazardous wastes.

HWMU — **Hazardous Waste Management Unit**. An area or building within an Operable Unit (OU) that is to be decontaminated and decommissioned. There are usually many HWMUs within an OU.

IROD — **Record of Decision for Interim Remedial Action**. Under CERCLA remedial response actions, a IROD is an interim draft decision pertaining to Operable Unit management. It is not a final Record of Decision (ROD).

LDR — **Land Disposal Restriction** Identifies hazardous wastes that are restricted from land disposal and defines those limited circumstances under which an otherwise prohibited waste may continue to be land disposed.

LLRW — **Low Level Radioactive Waste**. A term for any radioactive waste that is not spent fuel, high-level, or transuranic waste.

MAWS — **Minimum Additive Waste Stabilization**. A technology that remediates multiple waste streams in one integrated treatment system that is cost effective and produces an environmentally sound waste form of disposal.

MEK — **Methyl Ethyl Ketone**

uCi	**microcurie**. The amount of radioactivity in one microgram of the isotope radium 226.
MOU	**Memorandum of Understanding.** An agreement between the Department of Energy (DOE) and the Department of Health and Human Services (DHHS) which transfers responsibility for the the management and conduct of energy-related analytic epidemiologic research to HHS. HHS has designated the Centers for Disease Control (CDC) as the lead agency. The MOU established the need for CDC personnel, their contractors and grantees to access DOE facilities, workers and records to conduct community and worker-based health research and related activities.
MRDEP	**Medical Records Data Entry Program**. Personnel medical records in individual files maintained in a database format.
mrem	**millirem**. 1/1000th of the unit that expresses the biologically effective dose produced by any type of radiation.
NAR	**Nitric Acid Recovery** Process equipment associated with Plant 2/3 at the FEMP used for the recycling and recovery of nitric acid.
NIOSH	**National Institute of Occupational Safety and Health**. An federal agency associated with the Centers for Disease Control and the Public Health Service dedicated to research, evaluation and monitoring potential work related hazards.
NLO	**National Lead of Ohio**. The production era (1951-1989) Fernald site prime contractor.
NPDES	**National Pollutant Discharge and Elimination System**. Establishes standards under EPA and state regulations for point sources of discharges of pollutants.
NTS	**Nevada Test Site**. A 1,350-square-mile area of the southern Nevada desert that has been the site of most of the U.S. underground and atmospheric tests since it opened in 1951.
OEPA	**Ohio Environmental Protection Agency**. The Ohio State regulatory environmental protection agency in charge of enforcing environmental laws such as RCRA, TSCA, CERCLA and the state's more stringent standards.
OSDF	**On-Site Disposal Facility** The FEMP is in the process of creating a lined landfill type cell for the onsite storage of LLRW and LLMW.

OSHA **Occupational Safety and Health Administration**. The regulatory agency that enforces the law pertaining to employee safety and health.

OSWER **Office of Solid Waste and Emergency Response**. The office within the US EPA that provides directives pertaining to solid waste treatment and emergency responses.

OU **Operable Unit**. A discrete action that comprises an incremental step toward comprehensively addressing site problems. Operable Units may address geographical portions of a site, specific site problems, or initial phases of an action performed over time, or any actions that are concurrent but located in different parts of the site.

PCB **Polychlorinated Biphenyls**. Commercially produced organic chemicals used in industrial applications throughout the nuclear weapons complex. PCBs are found in many of the gaskets and large electrical transformers and capacitors in the gaseous diffusion plants. PCBs have been proven to be toxic to both humans and laboratory animals.

pCi **picocurie.** The picocurie is 3.7×10^{-2} disintegrations per second and is often used to express the very low natural and environmental levels of radiation.

PEIC **Public Environmental Information Center.** Implemented by the DOE, the PEIC is an open reading room providing DOE documentation, US EPA regulation, site specific information and other radiation references. PEICs are usually located on or near the DOE site.

POC **Point of Contact**. POCs are designated as fundamental sources of information and for this particular study include FERMCO personnel, DOE officials and other experts in their field.

PPE **Personal Protective Equipment.** PPEs include any type of equipment used to protect the worker from potentially hazardous substances in the work place. PPEs may range from respiratory devices to protective clothing.

RA **Removal Action**. Removal Actions are actions necessary to monitor, assess, or evaluate the threat of concern. They are initiated when there is a need to accelerate cleanup activities involving hazardous wastes and are coordinated with US EPA and OEPA guidelines.

RCRA — **Resource Conservation and Recovery Act**. An act passed in 1976 as an amendment to the Solid Waste Disposal Act (1965). The primary goals of RCRA are to protect human health and the environment from the potential hazards of waste disposal; to conserve energy and natural resources, to reduce the amount of waste generated, including hazardous waste and to ensure that waste is managed in an environmentally sound manner. RCRA was amended in 1984 by the Hazardous and Solid Waste Amendments, which expanded RCRA's scope.

