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OAK RIDGE NATIONAL LABORATORY

MARTIN MARIETTA

The ORNL Surplus Facilities Management Program Long Range Plan

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SURPLUS FACILITIES MANAGEMENT PROGRAM

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THE ORNL SURPLUS FACILITIES MANAGEMENT PROGRAM LONG RANGE PLAN

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EXECUTIVE SUMMARY

THE ORNL SURPLUS FACILITIES MANAGEMENT PROGRAM LONG RANGE PLAN

EXECUTIVE SUMMARY

The Surplus Facilities Management Program (SFMP) at Oak Ridge National Laboratory (ORNL) is part of the Department of Energy's (DOE) National SFMP, administered by the Richland Operations Office. This program was established to provide for the management of DOE surplus radioactively contaminated facilities from the end of their operating life until final facility disposition is completed. As part of this program, the ORNL SFMP oversees some 76 individual surplus facilities, ranging in complexity from abandoned waste storage tanks to large experimental reactors.

The ORNL SFMP has prepared this Long Range Plan to outline the long-term management strategy for those facilities included in the program. The primary objectives of this plan are to: (1) develop a base of information for each ORNL SFMP facility, (2) conduct preliminary decommissioning analyses to identify feasible alternatives, (3) assess the current and future risk of each facility, (4) establish a priority list for the decommissioning projects, and (5) integrate the individual project costs and schedules into an overall program schedule and cost estimate for the ORNL site. The Long Range Plan also provides an overview of the ORNL SFMP management structure, specifies the decommissioning criteria to be employed, and identifies special technical problems, research and development needs, and special facilities and equipment that may be required for decommissioning operations.

As detailed in this plan, final disposition of the current inventory of surplus ORNL facilities will require on the order of 20 years of dedicated operations. Resource requirements in support of this program are expected to increase in a step-wise fashion during the next five years of the program, ultimately resulting in a fairly levelized work force on decommissioning activities. The total estimated cost (FY 1985 dollars) for decommissioning of ORNL facilities is $103 million. Continuation of work beyond the scheduled end point would be dependent upon the availability of funds and the addition of projects during the interim years. The waste volume projections for the program point to the significant impacts that decommissioning activities will have on the ORNL waste disposal systems during the next 20 years. Although the annual waste generation rates are not expected to result in any major disruptions of routine activites, the total volume of solid waste (2.3×10^4 m^3) represents a significant allocation of the currently available on-site storage and disposal space.

Since the Long Range Plan represents the ORNL SFMP management strategy for site decommissioning, routine updating will be necessary in order to reflect changing program guidance, regulatory requirements, management philosophy, project prioritizations, and resource availability. As decommissioning projects are completed and as surplus facilities are added to the program, significant alterations in program direction can be anticipated.

1.0 INTRODUCTION

THE ORNL SURPLUS FACILITIES MANAGEMENT PROGRAM
LONG RANGE PLAN

1.0 INTRODUCTION

The Surplus Facilities Management Program (SFMP) at Oak Ridge National Laboratory (ORNL) is part of the Department of Energy's (DOE) National SFMP, administered by the Richland Operations Office. This program was established to provide for the management of all DOE surplus radioactively contaminated facilities from the end of their operating life until final facility disposition is completed. The purpose and objectives of the DOE SFMP are set forth in their current Program Plan,[1] and include:

1. The maintenance and surveillance of facilities awaiting decommissioning;
2. Comprehensive planning for the orderly decommissioning of these facilities; and
3. Implementation of a program to accomplish the facility disposition in a safe, cost-effective, and timely manner.

As part of this program, the ORNL SFMP oversees 76 individual surplus facilities, ranging in complexity from abandoned waste storage tanks to large experimental reactors. To provide effective management of this large number of sites, comprehensive long-range planning is essential. Decommissioning priorities must be established, based on health and safety concerns, budget constraints, and other programmatic considerations. To assist in making these decisions, the ORNL SFMP has prepared this Long Range Plan to outline the long-term management strategy for those facilities included in the program.

1.1 THE LONG RANGE PLAN

The DOE SFMP, as part of its Program Plan, has provided specific direction for document preparation in support of program activities, including long range planning. The ORNL Long Range Plan has been prepared in accordance with this guidance, as outlined in the following sections.

1.1.1 Plan Objectives

The primary objectives of this Long Range Plan are to:

(1) Develop a base of information for each SFMP facility at ORNL;
(2) Conduct preliminary decommissioning analyses of each facility in order to identify feasible alternatives, select the preferred option, and develop project schedules, costs and other pertinent design details;
(3) Assess the current and future risk associated with each facility;
(4) Establish a priority list for the decommissioning projects; and
(5) Integrate the individual decommissioning project costs and schedules into an overall program schedule and cost estimate for the ORNL site.

In addition to meeting these overall objectives, the Long Range Plan also provides an overview of the ORNL SFMP management structure, specifies the overall decommissioning criteria to be employed, and identifies special technical problems, research and development (R&D) needs, and special facilities and equipment that may be required for decommissioning operations. The program maintenance and surveillance requirements are summarized as part of the facility descriptions, with the details of these activities provided in a separate document.[2] Similarly, the facility characterization efforts, engineering assessments, decommissioning project plans and other supporting documentation are published as individual reports, with only summaries included in this plan.

1.1.2 Plan Structure

The ORNL SFMP Long Range Plan consists of nine chapters, of which this Introduction is the first. The contents of the remaining chapters are described briefly as follows:

Chapter 2.0 Site Description: Provides a summary description of the ORNL site, including its location, physical characteristics and scope of operations. Special emphasis is placed on those portions of the Laboratory that are a part of, or significantly affected by, the SFMP activities.

Chapter 3.0 Program Description: Presents an overview of the ORNL SFMP, in terms of the facilities included in the program, the ORNL management structure employed, the internal and external program interfaces, the program reporting requirements, and the project control methodology.

Chapter 4.0 Decommissioning Alternatives: Describes the range of decommissioning alternatives to be considered for facility disposition at ORNL, as well as the selection process involved in choosing the preferred alternative for any given facility.

Chapter 5.0 Design/Performance Criteria: Discusses the guidelines and policies that have been established for the management and decommissioning of SFMP facilities. Criteria are presented for program management, health and safety, waste disposal, materials reclamation, and final site certification concerns.

Chapter 6.0 Project Descriptions: Summarizes each of the SFMP projects in terms of the facility history, physical and radiological conditions, the routine maintenance and surveillance requirements, and details of the proposed decommissioning plan. Preliminary project schedules and cost estimates are also presented, based upon the proposed decommissioning activities.

Chapter 7.0 Project Prioritization: Presents the basis for project prioritization and provides a listing of the projects in the order of current priority at ORNL.

Chapter 8.0 Program Cost, Schedule, and Waste Volume Projections: Integrates the project schedule, cost, and waste volume estimates with the project prioritization results to provide an overall program-level long-range decommissioning schedule and cost estimate.

Chapter 9.0 References: Contains complete reference citations for all previous chapters in the plan.

In addition to these chapters, the Plan also contains four appendices, consisting of detailed descriptions of ORNL projects (Appendix I), a comprehensive record of ORNL SFMP documents covering current or completed decommissioning activities (Appendix II), a listing of applicable guidelines for the SFMP (Appendix III), and a list of acronyms used in the document (Appendix IV).

1.1.3 Update of the Plan

Since the Long Range Plan represents the ORNL SFMP management strategy for site decommissioning, routine updating will be necessary in order to reflect changing program guidance, regulatory requirements, management philosophy, project prioritizations, and resource availability. As decommissioning projects are completed and as surplus facilities are added to the program, significant alterations in program direction can be anticipated. To meet this need for periodic updating, the ORNL SFMP will review the plan on an annual basis, in support of the Field Task Proposal/Agreement preparation for the annual DOE budget review and analysis process. To meet the DOE budget review schedules, the Plan will be reviewed and updated as required during the first quarter of each fiscal year.

The Plan has been published in a loose-leaf format in order to make subsequent revisions simpler. Only those portions of the Plan that have been revised will be re-issued. Adequate control of the Plan distribution will be maintained to assure that the annual revisions are provided to all plan holders.

2.0 SITE DESCRIPTION

2.0 SITE DESCRIPTION

A brief description of the Oak Ridge National Laboratory site is provided in the following sections, including discussion of the scope of Laboratory activities and an overview of the ORNL facilities and surrounding environment. Special attention is given to the current waste management practices and operations, due to the importance of these activities to the ORNL decommissioning program. Further details on these topics are provided in references 3–6.

2.1 LABORATORY MISSION AND ORGANIZATION

The Oak Ridge National Laboratory was built in 1943 as a pilot plant for demonstrating production and separation of plutonium as part of the World War II Manhattan Project. Since that time, it has evolved from a laboratory almost wholly dedicated to nuclear technology research and development to one of the largest research and development laboratories in the United States. ORNL is a government-owned facility operated by Martin Marietta Energy Systems, Inc., (MMES) for the U.S. Department of Energy. The primary objective of ORNL is to support national fission and fusion energy goals through scientific research and technology development. Even though nuclear energy represents the major endeavor, the Laboratory also plays an important role in other areas of energy R&D, including conservation and fossil energy. In addition, ORNL produces and sells radioactive and stable isotopes that are not available commercially, to medical, industrial, and other research organizations.

The operating structure of the Laboratory is a matrix organization in which management duties are divided between functional and program lines. As shown in Fig. 2.1, the Associate Directors at ORNL administer the technical work of both individual divisions (functional line) and major programs (program line), and report directly to the Laboratory Director. In general, the functional line role is to develop and deploy a technical resource (skilled personnel) and the programmatic line role is to use this resource to meet programmatic objectives. Major programs may draw upon numerous divisions for technical personnel to meet their objectives.

The funding provided by DOE for the Laboratory's work is administered through the Oak Ridge Operations Office. However, as Fig. 2.1 shows, some ORNL research is sponsored by other federal agencies or non-federal organizations. Administration of these programs is provided through their respective program offices.

2.2 LABORATORY PHYSICAL DESCRIPTION

2.2.1 Location

ORNL is located on the DOE Oak Ridge Reservation, approximately 8 miles (13 km) southwest of the city of Oak Ridge (Fig. 2.2). The area is one of hills and valleys in the eastern part of the state of Tennessee. The DOE reservation, consisting of approximately 37,000 acres (15,000 ha), is bounded by the Clinch River on its eastern, southern and western borders, and by Black Oak

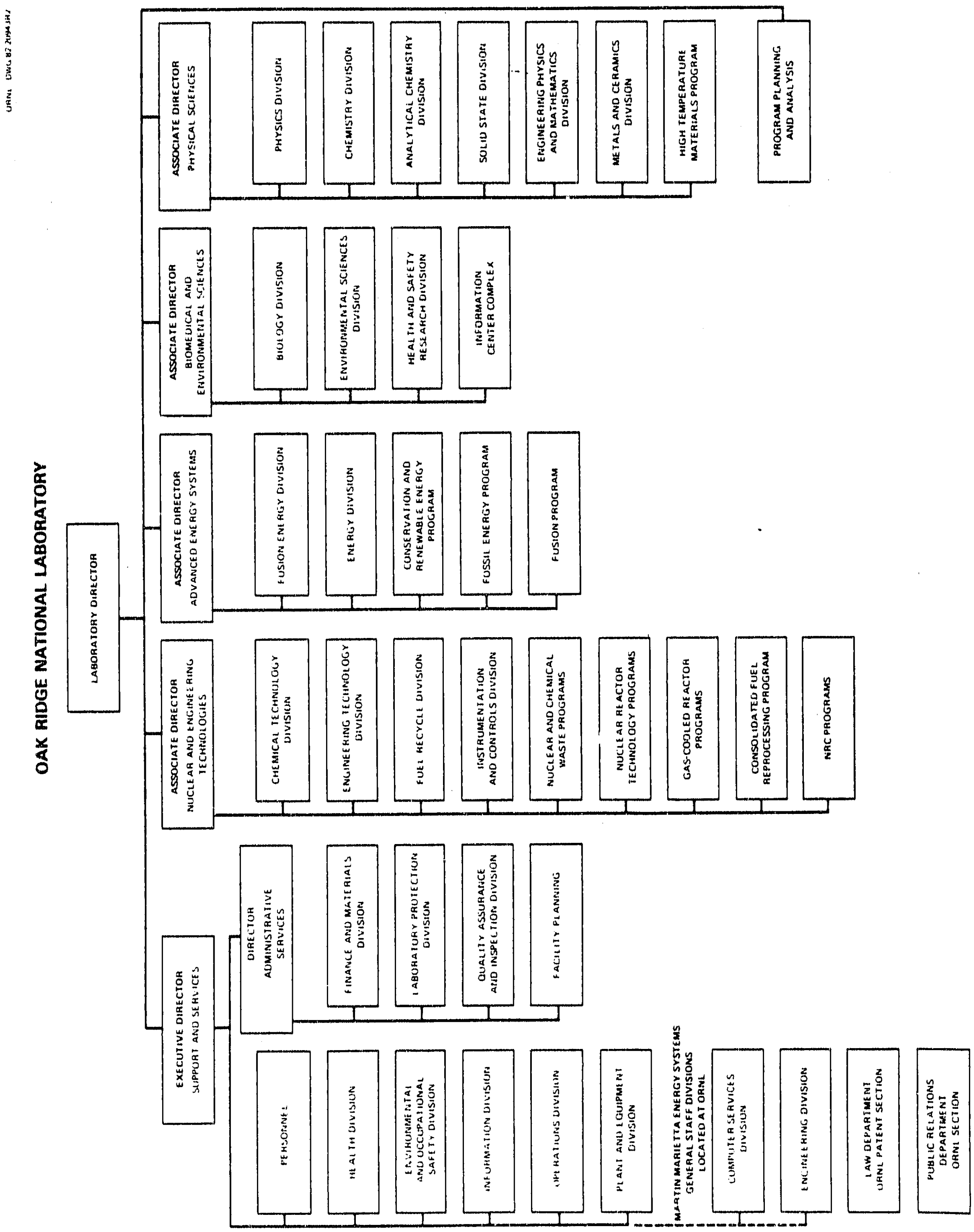
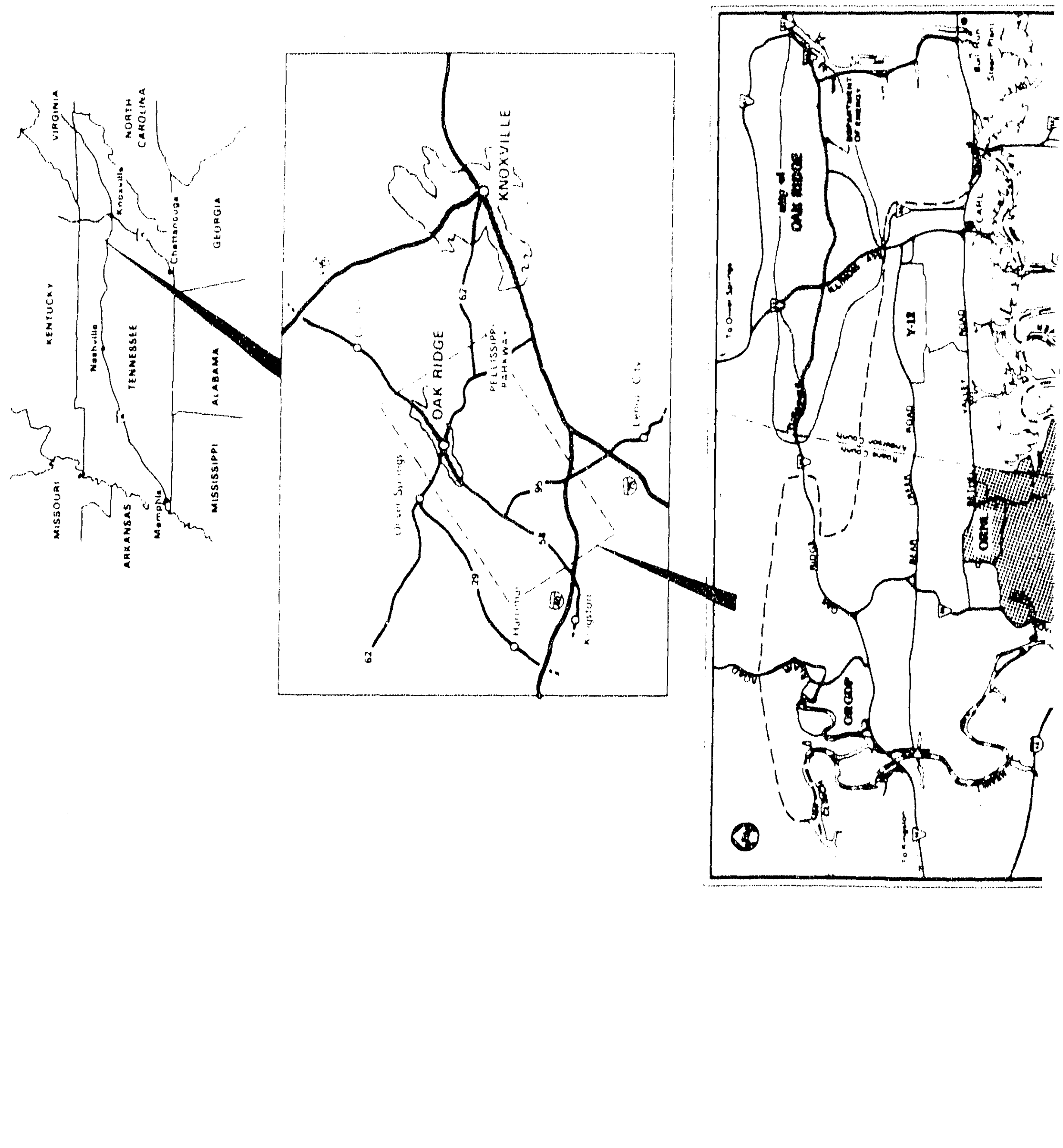


Fig. 2.1. Oak Ridge National Laboratory organization chart.

ORNL DWG 83 13652



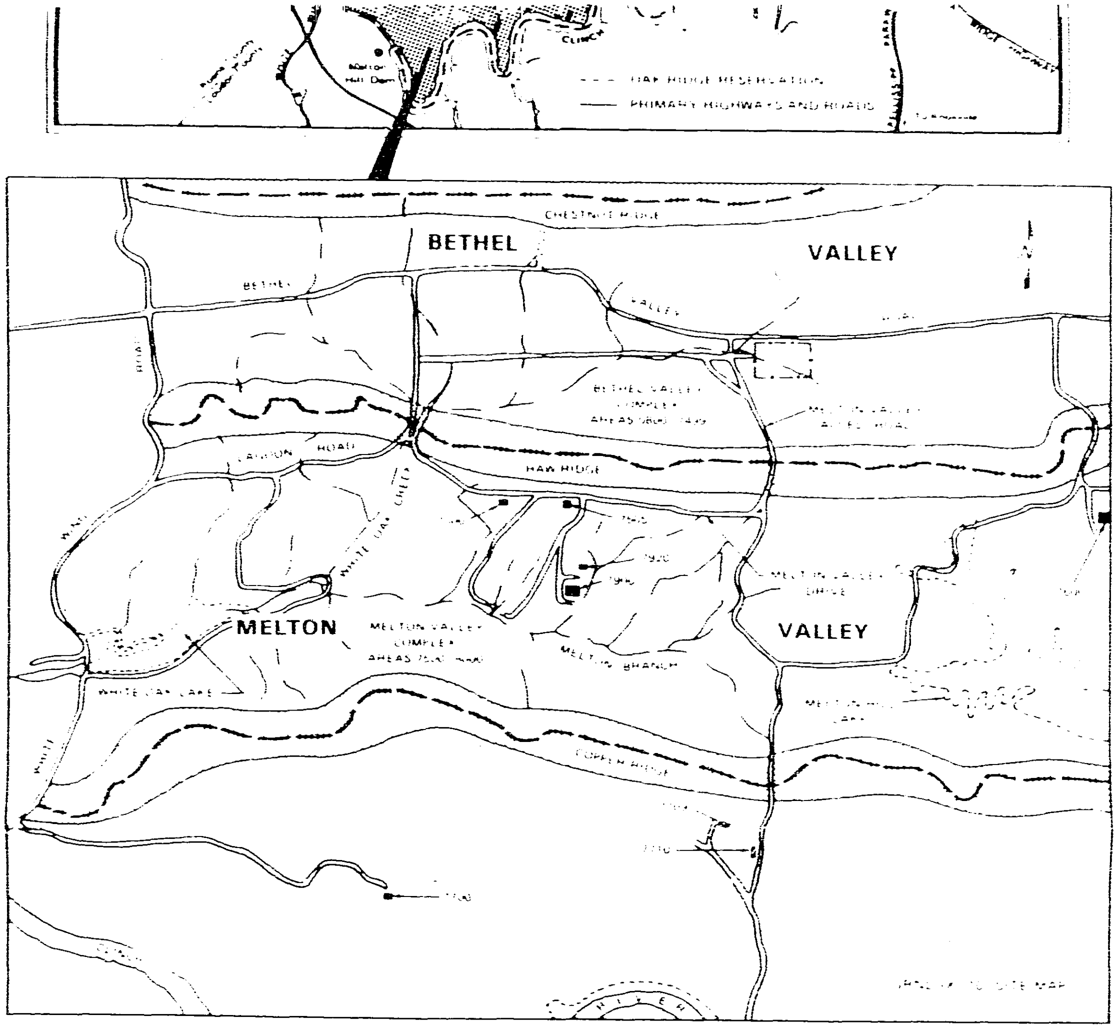


Fig. 2.2. Location map for the ORNL (X-10) site.

Ridge on the north. Within the reservation there are two DOE plant complexes in addition to ORNL: the Y-12 Production Plant, and the Oak Ridge Gaseous Diffusion Plant (ORGDP). A large portion of the remaining area on the reservation is designated as the Oak Ridge National Environmental Research Park.

The ORNL site (also referred to as X-10) covers a broad area on the southern border of the DOE reservation. The main ORNL complex lies in Bethel Valley, with additional facilities located to the south in the Melton Valley area and on Copper Ridge, just south of Melton Valley (Fig. 2.2). The site and buffer zone encompass approximately 8800 acres (3550 ha).

2.2.2 Facilities

The advanced research and technological development programs carried out at ORNL are supported by a variety of specialized facilities and equipment, some of which are found nowhere else in the world. Some examples of these facilities are (1) the Holifield Heavy Ion Research Facility for studies of heavy-ion nuclear reactions, (2) the High Flux Isotope Reactor and the transuranium-processing facilities for transuranium element production, processing and research, (3) the ORNL fusion research facilities including the ELMO Bumpy Torus scale device and the Large Coil Test Facility, and (4) the Surface Modification and Characterization Laboratory for materials research. These facilities are part of approximately 200 buildings contained in the X-10 site and at ORNL-managed areas at Y-12 (Fig. 2.3). As in any large plant, the age and condition of the facilities range from new construction to buildings erected as part of the original development in 1943. Many of the older facilities have reached the end of their design lifetimes and are in standby conditions or are part of the Surplus Facilities Program (see Section 3.0 for current listing of these surplus facilities).

In addition to the research areas at the Laboratory, numerous support systems and facilities are provided. These include electrical distribution systems, a coal-fired steam plant, and a water supply and sewage treatment system. These systems are for the most part similar to those included in most large production plants. In addition, a comprehensive radioactive waste management system and environmental monitoring network are provided for control of the Laboratory-generated wastes. Detailed descriptions of these waste management facilities are given in Section 2.4.

2.2.3 Site Security

As a restricted government installation, ORNL is provided with comprehensive safeguards, security, and protection systems. These systems include exclusion fencing around the reservation perimeter, continuously manned guard posts, controlled access for sensitive and hazardous areas, fire alarm and protection systems, a continuously manned and fully equipped fire department, and a routine security patrol. Because this complete protection is provided for ORNL as a whole, little additional security or protective measures are required for the SFMP facilities. Access to those facilities where potential hazards exist is further restricted by the facility operators who are required to minimize nonroutine personnel entry. This is normally accomplished by maintaining abandoned buildings in a locked and secured condition and providing adequate entry restrictions and radiation hazard posting for all accessible areas.

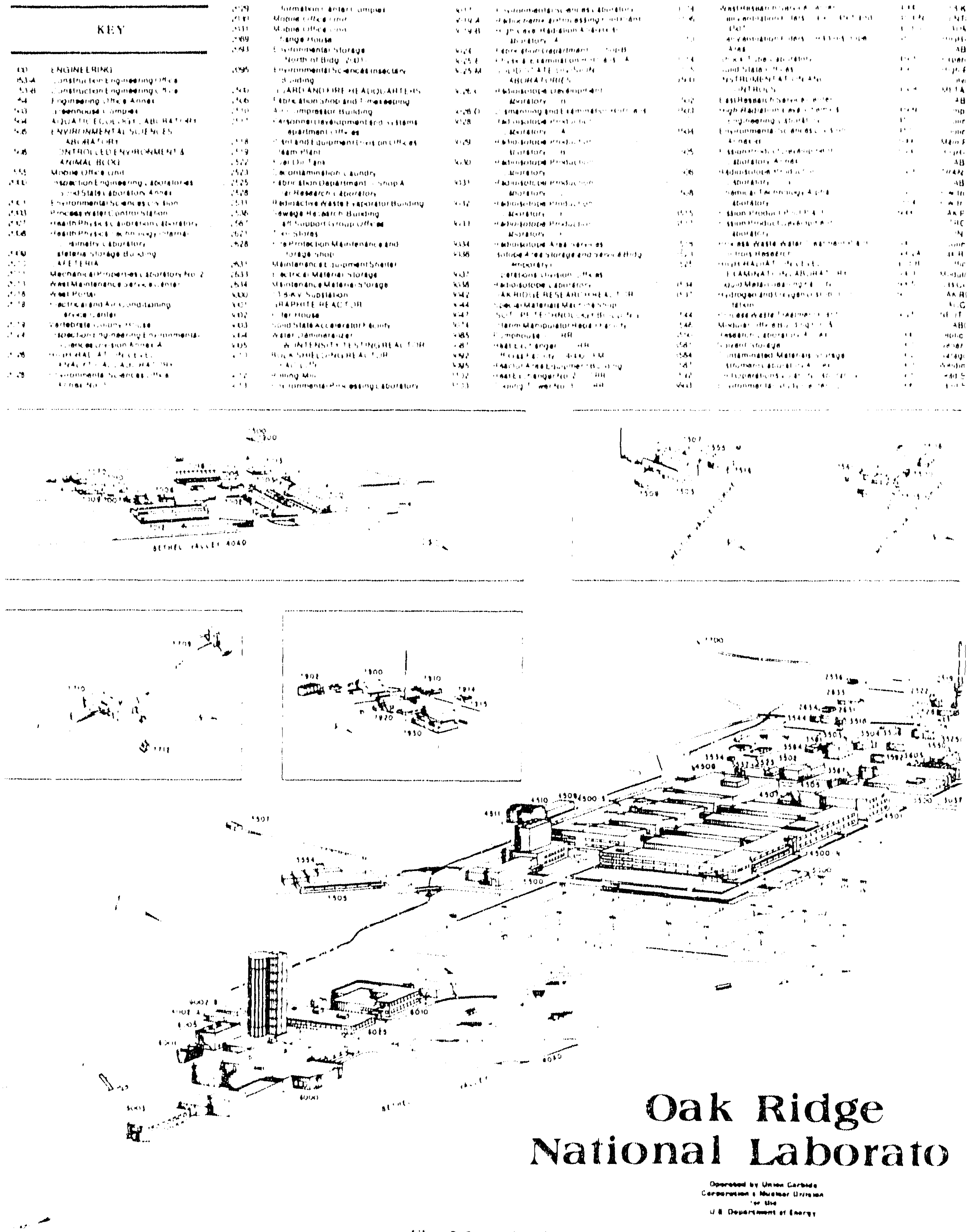


Fig. 2.3. Oak Ridge National Laboratory facilities (including facil

ORNL FACILITIES AT THE Y-12 PLANT

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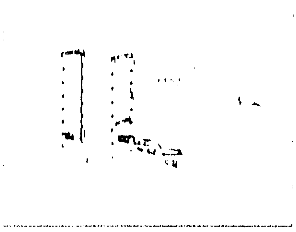

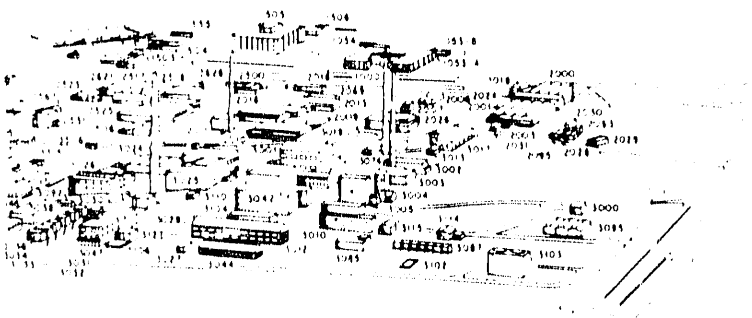

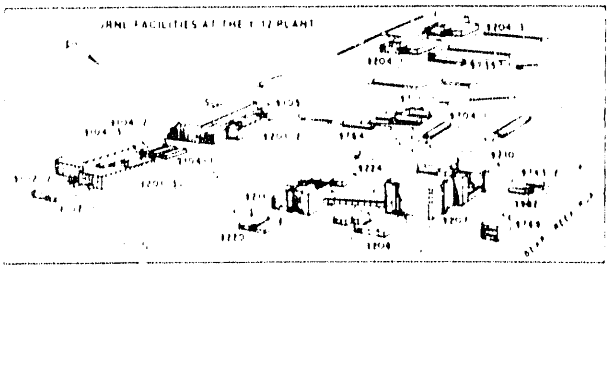

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s at Y-12).

2.3 CHARACTERIZATION OF EXISTING ENVIRONMENT

2.3.1 Geology

The ORNL site is located in the Appalachian Highland Physiographic Division of the eastern United States, within the Valley and Ridge Physiographic Province. The site topography conforms to this regional trend, characterized by a series of alternating elongated and parallel valley troughs and ridges tending northeast to southwest in general accord with the strike of the underlying rock strata. The valleys have been eroded in areas underlain by the less resistant limestone and shale strata, whereas the ridges are underlain by the more resistant sandstone, shale and cherty dolomite formations. The succession of alternating ridges and valleys at the ORNL site is illustrated in Fig. 2.2 and consists of Copper Ridge, Melton Valley, Haw Ridge, Bethel Valley and Chestnut Ridge, moving north from the Clinch River. Surface elevations associated with this varying topography range from about 740 ft (226 m) at the Clinch River on the southern border of the site, to approximately 1350 ft (410 m) at the crest of Melton Hill.

Nine geologic formations or groups ranging in age from Early Cambrian to Early Mississippian have been mapped within the Oak Ridge Reservation. All of the formations are of sedimentary origin, either chemical (limestone and dolomite) or clastic (sandstone and shale). From oldest to youngest they include the Rome formation, the Conasauga group, the Knox group, the Chickamauga limestone, the Sequatchie formation, the Rockwood formation, the Chattanooga shale, the Maury formation and the Fort Payne chert. The main ORNL complex lies primarily over the Chickamauga limestone, although other formations occur within relatively short distances from the site.

Although numerous faults exist within the area, they are all believed to have originated prior to the end of the Paleozoic era. Apparently major tectonic activity ceased thereafter. No physiographic evidence indicating tectonic activity has been observed along any of the thrust-fault areas in the ORNL region. Consequently, there is no reason to expect current or future translocations of these tectonic relics. Similarly, although the Oak Ridge area experiences a moderate level of seismic activity (5 earthquakes in the last 165 years with a Modified Mercalli intensity of V to VI), no incidence of surface deformation has been documented. Earthquakes of the types that occur within the region are common throughout the world. It is improbable that a shock of major intensity will occur in the Oak Ridge area for several thousand years. Forces from more seismically active areas (Charleston, South Carolina and Memphis, Tennessee regions) would be dissipated by distances of 400 miles (640 km) or greater.

2.3.2 Hydrology

The ORNL site is located in the White Oak Creek (WOC) watershed, which drains an approximately 6.4 miles^2 (16.4 km^2) area. As shown in Fig. 2.2, the primary tributary to the White Oak Creek is Melton Branch. The waters of the WOC are impounded by White Oak Dam at its intersection with White Wing Road (Tennessee State Route 95). The resulting White Oak Lake is a small, shallow impoundment, whose water level is controlled by a vertical sluice gate which remains in a fixed position during normal operations. The normal lake level since 1960 has been 745 ft (227 m) above mean sea level, creating a pool surface area of approximately 24 acres (9.8 ha), with approximately a 2-day retention time.

Water that drains from the White Oak Lake enters the Clinch River and subsequently the Tennessee River. The Clinch River originates in southwestern Virginia, and drains approximately 4410 miles^2 (11,340 km^2). Flow in this river system is controlled by the Tennessee Valley Authority (TVA) through three dams, the Norris Dam, Melton Hill Dam and the Watts Bar Dam. As indicated on Fig. 2.2, the nearest dam to the ORNL site is the Melton Hill Dam, located approximately 3 miles upstream from White Oak Creek. The pulsating flow pattern resulting from the TVA dam operations significantly affects the discharge from WOC. The average flowrate in the Clinch River near the WOC from 1963 through 1979 was 5280 ft^3/s (150 m^3/s).

There are nine public water supply systems, serving about 91,500 people, that withdraw surface water within a 20 mile (32 km) radius of ORNL. Of these, only one is downstream of the outfall from White Oak Dam. The intake for the city of Kingston is located approximately 21 river miles (34 km) below the dam. Recreational use of the waters in the ORNL vicinity is heavy. Surface water uses include boating, fishing, waterskiing, and swimming.

Over 100 private wells and springs and 8 industrial and 16 public groundwater supplies exist within about 20 miles (32 km) of ORNL. However, due to the stratigraphic and structural control of groundwater flow in the region, groundwater beneath the ORNL site is expected to migrate along the strike and discharge to surface water bodies. There is a low probability of groundwater migration from ORNL to offsite wells.

2.3.3 Meteorology

The climate of the Oak Ridge area is classified as humid continental. Oak Ridge is located within a broad valley between the Cumberland Mountains and Cumberland Plateau to the northwest and west, and the Great Smoky Mountains to the southeast. The weather and climate of the ORNL vicinity are greatly influenced by this regional terrain, as well as the local topography.

The prevailing surface winds usually blow up-valley from the southwest or down valley from the northeast. Besides influencing the wind direction, the regional and local terrain also acts to reduce surface wind speeds substantially. The annual average wind speed at the ORNL Melton Valley site is approximately 4.7 mph (7.6 km/h), while at the ORNL facilities on top of Copper Ridge, the average is 8.1 mph (13 km/h). Severe wind storms and tornadoes are rare in the ORNL vicinity, with the Oak Ridge-Clinch River area having one of the lowest probabilities of tornado occurrence in the state. However, periods of air stagnation, which have high potential for being air pollution episodes, occur relatively frequently in eastern Tennessee, averaging about one week per year.

Oak Ridge receives substantial amounts of precipitation throughout the year, with peak amounts occurring from December through March and a secondary peak during July. The majority of the precipitation [55 in. (140 cm) of water equivalent annually] falls as rain, although some snow is reported each year. High relative humidities and heavy loading of the atmosphere with aerosols are prevalent in this region and lead to poor visibility from haze much of the year.

The moderating influence of the surrounding mountains is noticeable in the temperatures observed at Oak Ridge. Seldom do temperatures rise above 100°F (38°C) or drop below 0°F (−18°C). The annual mean temperature is 68.6°F (20.3°C), with monthly means ranging from 38°F (3.4°C) in January to 77°F (25°C) in July.

2.3.4 Ecology

The Oak Ridge reservation is typical of the ecological systems of the Appalachian region. The reservation was predominantly agricultural land before federal acquisition in 1942, and much of the area has reverted back to natural plant cover since being withdrawn from public access. The dominant plant community is the oak-hickory forest, although elements of the mixed mesophytic forest are also present in scattered areas. Nonforest areas on the reservation include grasslands, devegetated areas, and developed locations. These nonforest areas predominate in and around the three plant locations (ORNL, Y-12 and ORGDP).

The plant communities on the reservation provide habitat for a large number of animal species. About 60 species of reptiles and amphibians, more than 120 species of terrestrial birds, 32 species of waterfowl, wading birds and shore birds, and about 40 species of mammals have been recorded. The aquatic habitat of the White Oak Creek watershed provides for a variety of aquatic biota, including benthic organisms, algaes and fish. The greatest numbers of these aquatic biota located within the ORNL site are found in the White Oak Lake.

Nine plant species listed by the state of Tennessee as threatened, rare or of special concern are present on the reservation, primarily in locations designated as natural areas. No endangered plant species have been found. Similarly, the geographic ranges of twelve animal species listed as endangered on the federal or state lists encompass the ORNL site, although the frequency of observation of these animals is rare or never. No threatened or endangered aquatic species have been encountered in the White Oak Creek watershed.

2.3.5 Demography and Land Use

The Oak Ridge Reservation is surrounded by five counties with a combined population of approximately 480,600. ORNL is located within 10 miles (16 km) of population concentrations in the city of Oak Ridge (total population of about 27,600). Knoxville, the principal population center in the area (population of approximately 183,000), lies 30 miles (48 km) east of the Laboratory. The total population within a 50-mile (80 km) radius of the X-10 site is about 690,000, with the largest percentage located to the east.

Of the total of approximately 16,500 MMES personnel employed at the three Oak Ridge Plants, about 4,900 are employed at ORNL. This number includes about 750 ORNL employees located at the Y-12 site. Most of the ORNL employees live within 25 miles (40 km) of the Laboratory.

The region in which the X-10 site is located encompasses residential, agricultural, industrial, and recreational areas. The region is traversed by numerous public roads and highways (Fig. 2.2). Farming in the area has decreased, although beef cattle production has increased in recent years. Five commercial dairy farms exist in the five county area. The principal cash crops harvested in surrounding counties are tobacco, corn, soybeans and wheat. Commercial forest land accounts for more than one-half of the land use in the region. Industrial development is limited in the immediate vicinity of the reservation. Recreational uses of area rivers and lakes are a major demand, although no hunting areas, wildlife preserves or sanctuaries exist in the vicinity of the site.

2.3.6 Ambient Radiological Characteristics

The natural background radiation dose to man is received from cosmic rays and external and internal exposure from terrestrial sources. The estimated average annual genetically significant dose equivalent to individuals in the Oak Ridge area from these natural sources is about 130 mrem/year (1.3 mSv/year). Man-made radiation sources which add to this natural background include residual fallout from nuclear weapons testing, routine nuclear power plant operation, medical uses of radiation, air travel, technologically enhanced radiation, and certain consumer products. The annual dose equivalent to a typical U.S. resident from these sources is estimated at approximately 105 mrem/year (1.0 mSv/year). In addition to these typical man-made exposures, residents in the Oak Ridge area are also exposed to routine releases from the DOE facilities on the Oak Ridge Reservation. The fifty-year dose equivalent commitment to the total body of the hypothetical maximally exposed individual from releases from the ORNL site has been estimated to be approximately 6 mrem (0.06 mSv).

2.4 ORNL WASTE MANAGEMENT PRACTICES

As part of its overall mission as defined by DOE, ORNL disposes of or stores all radioactive solid waste generated by the Laboratory. In addition, other hazardous solid wastes, all nonhazardous wastes, and all liquid and gaseous wastes produced by ORNL operations are treated and stored or properly disposed of on-site. In response to the need for on-site management of these ORNL waste streams, comprehensive waste handling, treatment, disposal and monitoring systems have been developed and are in use at the Laboratory. In general terms these waste streams can be separated into three major categories: (1) nonhazardous waste, (2) nonradioactive hazardous waste and (3) radioactive waste. Brief descriptions of the current waste management practices employed for each waste category, as well as the monitoring system provided for assessment of these practices, are given in the following sections. Further details on the specific waste disposal requirements for ORNL SFMP projects are provided in Chapter 5.0.

2.4.1 Nonhazardous Waste

The nonhazardous waste category includes a variety of normal solid wastes from facility operations such as paper products, various scrap materials, construction materials, cafeteria and office wastes and fossil fuel wastes. The solid wastes are generated at ORNL at an annual rate of approximately 1.9×10^4 tons/year (1.7×10^7 kg/year). The primary component of this waste is fly ash generated by the on-site coal-fired steam generator (1.3×10^4 tons annually).

Non-hazardous solid wastes are segregated and collected at local collection points and are transported to the appropriate disposal locations. For the salvageable materials and paper products, sale to off-site contractors and the public is provided. Cafeteria wastes, office wastes, and cooling tower sludge are disposed of off-site at the Y-12 sanitary landfill. Construction wastes and fossil fuel wastes are buried on-site at the contractor's landfill.

ORNL sewage and wastewater is treated at the Laboratory's sewage treatment plant prior to discharge into White Oak Creek. Approximately 2×10^5 gal (750 m^3) of treated wastewater are discharged daily.

2.4.2 Nonradioactive Hazardous Waste

The nonradioactive hazardous waste category is comprised of four major groups, according to their composition: asbestos-containing material, gas cylinders, chemicals, and waste oils. These wastes are generated by a variety of sources at ORNL, with an annual production of approximately

270 tons (2.4×10^5 kg) of solid and 1.1×10^5 gal (420 m^3) of liquid wastes. The largest single source of solid waste is animal bedding/waste, with PCB-contaminated oils making up the majority of the liquid wastes.

Because of the lack of an on-site hazardous waste disposal site, more than 90% of the materials included under the nonradioactive hazardous waste category are disposed of off-site, with the remaining 10% stored on-site for future processing or disposal. As shown in Fig. 2.4, this off-site disposal includes both commercial disposal and utilization of the sanitary landfill and Kerr Hollow Quarry at Y-12. ORNL burial grounds are utilized for the disposal of asbestos and animal carcasses, while another ORNL facility, the Hazardous Waste Storage Facility, is used for storage of a variety of waste chemicals and gas cylinders prior to shipment off-site. Silver-bearing wastes are treated to remove the recoverable silver prior to final processing for discharge to the sewage treatment system. PCB-contaminated oils are segregated according to PCB levels and either recycled or disposed of.

2.4.3 Radioactive Waste

Radioactive wastes constitute a major portion of the total wastes generated at ORNL. These wastes are produced during normal operations at a number of the research and development facilities at the Laboratory. There are 10 primary generators of radioactive waste: the Chemical Processing Plant, Fission Product Development Laboratory, Radioisotope Processing Area, Oak Ridge Research Reactor, Bulk Shielding Reactor, and Pool Critical Assembly, all in the Bethel Valley complex; and the Transuranium Processing Plant, Tower Shielding Facility, Health Physics Research Reactor, and High Flux Isotope Reactor in the Melton Valley area. In addition, there are 12–15 hot cell facilities and numerous research laboratories that generate small quantities of waste as a result of their operations. There are four categories of radioactive waste produced and managed by ORNL: (1) gas and airborne particulates, (2) process and low-level liquid wastes, (3) low-level and transuranic-contaminated solid wastes, and (4) radioactive hazardous wastes (co-contaminated). These waste streams require separate handling, treatment, and disposal systems as shown in Fig. 2.5. Brief descriptions of these waste management systems are provided in the following sections.

2.4.3.1 *Gaseous Wastes*

Waste gas streams are classified either as building and cell ventilation or as process off-gas. The building and cell ventilation streams originate in areas such as building containment zones, laboratory hoods, and process cells, and account for the largest fraction of the total waste gas volume but very little of the radioactivity. The process off-gas arises from ventilation of operating equipment and is a stream of gaseous waste of much smaller volume than cell ventilation waste but potentially contains more radioactive material. In addition to radioactivity, the off-gas also contains organic vapors and acid and caustic fumes that must be removed from the waste stream prior to release.

Most ORNL gaseous wastes are released to the atmosphere either through roof exhaust systems or through exhaust stacks, both specifically constructed for the discharge of such wastes. Radioactivity may be present in these streams as particulates, as an absorbable gas, or as a nonabsorbable gas. All gaseous wastes that may contain radioactivity are processed to reduce the radionuclide concentrations to acceptable levels prior to release. Waste streams are processed at the point

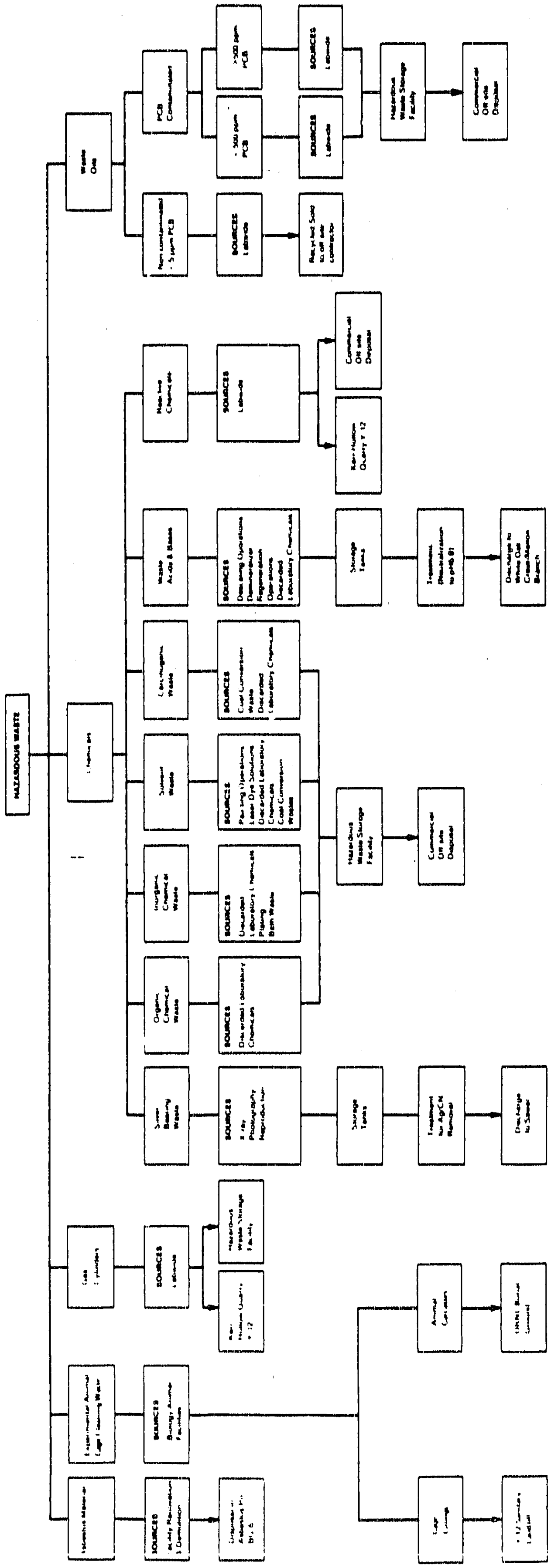

Fig. 2.4. Nonradioactive hazardous waste handling and disposal flow chart.

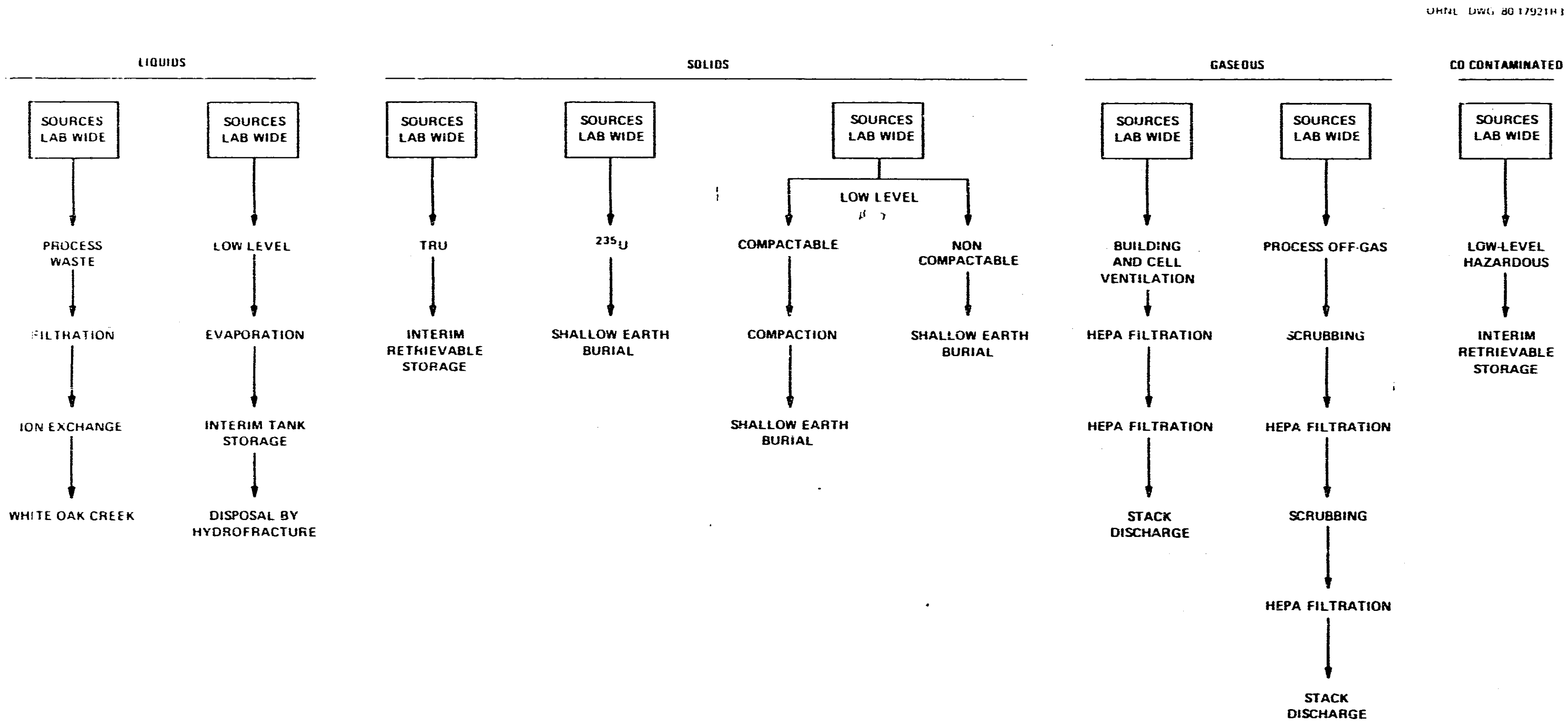

Fig. 2.5. ORNL radioactive waste flow chart.

of origin before discharging into the main laboratory ventilation system or release at local discharge points. Particulates are removed by roughing and HEPA filtration as a minimum, while gaseous waste forms are removed by specialized scrubbing techniques. Cell ventilation and process off-gas in the ORNL Bethel Valley complex is treated and discharged primarily through the 3039 stack area, while the 7911 stack serves as the primary release point in Melton Valley (see Fig. 2.3). Four other smaller stacks service various individual facilities in both valleys.

2.4.3.2 *Liquid Wastes*

ORNL routinely handles relatively large amounts of liquid radioactive waste, primarily in the form of low-level waste (LLW) and process waste. Special facilities are also available to store high-level and transuranic (TRU) liquid wastes, although at present very little of these waste forms are produced at the Laboratory. Figure 2.6 provides a schematic of the current liquid waste transport and treatment system for the two principal waste streams, the LLW and process waste streams.

The process waste streams are primarily effluents that contain little or no radioactivity under normal operating conditions but could become contaminated as a result of equipment failure or human error. Process waste includes steam condensate from heating coils in vessels containing radioactive solutions, process vessel cooling water, rainwater runoff from potentially contaminated areas, condensate from the LLW evaporator, and building sinks and floor drains. A complex system of underground piping is provided to collect the waste, which flows by gravity to open collection ponds. After collection in the ponds, the wastewater is sampled and either sent to the Process Waste Treatment Plant or discharged directly to White Oak Creek. At the treatment plant the waste solution is passed through a filtration and ion-exchange system to remove the radioactive contaminants. The effluent is then adjusted back to a neutral pH and discharged to White Oak Creek. The ion-exchange resins are periodically regenerated with the radioactive concentrate sent to the LLW system for further treatment and disposal. The average flow rate of the process waste system is approximately 80 gpm (300 L/m), with a total of about 5.4×10^7 gal (2.0×10^8 L) processed annually.

Low-level liquid wastes that are generated as part of the R&D activities at ORNL are transferred from the various sources by underground pipes to one of 23 stainless steel collection tanks located throughout the Laboratory complex. The waste solutions which accumulate in these collection tanks are periodically transferred to large collection tanks at the LLW evaporator facility (Building 2531). The average activity level in the LLW after collection and intermixing is about 30 mCi/gal (0.3 GBq/L), although the system is designed to handle concentrations up to a factor of 10^3 higher. Waste from the storage tanks is transferred to one of two evaporators where the aqueous solution is concentrated by a factor of 10 to 30. Condensate from the evaporator is normally directed to the process waste system, while the waste concentrate is transferred to the ORNL Hydrofracture Facility in nearby Melton Valley.

The concentrate is stored in stainless steel collection tanks at the Hydrofracture Facility until sufficient quantities have accumulated for disposal. In the hydrofracturing process, hydraulic pressure is used to initiate the formation of a crack between layers of Conasauga shale, at depths between 700 and 1000 ft (210 and 300 m). The LLW solution is mixed with a blend of solids composed of cement and other additives, and the mixture is injected under pressure into the shale fracture. As the injection progresses, the grout mix continues the shale fracturing, forming a thin hori-

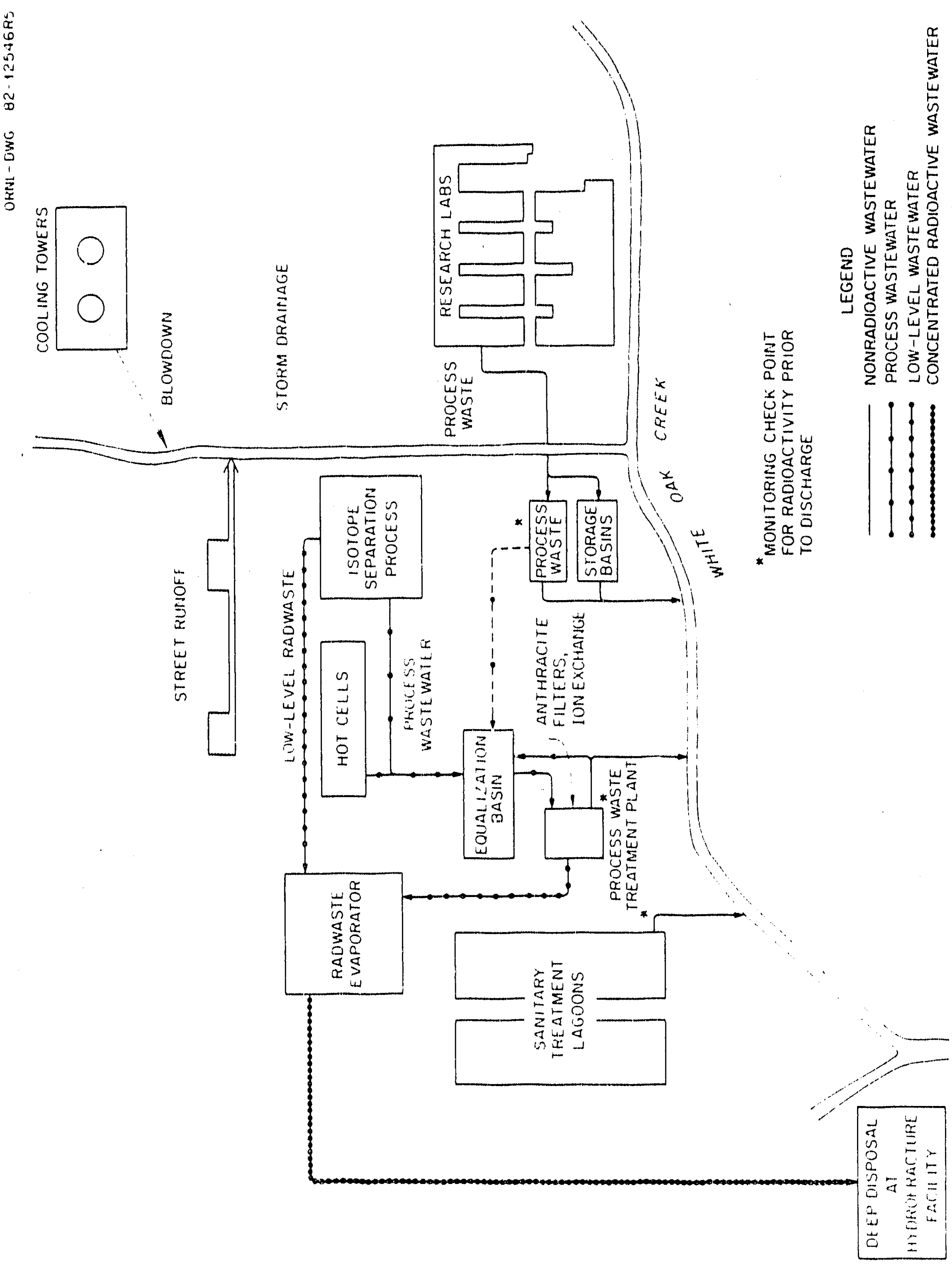

Fig. 2.6. Schematic of the ORNL liquid waste collection, treatment, and disposal systems.

zontal sheet several hundred feet across. The grout sets in a few hours after injection, permanently fixing the radioactive wastes in the impermeable shale formation.

The volume of LLW treated annually varies from approximately 1.3×10^6 to 1.5×10^6 gal (5.0×10^6 to 5.7×10^6 L). After being concentrated, this waste requires injection of approximately 140,000 gal (530,000 L) at the Hydrofracture Facility, which represents about one injection per year. The primary radionuclides disposed of by this method are ^{90}Sr, ^{137}Cs, ^{106}Ru, ^{60}Co and rare earths.

2.4.3.3 *Solid Wastes*

Solid radioactive waste originates from about 20 major sources at ORNL. Shipments have also been received from other facilities in accordance with agreements with DOE. These wastes contain, or have been judged to potentially contain, radionuclides in concentrations unacceptable for routine burial in sanitary landfills. The wastes are segregated and disposed of according to the type of material present. Such categories include: (1) ^{235}U-contaminated waste, (2) TRU-contaminated waste, and (3) low-level solid waste. Wastes are further segregated according to compactibility and radiation levels as part of the normal collection and processing operations.

Solid waste disposal at ORNL is accomplished in most cases by placing the waste below ground in either shallow trenches or auger holes. The levels of radioactivity and the physical characteristics of the waste dictate the method of disposal. Only two of the six solid waste storage areas (SWSAs) constructed and operated at ORNL since the early 1940's are still active. The two active burial grounds (SWSAs 5 and 6) are located in the Melton Valley area of ORNL as indicated in Fig. 2.7. All trench burial is conducted in SWSA 6, with SWSA 5 used only for retrievable storage of TRU waste. Since the beginning of on-site burial of solid wastes, over 6 million ft^3 (170,000 m^3) have been disposed of.

Solid wastes containing ^{235}U in concentrations greater than 1 g/ft^3 or 1 g total weight must be handled and disposed of in accordance with ORNL special nuclear material control procedures and criticality safety procedures. The amount of fissile material present in each package is determined before being transported to SWSA 6 for burial in unlined auger holes. When the holes are filled, they are capped with concrete and a record kept on file of the location and contents. Approximately 200 ft^3 (6 m^3) of ^{235}U contaminated waste is buried annually at ORNL.

Transuranic wastes are those containing greater than 100 nCi/g (3700 Bq/g) of ^{233}U or transuranic radionuclides. About 2600 ft^3/year (75 m^3/year) of TRU wastes are retrievably stored at ORNL (SWSA 5) for eventual transfer to a federal repository. These wastes are handled and stored according to the radiation level of the individual packages. Wastes are normally packaged by the waste generator in stainless steel 30 or 55 gal (110 or 210 L) drums, or in reinforced concrete casks when shielding is required. The drums are transferred to the Retrievable Drum Storage Facility where they are stored below grade in concrete block structures. The casks are retrievably stored in trenches and engineered caves, while TRU wastes with high beta-gamma activity levels are stored in stainless steel lined wells with concrete shield plug closures.

Low-level (<200 mrem/h) beta- and gamma-contaminated wastes are segregated at the source into compactible and non-compactible fractions and placed into suitable transport containers. Compactible wastes are transferred to the Solid Waste Compactor Facility where they are compacted into bales before disposal. The compacted waste, as well as all other appropriately packaged solid wastes, is buried in trenches in SWSA 6. Terrain and soil conditions determine the type of trench for each location. Excavations are controlled so that trench bottoms are at least 2 ft (0.6 m) above the water table, with normal trench dimensions of 10 ft (3 m) wide, 14 ft (4 m) deep and up to 50

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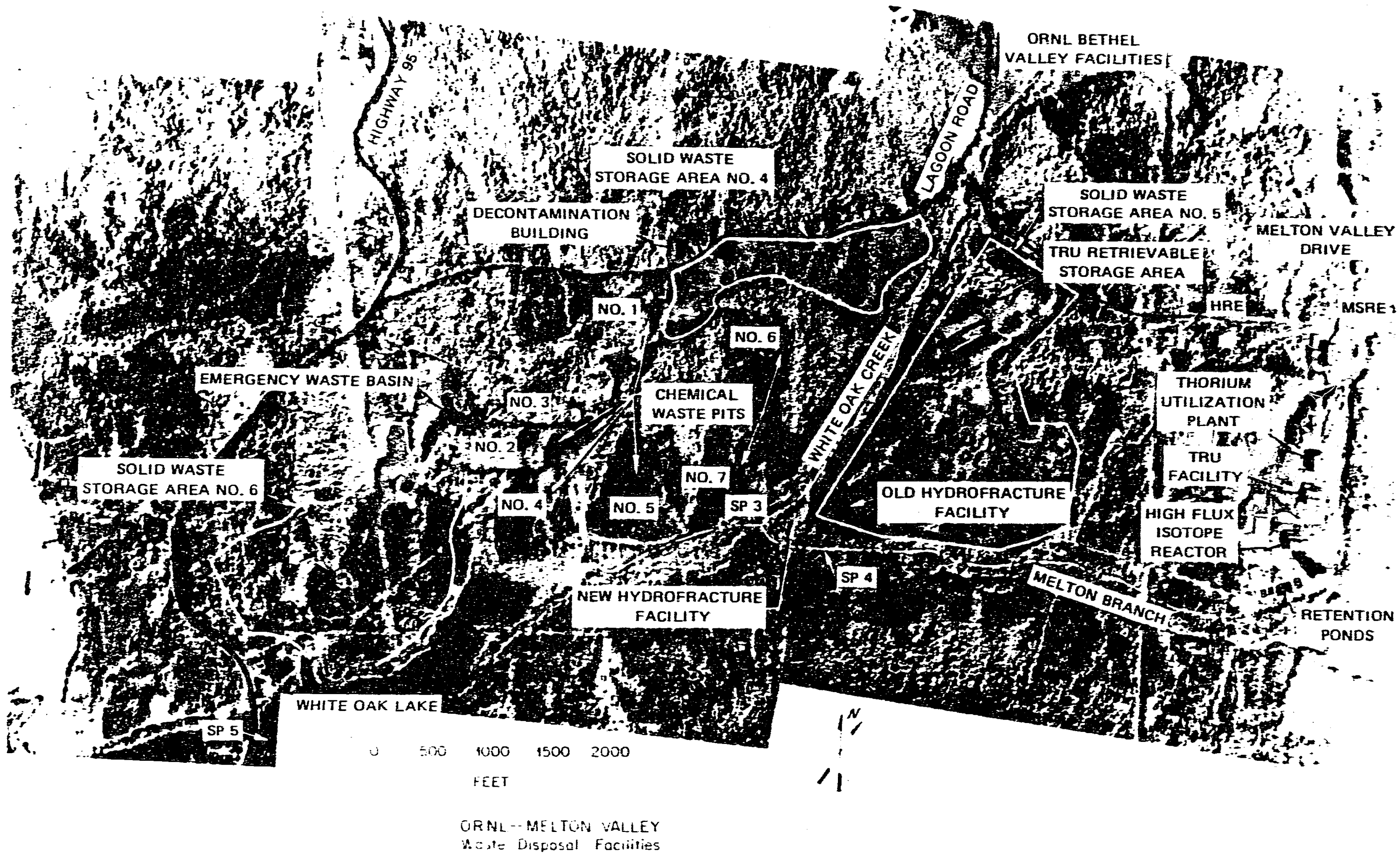

Fig. 2.7. Location map for ORNL Melton Valley waste disposal facilities.

ft (15 m) long. The trenches are backfilled to cover the waste with at least 3 ft (0.9 m) of earth. Approximately 70,000 ft^3 (2,000 m^3) of low-level solid wastes are buried annually at ORNL.

Usable burial and retrievable storage space within the currently operating solid waste storage areas is limited. Of the original area available for storage, only 3.5 acres (1.4 ha) of SWSA 5 can be used for retrievable storage and approximately 8–10 acres (3.2–4.0 ha) remain in SWSA 6 for trench burial. In response to this shortage of long-term burial space, site identification and design studies are currently under way to provide additional storage area by 1988.

2.4.3.4 *Co-contaminated Wastes*

Co-contaminated wastes are low-level radioactive wastes that also contain or consist of other hazardous wastes. Scintillation fluid containing radioactive tracers such as ^{14}C and ^{3}H, and carcinogenic materials labeled with these same tracers are two examples of this waste type. These wastes are generated by a variety of sources at ORNL at a rate of approximately 3 tons/year (2700 kg/year). Because of current regulations, these wastes cannot be buried on-site since many are in a liquid state and cannot be shipped off-site to other radioactive disposal sites. Since no on-site treatment or processing systems are currently available, these wastes are being placed in retrievable storage with other hazardous wastes.

2.4.4 Waste Operations and Environmental Monitoring

As part of the ORNL Waste Management Program, a comprehensive waste operations and environmental monitoring system is maintained by the Laboratory. Gaseous and liquid waste management systems at ORNL are monitored through the Waste Operations Control Center (WOCC), which contains instrumentation for continuous monitoring and recording of system operating characteristics (flow rates, liquid levels, radiation levels, etc.). This remote surveillance is provided through telemetered data from the operating waste handling system, with visual and audible alarms activated when preset limits are exceeded. In the event of abnormal system performance or evidence of a nonroutine release of radioactivity, the control-center operator alerts the appropriate supervision and the respective facility operator so that corrective action can be taken.

Environmental surveillance of the Laboratory complex and the surrounding area is provided by an extensive network of monitoring facilities and a program of biological sampling. Airborne pollutants (radioactive and nonradioactive) are measured through a series of 23 local, 9 perimeter, and 7 remote air monitors located strategically on and around the ORNL site and at distances up to 75 miles from the site. Although the monitoring facilities are different for each of the three types of stations, most of the stations provide for the collection and measurement of: (1) airborne radioactive particulates, (2) radioactive fallout, (3) rainwater, and (4) radioiodine. External gamma radiation background is measured at all stations using thermoluminescent dosimeters. Additional information is obtained from high volume air samplers and tritium monitors at a few of the locations. Measurements of ambient concentrations of flourides and sulfates are obtained on a regular basis within the Oak Ridge Reservation.

Soil, sediment, vegetation, animal, produce, and milk samples are routinely collected and analyzed for uranium, plutonium, and other radioisotopes using gamma spectroscopy and radiochemical techniques. Radionuclide concentrations and nonradiological water quality information are determined for water samples from streams, lakes, and other water bodies on and adjacent to the ORNL site. These biological and water samples are used to provide information about the spread of radioactivity from the site and interaction of the radionuclides with the environment.

3.0 PROGRAM DESCRIPTION

3.0 PROGRAM DESCRIPTION

The Surplus Facilities Management Program (SFMP) was established at ORNL in 1976 in order to provide collective management of all of the surplus radioactively contaminated sites under ORNL control on the Oak Ridge Reservation. The principal objective of the ORNL SFMP is to provide safe, cost-effective control of those facilities included in the program through (1) routine facility maintenance and surveillance, (2) comprehensive program and project planning, and (3) timely implementation of decontamination and decommissioning (D&D) activities. Some 76 facilities are currently managed under the program, ranging in complexity from abandoned waste storage tanks to large experimental reactors. As these facilities are decommissioned, and as other surplus facilities are accepted into the program, the scope of the ORNL SFMP is expected to change significantly in the coming years.

