DOE/EH-0568

Cost-Effective Facility Disposition Planning
with
Safety and Health Lessons Learned and Good Practices
from the
Oak Ridge Decontamination and Decommissioning Program

May 1998

U.S. Department of Energy
Assistant Secretary for Environment, Safety and Health
Office of the Deputy Assistant Secretary for Worker Health and Safety

in partnership with

U.S. Department of Energy Oak Ridge Operations,
Lockheed Martin Energy Systems, and
Lockheed Martin Energy Research

Comments, suggestions, or other related information are welcomed for consideration and possible incorporation into future iterations of this report. Please send any such materials and correspondence to either of the following individuals:

Robert Barber
Department of Energy
Office of Worker Health and Safety
19901 Germantown Road
Germantown, MD 20874-1290
Telephone: 301-903-3477
Fax: 301-903-8817
Internet: robert.barber@eh.doe.gov

or

Charles Campbell
Project Task Leader
Department of Energy
Office of Worker Health and Safety
19901 Germantown Road
Germantown, MD 20874-1290
Telephone: 301-903-1441
Fax: 301-903-8817
Internet: charles.campbell@eh.doe.gov

DOE/EH-0568

Cost-Effective Facility Disposition Planning

with

Safety and Health Lessons Learned and Good Practices

from the

Oak Ridge Decontamination and Decommissioning Program

May 1998

MASTER

U.S. Department of Energy
Assistant Secretary for Environment, Safety and Health
Office of the Deputy Assistant Secretary for Worker Health and Safety
Washington, DC 20585

in partnership with

U.S. Department of Energy Oak Ridge Operations,
Lockheed Martin Energy Systems, and
Lockheed Martin Energy Research

DISCLAIMER

Portions of this document may be illegible electronic image products. Images are produced from the best available original document.

FOREWORD

This report summarizes the lessons learned and good practices related to facility disposition activities conducted at Oak Ridge sites.

The Department of Energy (DOE) Office of Worker Health and Safety (EH-5), DOE Oak Ridge Operations Office (DOE-OR), Lockheed Martin Energy Systems (LMES), and Lockheed Martin Energy Research (LMER) have teamed to produce this report by contributing important insights and useful practices regarding cost-effective planning approaches for facility disposition work that also emphasize creating a safer working environment. The Oak Ridge approaches to facility disposition work planning have resulted in improved safety and health performance, as well as substantial reductions in project costs and schedules.

We believe this report, along with the Department's Technical Standard, *Integration of Environment, Safety and Health into Facility Disposition Activities*, DOE-STD-1120-98, and other EH-5 lessons learned reports, can provide insights to improve environment, safety, and health performance and reduce costs for all facility disposition projects. Our confidence is based largely upon the measurable safety and health and project performance results from implementing these approaches.

For copies of this report, contact Peter Gross, DOE-OR, at (423) 576-0845; John Rothrock, DOE-OR, at (423) 576-0831; Kenneth Leifheit, DOE-OR, at (423) 576-0835; Tony Eng, DOE Office of Field Support (EH-53), at 301-903-4210; or Charles Campbell, DOE EH-53, at (301) 903-1441.

Joseph E. Fitzgerald, Jr.
Deputy Assistant Secretary for
Worker Health and Safety (EH-5)
Department of Energy

Robert Poe
Assistant Manager
Environment, Safety and Quality
Department of Energy
Oak Ridge Operations Office

Rodney Nelson
Assistant Manager
Environmental Management
Department of Energy
Oak Ridge Operations Office

David Milan, CIH*
Director
Safety and Health
Lockheed Martin Energy Research

* Formerly the Director of Safety and Health for Lockheed Martin Energy Systems.

ACKNOWLEDGMENTS

Preparation of this report has been made possible through the concerted efforts and cooperation of many individuals. We would like to specifically acknowledge the following individuals and organizations for their support, contributions, and assistance in developing this report.

Robert Poe
Assistant Manager
Environment, Safety and Quality
Department of Energy
Oak Ridge Operations Office

David Milan, CIH
Director
Safety and Health
Lockheed Martin Energy Research

Ken Leifheit
ESH&QA Programs Lead
Environmental Management Support Team
Department of Energy
Oak Ridge Operations Office

Greg Bazzell
Facility Representative
Department of Energy
Paducah Site Office

Russell Rickard
Industrial Hygienist
East Tennessee Technology Park
Bechtel Jacobs Company, LLC

Tony Medley
Oak Ridge National Laboratory
Lockheed Martin Energy Research

Mickey Crowley
Project Manager
Oak Ridge National Laboratory

David Landguth
Health Sciences Research Division
Lockheed Martin Energy Research

Rodney Nelson
Assistant Manager
Environmental Management
Department of Energy
Oak Ridge Operations Office

Jerry Swanks
Associate Director and Vice President
Operations Environment, Safety and Health
Lockheed Martin Energy Research

Teresa Perry
Lead Environmental Engineer
Technical Services Team
Department of Energy
Oak Ridge Operations Office

Suzanne Herron
Program Manager
ORNL Surveillance and Maintenance
Lockheed Martin Energy Systems

Darrell Dillinger
Facility Manager
ORNL Surveillance and Maintenance
Lockheed Martin Energy Systems

E. Paul Larson
Project Manager
Bechtel Jacobs Company, LLC

Claretta Sullivan
Lessons Learned Coordinator
Oak Ridge National Laboratory

We would also like to thank the many individuals who, in-person or via telephone, fax, or Internet, provided their time and valuable insights for developing and improving this report.

CONTENTS

page

FOREWORD ... i

ACKNOWLEDGMENTS ... ii

LIST OF FIGURES ... iv

DEFINITIONS ... v

ACRONYMS ... vii

EXECUTIVE SUMMARY ... viii

1.0 INTRODUCTION ... 1
- 1.1 Purpose of this Report ... 1
- 1.2 Report Organization ... 1

2.0 OVERVIEW OF OAK RIDGE FACILITY DISPOSITION ACTIVITIES ... 3
- 2.1 Cooling Tower Demolition Project ... 3
- 2.2 Powerhouse Demolition Project ... 4
- 2.3 Deposit Removal Project ... 5
- 2.4 Y-12 Plant Building 9201-4 Dispositioning ... 7
- 2.5 ORNL High Radiation Level Chemical Development Laboratory ... 7

3.0 LESSONS LEARNED AND GOOD PRACTICES ... 9
- 3.1 Use Former Employees to Augment Facility Hazards Information ... 10
- 3.2 Consider Facility Post-Operations Uses and Conditions ... 11
- 3.3 Use Occurrence and Lessons Learned Reports ... 12
- 3.4 Use Incentive Contracts ... 13
- 3.5 Coordinate and Integrate the Project Team ... 15
- 3.6 Involve Stakeholders Early ... 17
- 3.7 Implement Training Mock-Ups ... 18

4.0 CONCLUSIONS ... 19

5.0 REFERENCES ... 21

LIST OF FIGURES

page

Figure 1. Cooling Tower Area Before Demolition Activities 4

Figure 2. Cooling Tower Demolition 4

Figure 3. Cooling Tower Area After Demolition Activities 4

Figure 4. Powerhouse Area Before Demolition 5

Figure 5. Powerhouse Structure Demolition 5

Figure 6. Powerhouse Area After Demolition 5

Figure 7. Layer of Deposit Material Approximately 0.375 inches Thick 6

Figure 8. Deposit Removal Using Standard Decontamination Tools (Shovels, Hoes, Chisels) 6

Figure 9. ISMS Core Functions 9

Figure 10. Parts Storage in the Powerhouse 12

Figure 11. Contract Paperwork - Standard Award Fee vs. EPIC (in hands) Contracting 14

Figure 12. Average Number of Bids 14

Figure 13. Regular Project Status Meetings of the Integrated Project Team 16

DEFINITIONS

Deactivation: The process of placing a facility in a safe and stable condition including the removal of readily removable hazardous and radioactive materials to minimize the long-term cost of a surveillance and maintenance program that is protective of workers, the public, and the environment. Deactivation activities can include one-of-a-kind and first-of-a-kind tasks, such as removal of radioactive materials in ventilation duct work. Deactivation also includes routine surveillance and maintenance tasks that are typically part of facility operation. (*DOE-STD-1120-98*)