RI — **Remedial Investigation**. As directed by CERCLA, a Remedial Investigation gathers the data to determine the nature and extent of contamination at a CERCLA site, establishes criteria for cleaning up and identifies alternatives for remedial action. The RI is usually done with a Feasibility Study and are referred to as a RI/FS.

RI/FS — **Remedial Investigation and Feasibility Study.** A formal examination of the nature and extent of contamination, assessment of the risk and selections of the final remedy based on an evaluation of possible alternatives.

RMI — **Reactive Metals Inc**. A DOE contracted facility located in Ashtabula, Ohio where depleted uranium billets were sent for further processing and extrusion into rods during the production era.

ROD — **Record of Decision**. Under CERCLA remedial response actions, a ROD is a draft or finalized decision pertaining to Operable Unit management.

SARA — **Superfund Amendment and Reauthorization Act**. The 1986 Act reauthorizing and amending CERCLA and including the Emergency Planning and Community Right to Know Act of 1986 and the Radon Gas and Indoor Air Quality Act of 1986.

SCQ — **Sitewide CERCLA Quality Assurance Project Plan**. Directed under CERCLA, SCQ provides a standard for quality assurance specific to the site. Quality assurance ensures accuracy and approval from expertise.

SDWA — **Safe Drinking Water Act**. Enacted in 1975, the primary purpose of this act is to protect drinking water resources. Standards set by SDWA determine ground water protection regulations.

SOP — **Standard Operating Procedure**. A SOP in any case refers to the guidelines for operation or standards for completing a project. A SOP will include quality assurance guidelines as well as procedures for obtaining a final goal or end point.

SRPD	**Self Reading Pocket Dosimeter**. An individually worn device that measures gamma particles and gives an immediate reading of exposure.
SS	**Safe Shutdown**. Safe Shutdown refers to a sub-group of HW and CW workers that are specifically controlled by a CERCLA Removal Action #12. Primary functions include removal of material from former process equipment..
STP	**Site Treatment Plan**. The STP documents the methods and actions needed to obtain proper and cost effective cleanup of a specific site.
SWAMI	**Stored Waste Autonomous Mobile Inspector**. A self navigating robot base outfitted with Charge Coupled Device (CCD) cameras and other sensors to identify rust spots and other features indicating defects in drums.
SWIFTS	**Sitewide Waste Information, Forecasting and Tracking System** An Oracle® database computer system used in forecasting, characterizing, tracking and shipping wastes generated at the FEMP.
SWMU	**Solid Waste Management Unit**. Any facility for the collection, source separation, storage, transportation, transfer, processing, treatment or disposal of solid wastes, including hazardous wastes, whether such facility is associated with facilities generating such wastes or otherwise.
TBP	**Tributyl Phosphate**
TCLP	**Toxicity Characteristic Leaching Procedure**. A test method evaluating solid waste, physical/chemical properties per EPA publication SW-846.
TEDE	**Total Effective Dose Equivalent.** The total summation of all weighted dose equivalents for all irradiated tissues, using the weighting factors in ICRP Publication 26.
TLD	**Thermo Luminescent Dosimeter**. A device which is used to monitor the amount of radiation to which it has been exposed.
TRIMS	**Training Records Information Management System.** A database containing personnel training records. Information includes site and job specific training procedures.
TSCA	**Toxic Substances Control Act.** A Federal law, enacted in 1976 to protect human health and the environment from unreasonable risk caused by exposure to or the manufacturing, distribution, use, or disposal of substances containing toxic chemicals.

TSDF **Treatment Storage and Disposal Facility**

UF_4 **Uranium Tetrafluoride** - "Green Salt"

UF_6 **Uranium Hexafluoride**

UNH **Uranyl Nitrate Hexahydrate**

UO_2 **Uranium Dioxide** - "Brown Oxide"

UO_3 **Uranium Trioxide** - "Orange Oxide"

USEPA **United States Environmental Protection Agency**. A Federal agency established in 1970 responsible for enforcing environmental laws, including RCRA, CERCLA and TSCA.

WAC **Waste Acceptance Criteria**. EPA site specific regulatory guidelines governing land disposal restrictions at landfill sites.

WEMCO **Westinghouse Environmental Management Company of Ohio**. The primary environmental management contractor for the Fernald site from 1986 to 1992.

W Solubility Class That class of materials deposited in the lung that has a clearance half-time on the order of weeks. This material is considered to be moderately soluble.

Y Solubility Class That class of materials deposited in the lung that has a clearance half-time on the order of years. This material is considered to be chemically insoluble.