As described in the following sections (3.1 and 3.2), the ORNL SFMP management approach is designed to be responsive to the programmatic and technical requirements of the DOE and Laboratory management, as well as provide guidance and program support for the various planning and operations groups involved in the program. Program implementation is conducted according to the general guidelines set forth in the DOE SFMP Program Plan[1], as further defined for ORNL in this chapter. An outline of the current scope of decommissioning activities at ORNL is given in Section 3.3, with details of the facility descriptions and decommissioning plans provided in subsequent chapters.

3.1 PROGRAM MANAGEMENT

The activities of the ORNL SFMP are directed through a combination of DOE Headquarters, Lead Field and Local Field Offices as part of the national Surplus Facilities Management Program. Further technical guidance is provided through a technical support contractor, reporting directly to DOE. Internal programmatic and technical control of the ORNL SFMP is provided through the normal Laboratory management structure. The reporting positions of these various organizations are identified in Fig. 3.1, with further discussion of the responsibilities and interfaces provided below.

3.1.1 DOE Organization

Responsibility for the DOE Surplus Facilities Management Program rests jointly with the Office of the Assistant Secretary for Nuclear Energy (Civilian Program) and the Office of the Assistant Secretary for Defense Programs (Defense Program). In the Civilian Program, SFMP administration is provided through the Division of Remedial Action Projects, while for the Defense Program, the Office of Defense Waste and Byproducts Management directs the program activities. Both of these DOE Headquarters (DOE-HQ) offices have delegated the responsibility for management of the combined surplus program to the DOE-Richland Operations Office (DOE-RL), which

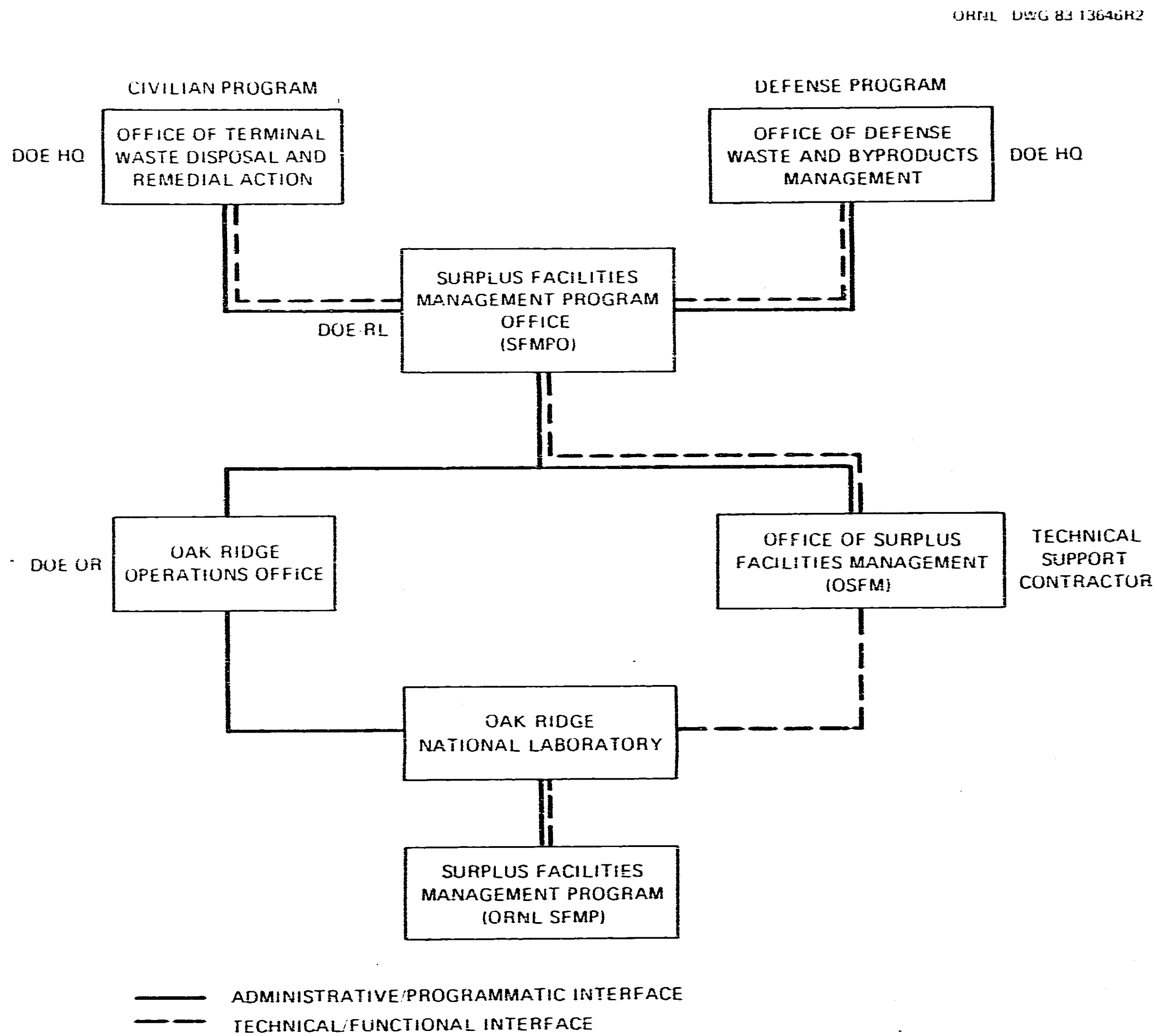

Fig. 3.1. Surplus Facilities Management Program organization.

acts as the SFMP Lead Field Office. The Surplus Facilities Management Program Office (SFMPO) was established at DOE-RL to conduct the program in accordance with policy and guidance provided by DOE-HQ.

Program implementation at the ORNL site is directed through the DOE Oak Ridge Operations Office (DOE-OR). Within the DOE-OR, the ORNL SFMP is administered through the Assistant Manager for Energy Research and Development by members of the Nuclear Research and Development Division. The day-to-day program management is provided through the Fission Reactor Branch as part of the Radioactive Waste Management Program.

The specific responsibilities of the DOE-HQ, SFMPO, and DOE-OR are defined in the SFMP Program Plan. In general, these organizations are responsible for developing overall program policy, providing broad program guidance and establishing the DOE program budget. Program implementation in these areas is controlled at the ORNL site by the local DOE-OR management.

3.1.2 DOE Technical Support Contractor

To assist the DOE SFMPO in the management of the program, certain responsibilities have been assigned to a technical support contractor. This contractor, UNC Nuclear Industries of Richland, Washington, manages the Office of Surplus Facilities Management (OSFM), reporting directly to the SFMPO. In this capacity, OSFM monitors the technical activities of all participating contractors, including MMES, and reports on the overall program progress. The OSFM routinely assists in the preparation of budget and other program documentation, at the request of the SFMPO.

3.1.3 ORNL Management

The DOE Surplus Facilities Management Program is administered at ORNL through the Executive Director for Support and Services and the Associate Director for Nuclear and Engineering Technologies, acting for the Laboratory Director. Programmatic and functional control of the ORNL SFMP is provided through the Nuclear and Chemical Waste Programs Office and Operations Division, as shown in Fig. 3.2. This operating structure is a matrix organization in which the management duties are divided between functional and program lines, providing more unified program guidance and greater flexibility in program operations. Day-to-day program activities are handled by the ORNL SFMP Program Office, as part of the Radioactive Waste Management Section of the Operations Division, through the Decontamination and Decommissioning Group (Fig. 3.3).

3.1.3.1 *ORNL SFMP Organization*

The ORNL SFMP Program Office was established to provide administrative control over all program activities at ORNL. Currently, this office consists of the Program Manager and associated administrative support staff. As shown in Fig. 3.4, the SFMP organization is structured around a project control format, where ORNL technical staff are assigned overall responsibilities for particular projects and report directly to the program office for guidance. These project leaders (identified as Principal Investigators) in turn direct the activities of the appropriate facility supervisor(s), support groups from ORNL research and support divisions, and any technical support from outside subcontractors. Principal investigators (PIs) may have control over disposition efforts for a single facility, a group of facilities, or may be responsible for broad programs or planning efforts for the entire ORNL SFMP.

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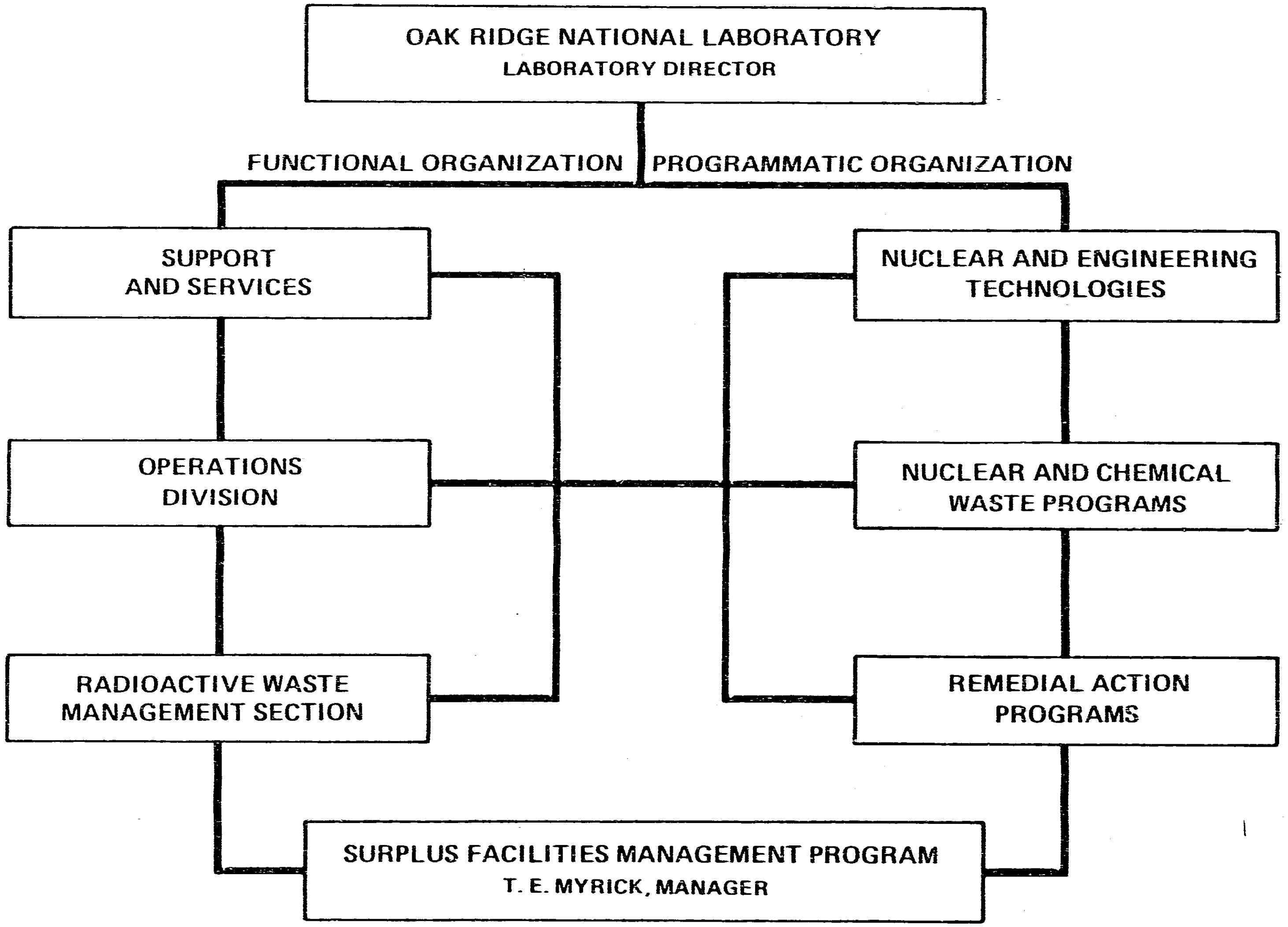

Fig. 3.2. ORNL organizational structure for the Surplus Facilities Management Program.

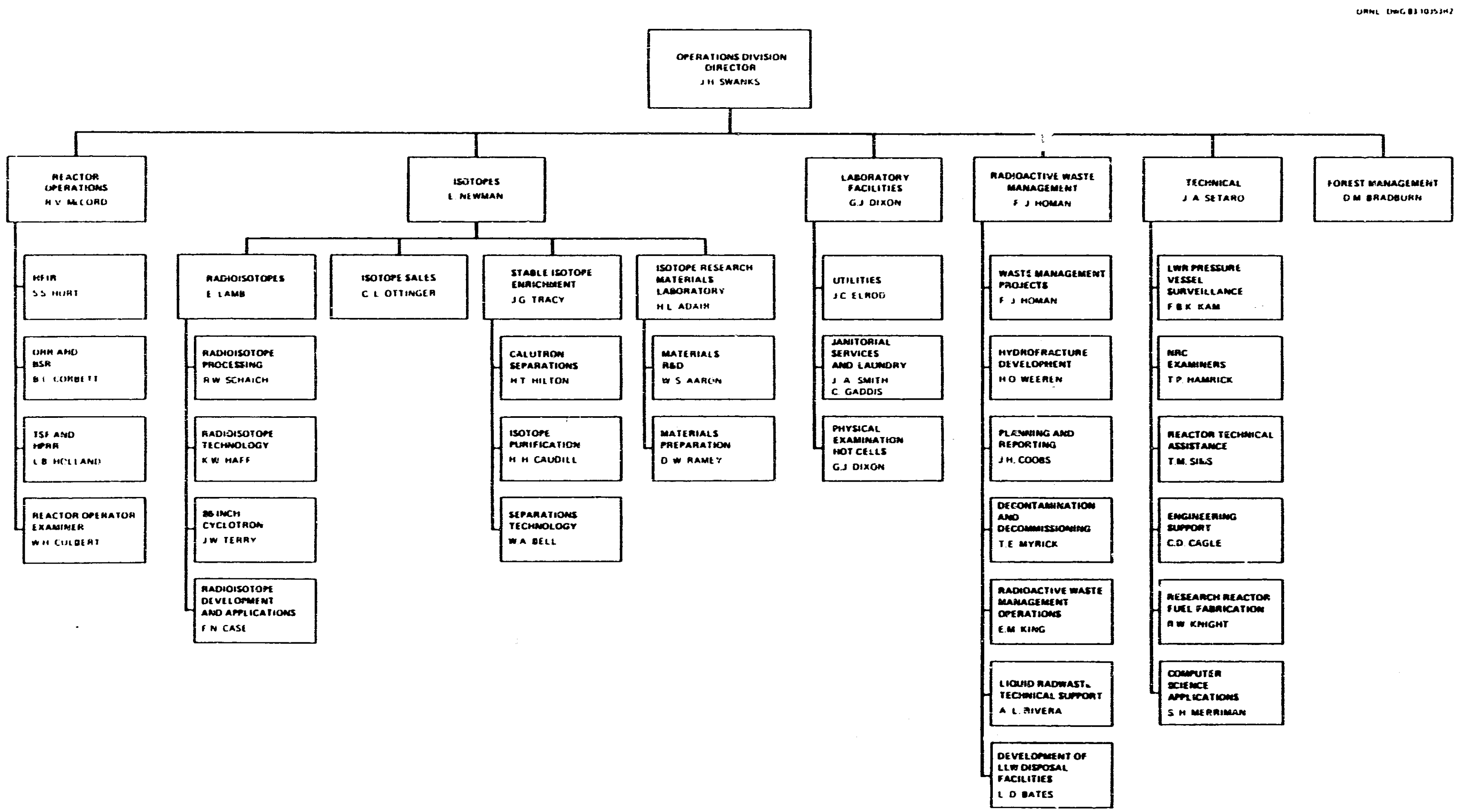

Fig. 3.3. Operations Division organization.

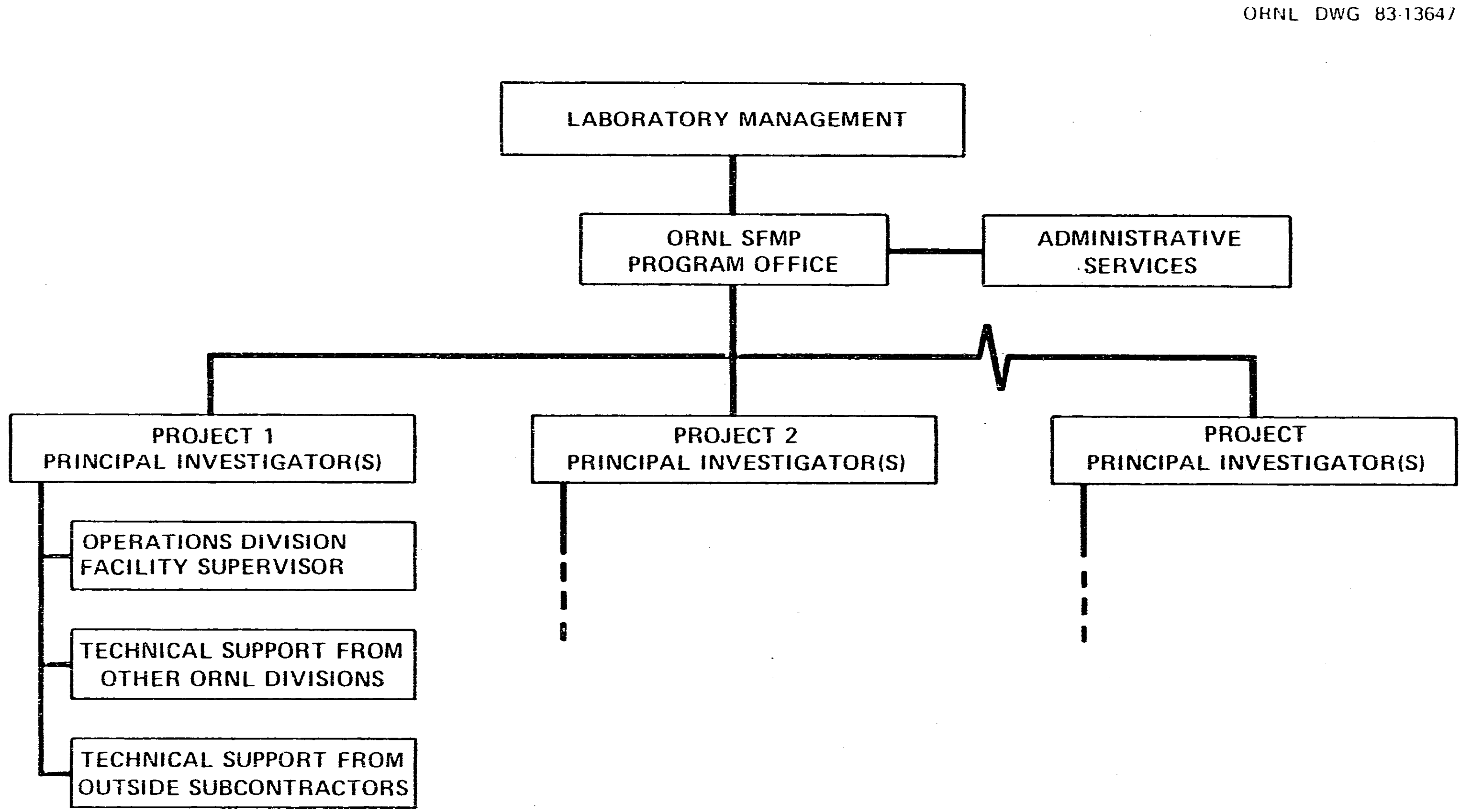

Fig. 3.4. ORNL SFMP project management structure.

Technical support for the program is obtained from a number of ORNL divisions, including (see Fig. 2.1):

1. Operations
2. Environmental and Occupational Safety
3. Engineering
4. Plant and Equipment
5. Chemical Technology
6. Analytical Chemistry
7. Instrumentation and Controls
8. Quality Assurance and Inspection
9. Environmental Sciences

This support is provided either at the request of the ORNL SFMP or is conducted independently as part of the overall Laboratory operations. Additional support from outside subcontractors may be routinely obtained and managed by the principal investigators according to ORNL standard practices.

3.1.3.2 *Management Responsibilities*

As a participating contractor in the DOE SFMP, ORNL is responsible for implementing all portions of the program related to Laboratory-controlled facilities on the Oak Ridge Reservation. As defined in the DOE SFMP Program Plan, the program management responsibilities include: (1) interfacing with the DOE and OSFM on programmatic and technical matters, and (2) providing comprehensive program and project planning and reporting in support of program implementation. As requested, the ORNL SFMP assists the OSFM in developing portions of the DOE SFMP Program Plan, scopes of work, project schedules and budget information. It is the responsibility of the ORNL SFMP to keep OSFM advised of technical problems and proposed solutions, and to routinely report to DOE-OR on technical progress, costs, schedule status, and milestone achievements for all projects. Technical reports are prepared as required, including safety and environmental assessments, program and project planning documents, engineering designs, reports on completed projects, routine project reports, and other topical reports.

Responsibilities for program communications, planning and reporting have been delegated within the ORNL SFMP according to the program organization as described in the previous section. These responsibilities are summarized in Table 3.1 and are discussed below.

Communications

All ORNL SFMP interfaces with the DOE-OR or the OSFM are handled through the ORNL SFMP Program Office. Such communications include program budget submissions, planning information, and technical status reports. All written communications are routed through the Nuclear Waste Programs Office at ORNL to DOE-OR, with copies to SFMPO and OSFM as appropriate.

Internal interactions between ORNL SFMP project participants are less structured than those with DOE. The principal interface with the ORNL SFMP Program Office is through the Project Principal Investigator(s), although discussions are routinely held with other members of the project teams. Program guidance is provided to PIs as required, for subsequent implementation by other project participants. Technical information is obtained from various support groups on an as-required basis, reporting either through the PI or directly to the Program Office.

Table 3.1. ORNL SFMP interfaces and responsibilities.

RESPONSIBILITY	ORNL SFMP ORGANIZATION				
	LABORATORY MANAGEMENT	ORNL SFMP PROGRAM OFFICE	PROJECT PRINCIPAL INVESTIGATOR	FACILITY SUPERVISOR	OTHER ORNL DIVISIONS OR SUBCONTRACTORS
COMMUNICATIONS					
A. DOE OR	D/R	D/P/I	I	T	T
B. OSFM	R	D	P/I	T	T
C. ORNL SFMP	D	–	D/I	T	T
D. PROJECT PI	R	D	–	D/I	T
PLANNING/REPORTING					
A. LONG RANGE PLAN	R/A	P/R/A/I	P/I	T	T
B. MAINTENANCE AND SURVEILLANCE PLAN	R/A	P/R/A/I	P/I	I	T
C. FTP/A AND BUDGET REVIEWS	R/A	P/R/A/I	P/I	T	T
D. MONTHLY STATUS AND COST	R/A	P/R	P	T	T
E. ORNL/DOE AUDITS	R	P/I	P/I	I	T
F. PROJECT PLANS	R/A	R/A	P/I	T/I	T/I
G. TECHNICAL REPORTS	R	R/A	P	T	T/P
H. ROUTINE PROJECT REPORTS	R	R	P	T	T
I. FINAL PROJECT REPORTS	R/A	R/A	P	T	T

A APPROVAL
D DIRECT INTERFACE
I IMPLEMENT (AS APPROPRIATE)
P PREPARE (AS APPROPRIATE)
R REVIEW
T TECHNICAL SUPPORT

Planning/Reporting

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In general, the responsibility for preparing the detailed SFMP documentation rests with the Principal Investigators. The ORNL SFMP Program Office oversees and assists in the preparation of all program-level reports (i.e., Long Range Plan, Maintenance and Surveillance Plan, and Field Task Proposal Agreements (FTP/A)), although the Program Office role for project-level documents is mainly one of review and approval. In preparing the project documentation, the PI follows the guidance provided by the DOE Program Plan, as detailed by the ORNL SFMP Program Office. Technical support for report preparation is often provided by other organizations, including the Engineering Division for design-related documents, Environmental and Occupational Safety Division for safety and environmental assessments, and various research divisions for topical reports. Facility-specific data are normally obtained directly from the facility supervisor. Submission of all program-related documentation to DOE is conducted according to the interface outlined previously.

3.2 PROGRAM IMPLEMENTATION

Implementation of the Surplus Facilities Management Program at ORNL is a complex process, beginning with acceptance of a facility into the Program and ending with transfer of responsibility for the decommissioned site to another program. Between these two milestones is a complex path of program planning, project assessments, on-site operations and project reporting that can extend over relatively short time frames (1–2 years) or may last for 10–20 years. The path chosen is dependent upon a number of variables, including facility characteristics, programmatic concerns, and resource availability. Every facility managed by the SFMP receives the same general treatment, whether it is a single piece of contaminated equipment or a complex processing facility.

A flowchart of the ORNL SFMP project implementation sequence is presented in Fig. 3.5. Development of this plan was based on the general guidelines established by DOE in their Program Plan and modified for application at ORNL. As defined in this flowchart, progam implementation can be divided into seven distinct phases:

1. Facility Acceptance
2. Project Prioritization
3. Maintenance and Surveillance
4. Alternatives Assessment
5. Project Planning
6. Project D&D Operations
7. Final Project Reporting

Within each of these phases, a variety of plans and reports are developed to make decisions concerning the disposition of the individual surplus facilities. The complexity of these investigations and

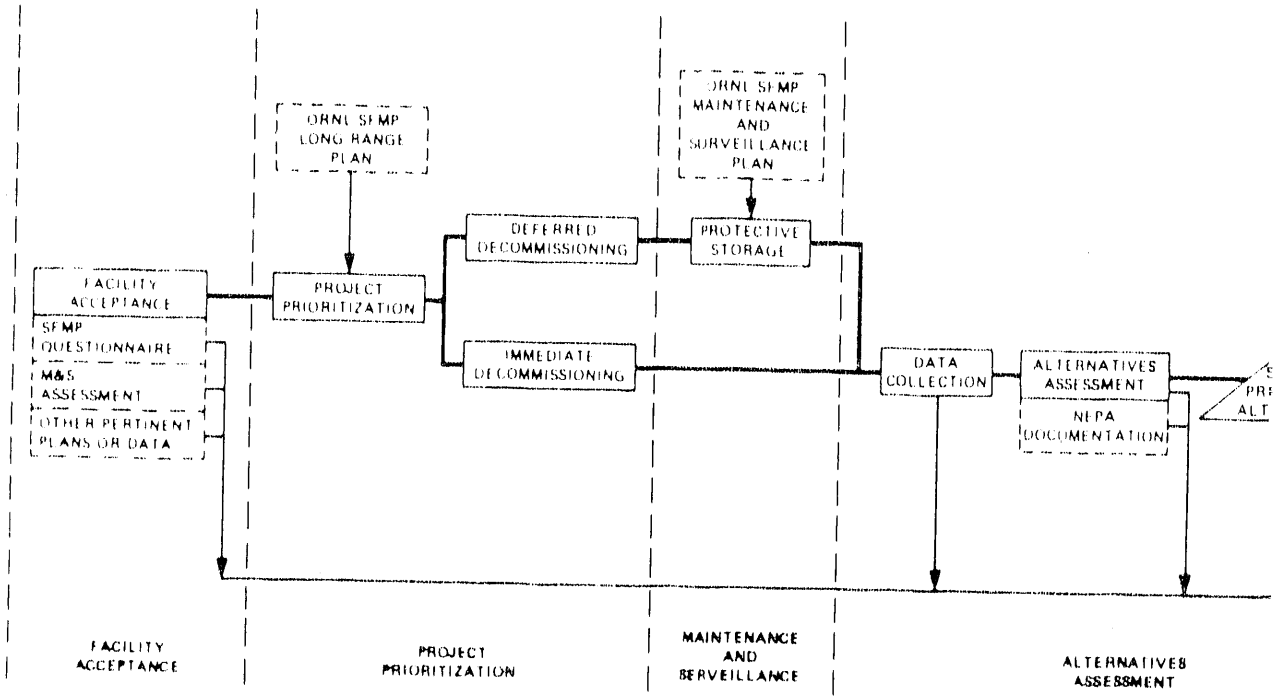

Fig. 3.5. ORNL SF

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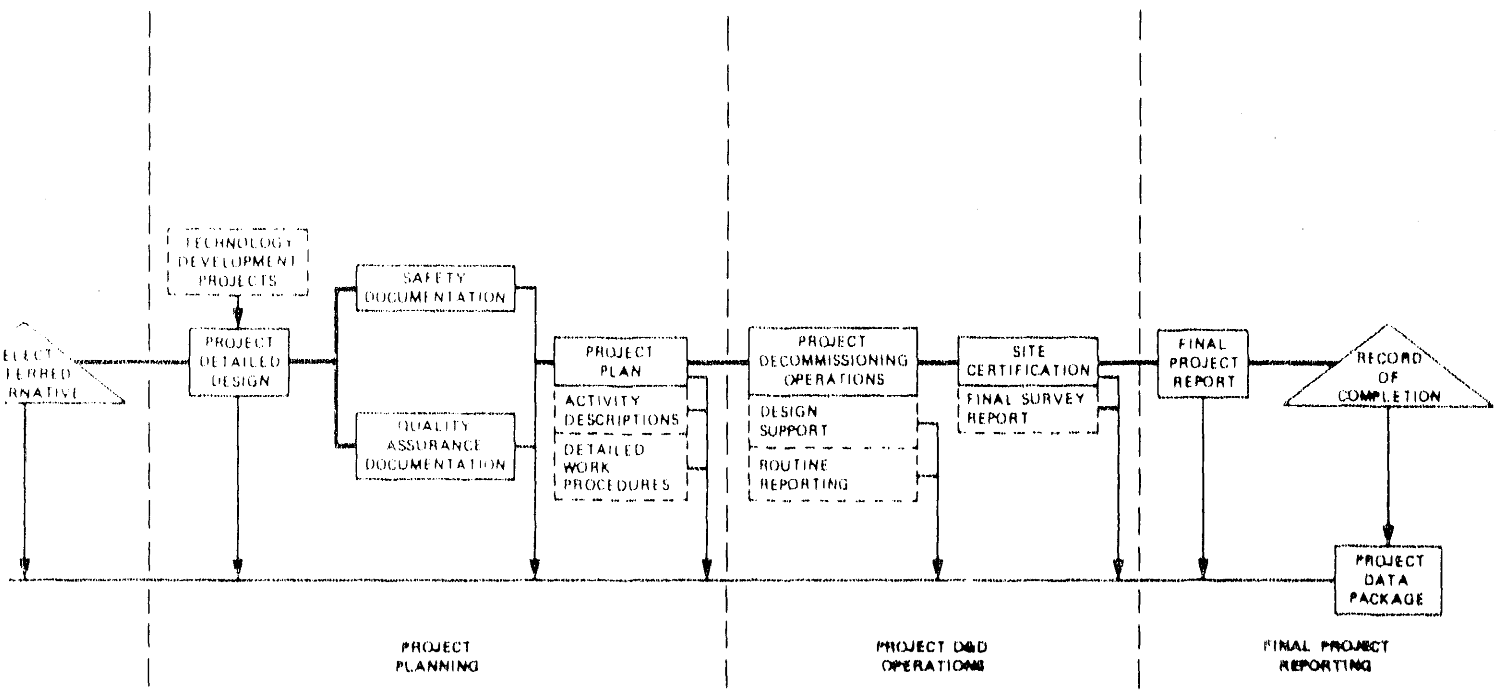

SFMP program implementation flow chart.

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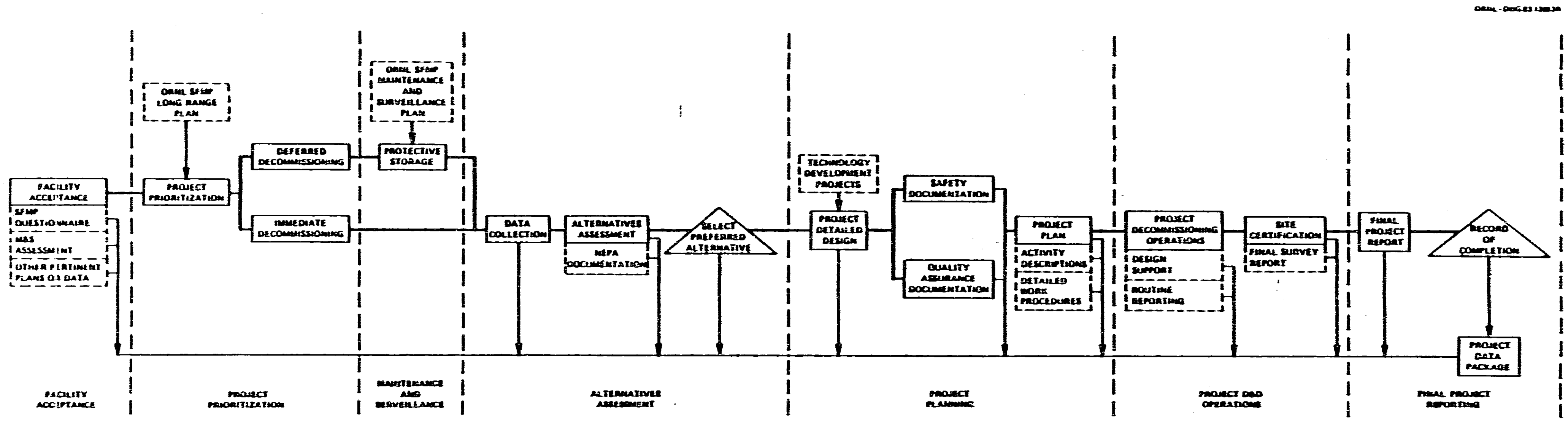

Fig. 3.5. ORNL SFMP program implementation flow chart.

decisions depends, of course, upon the complexity of the facility and the number of options to be considered. For some of the smaller projects, with only minor health and safety concerns, many of the intermediate steps are simple matters; while for major facilities, detailed planning and assessments are required. In either case, however, the overall path is the same.

To provide insight into the project implementation process at ORNL, each of the process steps outlined above is briefly discussed in the following sections. For many of these steps, further details are provided in subsequent chapters of this plan or are addressed in separate documents.

3.2.1 Facility Acceptance

Acceptance of facilities into the ORNL SFMP is conducted in accordance with the guidelines established by DOE. These guidelines specify that:

1. The facility shall be in a radiologically safe condition with current documentation available to support this declaration;
2. All stored materials (i.e., special nuclear materials, reactor fuels, hazardous materials) shall have been removed from the site;
3. The shutdown status of the facility shall have been documented and records of past operations made available;
4. An assessment of the maintenance and surveillance requirements shall have been prepared, defining the storage option to be employed and the associated costs (funding arrangements must be made by the user to cover the first two years); and
5. Interim usage of the facility should be limited, with maintenance and surveillance costs apportioned according to the use. Uses which will increase decommissioning costs shall not be allowed.

Procedures have been established by the ORNL SFMP to assure compliance with these requirements prior to submission of the request to SFMPO for facility acceptance. Facility supervisors are required to: (1) provide the needed information to complete the SFMPO "Identification and Description of Contaminated Surplus Facilities" questionnaire for the facility, (2) assess the short-term maintenance and surveillance needs of the facility and make a recommendation concerning the alternatives for long-term protective storage, and (3) assemble a complete data package on facility construction, operation, and shutdown activities. When this information has been supplied, a formal request is made by the ORNL SFMP Program Office to DOE-OR, according to the transfer procedures specified in the DOE SFMP Program Plan.

3.2.2 Project Prioritization

Once a facility has become part of the SFMP, an analysis is conducted to determine its priority for final disposition compared to the other facilities managed by the ORNL program. This analysis step is an integral part of the long-range planning activities and results in a recommendation for either immediate or deferred decommissioning of the facility. The prioritization process must take into account legal and contractual requirements, health and safety considerations, economic impacts, site planning requirements, cost effective program management, and other programmatic concerns in determining which projects should be allocated the limited funds available. The methods used for prioritizing projects at ORNL are further described in Chapter 7.0. Project priorities are examined each year as part of the long range planning activities; and as projects are completed, site conditions change, or programmatic concerns shift, the position of individual facilities in the prioritized listing is adjusted. Facilities ranked as low priority are placed in a protective storage mode awaiting final disposition, while high priority facilities enter the project phase of D&D.

3.2.3 Maintenance and Surveillance

For those facilities in which decommissioning has been deferred, a comprehensive maintenance and surveillance (M&S) Program has been instituted by the ORNL SFMP to (1) ensure adequate containment of the residual radioactive materials remaining in the surplus facilities, (2) provide safety and security controls to minimize the potential hazards to on-site personnel and the general public, and (3) manage these facilities in the most cost-effective manner. Routine maintenance and surveillance are provided to assure that all SFMP facilities are maintained in accordance with ORNL guidelines and applicable national standards.

As part of this maintenance and surveillance task, a program-level Maintenance and Surveillance Plan[2] is prepared that defines the goals of the program and outlines the scope of the M&S activities at each facility. For new facilities coming into the program, assessments are conducted as part of this planning exercise to determine the protective storage option to be employed (see Chapter 4.0) and the corresponding M&S needs.

3.2.4 Alternatives Assessment

At the point that a project becomes a high priority for decommissioning, appropriate studies are conducted to determine the preferred alternative for final facility disposition. As discussed in Chapter 4.0, these alternatives include protective storage, decontamination for reuse, entombment, and/or dismantlement. Combinations of these options may be employed for different portions of a single facility, depending on site characteristics and programmatic considerations. The alternatives assessment phase of program implementation is a complex step involving numerous technical disciplines. In support of this selection process, the ORNL SFMP has developed specific criteria that must be used in determining the best disposition option for a given facility. Criteria have been established in five areas of concern, including (1) program management, (2) site planning, (3) risk, (4) economics, and (5) waste management. A listing of these criteria and an outline of the assessment steps utilized in making a decision on facility D&D are detailed in the following Chapter 4.0.

3.2.5 Project Planning

Once the decision has been made concerning the preferred alternatives for facility decommissioning in accordance with the NEPA process, detailed project planning is conducted to document the tasks necessary to complete the project, comply with ORNL requirements for safety and quality assurance reviews, and outline the management approach to be used for the planned D&D operations. In support of these planning efforts, technology development projects may be undertaken or information obtained from similar programs elsewhere to provide needed data on decommissioning techniques for application at the facility.

For most projects, the following major planning documents would be developed during this implementation phase: the project detailed design, the assessment or analysis documentation for safety and quality assurance concerns, and the Project Plan. The scope and content of each of these reports are well defined through guidance provided by the SFMPO and ORNL management, and review procedures have been established by the ORNL SFMP to ensure adequate peer review. In addition to these major documents, numerous other reports, procedures, and assessments are prepared as appropriate in support of project activities.

3.2.6 Project D&D Operations

Facility decommissioning activities are carried out according to the Project Plan, and modified as required to meet operational needs. Project D&D operations are managed by the Principal Investigator through the appropriate facility supervisor and project crews. In support of the on-site operations, additional engineering designs may be necessary to direct work crews. Strict adherence to DOE and ORNL guidelines for health and safety, quality assurance, waste management, and project management is maintained throughout the operational phase of the project. Program review and guidance are provided through routine project reporting.

As D&D operations come to a close, comprehensive site certification is conducted to verify the results of the decommissioning efforts and compare the accomplishments with the project objectives and the site release criteria (see Chapter 5.0). For some facilities, site release may not require decontamination to unrestricted levels, but rather to levels acceptable for reuse by other nuclear programs. As part of the certification effort, a final health physics survey report is prepared that characterizes the facility conditions. When the residual contamination levels are determined to meet the desired objectives, D&D operations will cease.

3.2.7 Final Project Reporting

Following completion of the planned decommissioning work, a Final Project Report is prepared that provides an overview of the project activities, accomplishments, final facility status, and lessons learned. As a part of this report, details of the project cost, schedule, waste volumes generated, and occupational exposures are included. Based on this report, a formal Record of Completion is prepared by the ORNL SFMP that summarizes the status of the site and provides recommendations for transfer of the facility out of the DOE SFMP or for continued maintenance and surveillance, as necessary. As a project is completed, a Project Data Package is collected that provides a documented history of the decommissioning activities, from facility acceptance through final project reporting. All pertinent correspondence, assessments, plans and reports that are maintained on file throughout the lifetime of a project will be included in this final data package for archiving at ORNL and DOE-OR. Appropriate documentation on ORNL site records will be conducted prior to request to the DOE SFMP for facility transfer out of the progam.

3.3 ORNL SFMP PROJECTS

Currently the ORNL SFMP is responsible for the management of 76 facilities at the X-10 site. These facilities have been grouped into 16 SFMP decommissioning projects based on previous operating history, location, or facility type. These projects are listed in Table 3.2 according to the SFMP Program category (Defense or Civilian) and administrative grouping. Facility identifications are also provided in this table by building number, with corresponding locations highlighted in Figs. 3.6 and 3.7. As indicated in these figures, the surplus facilities are scattered throughout the Laboratory site, in both the Bethel Valley and Melton Valley areas. The variation in the facility physical

Table 3.2. Facilities currently managed by the ORNL SFMP

Program Category	Administrative Grouping	Project	Location[a]
Defense Program	Isotope Group	Fission Product Development Laboratory	Bldg. 3517
		Metal Recovery Facility	Bldg. 3505
	Reactor Group	ORNL Graphite Reactor	Bldg. 3001
	Radwaste Group	Waste Holding Basin	Site 3513
		Gunite Storage Tanks W5-W10	Site 3507
		Waste Storage Tanks:	
		Waste Tank WC-1	SW of Bldg. 3037
		Waste Tanks WC-15, WC-17	SE of Bldg. 3587
		Waste Tanks W1-W4, W13-W15	Site 3023
		Waste Tank W11	S of Bldg. 3536
		Waste Tanks TH1-TH3	S of Bldg. 3503
		Waste Tank TH4	SW of Bldg. 3500
		Old Hydrofracture Facility	Site 7852
Civilian Program	Isotope Group	Storage Garden 3033	N of Bldg. 3033
		C-14 Process System	Bldg. 3033-A
		Waste Evaporator Facility	Bldg. 3506
		Fission Product Pilot Plant	Bldg. 3515
		Shielded Transfer Tanks (5)	SWSA 4
	Reactor Group	Molten Salt Reactor Experiment	Bldg. 7503
		Low Intensity Test Reactor	Bldg. 3005
		Homogeneous Reactor Experiment	Bldg. 7500
		ORR Experimental Facilities:	
		Reactor Experiments	Bldg. 3042
		ORR Heat Exchanger	Bldg. 3087

[a]See Figs. 3.6 and 3.7 for facility locations.

conditions, radionuclide inventories, and hazard potentials is indicative of the wide scope of activities carried out over the past 40 years of ORNL operations. The complexity of the sites ranges from single abandoned waste storage tanks to large experimental reactor systems that include a myriad of piping, process equipment, waste handling components, and numerous ancillary systems. Residual contamination contained within these facilities varies from relatively insignificant amounts of surface contamination to curie quantities of fission products remaining in process equipment.

Summary descriptions of the facilities currently managed by the ORNL SFMP are provided in Chapter 6.0. These descriptions include details of the facility history, current physical and radiological conditions, the routine maintenance and surveillance requirements, and the proposed decommissioning plans. Brief outlines of the projects currently underway for disposition of these facilities are presented in the following Section 3.3.1. Section 3.3.2 summarizes the projects that have already been completed as part of the SFMP.

3.3.1 Current Projects

The current activities of the ORNL SFMP consist of (1) routine maintenance and surveillance of all facilities included in the program, (2) continuation of decommissioning activities at the Fission Product Development Laboratory (FPDL) and the Metal Recovery Facility (MRF), (3) initia-

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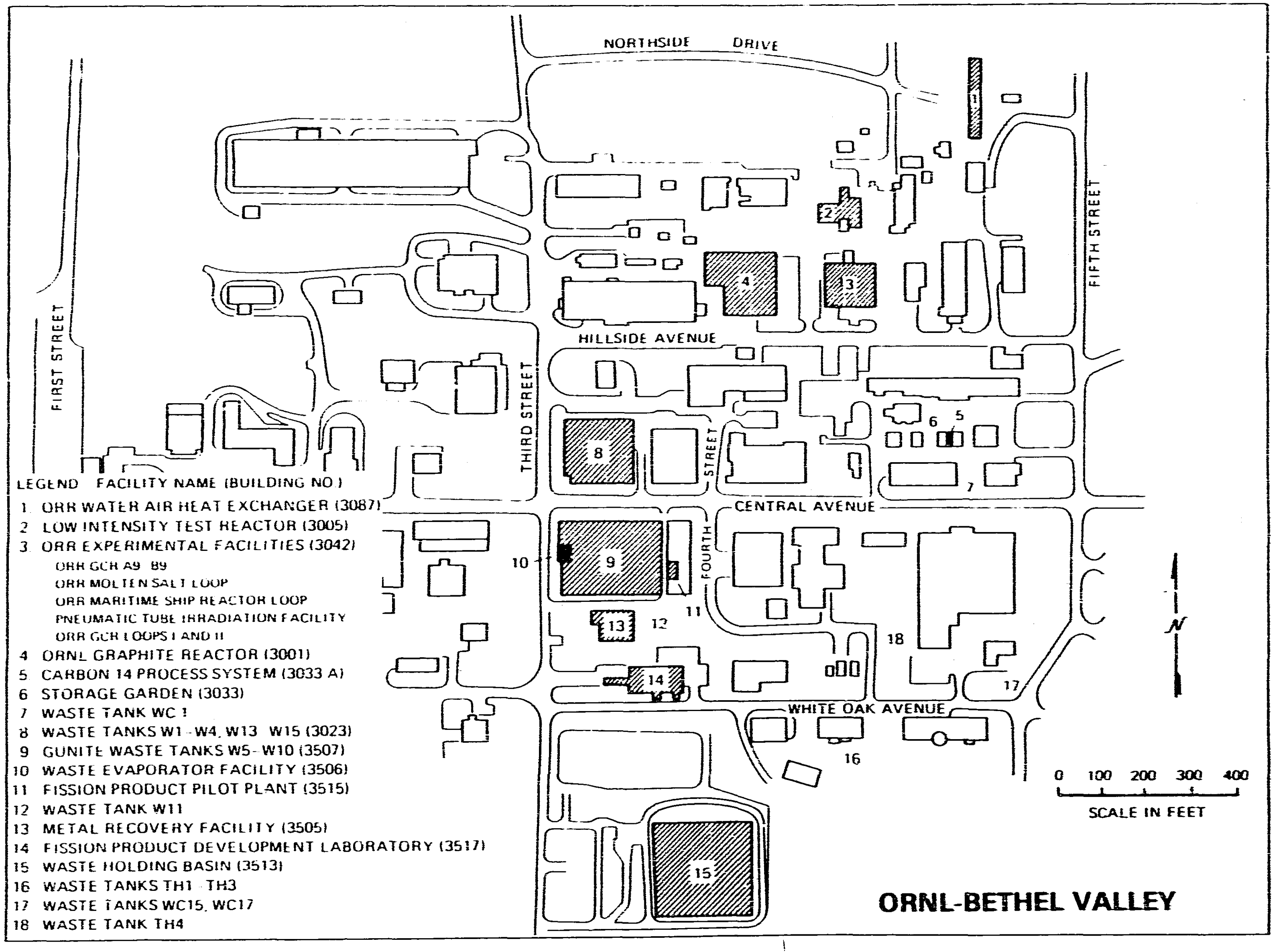

Fig. 3.6. Location map for the ORNL surplus facilities—Bethel Valley.

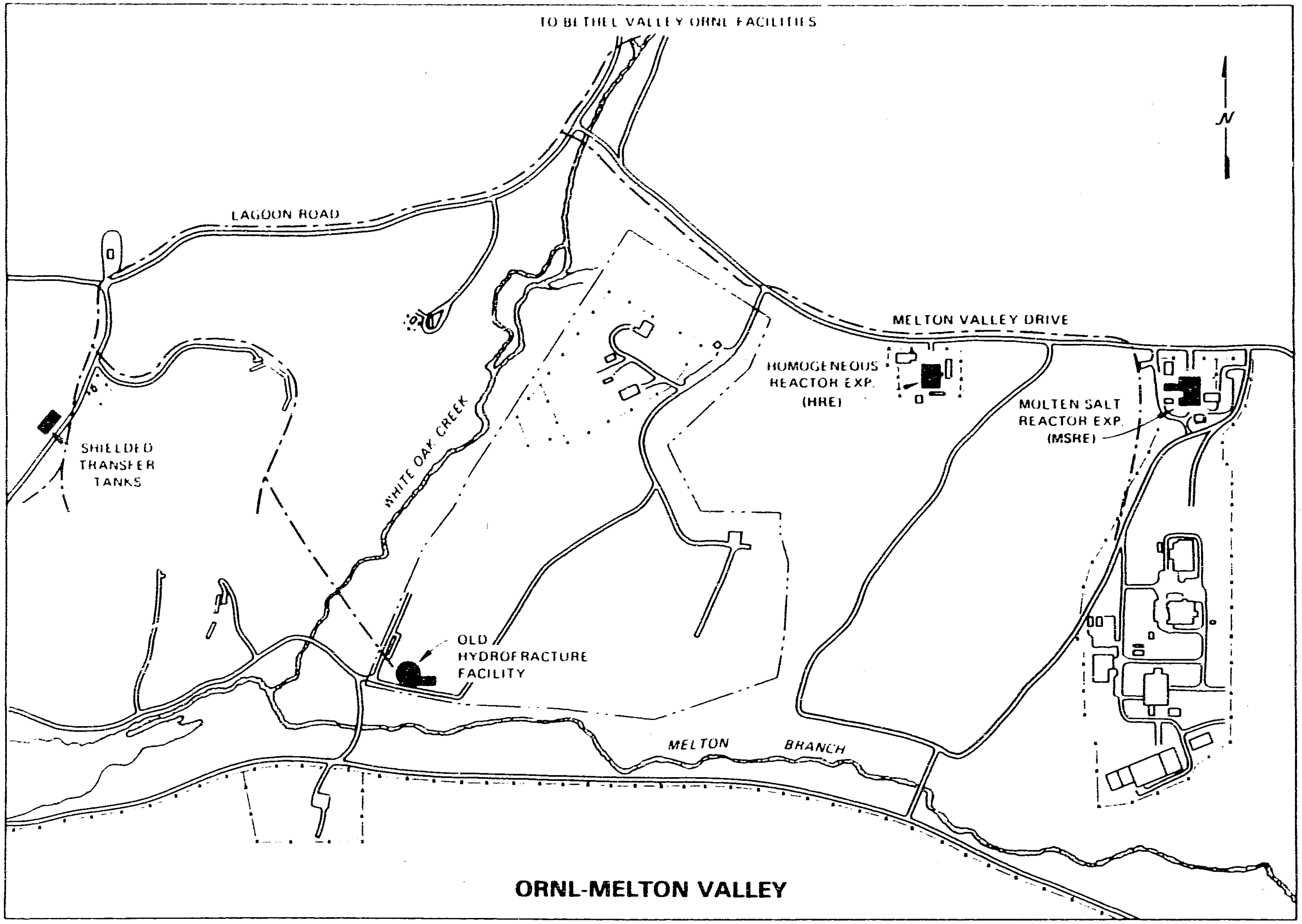

Fig. 3.7. Location map for the ORNL surplus facilities—Melton Valley.

tion of alternatives assessment for decommissioning the Molten Salt Reactor Experiment (MSRE), and (4) site characterizations and assessments of the open ponds at the Old Hydrofracture Facility and Waste Holding Basin.

3.3.1.1 *Facility Maintenance and Surveillance*

Routine maintenance and surveillance are provided to assure that all SFMP facilities remain in a safe condition until final disposition activities are undertaken. This task has the highest priority of any of the SFMP project tasks and will be a continuing part of the program. Surveillance activities include radiological monitoring, operational system checks, containment ventilation checks, and other tasks as appropriate for the facility. Routine maintenance is provided to assure containment system performance and structural integrity, and to prevent radionuclide migration. Major facility alterations or improvements are conducted, as required, to correct structural degradation problems or to eliminate a significant safety concern. Further details on this task, including identification of current facility M&S requirements and long range M&S plans, are contained in Ref. 2.

3.3.1.2 *Fission Product Development Laboratory*

The Fission Product Development Laboratory (FPDL) was a full-scale processing facility operating from 1958 to 1975 for separating up to megacurie quantities of ^{90}Sr, ^{137}Cs, and ^{144}Ce for a variety of source applications. Due to the significant radionuclide inventory remaining in the facility, the high M&S costs necessary to assure radionuclide containment, and the potential for reuse of the facility by other programs, the decommissioning of the inactive portions of the FPDL was given a high priority by the SFMP, with D&D operations being initiated in May 1983. These activities are anticipated to take approximately 5½ years, with project completion expected in FY 1988.

The objectives of the current D&D efforts at the FPDL are to (1) remove all excess contaminated process equipment from the unused portion of the facility, (2) decontaminate these areas to acceptable levels for reuse, and (3) place these portions of the facility in a standby mode, awaiting other applications. Since the FPDL is in an operable condition with portions of the facility presently being used for radioactive processing and ORNL decontamination operations, no plans are being made for the complete decommissioning and dismantlement of the building. Such final facility disposition will be delayed until the end of the useful life of the facility (15–20 years).

3.3.1.3 *Metal Recovery Facility*

The Metal Recovery Facility Decommissioning Project is following similar lines as the FPDL by making space available for other ORNL programs. Decontamination of this former pilot and small-scale nuclear fuel reprocessing plant was initiated in FY 1984 and is focusing on cleanup of the process cells, dissolver room, fuel handling canal, and abandoned waste tanks. Decommissioning efforts involve process equipment removal, decontamination of cell surfaces, dismantlement and removal of surplus ancillary equipment, and general facility cleanup. Prior to completion of the cell decontamination efforts, the facility will be analyzed for its reuse potential and plans made to either turn over the site to an operating program or completely dismantle the building to make room for future ORNL needs.

3.3.1.4 *Molten Salt Reactor Experiment*

The Molten Salt Reactor Experiment (MSRE) was a homogeneous-fueled reactor built to investigate the potential applications of molten salt reactor concepts. The MSRE operated from 1965 to 1969. Following shut-down, the fuel and coolant salts were drained to storage tanks within containment cells and isolated. The scope of the proposed decommissioning activities at the MSRE involves two major tasks: (1) fuel and flush salt disposition, and (2) facility decontamination and decommissioning. Prior to initiation of these tasks, significant technical effort will be required to assess the feasible options for the site and determine the most viable, cost-effective solution. Fuel and flush salt disposition will be a complex undertaking, with the ultimate decision on disposal options dependent upon both technical and political constraints. The choice for fuel disposal will, in turn, significantly impact the available options for facility decommissioning.

The MSRE decommissioning project will be, by far, the most complex and costly single effort undertaken by the ORNL SFMP. Studies are being initiated in FY 1985 to analyze the project issues and constraints in detail, in an effort to identify the most logical course of action for subsequent maintenance and surveillance aspects and future decommissioning efforts.

3.3.1.5 Characterization of Contaminated Ponds

The Waste Holding Basin (3513) and Old Hydrofracture Facility (OHF) contain open, contaminated ponds. The 3513 pond is an unlined, earth-bermed structure of a nominal 1.6×10^6 gal. capacity, containing approximately 250 Ci of radioactivity as well as detectable quantities of PCBs and heavy metals. The OHF pond is smaller, only 100,000 gal. capacity, but contains a similar quantity of residual radioactivity and hazardous wastes. Both ponds are structually sound but do represent potential sources of contamination to the surrounding environment in their current open conditions. The State of Tennessee has requested that these and other open ponds at the ORNL site be assessed and appropriate actions taken to alleviate any long-term hazards. In response to this request, site characterizations will be conducted in FY 1985 at these two facilities in order to determine their current status and recommend alternatives for interim stabilization or permanent disposition. Any necessary remedial actions at these sites would be performed in subsequent years.

3.3.2 Completed Projects

Since the ORNL SFMP inception in 1976, four decommissioning projects have been completed and the facilities removed from SFMP control. These projects consisted of the:

1. Standard Pile and DOSAR Accelerator
2. Building 3026-C Radiochemical Waste System
3. Intermediate-Level Waste Transfer Line
4. Curium Source Fabrication Facility

The D&D activities are summarized in Table 3.3 and a document record of project reports provided in Appendix II.

Each of these completed projects represents an important step in the growth of the SFMP at ORNL. Although the first two projects were relatively small in scope, they provided valuable experience in D&D project management. The latter two projects required a greater investment in resources and more comprehensive planning and control. In two of the four projects (Projects 1 and 4), a significant savings was realized through reuse of materials, equipment and facilities following

TABLE 3.3. Completed ORNL SFMP projects

	Project	Scope of Decommissioning Activities	Decommissioning Planning/Operations					
			Time Span	Estimated Cost ($ × 10³)	Materials Reuse Potential ($ × 10³)	Waste Volumes (m³)		
						Solid TRU	Solid LLW	Liquid
1.	Standard Pile and DOSAR Accelerator	Dismantlement of graphite pile; Disassembly of accelerator and associated equipment	FY 78-79	$ 82	$ 130		<1	<1
2.	3026-C Radiochemical Waste System	Removal of contaminated tanks, piping and controls; Entombment of remaining structure	FY 80	$200			14	<1
3.	Intermediate-Level Waste Transfer Line	Removal of 700 ft of pipe from floodplain; Entombment of two leak sites	FY 81-83	$550		0.7	112	<1
4.	Curium Source Fabrication Facility	Removal of in-cell equipment; Decontamination of cells and operating areas to levels for reuse	FY 82-83	$700	$12,000	13		50

decommissioning work. In the Standard Pile and DOSAR Accelerator Project, graphite blocks, cadmium sheeting, and over 500 items of equipment, tools, and other supplies were returned for salvage and/or reuse. The estimated replacement cost of these materials exceeded the cost of the decommissioning efforts (Table 3.3). On an even larger scale, the decontamination of the Curium Source Fabrication Facility and subsequent reuse by another program resulted in a savings of over $11 million by eliminating the need for new facility construction. These two examples highlight the potential savings to DOE that can be realized from decommissioning surplus facilities.

4.0 DECOMMISSIONING ALTERNATIVES

4.0 DECOMMISSIONING ALTERNATIVES

As ORNL nuclear-related facilities reach the end of their useful life, actions must be taken to retire the facility from active service and provide for removal or long-term control of any radioactivity present. These activities are required to assure that radiation exposures to on-site workers and, potentially, to the general public are maintained as low as reasonably achievable. The goal of the ORNL SFMP decommissioning efforts is to allow unrestricted or restricted use of the facility site, within the context of the mission and controls in effect on the Oak Ridge Reservation.

There are several decommissioning alternatives that could be applied to the management of ORNL surplus facilities. These alternatives include:

1. *no action*–simple abandonment of a facility at the end of its useful lifetime,
2. *protective storage*–maintenance of a facility in a safe shutdown mode awaiting final disposition,
3. *decontamination for reuse*–removal of radioactivity to levels that are suitable for potential reuse of the facility,
4. *entombment*–sealing or burying contaminated materials to provide permanent radionuclide containment, and
5. *dismantlement*–decontamination and disassembly of a facility to unrestricted use levels.

For any facility being decommissioned, various combinations of these alternatives could be utilized. Final facility disposition could be delayed to a future date by choosing the appropriate option.

A graphic presentation of the decommissioning alternatives is provided in Fig. 4.1. These alternatives are further defined and discussed in Section 4.1, with presentation of ORNL decommissioning alternatives selection criteria provided in Section 4.2.

4.1 DISCUSSION OF ALTERNATIVES

Brief discussions of the decommissioning alternatives are provided in the following sections. A summary of the characteristics of each option is presented in Table 4.1.

4.1.1 No Action

The no action alternative involves the simple abandonment of a facility upon completion of its mission. However, the objective of decommissioning is to return a surplus facility and/or its site to a condition that presents no unreasonable risk to workers or the public. To ensure that the risk from the facility is within acceptable bounds, some action would be required, even if it only amounted to performing a terminal radiation survey to document that the site is suitable for other uses. Therefore, independent of the type of facility or its level of contamination, the no action alternative is not considered a viable option at ORNL. Hence, this alternative will not be discussed further in this plan.

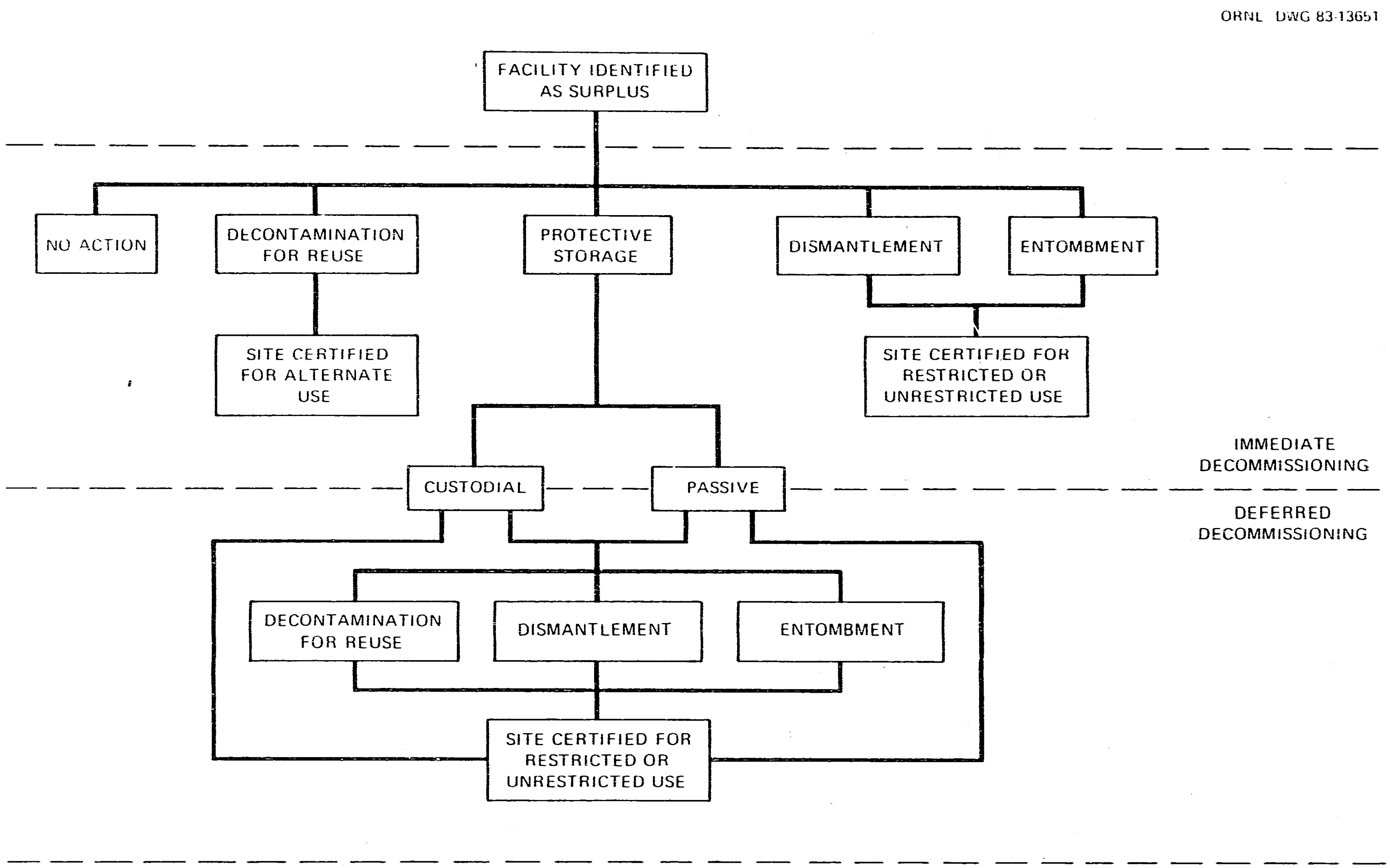

Fig. 4.1. Decommissioning alternatives flow chart.

Table 4.1. Decommissioning alternatives characteristics

Alternative	Facility Status	Monitoring/Control	Facility/Site Usage
A. Protective Storage			
1. Custodial	Structures - Intact Equipment - Most intact, some operating Contamination - Confined	Surveillance - Continuous Maintenance - Continuous Security-Continuous	Facility usage is restricted until final disposition is completed.
2. Passive	Structures - Intact Equipment - Most intact, some operating Contamination - Immobilized/ sometimes sealed	Surveillance - Periodic Maintenance - Periodic Security - Remote alarms	Facility usage is restricted until final disposition is completed.
B. Decontamination for Reuse	Structures - Intact Equipment - Removed only if excess for potential reuse Contamination - Removed to levels acceptable for potential reuse	Surveillance - Responsibility of new program Maintenance - Responsibility of new program Security - Responsibility of new program	Site use regulated by restrictions associated with alternate use.
C. Entombment	Structures - Partial removal optional Equipment - Removal optional, none operating Contamination - Sealed in monolithic structure	Surveillance - Infrequent Maintenance - Infrequent Security - Hardened barrier, posted	Entombed site is restricted.
D. Dismantlement	Structures - Removal optional Equipment - Removed if contaminated or not reusable Contamination - Removed to levels acceptable for release	Surveillance - None Maintenance - None Security - None	Remaining facility/site is available for restricted or unrestricted use.

4.1.2 Protective Storage

Protective Storage can be defined as those activities required to place and maintain a surplus facility in a condition that allows for adequate containment of residual radioactivity during a storage period of undetermined length. This alternative is designed to satisfy the requirements for occupational and public safety while minimizing the initial and interim resource commitments. The storage concept consists of a period of site preparation (decontamination and facility modification) followed by a period of interim care where security, maintenance, and surveillance are provided. Two categories of protective storage are considered for management of surplus facilities at ORNL, those being:

1. *Custodial Protective Storage*—Requires a minimum cleanup and decontamination effort initially, followed by a period of continuing care. Protection systems (ventilation, fire, and security) are kept in service throughout the storage period. Maintenance, surveillance, and security activities are carried out by operating personnel to provide radiation monitoring, conduct maintenance of equipment and containment structures, and prevent accidental or deliberate intrusion into the facility.

2. *Passive Protective Storage*—Requires a comprehensive cleanup and decontamination effort sufficient to permit shutdown of the active protection systems (i.e., ventilation) during the continuing care period. Structures are secured, additional barriers installed to ensure confinement of radioactivity, and electronic surveillance provided to detect intrusion. Periodic monitoring and maintenance of the structural integrity are required.

Both categories of protective storage require some action at the conclusion of the storage period, prior to the release of the facility for other use. Depending on the nature of the facility and its operating history, the necessary action can range from a radiation survey which documents that the residual radioactivity has decayed to appropriate release levels, to decontamination, dismantlement, or entombment of the remaining contaminated equipment and structures. These final actions constitute deferred decommissioning (see Fig. 4.1).

The protective storage alternative is used primarily as a means to minimize the initial commitments of time, money, occupational radiation exposure, and waste disposal space, while maintaining adequate control of the residual radioactivity. Modifications to the facilities are limited to those which ensure the security and integrity of the structures and provide containment of radioactive materials. Generally, it is not intended that the facilities be reactivated. The savings afforded by this reduced initial effort (compared to immediate decommissioning) is tempered somewhat by the need for continued resource commitments for maintenance and surveillance activities required during facility storage.

The duration of the storage and surveillance period can vary from a few years to a few hundred years, depending on the type of facility (the upper bound is consistent with the proposed EPA policy of reliance on institutional control for radioactive containment[7]). As a result of radioactive decay of the residual contamination during the period of protective storage, significant reductions in personnel exposure during the deferred decommissioning operations may be realized. In addition, the volume of material requiring special handling and disposal can potentially be reduced, easing the impacts on the limited waste disposal facilities at ORNL.

Although delaying ultimate facility disposition provides numerous advantages, perhaps the most significant disadvantage results from the normal loss of personnel familiar with the facility over time. The intimate knowledge of the operational history and operating characteristics provided by experienced operators cannot be replaced. Additional resources would have to be allocated for orientation and training of new personnel when the deferred decommissioning is undertaken. Another disadvantage results from the fact that a site under protective storage is unavailable for other uses until decommissioning is completed, effectively removing that facility or location from beneficial near-term reuse.

4.1.3 Decontamination for Reuse

Decontamination for Reuse, although not strictly encompassed within the usual definition of decommissioning, is a viable and often preferred alternative for facility disposition at ORNL. It is a management option that must be evaluated early in the planning phases of the project since it directly competes with or takes precedence over the other alternatives. Decontamination for Reuse generally involves the removal of residual radioactivity and surplus contaminated equipment from a facility in order to potentially allow performance of a new function or continuation of activities similar to its original function. Decommissioning activities provided in the scope of this alternative include: (1) structural modification of existing facilities to support decommissioning activities, (2) decontamination of surfaces and equipment, (3) dismantlement and disposal of excess equipment and facilities, and (4) documentation of residual radioactivity. The degree or extent of these activities will be governed by the restrictions to be imposed on potential reuse of the facility.