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 a facility to retire it from service, with adequate regard for the health and safety of workers and the public and protection of the environment. The ultimate goal of decommissioning is unrestricted release or restricted use of the site. Surveillance and maintenance tasks conducted during decommissioning are typically routine activities that are similar to any other life-cycle phase. A disposition project or activity can also be in long-term surveillance and maintenance (quiescent state) if no deactivation, decontamination, and/or dismantlement activities are conducted. This definition is not meant to imply that CERCLA is the controlling regulation for long-term surveillance and maintenance when decommissioning is not immediately undertaken. *(DOE-STD-1120-98)*

Decontamination: The removal or reduction of residual radioactive and hazardous materials by mechanical, chemical, or other techniques to achieve a stated objective or condition. Decontamination may occur during all phases of facility decommissioning; however, the greatest decontamination activity usually occurs during decommissioning. (*DOE-STD-1120-98*)

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 or portions of the facility. (*DOE Decommissioning Resource Manual*)

Excess (Surplus) Facilities: Physical assets that are not required for DOE needs and the discharge of its responsibilities. *(DOE O 430.1A)*

Facilities: Land, buildings, and other structures, their functional systems and equipment, and other fixed systems and equipment installed therein; outside plant, including site development features outside the plant, such as landscaping, roads, walks, and parking areas; outside lighting and communication systems; central utility plants; utilities supply and distribution systems; and other physical plant features. (*DOE O 430.1A*)

Facility Disposition: The final stages of a facility's life-cycle, encompassing long-term surveillance and maintenance (S&M) after stabilization, deactivation, post-deactivation long-term S&M, and decommissioning. *(DOE-STD-1120-98)*

Hazard: A chemical property, energy source, or physical condition that has the potential to cause illness, injury, or death to personnel, or damage to property or to the environment, without regard for the likelihood or credibility of potential accidents or the mitigation of consequences. *(DOE-STD-1120-98)*

Health and Safety Plan (HASP): Defines health and safety hazards, controls, and requirements for individual activities at the work site and provides a formal mechanism for identifying and controlling health and safety elements of work site operations before field work begins. *(29 Code of Federal Regulations (CFR) 1910.120)*

Integrated Safety Management System: As defined in DOE P 450.4, *Safety Management System Policy*, a formalized approach for managing safety that consists of seven guiding principles and encompasses five core functions. The guiding principles are: (1) Line Management Responsibility for Safety, (2) clear roles and responsibilities, (3) competence commensurate with responsibilities, (4) balanced priorities, (5) identification of safety standards and requirements, (6) hazard controls tailored to work being performed, and (7) operations authorization. The core functions are: (1) define the work scope, (2) analyze the hazards, (3) develop and implement hazard controls, (4) perform work within controls, and (5) provide feedback and continuous improvement. *(DOE P 450.4)*

Manager: The individual responsible for supervising, planning, or providing project support (i.e., as opposed to physically performing the work activities). This individual may be a departmental manager, planner, safety engineer, project manager, job site supervisor, Environment Safety and Health compliance officer, or field team leader. *(DOE/EH-0566)*

Physical Assets: All DOE-owned or DOE-used and -controlled land, land improvements, structures, utilities, motor vehicles, equipment, and components are included. (*DOE O 430.1A*)

Safety and Health: As defined in this report, a conditional state in which both the public and workers are free from harm. It is also defined as the practice and application of techniques to help prevent illness, injury, death, and property loss as a result of unintentional and undesirable conditions and acts. *(DOE/EH-0486)*

Standards: As defined by the Department's Standards Committee, standards include: "Federal, state, and local laws and regulations; Department Orders; nationally and internationally recognized standards; and other documents (such as industrial standards) that protect the environment and the safety and health of our workers and the public." *(DOE/EH-0486)*

Surveillance and Maintenance (S&M): These activities are conducted throughout the facility life-cycle phase including when a facility is not operating and is not expected to operate again and continues until phased out during decommissioning. Activities include providing in a cost-effective manner periodic inspections and maintenance of structures, systems, and equipment necessary for the satisfactory containment of contamination and the protection of workers, the public, and the environment. A disposition project can be in a quiescent state of long-term surveillance and maintenance prior to deactivation or prior to decommissioning. (*DOE-STD-1120-98*)

ACRONYMS

ALARA	As Low As Reasonably Achievable
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
D&D	Decontamination and Decommissioning
DOE	Department of Energy
DRP	Deposit Removal Project
DRR	Deposit Removal Room
EH	DOE Office of Environment, Safety and Health
EM	DOE Office of Environmental Management
EPA	Environmental Protection Agency
EPIC	Environmental Management Program Integration Contracting
ETTP	East Tennessee Technology Park
FY	Fiscal Year
LEU	Low-Enriched Uranium
LMER	Lockheed Martin Energy Research
LMES	Lockheed Martin Energy Systems
HEU	High-Enriched Uranium
ISMS	Integrated Safety Management System
ISO	International Organization for Standardization
ITO	Incentive Task Order
NDA	Nondestructive Assay
NPL	National Priorities List
ORNL	Oak Ridge National Laboratory
ORGDP	Oak Ridge Gaseous Diffusion Plant
OR	Oak Ridge Operations Office
OSHA	Occupational Safety and Health Administration
RA	Remedial Action
RCRA	Resource Conservation Recovery Act
S&H	Safety and Health
S&M	Surveillance and Maintenance
UF_6	Uranium Hexafluoride

EXECUTIVE SUMMARY

This report focuses on the experiences at DOE Oak Ridge sites associated with providing cost-effective planning for facility disposition activities that is also protective of workers, the public, and the environment.

The objective of this report is to share with the DOE complex the accomplishments, successes, and lessons learned that identify the most cost-effective approaches to integrating safety and health (S&H) considerations into facility disposition planning. As a result of Oak Ridge's effective planning of facility disposition activities, S&H aspects are improving and projects are being completed substantially ahead of schedule and well below original cost estimates.

The DOE Office of Worker Health and Safety (EH-5), the DOE Oak Ridge Operations Office (DOE-OR), Lockheed Martin Energy Systems (LMES), and Lockheed Martin Energy Research (LMER) have jointly developed important insights and useful practices for integrating S&H into the planning of facility disposition projects at Oak Ridge sites. Examples of S&H lessons learned and good practices identified and discussed in this report include the following:

- Augmenting facility historical and characterization information by interviewing former employees.
- Soliciting worker input in project planning to gain insights from their experiences with similar projects.
- Including stakeholders and regulators early in project planning to provide an open dialogue and early resolution of potential safety issues.
- Characterizing facility hazards, including inherent hazards caused by aging and structural degradation, in the early stages of planning.
- Using incentive contracting approaches by prequalifying contractors and their S&H programs, using experts to support development of procurement performance specifications, and streamlining the procurement process.
- Forming multidisciplinary teams, including subcontractors, that are co-located and work together throughout the project to improve communication and teaming.
- Streamlining and focusing responsibility for S&H management by using a single project S&H point of contact.
- Using mock-ups to enhance worker training and familiarization with the work activities and conditions. In addition, mock-ups can be used to identify and resolve potential problems in performing the work.

1.0 INTRODUCTION

An emphasis on transition and safe disposition of DOE excess facilities has brought about significant challenges to managing worker, public, and environmental risks. The transition and disposition activities involve a diverse range of hazardous facilities that are old, poorly maintained, and contain radioactive and hazardous substances, the extent of which may be unknown. In addition, many excess facilities do not have historical facility documents such as operating records, plant and instrumentation diagrams, and incident records. Further, facility disposition activities involve some hazards and work activities that are inherently different from the production operations in which site and facility workers have been trained.

In responding to these challenges, EH-5 has worked closely with the DOE Office of Environmental Management (EM) and selected field sites to help identify cost-effective S&H strategies and associated lessons learned and good practices that can be integrated into site-specific facility disposition activities. This partnership has been successfully implemented at several sites and has achieved results such as:

- streamlining authorization basis processes and documentation for facility deactivation;
- developing effective strategies for involving workers in project S&H activities; and
- integrating hazard analyses so that all types of hazards and potential receptors are considered.

More recently, EH-5 has worked with DOE-OR to examine and highlight S&H good practices and lessons learned related to facility disposition activities at DOE Oak Ridge sites, with a focus on the Oak Ridge National Laboratory (ORNL), Y-12 Plant, and East Tennessee Technology Park (ETTP) (formerly referred to as the K-25 Site).

1.1 Purpose of this Report

The purpose of this report is to present an overview of the Oak Ridge Decontamination and Decommissioning (D&D) Program, its safety performance, and associated S&H lessons learned and good practices. Illustrative examples of these lessons learned and good practices are also provided. The primary focus of this report is on the S&H activities and implications associated with the planning phase of Oak Ridge facility disposition projects.

1.2 Report Organization

Section 1.0 of this report provides the background and purpose of the report. Section 2.0 presents an overview of the facility disposition activities from which the lessons learned and good practices discussed in Section 3.0 were derived.

2.0 OVERVIEW OF OAK RIDGE FACILITY DISPOSITION ACTIVITIES

For nearly half of a century, one of the primary missions of DOE and its predecessor agencies was the production of nuclear weapons for national defense. The City of Oak Ridge was one of the first "atomic cities," built to house parts of the government's secret World War II Manhattan Project. However, with the end of the Cold War, DOE's missions at Oak Ridge have shifted to support peacetime uses. Now, a major focus is on the cleanup of radioactive and hazardous waste from these earlier operations.

Weapons production at Oak Ridge resulted in radioactive and hazardous waste generation and subsequent contamination. The contamination at the Oak Ridge site led the Environmental Protection Agency (EPA) to place the site on the National Priorities List (NPL) in 1989. Once the site was added to the NPL, cleanup became subject to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) process. This law requires Federal agencies and private-sector businesses to investigate and remedy abandoned or uncontrolled hazardous waste sites where a release has occurred or may occur. Thus, DOE is faced with the challenge of cleaning up contamination in an environmentally responsible manner, while maintaining ongoing operations.

The ultimate goal of the cleanup process is to reduce or eliminate the risks to human health and the environment posed by these various contaminated areas. Cleanup of contaminated land and facilities is ongoing at all Oak Ridge sites. Over 200 areas have been identified at ORNL that are contaminated with hazardous waste, transuranic waste, and liquid and solid low-level and mixed waste. There are 33 facilities at ORNL in the D&D Program. Cleanup at Y-12 includes inactive waste disposal sites, storage tanks, and spill sites. At ETTP, sites in need of assessment and remedial action include burial grounds, waste storage facilities, underground tanks, surface impoundments, and waste treatment facilities. There are 82 facilities at ETTP slated for disposition. These facilities pose unique challenges because of their size, structural degradation, and the fact that most are contaminated with mixed waste.

The D&D Program, which involves the cleanup and demolition of dozens of enormous buildings at ETTP alone, is expected to cost billions of dollars. DOE's most pressing challenge is managing the cleanup and removal of numerous worker and environmental hazards associated with contaminated excess facilities, in the face of declining budgets.

The following subsections provide an overview of five Oak Ridge projects from which many of the lessons learned and good practices described in this report are derived.

2.1 Cooling Tower Demolition Project

Construction of the Oak Ridge Gaseous Diffusion Plant (ORGDP) in the ETTP area began in 1943 for the production of enriched uranium; operations ceased in 1985. The process buildings required cooling towers to transfer heat from recirculating process cooling water to the atmosphere.

Since shutdown of the process buildings in 1985, the towers have not been maintained and have deteriorated. Because the towers had been standing dry, the possibility of a fire developing in a wooden cooling tower structure was a major concern.

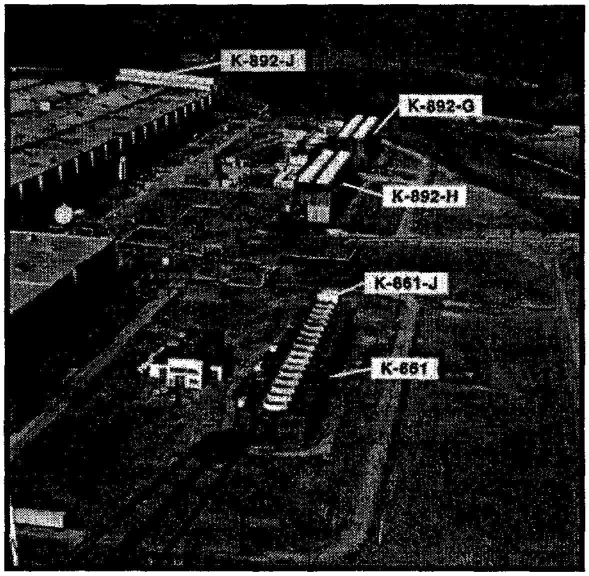

Figure 1. Cooling Tower Area Before Demolition Activities

The demolition of the cooling towers and their support facilities was completed in February 1997. The wooden superstructures were demolished using a clamshell/crane and a grappler/track-hoe, operated remotely by a crane operator and a flagman. Both devices provided maximum safety for personnel performing the work, resulting in only one minor recordable injury, which involved back muscle spasms.

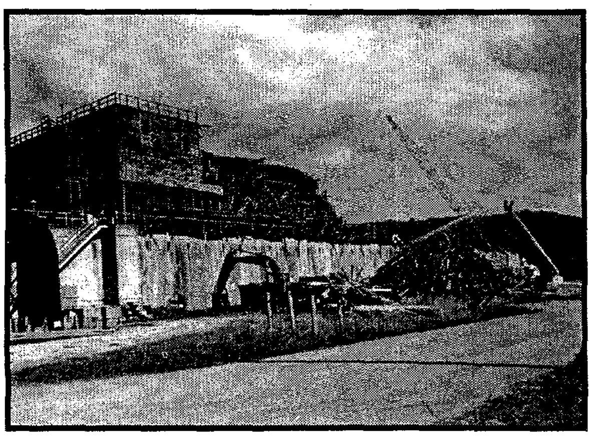

Figure 2. Cooling Tower Demolition

Pieces of the towers were broken off, lowered to the ground, segregated, reduced in size, and loaded into trucks for transportation to an Oak Ridge onsite landfill. The remaining piping was segregated from the wood after it was on the ground. All metal associated with the superstructure was considered potentially contaminated and was taken to the Oak Ridge onsite scrap yard for future recycling. Approximately 4,200 m^3 of wood and 750 m^3 of fiberglass were disposed at the landfill, with a resulting $4.5 million savings achieved from the negotiated price.

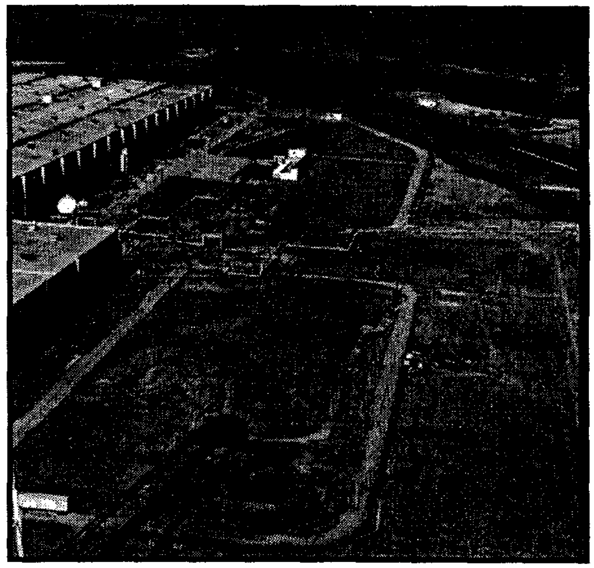

Figure 3. Cooling Tower Area After Demolition Activities

2.2 Powerhouse Demolition Project

The Powerhouse complex was built at the same time as the ORGDP cascade building for the purpose of providing ORGDP with electrical power. Initial power operations started in 1944 and continued until 1962. The "scrap-out" of the power-generating facilities started in the mid-1960s, with equipment removal from the boiler-turbine building completed in 1967. Essentially all auxiliary buildings were left intact, as were the boiler-turbine building structural skeletons.

The ancillary buildings in the Powerhouse area were used for special research projects associated with thermal diffusion, nuclear energy for the propulsion of aircraft, and miscellaneous storage and training facilities.

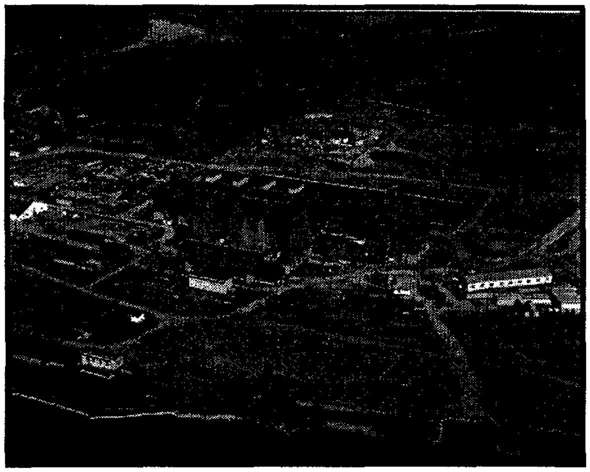

Figure 4. Powerhouse Area Before Demolition

The K-702 turbine-generator building presently houses an ORNL reactor vessel pressure test facility. Pressure vessel testing ended in the mid-1970s. More recently, numerous Powerhouse buildings were used for warehousing excess equipment. The only radioactive contamination present in the facilities was from contaminated pallets used during these warehousing activities.