It is difficult to make general comparisons between the reuse alternative and the other decommissioning modes because the extent of the decontamination efforts is so highly dependent upon the restrictions to be placed on reuse of the facility. In some instances, significant levels of contamination may be allowed to remain in the facility if these levels are consistent with the potential for reuse. Similarly, for certain other applications, decontamination may be desired to .llow unrestricted site usage. The principal advantages of facility decontamination for reuse are encompassed in the potential for significant cost savings over other alternatives and the concept of conservation of existing resources. If no potential alternate use can be identified, or the estimated costs associated with decontamination and modification activities exceed the costs for an equivalent new facility or for other alternatives, this decommissioning option would not be proposed.

4.1.4 Entombment

Entombment involves the encasement of radioactive materials in concrete or other structural material sufficiently strong and structurally long-lived to assure radionuclide containment until contamination levels have decayed sufficiently to permit unrestricted release of the facility. Typically, only certain portions of a facility would be entombed, while the remainder may not require decontamination or may be disposed of by another method.

Entombment activities include comprehensive decontamination of contaminated equipment and material identified for potential reuse, coupled with the construction of physical barriers around the remaining radioactive areas. These barriers are constructed such that accidental intrusion is impossible and deliberate intrusion extremely difficult. Efforts are made to minimize the volume of hardened material and to release as much of the facility as practicable for restricted or unrestricted use. Periodic maintenance and surveillance of the entombed structure may be required, depending on site characteristics.

The entombment option is intended for applications where the residual radioactivity contained in the structure will decay to levels permitting unrestricted access within a reasonable time. This period must consider the loss of structural integrity over time and be consistent with the proposed EPA policy on institutional control reliance for radioactive containment (a few hundred years).[7] In some instances, the decay time and inventory of radionuclides in a facility (termed the critical/abundant radionuclides) may be such that the time required to reach unrestricted release levels exceeds the demonstrated structural integrity of the proposed entombment materials and the institutional control limits. In such cases, entombment would not be considered a viable alternative at ORNL.

The advantages of entombment over other final disposition alternatives lie in the potential for reduced decommissioning costs and occupational and public radiation exposures. For entombment, decontamination and dismantlement activities are significantly reduced, and waste handling and disposal requirements are minimized. Entombment does, however, contribute to the problems associated with the increased number of sites at ORNL dedicated to long-term containment of radioactive waste. The locations of such entombed facilities may not be compatible with the long-range site utilization plans, making this alternative unattractive, if not completely unacceptable, for certain facilities.

4.1.5 Dismantlement

Dismantlement may be described as those actions required to remove radioactive and contaminated material from a facility such that residual radioactivity would be reduced to levels that would permit unrestricted use of the property. This is the most extensive decommissioning mode and requires a significant commitment of money, personnel, waste disposal space, and time. Dismantlement can occur immediately upon shutdown of the facility or can be deferred until the end of a protective storage period.

The dismantlement option typically involves the following tasks:

1. decontamination, disassembly, and removal of structures, systems or components that may be identified for potential reuse or salvage,
2. demolition and/or removal of bulk radioactive materials, activated components, and contaminated equipment with no identified reuse potential, for subsequent packaging and disposal or storage in ORNL burial grounds, and
3. decontamination of remaining radioactively contaminated structures, systems, and components to levels allowing unrestricted site use.

The final result of such decommissioning actions is to make the site available for other beneficial uses, with or without original structures remaining. No further security, maintenance, or surveillance activities attributable to the original project are required. Further, this option potentially results in the greatest reduction in long-term risk to the public by isolating all significant radioactivity in disposal areas.

The greatest disadvantage of the dismantlement option is the large commitment of resources required. Dismantling can be a labor-intensive, complex, time-consuming operation, resulting in extensive manpower requirements with attendant costs and greater personnel exposure. In addition, large quantities of radioactive waste can be generated during dismantlement which require packaging, transport, and storage or disposal in ORNL waste storage areas. Impacts on the disposal system could be significant, including the increased risk of occupational exposure. However, in some instances, the overall radiation doses and costs can be less than other alternatives, especially for deferred dismantlement where radiation levels have decayed, making the dismantlement task simpler, and waste volumes smaller.

4.2 DECOMMISSIONING ALTERNATIVE SELECTION

As described in Chapter 3.0, the selection of the alternatives to be used in decommissioning a surplus facility at ORNL is a complex process involving the evaluation of numerous factors. This process, as depicted in Fig. 4.2, begins with the identification of a site as surplus and submission of documentation on the facility for acceptance into the SFMP. Once it is established that facility management is to be transferred to the ORNL SFMP, an initial prioritization effort is undertaken to rank the site in relation to the other projects already included in the ORNL program.

Most of these facilities ceased operations 10–20 years ago and were already in a protective storage mode when accepted into the SFMP. Hence, the immediate decommissioning alternative has been dismissed and the facilities are in protective storage awaiting deferred decommissioning. Priorities have been established between the competing projects for disposition funding, and new additions to the SFMP would have to be ranked among these, according to need. The project prioritization is accomplished according to the methodology outlined in Chapter 7.0 of this plan.

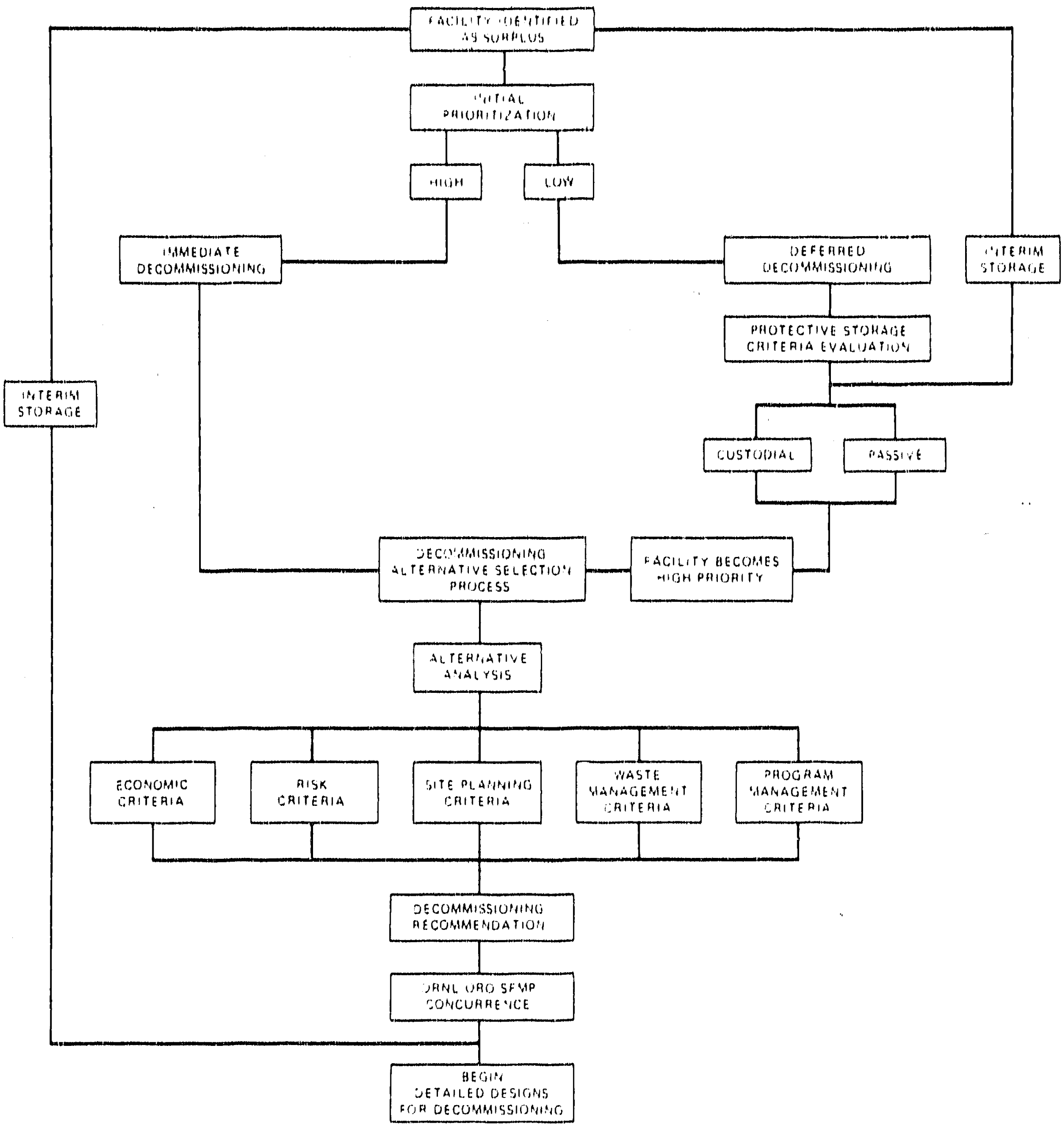

Fig. 4.2. Decommissioning alternatives selection process.

Based upon these initial findings, the facility would either be slated for immediate decommissioning analysis (high priority ranking) or deferred decommissioning (low priority ranking). If the prioritization and subsequent analyses are conducted prior to actual shutdown of the facility, decommissioning activities can begin promptly, pending availability of funding. However, when the analyses are conducted after shutdown, interim storage must be provided until the appropriate decommissioning mode is undertaken.

Once it has been determined whether the facility is to undergo immediate or deferred decommissioning, analyses must be conducted to choose between the various decommissioning options. For those facilities where final disposition is to be deferred, the choice is between Custodial and Passive Protective Storage. For final decommissioning, the three remaining alternatives (Decontamination for Reuse, Dismantlement, and Entombment) must be evaluated.

To provide a basis for comparison of alternatives, five broad categories of selection criteria are utilized by the ORNL SFMP. These categories are:

1. Economics,
2. Site Planning,
3. Risk,
4. Program Management, and
5. Waste Management.

Specific criteria have been established for each category which must be satisified in order for a decommissioning alternative to be recommended. These criteria are discussed in more detail in Section 4.2.1.

The analyses required in support of the selection process would include engineering studies, NEPA documentation, and safety assessments, on-site characterization surveys, and program management assessments. When sufficient information has been gathered to satisfy the criteria specifications, alternative selection can be made and a decommissioning plan submitted through proper channels for concurrence by ORNL management and DOE. Details of the analysis sequence for alternative comparisons are given in Section 4.2.2.

It is both the National and ORNL SFMP position that the decommissioning activities chosen should: (1) maximize the beneficial reuse of surplus facilities, materials, and equipment, and (2) minimize the overall project cost, while providing adequate protection for on-site personnel and the general public. In light of this guidance, the preferred alternative for decommissioning at ORNL is Decontamination for Reuse. However, final determination of a disposition made for any of the ORNL SFMP facilities will depend upon the results of the alternatives assessment (including NEPA compliance). In addition, in order to reduce overall project costs, program management should attempt to minimize the need for long-term maintenance and surveillance activities by providing for the disposition of facilities in the most timely manner.

4.2.1 Selection Criteria

Specific selection criteria have been defined for each of the five decommissioning alternative categories previously mentioned. A complete listing of these criteria is provided in Table 4.2, with a brief discussion of the scope of each of the selection standards to follow.

Table 4.2. Decommissioning alternatives selection criteria

Alternative	Category	Criteria
A. Protective Storage		
1. Custodial	Program Management	Facility is low on the ORNL SFMP priority list; continued resources can be assured for adequate maintenance and surveillance.
	Site Planning	Restrictions placed on facility and site during storage period are compatible with ORNL site plans.
	Risk	No major structural deficiencies present that would allow nuclide migration; personnel exposures during storage period are acceptable.
	Economics	Resources required to place facility in safe condition and provide continued maintenance and surveillance are comparable or less than those needed for passive storage.
	Waste Management	Impacts on ORNL waste management operations are acceptable.
2. Passive	Program Management	Facility is low on the ORNL SFMP priority list; resources can be assured for facility modifications and continued maintenance and surveillance.
	Site Planning	Restrictions placed on facility and site during storage period are compatible with ORNL site plans.
	Risk	Facility modifications can assure adequate radionuclide containment during storage period; personnel exposures during modifications and facility storage are acceptable.
	Economics	Resources required to place facility in passive safe mode and provide continued maintenance and surveillance are comparable or less than for custodial storage, or the additional needs are offset by savings gained during final disposition.
	Waste Management	Impacts on ORNL waste management operations are acceptable.
B. Decontamination for Reuse	Site Planning	Potential for alternate use; space cannot be provided elsewhere in comparable facilities.
	Economics	Potential use must be compatible with facility design; modifications must not result in greater costs than new construction.
	Risk	Occupational and public risk must be comparable or less than other alternatives; residual contamination levels must be acceptable for alternate use.
	Program Management	Continued resources can be assured for completion of project; facility modification costs to be provided by alternate use program.
	Waste Management	Impacts on ORNL waste management operations are acceptable.

Table 4.2. Decommissioning alternatives selection criteria (cont.)

Alternative	Category	Criteria
C. Entombment	Site Planning	Potential for facility reuse is low; facilities to be entombed are not compatible with potential needs of other ORNL programs; long-term restricted use of entombed site is compatible with ORNL site plans; site integrity can be assured through structural and administrative controls.
	Program Management	Facility is high on SFMP priority list; resources can be assured for completion of project once entombment operations have begun.
	Risk	Entombment must result in an equivalent or increased level of radionuclide containment compared to other feasible alternatives; consideration should be given to other decommissioning options if the critical/abundant radionuclides have half-lives >30 years; personnel exposures during entombment operations are acceptable.
	Economics	Resources required are comparable or less than those needed for other feasible options.
	Waste Management	Impacts on ORNL waste management operations are acceptable.
D. Dismantlement	Site Planning	Potential for facility reuse is low; facilities to be dismantled are not compatible with potential needs of other ORNL programs.
	Program Management	Facility is high on SFMP priority list; resources can be assured for completion of project once dismantlement has begun.
	Economics	Resources required are comparable or less than those needed for other feasible alternatives; proven dismantlement techniques must be available or R&D resources provided to develop them.
	Risk	Dismantlement activities must result in an equivalent or increased level of radionuclide containment compared to other feasible options; personnel exposures during dismantlement operations are acceptable.
	Waste Management	Impacts on ORNL waste management operations are acceptable.

4.2.1.1 *Economics*

In an evaluation of decommissioning alternatives from an economic viewpoint, the overall commitment of resources must be compared. This comparison includes analysis for each feasible alternative of engineering requirements, characterization costs, equipment needs, R&D requirements, manpower commitments, facility structural modifications, D&D operating and material costs, waste disposal costs, certification costs, and management requirements. In all cases, cost trade-offs should be tempered by the overriding concern for personnel and public health and safety. For facilities where decisions are being made between immediate and deferred decommissioning, maintenance and surveillance costs must be included and appropriate discount rates utilized over the assumed storage period to determine overall project resource requirements. In some instances, cost estimates can be reduced by assuming reuse of decontamination equipment and supplies utilized on other projects, existence of trained and/or experienced decommissioning personnel, and funding of facility modifications for reuse by another program.

4.2.1.2 *Site Planning*

Site-wide land use planning at ORNL is in its infancy. No comprehensive plan currently exists that can define the restrictions that apply to the future use of any of the facilities under consideration in the ORNL SFMP. In contrast to this lack of guidance is the importance that such direction has on the choice of decommissioning alternatives. The alternative selection criteria for site planning are focused on two main concerns:

1. the identification of potential reuse of SFMP facilities, and
2. definition of land use restrictions that apply for the sites where such facilities are located.

Since Decontamination for Reuse is, in general, the preferred decommissioning option at the Laboratory, specific guidance from appropriate program managers will be necessary to determine the potential for such reuse at each facility. If no projected alternate use can be identified, then other, usually more expensive and time consuming, alternatives would normally be specified. The option does exist, however, to further delay final disposition by returning the facility to a low priority status (requiring protective storage) in hopes of identifying a reuse application in the future.

Of equal concern is the need for definition of zoning requirements at each site. For areas where future nuclear processing or waste handling activities are not desired, the reuse potential for most of the SFMP facilities decreases. If unrestricted use of the site is desired, the decommissioning alternatives become very limited. Furthermore, if land use plans restrict the future use of an area from long-term waste disposal, the entombment option must be completely dismissed.

4.2.1.3 *Risk*

Safety and environmental concerns must be evaluated for each alternative and comparisons made in order to assure that the decommissioning choices are consistent with the concept of minimizing the overall risk to operating personnel and the public. Safety analyses of viable alternatives must include determination of radiation exposures and industrial safety hazards associated with the proposed decommissioning activities. Environmental effects due to migration and atmospheric dispersion of all hazardous wastes must also be evaluated, considering the impacts from the D&D operations phase as well as long-term waste disposal. For those decommissioning modes that include protective storage, the risks from the extended storage period must also be considered.

4.2.1.4 *Program Management*

An objective of the ORNL SFMP is to provide organized, cost-effective management of the decommissioning activities required at the Laboratory. In meeting this objective, many factors must be taken into account in determining the best allocation of the available manpower and funds. In most cases, a levelized resource commitment results in the most cost-effective program.

Program managers must consider project priorities in determining the optimum program direction. By assigning a priority to the projects to be completed, resources can be allocated to the most needed areas. As the total resources available fluctuate, the facility characteristics or program needs change, or as projects are completed and removed from SFMP control, the relative ranking of individual projects changes. When the project priority becomes high, adequate resouree allocations will be made to satisfy the appropriate decommissioning needs.

In terms of resource allocation, two areas have been identified that are critical to the safe execution of the decommissioning program and are prominent in the selection criteria utilized. These are (1) the guarantee that maintenance and surveillance funds are available to provide safe storage of appropriate facilities and (2) the assurance of adequate funds to allow completion of a D&D effort, once actual on-site work has begun. In both instances, loss of funding could result in situations that present significant risks to ORNL personnel and the general public. If reasonable assurance of adequate support throughout the lifetime of the proposed decommissioning alternative cannot be obtained, project initiation should be delayed or other options explored.

4.2.1.5 *Waste Management*

The waste management system at the Laboratory is designed and operated to provide necessary solid, liquid, and gaseous waste treatment, storage, and disposal for normal ORNL operations. The SFMP, in overseeing the final disposition of surplus facilities at the Laboratory, may produce types and volumes of waste that require significant investments of manpower and storage or disposal space from the ORNL Waste Management Program. In some instances, it may be impossible or very costly to comply with these needs. Hence, the waste management criterion may be the limiting factor that determines the acceptability of certain decommissioning alternatives.

4.2.2 Selection Process

The alternative selection process, as shown in Fig. 4.2 and briefly described in the introduction to this section, follows two separate paths depending on whether immediate or deferred decommissioning is specified. In both analysis paths, alternative characteristics are compared to specific selection criteria (Table 4.2) in order to determine the best decommissioning mode.

To determine the characteristics of each viable D&D option, various types of studies must be performed. The scope of these analyses could range from a brief review of the various waste disposal requirements of each option, to a detailed engineering assessment and costing study. The extent of the effort would depend upon the amount of supportive information already available and the number of alternatives that must be considered. To provide the needed information, the ORNL SFMP initiates study efforts for each project in the following areas:

1. On-Site Characterizations
2. Engineering Feasibility Studies
3. Safety Reviews
4. National Environmental Protection Act (NEPA) Documentation
5. ORNL Land Use Planning
6. Waste Management Reviews, and
7. Maintenance and Surveillance Planning

These studies are conducted or reviewed at the time a project is identified as high priority for decommissioning and resulting data used to evaluate the individual selection criterion.

4.2.2.1 *Protective Storage Options*

In the analysis of protective storage options, the guidelines established in the ORNL Maintenance and Surveillance Plan would be reviewed and the necessary evaluations conducted to determine whether passive or custodial storage would be most advantageous. Factors that would be considered are (1) the location of the facility with respect to available surveillance personnel, (2) condition of the facility in terms of structural integrity and radionuclide containment, (3) estimated costs to maintain the facility in a safe condition, and (4) potential for continued use of portions of the site. The recommendations resulting from this analysis would be reviewed by the ORNL SFMP Program Manager, and the final decision submitted to Laboratory management and the DOE SFMPO for concurrence.

4.2.2.2 *Final Facility Disposition*

Since final facility disposition will typically be a major undertaking, with the potential commitment of large amounts of DOE and ORNL resources, the disposition mode selection process is more complex than for the protective storage case. Here, multidisciplinary efforts must be utilized to assure that all significant impacts and available options are analyzed. To accomplish this evaluation task, the ORNL SFMP initiates the sequence of studies shown in Fig. 4.3, designed to provide the data needed for criteria application. Appropriate analyses, reviews, and documentation are carried out in accordance with ORNL and DOE management guidelines as set forth in Chapter 5.0.

Based on the assessment results, the final analysis step involves applying the individual criterion to each alternative (Table 4.2) to determine the most acceptable decommissioning mode to be adopted. This criteria application would be performed by ORNL SFMP staff consistent with the guidelines established by this Long-Range Plan. The resulting conclusions would be documented for Laboratory management and DOE-OR concurrence prior to submittal to the DOE program office as a final recommendation. Once agreement has been reached, detailed decommissioning design studies (i.e., conceptual design, safety analysis, quality assurance planning, Title I and II designs) can be undertaken, leading to initiation of actual D&D operations.

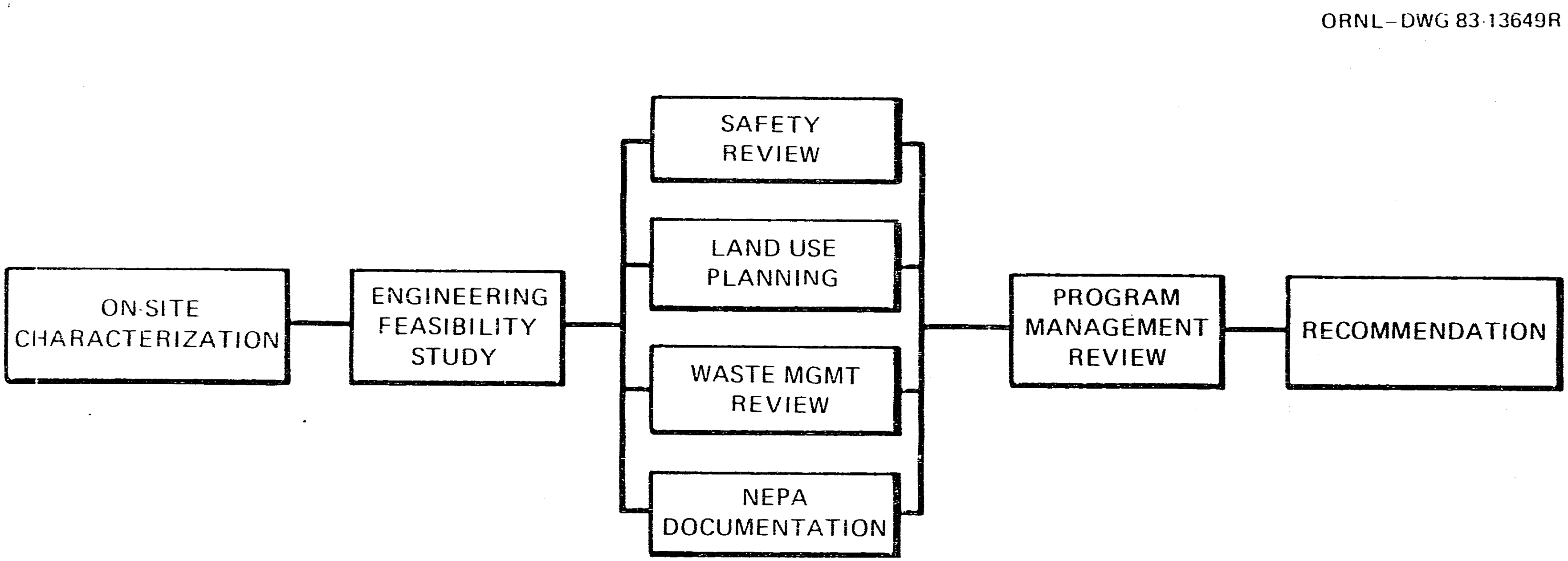

Fig. 4.3. Decommissioning alternatives analysis sequence.

5.0 DESIGN/PERFORMANCE CRITERIA

5.0 DESIGN/PERFORMANCE CRITERIA

Guidelines and policies have been established for the management and decommissioning of ORNL surplus radioactively contaminated facilities. Such design/performance criteria were designed to:

1. establish standard practices for program planning, management, and documentation;
2. provide design basis criteria for engineering specification of decommissioning projects;
3. ensure compatibility between interfacing systems;
4. regulate and monitor decommissioning operations; and
5. evaluate the effectiveness of the decommissioning activities.

The basis for the SFMP design criteria described in this Chapter is the draft DOE Order 5820.2, Chapter V, Decontamination and Decommissioning of Surplus Sites and Facilities. This order is part of the broad set of regulations defining waste management policies and guidelines for all DOE-regulated sites (DOE 5820–Radioactive Waste Management). The D&D policies set forth in 5820.2 provide for the management of SFMP sites in a safe and cost-effective manner, and stress the desire for recovery and reuse of facilities, equipment, and valuable materials, when practicable.

As referenced in 5820.2, numerous national and international standards on radiation safety, environmental controls, industrial safety, and other concerns are applicable to the surplus facilities program. Such guidance comes from (1) other DOE orders, (2) EPA standards, (3) ANSI standards, (4) OSHA regulations, (5) NEPA guidance, (6) NRC (NUREG) documents, (7) NCRP publications, and (8) ICRP reports, as well as numerous other sources. An abbreviated listing of the most pertinent standards that are applicable to the ORNL SFMP is provided in Appendix III.

To summarize the extensive amount of regulatory guidance and provide a concise set of procedures to be followed at ORNL on D&D work as well as other activities, numerous procedures and operations manuals are maintained at the Laboratory. These manuals (also listed in Appendix III) cover the range of activities from radiation protection to ORNL management practices and are the standards by which all operations at ORNL are performed. Hence, in the discussions of decommissioning criteria that follow, reference is usually made to the appropriate ORNL manual that covers the activity under consideration, rather than tracing back to the original DOE or other agency guidance. In certain instances, however, no ORNL guidelines have yet been established, and the DOE policies outlined in DOE 5820.2 are directly incorporated into the ORNL SFMP criteria.

Discussions of the design/performance criteria are provided in the following sections. These presentations have been divided into seven areas of concern, consisting of: (1) Program Management Guidelines, (2) Health and Safety Standards, (3) Quality Assurance Requirements, (4) NEPA Compliance, (5) Waste Disposal Requirements, (6) Materials Reclamation Policy, and (7) Certification Criteria.

5.1 PROGRAM MANAGEMENT GUIDELINES

Specific guidelines for the management of the ORNL SFMP are provided in the DOE SFMP Program Plan, as referenced in DOE Order 5820.2. This plan is the principal control document issued by the DOE SFMP to describe the administrative policies and procedures to be implemented by all program participants, including ORNL. As defined in this document, ORNL is required to assist the OSFM in developing the SFMP Program Plan, scopes of work, project schedules, and budget information, as well as to routinely report to DOE-OR on technical progress, costs, schedule status, and milestone achievements on assigned tasks. Technical reports are to be prepared on projects or other special topics. In addition, the Program Plan gives specific instructions regarding the release of public information, facility acceptance criteria, maintenance and surveillance activities, project prioritization, technology development, NEPA compliance, and project planning.

In response to these program management guidelines, the ORNL SFMP was established and a multi-disciplinary management team formed to implement the program. Identification of this team, the organization structure imposed, and the reporting lines established was provided in Chapter 3.0.

5.2 HEALTH AND SAFETY STANDARDS

Decommissioning activities, from the initial radiological characterizations, through routine maintenance and surveillance, to project planning and final facility disposition, are to be conducted in strict accordance with all applicable health and safety standards. Such standards have been promulgated for four primary areas at ORNL: radiation protection, industrial safety, environmental protection, and safety documentation.

5.2.1 Radiation Protection

The ORNL Health Physics Manual contains detailed procedures outlining the radiation protection requirements to be observed during decommissioning work. Specific guidance is given on administrative procedures, radiation and contamination control, personnel exposure control, and handling, transport and storage or disposal of radioactive materials. In general terms, the radiation safety policy at ORNL is:

1. To conduct all D&D operations in such a manner that personnel exposures to radiation or contamination are maintained at a level as low as reasonably achievable; in no case should internal or external exposure exceed the DOE standards for radiation protection as outlined in DOE Order 5480.1, Chapter XI;
2. To perform all work in such a manner that losses resulting from contamination are minimized; such losses include scheduling delays, cleanup costs, and equipment abandonment; and
3. To maintain environmental contamination at as low a level as possible, consistent with sound operating practice; in no case should the atmospheric or water contamination levels outside the controlled area exceed the maximum permissible concentration values applicable to individuals residing in uncontrolled areas (DOE 5480.1).

Numerical guidelines for personnel exposure, surface contamination limits, and radionuclide releases to the environment are provided within individual procedures in the Health Physics Manual for all operating conditions (i.e., controlled versus noncontrolled zones, maximum and average limits). The guidance provided in these procedures will be followed for all activities conducted as part of the ORNL SFMP. A summary of a few of the more important guidelines is given in Table 5.1.

Table 5.1. Radiation protection guidelines for the ORNL SFMP[a]

Mode of Exposure	Exposure Conditions	Guideline Values for Individuals: Occupational	Guideline Values for Individuals: Uncontrolled Areas
External Radiation	Whole Body - Annual	5 rem	0.5 rem
	- Quarterly	3 rem	
	Other Organs - Annual	15 rem	1.5 rem
	- Quarterly	5 rem	
	Bone - Annual	30 rem	
	- Quarterly	10 rem	
	Forearms - Annual	30 rem	
	- Quarterly	10 rem	
	Hands/Feet - Annual	75 rem	
	- Quarterly	25 rem	
Radioactive Contamination	Air - Non-Zoned Areas (daily average)	1/10 $(CG)_a$[b]	$(CG)_a$[b,d]
	Water - Potable and/or Process	1/10 $(CG)_w$[c]	$(CG)_w$[c,d]
	Items for Reuse/Salvage[e]		
	Direct Reading α	300 dpm/100 cm^2	
	Direct Reading β-γ	0.05 mrad/h	
	Transferable α	20 dpm/100 cm^2	
	Transferable β-γ	200 dpm/100 cm^2	

[a]This is a summary of the most important guidelines. Details of these and all other radiation protection standards applicable to the ORNL SFMP can be found in the ORNL Health Physics Manual.

[b]$(CG)_a$ represents the recommended concentration guideline values for air as set forth in DOE 5480.1. For the occupational exposure conditions, this is the 40-h per week value (Table I); for uncontrolled areas, it is for continuous (168 h per week) exposure (Table II).

[c]$(CG)_w$ represents the recommended concentration guideline values for water as set forth in DOE 5480.1. For both occupational and uncontrolled conditions, this is the continuous (168 h per week) exposure value.

[d]Limits (CG) for uncontrolled areas are a factor of 30 lower than for occupational setting.

[e]Limits are referred to at ORNL as "green tag."

As mentioned above, the policy at the Laboratory is to maintain all radiation exposures at a level as low as reasonably achievable (ALARA). The policy applies to all workers at the facility as well as the general public and the environment surrounding ORNL. General guidance for achieving this goal is contained in the ORNL Health Physics Manual (Procedures 6.1-6.5) and in DOE 5480.1. As a design basis for D&D work, occupational exposure levels should be held to less than 20% of the permissible dose equivalent limits referenced in Table 5.1. This objective must be considered during the design phase of D&D activities, in terms of planned exposure times, shielding requirements, and task implementing procedures. During actual decommissioning operations, work activities will be monitored to evaluate ALARA goals. Appropriate action will be taken (i.e., review and/or change of work procedures) when an annual whole body dose equivalent to an individual of 2 rem/year is observed, or a group of individuals receives in excess of 1 rem/year annual average, in an occupational exposure setting. Administrative and active control measures will be used to minimize the potential for contact with radioactive materials and/or radiation by persons not normally considered radiation workers or involved with the operation in question.

5.2.2 Industrial Safety

Decommissioning activities involve common construction and demolition practices occurring in areas containing radiation hazards. As such, the safety concerns are for the most part identical to those in other industrial operations, with an added emphasis on radiation protection, as discussed above. At ORNL, these types of operations have been conducted for many years, and comprehensive guidelines have been established to: (1) conduct all activities to minimize the risk of personal injury or property loss due to preventable accidents, (2) perform all work and maintain the working environment in accordance with applicable national codes and standards, and (3) investigate all significant accidents to determine their causes and then take steps to prevent recurrence of similar incidents. To this end, some 10 manuals specific to industrial safety concerns have been developed at ORNL (see Appendix III). These manuals deal with numerous topics, including industrial hygiene, hazardous materials control, construction procedures, safety analysis requirements, quality assurance, fire prevention, and maintenance procedures. These procedures have been written to conform with recognized industrial and federal guidelines such as ANSI standards, DOE orders and OSHA requirements, and represent ORNL management guidance in these areas. In keeping with this guidance, the ORNL SFMP has adopted these procedures as the design/performance criteria for industrial safety. All decommissioning work will be planned and accomplished according to these procedures.

5.2.3 Environmental Protection

It is an objective of the ORNL SFMP to conduct decommissioning operations in a manner that (1) provides safeguards against environmental pollution consistent with or more stringent than the requirements of applicable national standards and (2) assures that Laboratory personnel, the general public, and the environment are protected against releases of hazardous materials. For radionuclide releases, specific guidelines are addressed in the ORNL Health Physics Manual as discussed in Section 5.2.1. For all other hazardous materials, the ORNL guidance is provided in the ORNL Environmental Protection Manual and the Hazardous Materials Management and Control Manual. These manuals give specific requirements for the handling of certain potentially hazardous materials, as well as defining the guidelines for administrative procedures and obtaining air emission permits. The information presented and/or referenced in these documents forms the ORNL SFMP design and performance criteria for nonradioactive environmental concerns on all decommissioning actions.

5.2.4 Safety Documentation

DOE Order OR 5481.1A (Safety Analysis and Review System) requires that a safety review be performed and documentation be prepared for all activities where DOE has assumed responsibility for safety. The objective of this review and documentation process is to assure that: (1) potential hazards are systematically identified, (2) reasonable measures to eliminate, control, or mitigate the hazards have been taken, (3) potential risk from the operation has been evaluated, and (4) there is documented DOE management authorization of the operation based upon an objective assessment of the safety analysis.

In response to this guidance, ORNL and the ORNL SFMP have adopted the procedures outlined in the DOE Order OR 5481.1A for determining the types of facilities for which safety documentation should be prepared, the timing for preparation of such documents, and the requirements for approval. Four types of documents may be required as part of the safety review. These are the Safety Assessment, Preliminary Safety Analysis Report, Final Safety Analysis Report and the Operational Safety Requirements. The content and format of these documents are defined in the DOE order.

In addition to this DOE safety review during the project planning stages, all decommissioning operations for major facilities would be periodically reviewed by the ORNL Radioactive Operations Committee and the Office of Operational Safety. Approvals for all safety related procedures will be required prior to project initiation.

5.3 QUALITY ASSURANCE REQUIREMENTS

On all projects, the ORNL SFMP will implement the quality assurance (QA) requirements established by the DOE and ORNL as documented in the Operations Division Quality Assurance Manual. This QA program is implemented through a series of documented QA procedures and quality-related documents that are designed to assure adequate confidence that structures, systems, components or facilities will perform satisfactorily during decommissioning activities. To this end, procedures have been established for project planning, personnel training, operations control and routine reporting.

QA documentation is provided through a QA Assessment/Plan during the project planning stages, and QA Progress Reports, Quality Investigation Reports and Corrective Action Plans as required during project operations. The reporting and approval requirements are defined for each of these reports in the QA Manual. Audits of the ORNL SFMP are conducted periodically by the ORNL Quality Assurance Coordinator.

5.4 NEPA COMPLIANCE

Overall guidance and requirements applicable to planning of decommissioning projects for compliance with the National Environmental Policy Act (NEPA) are summarized in the DOE SFMP Program Plan.[1] Supplemental guidance for implementation of the NEPA process is obtained through the DOE-OR. As part of the alternatives assessment phase of the ORNL SFMP program implementation process (Section 3.2.4) consideration is given to NEPA requirements for determination of the environmental consequences of the proposed decommissioning activities. For actions which have potentially significant environmental impacts, appropriate documentation of the project alternatives and consequences is prepared and submitted for DOE review and approval. Generally, one of three levels of documentation may be specified, depending upon the complexity of the project. These include an Action Description Memorandum, an Environmental Assessment, and an Environmental Impact Statement. Report content, format, timing, and review/approval requirements are defined in the NEPA guidance, and are reflected in the ORNL guidelines for report preparation (Environmental Protection Manual). Upon DOE approval, the results of the environmental analysis are used as a basis for determining the decommissioning alternative specified for ORNL SFMP projects.

5.5 WASTE DISPOSAL REQUIREMENTS

The very nature of decommissioning activities involves the production of various types and quantities of solid, liquid, and gaseous hazardous wastes, both radioactive and nonradioactive. The handling and disposal of SFMP-produced wastes has the potential for creating a significant impact on the ORNL waste disposal system.

As part of its overall mission as defined by DOE, ORNL disposes of or stores all radioactive solid waste generated at the Laboratory. In addition, other hazardous solid wastes and all liquid and gaseous wastes produced during ORNL operations are treated on-site and are stored or properly disposed. The waste management system utilized for these purposes is described in Chapter 2.0. Procedures for the treatment and handling of these wastes are provided in the ORNL Radioactive Solid Waste Operations Manual, the Health Physics Manual, and the Environmental Protection Manual. The procedures established in these manuals define the requirements to be met during all D&D activities that generate waste. Discussions of some of the more important design/performance criteria relating to waste disposal are provided as follows.

5.5.1 Radioactive Wastes

Solid radioactive waste shall be kept segregated from uncontaminated wastes as they are generated and shall be further classified and handled according to the characteristics of the waste. These classifications are defined in Table 5.2 in terms of gross activity levels, acceptable packaging types, and location of final disposal or storage. Further details of the packaging size and weight restrictions, contamination limits, fissile and TRU material loadings, container sealing requirements, labeling and marking restrictions, handling procedures, and administrative controls are contained in the Health Physics Manual (Procedure 5.1) and the Radioactive Solid Waste Operations Manual. For special cases where off-site disposal or unique packaging and handling concepts are required during D&D operations, consultation with the ORNL Waste Management Program staff must be conducted early-on in order to define the criteria to be established for the safe packaging, handling, and transport of such wastes. Such criteria would be consistent with all applicable national standards.

Liquid and gaseous radioactive wastes generated during decommissioning operations are to be routed directly to the appropriate ORNL waste treatment system for subsequent treatment and disposal. Waste composition and flow rates must be compatible with the ORNL Operating Procedures for Liquid and Gaseous Waste Disposal. When utilization of the ORNL systems is not possible or practical, the wastes must be handled in accordance with the criteria set forth in DOE Order 5820.2, with releases to the environment maintained at concentrations within the guidelines defined in the ORNL Health Physics Manual (Procedure 2.5, regulation 5j). Liquid waste can be disposed of in the ORNL burial grounds only when it cannot be disposed of otherwise, and specific approval is obtained. Liquid wastes shall be immobilized before burial.

5.5.2 Nonradioactive Hazardous Wastes

Handling and disposal of nonradioactive hazardous wastes will be handled on a-case-by-case basis, depending upon the type of waste. Guidelines currently exist for disposal of asbestos, polychlorinated biphenyls (PCB), mercury, oil (non PCB), and cooling-tower sludge, as detailed in

Table 5.2. ORNL solid waste classifications

Waste Category	Waste Characteristics	Container Type[a]	Disposal or Storage Site[b]
Radioactive			
General High Range, Low-Level	<100 nCi/g TRU alpha >200 mrem/h beta-gamma[c]	Closed plastic Closed can Sealed wooden box Shielded cask Shielded yellow dumpster "Hot" truck	SWSA 6, in auger hole or trench
General Low Range Low-Level (Compactible)	<100 nCi/g TRU alpha <200 mrem/h beta-gamma[c]	Plastic bag Fiber carton Yellow can Walk-in yellow dumpster	SWSA 6, in trench after compaction at SWSA 5
General Low Radiation Level (Noncompactible)	<100 nCi/g TRU alpha <200 mrem/h beta-gamma[c]	Plastic bag Fiber carton Sealed wooden box Yellow can Yellow dumpster "Hot" truck	SWSA 6, in trench
^{233}U/TRU Waste (High Radiation Level)	>100 nCi/g TRU alpha[d] >200 mrem/h beta-gamma[c]	Sealed concrete cask Sealed special container Sealed metal box[e]	SWSA 5, in engineered cave
^{233}U/TRU Waste (Low Radiation Level)	>100 nCi/g TRU alpha[d] <200 mrem/h beta-gamma[c]	Sealed stainless drum[e] Sealed concrete cask Sealed metal box[e]	SWSA 5, in building, cave, or cell
^{235}U Waste	>1 g ^{235}U total or >1 g/ft^3 ^{235}U	Closed package Bulk	SWSA 6, in unlined auger hole or trench
Mixed Wastes	Combinations of those listed above	Container appropriate for most hazardous waste component	Disposal appropriate for most hazardous waste component
Low-Hazard	No measurable contamination but believed to be above "green tag" limits[f]	Plastic can Dumpster Trench	SWSA 6, special area
Nonradioactive			
Hazardous Waste	Uncontaminated chemicals toxic materials, pyrophoric materials, carcinogenic agents, etc.	Specified for each case[g]	On-site or off-site disposal specified for each case[g]

[a]For details of containers listed, see the ORNL Radioactive Solid Waste Operations Manual.
[b]Locations and descriptions of sites are provided in Chapter 2.0.
[c]Dose rate measured at the surface of unshielded container.
[d]As defined in the DOE Order 5820.2.
[e]Approved containers for transportation and implacement at the Waste Isolation Pilot Plant.
[f]"Green tag" limits are defined in Table 5.1.
[g]Specifications for container types and disposal guidelines can be found in the ORNL Environmental Protection Manual for numerous hazardous materials.

the ORNL Environmental Protection Manual. Guidance for other materials is to be developed as required. These guidelines provide for both on-site disposal and the use of off-site commercial disposal firms when appropriate. In all instances, the packaging, handling, transport, and disposal of SFMP generated hazardous wastes would be conducted according to the applicable national standards and ORNL procedures designed for safe isolation of these materials.

5.6 MATERIALS RECLAMATION POLICY

It is the policy at ORNL (as set forth in Standard Practice Procedure D-2-15) to make maximum utilization of serviceable material and equipment which are no longer needed by the program maintaining physical custody. Items to be considered for reclamation and reuse are defined as those which: (1) have monetary value exceeding their basic material content and (2) can be used through repair or rehabilitation at a cost which does not exceed 65% of new acquisition costs. As applied to the ORNL SFMP, these items could include equipment (i.e., pumps, lights, motors), piping and tanks, as well as complete structures.

It is the responsibility of the SFMP to identify those items that are excess to the needs of the program. Once identified, the ORNL Finance and Materials Division staff will evaluate the reclamation potential of each item and provide for the proper disposition of those materials deemed cost effective to reuse. The final disposition of such items must be conducted in a manner that assures compliance with ORNL radiation protection standards for contamination clearance, whether for in-plant reuse or for sale to the public. Details on these radiation guidelines can be found in the ORNL Health Physics Manual (Procedures 2.5 and 4.2).

In evaluation of the reuse potential for an entire structure, consideration must be given to the criteria for redesign and construction. The refurbished facility must be designed to meet current DOE requirements for containment that would be necessary for the reuse application, including the appropriate resistance to natural phenomena. The cost of redesign and construction would not be assumed by the SFMP, but must be considered during the decommissioning alternatives selection process (see Chapter 4.0).

5.7 CERTIFICATION CRITERIA

Performance criteria are necessary for certification of a site for release from the SFMP following decommissioning activities. Currently no specific guidance has been established by DOE concerning the certification of ORNL facilities. As a result, release criteria are being developed on a case-by-case basis rather than establishing overall guidelines. Such comprehensive program criteria will be determined and implemented as the program matures, as decommissioning experience is gained, and as national guidelines are established. In the interim, residual contamination limits used in the ORNL SFMP are being maintained consistent with Laboratory policies concerning radiation protection. A summary of the current release criteria, based on this guidance, is given in Table 5.3 and described below. Discussion of how these criteria are applied to project certification is provided in Chapter 3.0.

5.7.1 Restricted/Unrestricted Use Considerations

Due to the nature of the R&D activities conducted at ORNL and the potential for reuse of SFMP facilities in the conduct of nuclear-related programs, any criteria developed for certification

Table 5.3. Interim ORNL certification criteria for decommissioning of SFMP facilities

Site Use Category	Contamination Category	Limiting Value
Unrestricted Use	Equipment/Structure Surfaces:	
	Direct Reading α	300 dpm/100 cm^2
	Direct Reading $\beta-\gamma$	0.05 mrad/h
	Transferable α	20 dpm/100 cm^2
	Transferable $\beta-\gamma$ [a]	200 dpm/100 cm^2
	Water/Soil/Concrete:	
	Radionuclide Concentration	$(CG)_w$ [b]
	Air:	
	Radionuclide Concentration	$(CG)_a$ [c]
Restricted Use	Regulated or Contamination Zone	
	Direct Reading α	≥300 dpm/100 cm^2
	Direct Reading $\beta-\gamma$	≥0.25 mrad/h
	Transferable α	≥30 dpm/100 cm^2
	Transferable $\beta-\gamma$	≥1000 dpm/100 cm^2
	Radiation Zone	
	Direct Reading	>3.0 mrad/h
	Other Categories	d

[a] Applicable to all contaminants except ^{125}I, ^{129}I, and ^{227}Ac, for which the limiting value is 20 dpm/100 cm^2.

[b] $(CG)_w$ represents the recommended concentration guidelines for water as set forth in DOE 5480.1, for uncontrolled areas. For soil and concrete, these values are on a $\mu Ci/cm^3$ basis. By taking into account the density of the solid material, these values can be converted to pCi/g for comparative purposes.

[c] $(CG)_a$ represents the recommended concentration guidelines for air as set forth in DOE 5480.1, for uncontrolled areas.

[d] Certification criteria will be established on a case-by-case basis consistent with the proposed reuse and/or the surrounding environment. As a minimum, residual contamination levels must be consistent with the radiation protection guidelines for occupational exposures as summarized in Table 5.1.

of decommissioning work must consider the potential for restricted future use. While decontamination of facilities to allow unrestricted access may be necessary or desirable in certain instances, other projects may specify less extensive decommissioning actions, resulting in restrictions being placed on future use. Both options have their place in the ORNL SFMP management scheme.

Consideration must also be given to the location of SFMP facilities in relation to their surroundings. In some instances, sites to be decommissioned are located in areas where nuclear processing, waste treatment and disposal, or other hazardous operations are being conducted, which by association places restrictions on the reuse options for those D&D sites. Obviously, decontamination of such sites to background levels would be inconsistent with their surroundings and not cost effective. On the other hand, there are those facilities that if decontaminated to unrestricted levels, would provide much needed room for adjacent nonrestricted activities, or would return the area to a state compatible with its natural undisturbed surroundings. Analysis of these conditions will be made during the D&D planning stages for each facility to determine the decommissioning mode and the appropriate certification criteria.

Inherent in the application of certification criteria and the determination of the need for restricted or unrestricted considerations is the establishment of the physical boundaries of a project. Early in the planning stages, specific guidance will be obtained to define the area to which the certification criteria are to be applied.

5.7.2 Acceptable Residual Activity Levels

Limiting residual contamination levels have been established for interim use in the ORNL SFMP for equipment/structure surfaces, water, soil, concrete, and air (see Table 5.3). Specific limits are defined for unrestricted site access, with only general guidance given for restricted use. These criteria represent the basic guidelines for determining the adequacy of decommissioning efforts and may be supplemented by more extensive and/or restrictive limits on any particular SFMP project. As national standards are promulgated by the EPA or more detailed analysis is undertaken as part of the ORNL SFMP, these criteria will be revised to reflect such input.

For unrestricted site use, surface contamination limits have been specified that are consistent with the ORNL guidelines for declaring items "free of radiation or contamination hazard" prior to their handling or reuse. Water and air concentration guidelines are the same as those specified for normal ORNL operations in uncontrolled areas. The basis for soil and concrete residual activity limits, however, is not so easily obtainable. No ORNL guidelines currently exist for definition of acceptable concentrations of radionuclides in soil or concrete, for either controlled or uncontrolled areas. But because such guidance is critical to the performance of decommissioning activities, preliminary criteria have been established to assist in D&D planning.

The unrestricted-use limits listed in Table 5.3 for soil and concrete are the same, numerically, as those for water (uncontrolled areas). Such comparison with permissible levels in water may at first seem inconsistent; however, the rationale for choosing these limits stems from consideration of potential environmental transport of the residual activity. For most radionuclides, the primary mode for long-term release from a soil or concrete matrix would be through water-based leaching. Atmospheric resuspension would normally play only a minor role. Therefore, by limiting concentrations remaining in soil or concrete to levels that, even under hypothetical immediate release conditions (complete water mixing), are acceptable for uncontrolled exposures, the basic criteria for public health and safety can be assured. Although it is recognized that using these interim water-based criteria for other materials may prove to be overly conservative, these limits ensure adequate health protection until more definitive guidance is obtained or developed. To convert the water concentration values (μCi/ml) to more standard terms (weight-based) for soil and concrete analyses (pCi/g), the density (g/cm^3) of the material must be considered. For instance, for ^{90}Sr concentrations in soil, the limiting value would be computed as follows:

$$\frac{(\mathrm{CG})_w \times (\text{activity conversion factor})}{(\text{soil density})} = \text{Limit value}$$

$$\frac{(4 \times 10^{-5}\ \mu\mathrm{Ci/ml\ for\ insoluble\ }^{90}\mathrm{Sr}) \times (10^6\ \mathrm{pCi/Ci})}{(1.3\ \mathrm{g/cm^3\ avg})\ (1\ \mathrm{cm^3/1\ ml})} = 30\ \mathrm{pCi/g}$$

Similar limits for unrestricted releases can be computed for all individual radionuclides for which water standards exist, as well as for mixtures of nuclides as defined in the DOE standards.

For restricted use conditions, the corresponding certification criteria would have to be developed on a case-by-case basis. Depending upon the reuse application (i.e., nuclear-related work) and/or the surrounding environmental conditions (adjacent to contaminated operating areas), significantly different residual activity levels could be acceptable. Specific limits have been documented at ORNL for establishment of contamination, radiation, and regulated zones. These limits (see Table 4.3) can also be used to define the certification criteria for reuse applications. Decontaminating a facility to regulated- or even radiation-zone conditions will place restrictions on the reuse potential, but are certainly acceptable end-points for decommissioning operations, considering the future facility needs of the Laboratory. For some restricted use categories (such as soils) acceptable residual activity levels may need to be based on ambient levels, rather than specifying limits for a more undisturbed setting. In such cases, however, certification guidelines would still be required to meet the current ORNL occupational radiation protection standards.

6.0 PROJECT DESCRIPTIONS

6.0 PROJECT DESCRIPTIONS

Project summaries have been developed and are presented in Appendix I for each of the ORNL SFMP facilities currently included in the program. These summaries provide brief descriptions of the facility history and current conditions, as well as outline the proposed decommissioning plans. The project descriptions are presented according to their program category (Defense or Civilian) and administrative grouping, as given in Table 6.1. Projects have been defined as single facilities or as groups of facilities, where appropriate (i.e., several waste storage tanks in a single tank farm). Sixteen project summaries have been provided to cover the current inventory of 76 SFMP facilities.

Each project summary contains four general categories of information in a standardized format, as depicted in Fig. 6.1. These categories are defined as follows:

Project Summary—An information block that identifies the (1) project name, (2) DOE field office with jurisdiction over the project, (3) contractor responsible for the project, (4) applicable DOE budget/reporting code and Field Task Proposal/Agreement (FTP/A) numbers, (5) project work breakdown structure (WBS) number assigned by the SFMPO in the DOE Program Plan,[1] (6) project priority ranking as determined by the contractor (with space allocated for subsequent rankings by DOE program levels), (7) proposed disposition mode for the project, (8) preliminary total estimated cost (TEC) for project completion, and (9) estimated project duration. The data presented for items 7–9 are based on information detailed in subsequent summary categories.

Facility Description—A brief discussion of the facility operating history, physical description, and current conditions. Information is included on the types of processes employed during facility operation, the structural characteristics of the site (including photographs and schematics), the radiological inventory and hazards associated with the facility, the current facility occupancy, any unusual conditions or special circumstances (including reuse considerations), and the identification of any routine maintenance and surveillance provided or major maintenance activities anticipated. The facility descriptions are based on historical information and preliminary site characterization studies, and represent the best available knowledge of facility conditions. Detailed radiological characterizations and engineering studies will be conducted, as required, to provide design data for project planning. Additional information on the maintenance and surveillance activities for each facility is provided in Ref. 2.

Proposed Facility Disposition—Identification of the disposition mode proposed for each facility and a description of the scope of the task. Based on preliminary decommissioning studies, a disposition mode has been recommended for initial consideration at each site. Final selection of the decommissioning alternatives would, of course, be determined as part of the alternatives assessment phase (including NEPA documentation) for each project as the time approaches for project initiation. The selected mode is identified as one or a combination of the four feasible alternatives discussed in Chapter 4.0, namely (1) Protective Storage, (2) Decontamination for Reuse, (3) Entombment, and

TABLE 6.1. ORNL SFMP project descriptions index

Program Category	Administrative Grouping	SFMP WBS No.	Project Title	Facilities	Page No.
Defense	Isotope	4.6.7	Metal Recovery Facility Decom.	Bldg. 3505, Waste Tanks W-19, W-20	I-3
		4.6.8	Fission Product Development Laboratory Cell Decom.	Bldg. 3517	I-11
	Reactor	4.6.14	ORNL Graphite Reactor Decom.	Bldgs. 3001, 3002, 3003 and 3018 Stack	I-17
	Radwaste	4.6.11	Waste Holding Basin Decom.	Basin 3513	I-25
		4.6.12	Old Hydrofracture Facility Decom.	Bldg. 7852, Bulk Storage Tanks, Waste Tanks T1-T4, T9, Waste Pit, Waste Pond, Pump House	I-31
		4.6.13	Gunite Waste Storage Tanks Decom.	Waste Tanks W5-W10	I-39
		4.6.18	Waste Storage Tanks Decom.	Waste Tanks W1-4, W11, W13-15, WC1, WC15, WC17, TH1-4	I-47
Civilian	Isotope	4.6.16	Storage Garden Decom.	Storage Garden 3033	I-55
		4.6.19	C-14 Process System Decom.	Bldg. 3033A	I-59
		4.6.20	Waste Evaporator Facility Decom.	Bldg. 3506	I-63
		4.6.21	Fission Product Pilot Plant Decom.	Bldg. 3515	I-69
		4.6.22	Shielded Transfer Tanks Decom.	Transfer Tanks RD-C-43, 44, 47, 48 and STT-Model III	I-75
	Reactor	4.6.6	Molten Salt Reactor Experiment Decom.	Bldgs. 7503, 7511, 7512, 7513, 7514	I-81
		4.6.10	Low Intensity Test Reactor Decom.	Bldgs. 3005, 3077, Retention Pond	I-91
		4.6.15	ORR Experimental Facilities Decom.	Bldgs. 3042: GCR A9-B9 Fac., Molten Salt Loop, Maritime Ship Reactor Loop, Pneumatic Tube Irradiation Facility, GCR Loops I and II; Bldg. 3087	I-97
		4.6.17	Homogeneous Reactor Experiment Decom.	Bldgs. 7500, 7502, 7558, 7554, 7561, Retention Pond, and Underground Waste Tanks (2)	I-105

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PROJECT ______________________________

FIELD OFFICE ______________ CONTRACTOR ______________

BUDGET AND REPORTING CODE ________ FT P/A NO. ________ SFMP WBS ________

	CONTRACTOR	FIELD OFFICE	SFMPO
PROJECT PRIORITY			

PROPOSED DISPOSITION MODE ______________________________

PRELIMINARY TEC ______________ ESTIMATED PROJECT DURATION ______________

FACILITY DESCRIPTION

a. OPERATING HISTORY
b. PHYSICAL DESCRIPTION
c. SAFETY/ENVIRONMENTAL CONSIDERATIONS
d. FACILITY MAINTENANCE AND SURVEILLANCE
e. UNIQUE CONDITIONS/REUSE CONSIDERATIONS

PROPOSED FACILITY DISPOSITION

a. ALTERNATIVE SELECTION
b. DECOMMISSIONING PLAN
   1. TECHNICAL PLAN
   2. SPECIAL EQUIPMENT AND TECHNIQUES
   3. COST, SCHEDULE AND WASTE VOLUME PROJECTIONS

PRIORITY DETERMINATION CONSIDERATIONS

PROJECT ______________________________ SFMP WBS ______________

Fig. 6.1. Format for Project Summaries.

(4) Dismantlement. Brief discussion of the decommissioning plan is provided, including a statement of the project objectives, a listing of the primary decommissioning tasks, and an outline of the technical work plan. Any special facility or equipment needs, R&D requirements, or potentially salvageable materials (including stainless steel) are identified as part of this discussion. Waste disposal volumes are projected according to year of generation, type of material (soil, rubble, liquid), and waste classification [low-level waste (LLW), process waste, and transuranic wastes (TRU)].

Project decommissioning schedules and order of magnitude cost estimates are provided by project year, rather than calendar year, allowing for subsequent integration for the whole program. Cost and schedule estimates include project planning, engineering, site decommissioning and project close out. Costs are given in constant FY 1985 first quarter dollars unless otherwise noted.

Priority Determination Considerations—A discussion of the information relevant to the project priority determination, including special site characteristics, health and safety concerns or programmatic considerations. The basis for the actual assignment of project priorities is detailed in Chapter 7.0.

Additional, more detailed, information on each of the ORNL SFMP projects is available upon request through the ORNL SFMP Office. The document record included as Appendix II provides a listing of the currently available documentation for each site. Table 6.2 gives a brief summary of the project data included in the Appendix I project descriptions. Project costs, schedules and waste generation rates are integrated for the entire program in Chapter 8.0.

Table 6.2. ORNL SFMP project description summary

	Project[a]	Facility Type	Service Dates	Facility Status	Proposed Disposition Mode[b,c]	Preliminary TEC[c] ($ × 10^3)	Estimated Project Duration[c]	Special Considerations
Defense Program								
4.6.7	Metal Recovery Facility Decom.	Pilot Reprocessing Plant	1952-1960	Inactive/portion occupied	Decontamination for Reuse	$6,300	6 years	Reuse acceptability will be determined after cell decontamination is underway.
4.6.8	Fission Product Development Laboratory Cell Decom.	Full scale fission product recovery plant	1958-1975	Cells inactive/ remainder of facility operational	Decontamination for Reuse	$3,100	6 years	Maintenance and surveillance costs are significant; only inactive cells to be decommissioned.
4.6.11	Waste Holding Basin Decom.	Unlined open pond	1944-1977	Inactive/used as environmental study plot	Entombment	$7,200	5 years	Over 1 million gal of contaminated sludge remain in pond. Pond is open and unlined.
4.6.12	Old Hydro-fracture Facility Decom.	Deep-well injection facility for LLW	1964-1980	Inactive	Entombment	$2,900	5 years	Significant residual radioactivity in pond and tanks; location may influence disposition mode.
4.6.13	Gunite Waste Storage Tanks Decom.	Concrete LLW collection tanks	1943-1978	Inactive	Entombment	$5,700	4 years	Tanks have high potential for short-term reuse.
4.6.14	ORNL Graphite Reactor Decom.	Air-cooled, graphite moderated 3.6 MW reactor	1943-1963	Inactive/portions occupied	Passive Protective Storage	$8,000	4 years	Site registered as a National Historical Landmark.
4.6.18	Waste Storage Tanks Decom.	Concrete and S.S. LLW collection tanks	1943-1970	Inactive	Dismantlement	$8,500	7 years	Tanks of various sizes and uses located throughout the ORNL Bethel Valley area. Contain varying amounts of residual liquid and sludge.
Civilian Program								
4.6.6	Molten Salt Reactor Experiment Decom.	Homogeneous-fueled 8 MW reactor	1965-1969	Inactive/portions occupied	Fuel Disposal, Facility Entombment	$30,000	10 years	Uranium fuel remains on-site and will require disposal prior to facility decommissioning.
4.6.10	Low-Intensity Test Reactor Decom.	3 MW water cooled test reactor	1951-1968	Inactive/portions occupied	Dismantlement	$4,500	5 years	Location and structural condition limits decommissioning options.

Table 6.2. ORNL SFMP project description summary (continued)

	Project[a]	Facility Type	Service Dates	Facility Status	Proposed Disposition Mode[b,c]	Preliminary TEC[c] ($ × 10^3)	Estimated Project Duration[c]	Special Considerations
4.6.15	ORR Experimental Facilities Decom.	Six test loops and a heat exchanger	1958-1973	Inactive/reactor is operational	Dismantlement	$5,500	5 years	Experimental areas have potential for reuse.
4.6.16	Storage Garden Decom.	Subsurface storage wells	1946-1975	Inactive	Entombment	$60	<1 year	Limited reuse potential.
4.6.17	Homogeneous Reactor Exp. Decom.	5 MW aqueous homogeneous reactor	1957-1961	Inactive/portions occupied	Entombment	$14,500	6 years	Associated waste retention pond will require separate entombment[b].
4.6.19	C-14 Process System Decom.	Laboratory for C-14 production	1956-1975	Inactive/ partially Dismantled	Passive Protective Storage	$0	0	Facility is in stabilized condition requiring minimal routine surveillance.
4.6.20	Waste Evaporator Facility Decom.	Concentrator for LLW	1949-1954	Inactive/ partially Dismantled	Dismantlement	$650	2 years	Limited reuse potential; location will influence disposition mode.
4.6.21	Fission Product Pilot Plant Decom.	Pilot fission product recovery plant	1948-1958	Inactive/ partially entombed	Dismantlement	$1,100	3 years	Significant residual radioactivity in partially entombed structure.
4.6.22	Shielded Transfer Tanks Decom.	Transportable tanks for ^{137}Cs-loaded resins	1958-1970	Inactive	Entombment/ Disposal	$500	1 year	Remaining resins must be immobilized by in-situ grouting prior to burial.

[a]Listed by WBS number. Project priorities are defined in Chapter 7.0.
[b]Disposition mode recommended for initial consideration. Detailed assessments and NEPA documentation will be performed prior to final determination of project disposition.
[c]See Appendix I for details.

7.0 PROJECT PRIORITIZATION

7.0. PROJECT PRIORITIZATION

Because of the large number of surplus facilities maintained at ORNL and the limited funding that is available to perform final disposition tasks, decommissioning priorities must be established in order to make the best use of these resources. Guidance has been provided by the DOE SFMP, as part of the Program Plan,[1,8] for assessment of project characteristics to determine the relative ranking of projects in terms of:

- DOE legal and contractual obligations,
- Economic impacts of delayed versus immediate decommissioning,
- Health risks of delayed decommissioning,
- Future site plans,
- Cost effective program management, and
- Other special factors unique to individual projects.

The results of such assessments are to be used to maintain a priority listing of ORNL SFMP facilities and to provide for appropriate placement of new projects within the priority list.

7.1 METHODOLOGY FOR ESTABLISHING DECOMMISSIONING PRIORITIES

For establishment of ORNL SFMP project priorities, five assessment categories have been defined that incorporate the factors identified by DOE as important to project ranking. These categories include: (1) Legal Obligations, (2) Economic Considerations, (3) Health Risks, (4) Programmatic Concerns, and (5) Cost Effectiveness. Brief descriptions of each of these prioritization categories are provided in the sections to follow. For each category, analyses are conducted to determine the relative ranking of individual decommissioning projects according to the established criteria for that category. The results of these category rankings are then combined into an overall ranking utilizing appropriate weighting factors. The details of this final ranking are provided along with the results of the prioritization process for the ORNL SFMP facilities in Section 7.2.

7.1.1 Legal Obligations

The DOE and its contractors (ORNL) are required to provide adequate protection for their workers, the general public and the environment. Such requirements are specified in the applicable DOE Orders, as well as rules and regulations promulgated by the NRC, EPA, DOT, and local and State governments (see Appendix III). These safety obligations are considered the greatest concern within the SFMP and every effort is taken to assure that the facilities in the program pose no unacceptable safety risks. In light of the importance of this obligation, the routine maintenance and surveillance tasks for ORNL surplus facilities are given the highest priority. The ORNL SFMP will apply funds first to facility maintenance and surveillance, then to program management, with any remaining resources utilized to perform final facility disposition.

Should an ORNL SFMP facility be in a condition that violates a legal requirement or DOE safety standard, correction of the deficiency will be assigned a high priority and available maintenance and surveillance funds utilized. If an unsafe condition can be corrected only by initiation of a decommissioning project, then the ORNL SFMP will request funding for that project ahead of all others.

7.1.2 Economic Considerations

To determine the appropriate timing for facility decommissioning, economic considerations must be evaluated. In general, such considerations relate to the tradeoff between the cost of continued maintenance and surveillance, and the cost of final facility disposition. To aid in this assessment, the SFMP has developed an economic analysis model that utilizes a monetary discounting technique to calculate the "present value" costs associated with facility maintenance and surveillance as well as for decommissioning.[8] The objective of this model is to provide a method for determining if immediate or delayed decommissioning results in the lowest overall cost to the government.

The three major elements evaluated in the SFMP model are: (1) the annual maintenance and surveillance costs, plus any anticipated major repair costs, (2) total facility decommissioning costs, and (3) the value of any reuse of facilities, equipment or land. A discount rate of 1.2% was determined to be appropriate for use with SFMP projects, and is used to calculate the present value of each of the three major cost elements. In the economic analysis, yearly maintenance and surveillance costs are discounted and summed over a 25-year evaluation period, with discounted major repair costs added to the appropriate year. The project decommissioning costs are then discounted at periodic evaluation intervals beginning with immediate decommissioning, followed by delayed decommissioning project starts at 5-year intervals. The decommissioning costs at the delayed intervals include the maintenance and surveillance costs until the project is initiated. Any known equipment or facility reuse values are deducted from the cost of decommissioning prior to discounting the costs.

The results of the economic modeling provide a direct comparison of total facility disposition costs (M&S plus decommissioning) at 5-year intervals. Economic considerations would place higher priorities on projects where immediate decommissioning (0–5 years) was less costly than delayed decommissioning.

7.1.3 Health Risks

Inherent with the long-term management and decommissioning of radioactively contaminated facilities is the risk of worker and public exposures to the residual radioactive materials. Even though routine maintenance and surveillance of SFMP facilities is provided to minimize these risks during the protective storage mode, the potential exists for unforeseen structural failures, natural catastrophies (earthquakes, tornadoes), or other uncontrolled releases. In addition, there can be significant risks associated with the decommissioning activities themselves, due to radiation/contamination levels, the presence of other hazardous materials, and/or the normal industrial hazards of building dismantlement.

In order to establish a basis for project comparisons concerning health risks, the ORNL SFMP has conducted a preliminary risk assessment for each project in the current inventory of facilities.[9] This assessment included a generalized pathway analysis to determine the potential public and occupational exposures based on current facility conditions. This analysis was based on realistic exposure scenarios, not the worst case. Based on these assessments, relative rankings of projects were provided for use in project prioritization.

7.1.4 Programmatic Concerns

This assessment category covers a wide range of both quantifiable and subjective decommissioning considerations, including:

- ORNL Site Land Use Plans,
- Facility Reuse Potential,
- Interactions with Other ORNL Programs,
- Impacts on Waste Disposal Systems,
- Unique Research and Development Opportunities,
- Availability of Key Personnel, and
- Public Acceptance of Activities.

Analysis of such concerns does not lend itself to modeling efforts or other quantification. Therefore, evaluation of these factors was performed by a committee of ORNL Program and Division Managers who have responsibilities in the areas listed above. Summaries of the project characteristics were used for input to the committee decisions, including the results of the economic and risk assessments. No attempt was made to quantify the committee results into a numerical project ranking; rather, the projects were simply grouped into categories of high, medium, or low priority. Further breakdown of rank was to be provided through incorporation of the results of the other priority assessments.