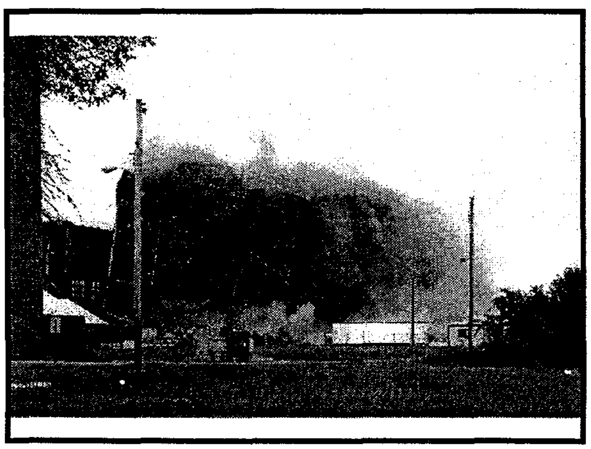

Figure 5. Powerhouse Structure Demolition

The Oak Ridge ETTP Site Powerhouse Area Demolition Project was an Environmental Management Incentive Task Order (ITO) project that provided for the safe, cost-effective, and efficient decontamination, demolition, and disposition of 15 structures located on the Powerhouse site. The facilities were demolished to grade level, leaving the slabs and underground structures, tunnels, and utilities in place. Emphasis was placed on protecting the environment, health, and safety of workers and the public, while improving management approaches for environmental restoration projects.

The project was completed in late 1995 at a cost savings of $7 million and 7 months ahead of schedule. Further, there were no recordable illnesses or injuries throughout the duration of the project.

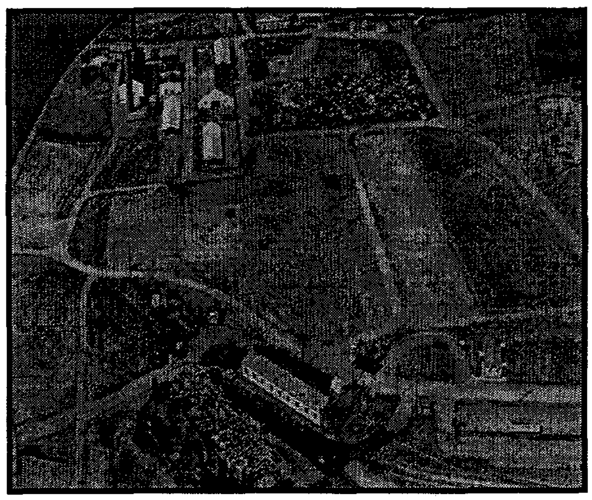

Figure 6. Powerhouse Area After Demolition

2.3 Deposit Removal Project

The K-25 (High-Enriched Uranium, HEU) and K-29 (Low-Enriched Uranium, LEU) Process Buildings were originally designed and built as part of the ORGDP cascade. The HEU Process Building housed a *full-gradient* cascade to yield uranium enriched to the weapons-grade level. The HEU process used uranium hexafluoride (UF_6) as the process gas. The LEU Process Building housed the low enrichment part of the ORGDP cascade.

The HEU Process Building was placed in operation in 1945; the LEU Process Building was placed in operation in 1951. The HEU Process Building was shut down in 1964; the LEU Process Building was placed in standby in 1985 and permanently shut down in 1987.

During the operations of these process buildings, residual deposits accumulated on the inner surfaces of the cascade equipment as a result of UF_6 reacting with moisture from the in-leakage of air. When operations ceased, the process equipment was evacuated and purged. However, most of the equipment was not treated with a fluorinating agent to remove the residual uranium deposits. In the late 1980s, nondestructive assay (NDA) measurements located and quantified deposits of uranium in the cascade equipment.

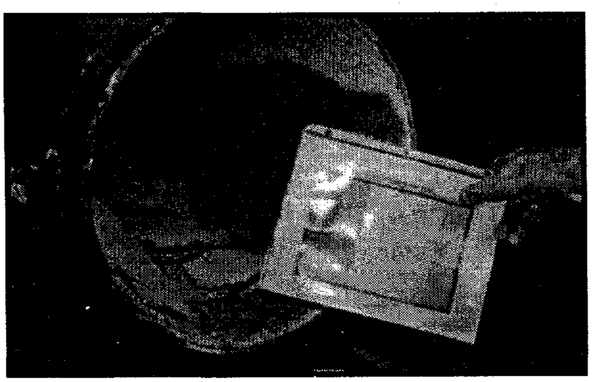

Figure 7. Layer of Deposit Material Approximately 0.375 inches Thick

The Deposit Removal Project (DRP) was planned and initiated to improve criticality safety by removing targeted deposits of enriched uranium from the cascade process piping and equipment. Following pilot demonstrations to check systems, procedures, and training, selected sections of large-diameter piping were removed from the process and transported to the Deposit Removal Room (DRR), where mechanical removal of uranium deposits occurred.

Figure 8. Deposit Removal Using Standard Decontamination Tools (Shovels, Hoes, Chisels)

In 1996, it was determined that the efficiency of deposit removal operations could be substantially improved by performing much, if not all, of the removal process in situ. In situ operations avoided the time, effort, and increased potential for releases and exposures resulting from disassembling the piping and equipment into small pieces and then transporting the pieces to the DRR.

The DRP is expected to be completed during Fiscal Year (FY) 1998. To date, there have been no recordable illnesses or injuries. The project expects to realize $7 million in cost savings.

2.4 Y-12 Plant Building 9201-4 Dispositioning

Building 9201-4, which is also referred to as "Alpha 4," began operating in 1945 as a uranium enrichment facility, using the electromagnetic separation process. In 1947, use of the electromagnetic process was abandoned. The building was not used again until 1953, when the column exchange process was installed. The column exchange process involved an electrochemical and solvent extraction method that required substantial quantities of mercury as a solvent agent to separate lithium-6 from lithium-7, in the form of lithium hydroxide. Production continued until 1962, when the equipment was drained of the majority of process materials. However, not all systems and components were cleaned and some recoverable quantities of mercury and lithium hydroxide remained within the equipment and lines.

In 1993, EM assumed ownership of the facility and provided for surveillance and maintenance (S&M) activities through the Y-12 Plant D&D Program. During FY 1997, activities were completed to place Alpha 4 in a safe and secure shutdown status and continue its ongoing S&M program. The S&M activities are being accomplished by risk mitigation, hazard abatement, and site preparation for subsequent D&D and/or long-term S&M. Some of the major activities accomplished in stabilizing the building included:

- Cleanup of all absorber rooms, which significantly reduced the mercury vapor levels in the building. More than 1,000 pounds of clean elemental mercury were collected during the cleanup operations and large quantities of nickel, copper, and aluminum were identified for recycling.

- Cleanup of the contaminated ventilation system, including the removal, packaging, and storage of all contaminated filters. The filter removal significantly reduced the possibility of any additional breakthrough and spread of airborne contamination.

- Isolation of electrical control centers throughout the building to assure there were no unidentified or abandoned circuits that could be accidentally re-energized. Additional upgrades to the emergency lights and exit signs were also completed.

- Removal of mercury from 26,000 gallons of lithium hydroxide solution.

- Removal of all drums and boxes stored in the Alpha 4 Resource Conservation Recovery Act (RCRA) permitted storage area to other permitted areas.

Stabilization of Alpha 4 was completed on December 31, 1996, six months ahead of schedule, $800 thousand below budget, and with no reportable injuries or illnesses. As a result of these activities, the annual S&M cost of the facility has been reduced by $3 million per year.

2.5 ORNL High Radiation Level Chemical Development Laboratory

The ORNL High Radiation Level Chemical Development Laboratory was constructed in 1957 as a laboratory and small-scale pilot plant for development studies of reactor fuel processing and separation and for recovery of transuranic materials and separation of fission products from aqueous wastes. The facility was shut down in 1980 and is currently waiting for D&D, which is targeted for FY

2008. Routine S&M has been ongoing since shutdown and is expected to continue throughout D&D.

The S&M Program at ORNL performs a variety of activities to ensure that sites and facilities within its responsibility remain in a safe condition and in compliance with applicable regulations. Many remedial action (RA) sites and D&D facilities are inspected and maintained by the S&M Program. Under the S&M Program, routine, preventive, and emergency maintenance activities are performed as needed at these sites and facilities. In addition, stabilization activities are performed to reduce risks and reduce future S&M costs.

S&M activities have historically been labor intensive, which increases the potential for exposing workers to contamination and other facility hazards. At the ORNL High Radiation Level Chemical Development Laboratory, daily surveillance was performed to check the alarm system, which monitored airborne radiation, radiation fields, cell ventilation, and certain tank and sump levels. To eliminate the daily entries for these checks, magnehelic gauges were replaced with analog gauges and commercially available software was installed to allow the collection of information from a remote central point for evaluation and analysis, using an existing phone line for data transmission. The remote monitoring software permits the recording of electronic data from the building instrumentation at variable intervals. It also provides analytical support, including trending and archiving features and eliminates a margin of human error in data collection and analysis.

Deployment of the remote monitoring system at the High Radiation Level Chemical Development Laboratory eliminated the need for personnel to enter the facility on a daily basis and eliminated 98 percent of the projected surveillance cost for this facility. The greatest value from the installment of the remote monitoring system is the enhanced worker S&H since the workers can now perform monitoring activities without having to actually enter the facility.

During FY 1997, all S&M activities were accomplished safely. There were no lost work days and no environmental noncompliances. In addition, all activities were performed within scheduled milestones and under budget.

3.0 LESSONS LEARNED AND GOOD PRACTICES

DOE is responsible for ensuring that work performed at its sites is performed safely and that hazards to workers, the public, and the environment are minimized, mitigated, and controlled. To formalize this responsibility, DOE issued DOE P 450.4, *Safety Management System Policy*, and its associated guide, DOE G 450.4-1, *Integrated Safety Management System Guide*. The Integrated Safety Management System (ISMS) policy specifies a formal, organized process based on seven guiding principles and five core functions for ensuring the integration of safety into all types of work, at all DOE sites and facilities, for all types of potential hazards.

In general, the development and implementation of ISMS involves integration of safety into all aspects of work planning and execution through the use of the guiding principles and core functions set forth in DOE P 450.4. Figure 9 illustrates the conceptual relationship among the ISMS core functions.

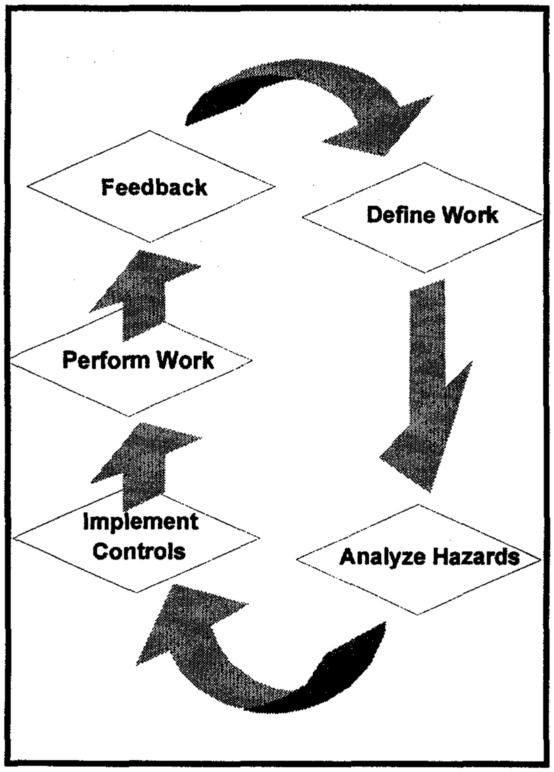

Figure 9. ISMS Core Functions

The ISMS core functions provide the necessary structure for any work activity that could potentially affect the public, workers, and the environment. The first core function, *Define the Scope of Work*, is defined in the policy as follows:

Missions are translated into work, expectations are set, tasks are identified and prioritized, and resources are allocated.

Based on this core function, a safe and cost-effective facility disposition requires a well-defined and structured project planning process that includes:

- a multidisciplinary project team, including S&H professionals and workers;
- definition of project tasks and end-point expectations;
- collection of relevant information on the facility and related potential hazards;
- identification of special requirements, exemptions, and permits;
- identification of stakeholder issues and expectations;
- identification of needed resources and training requirements;
- scheduling of work activities; and
- worker briefings on the work scope and activities to be conducted.

The above concepts are consistent with the principles of the International Organization for Standardization (ISO) 14000 series, *Environmental Management Standards*, which is being implemented throughout the Oak Ridge site.

This section presents the lessons learned and good practices identified and used during Oak Ridge facility disposition project planning.

3.1 Use Former Employees to Augment Facility Hazards Information

When initially planning a facility disposition activity, it is essential that information on potential hazardous conditions within the facility be collected and evaluated to ensure that workers are adequately protected and to minimize the potential of a release to the environment during the execution of the work.

The initial sources of safety-related information about a facility are its historical operating records, incident reports, and existing safety documentation. However, for many facilities that were constructed, operated, and shut down decades ago, this information either does not exist or is inadequate to determine the extent of the operations and hazards within the facility. In many cases, facility modifications occurred and additional activities and operations were initiated that are not reflected in the historical documentation. This is especially true for laboratory and experimentation facilities that were constantly expanding capabilities and experiments, often involving hazardous and radioactive materials.

To supplement the existing facility documentation, extensive use of former employees has been invaluable to the Oak Ridge facility disposition projects for determining the potential hazards at the facilities. These former employees have been able to identify and locate additional documentation and provide details on past facility operations, mishaps, and incidents. This information has been used to focus the planning and implementation of facility disposition activities.

EXAMPLE: INVOLVEMENT OF FORMER FACILITY EMPLOYEES IN HAZARD CHARACTERIZATION ACTIVITIES

Facility information, records, and knowledge of the hazards, contamination, and facility conditions in many areas of the ETTP site was limited. This situation would ordinarily necessitate a comprehensive characterization and sampling program. However, it was found that this gap in available information could be significantly improved by interviewing former employees who were knowledgeable of past operations, incidents, releases or spills, and facility modifications. Several documents on facility history have since been published based on former employee knowledge.

An example of one of these documents is K/D-6052, *K-25/K-27 Buildings, Historical Characterization*, September 1992. Historical information from available documentation and input/interviews from 15 former and current employees (from former staff members and research assistants, to operations managers and superintendents, to Division and Department managers) is documented in this report. Each section of the report was written by a former employee with expertise in a particular area. For example, an electrical engineering specialist provided details on the electrical power generation facilities, power distribution systems, switchyard installations, and K-25/K-27 power interface.

The report also discusses the K-25/K-27 operating history and evaluates and maps radionuclides within the facility process and external to the processes. Although it is not a definitive record of the entire history of these facilities, it does provide useful insight that has improved hazard characterization and reduced the need for extensive environmental sampling.

3.2 Consider Facility Post-Operations Uses and Conditions

Having identified the past operations and associated hazards from historical documents and interviews of former employees, the current facility condition needs to be investigated to identify any inherent or new hazards that have been created since the facility was shut down.

In the face of declining budgets, many facilities across the DOE complex have been "abandoned-in-place," with very limited maintenance, if any. Though this approach may reduce S&M costs, often the structural integrity of these facilities comes into question and increases the potential for the release and/or spread of radioactive and hazardous materials to the environment. Further, this approach often requires additional protective features to be put in place before allowing facility access (e.g., guard rails, facility access controls, use of respirators, etc.).

The abandon-in-place approach was heavily criticized in a recent DOE evaluation of facility disposition programs at ETTP, EH2PUB/09-97/05SR, *Special Report: Safety Management Evaluation of Facility Disposition Programs at the East Tennessee Technology Park*. This evaluation states that many of these facilities are being allowed to degrade, which could potentially make the eventual disposition of these facilities more complex and costly and could introduce more hazardous conditions for the facility disposition workers. These conditions are clearly not conducive to safety, even for the limited amount of access that may be required as part of the S&M program.

The evaluation recommends that this approach be used only at nonhazardous facilities that are fenced off until final dismantlement. This may include office buildings, warehouses, and smoke stacks. The evaluation suggests that the S&M program be maintained for those facilities that continue to contain hazardous and/or radioactive materials.