7.1.5 Cost Effectiveness

Cost effective program management involves the optimum use of available manpower and other resources to perform the required task. For SFMP decommissioning projects, good management practices would include establishing and maintaining a trained decommissioning crew, providing levelized funding from year to year to avoid loss of trained personnel, initiating projects to make use of available key personnel, and concurrent or sequential scheduling of similar projects or projects in the same location. However, incorporation of these management goals into project priorities is not straightforward and in many cases requires subjective decisions. To aid in comparisons between projects, groupings have been made that identify projects that require the same basic expertise or decommissioning crews. Sequencing of projects within these groupings can then be used to aid in establishment of overall priorities. Levelizing the annual program funding to maintain these basic crews then becomes a matter of shifting project start dates to accommodate a reasonable staffing level.

7.2 ORNL SFMP PROJECT PRIORITIES

Based on the methodology outlined above, project priorities for each of the 16 ORNL SFMP decommissioning projects have been established and are presented in Table 7.1. Analysis results for

Table 7.1. ORNL SFMP project priorities

	Project	Program	Priority assessment categories								Totals	Project priority
			Programmatic concerns		Economic considerations[a]		Health risks[b]		Cost effectiveness			
			Ranking	Comment	Result	Rank (x 5)	Result	Rank (x 3)	Grouping	Rank (X 2)		
4.6.8	Fission Product Development Laboratory	Defense	High	High potential for reuse	I	1	H/M	2	Isotope	1	13	1
4.6.7	Metal Recovery Facility	Defense	High	High levels of contamination in a deteriorating structure	I/D	2	H	1	Isotope	1	15	2
4.6.12	Old Hydrofracture Facility	Defense	High	Environmental concern over open pond	I/D	2	H	1	Radwaste	3	19	3
4.6.6	Molten Salt Reactor Experiment	Civilian	High	Complex, long-term project requiring available key personnel	D	3	H/M	2	Reactor	2	25	4
4.6.11	Waste Holding Basin	Defense	High	Environmental concern over open pond	D	3	H/M	2	Radwaste	3	27	5
4.6.18	Waste Storage Tanks	Defense	Medium	Environmental concern and high land reuse potential	D	3	H/M	2	Radwaste	1	23	6
4.6.17	Homogeneous Reactor Experiment	Civilian	Medium	Environmental concern over pond and other outlying areas	D	3	M/H	3	Reactor	2	28	7
4.6.21	Fission Product Pilot Plant	Civilian	Medium	Contamination source in central area	I/D	2	M	4	Isotope	3	28	8
4.6.20	Waste Evaporator Facility	Civilian	Medium	Contamination source in central area	I/D	2	M	4	Isotope	3	28	9
4.6.13	Gunite Storage Tanks	Defense	Medium	High potential for interim reuse	D	3	M/H	3	Radwaste	3	30	10

Table 7.1. ORNL SFMP project priorities (continued)

	Project	Program	Programmatic concerns: Ranking	Programmatic concerns: Comment	Economic considerations[a]: Result	Economic considerations[a]: Rank (x 5)	Health risks[b]: Result	Health risks[b]: Rank (x 3)	Cost effectiveness: Grouping	Cost effectiveness: Rank (X 2)	Totals	Project priority
4.6.14	ORNL Graphite Reactor	Defense	Low	National Historic Landmark; building occupied	I	1	M/L	5	Reactor	1	22	11
4.6.10	Low Intensity Test Reactor	Civilian	Low	Low-levels of contamination in a contained structure	I/D	2	M	4	Reactor	2	26	12
4.6.16	Storage Garden	Civilian	Low	Minimal contamination or M&S costs	I/D	2	L	6	Isotope	4	36	13
4.6.15	ORR Experimental Facilities	Civilian	Low	Low potential for near-term facility reuse	D	3	L	6	Reactor	3	39	14
4.6.22	Shielded Transfer Tanks	Civilian	Low	Well-contained source in restricted area	D	3	L	6	Isotope	4	41	15
4.6.19	C-14 Process System	Civilian	Low	No further decommissioning necessary	D	3	L	6	Isotope	4	41	16

[a]Results given as (I)-Immediate or (D)-Delayed decommissioning, or as (I/D) if analysis did not significantly favor one over the other.
[b]Results given as relative rankings of (H)-High, (H/M)-High-Medium, (M/H)-Medium-High, (M)-Medium, (M/L)-Medium-Low, or (L)-Low.

each of the priority assessment categories (except Legal Obligations) are also summarized in this table. The Legal Obligations are to be met through the highest priority SFMP task, facility maintenance and surveillance. The relative weightings assigned to each assessment category were based on guidance set forth in the DOE SFMP Program Plan,[1] with Programmatic Concerns used only to make broad groupings of projects. It should be recognized, however, that because this ranking process depends on so many factors, some of which are highly subjective, the overall process itself is largely subjective. The numerical totals, therefore, indicate only relative differences and should not be used to imply quantitative differences between projects.

As listed in Table 7.1, the highest priority decommissioning projects for the ORNL SFMP are the Metal Recovery Facility (MRF), the Fission Product Development Laboratory (FPDL), the Molten Salt Reactor Experiment (MSRE), the Old Hyrofracture Facility, and the Waste Holding Basin. Brief descriptions of these projects have already been provided in Section 3.3.1 with the decommissioning details included in Appendix I. The two highest priority projects, the MRF and FPDL, are similar in that both are being decontaminated for potential reuse and have significant levels of residual radioactivity. These projects are taking advantage of available experienced personnel and complement each other by utilizing the same general types of decontamination crews. This symbiotic relationship is further enhanced since the FPDL work involves significant personnel exposures, while the MRF decontamination is basically non-exposure, allowing for shifting of personnel from one job to the other. The results of the economic analysis for both projects indicated a need for immediate decommissioning, although the case is much stronger for the FPDL due to high routine maintenance and surveillance costs.

The Molten Salt Reactor Experiment (MSRE) Decommissioning Project is unique in that the fuel still remains with the reactor. This aspect of the project drives the need for initiation of decommissioning activities. Disposal of the fuel will be a significant undertaking, equivalent to if not greater than the decommissioning of the reactor itself. A team of key personnel knowledgeable about the MSRE fuel characteristics and reactor operations is currently available, but as time passes, this expertise will be gone, resulting in an increase in project costs due to the need for retraining. Early use of this expertise in project planning, especially for fuel salt disposition, is essential. Actual facility decommissioning efforts could, however, be delayed as long as the current containment system is judged adequate.

The Old Hydrofracture Facility and Waste Holding Basin both contain open, contaminated ponds that are driving the need for early decommissioning. Environmental concerns over potential releases from these ponds have been expressed by the State of Tennessee, and a request made for action to eliminate these potential contamination sources. Such action could involve interim stabilization of the pond sites or may require complete facility decommissioning to alleviate these concerns.

Those projects listed as medium or low priority will be reevaluated on an annual basis, and as high priority tasks are completed, as additional funds become available, or as programmatic concerns change, the rankings will be adjusted to allow for project initiation. The current schedule for completion of all of the ORNL SFMP projects based on the reference priority listing is provided in Chapter 8.0.

8.0 PROGRAM COST, SCHEDULE AND WASTE VOLUME PROJECTIONS

8.0 PROGRAM COST, SCHEDULE, AND WASTE VOLUME PROJECTIONS

A comprehensive long-range schedule and cost estimate for ORNL SFMP decommissioning activities has been developed based on the project descriptions provided in Appendix I and the project prioritization documented in Chapter 7.0. This schedule, presented in Fig. 8.1, outlines the scope of the program for fiscal years 1985–2005 and includes preliminary estimates of the program costs and radioactive waste generation rates. Program costs (including both operating and capital expenditures) are given in first quarter FY 1985 dollars. The project schedules summarized in Fig. 8.1 are in general agreement with the detailed schedules presented in Appendix I, with only minor adjustments made where required to yield a levelized program. The summary schedules include all project related activities, from initial characterization work to final project reporting. Waste volume projections are given by year of expected generation, according to the two primary categories of solid and liquid radioactive waste. The near term (5 year) program cost and schedule projections should be considered reliable, with outyear estimates based only on the current projections of future facility conditions and program directions. Significant changes in ORNL SFMP responsibilities and subsequent project priorities can be anticipated in the future.

As highlighted in Fig. 8.1, final disposition of the current inventory of surplus ORNL facilities will require on the order of 20 years of dedicated operations. Resource requirements are expected to increase in a step-wise fashion during the next 5 years of the program, ultimately resulting in a fairly levelized work force on decommissioning activities. Continuation of work beyond the scheduled endpoint or additional resource needs in the outyears would be dependent upon the availability of funds and the addition of projects into the ORNL SFMP. The total, estimated cost (unescalated) for decommissioning of ORNL facilities is approximately $103 million.

Decommissioning project costs over the next 5 years are projected to be associated primarily with completion of the Fission Product Development Laboratory and Metal Recovery Facility decontamination efforts. In addition, according to the proposed schedule, characterization and assessment work would be initiated in FY 1985 for the pond at the Old Hydrofracture Facility and the Waste Holding Basin, with actual decommissioning efforts conducted in later years (FY 1987–1991). Preliminary assessment and planning of fuel and facility disposition at the Molten Salt Reactor Experiment has been proposed for FY 1985 and 1986. Actual process development and onsite work has been specified for a later time period, when the regulatory picture concerning this atypical spent fuel form is better defined and more disposal options are available. The early planning efforts proposed for the MSRE are necessary in order to make use of knowledgeable personnel that are presently available, but who would not be when the decommissioning project actually got under way.

Facilities maintenance and surveillance will continue to be the highest priority for the program. although funding levels will continue to decrease in outyears as decommissioning projects are initiated. With the current inventory of facilities and the proposed decommissioning schedule, maintenance and surveillance funds would be expected to decrease from a high of $480,000 in FY 1985, to $85,000 in FY 2000, the last year of M&S needs.

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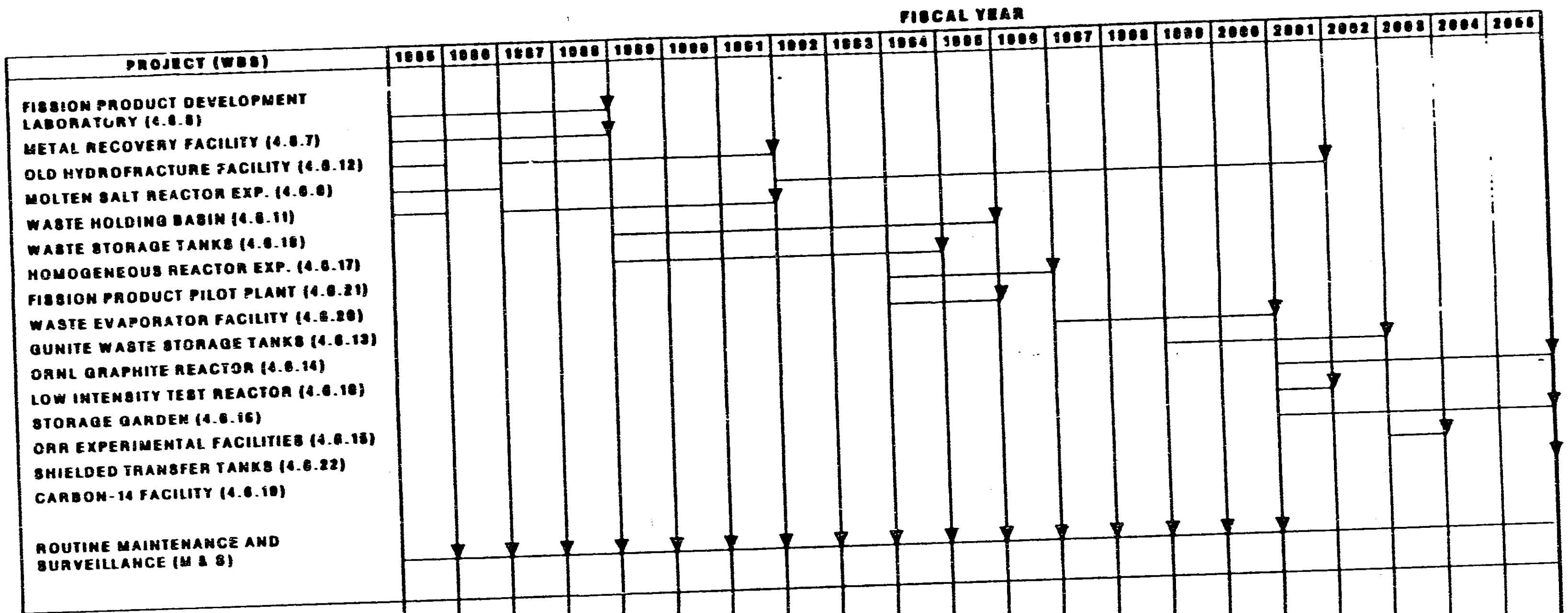

ESTIMATED COST ($X10³)	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
DEFENSE PROGRAM																					
EXPENSE M & S	190	300	225	225	290	175	175	175	175	175	150	150	135	135	---	---	---	---	---	---	---
EXPENSE PROJECTS	1680	1955	2685	2955	2270	3320	3195	2960	2870	840	570	---	200	600	2815	3700	3700	2560	---	---	---
CAPITAL EQUIPMENT	260	190	25	25	175	405	255	25	25	25	10	---	---	---	25	25	50	25	---	---	---
SUBTOTAL	2130	2445	2935	3205	2735	3900	3625	3150	3070	1040	730	150	335	735	2840	3725	3750	2585	0	0	0
CIVILIAN PROGRAM																					
EXPENSE M & S	290	310	305	320	345	230	230	125	125	110	85	85	85	85	85	85	---	---	---	---	---
EXPENSE PROJECTS	100	100	---	---	350	1040	2185	4450	4375	5560	3295	5075	5500	5450	4000	2300	945	1560	3520	2710	1920
CAPITAL EQUIPMENT	---	---	---	---	---	---	20	85	130	165	910	210	110	100	260	100	---	10	120	90	150
SUBTOTAL	390	410	305	320	695	1270	2435	4670	4630	5835	4290	5370	5695	5635	4345	2485	945	1570	3640	2800	2070
TOTAL PROGRAM COST ($X10³)																					
EXPENSE	2260	2665	3215	3500	3255	4765	5785	7710	7545	6685	4100	5310	5920	6270	6900	6085	4645	4120	3520	2710	1920
CAPITAL EQUIPMENT	260	190	25	25	175	405	275	110	155	190	920	210	110	100	285	125	50	35	120	90	150
GRAND TOTAL	2520	2855	3240	3525	3430	5170	6060	7820	7700	6875	5020	5520	6030	6370	7185	6210	4695	4155	3640	2800	2070

Fig. 8.1. ORNL SFMP schedule and cost projections.

8.0 PROGRAM COST, SCHEDULE, AND WASTE VOLUME PROJECTIONS

A comprehensive long-range schedule and cost estimate for ORNL SFMP decommissioning activities has been developed based on the project descriptions provided in Appendix I and the project prioritization documented in Chapter 7.0. This schedule, presented in Fig. 8.1, outlines the scope of the program for fiscal years 1985–2005 and includes preliminary estimates of the program costs and radioactive waste generation rates. Program costs (including both operating and capital expenditures) are given in first quarter FY 1985 dollars. The project schedules summarized in Fig. 8.1 are in general agreement with the detailed schedules presented in Appendix I, with only minor adjustments made where required to yield a levelized program. The summary schedules include all project related activities, from initial characterization work to final project reporting. Waste volume projections are given by year of expected generation, according to the two primary categories of solid and liquid radioactive waste. The near term (5 year) program cost and schedule projections should be considered reliable, with outyear estimates based only on the current projections of future facility conditions and program directions. Significant changes in ORNL SFMP responsibilities and subsequent project priorities can be anticipated in the future.

As highlighted in Fig. 8.1, final disposition of the current inventory of surplus ORNL facilities will require on the order of 20 years of dedicated operations. Resource requirements are expected to increase in a step-wise fashion during the next 5 years of the program, ultimately resulting in a fairly levelized work force on decommissioning activities. Continuation of work beyond the scheduled endpoint or additional resource needs in the outyears would be dependent upon the availability of funds and the addition of projects into the ORNL SFMP. The total, estimated cost (unescalated) for decommissioning of ORNL facilities is approximately $103 million.

Decommissioning project costs over the next 5 years are projected to be associated primarily with completion of the Fission Product Development Laboratory and Metal Recovery Facility decontamination efforts. In addition, according to the proposed schedule, characterization and assessment work would be initiated in FY 1985 for the pond at the Old Hydrofracture Facility and the Waste Holding Basin, with actual decommissioning efforts conducted in later years (FY 1987-1991) Preliminary assessment and planning of fuel and facility disposition at the Molten Salt Reactor Experiment has been proposed for FY 1985 and 1986. Actual process development and onsite work has been specified for a later time period, when the regulatory picture concerning this atypical spent fuel form is better defined and more disposal options are available. The early planning efforts proposed for the MSRE are necessary in order to make use of knowledgeable personnel that are presently available, but who would not be when the decommissioning project actually got under way.

Facilities maintenance and surveillance will continue to be the highest priority for the program although funding levels will continue to decrease in outyears as decommissioning projects are initiated. With the current inventory of facilities and the proposed decommissioning schedule, maintenance and surveillance funds would be expected to decrease from a high of $480,000 in FY 1985, to $85,000 in FY 2000, the last year of M&S needs.

PROJECT (WBS)	1985	1986	1987	1988	1989	19
FISSION PRODUCT DEVELOPMENT LABORATORY (4.6.8)						
METAL RECOVERY FACILITY (4.6.7)						
OLD HYDROFRACTURE FACILITY (4.6.12)						
MOLTEN SALT REACTOR EXP. (4.6.6)						
WASTE HOLDING BASIN (4.6.11)						
WASTE STORAGE TANKS (4.6.18)						
HOMOGENEOUS REACTOR EXP. (4.6.17)						
FISSION PRODUCT PILOT PLANT (4.6.21)						
WASTE EVAPORATOR FACILITY (4.6.20)						
GUNITE WASTE STORAGE TANKS (4.6.13)						
ORNL GRAPHITE REACTOR (4.6.14)						
LOW INTENSITY TEST REACTOR (4.6.10)						
STORAGE GARDEN (4.6.16)						
ORR EXPERIMENTAL FACILITIES (4.6.15)						
SHIELDED TRANSFER TANKS (4.6.22)						
CARBON-14 FACILITY (4.6.19)						
ROUTINE MAINTENANCE AND SURVEILLANCE (M & S)						

ESTIMATED COST ($X10^3)	1985	1986	1987	1988	1989	19
DEFENSE PROGRAM						
EXPENSE M & S	190	390	225	225	290	1
EXPENSE PROJECTS	1680	1955	2685	2955	2270	33
CAPITAL EQUIPMENT	260	100	25	25	175	4
SUBTOTAL	2130	2445	2935	3205	2735	3
CIVILIAN PROGRAM						
EXPENSE M & S	290	310	305	320	345	[illegible]
EXPENSE PROJECTS	100	100	---	---	350	10
CAPITAL EQUIPMENT	---	---	---	---	---	-
SUBTOTAL	390	410	305	320	695	12
TOTAL PROGRAM COST ($X10^3)						
EXPENSE	2260	2755	3215	3500	3255	47
CAPITAL EQUIPMENT	260	100	25	25	175	4
GRAND TOTAL	2520	2855	3240	3525	3430	51

Fig. 8.1

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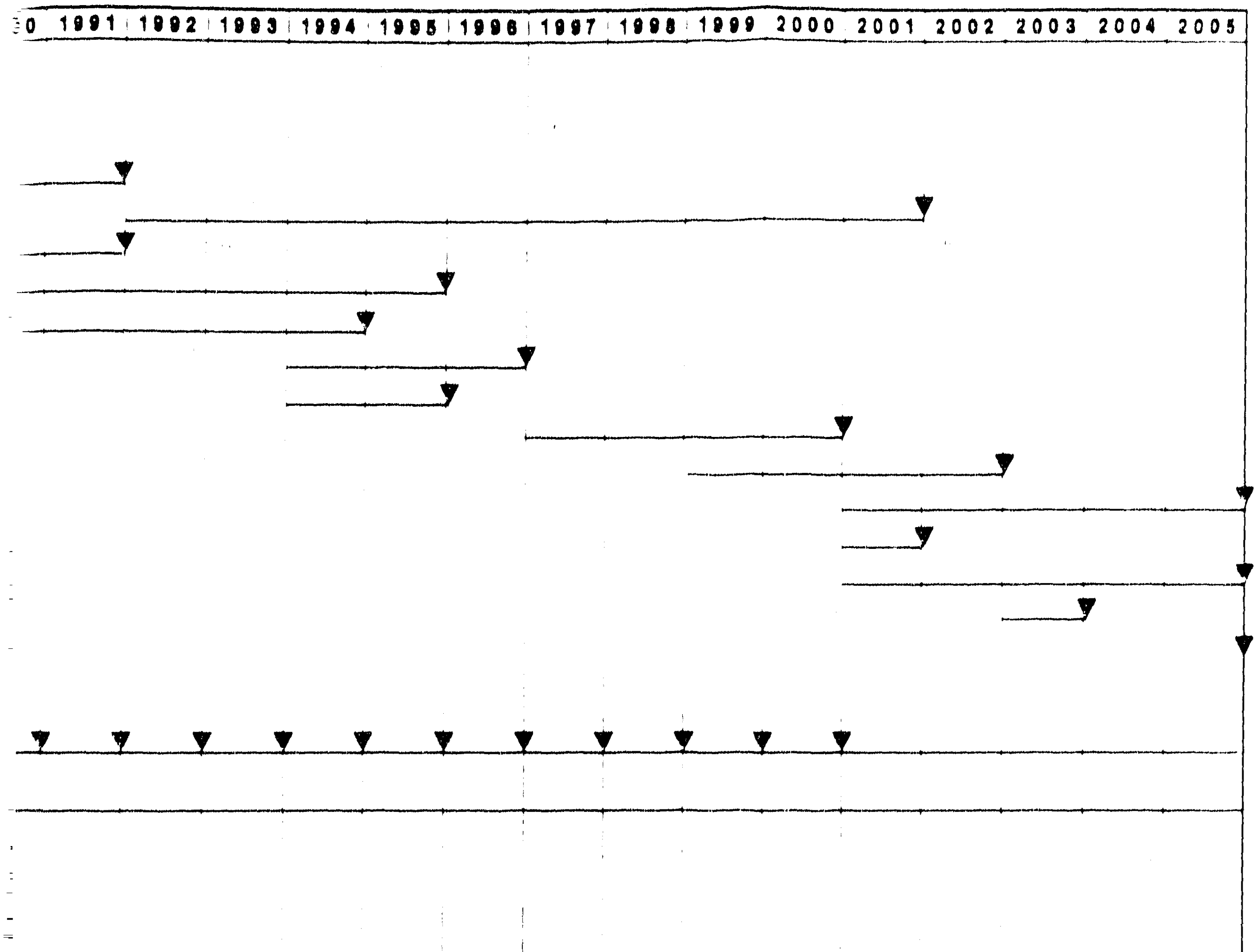


…0	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
5	175	175	175	175	150	150	135	135	---	---	---	---	---	---	---
0	3195	2950	2870	840	570	---	200	600	2815	3700	3700	2560	---	---	---
5	255	25	25	25	10	---	---	---	25	25	50	25	---	---	---
0	3625	3150	3070	1040	730	150	335	735	2840	3725	3750	2585	0	0	0
0	230	125	125	110	85	85	85	85	85	85	---	---	---	---	---
0	2185	4460	4375	5560	3295	5075	5500	5450	4000	2300	945	1560	3520	2710	1920
-	20	85	130	165	910	210	110	100	260	100	---	10	120	90	150
0	2435	4670	4630	58[illegible]5	4290	5370	5695	5635	4345	2485	945	1570	3640	2800	2070
5	5785	7710	7545	6685	4100	5310	5920	6270	6900	6085	4645	4120	3520	2710	1920
5	275	110	155	190	920	210	110	100	285	125	50	35	120	90	150
0	6060	7820	7700	6875	5020	5520	6030	6370	7185	6210	4695	4155	3640	2800	2070

…ORNL SFMP schedule and cost projections.

Capital equipment requirements will be highly dependent upon the decommissioning alternatives chosen and the engineering designs developed. Hence, the current estimate of approximately $3.9 million for the total program represents only a "best guess" at this point in time. Equipment requests for the next four years appear to be reasonable for the proposed activities and should serve adequately for planning purposes.

The waste volume projections for the program (Table 8.1) point to the significant impacts that decommissioning activities will have on the ORNL waste disposal systems during the next 20 years. Although the annual waste generation rates are not expected to result in any major disruptions of routine activities, the total volume of solid waste (2.3×10^4 m^3) represents a significant allocation of the available on-site storage and disposal space. The waste projections, like the cost and schedules, are, of course, highly dependent upon the ultimate methods of facility disposition and may change appreciably in the future years of the program.

Table 8.1. ORNL SFMP decommissioning waste volume projections

Waste Type		Waste Volume Projections by Fiscal Year (m^3)																					Category Totals
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	
Solid Radioactive Waste																							
Soil	(LLW)	-	-	-	15	-	200	130	4560	4610	670	695	430	-	-	3000	3000	-	-	25	-	20	17,355
	(TRU)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rubble	(LLW)	10	10	-	25	85	125	-	65	80	90	400	570	-	-	100	100	10	1055	-	200	85	3010
	(TRU)	-	5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
Metal	(LLW)	110	110	35	105	35	20	10	30	35	25	5	5	50	50	150	150	160	70	255	105	105	1620
	(TRU)	5	5	-	-	-	-	-	-	-	-	-	-	25	25	25	25	25	-	-	30	5	170
Misc.	(LLW)	10	10	10	15	-	300	110	25	25	95	310	5	75	75	75	75	90	60	-	5	-	1370
	(TRU)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Solid Total	(LLW)	130	130	45	160	120	645	250	4680	4750	880	1410	1010	125	125	3325	3325	260	1185	280	310	210	23,355
	(TRU)	5	10	5	-	-	-	-	-	-	-	-	-	25	25	25	25	25	-	-	30	5	180
Liquid Radioactive Waste																							
Process Waste		-	15	20	5	-	-	75	-	-	-	-	-	5	5	-	5	5	-	-	-	-	135
LLW		60	115	115	40	-	20	200	550	610	305	745	200	15	15	850	850	90	70	5	125	125	5105

9.0 REFERENCES

9.0 REFERENCES

1. U.S. Department of Energy, *Surplus Facilities Management Program–Program Plan FY 1984–1988,* Richland Operations Office, October 1983; RLO/SFM-83-12.

2. J. H. Coobs and T. E. Myrick, *The ORNL Surplus Facilities Management Program Maintenance and Surveillance Plan for Fiscal Year 1984,* June 1983, private communication.

3. J. W. Boyle, et al., *Environmental Analysis of the Operation of Oak Ridge National Laboratory (X-10 Site),* November 1982; ORNL-5870.

4. B. M. Eisenhower, et al., *Current Waste Management Practices and Operations at Oak Ridge National Laboratory,* September 1982; ORNL-5917.

5. Oak Ridge National Laboratory, *Trends and Balances, ORNL 1983–1988,* January 1983; ORNL/PPA-83/1.

6. F. C. Fitzpatrick, *Oak Ridge National Laboratory Site Data for Safety Analysis Reports,* December 1982; ORNL/ENG/TM-19.

7. U.S. Environmental Protection Agency, "Environmental Standards for the Management and Disposal of Spent Fuel, High-Level and Transuranic Radioactive Wastes, Proposed Rule, 40 CFR Part 191," Federal Register, 47, (Pt 191), 250 (December 29, 1982).

8. U.S. Department of Energy, *Surplus Facilities Management Program–Methodology for Establishing Decommissioning Priorities,* Richland Operations Office, June 1982; RLO/SFM-82-7.

9. H. M. Braunstein, W. F. Ohnesorge, and T. W. Oakes, *Preliminary Assessment for Decommissioning Surplus Facilities at ORNL: Environmental and Health Risks,* September 1984, private communication.

APPENDIX
PROJECT DESCRIPTIONS

APPENDIX I

PROJECT DESCRIPTIONS

TABLE I.1. ORNL SFMP project descriptions index

Program Category	Administrative Grouping	SFMP WBS No.	Project Title	Facilities	Page No.
Defense	Isotope	4.6.7	Metal Recovery Facility Decom.	Bldg. 3505, Waste Tanks W-19, W-20	I-3
		4.6.8	Fission Product Development Laboratory Cell Decom.	Bldg. 3517	I-11
	Reactor	4.6.14	ORNL Graphite Reactor Decom.	Bldgs. 3001, 3002, 3003 and 3018 Stack	I-17
	Radwaste	4.6.11	Waste Holding Basin Decom.	Basin 3513	I-25
		4.6.12	Old Hydrofracture Facility Decom.	Bldg. 7852, Bulk Storage Tanks, Waste Tanks T1-T4, T9, Waste Pit, Waste Pond, Pump House	I-31
		4.6.13	Gunite Waste Storage Tanks Decom.	Waste Tanks W5-W10	I-39
		4.6.18	Waste Storage Tanks Decom.	Waste Tanks W1-4, W11, W13-15, WC1, WC15, WC17, TH1-4	I-47
Civilian	Isotope	4.6.16	Storage Garden Decom.	Storage Garden 3033	I-55
		4.6.19	C-14 Process System Decom.	Bldg. 3033A	I-59
		4.6.20	Waste Evaporator Facility Decom.	Bldg. 3506	I-63
		4.6.21	Fission Product Pilot Plant Decom.	Bldg. 3515	I-69
		4.6.22	Shielded Transfer Tanks Decom.	Transfer Tanks RD-C-43, 44, 47, 48 and STT-Model III	I-75
	Reactor	4.6.6	Molten Salt Reactor Experiment Decom.	Bldgs. 7503, 7511, 7512, 7513, 7514	I-81
		4.6.10	Low Intensity Test Reactor Decom.	Bldgs. 3005, 3077, Retention Pond	I-91
		4.6.15	ORR Experimental Facilities Decom.	Bldgs. 3042: GCR A9-B9 Fac., Molten Salt Loop, Maritime Ship Reactor Loop, Pneumatic Tube Irradiation Facility, GCR Loops I and II; Bldg. 3087	I-97
		4.6.17	Homogeneous Reactor Experiment Decom.	Bldgs. 7500, 7502, 7558, 7554, 7561, Retention Pond, and Underground Waste Tanks (2)	I-105

PROJECT Metal Recovery Facility Decommissioning
FIELD OFFICE Oak Ridge **CONTRACTOR** Martin Marietta (ORNL)
BUDGET AND REPORTING CODE AR 05 10 10 **FTP/A NO.** ONL-WD12 **SFMP WBS** 4.6.7
CONTRACTOR FIELD OFFICE SFMPO

PROJECT PRIORITY 2
PROPOSED DISPOSITION MODE Decontamination for Reuse
PRELIMINARY TEC $6,300 K **ESTIMATED PROJECT DURATION** 6 years

FACILITY DESCRIPTION

a. *Operating History.* The Metal Recovery Facility (MRF) was a small-scale production reprocessing plant, originally constructed in 1951 for the recovery of uranium from fuel and waste solutions, utilizing a modified Purex Process. The facility was later found to be extremely useful for recovering uranium, plutonium, neptunium, americium and other miscellaneous materials from a variety of low-burnup reactor fuels and other special feed materials. During the nine years of operation (1952-1960), some 25 separate processing campaigns were conducted at the MRF, yielding approximately 320 metric tons of uranium, 140 kg of plutonium, 1.3 metric tons of neptunium, and 55 kg of americium.

b. *Physical Description.* The MRF consists of Building 3505, an adjacent below-grade canal, and two nearby buried waste tanks (Fig. I.1). The building is basically a one-story, steel siding structure (Fig. I.2) constructed around seven above-grade concrete process cells and a below-grade dissolver tank pit. A series of operating galleries surround the cells and pit, along with various personnel areas. The process cells still contain a variety of tanks, process columns, and assorted piping, samplers, and instrumentation. The facility has few special features for contamination control, although it does have a cell ventilation system. The canal (Fig. I.3) is a 14-ft-deep water-filled concrete basin that was utilized for storage and handling of fuel slugs. Waste tanks W-19 and W-20 are both of 2,250 gal capacity and are located below grade approximately 50 ft east of the building.

c. *Safety/Environmental Considerations.* The conditions of the building structure, process cells, canal, dissolver pit and waste tanks are generally known, although direct access to some of these areas has been limited over the past 20 years. As would be expected, the process cells, dissolver pit, and canal are the primary radiation hazards associated with the facility. These areas contain the majority of the abandoned contaminated process equipment and exhibit significant levels of both alpha and beta-gamma contamination, with isolated spots in almost every cell exceeding 500,000 dpm/100 cm^2 direct alpha and beta-gamma dose rates in one cell of 400 mrad/h. Samples from the cell walls and floors indicate the presence of significant transuranic contamination.

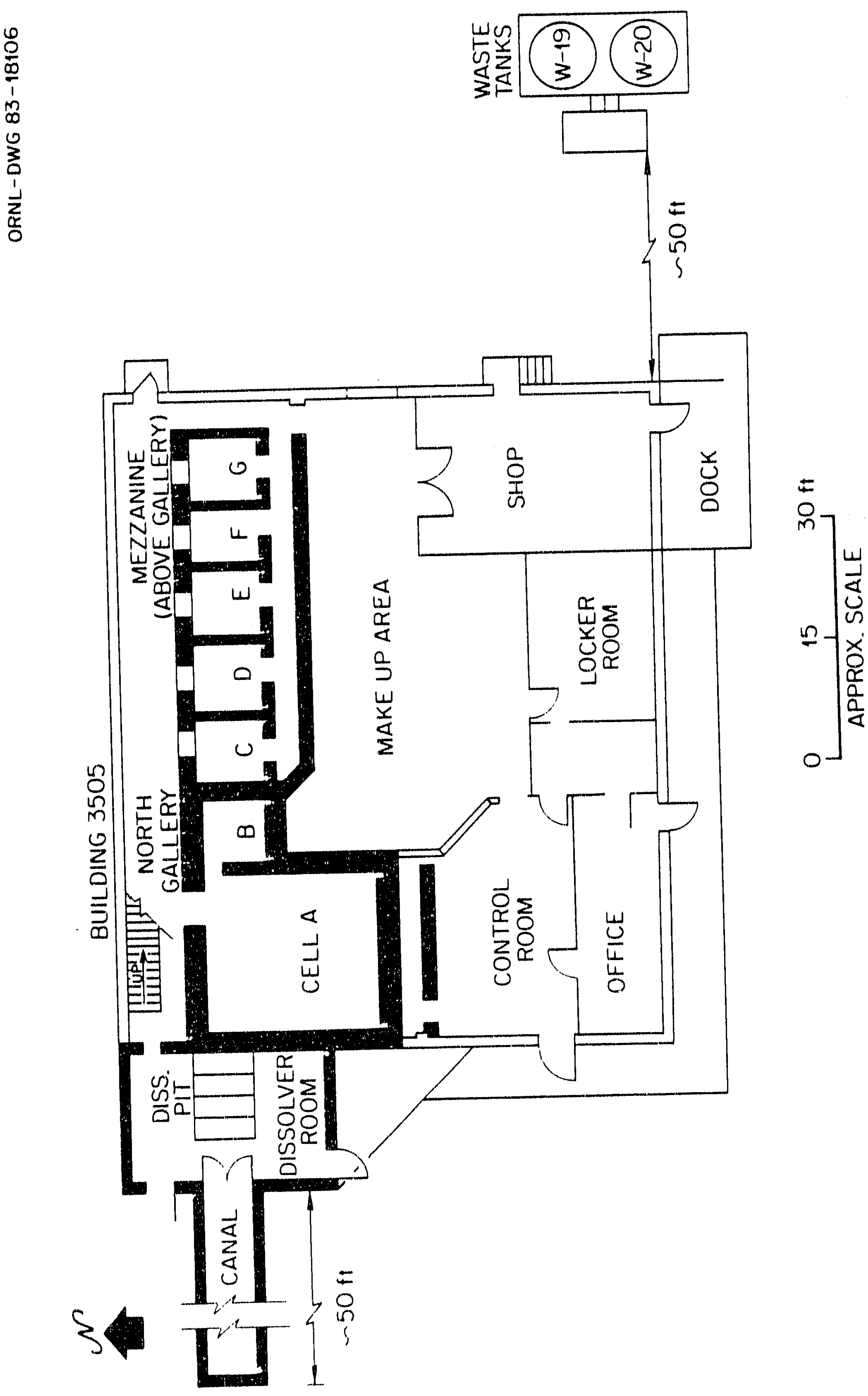


Fig. I.1. Schematic of the Metal Recovery Facility.

ORNL-PHOTO 3271-79

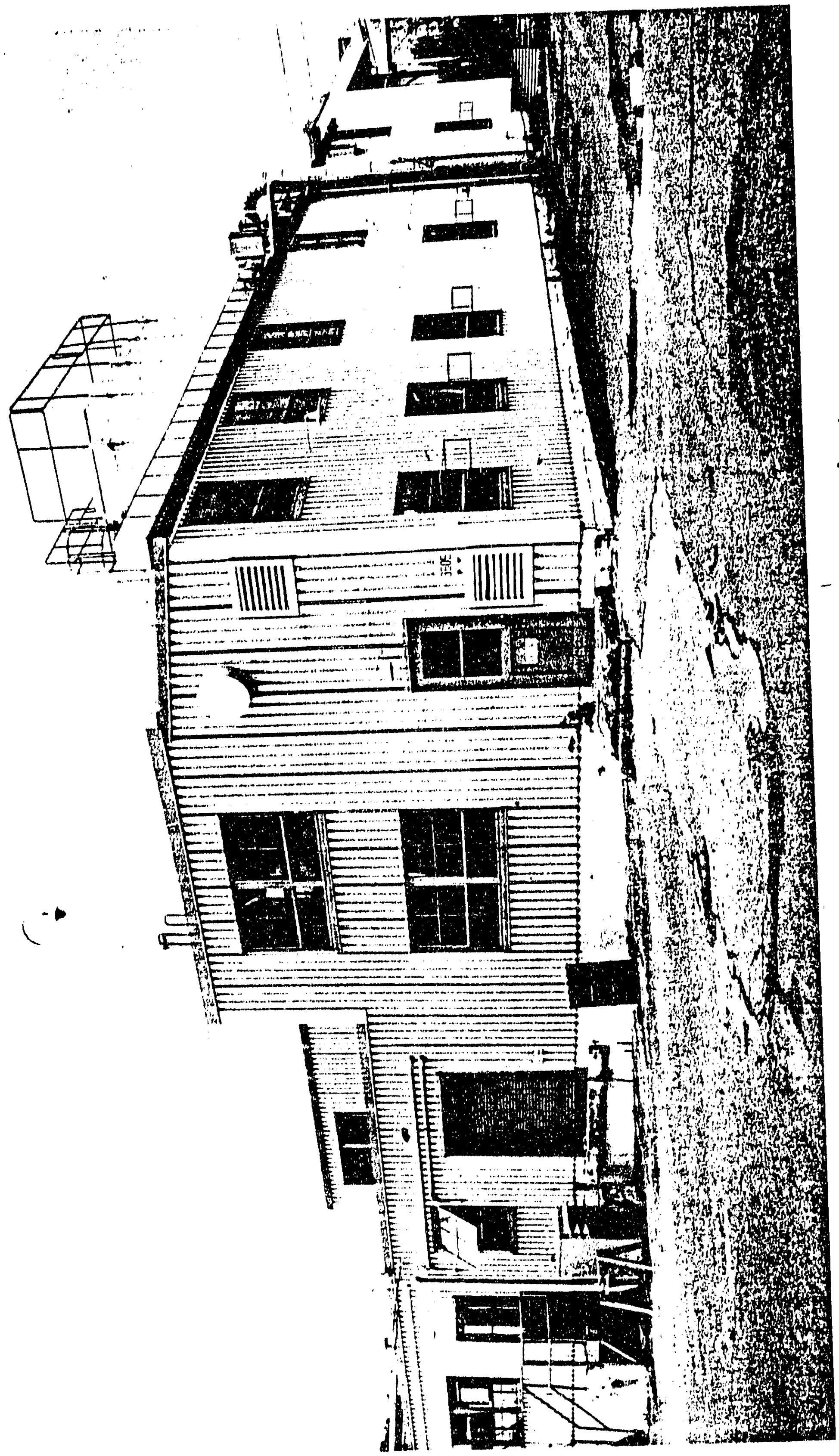


Fig. I.2. View of the Metal Recovery Facility from the northeast.

ORNL-PHOTO 3273-79

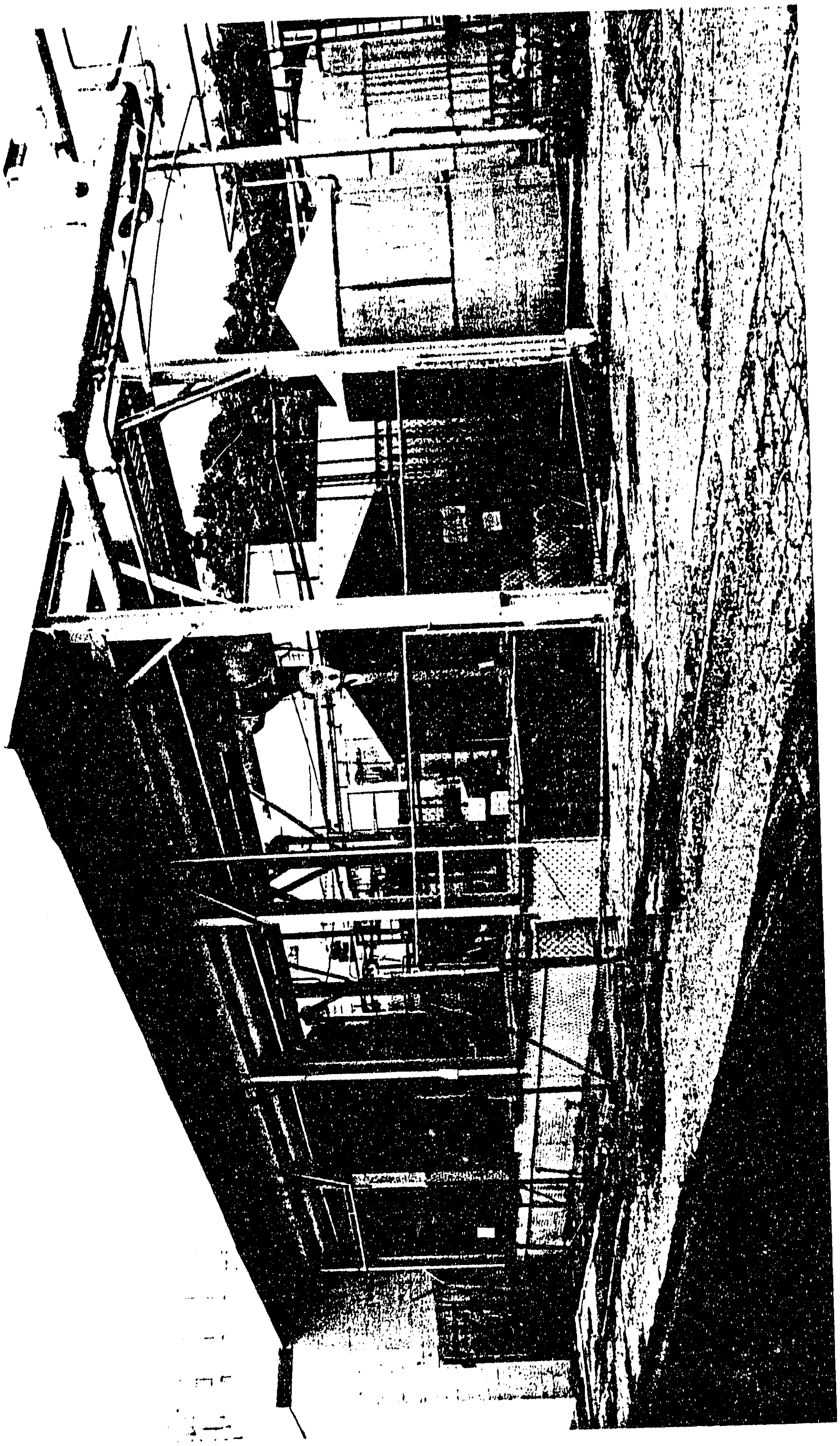


Fig. I.3. View of the Metal Recovery Facility canal area.

The canal and dissolver pit walls are also heavily contaminated with alpha and beta-gamma emitters. Dose rates in the canal range from 1 to 100 rad/h. The remainder of Building 3505 and the surrounding grounds do not represent appreciable radiation hazards, although the buried waste tanks are known to be internally contaminated. Initial estimates of the radionuclide inventory of the MRF are 10 Ci of ^{90}Sr and ^{137}Cs and 1 Ci of $^{238,239}Pu$.

d. ***Facility Maintenance and Surveillance.*** Since being accepted into the SFMP in 1976, the MRF has been maintained to ensure adequate containment of the residual radioactive materials. A comprehensive maintenance and surveillance program was instituted to provide routine cell inspections, ventilation system checks, health physics monitoring, and safety inspections. Preventive maintenance and major repairs to the cell roof hatches, cell doors, canal covers, and building roof have been provided as required. The surveillance program requires an estimated 0.5 man-year of effort annually. Due to the abandoned state of the facility, however, structural degradation continues.

e. ***Unique Conditions/Reuse Considerations.*** In its present condition, with light cell roof construction and hatches opening directly to the environment, the MRF provides inadequate containment for processing radioactive materials. Hence, the potential for reuse of this facility for nuclear materials processing is negligible without significant refurbishment. However, the structure itself is sound and if the cells and supporting areas were decontaminated, the facility has a high potential for reuse for low-level or non-radioactive applications, due to its location, available services and operating areas.

PROPOSED FACILITY DISPOSITION

a. ***Alternative Selection.*** Due to the potential for future use of the MRF by other programs, the disposition mode selected is Decontamination for Reuse. No plans are being made at the present time for complete dismantlement of the building. Entombment of the canal and removal of the associated waste tanks have been specified to isolate the hazards associated with these ancillary facilities. If, as the facility decontamination efforts are nearing completion, it becomes obvious that the remaining facilities are unsuitable for future occupancy due to structural deficiencies or radiological hazards, then a program for complete facility dismantlement would be required.

b. ***Decommissioning Plan.***

1. ***Technical Plan.*** The primary objectives of the proposed MRF decontamination efforts are to remove all excess contaminated equipment from the facility, decontaminate the remaining facility to acceptable levels for reuse, and then to place the facility in a safe storage mode awaiting other applications. To accomplish these goals, five major tasks have been proposed: (1) preparation of the abandoned facility for initiation of decommissioning activities, (2) removal of all excess equipment from the process cells and operating areas of the building, (3) decontamination of facility surfaces to levels appropriate for reuse, (4) entombment of the canal and dissolver pit, and (5) removal of the abandoned waste storage tanks.

   In order to allow use of the Building 3505 facilities for support of its own decommissioning, a general upgrading and reconditioning of the structures, services and ventilation system will be required as part of the first task. Equipment removal will be initiated after sufficient building containment has been provided for handling and transfer of the contaminated equipment. The majority of the in-cell equipment and all out-cell equipment would be dismantled in-place, segmented as feasible and appropriately disposed. Once the equipment has been removed, cell and building decontamination will be accomplished through the use of scarification, vacuum blasting and chemical washing techniques. After decontamination is completed, cell surfaces will be sealed and the cells placed in a standby condition. For the canal and dissolver pit, a preparatory phase will be conducted that will place the basins in a standby mode with all internal equipment removed and the current radiation hazards eliminated. The second phase of operations would involve permanent entombment of the basins with concrete and other structural materials. The waste tanks W-19 and W-20 would be completely excavated and the tanks, associated jet pit, and contaminated soil disposed of as LLW.

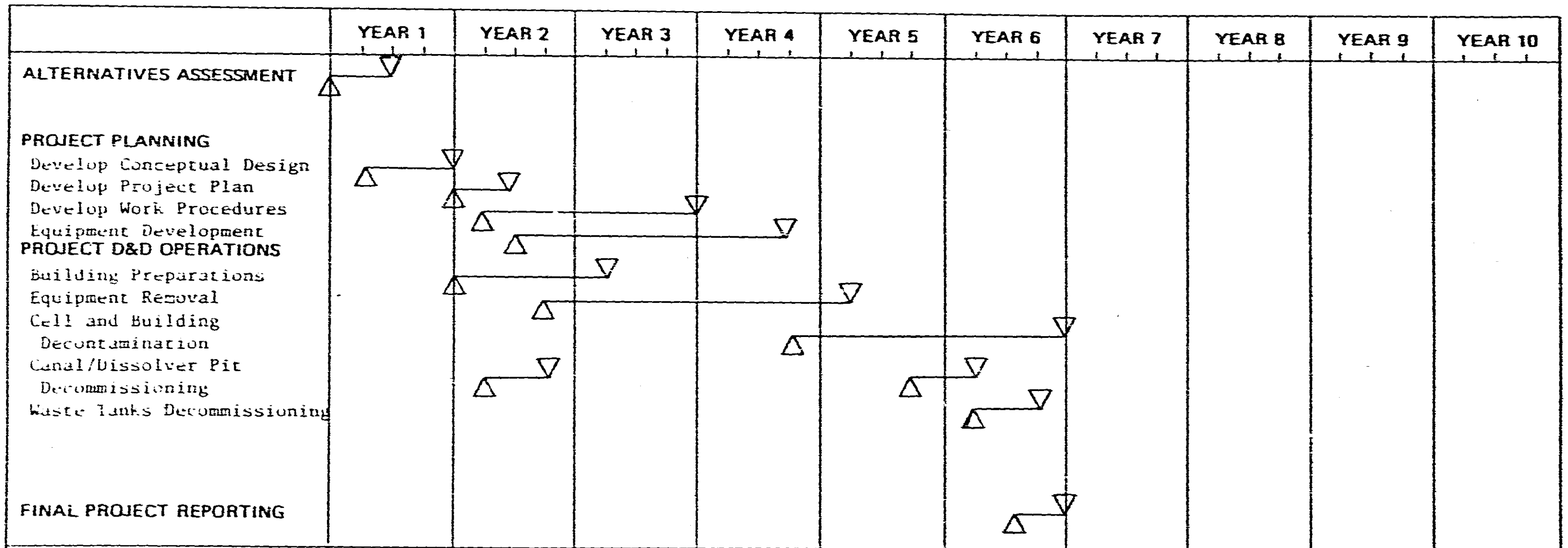
2. ***Special Equipment and Techniques.*** The proposed decommissioning activities at the MRF are in most instances routine procedures for ORNL operations. Hence, most of the facilities and equipment that will be required for these types of operations are readily available. However, three areas have been identified where special equipment and/or techniques will be necessary in order to meet the project objectives. These areas include: (1) upgrading the cell ventilation system with portable, reusable, standalone ventilation units connecting to the present ductwork, (2) segmenting the contaminated equipment and concrete structure using an ultra-high-pressure water jet abrasive cutting system, and (3) decontaminating cell and building surfaces, utilizing vacuum blasting or ultra-high-pressure water jet scarification techniques.

3. ***Cost, Schedule and Waste Volume Projections.*** A summary of the project schedule, estimated costs and waste disposal requirements for the proposed MRF decommissioning is provided in Fig. I.4. Project planning, equipment development, on-site D&D operations and project closeout are estimated to extend over a period of approximately six years, at a total estimated cost of \$6.3 million (including capital equipment). Approximately 1×10^5 gal (380 m^3) of liquid radioactive waste and 1×10^4 ft^3 (330 m^3) of solid radioactive waste will require appropriate handling and disposal. No significant volume of low-contamination-level stainless steel will be generated.

PRIORITY DETERMINATION CONSIDERATIONS

The lack of secondary containment for the facility, its gradually deteriorating structural condition and the suitability of the facility for potential near-term reuse make early decommissioning of the MRF attractive.

ORNL-DWG 83-14840R2



PROJECT COSTS ($K) *	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6
Annual Expense	250	445	855	1290	1460	1460
Capital Equipment	–	155	260	100	25	25
Total	250	600	1115	1390	1485	1485

WASTE VOLUME PROJECTIONS	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6
Solid (m^3)						
Soil (LLW)	–	–	–	–	–	15
(TRU)	–	–	–	–	–	–
Rubble (LLW)	–	5	10	10	–	25
(TRU)	–	–	–	2	5	–
Metal (LLW)	–	35	80	80	–	35
(TRU)	–	1	5	3	–	–
Misc. (LLW)	–	10	5	5	5	10
(TRU)	–	–	–	–	–	–
Total (LLW)	0	50	95	95	5	85
(TRU)	0	1	5	5	5	–
Liquid (m^3)						
Process Waste	0	0	0	15	20	5
LLW	0	190	0	55	75	20

*Costs given in year of expenditure dollars beginning in FY 1983.

Fig. I.4. Metal Recovery Facility decommissioning project summary.

PROJECT Fission Product Development Laboratory Cell Decommissioning
FIELD OFFICE Oak Ridge **CONTRACTOR** Martin Marietta (ORNL)
BUDGET AND REPORTING CODE AR 05 10 10 **FTP/A NO.** ONL-WD05 **SFMP WBS** 4.6.8

	CONTRACTOR	FIELD OFFICE	SFMPO
PROJECT PRIORITY	1		

PROPOSED DISPOSITION MODE Decontamination for Reuse
PRELIMINARY TEC $3,100 K **ESTIMATED PROJECT DURATION** 6 years

FACILITY DESCRIPTION

a. ***Operating History.*** The Fission Product Development Laboratory Cell Decommissioning (FPDL) was originally designed and constructed in 1958 to separate kilocurie quantities of ^{137}Cs, ^{90}Sr, ^{144}Ce, and ^{147}Pm from Redox- and Purex-type waste streams. The facility was modified in 1963 to allow production of megacurie amounts of ^{137}Cs, ^{90}Sr, and ^{144}Ce, primarily for use in the Atomic Energy Commission's Systems for Nuclear Auxiliary Power (SNAP) Program. At the conclusion of this program in 1975, the facility was placed in standby condition and initial decontamination efforts undertaken. Since that time, portions of the facility have been reactivated for additional fission product processing and for use as ORNL's decontamination facility.

b. ***Physical Description.*** The FPDL (Building 3517) consists of 23 large-volume, stainless steel lined, concrete-shielded hot cells with associated manipulator galleries and operating areas (Fig. I.5). The facilities are enclosed in a reinforced concrete, steel, and brick structure with adjacent below-grade tank farm cells (Fig. I.6). The FPDL contains a cell ventilation and off-gas system, a process chilled water system, radiation and contamination monitoring systems, general building services, and a process waste and LLW collection system. Decontamination facilities consisting of a vibratory finisher and electropolishing unit have been installed for general plant use.

c. ***Safety/Environmental Considerations.*** The conditions of the inactive cells are generally known, although direct cell access has been limited over the past 10 years. The process cells contain an array of contaminated tanks, piping, samplers, services, and instrumentation. Background radiation levels in these inactive cells are in the range of 1–100 rad/h, with isolated hot spots of 100–1000 rad/h. The inactive manipulator cells contain a variety of solid wastes, obsolete equipment, and residual cesium and strontium powder. Due to the presence of this powder, radiation levels exceeding 10^6 rad/h are found in some of these cells. As evidenced by the radiation levels observed in the inactive cells, significant quantities of residual radioactive materials remain in the facility (estimated at 1000 curies each of ^{90}Sr and ^{137}Cs).

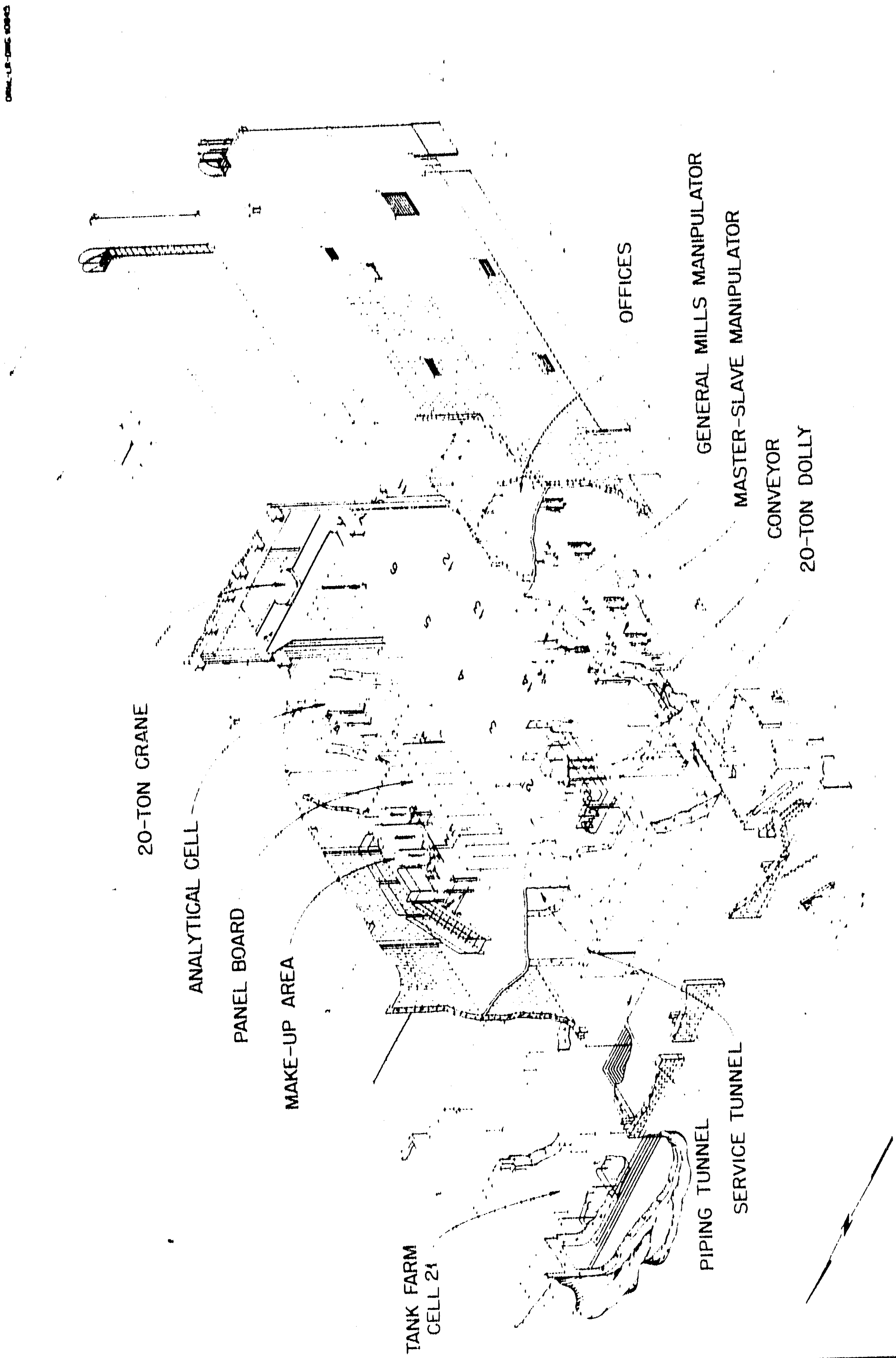


Fig. I.5. Isometric view of the Fission Product Development Laboratory.

ORNL-PHOTO 62847

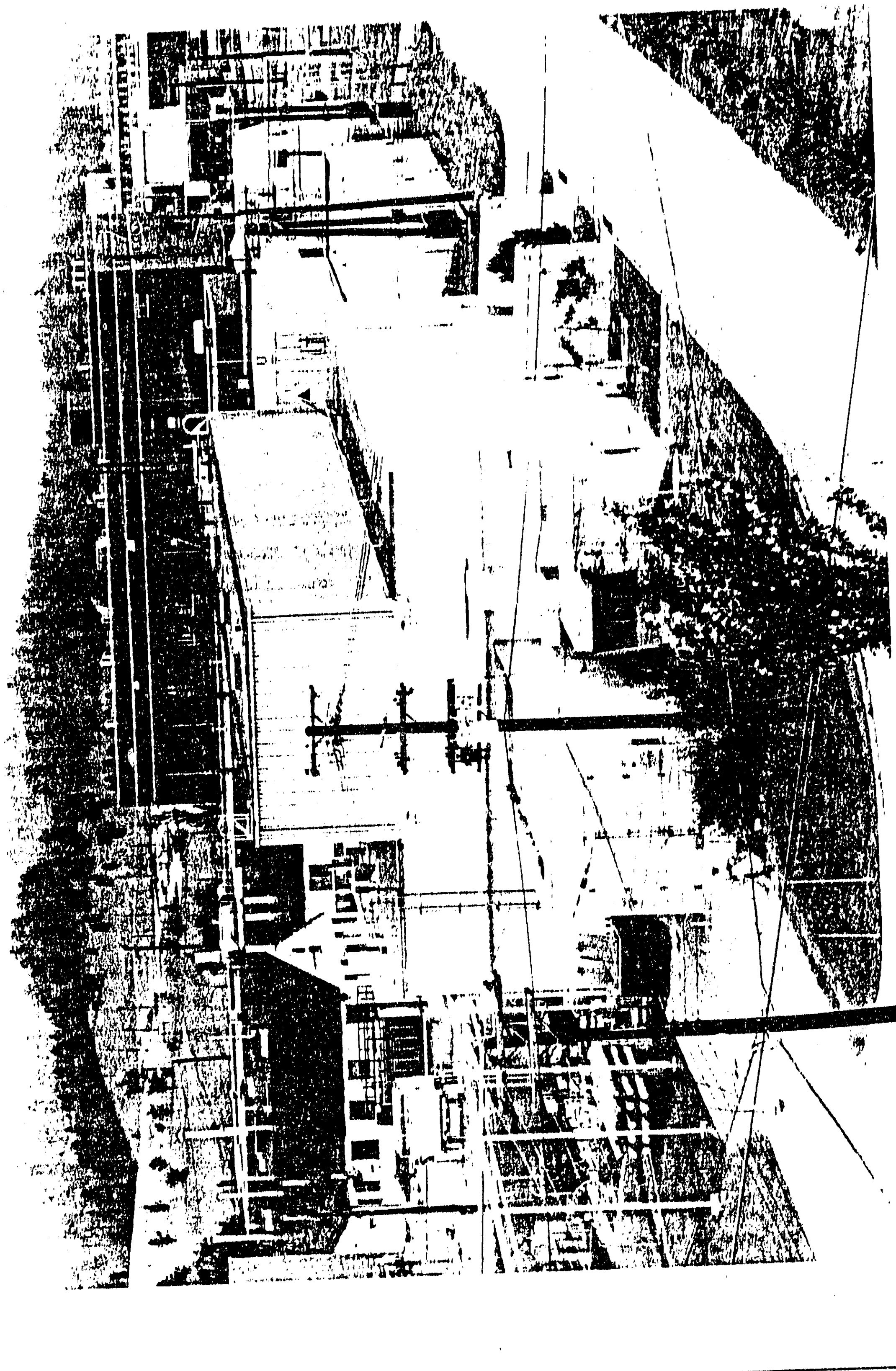


Fig. I.6. The Fission Product Development Laboratory.

d. ***Facility Maintenance and Surveillance.*** Adequate controls have been provided to assure containment of residual contamination through a comprehensive facility maintenance and surveillance program funded jointly by the SFMP and the facility operating programs. Routine inspections of cell and building containment systems and services, radiological surveillance of operating areas and maintenance activities, and regular testing of safety systems are performed as part of this program. Facility maintenance includes general repairs, exhaust filter changes, and instrumentation and controls maintenance/calibration. The routine maintenance and surveillance tasks require approximately 2.5 man-years of annual SFMP effort. No major facility repairs or improvements are anticipated for this facility in the near future.

e. ***Unique Conditions/Reuse Considerations.*** The FPDL has been maintained in an operable condition since placed in standby in 1975. The building structure is sound and the supporting services fully functional. Of the 23 available cells, 8 are utilized on a part-time or full-time basis by operating programs. Due to the condition of the facility, there would be a high potential for reuse of the inactive cells if remaining excess equipment was removed and they were decontaminated to levels that allow personnel access for installation of new processes.

PROPOSED FACILITY DISPOSITION

a. ***Alternative Selection.*** Since the FPDL is in an operable condition, with a high potential for reuse of the facility by other programs, the disposition mode selected is Decontamination for Reuse. No plans are being made for the complete decommissioning of the building. Such final facility disposition will be delayed until the end of the useful lifetime of the facility (15-20 years).

b. ***Decommissioning Plan.***

1. ***Technical Plan.*** The objective of the proposed FPDL cell decommissioning efforts is to decontaminate the inactive portions of the facility in order to reduce the hazards associated with residual radioactivity and make these areas available for potential reuse. This task will include: (1) the decontamination of inactive process, manipulator, and tank farm cells, service tunnel, and associated in-cell equipment; (2) the removal of all surplus in-cell equipment for appropriate disposal; and (3) the placement of these portions of the facility in a standby mode, awaiting reuse applications. The cells to be included in this effort are the Process Cells 1-8, Manipulator Cells 13-15 and 18, Tank Farm Cells 21 and 22, and the Service Tunnel behind Process Cells 1-8.

   Decommissioning of each of the FPDL cells will follow similar steps, beginning with remote decontamination of cell walls and equipment surfaces by high pressure spraying techniques, using manipulators or special shields covering cell openings. When the cell is decontaminated to an acceptable level for personnel entry, maintenance personnel will remove all excess piping and equipment and cap all service lines and cell penetrations. Decontamination of the bare cells will then be conducted to acceptable levels for reuse. Special consideration will be given to removal of residual powders from the manipulator cells, dismantlement of the process cells instrument panel board, and handling and disposal of the large LLW tanks. Other than the cells themselves, no readily salvageable equipment or materials have been identified for reuse at the FPDL.

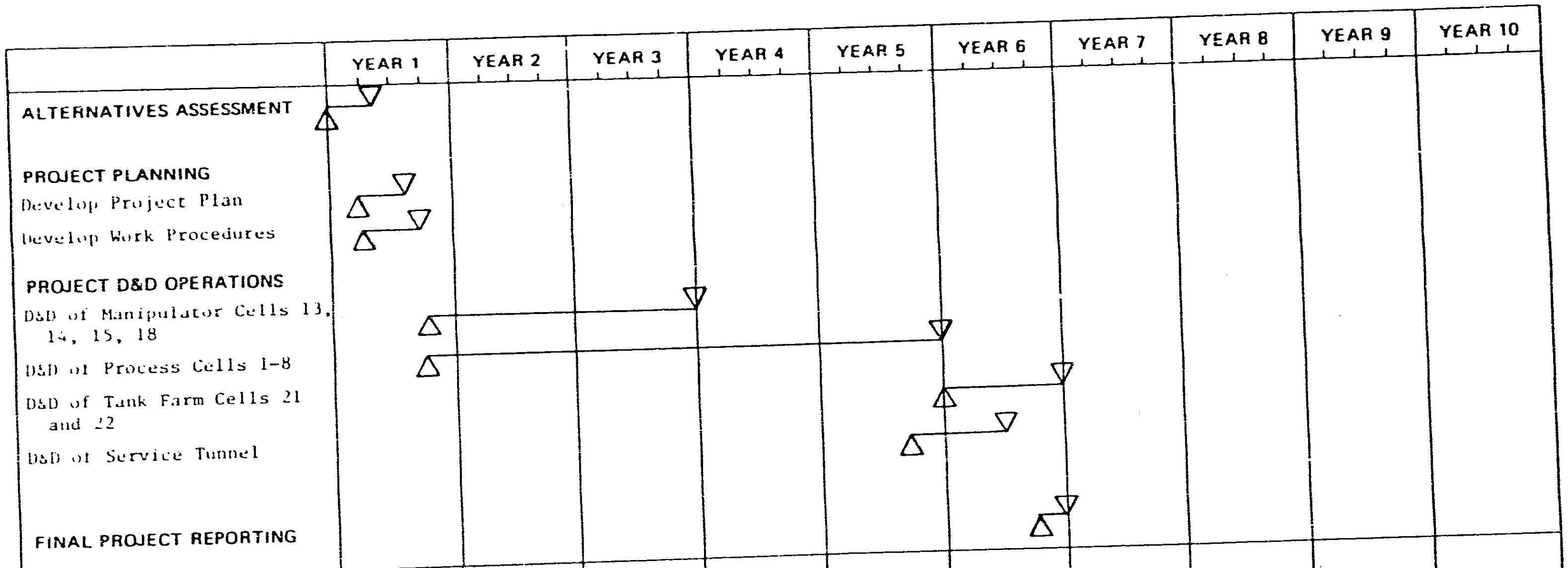
2. ***Special Equipment and Techniques.*** The proposed cell decommissioning activities at the FPDL are basically an expansion of routine maintenance efforts that have been conducted extensively in the past. Hence, the facilities and equipment that are needed for these types of operations are for the most part already on hand. Some development work will need to be conducted in the area of remote equipment cutting techniques, particularly for stainless-steel piping. Two techniques are being considered for this work: use of ultra-high pressure water jet and a plasma arc torch. Both systems are available at ORNL for this application.

3. ***Cost, Schedule and Waste Volume Projections.*** A summary of the project schedule, estimated costs and waste disposal requirements for the proposed FPDL cell decommissioning is provided in Fig. I.7. Project planning, on-site D&D operations, and project closeout are estimated to extend over a period of approximately six years at a total estimated cost of $3.1 million. Approximately 8,000 ft^3 (227 m^3) of solid LLW and 70,000 gal (265 m^3) of liquid LLW will be generated during the course of the project. No significant volumes of low-contamination-level stainless steel will be generated.

PRIORITY DETERMINATION CONSIDERATIONS

The high annual maintenance and surveillance costs and the suitability of the facility for potential near-term reuse make early decommissioning of the FPDL attractive. In addition, the availability of experienced operating personnel further supports immediate facility disposition.

ORNL-DWG 83-14840R2



	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
PROJECT COSTS ($K) *										
Annual Expense	100	470	625	665	680	510				
Capital Equipment	–	–	–	–	–	–				
Total	100	470	625	665	680	510				
WASTE VOLUME PROJECTIONS										
Solid (m^3)										
Soil (LLW)	–	–	–	–	–	–				
Soil (TRU)	–	–	–	–	–	–				
Rubble (LLW)	–	–	–	–	–	–				
Rubble (TRU)	–	–	–	–	–	–				
Metal (LLW)	15	30	30	30	35	70				
Metal (TRU)	–	–	–	–	–	–				
Misc. (LLW)	1	5	5	5	5	5				
Misc. (TRU)	–	–	–	–	–	–				
Total (LLW)	16	35	35	35	40	75				
Total (TRU)	–	–	–	–	–	–				
Liquid (m^3)										
Process Waste	–	–	–	–	–	–				
LLW	23	60	60	60	40	20				

*Costs given in year of expenditure dollars beginning in FY 1983.

Fig. I.7. FPDL cell decommissioning project summary.

PROJECT ORNL Graphite Reactor Decommissioning
FIELD OFFICE Oak Ridge **CONTRACTOR** Martin Marietta
BUDGET AND REPORTING CODE AR 05 10 10 **FTP/A NO.** ONL-WD08 **SFMP WBS** 4.6.14
CONTRACTOR **FIELD OFFICE** **SFMPO**
PROJECT PRIORITY 11
PROPOSED DISPOSITION MODE Passive Protective Storage
PRELIMINARY TEC $8,000 K **ESTIMATED PROJECT DURATION** 4 years

FACILITY DESCRIPTION

a. ***Operating History.*** The ORNL Graphite Reactor (OGR) was the world's first continuously operable nuclear reactor, achieving criticality in November 1943. The OGR was built as a pilot plant for obtaining design information for construction and startup of the large plutonium production reactors at Hanford, Washington. Although originally designed for a 1 MW power level, in 1944 improvements in the cooling system and fuel cladding allowed the power level to be increased to an average rate of 3.6 MW. The reactor was successfully operated for 20 years as a testing and experimental facility, being shut down in November 1963. In September 1966, the OGR was designated as a National Historical Landmark, based on the significance of its early purpose.

b. ***Physical Description.*** The OGR was an air-cooled graphite-moderated and reflected, heterogeneous, natural-uranium-fueled reactor. The moderator assembly is a 24-ft cube of graphite blocks, with spaces allowed for experimental access, thermocouples, and fuel slugs. The fuel channels extend through the block for fuel loading and unloading operations as well as providing for coolant air flow. The assembly is surrounded by a 7 ft thick reinforced concrete shield (Fig. I.8). A subsurface water-filled canal was utilized in the handling of spent reactor fuel. This main reactor facility is housed in a three story corregated metal structure (Fig. I.9). Coolant air was supplied through underground concrete ducts to the inlet manifold where it was routed through the fuel channels to the exhaust manifold. Exhaust air was then passed through underground concrete ducts to a filter house for roughing and HEPA filtration prior to exhaust through the fan house to a 200 ft concrete stack (Fig. I.10).

c. ***Safety/Environmental Considerations.*** Although the fuel was removed from the OGR in 1966 the reactor still contains significant quantities of fission and activation products, as well as trace quantities of ^{239}Pu and uranium oxide. Current estimates place the total radionuclide inventory in the reactor at less than 50 Ci. Exposure levels at the face of the graphite block are in the range of 2-4 rad/h. Containment ventilation is still provided through the coolant air system. The

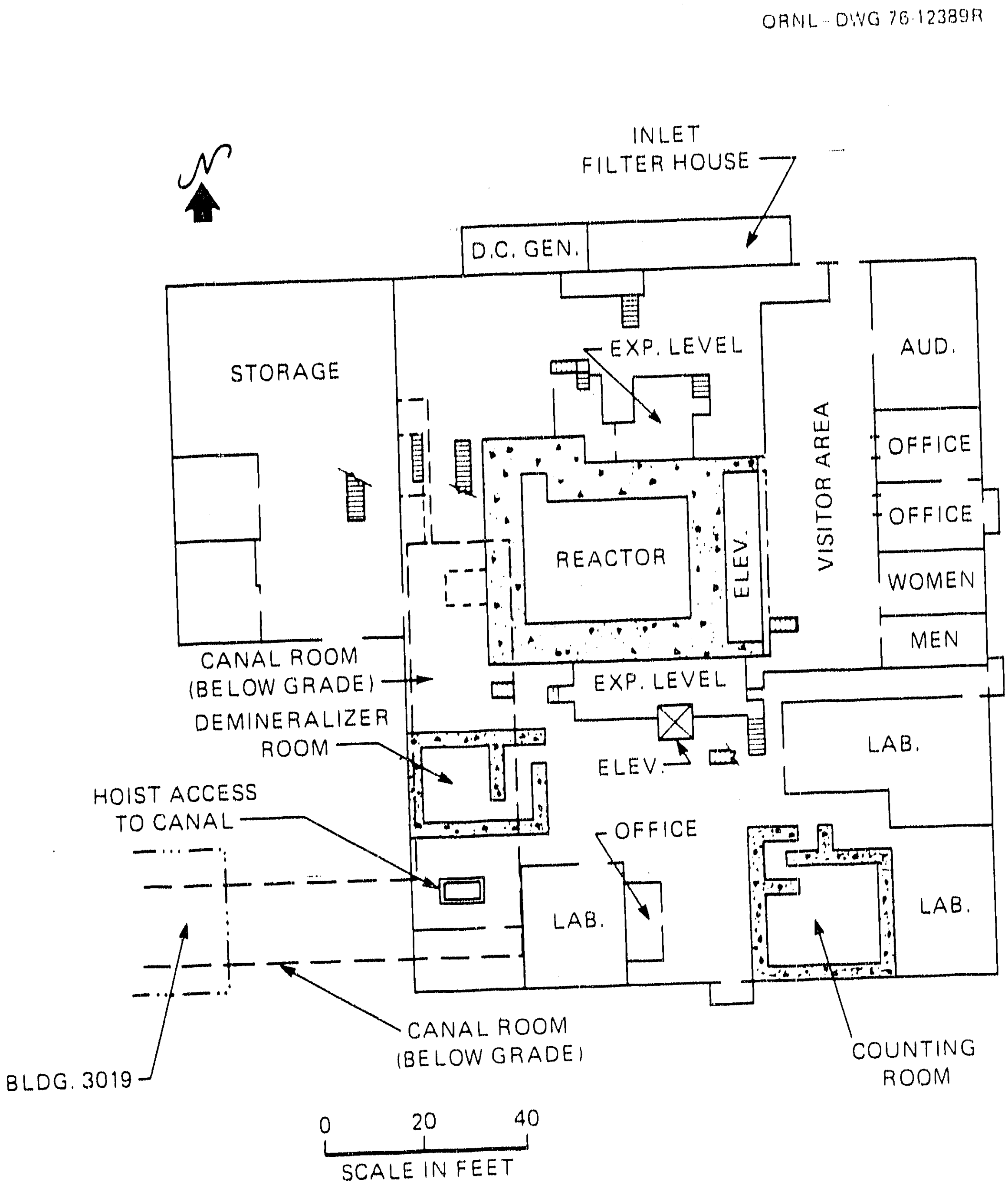


Fig. I.8. Floor plan (first level) for the Graphite Reactor (Building 3001).

ORNL-PHOTO 2141-76

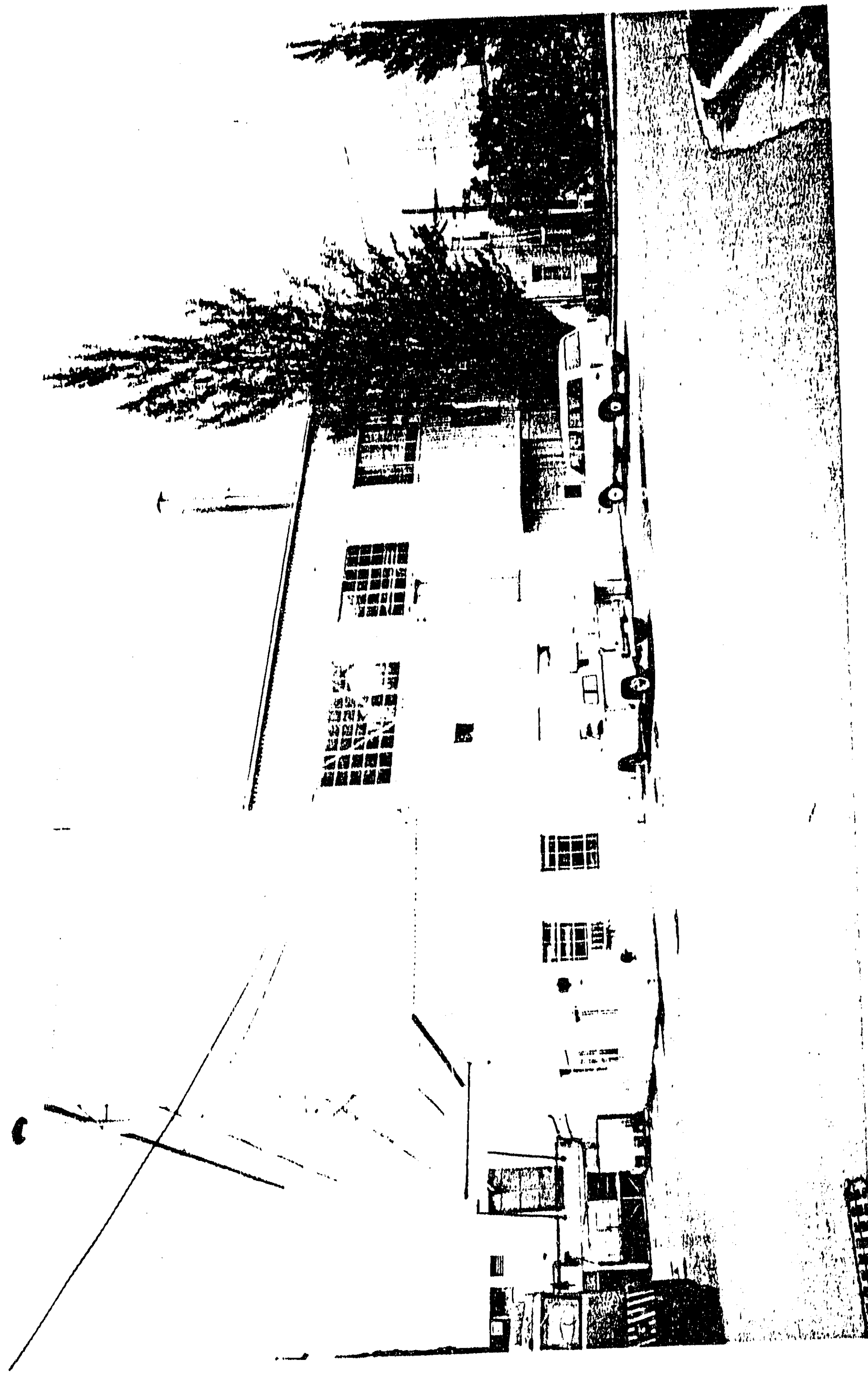


Fig. I.9. Graphite Reactor Building as viewed from the south.

ORNL-PHOTO 2142-76

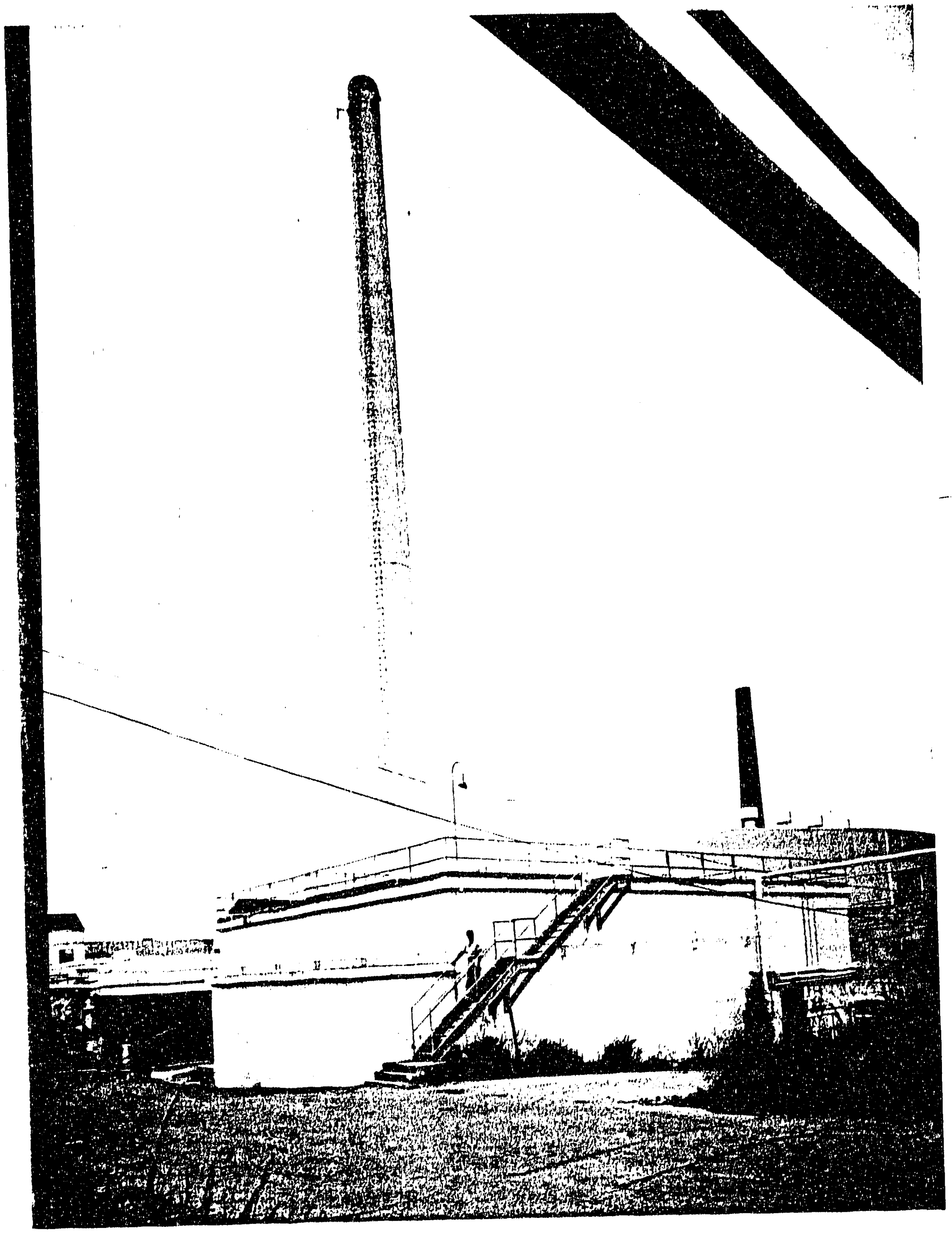


Fig. I.10. Air discharge stack and filter house, as viewed from the northwest.

associated exhaust air ducts, filter house, fan house, and stack are contaminated, primarily with ^{137}Cs and ^{90}Sr. Dose rates in the duct work are known to range up to 500 mrad/h with transferable beta-gamma contamination levels up to 300,000 dpm/100 cm^2. Preliminary sampling indicates that the concentration of TRU radionuclides in the concrete duct and stack are below the guidelines for classification as TRU waste. The fuel discharge canal contains a number of stored radiation sources, as well as significant quantities of sludge and miscellaneous contaminated materials. Dose rates in the canal range from 40 mrad/h to 1,000 rad/h, with the highest levels being associated with the stored ^{90}Sr and ^{137}Cs sources. A radionuclide inventory of several hundred curies remains in the canal.

d. ***Facility Maintenance and Surveillance.*** A comprehensive maintenance and surveillance program is provided to assure adequate containment of the residual radioactivity at the OGR. Routine inspections of the containment systems, building services, canal and ductwork, radiological surveillance of the canal and operating areas, and regular testing of safety systems are performed as part of this program. Facility maintenance includes general repairs, exhaust duct filter changes, regeneration of the canal demineralizer, and instrumentation and controls maintenance. These routine maintenance and surveillance tasks require approximately 1.0 man-year of annual SFMP support. Clean-up of the canal area has been identified as a special maintenance project for FY 1986.

e. ***Unique Conditions/Reuse Considerations.*** As caretaker for a National Historical Landmark, the ORNL SFMP is expected to make a reasonable effort to preserve the OGR in order to enable visitors to associate the site with the historical events which gave the landmark its significance. This does not imply that all structures and equipment must be retained, or that use of the site for other purposes is prohibited, but rather that some appropriate evidence of the landmark must be preserved. This responsibility places restrictions on the decommissioning alternatives for the site, and limits the reuse of the main reactor area. Currently, the reactor face and a portion of the adjacent operating area is being utilized for public displays, with the rest of the facility occupied by ORNL research groups.

PROPOSED FACILITY DISPOSITION

a. ***Alternative Selection.*** The alternative selection for the OGR centers around the preservation of the site as a National Historical Landmark. It is assumed that the reactor will remain a landmark and that any decommissioning activities specified will not result in destruction of the principal reactor structure. Based on this guidance, the alternatives for the OGR were basically to (1) entomb the reactor internals, or (2) remove all contaminated equipment from within the reactor shield. Due to the levels of contamination within the graphite blocks and the induced activity of the surrounding concrete shield walls, removal of the residual radioactive materials without dismantling the structure would be an extremely complex and hazardous undertaking. In fact, removal of the contaminated concrete layer from within the reactor shield could result in an unacceptable weakening of the structure. Reactor entombment, however, provides long-term control over the residual contamination, adds additional structural integrity to the reactor shield and is less costly and hazardous. Dismantlement of the reactor in the future (if desired) would not be significantly hampered by these actions, since it would require a major effort to access the graphite blocks even without the addition of the entombment structure. Hence, the most cost-effective decommissioning alternative for the OGR appears to be a form of passive protective storage involving entombment of the reactor and associated fuel handling canal, with various decontamination and dismantlement techniques to be utilized for the remaining facilities.

b. *Decommissioning Plan.*

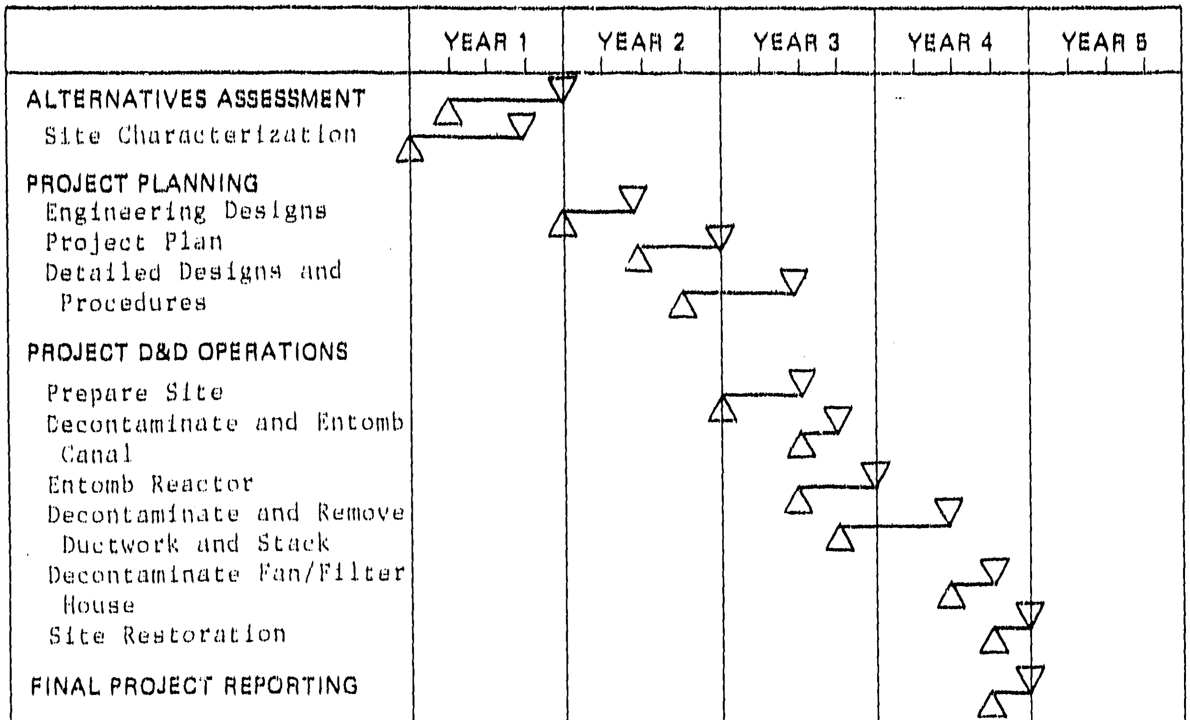
1. ***Technical Plan.*** A conceptual plan for decommissioning the OGR has been developed that specifies entombment of the graphite reactor block and the below-grade fuel handling canal. The majority of the underground ductwork outside the reactor building would be removed, the fan and filter house decontaminated for potential reuse, and the 3018 stack demolished. Active services (drains, electrical, HVAC) would be left intact to enhance the value of the buildings for other uses.

   According to this plan, decommissioning of the OGR would begin with the canal area. All remaining contaminated equipment and materials would be removed from the area and the canal and tunnel decontaminated in preparation for entombment. This entombment would involve filling of the canal and tunnel voids with concrete. After the canal work is completed, the reactor building would be prepared for decommissioning by relocating current occupants, removing uncontaminated surplus equipment and installing temporary ventilation and other services. Controlled access would then be gained into the reactor containment for grouting operations. Grout specifications would be developed to define a pumpable grout with long-term containment characteristics and compatability with the graphite block. After reactor grouting was complete and the entombed structure sealed, work would begin on the ancillary facilities. The air ducts would be decontaminated and removed, the filter and fan houses decontaminated for reuse, and the 3018 stack decontaminated and surfaces sealed. The stack would be demolished by piecemeal dismantlement, with sectioning of the structure from the top down. Rubble would be collected within the stack and removed through access at the base.

2. ***Special Equipment and Techniques.*** Decommissioning of the OGR will require extensive decontamination efforts, significant use of grouting equipment and techniques, and a careful stack removal process. However, these tasks are not expected to require significant development of special equipment or techniques. The decontamination efforts can be expected to utilize the scarification and chemical decontamination techniques already in use or being developed (ultra-high pressure water jet). Similarly, current grouting technology appears adequate for the proposed application. Stack demolition similar to what is required for this project has been demonstrated elsewhere, with expertise available in the commercial sector.

3. ***Cost, Schedule, and Waste Volume Projections.*** A summary of the project schedule, estimated costs, and waste disposal requirements for the proposed Graphite Reactor decommissioning project is provided in Fig. I.11. Project planning, on-site D&D operations and project closeout are estimated to extend over a period of approximately four years, at a total estimated cost of \$8.0 million. Approximately 4×10^4 ft^3 (1255 m^3) of solid radioactive waste and 1.5×10^5 gal (545 m^3) of liquid radioactive waste will require appropriate handling and disposal. No significant volume of low-contamination level stainless steel will be generated.

ORNL-DWG 83-14840R3



PROJECT COSTS ($K)	Year 1	Year 2	Year 3	Year 4	Year 5
Annual Expense	390	1275	3700	2560	
Capital Equipment	–	–	50	25	
Total	390	1275	3750	2585	

WASTE VOLUME PROJECTIONS	Year 1	Year 2	Year 3	Year 4	Year 5
Solid (m^3)					
Soil (LLW)	–	–	–	–	
Soil (TRU)	–	–	–	–	
Rubble (LLW)	–	–	10	1055	
Rubble (TRU)	–	–	–	–	
Metal (LLW)	–	–	110	5	
Metal (TRU)	–	–	–	–	
Misc. (LLW)	–	–	15	60	
Misc. (TRU)	–	–	–	–	
Total (LLW)	–	–	135	1120	
Total (TRU)	–	–	–	–	
Liquid (m^3)					
Process Waste	–	–	–	–	
LLW	–	–	475	70	

Fig. I.11. ORNL Graphite Reactor decommissioning project summary.

PRIORITY DETERMINATION CONSIDERATIONS

In its present condition, the OGR does not pose any immediate danger to ORNL personnel, the public, or the environment. However, due to the significant inventory of residual radioactive materials present in the reactor, canal, and contaminated ductwork, consideration should be given to eliminating the long-term potential hazards associated with this site.

PROJECT Waste Holding Basin Decommissioning
FIELD OFFICE Oak Ridge **CONTRACTOR** Martin Marietta
BUDGET AND REPORTING CODE AR 05 10 10 **FTP/A NO.** ONL-WD08 **SFMP WBS** 4.6.11

	CONTRACTOR	**FIELD OFFICE**	**SFMPO**
PROJECT PRIORITY	5		

PROPOSED DISPOSITION MODE Entombment
PRELIMINARY TEC $7,150 K **ESTIMATED PROJECT DURATION** 5 years

FACILITY DESCRIPTION

a. ***Operating History.*** The waste holding basin (3513 Pond) was constructed in 1944, serving as a liquid process-waste receiving, sampling, and settling pond throughout most of its active service life (1944-1977). The pond received the slightly contaminated aqueous solutions arising from laboratory floor drains, steam and cooling water leakage, flush drains, etc., and contained the liquid until transfer to the process waste treatment plant or discharge. In the latter years of use, the pond received only the liquid effluent from the process plant, serving as a settling basin prior to discharge to the adjacent White Oak Creek. With the installation of a new ion-exchange plant for process waste treatment, the pond was no longer required, and was placed into an inactive state.

b. ***Physical Description.*** The basin is an unlined, earth-bermed structure, approximately 230 ft by 250 ft at the top of the berm, with sloping sides down to the pond bottom (nominally 1.6×10^6 gal capacity). The pond is open to the environment, with vegetation established along the riprap banks (see Fig. I.12). The depth of water in the basin varies, but averages about 6 ft over a sediment/sludge layer of approximately 2 ft. Pond overflow is routed through a monitored weir box that provides pumping capabilities to the adjacent, active equilization basin. Effluents from this pond are treated at the process waste treatment plant prior to discharge to White Oak Creek.

c. ***Safety/Environmental Considerations.*** The pond sediment is contaminated with fission products, actinides, and hazardous chemical wastes as a result of waste settling processes over the years. Preliminary estimates of the radionuclide inventories of ^{90}Sr, ^{137}Cs, and $^{239,240}Pu$ are 34 Ci, 200 Ci, and 5 Ci, respectively. The concentration of $^{239,240}Pu$ in individual sediment samples ranges from <1 to 70 nCi/g. The sediment is known to contain detectable quantities of PCBs and heavy metals (Pb, Hg, Cr). The pond water, however, appears to be only slightly contaminated with radioactivity. Due to the location of the pond on the floodplain of White Oak Creek, the potential exists for environmental insult under 100-yr flood conditions. No significant leak-

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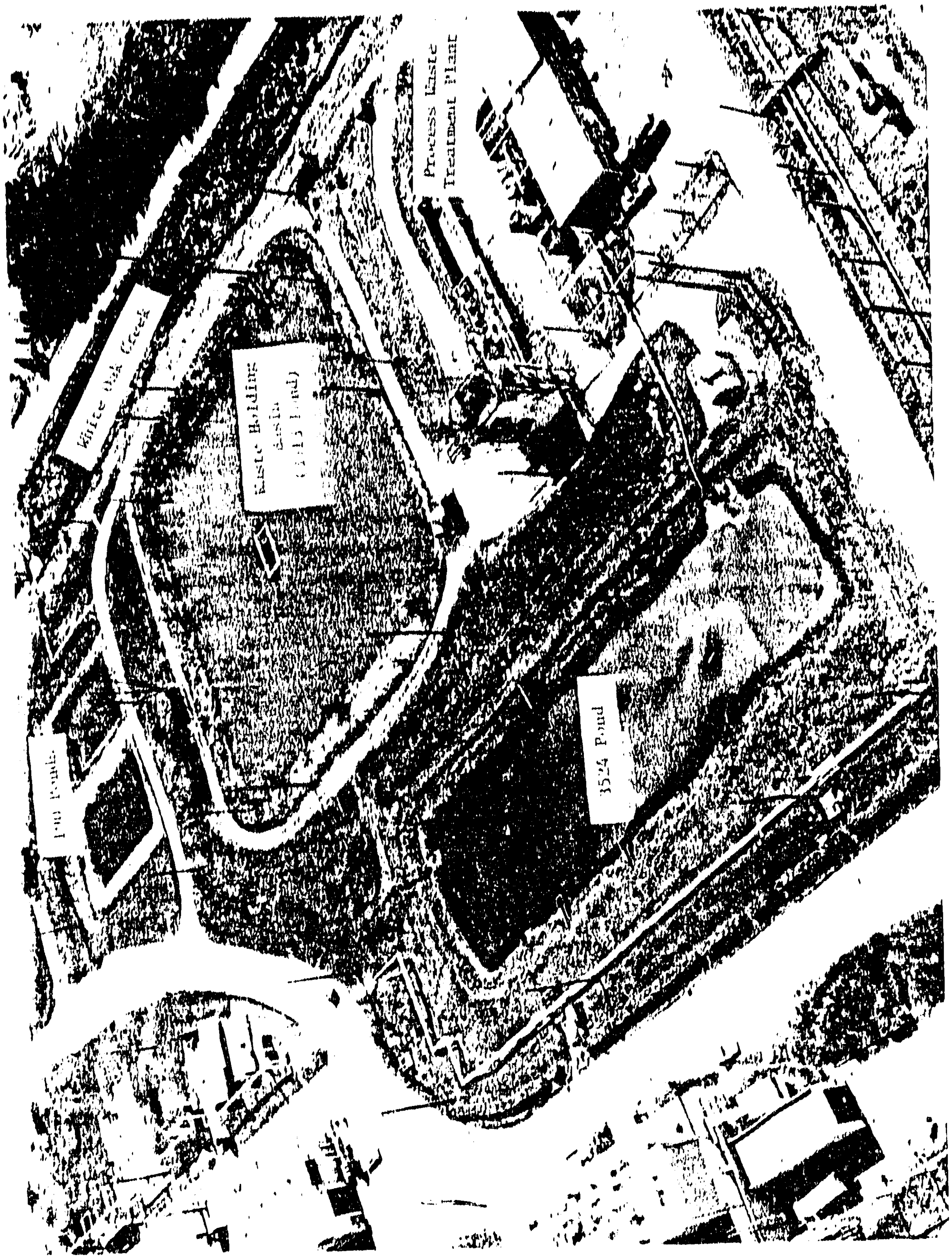


Fig. I.12. Aerial view of the Waste Holding Basin and surrounding facilities.

age from the pond has been detected, although surface soil contamination within the pond perimeter is present due to past operations. The basin has been used in the past as an experimental plot for the study of environmental transport mechanisms.

d. ***Facility Maintenance and Surveillance.*** Routine maintenance and surveillance of the basin is limited to grounds maintenance, semi-annual safety inspections and continuous monitoring of effluents from the pond overflow. These activities require less than 0.1 man-year of annual SFMP support. Additional comprehensive monitoring (pond characterization and ground water flow determinations) and pond repairs (lining application or overflow system modifications) may be required in the near future under DOE agreements with the State of Tennessee to alleviate environmental concerns.

e. ***Unique Conditions/Reuse Considerations.*** The waste holding basin is located in an area of the Laboratory which has a high potential for reuse, if the site was restored to a clean condition. Several design concepts have been explored recently that proposed siting of facilities in this area, although none have been adopted. In addition to siting considerations, the presence of hazardous materials along with radioactivity provides unique concerns on potential disposal options. These disposal constraints are addressed further in the following section.

PROPOSED FACILITY DISPOSITION

a. ***Alternative Selection.*** Two basic alternatives were considered for long-term disposition of the holding basin: (1) removal, solidification and remote disposal of the contaminated pond sediments, and (2) in-situ stabilization (entombment) of the residual radioactive and hazardous materials at the pond site. Both alternatives are feasible with current technology. Other options, including reuse applications, direct disposal of untreated sludge by shallow land burial, or use of hydrofracture for deep well disposal, were dismissed due to current technical constraints or programmatic considerations. The presence of hazardous wastes in the residual sediment complicates the alternative selection by placing constraints on the acceptable waste form and disposal site conditions. A proven stabilized waste form (grout) would be required to eliminate the hazardous waste classification, and/or licensed facilities utilized for disposal (hydrofracture is not currently licensed for hazardous wastes).

Although removal of the residual waste materials from the pond site would minimize the long-term risk of radionuclide releases to the White Oak Creek watershed, the expense and worker exposure involved in conduct of these operations could not be justified at the present time, considering the comparatively small inventory of radioactive materials present. Instead, in-situ stabilization of the waste is being proposed due to the relative simplicity of the operation compared to other alternatives. In-place grouting of the pond sediment would effectively tie up the residual activity and eliminate the cost and use of off-site burial ground space. Groundwater interaction with the waste could be adequately controlled with proper grout formulations. Application of this option does, however, place restrictions on the use of this area for future Laboratory activities and requires some level of long-term site monitoring.

Due to the numerous issues that remain to be resolved on decommissioning of the 3513 Pond, significant additional site characterizations and feasibility studies will have to be conducted before a final decision is made on the choice for site disposition. The plan presented as follows does, however, represent a feasible solution to the problem.

b. ***Decommissioning Plan***

1. ***Technical Plan.*** Based on the concept of in-situ stabilization of the pond sediment, the objectives of the site decommissioning are to solidify all radioactive and hazardous wastes into a stable waste form on-site, and isolate the disposal site from long-term interactions with surface water and groundwater. According to the conceptual plan for this site, the pond would be segmented into smaller areas to provide a better controlled and more thorough fixation of the pond contents. The majority of the clear water above the pond sediment would be transferred to the process waste treatment system for processing prior to release. Truck-mounted equipment would then move along the accessible side of each pond segment, extracting the sediment/sludge, mixing it with grout and returning it back into the basin. A closed-loop suction, mixing, and discharge system has been specified to eliminate the concerns with airborne particulates. After the grout had sufficiently hardened, the remaining free liquids would be transferred to the process system while an additional concrete cap is applied. Compacted fill, graded aggregate, and appropriate capping (soil or asphalt) would follow, resulting in a site grade that would alleviate surface runoff and infiltration concerns. Groundwater control would be provided through installation of a slurry wall or grout curtain surrounding the site.

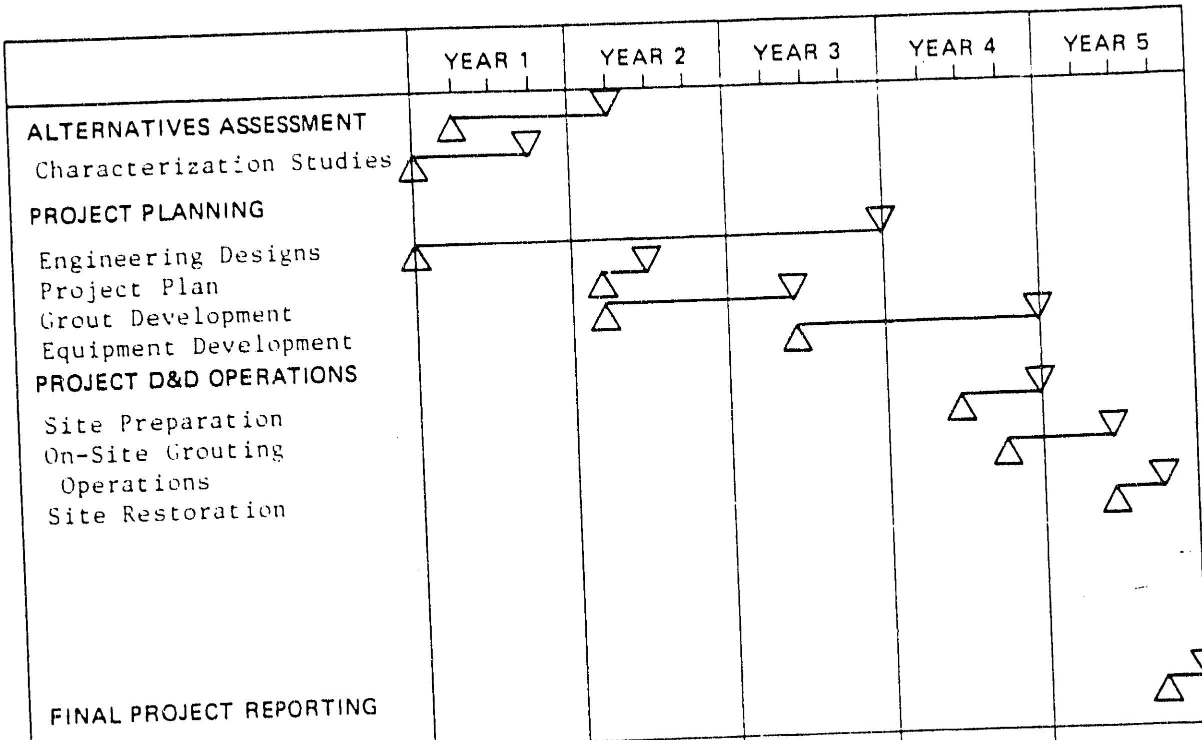
2. ***Special Equipment and Techniques.*** The in-situ grouting technique specified for this project will require development work in terms of grout constituents and in grouting equipment modifications. Laboratory analysis will be required to specify the materials and composition for long-term stabilization of the sediments. Special consideration will have to be given to the grout characteristics in order to eliminate concerns over the hazardous wastes involved. Grout studies will also be necessary prior to specification of the materials used for the grout curtain/slurry wall. The conceptualized grouting equipment is similar to commercially available equipment and would only require minor modifications to be suitable for this application. Significant preoperational testing of the system and technique would be required prior to application at the site.

3. ***Cost, Schedule, and Waste Volume Projections.*** A summary of the project schedule, estimated cost, and waste disposal requirements for the proposed waste holding basin decommissioning project is provided in Fig. I.13. Project planning, equipment and grout development, on-site D&D operations, and project closeout are estimated to extend over approximately six years, at a total estimated cost of $7.15 million. Approximately 1.8×10^7 gal (7×10^4 m^3) of liquid waste will require handling and processing, with 2.4×10^4 ft^3 (690 m^3) of solid waste generated.

PRIORITY DETERMINATION CONSIDERATIONS

The project priority for waste holding basin decommissioning will be determined by the perceived risk of environmental insult due to the location of the site on the floodplain of White Oak Creek and on the need for the site for future Laboratory expansion. Based on the current conditions of the basin (relatively small inventory of radionuclides in a contained state), and on the availability of other building sites at ORNL, immediate decommissioning does not appear to be necessary.

ORNL-DWG 83-14840R3



	Year 1	Year 2	Year 3	Year 4	Year 5
PROJECT COSTS (\$K)					
Annual Expense	425	735	1,415	2,065	2,200
Capital Equipment	–	–	150	150	15
Total	425	735	1,565	2,215	2,215
WASTE VOLUME PROJECTIONS					
Solid (m^3)					
Soil (LLW)	–	–	–	200	100
Soil (TRU)	–	–	–	–	–
Rubble (LLW)	–	–	–	–	–
Rubble (TRU)	–	–	–	–	–
Metal (LLW)	–	–	–	–	–
Metal (TRU)	–	–	–	–	–
Misc. (LLW)	–	–	–	290	100
Misc. (TRU)	–	–	–	–	–
Total (LLW)	–	–	–	490	200
Total (TRU)	–	–	–	–	–
Liquid (m^3)					
Process Waste	–	–	–	–	75
LLW	–	–	–	–	190

Fig. I.13. Waste Holding Basin decommissioning project summary.

PROJECT Old Hydrofracture Facility Decommissioning
FIELD OFFICE Oak Ridge **CONTRACTOR** Martin Marietta
BUDGET AND REPORTING CODE AR 05 10 10 **FTP/A No.** ONL-WD08 **SFMP WBS** 4.6.12
CONTRACTOR FIELD OFFICE SFMPO

PROJECT PRIORITY 3
PROPOSED DISPOSITION MODE Entombment
PRELIMINARY TEC $2,890 K **ESTIMATED PROJECT DURATION** 5 years

FACILITY DESCRIPTION

a. ***Operating History.*** The Old Hydrofracture Facility (OHF) was an experimental and operational plant for the injection of waste grout into a fractured shale formation. The experimental design was tested in 1964-1965 using dilute and concentrated waste solutions. Beginning in 1966, operational injections of concentrated liquid waste from the ORNL LLW system were routinely made until facility shutdown in 1980. During its operation, 18 injections were made at the facility, resulting in disposal of more than 8 million gal of waste grout containing over 6×10^5 Ci of radioactivity. The plant was closed when the New Hydrofracture Facility, located just south of this site, was brought on-line in 1982.

b. ***Physical Description.*** The facility (see Figs. I.14 and I.15) consists primarily of an injection well approximately 1000 ft deep, five waste storage tanks, four bulk storage tanks for cement and other solid constituents of the grout mix, waste and injection pumps, a waste/grout mixer, and assorted piping and other equipment. The wellhead, injection pumps, and mixer are enclosed in concrete block containment cells, while the waste transfer pumps, waste storage tanks, and bulk storage tanks are separate structures. The waste storage tanks (T1–T4, T9) are buried, individually contained, with a dry well available for observation of each tank. A concrete waste pit, built to provide reuse of slightly contaminated process and wash water during injection operations, is located 50 ft north of the injection well. A 100,000 gal open-air earth-bermed emergency waste pond (Fig. I.16) was constructed to contain the waste/grout mixture in the event of a wellhead rupture or for other surge applications during a normal injection.

c. ***Safety/Environmental Considerations.*** Past operations have resulted in significant contamination of the OHF, primarily associated with the injection/mixing cells, the waste storage tanks, waste pit and emergency waste pond. The contaminants are principally mixed fission products (^{137}Cs, ^{90}Sr, ^{60}Co), with some trace amounts of transuranic isotopes. Based on preliminary site characterizations, approximately 6000 Ci of residual radioactive materials are estimated to remain at the site. The majority of this activity is believed to be associated with sludge in the buried waste tanks, although the inventory in the waste pit and pond is also significant (several hundred

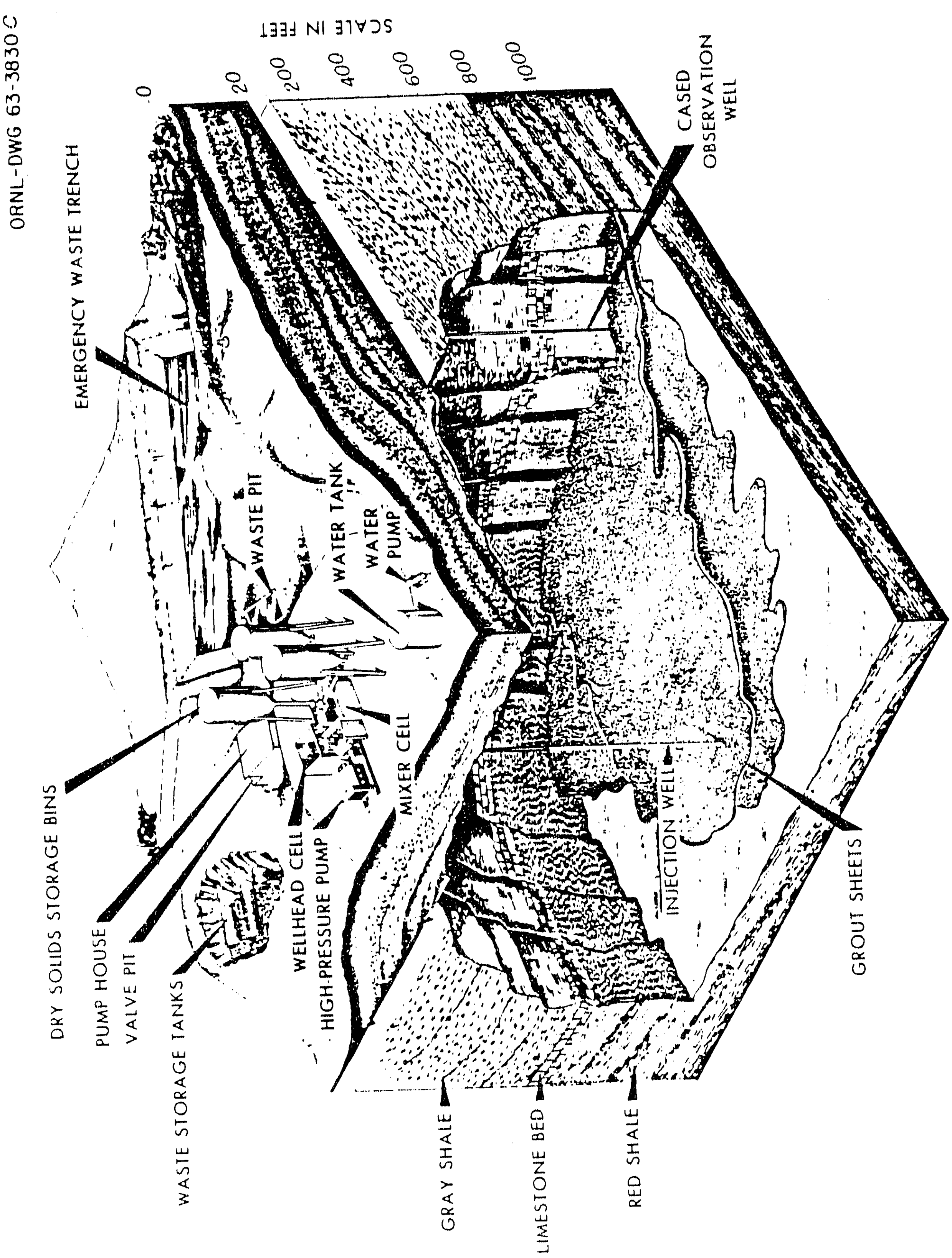


Fig. I.14. Schematic of the Old Hydrofracture Facility.

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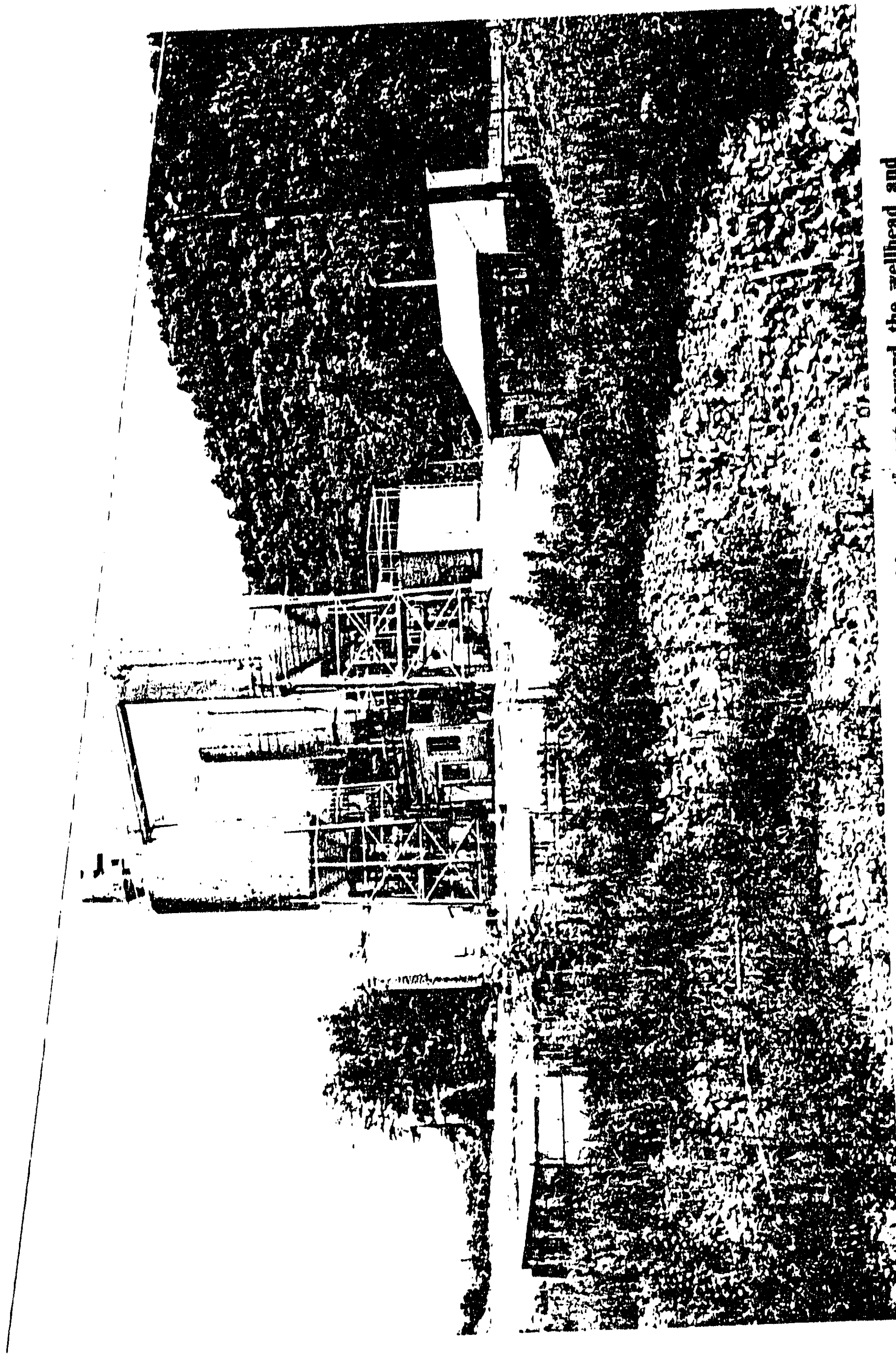

Fig. I.15. View of the Old Hydrofracture Facility, looking southeast toward the wellhead and mixing cells.

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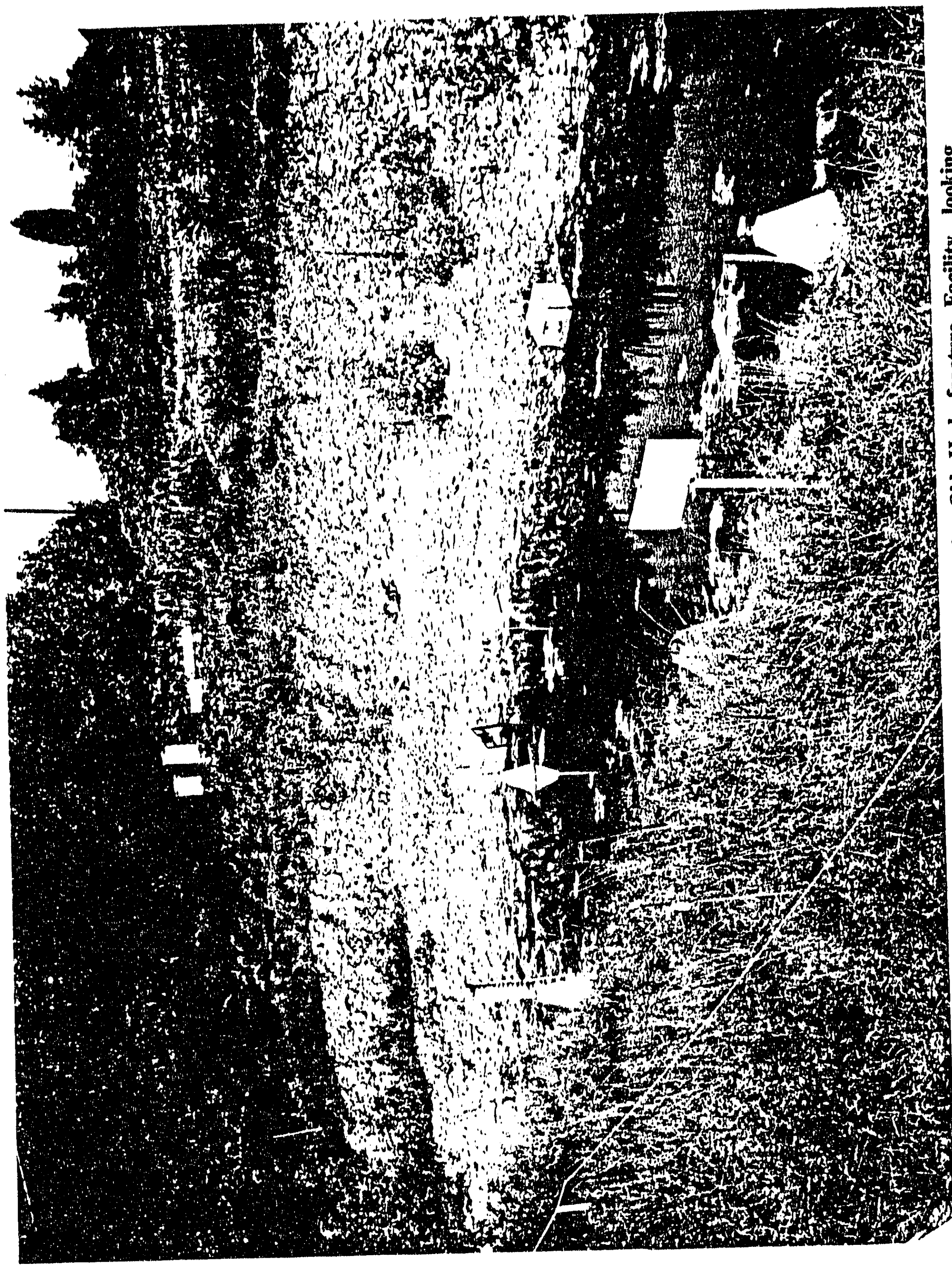


Fig. I.16. View of the emergency waste pond at the Old Hydrofracture Facility, looking northeast.

curies each). In addition to the radioactivity, hazardous chemical wastes (PCB, heavy metals) are known to be present in the pond. The injection well has not been capped, but the well casing in the waste disposal zone has been permanently grouted.

The OHF facilities are basically sound, although gradually deteriorating with time. Adequate containment of the residual radioactivity is maintained through an active-cell ventilation system and routine maintenance and surveillance. The waste storage tanks remain operational and exhibit no detectable leaks. No leaks have been observed from the emergency pond or waste pit; however, the presence of open, contaminated waters is not an acceptable long-term condition.

d. ***Facility Maintenance and Surveillance.*** Surveillance activities at the OHF include routine inspections of the site, daily checks of negative pressure in the containment cells, sampling and analysis of the waste tanks dry wells, monitoring of tank liquid levels, and periodic safety inspections. Cathodic and freeze protection is provided for the tanks and the transfer system, as well as continuous off-gas treatment. Facilities maintenance consists of general repairs, exhaust duct filter changes, and instrumentation and controls maintenance. These routine maintenance and surveillance tasks require approximately 0.1 man-year of annual SFMP support.

e. ***Unique Conditions/Reuse Considerations.*** Due to the specific nature of its design and its current contaminated and deteriorated condition, reuse of the OHF for future waste processing or other research applications appears impractical. However, certain equipment items (storage building, bulk storage tanks) may have salvage value which would be addressed as part of the decommissioning planning. In addition, the subsurface grout sheet (and its associated observation wells) are expected to receive long-term attention as monitoring of the grouted waste form continues. Hence, decommissioning activities should not compromise the grout sheet, nor eliminate existing perimeter observation wells that will be used for this monitoring.

PROPOSED FACILITY DISPOSITION

a. ***Alternative Selection.*** The assessment of alternatives for the OHF centers around the location of the site adjacent to the inactive SWSA 5 trench area and the implications that this location might have on the final disposal options for the site. As discussed above, reuse of the site for future waste processing or research applications does not appear to be practical. Dismantlement and disposal of all of the facilities as LLW in shallow land burial sites away from the area does not seem reasonable when similar disposal facilities are so close. Rather, the most reasonable alternative appears to be a combination of facility dismantlement and entombment, with on-site disposal of most of the contaminated wastes. Under this scenario, the site would be stabilized to meet the requirements of long-term burial ground performance and would essentially become a part of the adjacent SWSA 5.

b. ***Decommissioning Plan.***

1. ***Technical Plan.*** According to the conceptual plan for on-site stabilization of the OHF, all contaminated above-ground structures (hot cells and pump house) would be decontaminated to levels that would allow safe dismantlement of the structures. A burial trench would be constructed on-site for disposal of all of the LLW solid waste generated. The injection well would be grouted to a point approximately 10 ft below grade, the casing cut at that level and a concrete cap poured to the surface. A permanent marker would be installed to identify the loca-

tion of the former well-head. Entombment activities would be performed for the buried waste tanks, the waste pit cells, and the emergency pond. The tanks would require a decontamination campaign to resuspend the residual sludge prior to fixation within the tank cavities. The waste pit cells have already been stabilized to some extent and would require only a final clean-out and concrete capping to complete the effort. The pond would be stabilized in place by solidifying the residual sediment and sludge on the pond bottom and consolidating the remaining pond structures (riprap and equipment) into a fixed form. The overall site grade over the entombed structures would be made consistent with the lay of the land and burial ground requirements. Any underground piping would be left in place, but grouted to restrict groundwater transfer. All uncontaminated structures (bulk storage tanks, water tank, etc.) would be evaluated for salvage or disposed of in the contractor's landfill. The storage building 7853 would be left in its present condition for potential reuse.

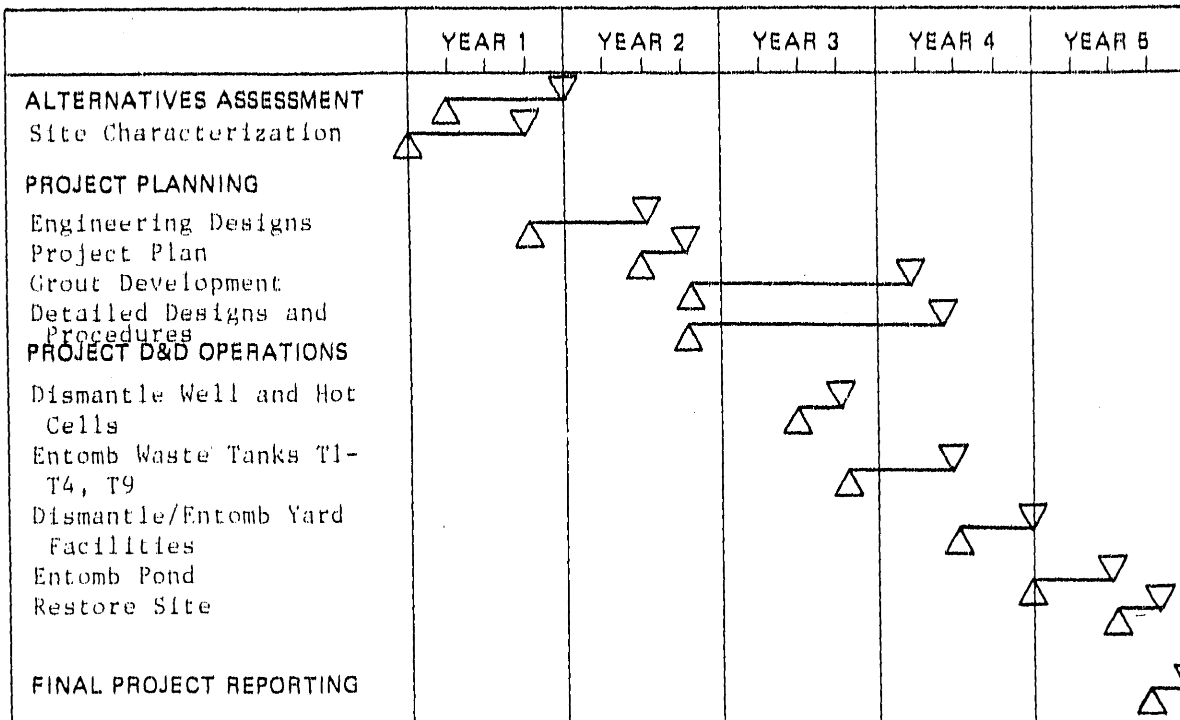
2. ***Special Equipment and Techniques.*** On-site stabilization activities will require special equipment and techniques in three major areas: (1) cell decontamination, (2) waste tank sludge removal and solidification, and (3) pond sediment solidification. Decontamination techniques in use on other SFMP projects (ultra-high-pressure water jet scarification and abrasive cutting, plasma arc torch cutting, chemical treatments, etc.) should be applicable to this facility, with little additional development required. Waste tank clean-out would be expected to follow similar lines as the Waste Storage Tanks project (WBS 4.6.18), with slight modifications needed to allow for the horizontal placement of the OHF tanks, the rubber linings in the tanks, and the grout formulation for in-tank solidification. Solidification of the waste pond will also require special techniques due to the nature of the pond sediments (radioactive and hazardous wastes). Techniques similar to those employed for the Waste Holding Basin (WBS 4.6.1) may be appropriate at this site also.

3. ***Cost, Schedule, and Waste Volume Projections.*** A summary of the project schedule, cost, and waste disposal requirements for the proposed Old Hydrofracture Facility decommissioning project is provided in Fig. I.17. Project planning, equipment and grout development, on-site D&D operations, and project closeout are estimated to extend over approximately five years, at a total estimated cost of $2.9 million. Approximately 8×10^3 gal (30 m^3) of liquid waste and 7×10^3 ft^3 (205 m^3) of solid waste will require appropriate handling and disposal. No significant quantities of low-contamination level stainless steel will be generated as part of this project.

PRIORITY DETERMINATION CONSIDERATIONS

Due to the remote location of the OHF and its current contained state, there is no immediate incentive for decommissioning the site. The project priority may be determined by the perceived risk of environmental insult due to the presence of the contaminated open pond on the site and the nearness of the site boundary to the White Oak Creek floodplain.

ORNL-DWG 83-14840R3



	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
PROJECT COSTS ($K)					
Annual Expense	180	310	775	985	600
Capital Equipment	-	-	25	15	-
Total	180	310	800	1000	600
WASTE VOLUME PROJECTIONS					
Solid (m³)					
Soil (LLW)	-	-	-	-	-
Soil (TRU)	-	-	-	-	-
Rubble (LLW)	-	-	85	40	-
Rubble (TRU)	-	-	-	-	-
Metal (LLW)	-	-	35	20	5
Metal (TRU)	-	-	-	-	-
Misc. (LLW)	-	-	-	10	10
Misc. (TRU)	-	-	-	-	-
Total (LLW)	-	-	120	70	15
Total (TRU)	-	-	-	-	-
Liquid (m³)					
Process Waste	-	-	-	-	-
LLW	-	-	-	20	10

Fig. I.17. Old Hydrofracture Facility decommissioning project summary.

PROJECT Gunite Storage Tanks Decommissioning

FIELD OFFICE Oak Ridge **CONTRACTOR** Martin Marietta

BUDGET AND REPORTING CODE AR 05 10 10 **FTP/A No.** ONL-WD08 **SFMP WBS** 4.6.13

	CONTRACTOR	FIELD OFFICE	SFMPO
PROJECT PRIORITY	10		

PROPOSED DISPOSITION MODE Entombment

PRELIMINARY TEC $5,700 K **ESTIMATED PROJECT DURATION** 4 years

FACILITY DESCRIPTION

a. ***Operating History.*** The Gunite Storage Tanks were installed in 1943 for the collection, storage, and transfer of liquid LLW as an integral part of the ORNL liquid waste system. During the 35 years of active service (1943-1978), they served numerous research and development projects, and received a variety of waste compositions. Liquid wastes were collected, treated, and stored in these tanks, with periodic transfers to the waste evaporator for volume reduction and then to final disposal sites in the adjacent Melton Valley. The early practice of neutralization of the acidic waste solutions with NaOH or $CaCO_3$ resulted in precipitation of chemical salts and other compounds, with subsequent collection on the tank bottoms. These precipitates accumulated as sludge layers in many of the tanks, and at the end of active service approximately 400,000 gal of residual material remained in the tanks. A sludge removal campaign was conducted in 1982-84 by the ORNL Waste Management Operations Program to dispose of the majority of the remaining material. At the conclusion of this effort, less than 100,000 gal of tank heels remained. Further efforts to remove these heels are planned for FY 1985-86.

b. ***Physical Description.*** The south tank farm (Site 3507) containing the Gunite Tanks, is located in the approximate center of the ORNL Bethel Valley complex, surrounded by several active facilities and major thoroughfares (Fig. I.18). This tank farm consists of six cylindrical, domed waste storage tanks (W-5 to W-10), each 50 ft in diameter with an 18 ft vertical height at the center and 15 ft height at the walls. The storage capacity for each tank is approximately 170,000 gal. The tanks were built of steel-reinforced Gunite (a trade name for a mix of cement, sand, and water sprayed against a form) with no inside liner. The six tanks are buried under 5 to 6 ft of earth cover and are arranged in a 60 ft center-to-center square matrix. Each tank was set on a concrete dish and installed with a sampling dry well, associated piping, valve pit, controls, and an off-gas monitoring and filtering system. The sludge removal project has resulted in little physical change in the tanks. Additional access holes have been drilled into the tanks and permanent structural supports and sluicing equipment constructed within the tank farm area (Fig.

ORNL-PHOTO 79-837

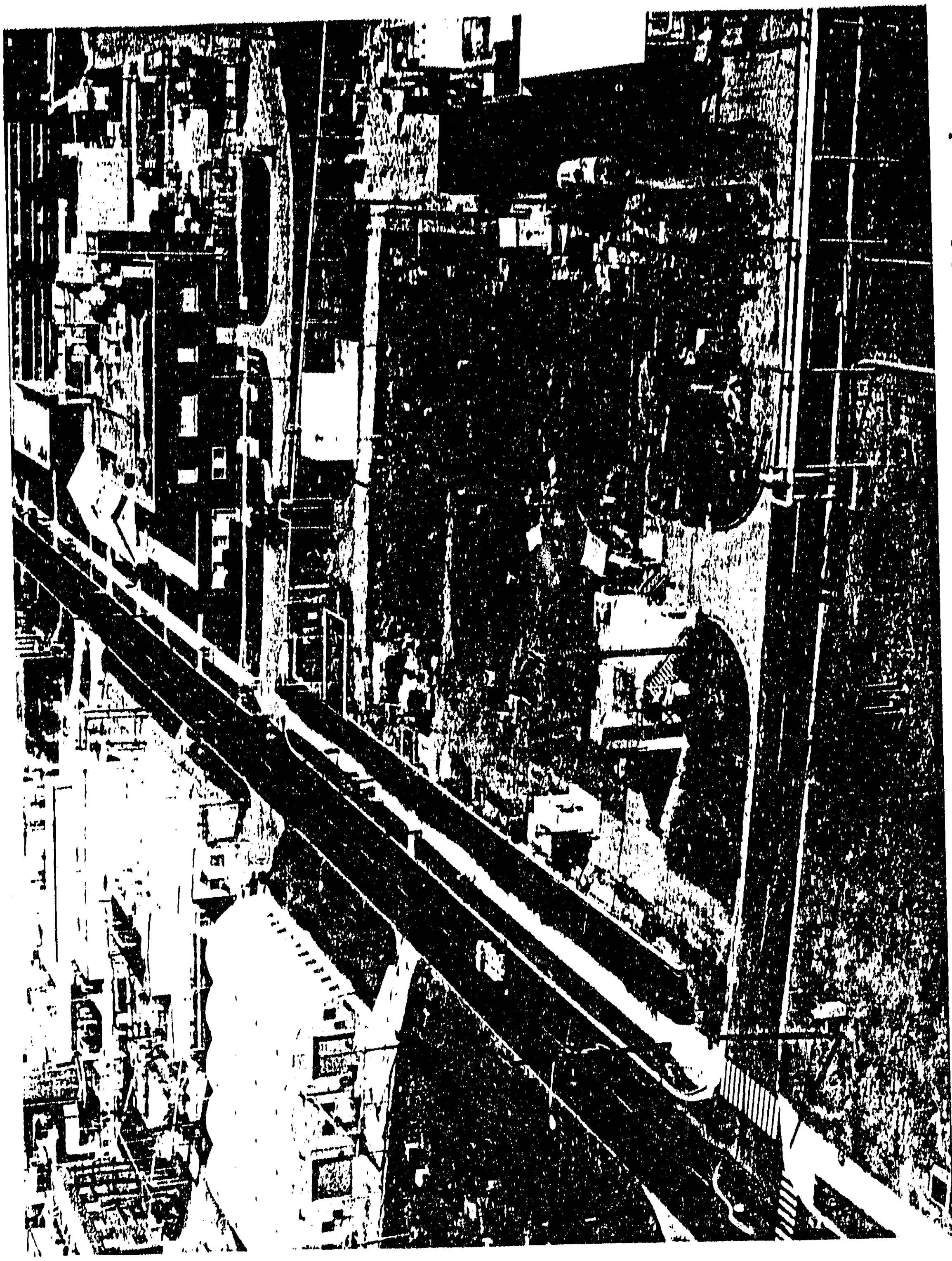


Fig. I.18. Aerial view of the Gunite Tanks in the south tank farm prior to sludge removal activities.