EXAMPLE: PLANNING SHOULD RECOGNIZE THAT FACILITY CONDITIONS CHANGE WHILE FACILITIES WAIT TO BE DISPOSITIONED

Despite being among the top five risk-ranked radiologically contaminated buildings for D&D, Buildings K-1131 and K-725 were categorized as "abandoned-in-place." At these facilities, hazardous materials, including UF_6 cylinders and uranium deposits, were still present, and the facility conditions were not stabilized. Essentially all maintenance was discontinued and normal building services (i.e., electrical power; heating, ventilation, and air conditioning; automatic fire protection; and exit lighting) were taken out of service. Because of the rapidly deteriorating conditions, a respirator is now required for entry to the facility. Such measures were not required until recent months. The additional protective actions had to be identified and implemented before allowing continued access to the facility and will have to be factored into the planning of D&D activities. Further, the potential for increased personnel exposure during D&D is greater due to these deteriorated facility conditions.

At the Powerhouse Demolition Project, the only radioactive contamination present in the facility was from a contaminated pallet that had been moved in to store equipment. Because of this storage, the area had to be decontaminated before the contractor initiated demolition work. This resulted in delaying the project and presented the potential for an unexpected radiological exposure to the workers from material in a supposedly clean area.

In addition, on more than one occasion, shutdown facilities have become uncontrolled storage areas for spare parts and equipment. The use of shutdown facilities for storage can be accomplished without increasing problems for future facility use or disposition, if the storage activities are well planned and controlled. However, these facilities often become uncontrolled scrap areas for excess parts, including radioactively contaminated parts.

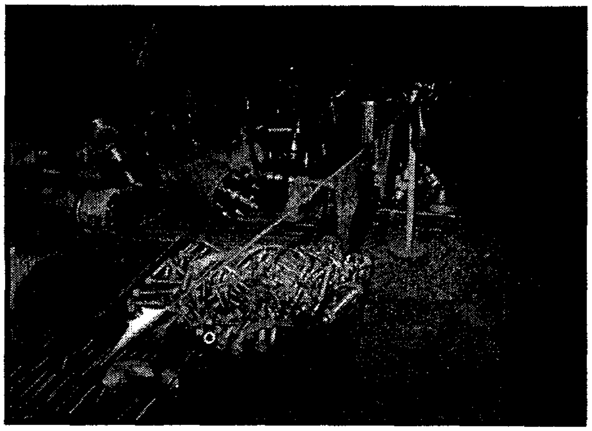

Figure 10. Parts Storage in the Powerhouse

Some initial activities can be conducted to reduce the eventual S&H and cost impacts associated with dispositioning facilities, especially if these facilities will be in long-term S&M, abandoned, or used to store excess equipment. A critical first step is to remove the hazardous and/or radioactive materials from these facilities before they are shut down or placed into long-term S&M.

Once a decision is made to place a facility in standby or shutdown, there is no need to have large quantities of hazardous and/or radioactive materials remain in the facility processes. This initial step can greatly reduce the facility hazards and reduce the hazard controls required, thereby reducing the required S&M activities and simplifying the eventual decommissioning activities.

The use of this hazard/risk reduction approach at Y-12 and ORNL has:

- reduced hazards and risks associated with performing S&M activities,
- reduced overall costs, and
- enhanced the S&H aspects of the eventual decommissioning of the facilities and remediation of the surrounding areas.

3.3 Use Occurrence and Lessons Learned Reports

Other sources of information that should be considered during the planning of disposition activities and used throughout the project are lessons learned associated with incidents and accidents from across the complex.

The key to using this information is to identify lessons learned that are pertinent to the scope of work being planned at the facility. For example, an event that occurs at an operating facility may be applicable to a dispositioning activity if similar conditions, hazards, or activities are involved. Lessons learned and discussions of incidents can be found on DOE or site-specific lessons learned web sites, in EH publications (e.g., references 3, 4, and 5 of this report), and through the DOE Operating Experience Weekly Summaries and DOE Occurrence Reporting and Processing System.

To properly use this information requires management commitment and attention to tracking and trending events from across the complex, not just from within the local site's activities. In addition, a concerted effort should be expended to ensure that the lessons learned from these incidents are evaluated and disseminated to the appropriate personnel and that any identified corrective actions are tracked until fully implemented.

EXAMPLE: LESSONS FROM OTHER SITES CAN HELP AVOID COSTLY INCIDENTS

On September 5, 1997, at the Paducah Gaseous Diffusion Plant, a double overpacked drum containing a radioactive concentrated nitric acid waste mixture ruptured violently due to overpressurization inside the RCRA Waste Storage Facility and spilled its contents over an area of approximately 400 square feet. The rupture occurred when the polyethylene container failed due to aging embrittlement and allowed the acid to contact the steel outer container. This led to a chemical reaction that resulted in the overpressurization and rupture of the drum.

This event might have been avoided if the lessons learned from the Hanford Plutonium Reclamation Facility hydroxylamine nitric acid reaction/explosion had been recognized as applicable to Paducah's storage activities. Findings during the DOE investigation of the Paducah event identified components of their occurrence reporting and lessons learned programs to be inadequate. In particular, the findings identify that there is no single organization or individual responsible for tracking and trending information from the occurrence reporting or lessons learned systems. In addition, the findings and recommendations of a 1991 Lockheed Martin Energy Systems (LMES) report (*Proposed Neutralization/Pretreatment for Nitric Acid Strip Tank Waste and Other Drummed Lab Wastes Stored in the Vault 4A Facility*) and a yellow alert (Y-PAD-91-0002, *Polyethylene Reagent Container Failure*) were disregarded. The net result was that management did not recognize the significance of and/or act appropriately on information regarding the incompatibility between acids and containers. While nitric acid waste was initially packaged in a compatible polyethylene container, the potential problem associated with long-term storage, which caused the embrittlement of the polyethylene container, coupled with overpacking in an incompatible container was not recognized. This lack of recognition and action allowed conditions to exist that lead directly to the drum overpressurization.

3.4 Use Incentive Contracts

Subcontractors are being used to accomplish much of the facility disposition work at the Oak Ridge site. LMES has learned the importance of prequalifying subcontractor S&H programs as part of the contracting process. LMES examines subcontractor S&H procedures, the company's Occupational Safety and Health Administration (OSHA) 200 log, and references on similar jobs. S&H-related incentives that reward both management and workers for good performance are also placed in the contract. LMES has found this to be one of the most important tools for improving S&H performance.

In addition, Oak Ridge has used an innovative contracting method, referred to as Environmental Management Program Integration Contracting (EPIC), to reduce project costs, improve safety performance, and ensure management accountability. Features of this "incentive task order contracting" approach include:

- obtaining a multi-contractor team,
- using fixed-price contracting,
- providing an incentive for finishing under budget and within specific S&H performance criteria,
- applying a penalty for any cost overruns or unsatisfactory S&H performance, and
- using technical experts to help streamline and focus procurement performance specifications, thereby simplifying the process and reducing cost estimates.

This contracting approach was piloted at the Powerhouse Demolition Project and the Cooling Towers Demolition Project.

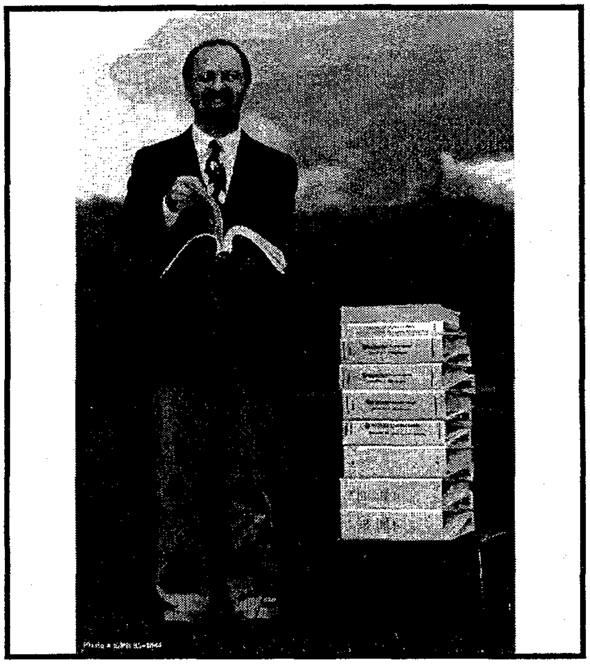

Figure 11. Contract Paperwork - Standard Award Fee vs. EPIC (in hands) Contracting

Based on the successes of these projects, incentive contracting has been used in other Oak Ridge disposition activities, such as the ORNL S&M Program.