I.19). Upon completion of the sludge removal efforts, this equipment will likely remain in place for use in final decommissioning activities.

c. ***Safety/Environmental Considerations.*** The tanks are believed to be structurally sound and are in an operable condition. However, based on observations during the sludge removal project, the interior walls have suffered some deterioration. Containment of the residual radioactivity (estimated at approximately 2 × 10^4 Ci) is still considered adequate and the further scheduled clean out of the tanks should reduce the inventory considerably. The principal radionuclides remaining are ^{137}Cs and ^{90}Sr, with some transuranics present. Measured dose rates in the tanks at the present time range from 15 to 250 mrad/h at the tank openings, to 20 rad/h just above the waste solution remaining in tank W-10. Surface and subsurface soil contamination is present at the tank farm and the area is identified as a radiation/contamination zone.

d. ***Facility Maintenance and Surveillance.*** Routine surveillance and tank farm monitoring is provided through the ORNL SFMP maintenance and surveillance program. The ORNL Waste Operations Control Center is utilized for continuous surveillance of collection tank inventories and transfers, and monitoring of groundwater in the vicinity of the site. Periodic sampling and analysis is conducted from dry wells adjacent to the tanks to give an indication of the tank containment integrity. Off-gas monitoring and filter testing is performed routinely. Maintenance of monitoring equipment and controls is performed on an as-required basis, with the majority of site repairs and improvement provided through the active sludge removal project. The routine maintenance and surveillance tasks involve approximately 0.2 man-year of annual SFMP support. Other than the heels removal project identified earlier, no major facility repairs or improvements have been identified for these facilities in the near future.

e. ***Unique Conditions/Reuse Considerations.*** Even in their present condition, the Gunite Tanks are viewed as an asset to the Laboratory. The 1 million gallons of storage capacity represented by these tanks provides operational surge capacity for the active waste system. Although long-term reuse of the tanks is not considered feasible due to structural limitations and the lack of secondary containment, these tanks have the potential for limited use as an interim collection and transfer point. The tanks have found use within the ORNL SFMP by providing cost-effective waste collection during decommissioning work at the adjacent Metal Recovery Facility (WBS 4.6.7). Other potential applications include use of the tanks for collection, holdup, and transfer of the Laboratory process waste while replacement of the currently used Equalization Basin is conducted, and use for emergency holdup of liquid LLW in case of a prolonged disruption of disposal operations.

PROPOSED FACILITY DISPOSITION

a. ***Alternative Selection.*** As discussed above, reuse of the Gunite Tanks for long-term transfer and storage of liquid waste is not considered feasible due to their structural limitations and lack of secondary containment. Extensive decontamination would be required prior to any attempt at facility refurbishment, the cost of which would be prohibitive. Therefore, consideration has been given to the dismantlement and entombment options as the most likely alternatives. While both are technically feasible, the cost associated with controlled segmenting of the tanks was significantly more than for entombment. In addition, the radiation hazards associated with tank dismantlement make the entombment option even more attractive. While the concept of long-term

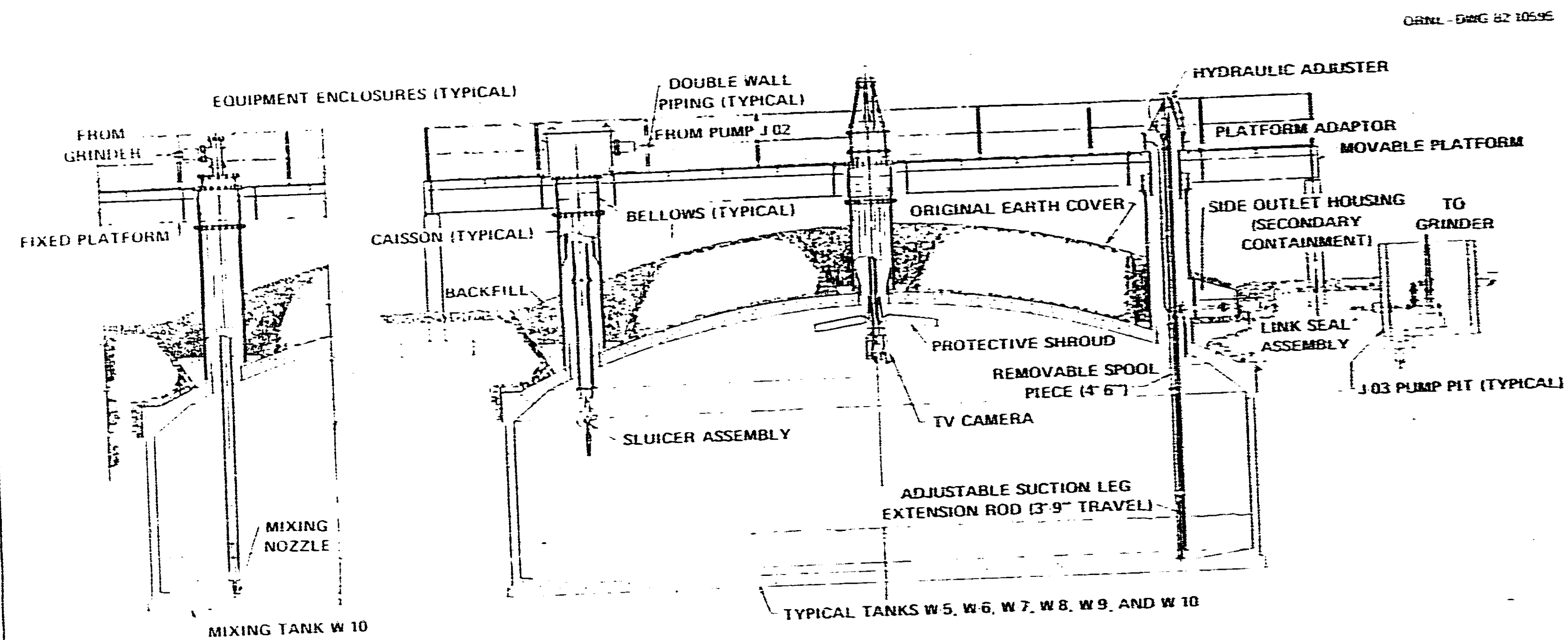


Fig. I.19. Schematic view of Gunite Tank construction showing sludge removal equipment.

waste disposal in this location of the Laboratory is not consistent with the Laboratory's long-range site plans, the increased cost and personnel exposures that would result from the removal option cannot be justified. Based on these considerations, entombment has been specified for the Gunite Tanks, with removal of the contaminated soil and surplus equipment recommended for the surrounding site.

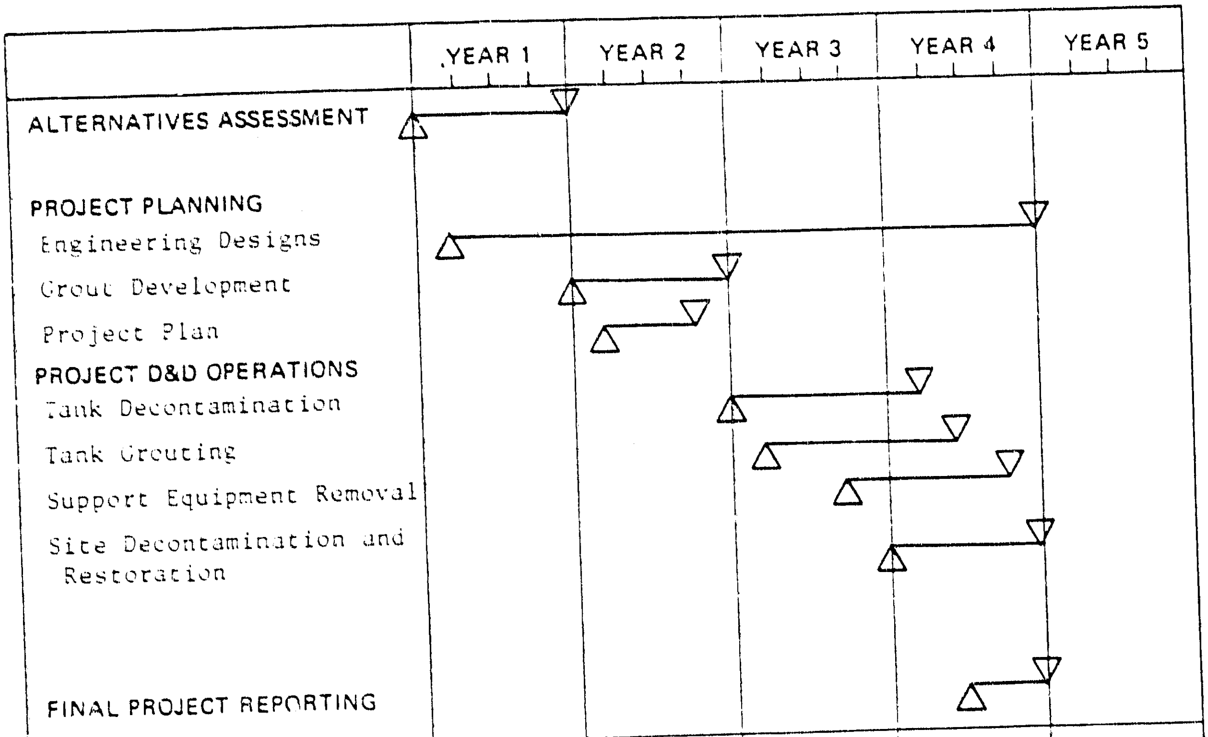
b. ***Decommissioning Plan.***

1. ***Technical Plan.*** The conceptual plan for Gunite Tank decommissioning specifies remote removal of any residual liquids and sludges, cursory decontamination of tank interior surfaces, entombment of the tank voids with grout or other appropriate materials, dismantlement of transfer lines, pump and valve pits and other associated instrumentation and controls, removal of contaminated soil from the vicinity of the tanks, and restoration of the site to a natural grade. Decontamination activities for the tanks would be conducted remotely from existing work platforms, with the goal of removing any free liquids and easily-removable solids. If the current heels removal campaign being conducted in the tanks is successful, this step could be significantly reduced in scope. Wall decontamination using high pressure sprays may also be utilized to further reduce contamination associated with the concrete surface layers. After tank decontamination is completed, entombment operations could begin, utilizing a specially formulated grout mix, or a more simplified mix specified as appropriate. This decision would have to be based on an assessment of the long-term stability and containment features required. As tanks are entombed, the associated support piping, valve stations, off-gas lines and other instrumentation and controls would be dismantled, and appropriately packaged for burial as LLW. Work platforms would be moved from tank to tank and finally dismantled and stored at the end of the effort. The final site activity would involve removal of the large volume of contaminated soil surrounding the tanks. While not all of the soil in the tank farm is contaminated, this conceptual plan has specified removal to an average depth of five feet over the entire site. Additional soil characterization would have to be conducted to determine the actual extent of this effort. Fill dirt would then be provided to bring the site grade to a level consistent with the surrounding area and appropriate site monitoring provided.

2. ***Special Equipment and Techniques.*** Tank decontamination and grouting will require special remote-operated equipment. While the basic support equipment (platforms, pumps, piping and controls) is already available at this site, some refurbishment and alterations will have to be made. Reuse of the robotic equipment specified for the Waste Storage Tanks Project (WBS 4.6.18) has been assumed for this project also. Tank grouting will require some development work prior to operations to determine the optimum grout composition and operating parameters.

3. ***Cost, Schedule, and Waste Volume Projects.*** A summary of the project schedule, estimated costs and waste disposal requirements for the proposed Gunite Tanks decommissioning project is provided in Fig. I.20. Project planning, D&D operations, and project closeout are estimated to extend over a period of approximately four years, at a total estimated cost of $5.7 million. Approximately 2.3×10^5 ft^3 (6400 m^3) of solid radioactive waste and 4.4×10^5 gal (1.7×10^3 m^3) of liquid radioactive waste will require appropriate handling and disposal.

ORNL-DWG 83-14840R3



PROJECT COSTS ($K)	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
Annual Expense	200	600	2,425	2,425	
Capital Equipment	–	–	25	25	
Total	200	600	2,450	2,450	

WASTE VOLUME PROJECTIONS	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
Solid (m^3)					
Soil (LLW)	–	–	3,000	3,000	
(TRU)	–	–	–	–	
Rubble (LLW)	–	–	100	100	
(TRU)	–	–	–	–	
Metal (LLW)	–	–	100	100	
(TRU)	–	–	–	–	
Misc. (LLW)	–	–	–	–	
(TRU)	–	–	–	–	
Total (LLW)	–	–	3,200	3,200	
(TRU)	–	–	–	–	
Liquid (m^3)					
Process Waste	–	–	–	–	
LLW	–	–	835	835	

Fig. I.20. Gunite Storage Tanks decommissioning project summary.

PRIORITY DETERMINATION CONSIDERATIONS

The Gunite Tanks present no immediate occupational, public or environmental concern in their present conditions. In fact, the tanks represent a valuable asset for short-term liquid waste holdup and storage. Reuse of these tanks is being considered by the Waste Management Operations Program for the next several years. Consideration should therefore be given to delaying final tank entombment until their useful life has been exhausted.

PROJECT Waste Storage Tanks Decommissioning

FIELD OFFICE Oak Ridge **CONTRACTOR** Martin Marietta

BUDGET AND REPORTING CODE AR 05 10 10 **FTP/A No.** ONL-WD08 **SFMP WBS** 4.6.18

CONTRACTOR **FIELD OFFICE** **SFMPO**

PROJECT PRIORITY 6

PROPOSED DISPOSITION MODE Dismantlement

PRELIMINARY TEC $8,500 K **ESTIMATED PROJECT DURATION** 7 years

FACILITY DESCRIPTION

a. ***Operating History.*** Since the beginning of ORNL operations, underground waste storage tanks have been utilized for collection, interim storage, and transfer of liquid wastes. In general, tanks were installed to service specific laboratory facilities and provide a central hold-up and pretreatment location prior to final processing through the LLW evaporator system. When the requirements for tanks usage were completed, or operational problems forced tanks to be taken out of service, the individual tanks were placed into a standby condition awaiting final disposition. Fifteen of the tanks are in such an abandoned state as part of this ORNL SFMP project. The name, location, and characteristics of these tanks are listed in Table I.2. Six additional abandoned tanks are included as a separate project (WBS 4.6.13).

b. ***Physical Description.*** The abandoned waste storage tanks can be classified into two general categories based on their physical characteristics. As identified in Table I.2, 6 of the 15 tanks are of sprayed concrete (Gunite) construction, while the remaining 9 are of stainless steel (S.S.). Typical installation schematics of each tank type are provided in Figs. I.21 and I.22. Tank capacities vary from 1,000–42,500 gal (Table I.2). Most of the tanks are buried approximately 6 ft below ground, have buried piping and controls still intact, and contain some groundwater monitoring capabilities. Eight of the tanks have experienced leaks in the transfer piping or the tanks themselves, or are collecting groundwater through infiltration.

c. ***Safety/Environmental Consideration.*** In their present states, the waste storage tanks present little hazard to operating personnel, the public, or the environment. Although the tanks contain varying amounts of residual liquid and sludge, exhibit internal dose rates from <1 to 6,500 mrad/h, and have surface contamination on all internal surfaces, the containment and monitoring systems are adequate for control of the remaining activity. Approximately 200 Ci of activity (principally ^{137}Cs and ^{90}Sr) is estimated to be present in the abandoned tanks. In addition, due to past operations, soil in the vicinity of many of the tanks has become contaminated, resulting in establishment of radiation/contamination zones for most of the tank farms. Radionuclide migration away from these sites has been minimal.

Table I.2. Waste Storage Tanks Summary

Tank	Location	Service Dates	Reason for Abandonment	Construction	Capacity (gal)	Present Contents
W-1	Site 3023	1940s-1960s	Leaks	Gunite	4,800	Liquid
W-2	Site 3023	1940s-1960s	Leaks	Gunite	4,800	Liquid/sludge
W-3	Site 3023	1940s-1960s	Collects water	Gunite	42,500	Liquid/sludge
W-4	Site 3023	1940s-1960s	Collects water	Gunite	42,500	Liquid/sludge
W-11	Site 3023	1940s-1960s	Leaks	Gunite	1,500	Liquid/sludge
W-13	Site 3023	1940s-1958	No use	S.S.	2,000	Liquid
W-14	Site 3023	1940s-1958	No use	S.S.	2,000	Liquid
W-15	Site 3023	1940s-1958	No use	S.S.	2,000	Liquid/sludge
WC-1	SW of 3037	1950-1968	Leaks	S.S.	2,000	Empty
WC-15	SE of 3587	1951-1960s	Leaks	S.S.	1,000	Liquid/sludge
WC-17	SE of 3587	1951-1960s	Leaks	S.S.	1,000	Liquid/sludge
TH-1	S of 3503	1948-1970	No use	S.S.	2,500	Liquid
TH-2	S of 3503	1952-1970	No use	S.S.	2,400	Empty
TH-3	S of 3503	1952-1970	No use	S.S.	3,300	Liquid
TH-4	SW of 3500	1940s-1960s	Filled w/sludge	Gunite	14,000	Liquid/sludge

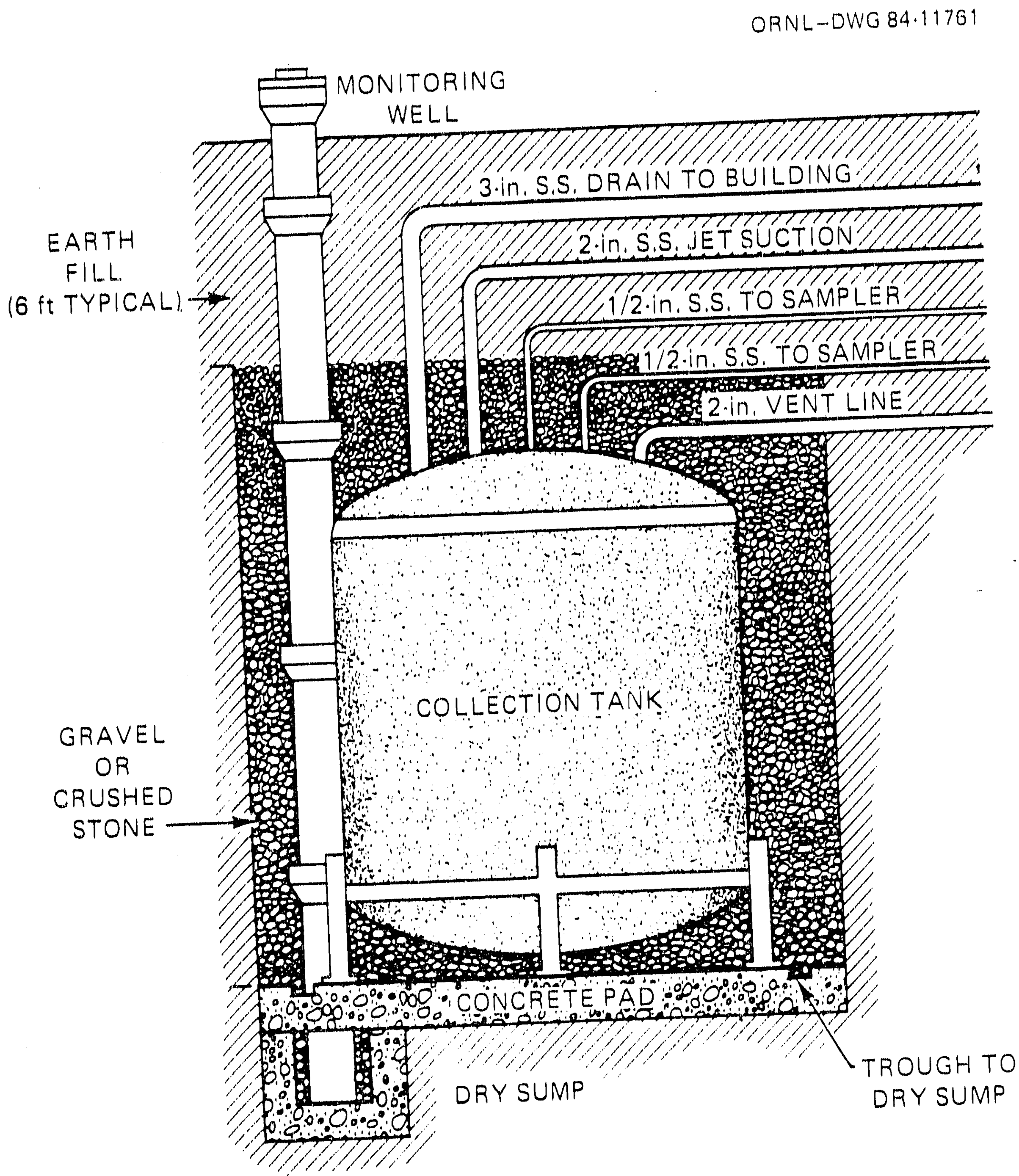


Fig. I.21. Typical stainless steel collection tank installation.

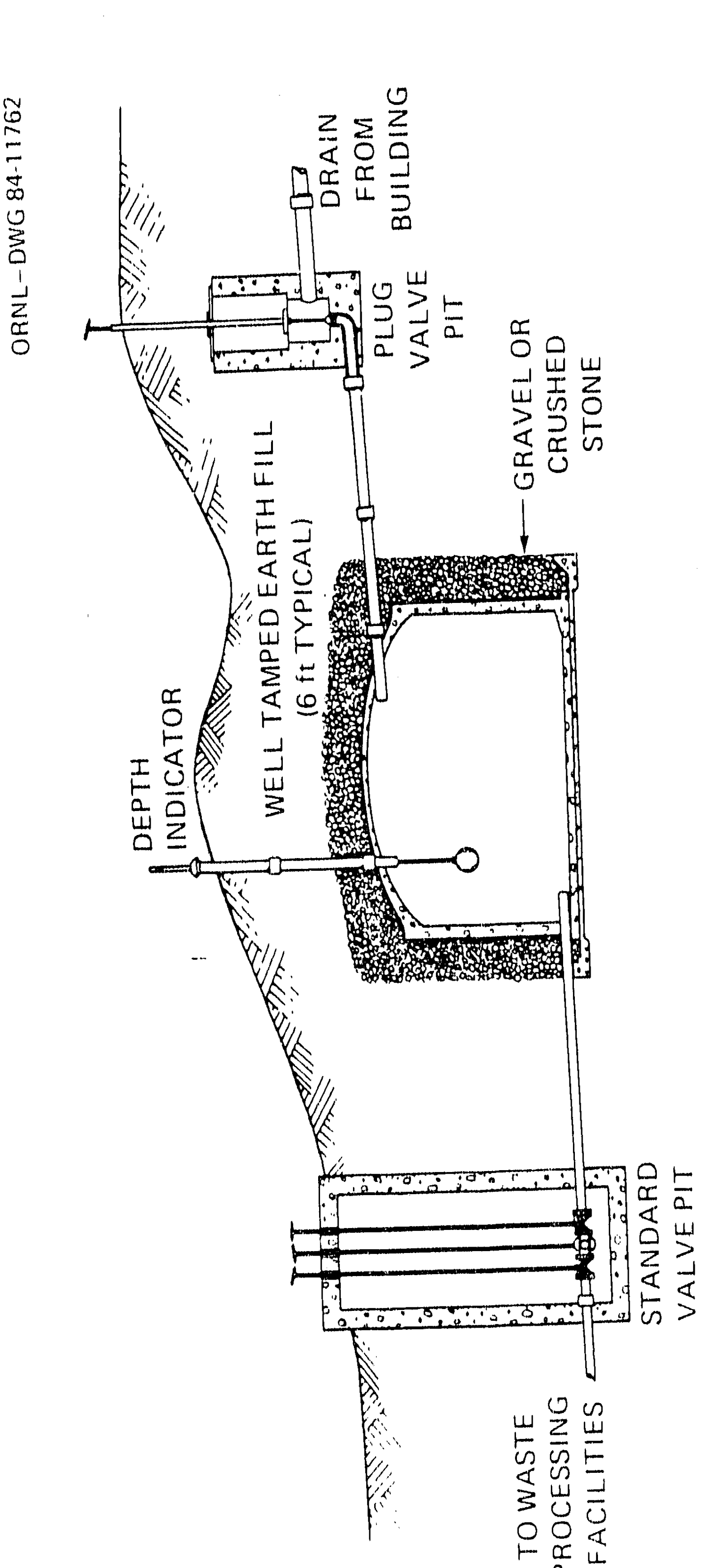


Fig. I.22. Typical concrete waste tank installation.

d. ***Facility Maintenance and Surveillance.*** Routine surveillance and tank farm monitoring is provided for all of the inactive waste tanks through the ORNL SFMP maintenance and surveillance program. The ORNL Waste Operations Control Center is utilized for continuous surveillance of collection tank inventories and transfers, and monitoring of groundwater in the vicinity of the tank farms. In addition, periodic sampling and analysis is conducted from dry wells adjacent to the tanks to give an indication of the tank containment integrity. Maintenance of monitoring equipment and controls is performed on an as-required basis in conjunction with operations at nearby active facilities. The routine maintenance and surveillance tasks involve approximately 0.2 man-year of annual SFMP support. No major facility repairs or improvements have been identified for these facilities in the near future.

e. ***Unique Conditions/Reuse Considerations.*** Due to their current conditions and design limitations, reuse of the abandoned waste tanks is not considered practical. The lack of double containment and the suspect integrity of many of the tanks would not allow their use for any long-term process applications. The presence of sludge in several of the tanks will complicate the decontamination and/or disposal tasks by requiring significant waste removal efforts prior to final decommissioning.

PROPOSED FACILITY DISPOSITION

a. ***Alternative Selection.*** The assessment of alternatives for the waste storage tanks centered around the two basic options of entombment and complete removal (dismantlement). As discussed above, reuse of the tanks is impractical due to the presence of leaks in many of the tanks and the outdated containment, transfer, and monitoring designs. The proposed alternative of tank dismantlement was determined to be the only option that provided an acceptable long-term solution to the abandoned tanks. Tank entombment would only result in an increase in the number of radioactive waste disposal sites at ORNL, and would permanently tie up potentially valuable areas within the main ORNL complex. Furthermore, entombment of the tanks would not adequately address the soil contamination problems that are associated with many of the abandoned tank farms.

b. ***Decommissioning Plan.***

1. ***Technical Plan.*** The conceptual plan for waste tanks decommissioning specifies the disposal of the residual waste in the tanks, the tanks themselves and all associated piping and controls, and the contaminated soil in the vicinity of the tanks. One-piece tank removal was selected for the stainless steel tanks and the smaller concrete tanks (<15,000 gal) with controlled segmenting specified for the larger concrete tanks. Prior to removal of any of the tanks, the remaining liquids and sludges would have to be removed. Although most of the tanks have been isolated from the active tank farm system, temporary tie-ins would be established to allow for access to the active process systems. Residual materials would be resuspended and transferred to the waste evaporator facility for volume reduction prior to disposal via hydrofracture. Additional decontamination of the interior of the tanks would be accomplished by chemical washing or concrete scarification, as appropriate. In addition to the removal of the tanks, all associated facilities (pump pits, valve stations, etc.) and contaminated soil would be disposed of as solid LLW. In some instances, only that soil immediately adjacent to the tanks would require disposal, while in other instances, the soil throughout the tank farm

would have to be removed. The transfer pipelines into and away from the sites would be removed to the nearest tie-in to the active system or at a well-defined site boundary. The final project task would involve restoration of the site to a natural, controlled state.

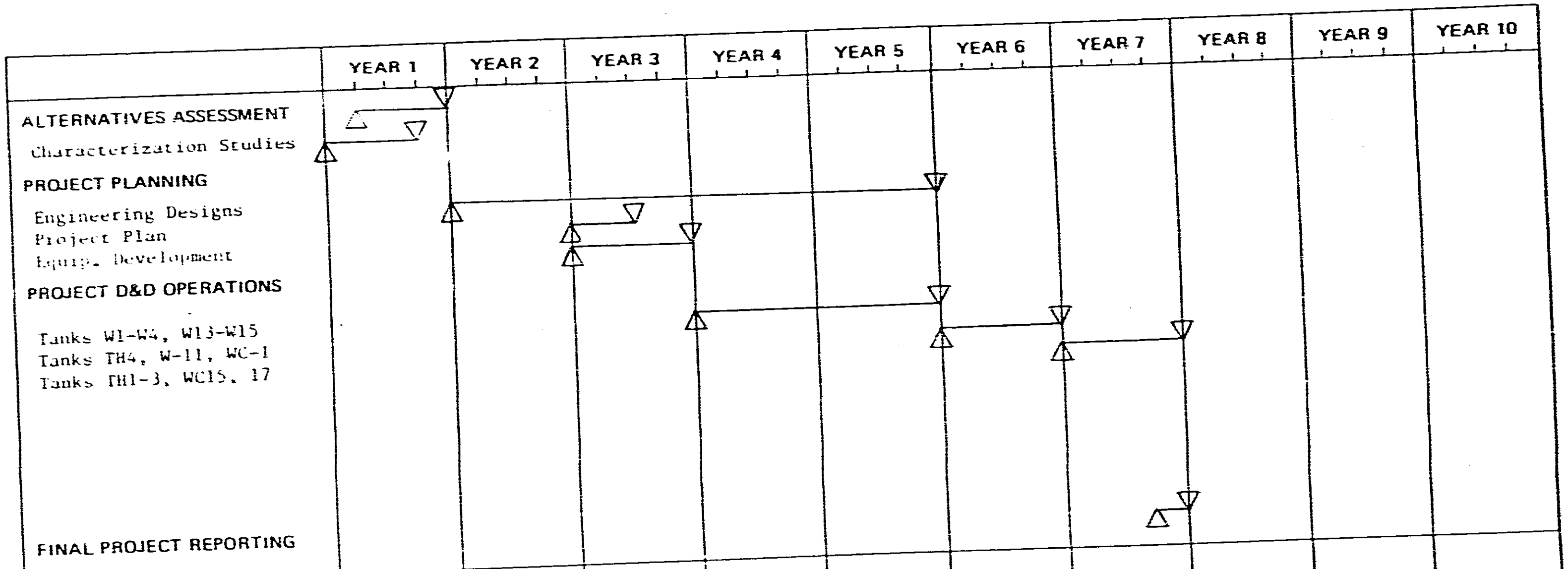
2. ***Special Equipment and Techniques.*** Both the decontamination and tank segmenting tasks will require development and use of special equipment and techniques. Sluicing and removal of the remaining liquids and sludge from the tanks will involve remote operated process equipment, as will the chemical decontamination and scarification of the interior surfaces. High pressure and ultra-high-pressure water jet systems have been specified for use for this project, with robotic control of the spray nozzels. Tank access would be made through the top utilizing special contained work platforms. Segmenting of the concrete tanks will require special containment to control the process, again utilizing the water jet system for abrasive cutting.

3. ***Cost, Schedule, and Waste Volume Projections.*** A summary of the project schedule, estimated costs and waste disposal requirements for the proposed waste storage tanks decommissioning project is provided in Fig. I.23. Project planning, D&D operations, and project closeout are estimated to extend over a period of approximately seven years, at a total estimated cost of $8.5 million. Approximately 4×10^5 ft^3 (1×10^4 m^3) of solid radioactive waste and 5.5×10^5 gal (2×10^3 m^3) of liquid waste will require appropriate handling and disposal.

PRIORITY DETERMINATION CONSIDERATIONS

Although the waste storage tanks present no immediate occupational, public, or environmental concern in their present conditions, the presence of such contaminated facilities in widely scattered locations in the main ORNL complex is not an acceptable long-term situation. Consideration should be given to disposition of tanks on a priority basis (based on hazard) as complete tank farms are abandoned. Removal of tanks from active locations should be avoided, unless deteriorating conditions require more immediate action.

ORNL-DWG 83-14840R2



PROJECT COSTS ($K)	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
Annual Expense	80	270	395	2950	2870	840	570			
Capital Equipment	–	240	240	25	25	25	10			
Total	80	510	635	2975	2895	865	580			

WASTE VOLUME PROJECTIONS	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
Solid (m^3)										
Soil (LLW)	–	–	–	4560	4560	500	470			
Soil (TRU)	–	–	–	–	–	–	–			
Rubble (LLW)	–	–	–	65	65	30	–			
Rubble (TRU)	–	–	–	–	–	–	–			
Metal (LLW)	–	–	–	30	30	5	5			
Metal (TRU)	–	–	–	–	–	–	–			
Misc. (LLW)	–	–	–	25	25	95	290			
Misc. (TRU)	–	–	–	–	–	–	–			
Total (LLW)	–	–	–	4680	4680	630	765			
Total (TRU)	–	–	–	–	–	–	–			
Liquid (m^3)										
Process Waste	–	–	–	–	–	–	–			
LLW	–	–	–	550	550	290	715			

Fig. I.23. Waste storage tanks decommissioning project summary.

PROJECT Storage Garden Decommissioning
FIELD OFFICE Oak Ridge **CONTRACTOR** Martin Marietta
BUDGET AND REPORTING CODE AH 10 20 00 **FTP/A No.** ONL-WD09 **SFMP WBS** 4.6.16
CONTRACTOR **FIELD OFFICE** **SFMPO**
PROJECT PRIORITY 13
PROPOSED DISPOSITION MODE Entombment
PRELIMINARY TEC $55 K **ESTIMATED PROJECT DURATION** 1 year

FACILITY DESCRIPTION

a. ***Operating History.*** The 3033 Storage Garden was used to store sealed radioactive sources, miscellaneous contaminated items, and irradiated targets prior to processing, during the period 1956 to 1975. Its use was discontinued due to the lack of need for this type of facility in its present location and due to the limited amount of shielding provided.

b. ***Physical Description.*** The facility consists of seven stainless steel cylinders, approximately 1 ft in diameter and 5 ft long, set in concrete with about 3 in. extending above ground-level. Each well is equipped with a shielded cover that extends approximately 1 ft into the well. Several of the wells contain metal storage racks. The garden is located immediately behind Building 3033, in a little used or accessed area Fig. (I.24).

c. ***Safety/Environmental Considerations.*** Only low levels of residual contamination remain in the storage garden, principally in the form of surface contamination on the steel walls. Beta-gamma dose rates on the interior of the wells range from <0.1 to 40 mrad/h, with measured transferable contamination levels from <200 to 9,400 dpm/100 cm^2. No stored radioactive materials or radiation sources remain in any of the wells. The garden is believed to be structurally sound, with no evidence of past leakage.

d. ***Facility Maintenance and Surveillance.*** Minimal routine maintenance and surveillance is required for this facility, due to the low levels of contamination present, its isolated and regulated location and the current structural conditions. Periodic radiological surveillance is conducted to document the site conditions, and maintenance performed only as required.

e. ***Unique Conditions/Reuse Considerations.*** There is limited reuse potential for the storage garden due to its shielding limitations and access restrictions. Current activities in the adjacent laboratories do not require this type of facility, nor would it be feasible to reuse the wells for storage of high-activity samples without structural modifications to provide double containment and additional shielding.

ORNL-PHOTO 0874-84

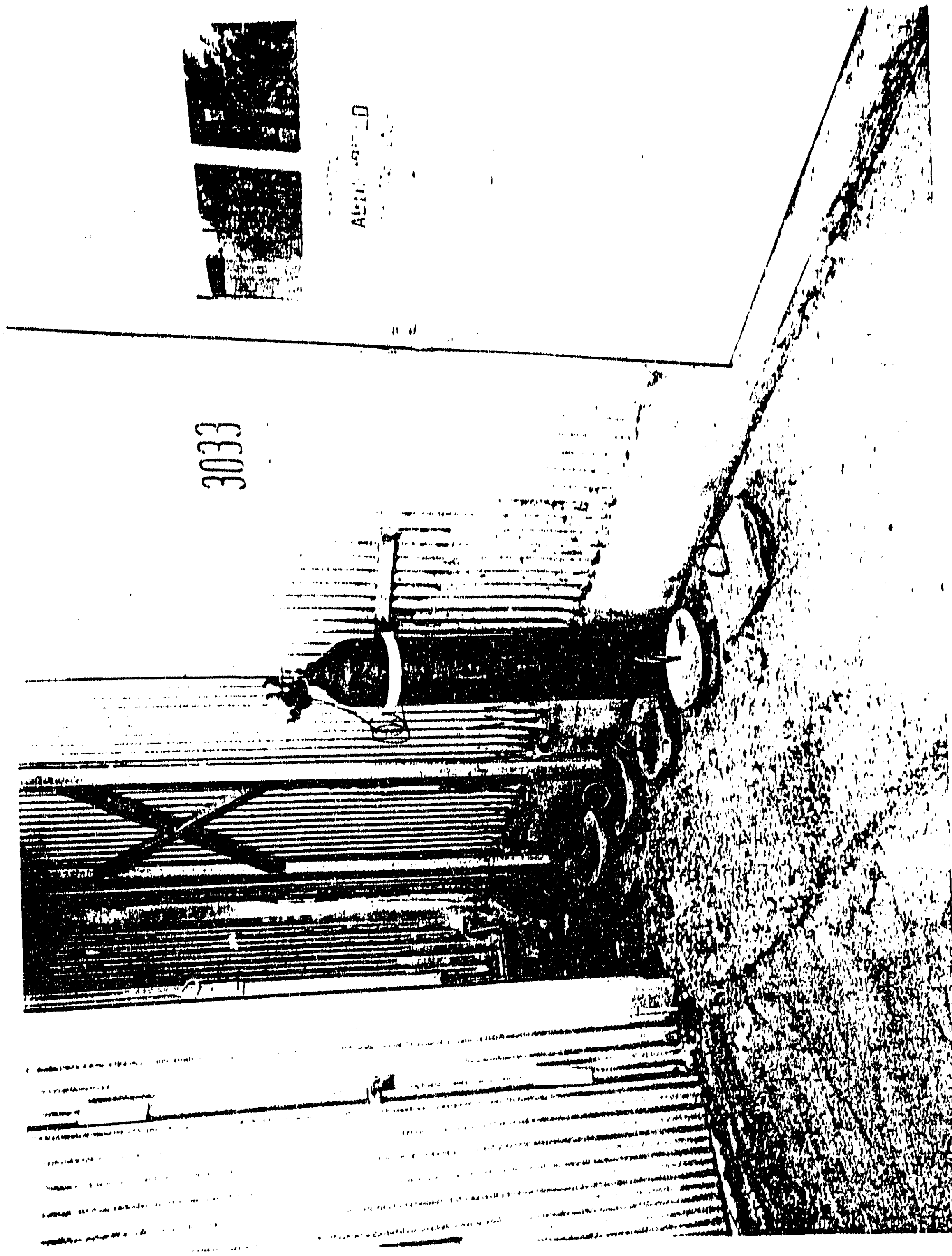


Fig. I.24. View of the 3033 Storage Garden.

PROPOSED FACILITY DISPOSITION

a. ***Alternative Selection.*** The location and structural characteristics of the 3033 Storage Garden severely restrict its reuse potential. In addition, due to the active research facilities immediately adjacent to the site, access limitations would hinder any significant dismantlement efforts. Therefore, it is proposed that the storage wells be decontaminated to low smear levels and entombed in place. This entombment is not expected to impact future use of this area nor place restrictions on the ultimate disposition of the adjacent facilities.

b. ***Decommissioning Plan.***

1. ***Technical Plan.*** Entombment of the storage garden would involve initial decontamination of the stainless steel wells and surrounding surface areas using standard chemical washing techniques. The storage racks and shielded covers would be removed and disposed of as LLW. Once manual decontamination efforts had resulted in acceptably low levels of residual surface contamination, the wells would be filled with grout, an appropriate cap poured over the entire garden area, and a permanent marker installed to document the entombment conditions.

2. ***Special Equipment and Techniques.*** No special equipment or techniques would be required for this project. Due to the low-levels of residual contamination, hands-on decontamination and use of long-handled tools are all that will be needed.

3. ***Cost, Schedule and Waste Volume Projections.*** A summary of the project schedule, estimated costs, and waste disposal requirements for the proposed Storage Garden Decommissioning Project is provided in Fig. I.25. Project planning, on-site D&D operations, and project closeout are estimated to extend over a period of approximately twelve months, at a total estimated cost of $55,000. Approximately 70 ft^3 (2 m^3) of solid waste will require appropriate handling and disposal.

PRIORITY DETERMINATION CONSIDERATIONS

Due to the isolated location of the storage garden, its low levels of residual contamination, and its structural integrity, there is no immediate incentive for decommissioning the site. However, due to the small magnitude of the proposed effort, it could be conducted whenever the required level of funding was available.

ORNL-DWG 83-14840R3

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
ALTERNATIVES ASSESSMENT					
PROJECT PLANNING					
Project Plan					
PROJECT D&D OPERATIONS					
Facility Decontamination					
Facility Entombment					
FINAL PROJECT REPORTING					
PROJECT COSTS ($K)					
Annual Expense	55				
Capital Equipment	–				
Total	55				
WASTE VOLUME PROJECTIONS					
Solid (m^3)					
Soil (LLW)	–				
(TRU)	–				
Rubble (LLW)	–				
(TRU)	–				
Metal (LLW)	1				
(TRU)	–				
Misc. (LLW)	1				
(TRU)	–				
Total (LLW)	2				
(TRU)	–				
Liquid (m^3)					
Process Waste	–				
LLW	–				

Fig. I.25. 3033 Storage Garden decommissioning project summary.

PROJECT Carbon-14 Process System Decommissioning
FIELD OFFICE Oak Ridge **CONTRACTOR** Martin Marietta
BUDGET AND REPORTING CODE AH 10 20 00 **FTP/A No.** ONL-WD09 **SFMP WBS** 4.6.19
CONTRACTOR **FIELD OFFICE** **SFMPO**
PROJECT PRIORITY 16
PROPOSED DISPOSITION MODE Passive Protective Storage
PRELIMINARY TEC * **ESTIMATED PROJECT DURATION** *

* Remaining project funding will be provided through maintenance and surveillance task.

FACILITY DESCRIPTION

a. ***Operating History.*** The carbon-14 process system was constructed in 1956 to prepare ^{14}C (as barium carbonate) from beryllium nitride targets that had been irradiated at Hanford. The facility was operated until 1975, when commercial production of ^{14}C eliminated the need for routine production of this radionuclide in a government facility.

b. ***Physical Description.*** The process facility is located in a containment enclosure in the southwest corner of Building 3033-A, a corregated-metal sided structure. The ^{14}C process equipment consisted primarily of a 20 gal dissolver vessel (glass-lined steel) located in a concrete shielded pit under the floor of the facility, a stainless steel glove-box, and a general process hood containing scrubbers, furnaces and gas converters (Fig. I.26). The equipment was housed in a 9 ft by 12 ft room with concrete floor, separated from adjacent laboratory facilities by a removable wall panel and access door. Decontamination efforts conducted in 1983-1984 resulted in the removal of all of the process equipment and placement of the facility into a passive protective storage mode. The room is now empty (Fig. I.27).

c. ***Safety/Environmental Considerations.*** Prior to the 1983-1984 decontamination efforts, the facility was significantly contaminated with beta activity associated with residual ^{14}C (up to 10^6 dpm/100 cm^2). This residual activity was the source of recurring contamination problems in the adjacent, active laboratory and was the reason for the decontamination campaign. At the conclusion of the facility decontamination efforts, all major sources of contamination were removed, the remaining activity fixed in-place, and the facility designated as a regulated zone (<1000 dpm/100 cm^2 transferable beta-gamma, <0.25 mrad/h direct beta-gamma). There are no significant safety or environmental concerns with the facility in its current condition.

ORNL-PHOTO 0600-83

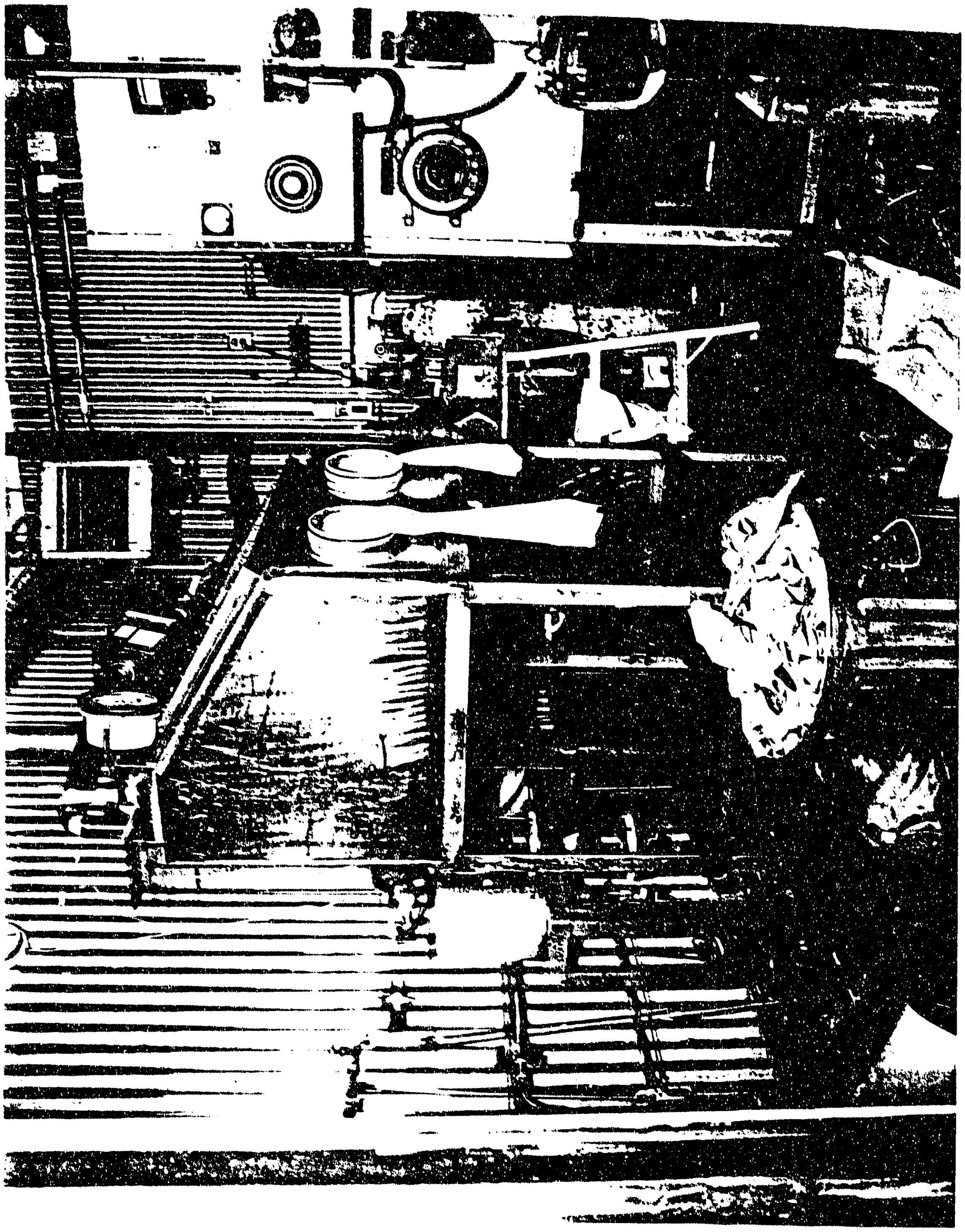


Fig. I.26. The carbon-14 process system prior to decontamination.

ORNL-PHOTO 2742-84

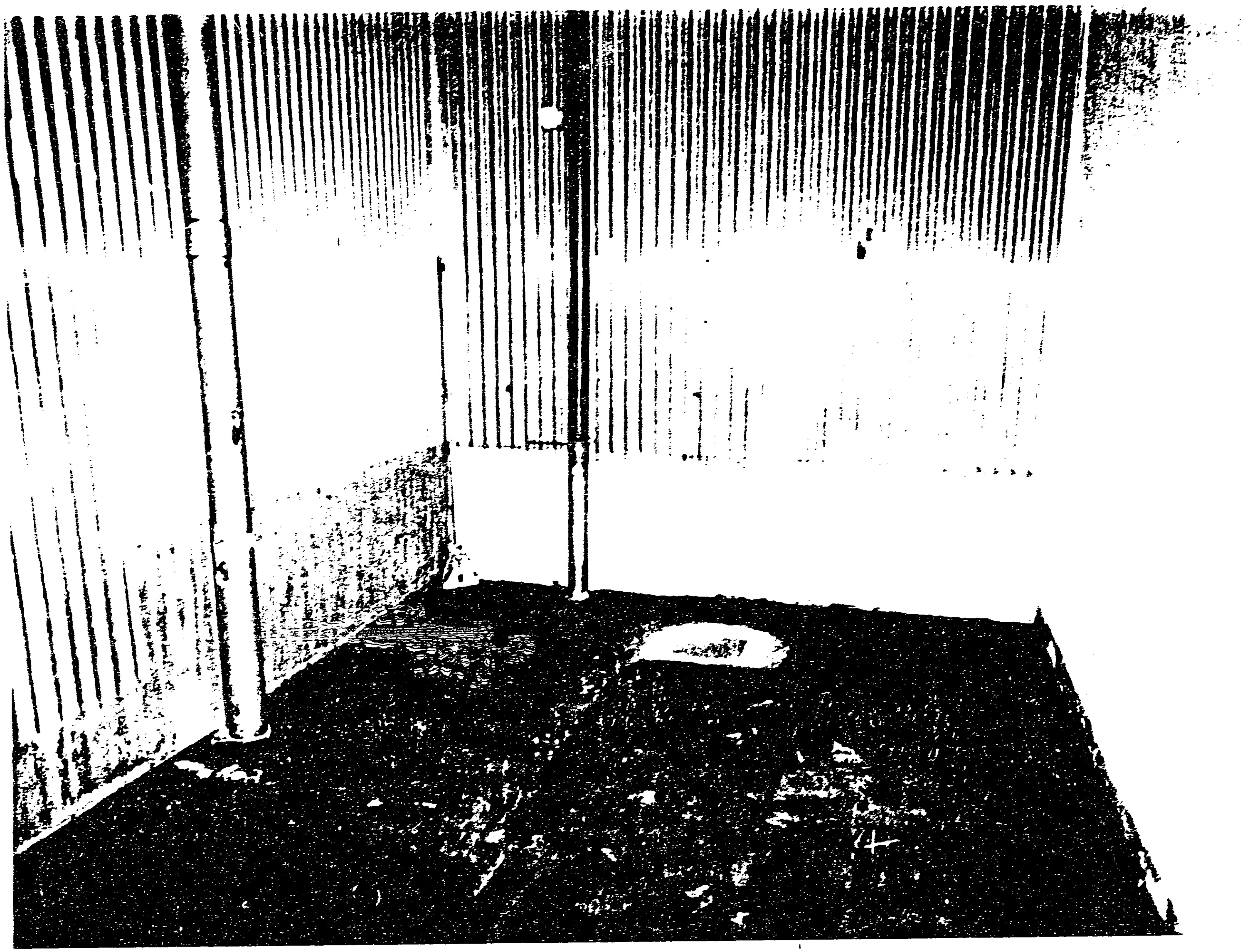


Fig. I.27. Current condition of the Carbon-14 Facility.

d. ***Facility Maintenance and Surveillance.*** In its present condition, the carbon-14 facility requires minimal annual maintenance and surveillance (<0.1 man-year). No major repairs have been identified through the planning period.

e. ***Unique Conditions/Reuse Considerations.*** The C-14 facility is in a reusable condition at the present time. The facility is located in the Isotopes area of ORNL, with adequate containment systems to allow for future processing applications. Few restrictions would be placed on the reuse of the site due to the low levels of fixed contamination remaining.

PROPOSED FACILITY DISPOSITION

The C-14 facility has been placed in a passive protective storage mode with all of the former process equipment and significant residual radioactive materials removed. No further decontamination or decommissioning efforts are planned for this facility. The site will be maintained under SFMP maintenance and surveillance control until an acceptable reuse for the site is found, or until final disposition of the adjacent laboratory (not currently an SFMP site) is undertaken. No additional decommissioning funding or waste generation is anticipated for this project.

PRIORITY DETERMINATION CONSIDERATIONS

As no project decommissioning funds will be required for this facility, no priority determination is necessary for this project.

PROJECT Waste Evaporator Facility Decommissioning
FIELD OFFICE Oak Ridge **CONTRACTOR** Martin Marietta
BUDGET AND REPORTING CODE AH 10 20 00 **FTP/A No.** ONL-WD09 **SFMP WBS** 4.6.20
CONTRACTOR **FIELD OFFICE** **SFMPO**
PROJECT PRIORITY 9
PROPOSED DISPOSITION MODE Dismantlement
PRELIMINARY TEC $650 K **ESTIMATED PROJECT DURATION** 2 years

FACILITY DESCRIPTION

a. ***Operating History.*** The Waste Evaporator Facility (Building 3506) received the LLW liquid waste streams from ORNL Laboratories and other processing areas during the period 1949-1954. The evaporator system was used for concentration and volume reduction of the liquid waste stream prior to its final disposal in the adjacent Melton Valley. The facilities were deactivated and placed into a standby mode when the currently active LLW evaporator facility (Building 2531) was brought on-line. Subsequent decontamination of the Waste Evaporator Facility was conducted to provide room for installation of experimental equipment for fission product purification studies and for demonstration of radioactive waste incineration. The facility has been inactive, except for use as a temporary storage area and change house, for approximately ten years.

b. ***Physical Description.*** The facility, located on the west end of the south tank farm (Site 3507), consists primarily of a reinforced concrete cell with underground piping, valve pit and an attached wood-framed operating area (Fig. I.28). Almost all of the original process equipment has been removed from the building during previous decontamination campaigns. As part of these decontamination efforts, a new concrete floor was poured in the cell area in order to fix any remaining activity. The building structure is basically sound, although the interior is in a state of disrepair due to its abandoned condition.

c. ***Safety/Environmental Considerations.*** Due to previous decontamination activities, the accessible areas of the facility contain only low levels of contamination. Contaminated pipe chases and surplus support equipment associated with the previous evaporator operations were found to exhibit dose rates up to 10 mrad/h, with transferable surface contamination of several thousand dpm/100 cm^2. The most significant radiological hazards remaining at the site are the abandoned valve pit on the north side of the cell, and the fixed contamination in the cell floor. Curie levels of residual radioactivity are known to remain in these areas, with estimated exposure rates of

ORNL-PHOTO 4724-84

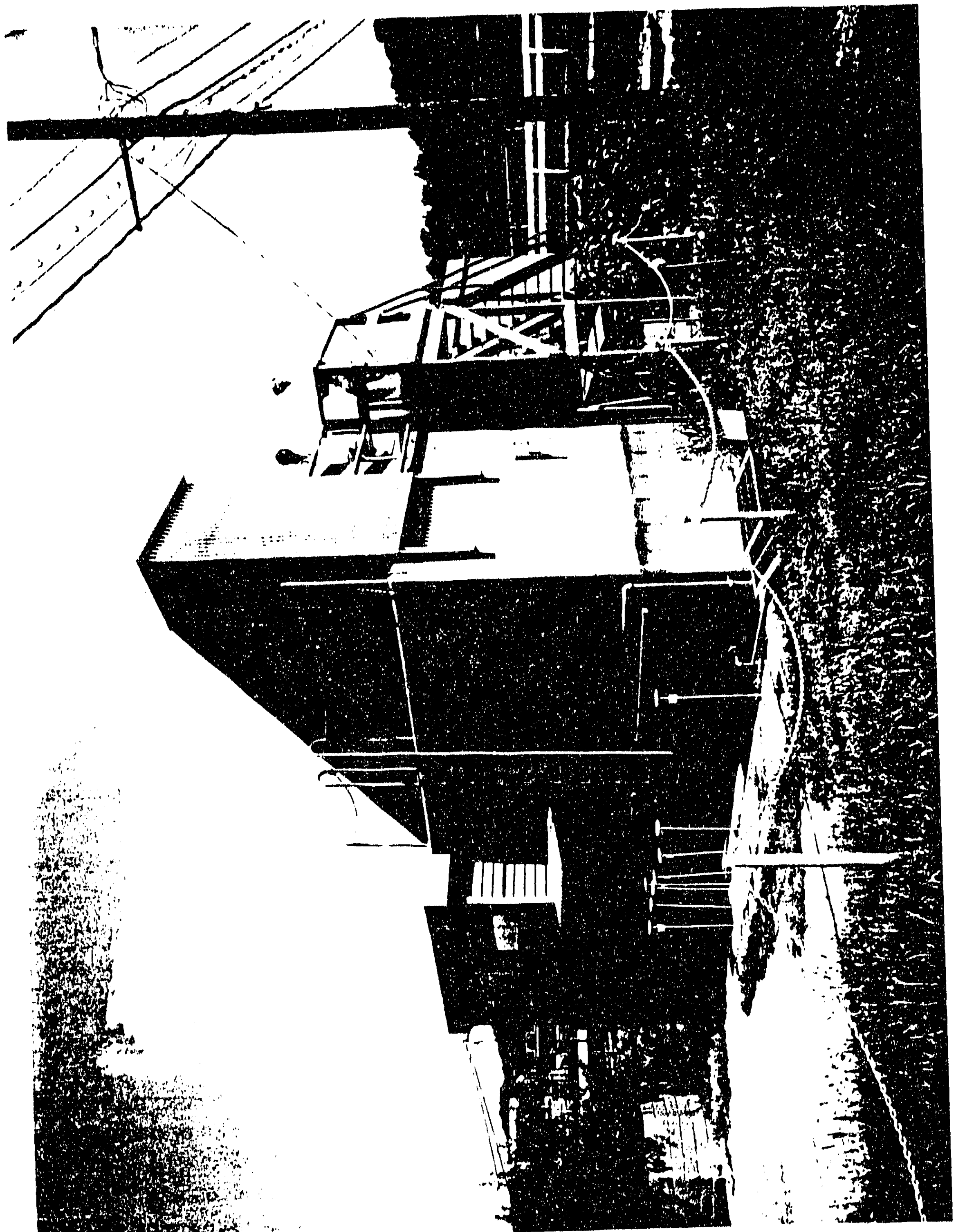


Fig. I.28. View of the Waste Evaporator Facility, looking southeast.

1–100 R/h. Soil contamination in the vicinity of the site is known to exist, associated with both the evaporator operations and the activities of the adjacent tank farm.

d. ***Facility Maintenance and Surveillance.*** Minimal routine maintenance or surveillance is required for the facility in its current state. Periodic safety inspections and radiological surveillance are conducted to document the status of the site. Maintenance of the facility is provided on an as-required basis. Less than 0.1 man-year of SFMP support is required for the M&S activities. No major repairs or improvements to this facility are planned for the near future.

e. ***Unique Conditions/Reuse Considerations.*** Due to structural deficiencies of the building, the lack of foreseeable need for this type of structure, and the restrictions that would be placed on future site usage in the tank farm area, there appears to be little reuse potential for the Waste Evaporator Facility.

PROPOSED FACILITY DISPOSITION

a. ***Alternative Selection.*** As discussed above, the limited reuse potential of the facility leaves the options of entombment and dismantlement as the most feasible decommissioning alternatives. Facility entombment, although technically acceptable, would place restrictions on the future use of the site and would result in either a near-surface or above-ground monolithic structure. The presence of such a structure in a centrally located area of the Laboratory would not be desirable or consistent with the current policy of separating waste disposal operations from the main ORNL research areas. Due to the relatively low levels of contamination remaining at the site, and the simplicity of the facility, structural dismantlement appears feasible. It would not result in significantly more personnel exposure, cost, or burial ground space than the entombment option. In addition, the dismantlement option provides for a more comprehensive clean-up of the contaminated soil associated with the site. Therefore, based on these considerations, facility dismantlement has been chosen as the proposed decommissioning alternative.

b. ***Decommissioning Plan.***

1. ***Technical Plan.*** The conceptual plan for facility dismantlement is relatively straightforward. The two primary areas of concern are the contaminated valve pit and the fixed activity in the cell floor. Dismantlement activities would begin with removal of the uncontaminated or slightly contaminated upper structures. After providing adequate containment over the more contaminated evaporator cell and valve pit, concrete segmenting would be conducted. The valve pit would be cut loose from its transfer piping and removed intact. Similarly, the evaporator cell floor would be cut into blocks and removed intact as individual pieces. By avoiding the extensive decontamination that would be required for more piecemeal dismantlement, significant cost and personnel exposure could be avoided. After the building has been razed, the contaminated soil under the site, as well as the soil and piping immediately adjacent to the site, would be removed. Utility services, transfer piping, and cell ventilation ductwork would be capped at the established site boundary. Site grade would be reestablished after dismantlement is completed, to be consistent with the surrounding area.

2. ***Special Equipment and Techniques.*** Special equipment and facilities would be required to provide containment of the dismantlement operations and for concrete cutting. Modifications to the existing cell ventilation system may be sufficient for contamination control, or a new

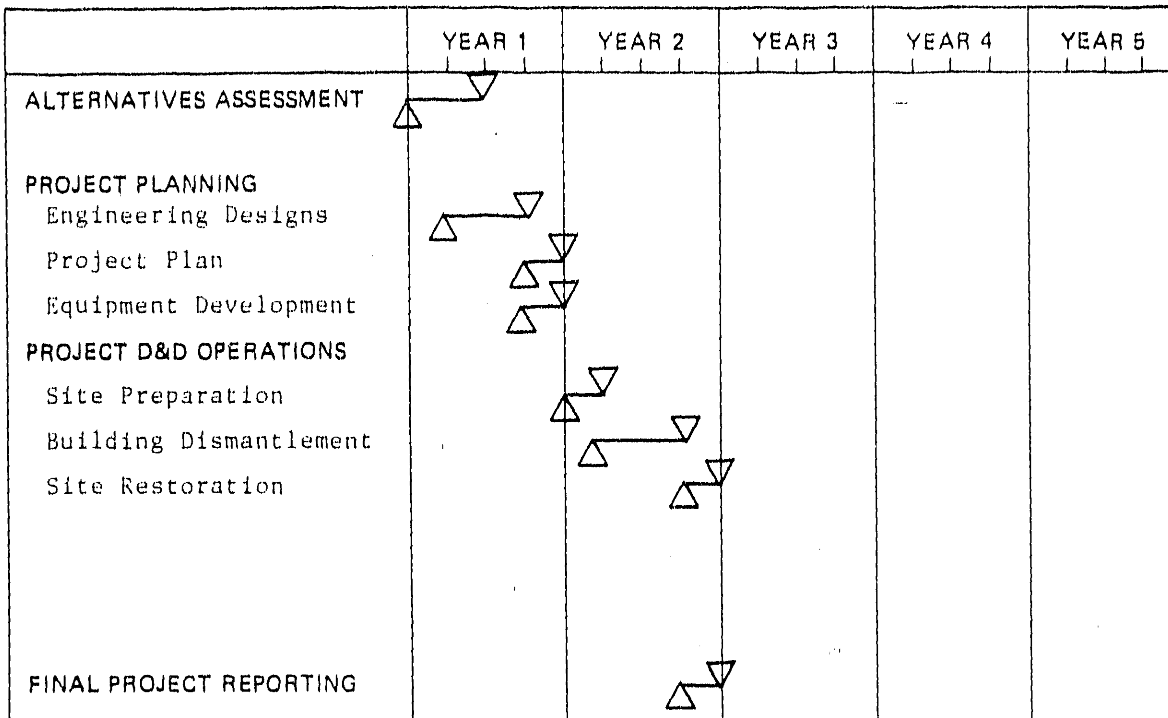
ventilation and filtration system required. An additional temporary enclosure will be necessary once the structural dismantlement of contaminated areas begins. Ultra-high-pressure water jet abrasive cutting capabilities should be available for use on this project for the concrete segmenting needs.

3. ***Cost, Schedule, and Waste Volume Projections.*** A summary of the project schedule, estimated costs and waste disposal requirements for the proposed Waste Evaporator Facility decommissioning project is provided in Fig. I.29. Project planning, D&D operations, and project closeout are estimated to extend over a period of approximately two years, at a total estimated cost of $650,000. Approximately 2×10^4 ft^3 (645 m^3) of solid radioactive waste and 8×10^3 gal (30 m^3) of liquid waste will require appropriate handling and disposal. No significant volumes of low-contamination level stainless steel will be generated.

PROJECT DETERMINATION CONSIDERATIONS

In its present condition, the Waste Evaporator Facility does not pose any immediate hazard to ORNL personnel, the public, or the environment. Decommissioning of the facility should be coordinated with the final disposition of the adjacent facilities in the south tank farm area, due to their location, the interrelationships between facility services, piping, and ventilation systems, and the need to address the soil contamination problem of the whole area at one time.

ORNL-DWG 83-14840R3



	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
PROJECT COSTS ($K)					
Annual Expense	125	490			
Capital Equipment	25	10			
Total	150	500			
WASTE VOLUME PROJECTIONS					
Solid (m^3)					
Soil (LLW)	–	225			
(TRU)	–	–			
Rubble (LLW)	–	400			
(TRU)	–	–			
Metal (LLW)	–	–			
(TRU)	–	–			
Misc. (LLW)	–	20			
(TRU)	–	–			
Total (LLW)	–	645			
(TRU)	–	–			
Liquid (m^3)					
Process Waste	–	–			
LLW	–	30			

Fig. I.29. Waste Evaporator Facility decommissioning project summary.

PROJECT Fission Product Pilot Plant Decommissioning
FIELD OFFICE Oak Ridge **CONTRACTOR** Martin Marietta (ORNL)
BUDGET AND REPORTING CODE AH 10 20 00 **FTP/A NO.** ONL-WD09 **SFMP WBS** 4.6.21

	CONTRACTOR	**FIELD OFFICE**	**SFMPO**
PROJECT PRIORITY	8		

PROPOSED DISPOSITION MODE Dismantlement
PRELIMINARY TEC $1,065 K **ESTIMATED PROJECT DURATION** 3 years

FACILITY DESCRIPTION

a. ***Operating History.*** The Fission Product Pilot Plant (FPPP), as now named, first existed in 1948 and was referred to as the ^{106}Ru tank arrangement. At that time, the facility consisted of a concrete pad with tanks, surrounded by stacks of concrete blocks. Several modifications around 1950-51 resulted in a hot cell facility with attached operating areas. The FPPP was used in the fission product development program for the separation of curie quantities of various radionuclides from LLW liquid waste streams. It was abandoned in 1958 when it was replaced by the Fission Product Development Laboratory (WBS 4.6.8).

b. ***Physical Description.*** The facility consists primarily of an unlined concrete-shielded cell, approximately 20 ft by 10 ft by 8 ft high, with an adjacent shielded operating area. At the time it was abandoned, the hot cell contained several small (50-gal capacity) stainless steel vessels and columns, with associated piping, valving and controls. After shutdown, the remaining hot cell portion of the building was sealed with concrete block and additional concrete block shielding added to reduce the radiation levels in the surrounding area. The total wall thickness of the current structure varies from 3 1/2 to 4 1/2 ft with a 2 ft concrete roof. All entrances to the building are completely sealed. The FPPP (Building 3515) is located on the east side of the south tank farm (Fig. I.30).

c. ***Safety/Environmental Considerations.*** Radiation levels within the hot cell prior to facility closure ranged up to 100 R/h, with the major contaminants being ^{137}Cs and ^{90}Sr. The residual radionuclide inventory is believed to be in the range of 10 to 100 Ci, although no recent survey information is available due to the lack of direct access. Contamination is known to be present underneath and adjacent to the building due to drain line leaks during past operations. The current encasement structure appears to be structurally sound and providing adequate containment.

d. ***Facility Maintenance and Surveillance.*** Minimal routine maintenance or surveillance is required for the FPPP in its current contained condition. Annual safety inspections and periodic radiologi-

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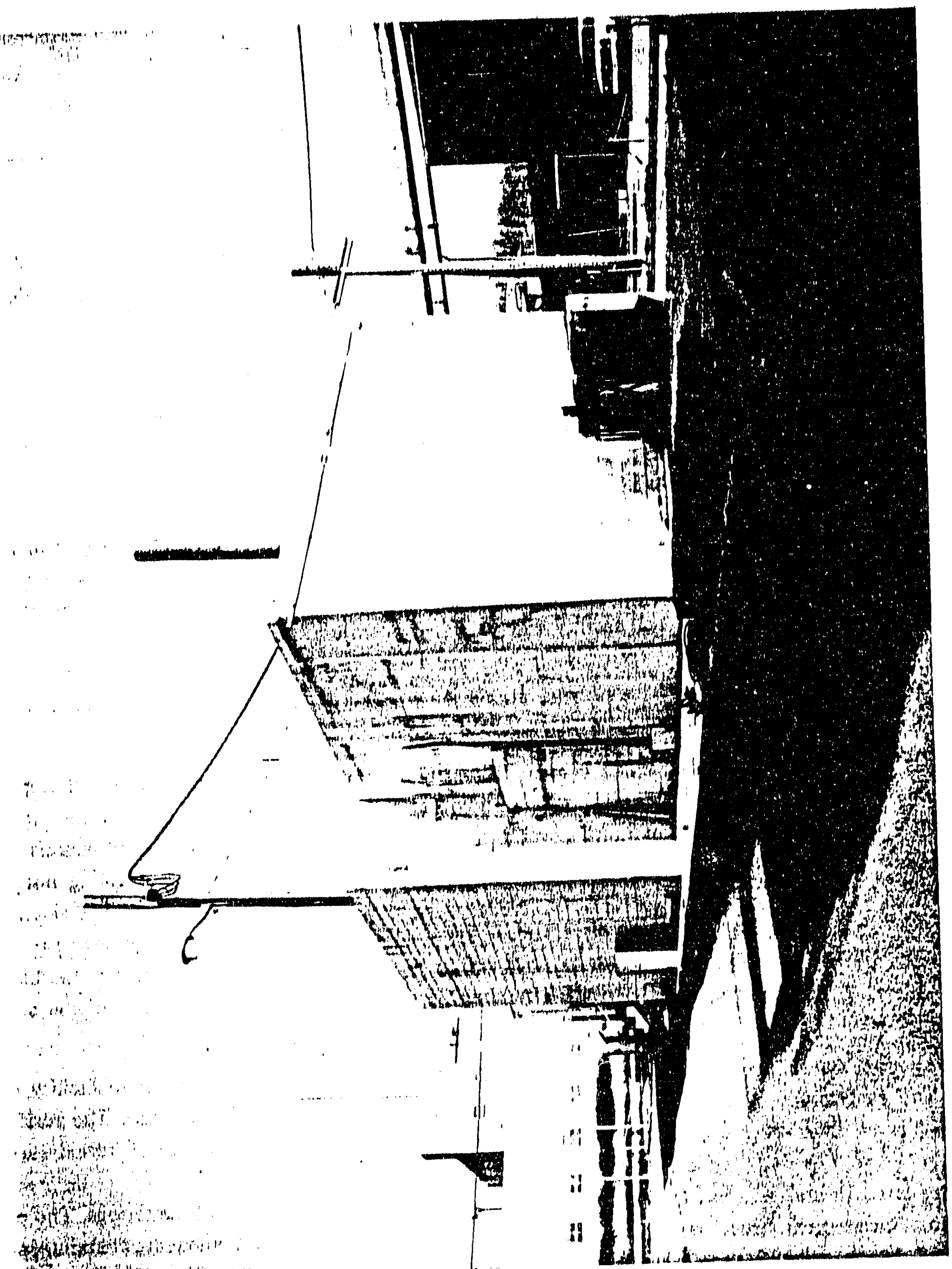

Fig. I.30. View of the Fission Product Pilot Plant, Building 3515.

cal surveillance are performed to document the conditions of the site. No routine maintenance is performed, and no major repairs or improvements are anticipated in the near future.

e. ***Unique Conditions/Reuse Considerations.*** Due to the high contamination levels associated with the building, process equipment and surrounding soil, reuse of the FPPP appears to be impractical. In addition, the current structural encasement and facility location in the south tank farm would place significant restrictions on any future applications of the site.

PROPOSED FACILITY DISPOSITION

a. ***Alternative Selection.*** As discussed above, the limited reuse potential of the facility leaves the options of entombment and dismantlement as the most feasible decommissioning alternatives. Facility entombment, although technically acceptable, would place long-term restrictions on the future use of the site and would result in a permanent above-ground monolithic structure. The presence of such a structure in a centrally located area of the Laboratory would not be desirable or consistent with the current policy of separating waste disposal operations from the main ORNL research areas. In addition, the entombment option would not effectively deal with the soil contamination problems immediately adjacent to and below the building. Based on these concerns, facility dismantlement has been proposed for the FPPP.

b. ***Decommissioning Plan.***

1. ***Technical Plan.*** The conceptual plan for facility dismantlement includes: (1) preparation of the site for decommissioning operations, (2) decontamination of the building surfaces and equipment, (3) removal of all equipment from the cell and operating areas, (4) further decontamination and/or scarification of wall and floor surfaces to levels that allow for dismantlement, (5) controlled dismantlement of the concrete structure, (6) removal of contaminated soil in the vicinity of the site, and (7) final site restoration. Access into the encased structure would be gained through the roof, and the majority of the operations conducted remotely from that level. Additional containment would have to be provided over this work area, including a self-contained ventilation system. Collection and transfer of the decontamination liquid wastes would have to be provided through a new system. Concrete segmenting and handling would also have to be performed under additional containment due to the high levels of contamination. The contaminated equipment, concrete, and soil would be handled as solid LLW, with the liquids routed to the LLW treatment system.

2. ***Special Equipment and Techniques.*** Special equipment and facilities would be required to provide containment of the dismantlement operations and for concrete cutting. A stand-alone ventilation system, including appropriate filtration and discharge, would have to be installed prior to initiation of in-cell work. The units being utilized for the Metal Recovery Facility decommissioning effort (WBS 4.6.7) may serve this need, with some modifications. A temporary enclosure over the entire facility will be necessary for both equipment removal and building dismantlement activities. Ultra-high-pressure water jet abrasive cutting capabilities should be available for use on this project for the concrete segmenting needs.

3. ***Cost, Schedule, and Waste Volume Projections.*** A summary of the project schedule, estimated cost, and waste disposal requirements for the proposed FPPP decommissioning project is provided in Fig. I.31. Project planning, D&D operations, and project closeout are

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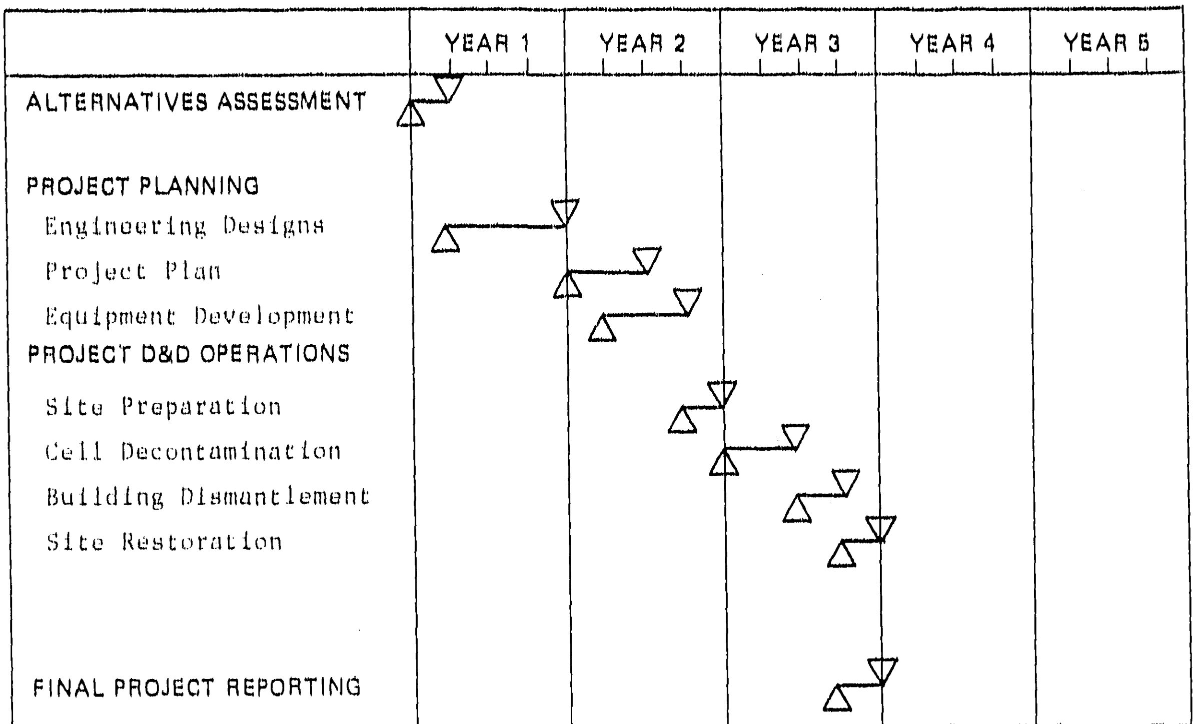

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
PROJECT COSTS ($K)					
Annual Expense	145	45	565		
Capital Equipment	–	300	10		
Total	145	345	575		
WASTE VOLUME PROJECTIONS					
Solid (m^3)					
Soil (LLW)	–	–	430		
(TRU)	–	–	–		
Rubble (LLW)	–	–	570		
(TRU)	–	–	–		
Metal (LLW)	–	–	5		
(TRU)	–	–	–		
Misc. (LLW)	–	–	5		
(TRU)	–	–	–		
Total (LLW)	–	–	1010		
(TRU)	–	–	–		
Liquid (m^3)					
Process Waste	–	–	–		
LLW	–	–	200		

Fig. I.31. Fission Product Plant decommissioning project summary.

estimated to extend over a period of approximately three years, at a total estimated cost of about \$1.1 million. Approximately 3.6×10^4 ft^3 (1010 m^3) of solid radioactive waste and 5.3×10^4 gal (200 m^3) of liquid waste will require appropriate handling and disposal. No significant volume of low-contamination level stainless steel will be generated.

PRIORITY DETERMINATION CONSIDERATIONS

In its present condition, the FPPP does not pose any immediate hazard to ORNL personnel, the public, or the environment. Decommissioning of this facility should be coordinated with the final disposition of the adjacent facilities in the south tank farm area, due to their location, the interrelationships between facility services, piping, and ventilation systems, and the need to address the soil contamination problem of the whole area at one time.

PROJECT Shielded Transfer Tanks Decommissioning

FIELD OFFICE Oak Ridge **CONTRACTOR** Martin Marietta (ORNL)

BUDGET AND REPORTING CODE AH 10 20 00 **FTP/A NO.** ONL-WD09 **SFMP WBS** 4.6.22

	CONTRACTOR	FIELD OFFICE	SFMPO
PROJECT PRIORITY	15		

PROPOSED DISPOSITION MODE Entombment (Shallow Land Burial)

PRELIMINARY TEC $500 K **ESTIMATED PROJECT DURATION** 1 year

FACILITY DESCRIPTION

a. ***Operating History.*** Four model II Shielded Transfer Tanks (STT-II) and one gunbarrel tank (STT-III) were used repeatedly during the 1960s for shipment of ^{137}Cs-loaded ion exchange resins from Hanford Atomic Products Operations (HAPO) to the ORNL Fission Product Development Laboratory (FPDL) for further processing. The STT-IIs had been used even earlier (late 1950s) to transport lower concentrations of aqueous cesium and strontium waste from Arco, Idaho, to ORNL without the use of the ion-exchange medium. Three of the STT-IIs and the STT-III were removed from service in 1967. A fourth STT-II was modified later and utilized in the period 1970-71 for transferring a caustic solution with high-level fission product waste within ORNL.

b. ***Physical Description.*** A schematic of the three unmodified, lead shielded STT-IIs, including the fire shield originally used in transport, is shown in Fig. I.32. The bare, empty tanks weigh approximately 31,000 lbs. The modified STT-II, shown in Fig. I.33, included an operator's platform and access ladder. The STT-III was fabricated from a surplus gun barrel, with dimensions as shown in Fig. I.34. All five shielded tanks have lifting fixtures adequate for safe handling. The tanks are stored outdoors in a materials storage yard in Solid Waste Storage Area 4.

c. ***Safety/Environmental Considerations.*** Three of the four STT-II tanks still contain approximately 400 gal of DeCalso inorganic ion-exchange media that has been stripped of most of the ^{137}Cs. The other Model II tank contains an unknown amount of actinide-contaminated sludge that could not be removed when the final transfer was made from the tank. The STT-III tank is believed to contain approximately 150 gal of AW-500 inorganic ion-exchange media, also stripped of the majority of the fission products. The principal contaminant remaining in the tanks is residual ^{137}Cs, with a range of estimated activity between 50–700 Ci each. There is no evidence of loss of containment in any of the tanks. The tanks are stored without protection from the environment and are only showing signs of minor external deterioration.

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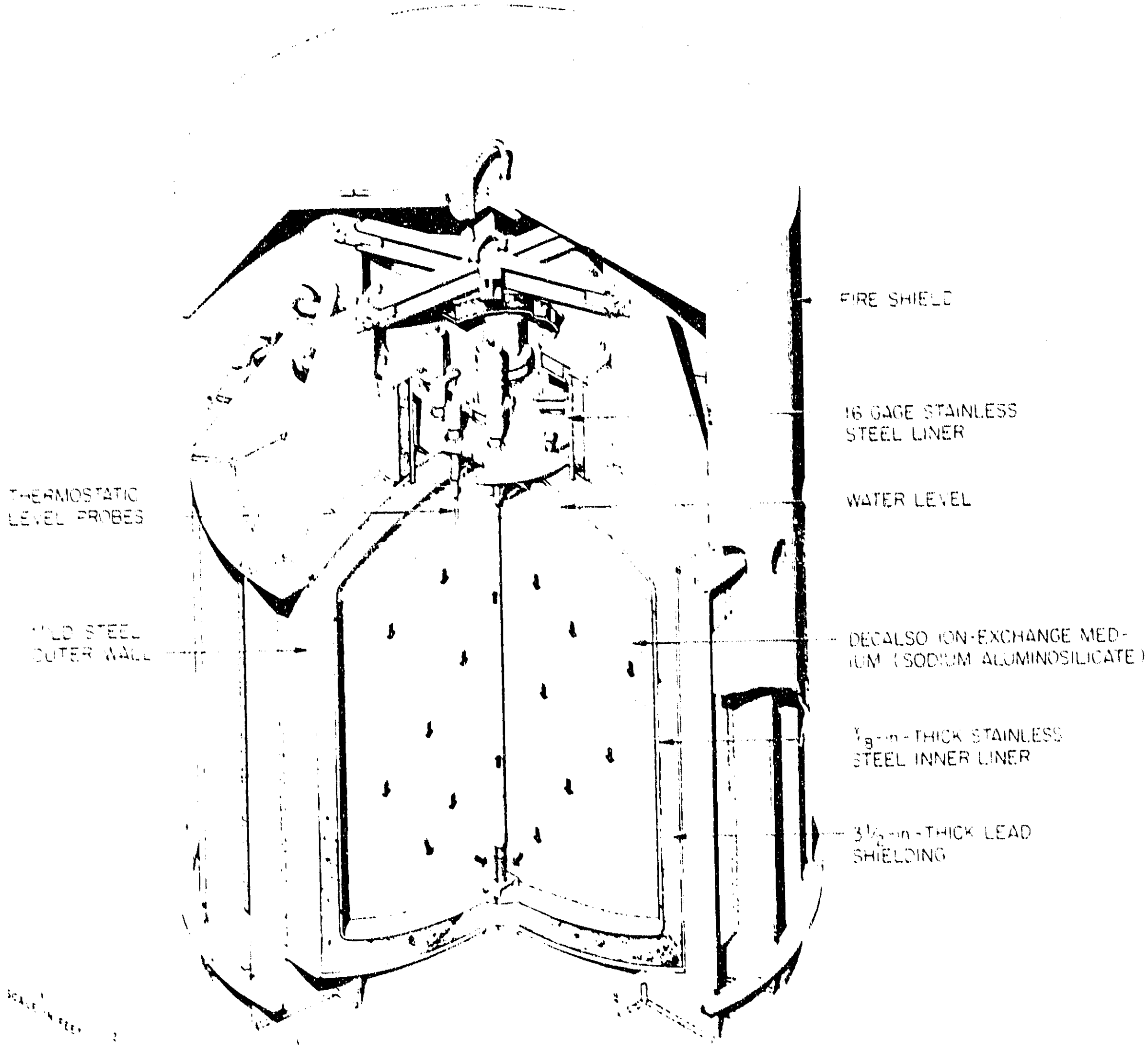

Fig. I.32. Schematic view of the unmodified STT-IIs (RD-C-43, 47, and 48).

ORNL-PHOTO 5559-79

Fig. I.33. Modified STT-Model II tank.

ORNL-DWG 79-20020

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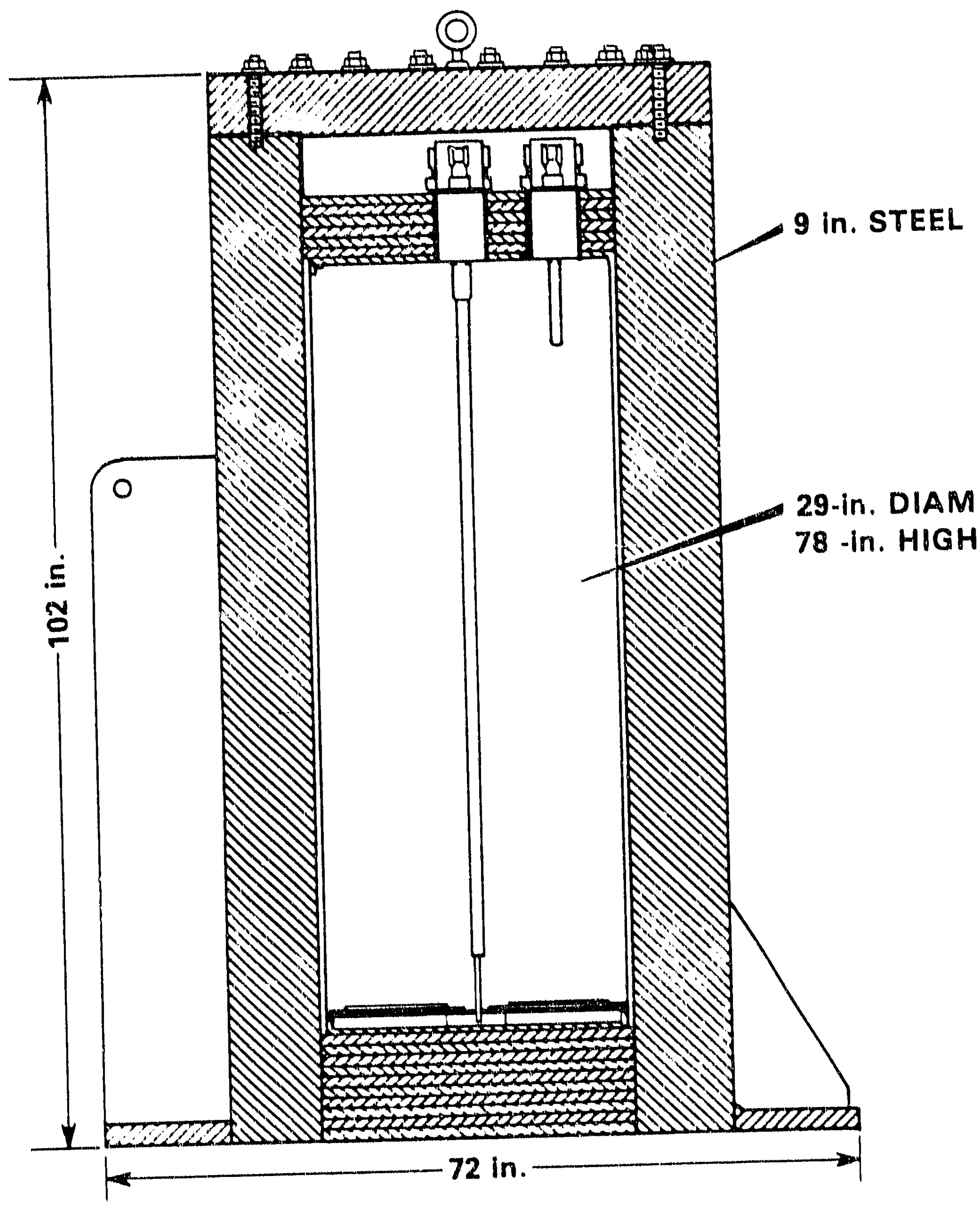
SHIELDED TRANSFER TANK-MODEL III



WEIGHT—42,000 lb.
AUTHORIZED CONTENTS—90,000 Ci ^{137}Cs.

Fig. I.34. STT-Model III (gunbarrel tank).

d. ***Facility Maintenance and Surveillance.*** Routine surveillance of external surface contamination and radiation levels is conducted for each of the tanks, requiring approximately 0.1 man-year of effort. No routine maintenance is required.

e. ***Unique Conditions/Reuse Considerations.*** Due to the presence of liquids in four of the tanks and actinide-contaminated sludge in the fifth, direct burial of the tanks in their present form would be unacceptable according to current ORNL waste disposal guidelines. As a minimum, free liquids would have to be removed or converted to a solid form and TRU concentrations certified prior to burial.

PROPOSED FACILITY DISPOSITION

a. ***Alternative Selection.*** At the present time there appears to be no viable reuse application for these tanks at ORNL or other DOE sites. Extensive decontamination and structural alterations would be necessary to make these tanks acceptable for in-plant transfers, much less over-the-road transport. Similarly, the cost of decontamination and dismantlement of the tanks would far exceed the salvage potential of the lead shielding or other structural materials present. Based on these factors, the decommissioning alternative proposed for these tanks is a form of entombment involving final disposal as LLW.

b. ***Decommissioning Plan.***

1. ***Technical Plan.*** The proposed decommissioning plan for the STTs would involve (1) transport of the tanks to a controlled environment for venting of gases and removal of free liquids and TRU-contaminated sludge, (2) addition of a grout mix to the tanks to immobilize the remaining waste and fill the void volume, and (3) burial of the entombed tanks in the ORNL Solid Waste Storage Area as low-level solid waste. The conceptual plan for disposition of the STTs has been developed based on use of the FPDL (Building 3517) for tank handling, material processing and void grouting. Only minor modifications and facility upgrade would be required at the FPDL for performance of this task. Special grout studies and tests would be conducted to specify suitable materials as well as mixing and grouting procedures.

2. ***Special Equipment and Techniques.*** No special equipment or techniques will be required for this project, assuming that the facilities at the FPDL are available for use when required.

3. ***Cost, Schedule, and Waste Volume Projections.*** A summary of the project schedule, estimated costs and waste disposal requirements for the proposed STT decommissioning is provided in Fig. I.35. Project planning, D&D operations, and project closeout are estimated to extend over a period of one year at a total estimated cost of $500,000. Approximately 1500 ft^3 (42 m^3) of solid LLW and 500 gal (2 m^3) of liquid LLW will be generated during the course of the project. No significant volumes of low-contamination level stainless steel will be generated.

PRIORITY DETERMINATION CONSIDERATIONS

The primary concern with decommissioning these tanks is the availability of the FPDL for processing and of personnel knowledgeable about the previous tank operations. Both concerns could be eliminated by near-term disposition of the tanks.

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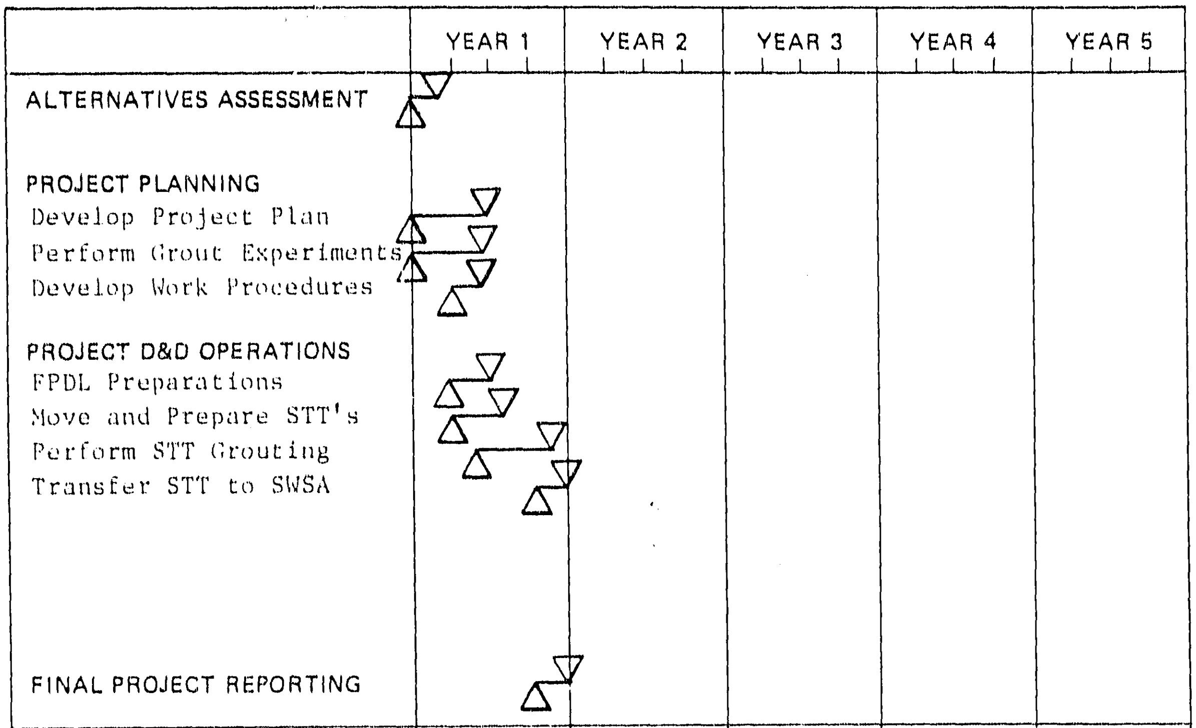

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
PROJECT COSTS ($K)					
Annual Expense	500				
Capital Equipment	–				
Total	500				
WASTE VOLUME PROJECTIONS					
Solid (m^3)					
Soil (LLW)	–				
(TRU)	–				
Rubble (LLW)	–				
(TRU)	–				
Metal (LLW)	40				
(TRU)	–				
Misc. (LLW)	–				
(TRU)	–				
Total (LLW)	40				
(TRU)	–				
Liquid (m^3)					
Process Waste	–				
LLW	5				

Fig. I.35. Shielded Transfer Tanks decommissioning project summary.

PROJECT Molten Salt Reactor Experiment Decommissioning
FIELD OFFICE Oak Ridge **CONTRACTOR** Martin Marietta (ORNL)
BUDGET AND REPORTING CODE AH 10 20 00 **FTP/A NO.** ONL-WD15 **SFMP WBS** 4.6.6
CONTRACTOR **FIELD OFFICE** **SFMPO**
PROJECT PRIORITY 4
PROPOSED DISPOSITION MODE Disposal of Fuel, Entombment of Reactor
PRELIMINARY TEC $30,000 K **ESTIMATED PROJECT DURATION** 10 years

FACILITY DESCRIPTION

a. *Operating History.* The Molten Salt Reactor Experiment (MSRE) was a single-region, unclad graphite-moderated, homogeneous-fueled reactor built to investigate the practicality of the molten salt reactor concept for central power station application. It was operated from June 1965 to December 1969 at a nominal full power level of 8.0 MW. The circulating fuel solution was a mixture of lithium, beryllium, and zirconium-fluoride salts, containing uranium fluoride as the fuel. The initial fuel charge was highly enriched ^{235}U, which was later replaced with a charge of ^{233}U. Processing capabilities were included as part of the facility for on-line fuel additions, removal of impurities, and uranium recovery. A total of 105,737 MWh was accumulated in the two phases of operation. Following reactor shutdown, the fuel and flush salts were drained to critically safe storage tanks and isolated.

b. *Physical Description.* The primary reactor components (reactor vessel, coolant equipment, fuel transfer and storage system, and fuel processing system) were located below grade in reinforced concrete containment cells (Fig. I.36). Access to these cells is through removable concrete roof plugs. The reactor and associated equipment are housed in a steel, concrete, and transite structure (Fig. I.37) that includes special containment features. The containment cells and high-bay area are maintained under negative pressure, with an active ventilation system consisting of centrifugal fans and roughing and HEPA filters exhausting through a 100-ft steel discharge stack. The heat dissipation system included a salt-to-air radiator exhausting through a steel stack and a drain tank for storage of the salt (currently full). Ancillary facilities at the site include an office building (7509), a diesel generator house, utility building, blower house, cooling water tower, and vapor condensing system, as shown in Fig. I.38.

c. *Safety/Environmental Considerations.* The presence of the solidified, stored fuel and flush salts is the most significant aspect of the MSRE. Over 4600 kg of fuel salt and 4300 kg of flush salt, containing some 37 kg of uranium (primarily ^{233}U) and 743 g of plutonium (primarily ^{239}Pu) remain in the drain tanks. Calculated fuel and fission product activities of the fuel and

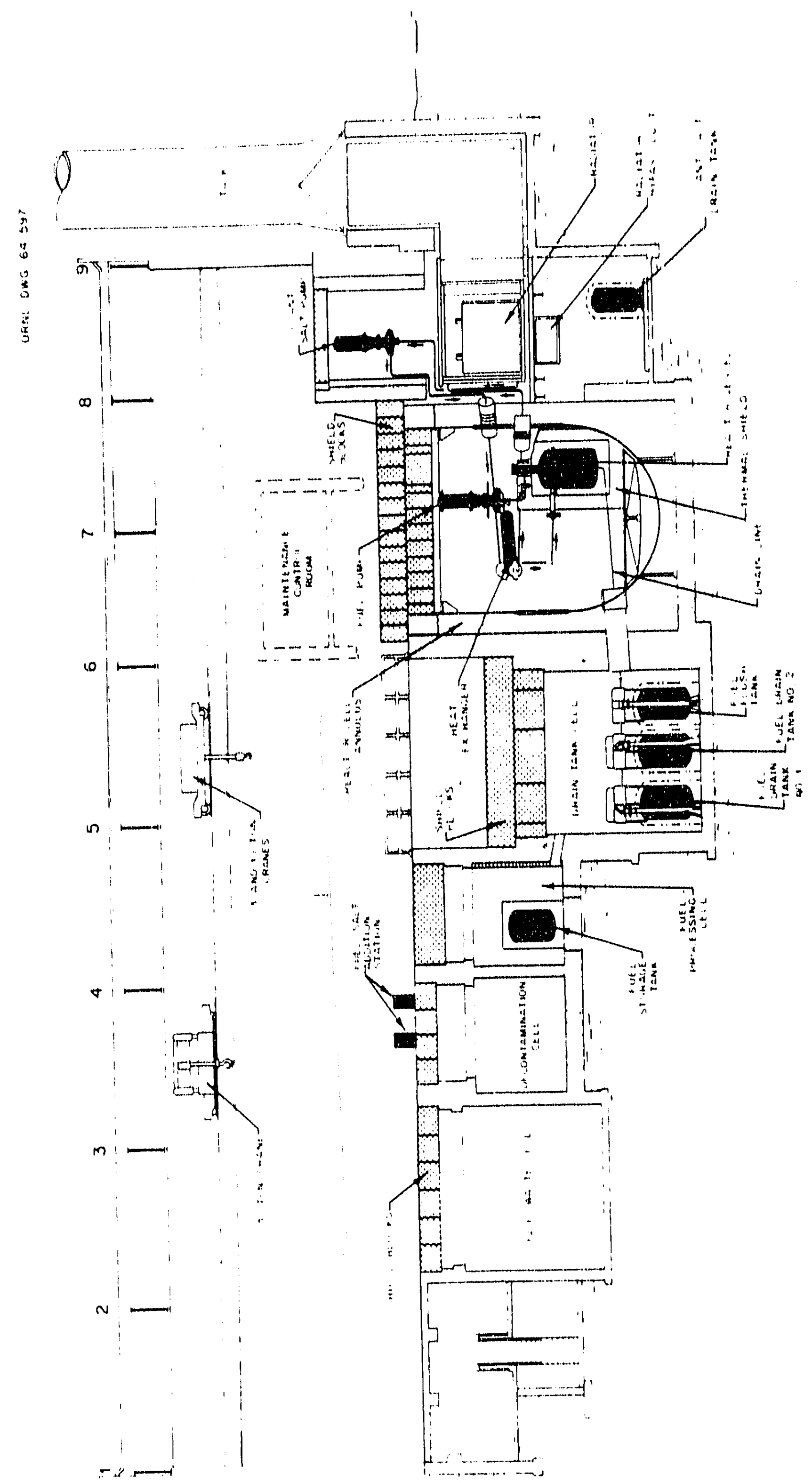

Fig. I.36. Schematic of the MSRE reactor system.

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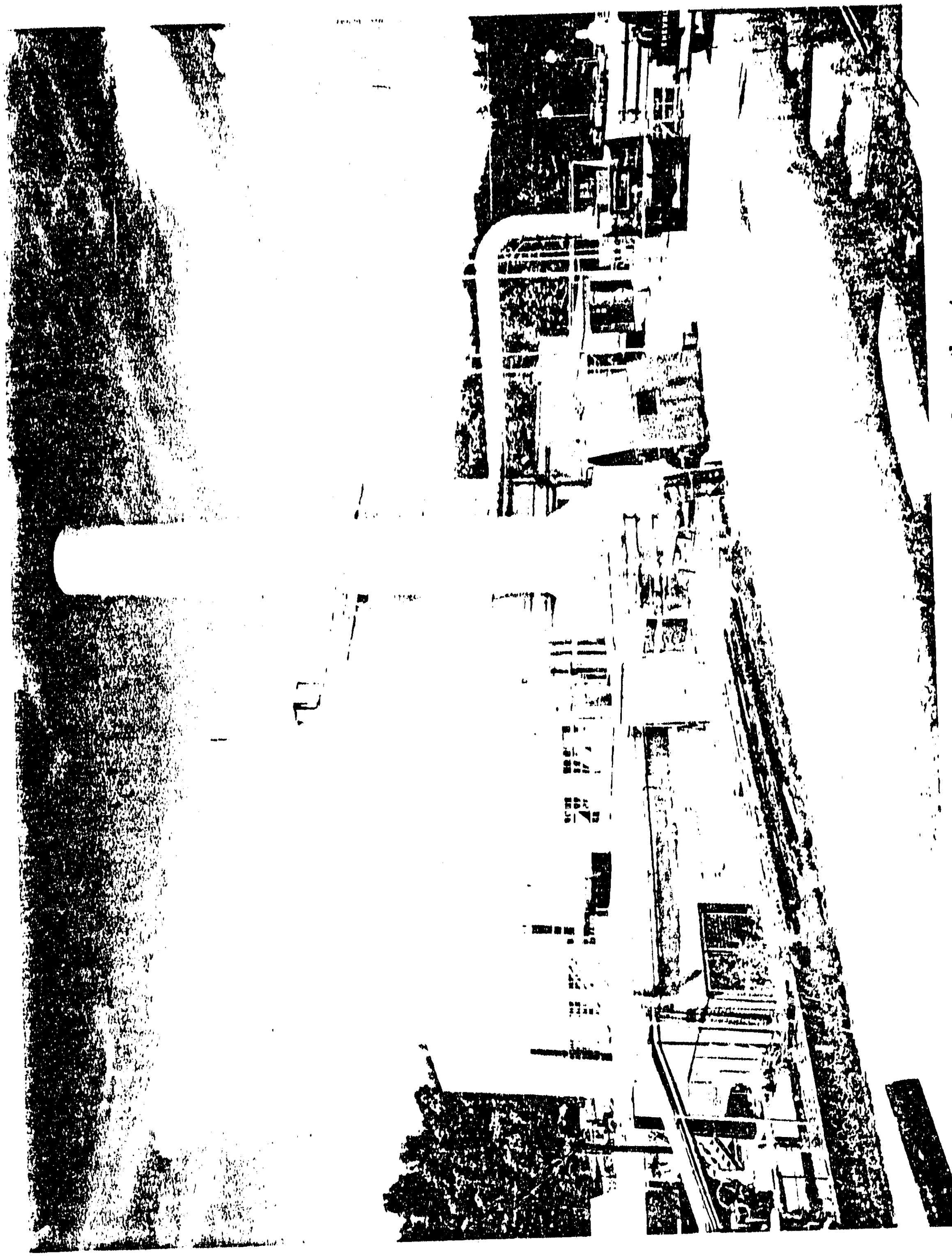

Fig. I.37. View of the MSRE reactor building from the southwest.

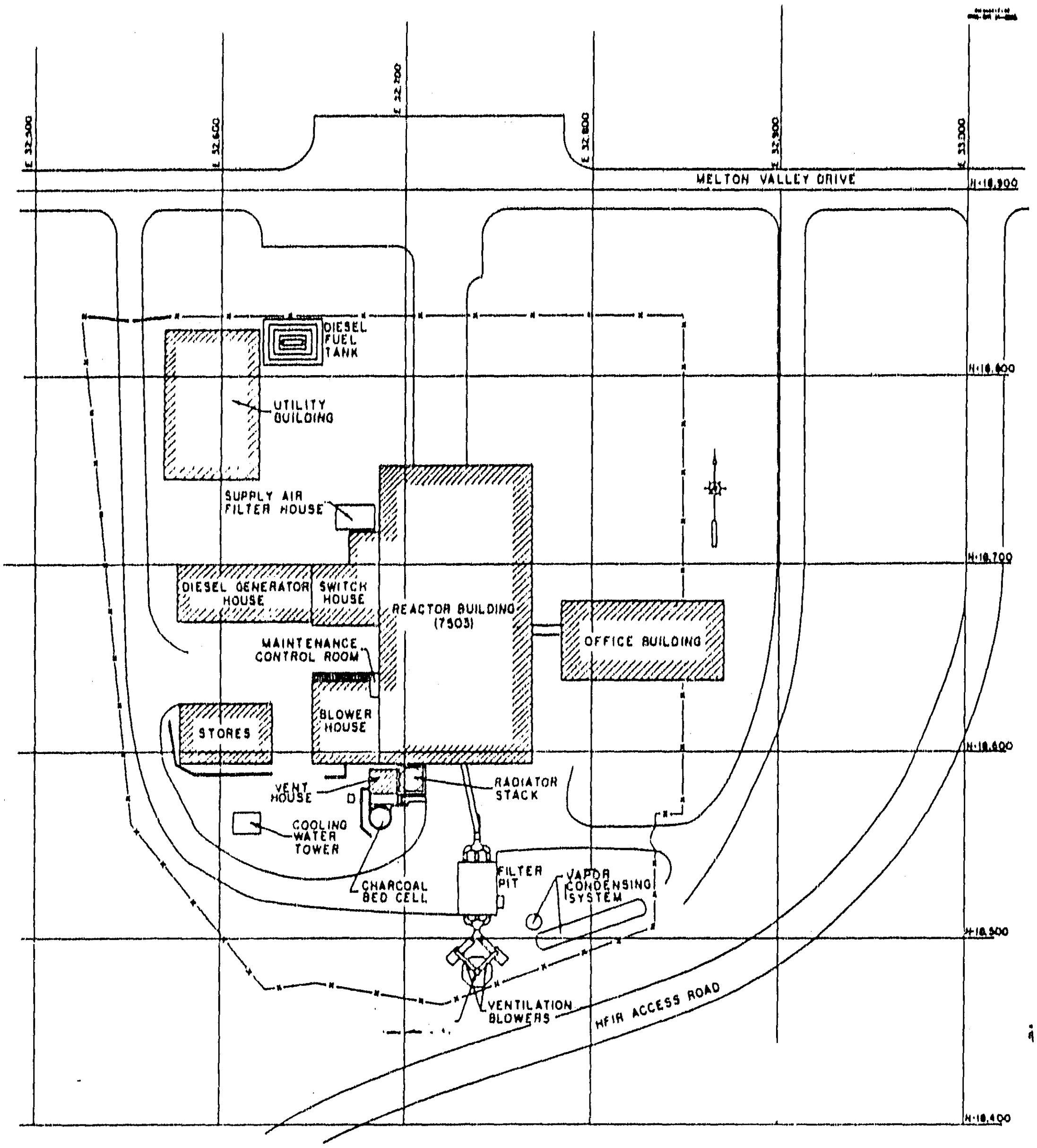

Fig. I.38. Site plan for the MSRE complex.

flush salt, decayed to 1984, total almost 38,000 Ci, with an estimated TRU inventory of 4×10^5 nCi/g in the fuel salt. As expected, the radiation hazards associated with the stored fuel are significant. Gamma and neutron dose rates within the storage cells are in the thousands of rad/h. Decay heat from the fuel and fission products in the fuel salt results in the generation of radiolytic fluorine gas, which must be recombined by routine salt heating. The stored salt is in a stable non-corrosive state as a dry frozen solid.

Next to the stored fuel, the principal areas of concern at the MSRE are the inactive reactor components and process equipment remaining in the below-grade containment cells. These components are both internally contaminated and, in some cases, highly neutron activated. Exposure rates of up to 2200 R/h have been measured in the reactor vessel, attributed primarily to ^{60}Co. The inventory of residual radioactive materials in the reactor and fuel processing cells (the primary contamination concerns outside the fuel tank cell) is estimated to be several thousand curies, with the majority of that activity being associated with fission and activation products. The remaining ancillary cells, process piping and associated operating areas are known to be slightly contaminated. The readily accessible areas of the reactor building (including the reactor bay and office areas) are generally uncontaminated.

The MSRE facility appears to be structurally sound and capable of retaining the current radionuclide inventory. No significant spread of contamination or personnel exposure has occurred since facility shutdown.

d. ***Facility Maintenance and Surveillance.*** A comprehensive maintenance and surveillance program is provided to assure adequate containment of the residual radioactivity at the MSRE. Routine inspections of the containment systems and building services, radiological surveillance of operating areas and ventilation exhaust, stored salt monitoring (temperature and pressure), and regular testing of safety systems are performed as part of this program. In addition, reheat of the fuel and flush salt is conducted in order to allow recombination of fluorine gas, and the containment cells given a pressure test, both on an annual basis. Facility maintenance includes general repairs, exhaust duct filter changes, and instrumentation and controls maintenance. These routine maintenance and surveillance tasks require approximately 0.8 man-year of annual SFMP support. Consolidation of the surveillance instrumentation, and periodic heater and controls tests are planned as major improvements to the current program.

e. ***Unique Conditions/Reuse Considerations.*** Without question, the most unique aspect of the MSRE project is the stored fuel and flush salts on-site. Plans for site decommissioning will have to address the fuel disposition issue prior to any decisions regarding the remaining facilities. The following section on decommissioning alternatives discusses the impacts that the presence of the fuel has on the overall project scope.

Reuse of the primary MSRE facilities (reactor, fuel storage and process cells) does not appear feasible due to design limitations and residual radioactivity. However, the potential for reuse of the ancillary facilities, including the high-bay area, offices and support buildings, is considered quite high due to the condition of these areas and the availability of support services. At the present time, the majority of this usable space is being occupied and maintained by other ORNL program staff for research, workshop, and storage space. Decommissioning planning should, therefore, consider the preservation of the reusable structures and facilities to the extent possible.

PROPOSED FACILITY DISPOSITION

a. ***Alternative Selection.*** The scope of the decommissioning activities at the MSRE will involve two major tasks: fuel and flush salt disposition, and facility decontamination and decommissioning. The considerations applicable to final disposal of the fuel and flush salts can be grouped into three major issues: (1) the location of the final fuel disposal site, (2) the physical form of the wastes to be disposed, and (3) whether the fuel should be processed to remove the residual uranium. Each of these issues has a range of potential options, many of which are interrelated. For instance, for the fuel salt disposal location several potential alternatives exist, including on-site entombment, shipment to a federal repository, long-term storage at the ORNL ^{233}U Repository, or disposal at ORNL via hydrofracture. Similarly, in terms of the salt physical form, options exist for processing to a more generally acceptable waste form, such as a calcined solid or borosilicate glass. The end product, however, would need to be selected specifically to meet the acceptance criteria of the desired disposal site. Finally, fluorination of the fuel salt to remove uranium could result in a simplification of shielding requirements for salt processing, eliminate the criticality hazard associated with the salt, and remove a significant fraction of the decay heat (and hence reduce radiolytic fluorine production rates). However, this fluorination would not eliminate: (1) the TRU waste classification for either the fuel or flush salts, (2) the need for shielding or remote operations for salt processing, or (3) the generation of radiolytic fluorine, nor would it alter the structure of the salt or eliminate the concerns associated with the acceptability of that waste form for disposal.

A logic diagram showing the basic decisions that would need to be made for determining the appropriate fuel disposal method is given in Fig. I.39. Obviously, the assessment of the possible options will be a complex task, considering numerous tradeoffs and requiring significant DOE involvement. It is impossible at this point in time to choose a preferred alternative, or even narrow the options any significant amount. However, for the purposes of long-range program planning, it seems prudent to specify the option of fuel and flush salt processing (including removal of uranium) leading to final disposal at a federal repository. Proposing this alternative would be the most conservative position in terms of funding requirements and, by providing a waste form that meets repository acceptance criteria, represents an option which would be accepted by definition.

Once the fuel issue is resolved, planning for final decommissioning of the MSRE could begin, focusing primarily on the alternatives of entombment or complete dismantlement. Decontamination of the facility for reuse, although feasible, does not seem practical due to the contamination levels present, the unusual layout and construction of the MSRE cells, and the cost that would be associated with such an endeavor. For the two likely options, the decision made for the fuel salt disposition would, in some instances, drive the decommissioning choice. For instance, if on-site disposal of the fuel or waste had been specified, then some form of entombment for the remaining facilities would appear logical. However, for the fuel option specified for consideration in this long-range plan (fuel processing with off-site disposal), few constraints would be placed on the decommissioning choice.

Without the presence of the fuel, the MSRE resembles the nearby Homogeneous Reactor Experiment (HRE) facilities (WBS 4.6.17). Due to the structural conditions of these facilities (below grade cells with steel linings and poured concrete encasement), they provide excellent locations

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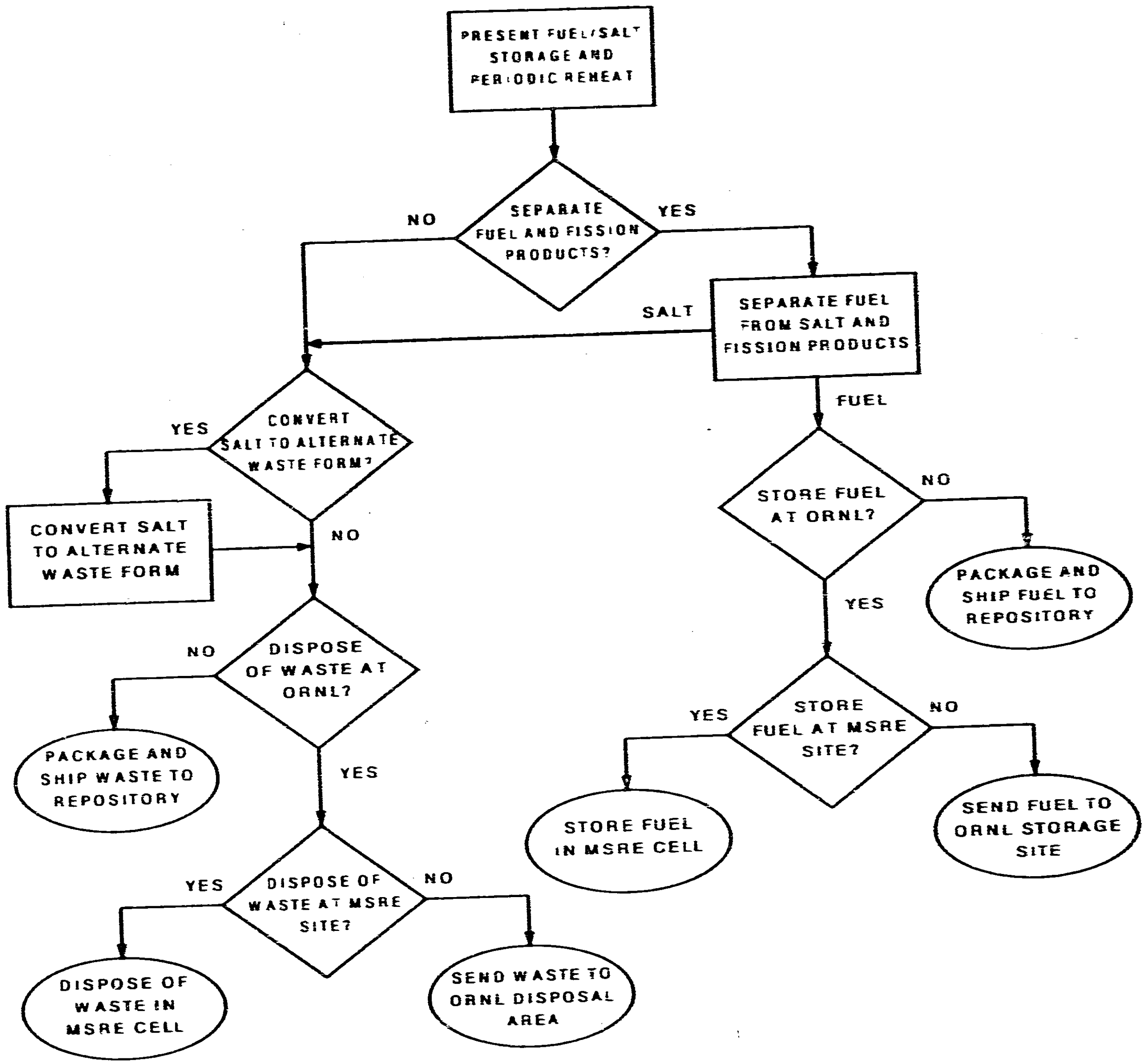

Fig. I.39. Logic diagram for MSRE fuel and flush salt disposal options.

for long-term waste containment. Entombment of the contaminated reactor components has been specified for the HRE, based on cost, personnel exposure, and conservation of burial ground space. Given the assumption on the disposition of the MSRE fuel, the entombment option for the main reactor components also appears to be the most cost-effective solution for the MSRE. Decontamination of many of the ancillary facilities (offices, support buildings) for reuse would be specified in order to make maximum use of this valuable space.

b. ***Decommissioning Plan.***

1. ***Technical Plan.*** No structured technical plan has yet been developed for the proposed fuel processing and disposal option. Until the final waste form is determined, the flowsheets and associated equipment designs cannot be specified. However, assuming that fluorination and processing of the salts would occur, flowsheet development and design and construction of a major, unique, remote-operated system would be required. Such an effort would begin with laboratory-scale development of a process flowsheet, leading to full-scale construction and check-out of on-site facilities. Fuel processing and transportation would then follow, with processing facilities decontamination and dismantlement ending this phase of the project.

   Based on the concept of entombment of the primary reactor facilities, a preliminary plan has been developed that calls for consolidation of contaminated equipment into the reactor and drain tank cells, entombment of these cells, and decontamination of the remaining MSRE facilities for potential reuse. This concept would require a minimum dismantlement of the highly contaminated reactor systems and result in a monolithic, below-grade structure providing long-term containment. Most of the support services (ventilation, off-gas) and ancillary structures (high bay, offices, support buildings) would be decontaminated to levels that allow for reuse and left standing.

2. ***Special Equipment and Techniques.*** As described briefly above, the proposed fuel disposal option would require development and construction of a complex processing facility. The designs for such a facility would be constrained by the structural limitations of the MSRE site, the significant shielding requirements for handling the fuel salt, criticality considerations, and the chosen final form for the waste. A remotely operated and maintained system is envisioned that would require a major development and design effort prior to even beginning the fuel processing. Compared to the fuel disposal, the technical requirements for the facility entombment would be minor. Some remote tooling and dismantlement techniques would certainly be needed, as well as detailed grout specification and grout application designs. However, at this stage in the decommissioning planning, detailed specifications of the equipment needs in support of this work are not available.

3. ***Cost, Schedule, and Waste Volume Projections.*** A summary of the project schedule, estimated costs, and waste disposal requirements for the proposed MSRE decommissioning project is provided in Fig. I.40. These estimates represent order of magnitude projections only, due to the lack of structured design concepts for fuel processing or final entombment. By general comparison to the costs of major chemical processing facilities for radioactive materials at ORNL, it seems unlikely that the cost for disposing of the fuel and flush salts would exceed $20 million, or require more than five years for design, construction and operation of the conversion equipment. Similarly, cost estimates for entombment of the reactor and

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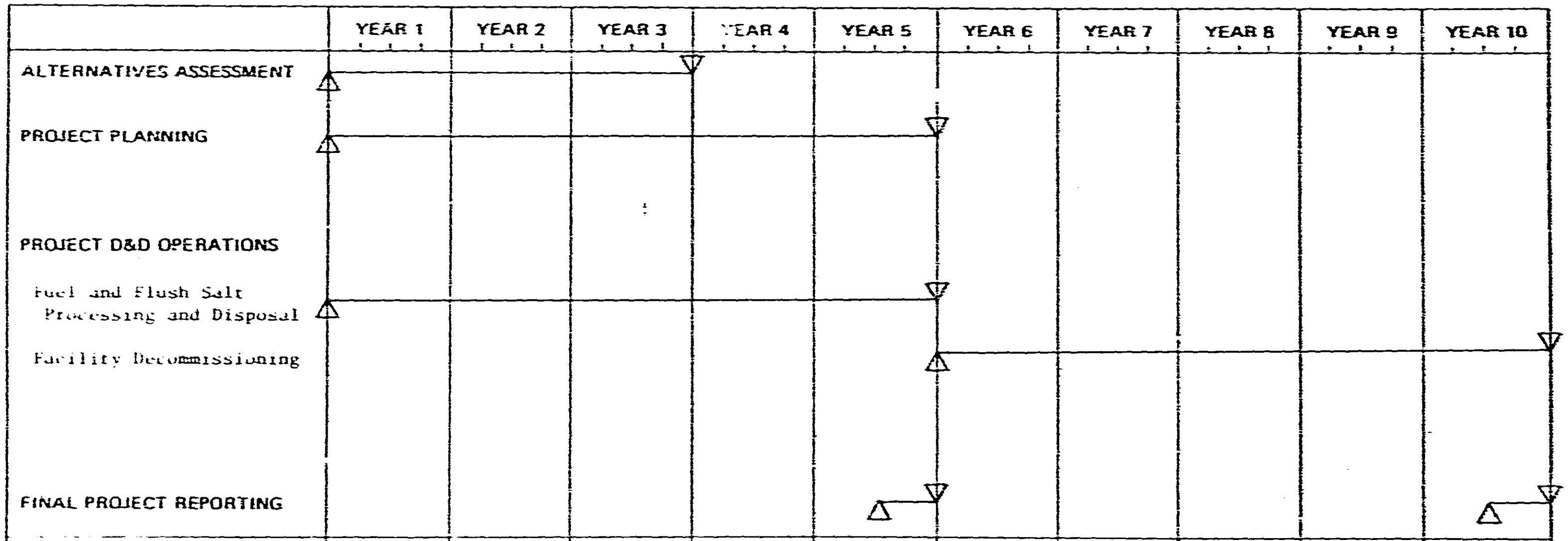


	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
PROJECT COSTS ($K)										
Annual Expense	330	1040	2000	2760	4510	5500	5450	4000	2300	510
Capital Equipment	–	100	130	600	200	110	100	260	100	–
Total	330	1140	2130	3360	4710	5610	5550	4260	2400	510
WASTE VOLUME PROJECTIONS										
Solid (m^3)										
Soil (LLW)	–	–	–	–	–	–	–	–	–	–
(TRU)	–	–	–	–	–	–	–	–	–	–
Rubble (LLW)	–	–	–	–	–	–	–	–	–	–
(TRU)	–	–	–	–	–	–	–	–	–	–
Metal (LLW)	–	–	–	–	–	50	50	50	50	50
(TRU)	–	–	–	–	–	25	25	25	25	25
Misc. (LLW)	–	–	–	–	–	75	75	75	75	75
(TRU)	–	–	–	–	–	–	–	–	–	–
Total (LLW)	–	–	–	–	–	125	125	125	125	125
(TRU)	–	–	–	–	–	25	25	25	25	25
Liquid (m^3)										
Process Waste	–	–	–	–	–	5	5	5	5	5
LLW	–	–	–	–	–	15	15	15	15	15

Fig. I.40. Molten Salt Reactor Experiment decommissioning project summary.

drain tank cells and decontaminating the rest of the facility for reuse were inferred by escalating estimates from a previous decommissioning study (ORNL/CF-77/391). This escalation resulted in an order of magnitude cost of approximately $10 million, spread over about five years of work. The total estimated project cost then, including both fuel processing and disposal and facility decommissioning, of $30 million over ten years should be adequate to represent the potential needs for the MSRE. An empirical cost spread over the ten years has been conducted according to DOE-OR cost estimating guidance. Waste volume estimates of 2.7×10^4 ft^3 (760 m^3) of solid LLW and 2.4×10^4 gal (90 m^3) of liquid waste should be representative of the potential impacts on the ORNL waste disposal system. No significant volumes of low-contamination level stainless steel will be generated.

PRIORITY DETERMINATION CONSIDERATIONS

In its present condition, the MSRE does not pose any immediate hazard to ORNL personnel, the public, or the environment. However, due to the large inventory of fuel and the significant quantities of residual contamination remaining at the site, consideration should be given to early elimination of the long-term hazard associated with this facility. The condition of the fuel containment, control and transfer system will continue to degrade with time. In addition, the loss of key personnel, knowledgeable about the fuel and facility operational characteristics, will become critical if the project is not initiated in the next few years.

PROJECT Low Intensity Test Reactor Decommissioning

FIELD OFFICE Oak Ridge **CONTRACTOR** Martin Marietta

BUDGET AND REPORTING CODE AH 10 20 00 **FTP/A No.** ONL-WD09 **SFMP WBS** 4.6.10

CONTRACTOR **FIELD OFFICE** **SFMPO**

PROJECT PRIORITY 12

PROPOSED DISPOSITION MODE Dismantlement

PRELIMINARY TEC $4,500 K **ESTIMATED PROJECT DURATION** 5 years

FACILITY DESCRIPTION

a. ***Operating History.*** The Low Intensity Test Reactor (LITR) was adapted from the hydraulic testing and critical mock-up of the Materials Testing Reactor (MTR), designed by ORNL and built at the National Reactor Testing Station in Idaho. In 1951 the LITR was converted to a 500 kW training reactor, and was later converted to a testing reactor, with a final power level of 3 MW. The LITR was a water moderated and cooled reactor, using enriched uranium as fuel and beryllium as a reflector. The reactor was utilized by a variety of research groups, primarily for irradiation of materials. The LITR was placed in a shutdown mode in 1968, with the fuel removed and the shield water drained.

b. ***Physical Description.*** The LITR reactor vessel is made up of cylindrical steel and aluminum sections connected by gasketed flanges, which house the reactor internals, controls and coolant pipes. All but the lowest tank section is above ground (Fig. I.41). As the reactor passed through stages from a training reactor to test reactor, additional shielding was added consisting of a thin layer of borated plastic surrounded by loose-stacked concrete blocks and river sand. Heat dissipation for the final design was provided by two 1-MW water-to-air heat exchangers (Building 3077) and one 1-MW water-to-water heat exchanger. The enclosure for the reactor (Building 3005) is not an integral building, but is a composite of essentially independent rooms built on an as-required basis. The structure is primarily of steel and corrugated metal construction, with reactor access at three levels (Fig. I.42). A slight negative pressure is maintained in the building through the cell ventilation system of the adjacent active Bulk Shielding Reactor. Two 18,000 gal retention ponds, originally used for holding of slightly contaminated waste water and located approximately 350 ft east of the reactor building, were stabilized with earth fill some 15 years ago.

c. ***Safety/Environmental Considerations.*** All of the internal components of the reactor (except the fuel and shim rods) are still in place and are highly radioactive. Dose rates in the core region are estimated to range from 200–300 rad/h. In addition, interior surfaces of the reactor tank and

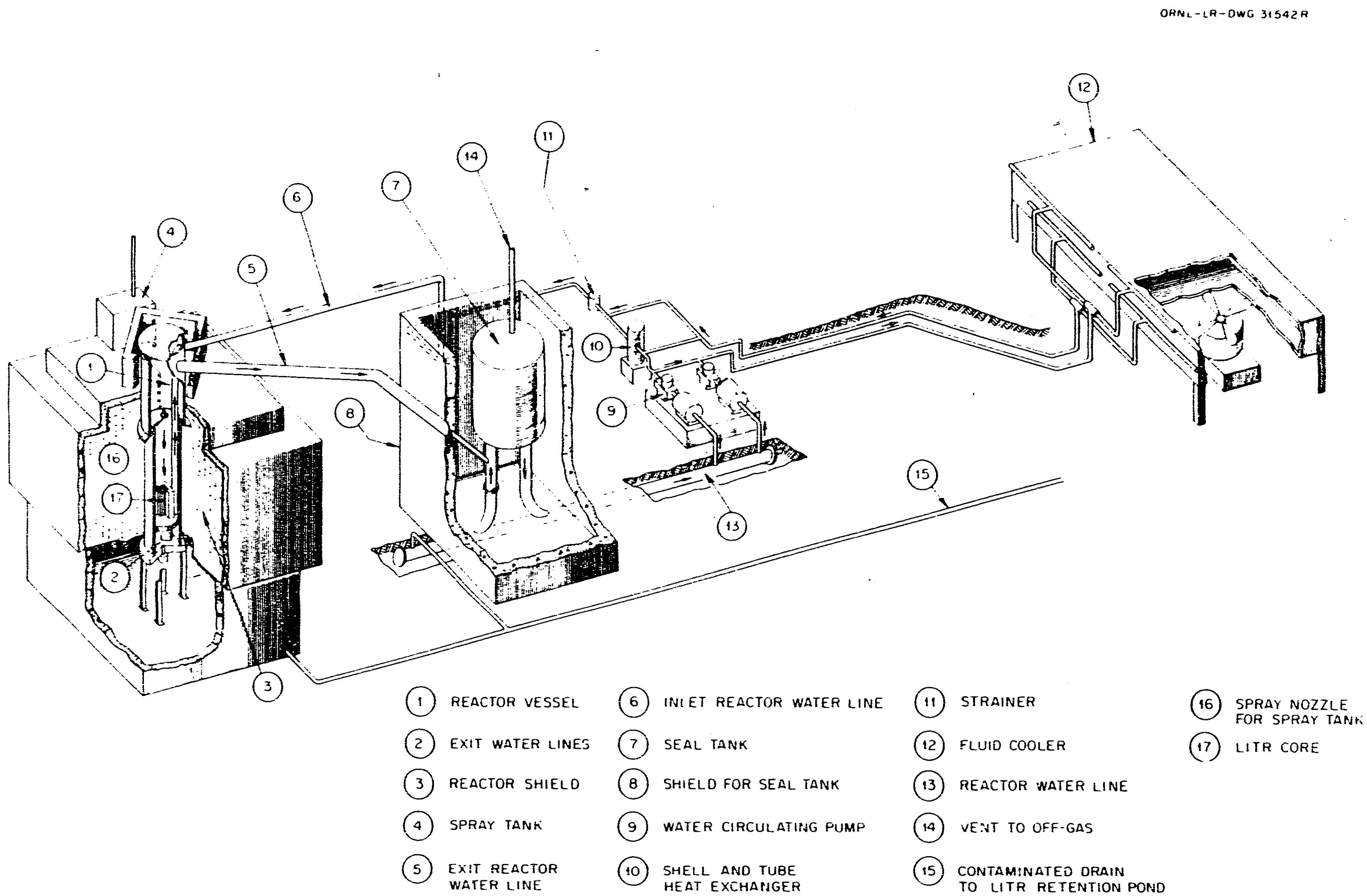


Fig. I.41. Schematic view of the LITR reactor and heat dissipation systems.

ORNL-PHOTO 85491

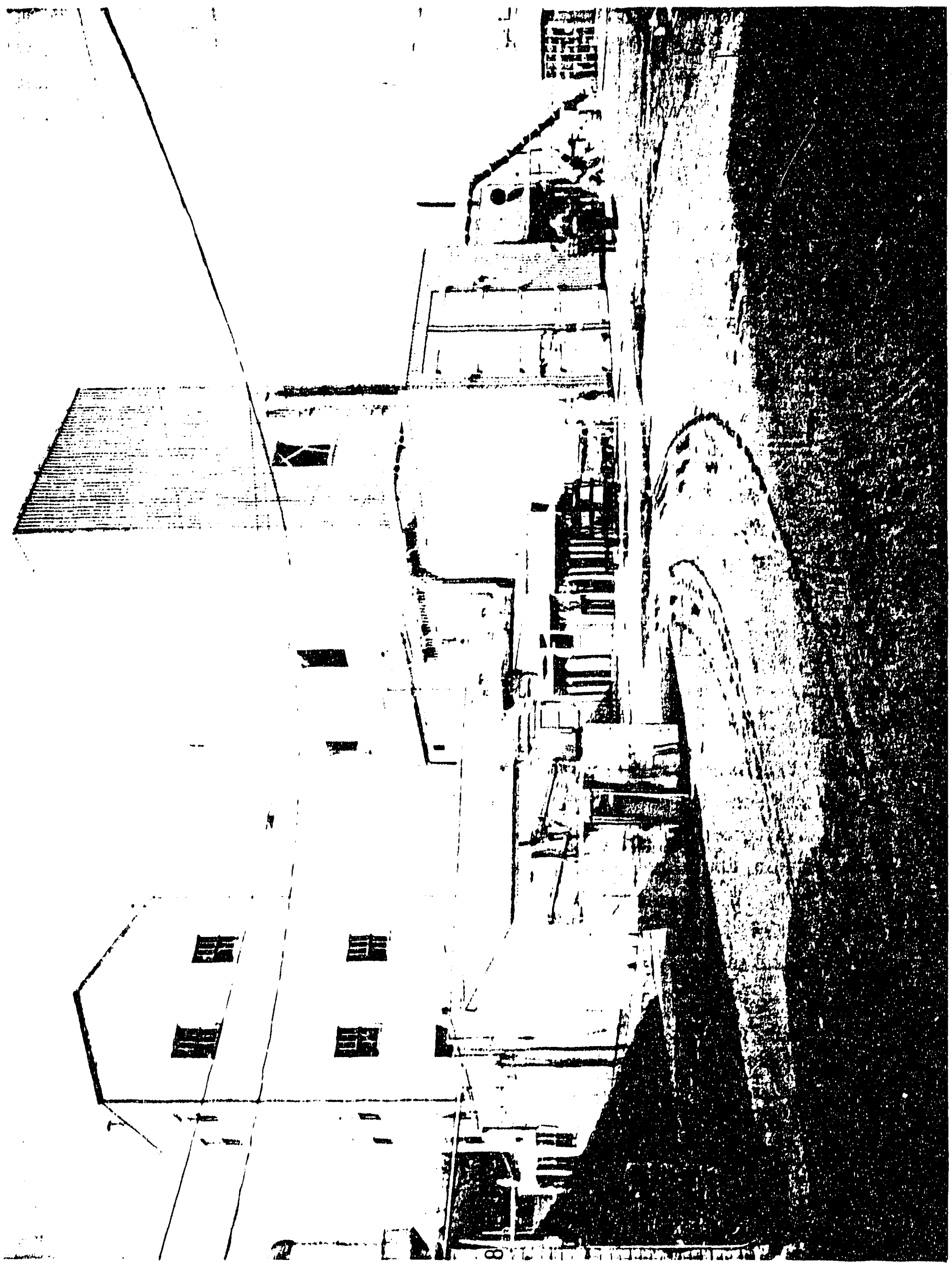


Fig. I.42. View of the LITR containment structure (Building 3005) looking north.

primary water piping are contaminated with corrosion products and traces of long-lived fission products. It is suspected that the concrete block and sand shielding materials are contaminated and contain some induced activity due to neutron leakage around the borated plastic shield. The total estimated inventory of residual radioactivity is less than 100 Ci, primarily due to ^{60}Co and ^{63}Ni. One other potential hazard is the beryllium reflector sections still remaining in the core region. Special care will be required to assure safe removal and disposal of these plates. The remaining accessible areas of the LITR are free of radiation and contamination hazards. Little is known about the final condition of the LITR retention ponds prior to closure, although there is no indication of significant activity remaining at this site.

d. ***Facility Maintenance and Surveillance.*** Adequate control of the residual radioactivity associated with the LITR is assured by the active containment system and the routine SFMP maintenance and surveillance. Routine inspections of containment systems and building services, radiological surveillance of operating areas and maintenance activities, and regular testing of safety systems are performed as part of this program. Facility maintenance includes general repairs, exhaust filter changes, and instrumentation and controls maintenance. These routine maintenance and surveillance tasks require approximately 0.3 man-year of annual SFMP support. No major facility repairs or improvements have been identified for this facility in the near future.

e. ***Unique Conditions/Reuse Considerations.*** Due to the location of the LITR in a centralized area of the Laboratory, the uncontaminated work space within the reactor building has a potential for reuse. This space on the first level is currently being utilized (and maintained) as a shop by two ORNL divisions. The upper two levels are unoccupied and have access restrictions that may limit their usefulness. Reuse of the reactor or the associated cooling system is considered impractical due to design restrictions and deteriorating structural conditions.