The implementation of the ITO contract places more emphasis on performance, including its safety aspects, and creates cost and schedule savings by focusing on completing the tasks in a safe, timely, and cost-effective manner. The negotiated provisions of this type of contract promote cost savings because the contractor profits from successfully driving down costs while not compromising worker safety.

In addition, it was found that increased competition affects the bid prices that are received. Fixed price subcontractor bids on ITO projects have been about half as much as the estimated costs, while nonincentive fixed price projects contracted during the same time period exceeded the government estimate by an average of 20 percent. Thus, taking steps to entice more qualified bidders to compete lowers the overall cost of the work. Figure 12 illustrates the increase in bidders using the EPIC approach.

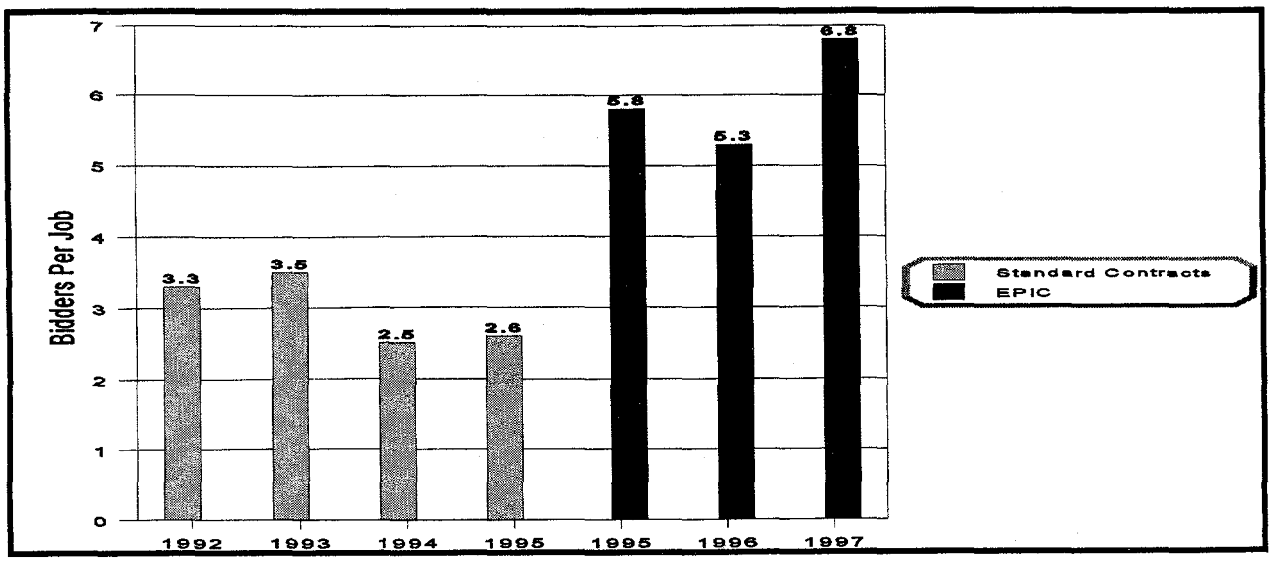

Figure 12. Average Number of Bids

EXAMPLE: USING INCENTIVE CONTRACTING REDUCES COSTS WHILE MAINTAINING SAFETY AND HEALTH

Historically, only one or two roofing contractors bid on roofing jobs at ETTP. In an effort to increase the number of potential bidders for the K-31 Roof Repair/Replacement Project, an independent roofing consultant provided technical support to the site project team in the preparation of the roofing procurement specification. The typical government procurement specifications were customized to look more like commercial specifications and included special terms and conditions that were made very project-specific.

Further, contamination issues discouraged contractors who were not accustomed to working in that environment from participating. To entice more bidders, the roof was decontaminated and "down-posted" to a nonradiation condition. Other innovative approaches, such as encapsulating the asbestos containing material near expansion joints, flashing, and parapet walls, were used in the procurement specifications.

A private construction road and access gate were put in place, and the area was "fenced off" from the rest of the ETTP before the subcontractor began the repair/replacement of the roof. This private access eliminated the need for Q-clearances, which are required inside the K-31 building, and the associated costs that would have been incurred. An added bonus of providing private access for this project is that this access can be used by other businesses that lease and use the fenced-off areas as part of the reindustrialization of ETTP.

The initial estimated cost (without fee) for the complete replacement of the K-31 roof was $12 million. Using a streamlined approach, which was suggested by the site project team and involved repairing salvageable portions of the roof instead of its complete replacement, the estimate was reduced to $10.5 million. The estimate at completion for this project was $6.5 million, which represents a $4 million savings from even the streamlined approach. More importantly, throughout the duration of the project, there were no reportable injuries or illnesses.

3.5 Coordinate and Integrate the Project Team

As part of several facility disposition projects, ETTP has used a multidisciplinary team to improve the facility disposition planning process, including the integration of S&H into project planning. Project management, safety and health, engineering, radiological control, fire protection, facility safety, quality, and operations and maintenance personnel form the team. They are tasked with clearly defining the scope of the project, identifying hazards and controls, and establishing S&H roles and responsibilities.

This process begins with a series of "brain storming" sessions whereby the team provides input on the feasibility of project milestones and task strategies, expected hazards, and potential impacts to cost and S&H considerations. Removable note pads (i.e., post-a-note, sticky pads, etc.) are used to capture the inputs and are organized in sequential order to determine when each task should start, its duration, and how it impacts other tasks. The team meets for consecutive days to address all aspects of the project and is generally lead by an unbiased facilitator who is familiar with the planning process.

Planning resources and project schedules are often reduced because of the intense and focused planning sessions. The process fosters creativity and increases ownership among participants. In turn, this improves the morale of the team participants and improves the awareness of project work scope and potential hazards.

Increased S&H awareness occurs as the project team identifies and focuses on facility safety, industrial safety, industrial hygiene, and radiological control concerns. Concerns shared among the disciplines, or unique to a discipline, are discussed. These sessions help the project team identify the appropriate S&H analyses needed (e.g., Safety Analysis Report, Basis for Interim Operation, and Health and Safety Plan), work approaches that eliminate or reduce hazards, and potential unknowns and uncertainties that require thorough characterization or more conservative hazard control strategies.

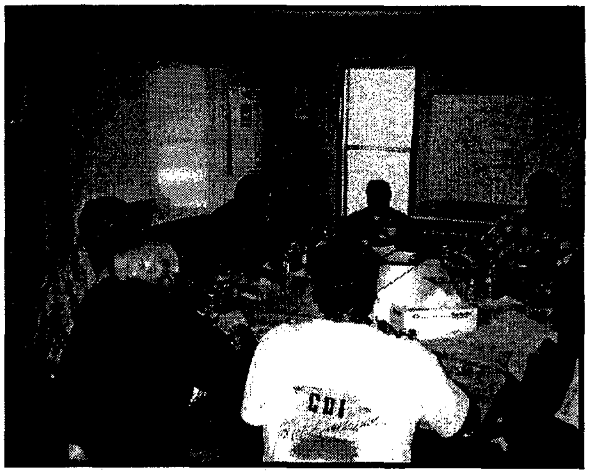

Figure 13. Regular Project Status Meetings of the Integrated Project Team

EXAMPLE: ELIMINATE THE HAZARD

At the ORNL High Radiation Level Chemical Development Laboratory, the S&M activities were labor intensive and required worker entry into radiologically contaminated facility areas on a daily basis. This activity increased the potential for contaminating and/or exposing the workers. To enhance worker safety and reduce the overall costs, remote monitoring equipment was installed to provide data on key facility parameters (e.g., airborne radiation, radiation fields, cell ventilation, and tank and sump levels). This minimized the need for workers to access the facility, thereby reducing the S&H risks. In addition, this equipment provided capabilities to perform real-time tracking and trending of the monitored data.

At the Y-12 Alpha 4 facility, the overall reduction of mercury vapor levels was a key factor in placing the building in a safe and secure shutdown status. A second key factor was the elimination of radiological contamination areas, which involved the cleaning and removal of radiologically contaminated filters in the building ventilation system. A third key factor was the isolation of electrical control centers throughout the building to assure that no unidentified or abandoned circuits could be accidentally re-energized. All of these efforts were undertaken to eliminate the potential hazards to the workers performing periodic surveillance of the building.

EXAMPLE: WORKERS IDENTIFY INNOVATIVE SOLUTIONS TO PROJECT ISSUES

Heat stress was a major concern for the Deposit Removal Project. This condition is created by the required level of protective clothing coupled with an absence of air cooling capabilities in many ETTP facilities. Based on suggestions and input from workers, LMES has reduced this hazard by using early morning shifts which begin at 5:00 a.m. Work is usually completed around 9:00 a.m., before daily temperatures reach their peak.

In addition to the project team planning sessions, "table-top" briefings are also conducted with workers, supervisors, project management, and S&H personnel. Before conducting these sessions, the team typically performs a walkdown of the job site to become familiar with the work environment and to identify hazards and review job methods and sequencing.

Worker input is solicited, which often results in modifications to the work plans. The workers help streamline the project, identify potential process/activity problems, and provide innovative solutions based on their specific knowledge and experience.

Also as a result of worker input, institutional memory has been maintained and operating methods for disassembly have been recovered. Awareness of worker safety is addressed and kept in the forefront in the documents and is also incorporated into the training and briefings that result from these reviews.

3.6 Involve Stakeholders Early

It is important for the cost-effectiveness of a project and the S&H of the workers for the work scope and regulatory framework to be well defined before commencing work. "Surprises" discovered during the performance of an activity can lead to stop work orders, schedule delays, cost overruns, and unnecessary exposures to the workers.

One component of establishing a well-defined work scope, in addition to those previously discussed (i.e., facility characterization activities, well-defined procurement performance specifications, coordinated and integrated project teams, etc.), is to identify and resolve stakeholder S&H and/or regulatory issues or concerns as early as possible in the planning stages of the project.

Having the stakeholders (e.g., DOE and regulators) involved with the project from the beginning can develop a good working relationship and trust. The stakeholders are able to see that the project team is striving wholeheartedly to work within the regulations. In addition, including stakeholders in the planning and status sessions allows the project team to get an initial "buy-in" on innovative, creative, and effective solutions.

Interaction between the stakeholders and the project team provides an opportunity to discuss and define the various roles of the stakeholders, from consolidating oversight activities to providing technical reviews. Reducing oversight burdens by sharing information among various inspectors, the prime contractor, DOE, and the state regulators, can reduce the costs associated with the project. Further, having a more informed regulator allows project reviews to be better focused on the technical issues instead of seeking additional information or explanations about the project. This approach supports the identification and resolution of issues more rapidly.

EXAMPLE: INVOLVING STAKEHOLDERS EARLY IN THE PLANNING PROCESS LEADS TO EARLY RESOLUTION OF PROJECT ISSUES

The demolition of the Powerhouse facilities generated 6,500 tons of metal. In the past, both contaminated and uncontaminated metals would be sent to the K-770 Scrap Yard for handling and storage. DOE Order 5400.5C, *Radiation Protection of the Public and the Environment*, requires that 100 percent of material taken offsite be surveyed for radiation contamination. Because the Powerhouse facilities have never been used for radiological operations, LMES suggested that a less stringent approach be taken for handling this contamination issue. LMES established a radiation protocol for testing and characterization that allowed certain types of statistical and bias sampling and requested permission from DOE to meet with the state to develop a more cost-effective way of disposing of the scrap metal offsite. By working with DOE and the state, a cost avoidance of approximately $6 million was realized using the project-specific material radiation protocol for the free release of scrap metal.

3.7 Implement Training Mock-Ups

Another lesson learned at the Oak Ridge site for identifying and resolving issues is to use training mock-ups to simulate the facility disposition operations and conditions before starting the work. Mock-ups allow the workers to be trained on the actual activities to be performed and provide a perspective of the physical layout, required tools and capabilities, and potential hazards that are not evident through routine job hazard analysis activities. This also provides the workers an opportunity to identify and practice work methods that are more efficient and safer. Mock-ups can be used to address issues associated with heat stress, radiation control, as low as reasonably achievable (ALARA) criteria, utilization of new equipment, process-specific hazards, and working in confined spaces, as well as other potential work-related issues.

EXAMPLE: MOCK-UPS HELP IDENTIFY AND SOLVE PROBLEMS BEFORE THE WORKERS GO TO THE FIELD

For the Deposit Removal Project, workers conducted various simulations of planned work activities, such as pipe cutting, to improve work schedule estimates and to identify the safest and most efficient manner for conducting the work. Work plans required that overhead piping be cut in place to remove uranium deposits. Since this required drilling operations, workers were concerned that deposits could be disturbed and released from the overhead pipes. Therefore, a training mock-up was conducted on clean pipe to examine the extent of induced vibration. It was determined that workers were being placed in a position that increased their potential for being contaminated and/or exposed to a release of the radioactive deposits. After reviewing this activity with the workers, it was decided to cut the piping into large sections, lower it to the floor, and perform the removal activities on the ground. In addition, the workers provided input on piping locations to be cut. These changes resulted in a safer and less expensive task.

4.0 CONCLUSIONS

There are several aspects of the Oak Ridge D&D Program related to cost-effective facility disposition planning that contribute to the safety record of this program. The review and evaluation of these items identified useful practices and important insights that have possible application throughout the DOE complex.

Identified lessons learned from the Oak Ridge D&D Program can be summarized in a set of key attributes as follows:

- Augment facility historical information by interviewing former employees.
- Solicit worker input in project planning to gain from their experience on similar projects.
- Include stakeholders and regulators early in project planning to provide open dialogue and early resolution of potential issues.
- Characterize the facility's hazards in the early stages of planning, including identifying inherent hazards caused by aging and structural degradation, to the extent practical.
- Use incentive contracting approaches by prequalifying contractors and their safety and health programs, using experts in developing procurement performance specifications, and streamlining the procurement process.
- Remove hazardous and/or radioactive materials before completely shutting down the facility or entering long-term surveillance and maintenance.
- Form multidisciplinary teams, including subcontractors, that work and are located together throughout the project to improve the communication and teaming environment.
- Streamline and focus responsibility for safety and health management by using a single safety and health point of contact for the project.
- Use mock-ups to enhance training and familiarize the workers with the work activities and conditions and to identify and resolve potential problems in performing the work.

Oak Ridge's continuing thrust and strategy will be to eliminate or reduce arcane and cumbersome policies, procedures, and practices that hinder cost-effective facility disposition activities. Ultimately, the lessons learned and insights gained from Oak Ridge's effective planning will improve overall environment, safety, and health performance and reduce the risks associated with the management of excess facilities.

5.0 REFERENCES

1. U.S. Department of Energy, *Integration of Environment, Safety and Health into Facility Disposition Activities*, DOE-STD-1120-98, May 1998.

2. U.S. Department of Energy Office of Environmental Management, *Decommissioning Resource Manual*, pages 3-3 and 3-4, August 1995.

3. U.S. Department of Energy, *Integrating Safety and Health During Deactivation with Lessons Learned from PUREX*, DOE/EH-0486, September 1996.

4. U.S. Department of Energy, *Integrating Safety and Health During Decommissioning with Lessons Learned from INEL*, DOE/EH-0546, September 1997.

5. U.S. Department of Energy, *Worker Involvement Lessons Learned & Good Practices from INEEL Facility Disposition Activities*, DOE/EH-0566, March 1998.

6. U.S. Department of Energy, *Lessons Learned for the Oak Ridge K-25 Powerhouse Demolition Project*, DOE/ORO/2042, May 1996.

7. U.S. Department of Energy, *Results Document for the Demolition of Cooling Towers at the Oak Ridge K-25 Site*, DOE/ORO/2058, August 1997.

8. U.S. Department of Energy, *Results Document of the K-31 Roof Repair/Replacement Project*, DOE/ORO/2050, March 1997.

9. U.S. Department of Energy, *Safety Management System Policy*, DOE P 450.4.

10. U.S. Department of Energy, *Integrated Safety Management System Guide*, DOE G 450.4-1.

11. U.S. Department of Energy, *Special Review: Safety Management Evaluation of Facility Disposition Programs at the East Tennessee Technology Park*, EH2PUB/09-97/05SR, September 1997.

12. U.S. Department of Energy, *Highly Enriched Uranium Working Group Report on Environment, Safety and Health Vulnerabilities Associated with the Department's Storage of Highly Enriched Uranium, Volume II: Number 7, Oak Ridge K-25 Site Working Group and Site Assessment*, DOE/EH-0525, December 1996.

13. U.S. Department of Energy, *K-25/K-27 Buildings Historical Characterization*, K/D-6052, September 1992.

14. U.S. Department of Energy, *Annual Report of Decommissioning and Remedial Action S&M Activities for the Environmental Management Program at Oak Ridge National Laboratory, Oak Ridge, Tennessee: Fiscal Year 1997*, ORNL/ER-426, November 1997.