PROPOSED FACILITY DISPOSITION

a. ***Alternative Selection.*** Design limitations and lack of need for this type of facility make reuse of the LITR impractical. The assessment of alternatives for the site was, therefore, centered on dismantlement or entombment. The radiation hazards associated with the facility are not restrictive for either option, and although the costs of complete dismantlement are estimated to be about a factor of two greater than entombment, the most important consideration was determined to be the suitability of the site for long-term waste isolation. The supporting reactor structure is not particularly well suited to providing greater confinement disposal. The above-grade reactor vessel would require a large monolithic concrete structure to be built, or significant reactor dismantlement into a below-grade pit for in-situ grouting. Neither of these concepts is considered acceptable from a technical standpoint, and such entombment would not be consistent with the current Laboratory policy on separating waste disposal operations from research areas. The proposed option for the LITR is, therefore, complete dismantlement of all contaminated structures and support facilities.

b. ***Decommissioning Plan.***

1. ***Technical Plan.*** A conceptual plan for decommissioning the LITR has been developed that calls for dismantlement and disposal of all contaminated reactor and ancillary facilities. The main portion of the building and all active support services (drains, utilities) would be left

intact. As part of this effort, the former retention ponds would be characterized to verify the believed low levels of activity remaining, but no remedial actions specified at this point. Most of the contaminated equipment removed during dismantlement would be disposed of as LLW by shallow land burial at ORNL, although some quantity of reactor components may require auger hole disposal. The building structural portions to be removed (second and third levels) would likely be uncontaminated and could be disposed of as construction waste.

Dismantlement activities would begin by preparation of the site for decommissioning. Outdoor facilities would be removed first, including the seal tank, heat exchanger, and associated piping. Equipment removal in Building 3005 would begin with the surplus controls and auxiliary equipment in the rooms adjacent to the reactor. The reactor internals would then be removed underwater. Shielding materials would be removed to the midriff level and the upper reactor vessel section dismantled. The remaining vessel and shielding removal would be conducted underwater in a specially constructed pool arrangement. Once the complete vessel and ancillary equipment has been dismantled and the water tank removed, the vessel pit would be decontaminated and filled to grade level. A final building decontamination phase would follow completion of the dismantlement activities.

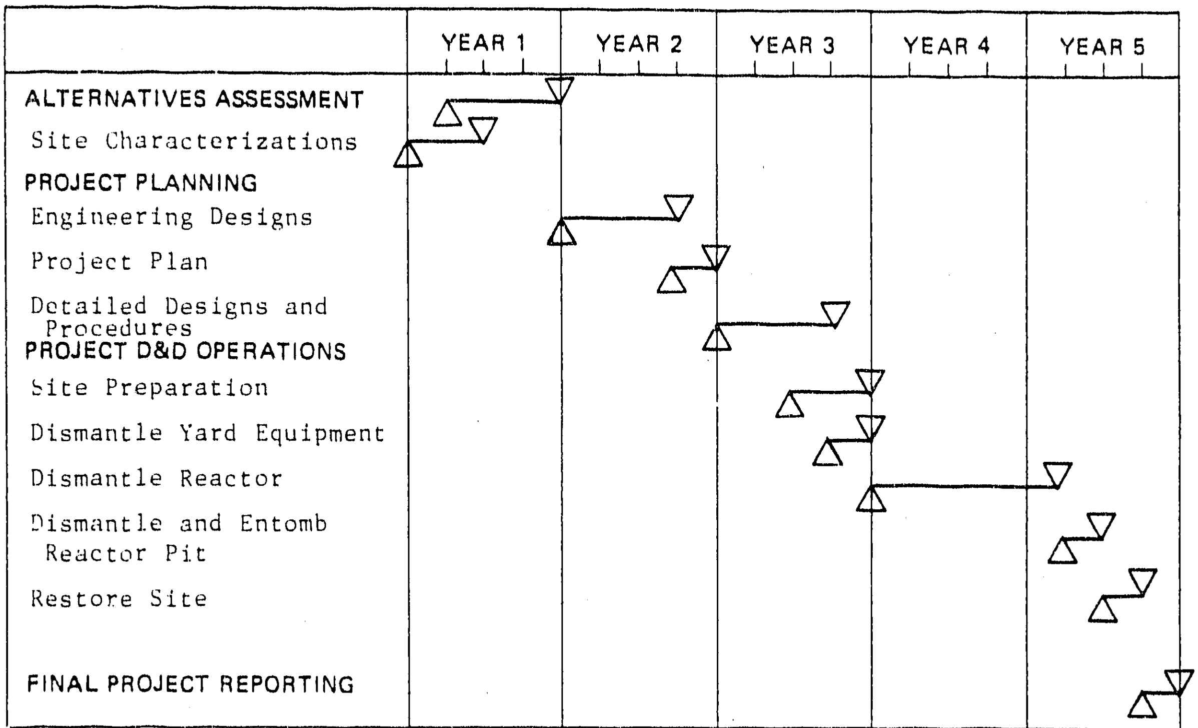
2. ***Special Equipment and Techniques.*** Removal of the reactor vessel internals would be done underwater with standard long-handled tools. In support of this work, a new recirculating water system would have to be installed, or the existing system refurbished to an operational state. In addition, a specially designed pool tank system would have to be constructed to allow underwater dismantlement of the concrete and sand shielding and for sectioning of the reactor vessel. Appropriate gaskets, liners, and support walls would be installed within Building 3005 surrounding the reactor vessel and shield. The recirculating water system would also be required for these pool operations.

3. ***Cost, Schedule, and Waste Volume Projections.*** A summary of the project schedule, estimated costs, and waste disposal requirements for the proposed LITR decommissioning project is provided in Fig. I.43. Project planning, D&D operations, and project closeout are estimated to extend over a period of approximately five years, at a total estimated cost of \$4.5 million. Approximately 1.6×10^4 ft^3 (445 m^3) of solid radioactive waste and 6.6×10^4 gal (250 m^3) of liquid waste will require appropriate handling and disposal. No significant volumes of low-contamination level stainless steel will be generated.

PRIORITY DETERMINATION CONSIDERATIONS

In its present condition, the LITR does not pose any immediate hazard to ORNL personnel, the public, or the environment. However, long-term containment of the residual radioactivity will become increasingly difficult as the facility continues to age. Early decommissioning of the reactor would provide better containment as well as needed experience for later, more complex reactor work.

ORNL-DWG 83-14840R3



	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
PROJECT COSTS ($K)					
Annual Expense	120	210.	1720	1370	770
Capital Equipment	–	–	110	50	150
Total	120	210	1830	1420	920
WASTE VOLUME PROJECTIONS					
Solid (m^3)					
Soil (LLW)	–	–	25	–	–
(TRU)	–	–	–	–	–
Rubble (LLW)	–	–	–	200	5
(TRU)	–	–	–	–	–
Metal (LLW)	–	–	140	10	25
(TRU)	–	–	–	30	5
Misc. (LLW)	–	–	–	5	–
(TRU)	–	–	–	–	–
Total (LLW)	–	–	165	215	30
(TRU)	–	–	–	30	5
Liquid (m^3)					
Process Waste	–	–	–	–	–
LLW	–	–	–	125	125

Fig. I.43. LITR decommissioning project summary.

PROJECT ORR Experimental Facilities

FIELD OFFICE Oak Ridge **CONTRACTOR** Martin Marietta

BUDGET AND REPORTING CODE AH 10 20 00 **FTP/A No.** ONL-WD09 **SFMP WBS** 4.6.15

	CONTRACTOR	FIELD OFFICE	SFMPO

PROJECT PRIORITY 14

PROPOSED DISPOSITION MODE Dismantlement

PRELIMINARY TEC $5,460 K **ESTIMATED PROJECT DURATION** 5 years

FACILITY DESCRIPTION

a. ***Operating History.*** Since 1959, several different experimental facilities have been installed at the Oak Ridge Research Reactor (ORR-Bldg. 3042) for use in testing of various materials, analysis of liquid and gaseous coolant systems, and irradiated sample transfers. Six of these facilities have been designated as surplus and have been accepted into the ORNL SFMP. These are: (1) GCR A9-B9 experiment (1960–1969) for measurement of fission product gases from ceramic fuels, (2) Molten Salt Loop (1959–1967) for analysis of homogeneous reactor fuels, (3) Maritime Ship Reactor Loop (1959–1962) for materials testing of structural materials and fuel pins for nuclear merchant ship applications, (4) Pneumatic Tube Irradiation Facility (1968–1973) for transfer of irradiated samples from the ORR to a laboratory in Bldg. 3001, (5) GCR Loop I (1960–1967) to test new fuels for gas-cooled reactors, and (6) GCR Loop II (1962–1963) for the irradiation of unclad graphite fuel specimens for study of fission product release. In addition to these experimental facilities, a water-to-air heat exchanger that served as the original heat dissipation system for the reactor is included in this SFMP project. This heat exchanger was abandoned in 1961 when it was replaced with a cooling tower of greater heat capacity.

b. ***Physical Description.*** Each of the experimental facilities at the ORR is a separate, identifiable unit with a variety of designs, structural materials, and flow patterns. All of the facilities included an in-reactor section, with associated piping, instrumentation and controls leading to away-from-reactor processing or experimental areas. As shown in Fig. I.44, these areas were located either immediately adjacent to the reactor or at remote locations, primarily in the basement of the ORR. The out-of-reactor portions of the facilities were normally contained in shielded cells, either lead, concrete block, or concrete and steel, with separate instrument and control panels. The complexity of the systems ranged from a simple lead-shielded stainless steel pneumatic tube to a large pressurized water loop consisting of pumps, heat exchangers, heaters, surge tanks, water purification systems, sampling stations, emergency electric supply, and continuously manned control room. The heat exchanger, located approximately 150 ft northeast of the ORR, consisted of eight aluminum 24 ft by 22 ft horizontally mounted, finned, water-to-air

ORNL-DWG 83-16505R

OAK RIDGE RESEARCH REACTOR (ORR) BUILDING PLAN

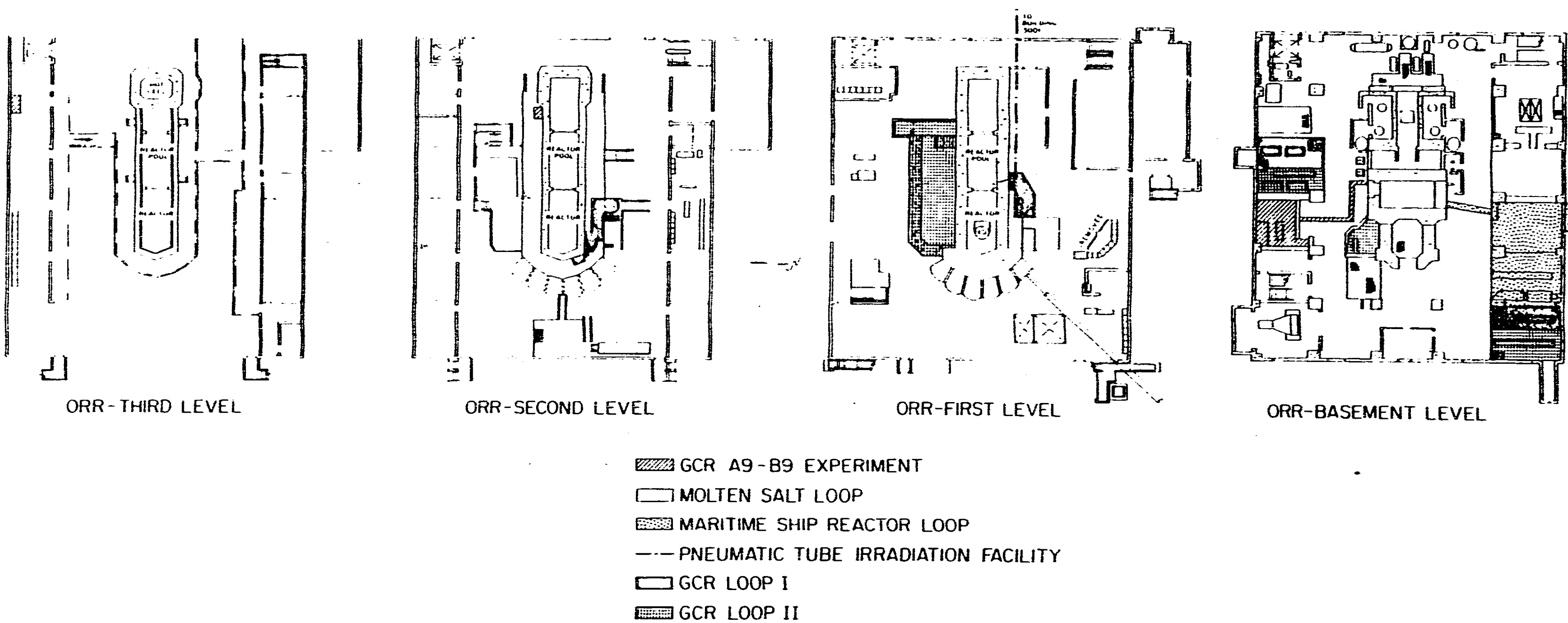


Fig. I.44. Plan view of the ORR, highlighting the locations of the Experimental Facilities.

radiators (2.5 MW capacity each). The units were housed in steel support structures, secured to concrete pads, and connected to the ORR by underground aluminum piping (Fig. I.45). Cooling air flow was provided by variable speed fans. One fan unit was removed in 1970 for use at an off-site location.

c. ***Safety/Environmental Considerations.*** All of the ORR facilities involved transfers of irradiated or contaminated solids, liquids, or gases during normal operations. As a result, the transfer piping and associated process equipment became contaminated with long-lived corrosion and/or fission products. Following completion of active service, most of the in-reactor portions of the facilities were removed and the remaining systems placed into a standby condition. Residual contamination levels associated with the experimental facilities vary, depending upon the original use and shutdown procedures employed. Only two facilities, the GCR-Loop II and the Maritime Ship Reactor Loop (MSRL), contain significant radiation hazards in their present conditions. Dose rates in the MSRL equipment room ranged up to 200 mrad/h, with transferable beta-gamma contamination levels from <500 to 72,000 dpm/100 cm^2. The Loop II facility still has an in-reactor section that is highly radioactive (>1 R/h) as well as minor contamination (up to 10 mrad/h) in the process piping. The remaining facilities, including the outside heat exchangers, exhibit only minor levels of surface contamination or direct radiation. The total radionuclide inventory in all of the ORR experimental facilities is estimated at <30 Ci.

d. ***Facility Maintenance and Surveillance.*** Adequate control of the residual radioactivity associated with the ORR experimental facilities is assured by the active containment system of the ORR and routine SFMP maintenance and surveillance. Routine inspections and radiological surveillance of experimental areas and the heat exchangers are performed and general maintenance provided for these areas on an as-required basis. Building ventilation and safety systems are provided and maintained as part of the reactor operations and do not require separate SFMP support. The routine maintenance and surveillance tasks involve approximately 0.2 man-year of annual SFMP support. No major facility repairs or improvements have been identified for these facilities in the near future.

e. ***Unique Conditions/Reuse Considerations.*** Because the ORR is an active research reactor, significant constraints will exist on the decommissioning options for these facilities until the reactor is shut down. The presence of the operating reactor does, however, eliminate the need for extensive SFMP involvement in building maintenance and containment system operations. Reuse of the experimental facilities in their present conditions is unlikely, but the potential for reuse of the space occupied by these facilities is much greater, as long as the reactor continues to be utilized for research. Removal of the contaminated equipment and support services would be required in most instances prior to significant reuse of any of these areas.

PROPOSED FACILITY DISPOSITION

a. ***Alternative Selection.*** Based on the limited reuse potential for any of the ORR experimental facilities, and the relatively low levels of residual contamination remaining, dismantlement has been specified as the proposed disposition mode for these facilities. Due to the specific nature of the facility designs, their age, and deteriorating conditions, reuse of these systems is considered impractical. Salvage of reusable equipment, however, would be considered as part of the disman-

ORNL-PHOTO 0988-84

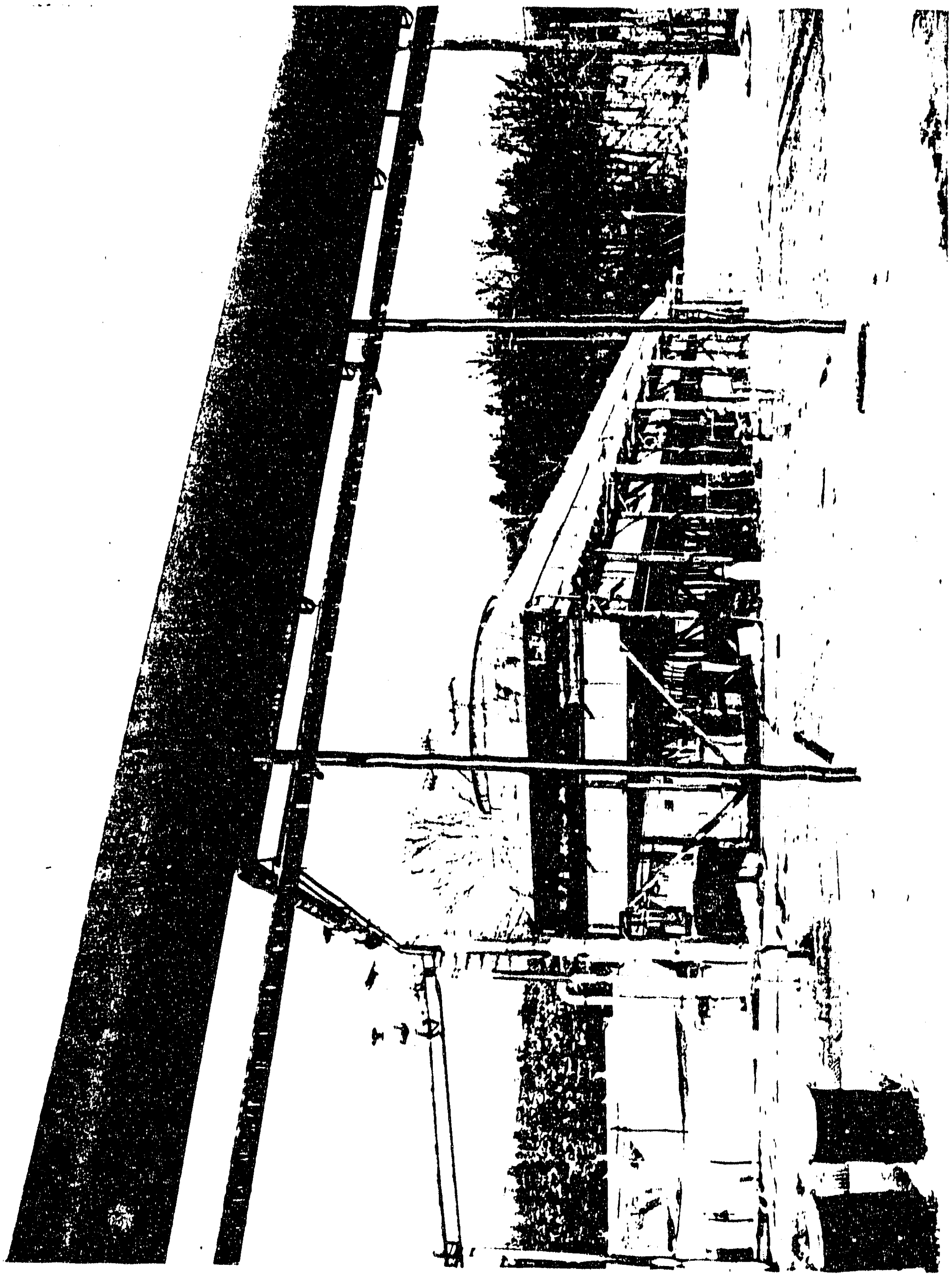


Fig. I.45. View of the ORR Water-to-Air Heat Exchanger, from the southeast.

tlement plan. Entombment of the experimental facilities does not appear to be a reasonable alternative in that it would tie up potentially valuable research and operational space within an active facility. Certainly, the contamination levels remaining do not warrant a monolithic entombment structure for long-term containment, nor do the levels pose significant risks to personnel during dismantlement operations. Facility dismantlement would increase the potential reuse of the ORR experimental areas, making use of the reactor for research more attractive.

b. ***Decommissioning Plan.***

1. ***Technical Plan.*** A conceptual plan for decommissioning the experimental facilities within the ORR and the ORR water-to-air heat exchanger has been developed that specifies complete dismantlement for the GCR A9-B9, Molten Salt Loop, GCR Loop I and the heat exchanger facilities, and partial dismantlement for the Maritime Ship Reactor Loop, Pneumatic Tube Irradiation Facility and GCR Loop II facilities. The active facilities and equipment associated with the ORR would not be affected by the proposed actions. Proper sequencing of dismantlement activities has been specified to maintain safe working conditions and minimize disruption of the reactor operations. In-reactor equipment removal and work at beam hole openings would be coordinated with routine shutdown of the reactor for maintenance. The in-core section of the Loop II facility would be left in place, with final removal conducted as a part of reactor decommissioning or facility upgrade for new experiments.

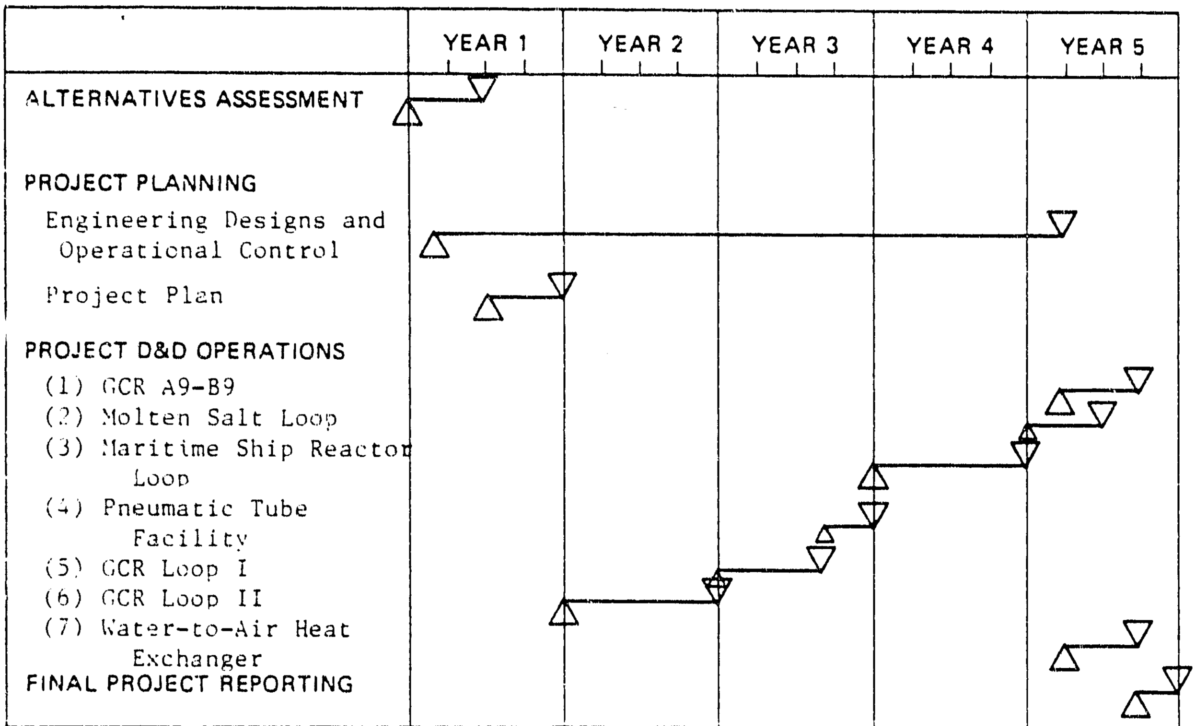
   Equipment dismantlement within the ORR would be performed according to routine procedures for contaminated equipment segmenting and handling. Small crews would be utilized to minimize impacts on the reactor operations. Project scheduling would result in removal of common facilities as a single task, beginning in those areas that have the greatest potential for reuse or that present the greatest hazard to reactor operations. Due to the proximity of the dismantlement activities to active reactor systems, significant efforts have been specified for appropriate identification and tagging of all piping and electrical circuits prior to issuing work orders for equipment removal.

   At the ORR heat exchanger, complete dismantlement of the fan units as well as the underground piping in the vicinity of the site would be performed utilizing routine techniques. Some minor site restoration would be required upon removal of the facility.

2. ***Special Equipment and Techniques.*** Other than the close coordination with the operations of the reactor, no special techniques have been identified for decommissioning of the ORR experimental facilities. Fabrication of a replacement beam hole assembly for the Molten Salt Loop would be the only special equipment required as part of this project.

3. ***Cost, Schedule, and Waste Volume Projections.*** A summary of the project schedule, estimated costs, and waste disposal requirements for the proposed ORR experimental facilities decommissioning project is provided in Fig. I.46. Project planning, D&D operations, and project closeout are estimated to extend over a period of approximately three years, at a total estimated cost of \$5.5 million. Approximately 1.5×10^4 ft^3 (415 m^3) of solid radioactive waste will require appropriate handling and disposal. No significant volumes of low-contamination-level stainless steel will be generated.

ORNL-DWG 83-14840R3



	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
PROJECT COSTS (\$K)					
Annual Expense	260	1350	1300	1340	1150
Capital Equipment	-	10	10	40	-
Total	260	1360	1310	1380	1150
WASTE VOLUME PROJECTIONS					
Solid (m^3)					
Soil (LLW)	-	-	-	-	20
(TRU)	-	-	-	-	-
Rubble (LLW)	-	-	-	-	80
(TRU)	-	-	-	-	-
Metal (LLW)	-	65	75	95	80
(TRU)	-	-	-	-	-
Misc. (LLW)	-	-	-	-	-
(TRU)	-	-	-	-	-
Total (LLW)	-	65	75	95	180
(TRU)	-	-	-	-	-
Liquid (m^3)					
Process Waste	-	-	-	-	-
LLW	-	-	-	-	-

Fig. I.46. ORR Experimental Facilities decommissioning project summary.

PRIORITY DETERMINATION CONSIDERATIONS

In their present condition, the ORR experimental facilities do not pose any immediate hazard to ORNL personnel, the public, or the environment. Decommissioning of these facilities in the near term would make space available for additional research uses of the active ORR. The dismantlement project could, however, be delayed until the complete reactor is decommissioned.

PROJECT Homogeneous Reactor Experiment Decommissioning

FIELD OFFICE Oak Ridge **CONTRACTOR** Martin Marietta

BUDGET AND REPORTING CODE AH 10 20 00 **FTP/A No.** ONL-WD09 **SFMP WBS** 4.6.17

	CONTRACTOR	FIELD OFFICE	SFMPO
PROJECT PRIORITY	7		

PROPOSED DISPOSITION MODE Entombment

PRELIMINARY TEC $14,475 K **ESTIMATED PROJECT DURATION** 6 years

FACILITY DESCRIPTION

a. ***Operating History.*** This facility was originally constructed in 1951 to house the Homogeneous Reactor Experiment No. 1 (HRE-1), the first of two experimental aqueous homogeneous reactors to be developed for nuclear power application analysis. In 1953, a decision was made to replace HRE-1 with a new experiment (HRE-2), and the second reactor was constructed in the same facility from 1953 to 1956. The HRE-2 was a two-region reactor containing 93% enriched ^{235}U [U_2SO_4 + $CUSO_4$ + D_2SO_4 in heavy water (D_2O)] as the fuel, surrounded by a blanket region of D_2O. The reactor, which included an on-line chemical processing plant, reached criticality in 1957, operating for most of its active life at a nominal full power level of 5 MW. Shortly after full-power operation was achieved, a hole developed in the reactor core tank, allowing mixing between the fuel and blanket regions. After extensive repair efforts failed, the reactor continued to operate with fuel in both regions. The reactor was shut down in April 1961 after approximately 16,295 MWh of operations.

b. ***Physical Description.*** The HRE-2 was a complex experimental reactor system principally housed in three below-grade steel-lined concrete cells, within a steel and reinforced concrete structure (see Figs. I.47 and I.48). The reactor cell contained the fuel and blanket systems, consisting of the reactor vessel, high and low pressure circulating loops, heat exchangers, and an off-gas handling system. A portion of the fuel flow was circulated through the chemical processing plant, also located in shielded cells, providing continuous removal of impurities from the fuel solution. Process liquid waste was handled and treated at the HRE through a system of underground stainless steel tanks, a separate concrete waste evaporator building (Bldg. 7502), and an unlined earthen 300,000 gal waste holding pond. Gaseous wastes were treated in the main building and vented through a 100 ft steel stack. Primary reactor heat removal was through a steam-to-air heat exchanger located on the building roof. Auxiliary heat dissipation was provided by a wooden water-to-air heat exchanger, located west of the reactor building (Site 7554).

ORNL-PHOTO 1921-83

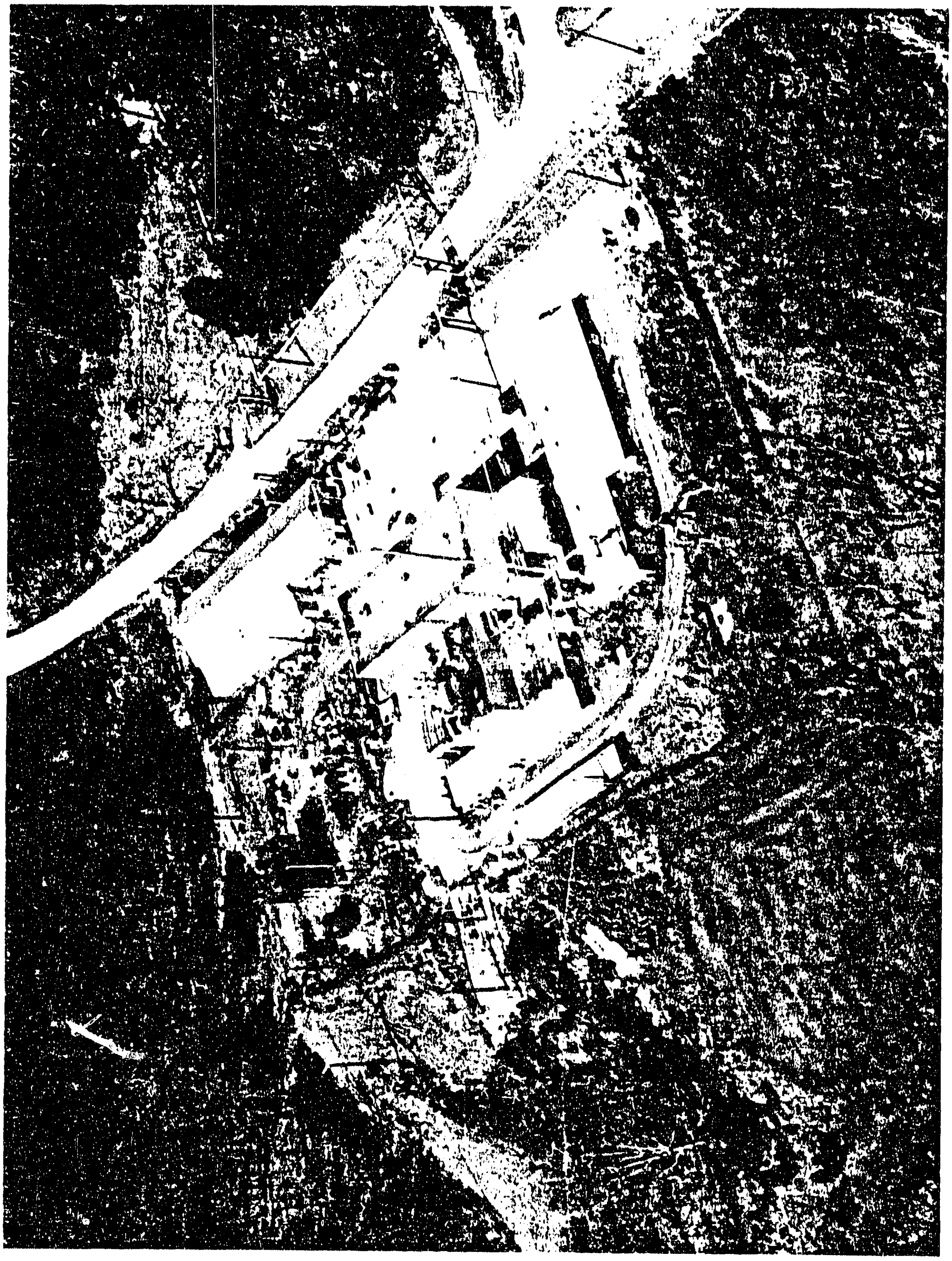


Fig. I.47. Aerial view of the HRE site.

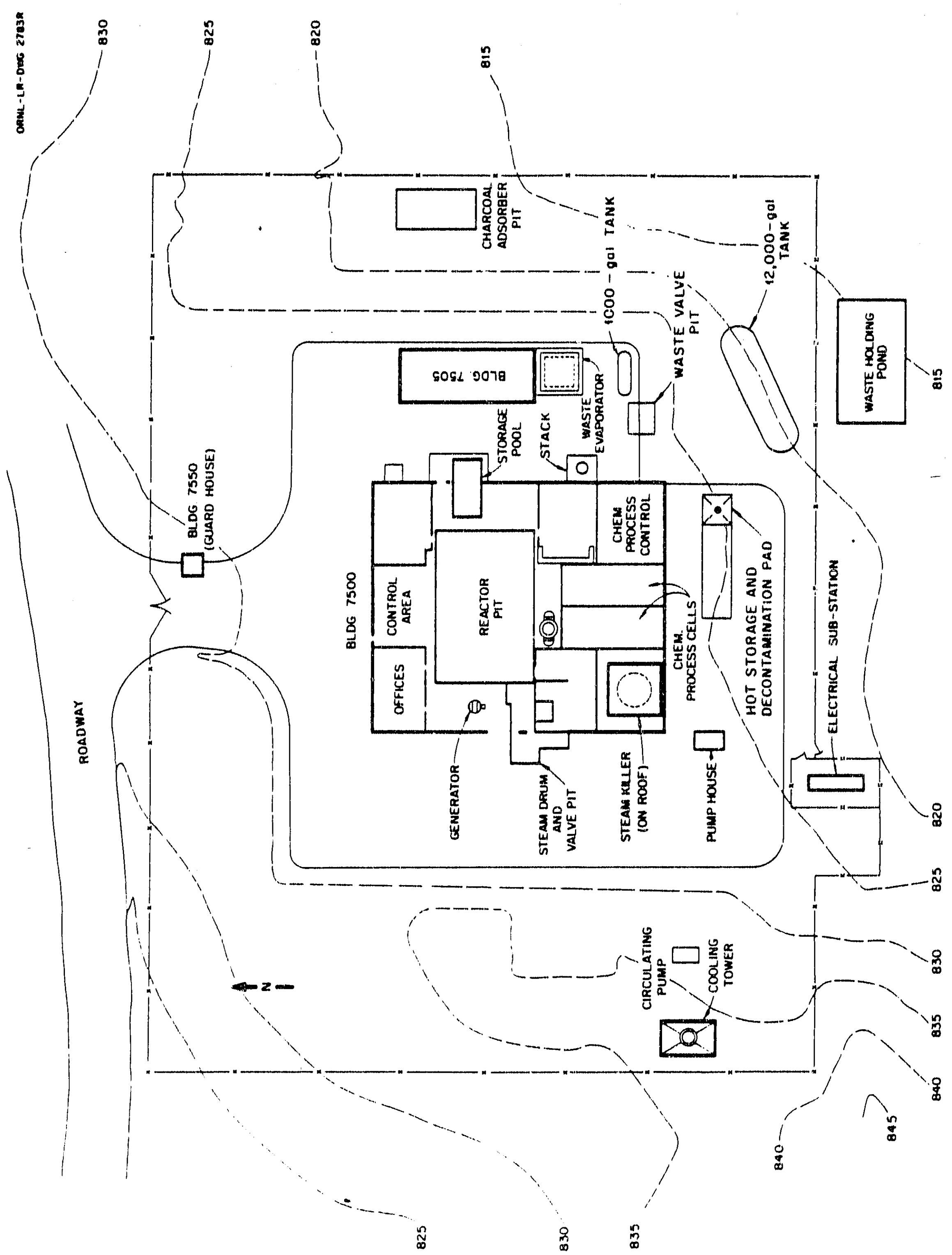


Fig. 1.48. Plot plan of the HRE site.

c. ***Safety/Environmental Considerations.*** During 1961–1962, the reactor fuel and heavy water were recovered from the system and the facility placed in standby condition. The most highly contaminated portions of the reactor system are located in the reactor cell. This cell was routinely flooded during maintenance operations, resulting in widespread contamination of the cell walls and equipment surfaces. Exposure rates up to 600 R/h have been measured in the cell area, primarily attributable to ^{90}Sr and ^{137}Cs. The estimated inventory of fission and corrosion products remaining in the process piping is 30–40 kg (<500 Ci). Personnel accessible areas outside the reactor and process cells are relatively free of contamination. Of the ancillary facilities, the waste evaporator and holding pond are known to contain significant residual radioactivity. The evaporator facility contains contaminated process equipment and operating areas, is structurally sound, but deteriorating with time. The holding basin is estimated to contain on the order of 50–100 Ci of activity, principally ^{137}Cs, ^{60}Co, and ^{90}Sr. The pond was filled with clay and rock and capped with asphaltic concrete in 1970. Soil contamination at the HRE site is primarily limited to those areas surrounding the evaporator and holding pond. Past operations have resulted in low levels of contamination in surface and subsurface soils in the vicinity of the site, as well as the adjacent creek and creek bed. The creek bed contamination is believed to be the result of radionuclide transport from the contaminated soil rather than leakage from the sealed pond.

d. ***Facility Maintenance and Surveillance.*** A comprehensive maintenance and surveillance program is provided to assure adequate containment of the residual radioactivity at the HRE site. Routine inspections of containment systems and building services, radiological surveillance of operating areas and maintenance activities, and regular testing of safety systems are performed as part of this program. Facility maintenance includes general repairs, exhaust filter changes, and instrumentation and controls maintenance. These routine maintenance and surveillance tasks require approximately 0.4 man-year of annual SFMP support. No major facility repairs or improvements have been identified for this facility in the near future. Additional comprehensive pond characterization is being conducted to identify environmental concerns and determine the need for interim stabilization.

e. ***Unique Conditions/Reuse Considerations.*** Portions of the reactor building, as well as several of the support buildings at the HRE site are being utilized and maintained by ORNL research groups and construction personnel. In particular, the chemical process cell B and the supporting operating and control room areas of the reactor provide unique facilities for a variety of research applications. Due to the location of the site, the availability of support services and the overall good condition of these facilities, use of the site is expected to continue into the foreseeable future. Decommissioning planning should, therefore, consider the preservation of the reusable structures and facilities to the extent possible.

PROPOSED FACILITY DISPOSITION

a. ***Alternative Selection.*** Based on the limited reuse potential of the reactor cell and associated process equipment, and the expense, use of burial ground space and personnel exposures that would be involved in reactor dismantlement, the entombment alternative for the primary reactor system is considered the most viable decommissioning mode. The structural condition of the below-grade reactor cell (stainless steel lining and poured concrete encasement) would provide excellent long-term waste containment. Dismantlement of the less contaminated out-of-cell components (process cell and waste evaporator) could be accomplished to make these areas available for reuse, with much of the contaminated equipment transferred to the reactor cell for entombment in order to further reduce the amount of waste requiring off-site disposal. Similarly, entombment is recommended for the waste holding pond, since that basin is already in a stabilized condition in a remote, continuously monitored area of the Laboratory, and since pond removal would result in significantly more cost, personnel exposure, and use of valuable burial ground space.

b. ***Decommissioning Plan.***

1. ***Technical Plan.*** A conceptual plan for decommissioning the HRE has been developed that specifies dismantlement of the Waste Evaporator Cell (Building 7502), removal of surplus equipment from cell C in Building 7500, removal of the buried waste handling system components (tanks and piping), and entombment of these contaminated materials in the reactor cell, along with the reactor components already in that cell. The research facilities and other buildings presently in use at the site would not be decommissioned as part of this effort, and would be available for reuse at the end of the decommissioning operations. The waste holding pond would be entombed utilizing pressurized grouting techniques to form a grout curtain around the pond and horizontal grout sheets at appropriate depths within the pond perimeter. Contaminated soil in the vicinity of the pond and within the reactor site boundary would be removed and treated as LLW.

   The decommissioning plan for the HRE would begin with preparation of the site for operations and preliminary decontamination, equipment consolidation, and isolation of the reactor cell for subsequent entombment operations. Once the cell was prepared, surplus equipment dismantlement from the areas within Building 7500 would be conducted, primarily concentrating on the chemical process plant in cell C. Decontamination of cell C after equipment removal was complete would make that cell available for reuse after site decommissioning was finished. The storage pool and east valve pit in Building 7500 would be entombed separately, following removal of any contaminated materials. Once Building 7500 has been stripped of surplus equipment, the waste evaporator cell, absorber bed pit, and gas holdup loop pit would be cleaned out of equipment, this equipment transferred to the reactor cell, and the pits demolished and disposed of as LLW. The underground tankage and piping adjacent to the reactor building would be excavated and transferred to the reactor cell. The removed contaminated soil would be treated as LLW and would be replaced by clean fill to repair the site grade. After all transfers of equipment to the reactor cell were complete, the cell would be filled with an appropriate grout mix, sealed, and permanently marked as a waste disposal site.

   The entombment of the waste holding pond could be conducted in concert with the reactor decommissioning, or earlier if it becomes an environmental concern. The current planning calls for simultaneous decommissioning operations. The first phase of pond stabilization would involve removal of 55-gal drums that are buried adjacent to the pond. These drums would be excavated and sent to the ORNL burial grounds as LLW. Formation of the grout curtain surrounding the pond would then follow, utilizing high pressure injection pumps. Grout sheets would then be formed above and below the contaminated pond sediments in order to isolate the contaminated materials from groundwater flows. Once the pond is stabilized, the asphalt concrete cap would be resurfaced, sealed, and permanently marked.

2. ***Special Equipment and Techniques.*** Decommissioning operations at the HRE will require development of special techniques in two general areas: remote equipment dismantlement and in-situ grouting. During operation of the HRE, routine maintenance of the reactor system was performed, utilizing shielded work platforms and remote tooling. Similar techniques and facilities would be required for preparing the cell for entombment. Much of this technology is available, but would have to be modified for use at the HRE. Also, grout studies would have to be conducted to specify the appropriate constituents for long-term stability for application both within the reactor cell and at the holding pond. In-situ grouting is a technique that is only in the development stage for use in long-term radioactive waste stabilization. Significant site evaluation and performance testing would be required in order to assure the acceptability of this technique.

3. ***Cost, Schedule, and Waste Volume Projections.*** A summary of the project schedule, estimated costs and waste disposal requirements for the proposed HRE decommissioning project is provided in Fig. I.49. Project planning, equipment and grout development, on-site D&D operations, and project closeout are estimated to extend over a period of approximately six years, at a total estimated cost of \$14.5 million. Approximately 1.3×10^4 ft^3 (355 m^3) of solid radioactive waste and 3×10^4 gal (115 m^3) of liquid radioactive waste will require appropriate handling and disposal. No significant volumes of low-contamination-level stainless steel will be generated.

PRIORITY DETERMINATION CONSIDERATIONS

In its present condition, the HRE does not pose any immediate hazard to ORNL personnel, the public, or the environment. However, due to the significant inventory of contaminated materials in the reactor cell, waste evaporator, and the stabilized waste holding pond, consideration should be given to eliminating the long-term potential hazards associated with this site.

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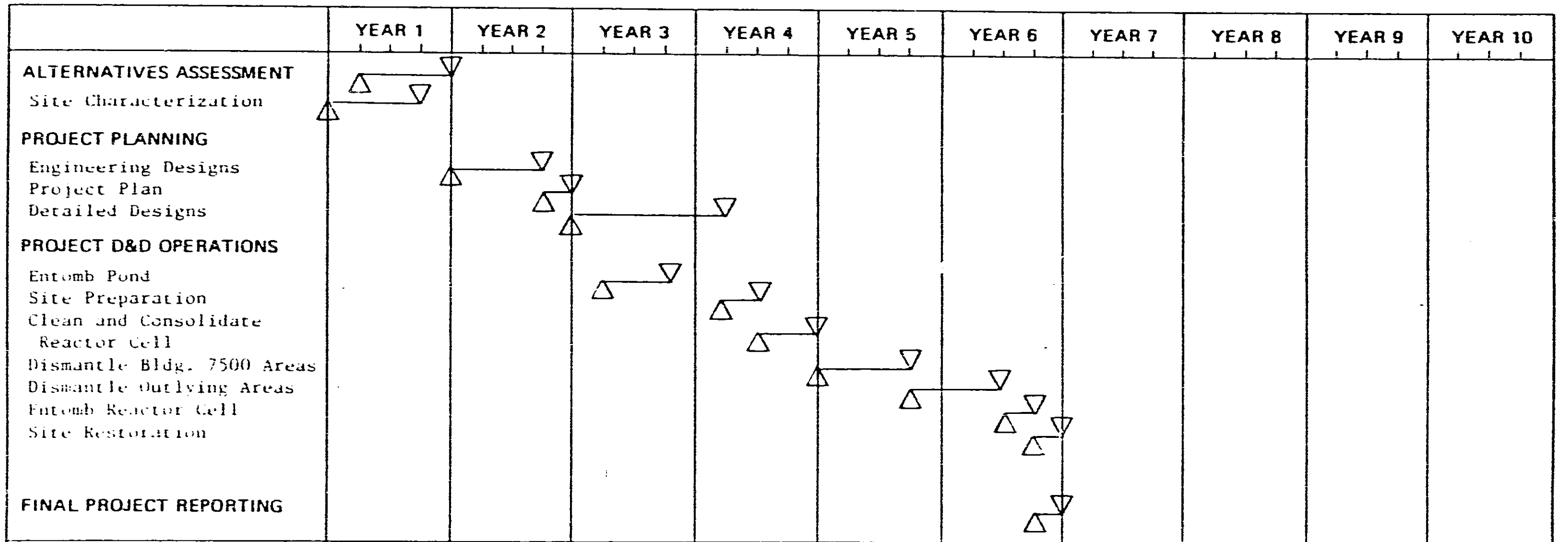

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
PROJECT COSTS ($K)										
Annual Expense	350	1040	2185	4130	3335	3290				
Capital Equipment	–	–	20	85	30	10				
Total	350	1040	2205	4215	3365	3300				
WASTE VOLUME PROJECTIONS										
Solid (m^3)										
Soil (LLW)	–	–	30	–	50	170				
(TRU)	–	–	–	–	–	–				
Rubble (LLW)	–	–	–	–	15	60				
(TRU)	–	–	–	–	–	–				
Metal (LLW)	–	–	5	–	5	20				
(TRU)	–	–	–	–	–	–				
Misc. (LLW)	–	–	–	–	–	–				
(TRU)	–	–	–	–	–	–				
Total (LLW)	–	–	35	–	70	250				
(TRU)	–	–	–	–	–	–				
Liquid (m^3)										
Process Waste	–	–	–	–	–	–				
LLW	–	–	–	40	60	15				

Fig. I.49. Homogenous Reactor Experiment decommissioning project summary.

APPENDIX II
PROGRAM DOCUMENT RECORD

APPENDIX II

PROGRAM DOCUMENT RECORD

The following listing represents a summary of the pertinent documentation for all ORNL SFMP projects, current or completed. These citations were, for the most part, generated by the SFMP as part of project decommissioning planning, operations, or closeout activities. An additional, comprehensive data base is available through the ORNL SFMP, covering the historical aspects of each facility (site construction, operations and shutdown).

I. GENERAL PROGRAM

T. E. Myrick, *The ORNL Surplus Facilities Management Program Long Range Plan*, September 1984, ORNL/TM-8957.

L. M. Braunstein, W. F. Ohnesorge, and T. W. Oakes, *Preliminary Assessment for Decommissioning Surplus Facilities at ORNL: Environmental and Health Risks*, September 1984, ORNL/CF-84/310.

J. H. Coobs and T. E. Myrick, *The ORNL Surplus Facilities Management Program Maintenance and Surveillance Plan for Fiscal Year 1984*, June 1983, ORNL/CF-83/56.

Union Carbide Corporation Nuclear Division, *Technical Manual for Decontamination and Decommissioning Program*, Engineering Division, May 1980, X-OE-115.

Union Carbide Corporation Nuclear Division, *Engineering Management Plan for Decontamination and Decommissioning Program*, Engineering Division, April 1980, X-OE-114.

II. COMPLETED PROJECTS

1. *Standard Pile and DOSAR Accelerator*

   E. E. Pierce, *Standard Pile and DOSAR Accelerator Decontamination and Decommissioning*, July 1979, ORNL/NFW-79/51.

2. *3026-C Radiochemical Waste System*

   E. E. Pierce, A. A. Walls, W. G. Tatum, *Decommissioning Building 3026-C Radiochemical Waste System*, January 1981, ORNL/NFW-81/2.

3. *Intermediate-Level Waste Transfer Line*

   A. A. Walls, S. P. duMont, W. G. Tatum, T. E. Myrick, *The Intermediate Level Waste Transfer Line Decommissioning Project Final Report*, December 1983, ORNL/TM-8897.

J. H. Schorn and S. P. duMont, *Safety Assessment–I.L.W. Pipeline Decommissioning, Pipeline Removal,* June 1982, ORNL/ENG/SA-577.

J. H. Schorn and S. P. duMont, *Safety Assessment–I.L.W. Pipeline Decommissioning, Seal Surface Leaks,* June 1982, ORNL/ENG/SA-578.

W. F. Ohnesorge, T. W. Oakes, D. W. Parsons, and J. C. Malone, *An Environmental Radiological Survey of the Intermediate-Level Waste System Pipeline,* September 1981, ORNL/TM-7858.

J. O. Duguid and O. M. Sealand, *Reconnaissance Survey of the Intermediate Level Liquid Waste Transfer Line Between X-10 and the Hydrofracture Site,* August 1975, ORNL/TM-4743.

4. *Curium Source Fabrication Facility*

R. W. Schaich, *Final Report on the Decontamination of the Curium Source Fabrication Facility,* December 1983, ORNL/TM-8376.

Union Carbide Corporation Nuclear Division, *Feasibility Study for Decommissioning the Curium Source Fabrication Facility,* Engineering Division, September 1981, X-OE-171.

III. CURRENT PROJECTS

1. *Molten Salt Reactor Experiment (WBS 4.6.6)*

F. J. Peretz and W. R. Reed, *Preliminary Decommissioning Study Reports Volume 5: Molten Salt Reactor Experiment,* September 1984, X-OE-231 Vol. 5.

D. R. Simpson, *Preliminary Radiological Characterization of the Molten Salt Reactor Experiment (MSRE),* July 1984, ORNL/CF-84/92.

C. D. Cagle and L. P. Pugh, *Decommissioning Study for the ORNL Molten Salt Reactor Experiment,* August 1977, ORNL/CF-77/391.

2. *Metal Recovery Facility (WBS 4.6.7)*

L. M. Blankenship, et al., *Building 3505 Decommissioning Risk Analysis,* June 1984, ORNL/ENG/INF-84/2.

L. M. Blankenship, *Safety Assessment—Building 3505 Decommissioning Addendum,* June 1984, ORNL/ENG/SA-1040.

Union Carbide Corporation Nuclear Division, *Conceptual Design Report for Decommissioning the Metal Recovery Facility,* Engineering Division, X-OE-222, March 1984.

T. E. Myrick, R. W. Schaich, J. R. DeVore, *Metal Recovery Facility Decommissioning Project Plan,* March 1984, ORNL/TM-9018.

J. R. DeVore, *Quality Assurance Assessment for Major Projects–Decontamination and Decommissioning of the Metal Recovery Facility,* December 1983, OP-RI-QAA-20.

Operations Division, "Operations Division–Radioisotope Department Operating Procedures," Number RD-P-O-20, Building 3505, Metal Recovery Facility, Oak Ridge National Laboratory, November 1983.

Union Carbide Corporation Nuclear Division, *Safety Assessment–Building 3505 Decommissioning*, Engineering Division, ORNL/ENG/SA-749, November 1983.

Oak Ridge National Laboratory, *Action Description Memorandum–Metal Recovery Facility Decommissioning*, Industrial Safety and Applied Health Physics Division, September 1983.

F. J. Peretz and J. F. Alexander, *Summary of the Radiological Characterization of Building 3505*, UCC-ND Engineering Division, X-OE-190, September 1982.

L. E. Boing, J. M. Mahathy, J. Burden, and D. G. Jacobs, *Results of the Radiological Survey of the Former Metal Recovery Facility at Oak Ridge National Laboratory*, Evaluation Research Corporation, Oak Ridge, Tennessee, September 1981.

Union Carbide Corporation Nuclear Division, *Feasibility Study for Building 3505 Decommissioning*, Engineering Division, X-OE-110, April 1980.

3. *Fission Product Development Laboratory (WBS 4.6.8).*

T. E. Myrick, R. W. Schaich, F. V. Williams, *Fission Product Development Laboratory Cell Decommissioning Project Plan*, August 1983, ORNL/TM-8779.

R. W. Schaich, et. al., *Quality Assurance Assessment for Major Projects, Fission Product Development Laboratory Operations*, Oak Ridge National Laboratory, OP-RI-QAA-2, May 1982.

Operations Division, *Operations Division–Radioisotope Department Operating Procedures, Number RD-P-O-2-6, Building 3517, Fission Products Development Laboratory*, Oak Ridge National Laboratory, revised March 3, 1982.

R. W. Schaich, *The Decommissioning of the Fission Product Development Laboratory at Holifield National Laboratory*, Proceedings of the Decontamination and Decommissioning of ERDA Facilities Conference, Idaho Falls, ID, August 1975, CONF-750822.

C. L. Ottinger and R. W. Schaich, *Hazards Report for Building 3517 Fission Products Development Laboratory*, ORNL/TM-753, revised February 1965.

4. *Low Intensity Test Reactor (WBS 4.6.10)*

W. R. Reed, *Preliminary Decommissioning Study Reports Volume 8: Low Intensity Test Reactor*, September 1984, X-OE-231 Vol. 8.

D. R. Simpson, J. H. Pemberton, and R. C. Cooper, *Preliminary Radiological Characterization of the Low Intensity Test Reactor*, July 1984, ORNL/CF-84/37.

C. D. Cagle and L. P. Pugh, *Decommissioning Study for the Low Intensity Test Reactor*, June 1975, ORNL/CF-75-6-67.

5. *Waste Holding Basin (WBS 4.6.11)*

   J. R. Horton, N. W. Durfee, F. J. Peretz, *Preliminary Decommissioning Study Reports Volume 2: Waste Settling Basin (3513),* September 1984, X-OE-231 Volume 2.

   S. F. Huang, W. A. Alexander, J. B. Watson and T. W. Oakes, *Preliminary Radiological Characterization of the Waste Holding Basin (3513),* September 1984, ORNL/CF-84/204.

   T. Tamura, O. M. Sealand, J. O. Duguid, *Preliminary Inventory of $^{239,240}Pu$, ^{90}Sr, and ^{137}Cs in Waste Pond No. 2 (3513),* June 1977, ORNL/TM-5802.

6. *Old Hydrofracture Facility (WBS 4.6.12)*

   W. R. Reed, *Preliminary Decommissioning Study Reports Volume 11: Old Hydrofracture Facility,* September 1984, X-OE-231 Volume 11.

   S. F. Huang, et. al., *Preliminary Radiological Characterization of the Old Hydrofracture Facility,* September 1984, ORNL/CF-84/202.

7. *Gunite Waste Storage Tanks (WBS 4.6.13)*

   J. R. Horton, *Preliminary Decommissioning Study Reports Volume 4: Gunite Waste Storage Tanks,* September 1984, X-OE-231 Volume 4.

   S. F. Huang, et. al., *Preliminary Radiological Survey of the Gunite Tanks in the South Tank Farm at Oak Ridge National Laboratory,* September 1984, ORNL/CF-84/206.

8. *ORNL Graphite Reactor (WBS 4.6.14)*

   W. R. Reed, *Preliminary Decommissioning Study Reports Volume 7: Old Hydrofracture Facility,* September 1984, X-OE-231 Volume 7.

   D. R. Simpson, J. H. Pemberton, and R. C. Cooper, *Preliminary Radiological Characterization of the Oak Ridge Graphite Reactor (OGR) Facility (Buildings 3001, 3002, and 3003),* July 1984, ORNL/CF-84/30.

   C. D. Cagle and L. P. Pugh, *Decommissioning Study for the ORNL Graphite Reactor,* July 1976, ORNL/CF-76/196.

9. *ORR Experimental Facilities (WBS 4.6.15)*

   J. R. Horton, *Preliminary Decommissioning Study Reports Volume 9: ORR Experimental Facilities,* September 1984, X-OE-231 Volume 9.

   J. R. Horton, N. W. Durfee, F. J. Peretz, *Preliminary Decommissioning Study Reports Volume 10: ORR Heat Exchangers,* September 1984, X-OE-231 Volume 10.

   D. R. Simpson and J. H. Pemberton, *Preliminary Radiological Characterization of the ORR Experimental Facilities,* January 1984, ORNL/CF-83/250.

   D. R. Simpson and S. F. Huang, *Preliminary Radiological Characterization of the ORR Water-to-Air Heat Exchangers (Building 3087),* August 1983, ORNL/CF-83/204.

10. *Storage Garden 3033 (WBS 4.6.16)*

    J. R. Horton, *Preliminary Decommissioning Study Reports Volume 13: 3033 Storage Garden,* September 1984, X-OE-231 Volume 13.

    S. F. Huang, et. al., *Preliminary Radiological Survey of Storage Gardens 3026-D and 3033 at Oak Ridge National Laboratory,* September 1984, ORNL/CF-84/205.

11. *Homogeneous Reactor Experiment (WBS 4.6.17)*

    W. R. Reed, *Preliminary Decommissioning Study Reports Volume 6: Homogeneous Reactor Test,* September 1984, X-0E-231 Vol. 6.

    W. R. Reed, *Preliminary Decommissioning Study Reports Volume 12: HRT Retention Pond,* September 1984, X-OE-231 Volume 12.

    S. F. Huang, et. al., *Preliminary Radiological Characterization of the Homogeneous Reactor Experiment No. 2 (HRE-2),* September 1984, ORNL/TM-9057.

    D. R. Simpson and S. DeLaGarza, *Preliminary Radiological Characterization of the Homogeneous Reactor Experiment No. 2 (HRE-2),* November 1982, ORNL/CF-82/288.

    C. D. Cagle and L. P. Pugh, *Decommissioning Study for the Homogeneous Reactor Experiment No. 2 (HRE-2),* February 1976, ORNL/CF-76/66.

12. *Waste Storage Tanks (WBS 4.6.18)*

    J. R. Horton, *Preliminary Decommissioning Study Reports Volume 3: LLW Collection Tanks,* September 1984, X-OE-231 Volume 3.

    S. F. Huang, et. al., *Preliminary Radiological Characterization of the LLW Collection Tanks,* September 1984, ORNL/CF-84/203.

13. *C-14 Process System (WBS 4.6.19)*

14. *Waste Evaporator Facility (WBS 4.6.20)*

    J. R. Horton, *Preliminary Decommissioning Study Reports Volume 14: Buildings 3506 and 3515,* September 1984, X-OE-231 Volume 14.

    D. R. Simpson, *Preliminary Radiological Characterization of the Waste Evaporator Facility (Bldg. 3506) and the Fission Product Pilot Plant (Bldg. 3515),* July 1984, ORNL/CF-84/93.

15. *Fission Product Pilot Plant (WBS 4.6.21)*

    J. R. Horton, *Preliminary Decommissioning Study Reports Volume 14: Buildings 3506 and 3515,* September 1984, X-OE-231 Volume 14.

    D. R. Simpson, *Preliminary Radiological Characterization of the Waste Evaporator Facility (Bldg. 3506) and the Fission Product Pilot Plant (Bldg. 3515),* July 1984, ORNL/CF-84/93.

16. *Shielded Transfer Tanks (WBS 4.6.22)*

W. R. Reed, F. J. Peretz, S. P. duMont, *Preliminary Decommissioning Study Reports Volume 1: Shielded Transfer Tanks,* UCC-ND Engineering Division, October 1983, X-OE-231 Vol. 1.

D. R. Simpson, *Preliminary Radiological Characterization of the Shielded Transfer Tanks,* May 1983, ORNL/CF-83/62.

APPENDIX III
APPLICABLE CODES, STANDARDS, AND OPERATING PROCEDURES

APPENDIX III

APPLICABLE CODES, STANDARDS, AND OPERATING PROCEDURES

BASIC POLICY AND GUIDANCE

The basic regulation that governs management of surplus facilities at ORNL is DOE Order 5820, "Radioactive Waste Management." The stated objective of Order 5820 is to establish requirements to assure that all DOE operations involving the management of radioactive waste, waste by-products, and surplus facilities are conducted to adequately protect the public health and safety, in accordance with DOE Order 5480.1. The order has five chapters which address specific implementing procedures and requirements for managing high-level waste, TRU waste, low-level waste, waste contaminated with naturally occurring radionuclides, and decontamination and decommissioning of surplus facilities. Several other DOE orders, as well as Order 5480.1, are referred to in Order 5820 as having supplemental and related requirements. These and other pertinent DOE orders and guides are listed in Table III.1.

Radioactive waste management at ORNL is also affected by the rules and regulations promulgated by NRC, EPA, DOT, and the State of Tennessee. Although NRC rules and licensing requirements currently have no direct impact on operations at ORNL and other DOE sites, the performance objectives of Order 5820.2 are comparable to those of NRCs requirements for disposal operations on high-level, TRU, and low-level wastes as promulgated in 10 CFR Parts 60 and 61. In addition, DOE and other executive agencies are required by Executive Order 12088 to comply with applicable pollution control standards of the EPA and of state and local agencies. Guidelines are provided by DOE for compliance with the applicable regulations and standards. The several EPA, NRC, DOE, and state regulations that are related to or applicable to surplus facilities and radioactive waste management at ORNL are listed in Table III.2.

The general trend in the standards and regulations developed by agencies other than DOE has been toward a reduction of allowable radiation exposures. This trend is reflected in EPA's proposed "National Emission Standards for Hazardous Air Pollutants. Standards for Radionuclides," 40 CFR Part 61, and in the proposed standards for management and disposal of spent fuel and high-level and TRU wastes, 40 CFR Part 191. The trend should also be anticipated in 40 CFR Part 193, "Environmental Radiation Protection Standards for Low-Level Radioactive Waste Disposal," which EPA is beginning to develop. Those responsible for radioactive waste management at ORNL should accordingly expect eventual standards that will restrict exposures to lower levels than currently permitted by DOE orders. On the other hand, this philosophy is consistent with the ALARA guidelines and objectives that are found in policy statements by DOE and the Laboratory.

To summarize the extensive amount of federal and state regulations and guidance, and to provide a concise set of procudures that address applicable industry standards (OSHA, ANSI, etc.), numerous procedures and operations manuals are maintained at ORNL. These manuals, listed in Table III.3, cover the range of activities from radiation protection to ORNL management practices, and are the standards by which all operations at the Laboratory are performed.

TABLE III.1. Applicable DOE orders and guides

Order/Guide	Date	Title
DOE Order 1540.1	May 1982	Materials Transportation and Traffic Management
DOE Order 4320.1	April 1981	Site Development and Facility Utilization Planning
DOE Order 5440.1B	May 1982	Implementation of the National Environmental Policy Act
DOE Order 5480.1A	August 1981	Environmental Protection, Safety, and Health Protection Program for DOE Operations
DOE Order 5480.2	May 1983	Hazardous and Radioactive Mixed Waste Management
DOE Order 5480.4	May 1984	Environmental Protection, Safety, and Health Protection Standards
DOE Order 5481.1A	June 1982	Safety Analysis and Review
DOE Order 5483.1	April 1979	Occupational Safety and Health Program for Government-Owned Contractor Operated Facilities
DOE Order 5484.1	February 1981	Environmental Protection, Safety, and Health Protection Information Reporting Requirements
DOE Order 5500.2	August 1981	Emergency Planning, Preparedness, and Response for Operations
DOE Order 5500.3	August 1981	Reactor and Nonreactor Nuclear Facility Emergency Planning
DOE Order 5632.2	February 1979	Physical Protection of Special Materials Quality Assurance
DOE Order 5700.6A	August 1981	Quality Assurance
DOE Order 5820	February 1984	Radioactive Waste Management
DOE Order 6410.1	March 1983	Management of Construction Projects
DOE/EP-0058	June 1982	Environmental Compliance Guide for DOE Compliance with Endangered Species Act
DOE/EP-0023	1981	Guide for Environmental Radiological Surveillance at DOE Installations
DOE/EV-0132 Vol. 1 and 2	February 1981	DOE Environmental Compliance Guide
DOE/EV/1830-T5	1980	A Guide to Reducing Radiation Exposure to As-Low-As-Reasonably-Achievable (ALARA)

Table III.2. Applicable non-DOE regulations

Title	Reference
NRC Licensing Requirements for Land Disposal of Radioactive Waste	10 CFR 61
EPA Clean Air Act	Public Law 95-95
EPA Clean Water Act	Public Law 95-217
CEQ Regulations for Implementing the NEPA Act	40 CFR 1500-1508
EPA Resource Conservation and Recovery Act	Public Law 94-580
EPA Safe Drinking Water Act	Public Law 93-523
DOT Transportation Regulations	49 CFR Part 4
Tennessee Hazardous Waste Management Rules	Chapter 1200-1-11
Tennessee Solid Waste Disposal Act	Tennessee Code, Title 53, Chapter 43
Tennessee Hazardous Waste Management Act	Tennessee Code, Title 53, Chapter 63
Tennessee Solid Waste Regulations	Chapter 1200-1-7
Tennessee General Regulations	Chapter 1200-4-1
Tennessee Water Quality Criteria	Chapter 1200-4, Rule 3
Tennessee Effluent Limitations and Standards	Chapter 1200-4-5
Tennessee Air Quality Act	Tennessee Code, Title 553, Chapter 34
Tennessee Air Pollution Control Regulation	Chapter 1200-3
Tennessee Water Quality Control Act	Tennessee Code, Title 70, Chapter 3

Table III.3. ORNL manuals and procedures

Safety Manual
Health Physics Procedure Manual
The Safety and Loss Control Programs of the Oak Ridge National Laboratory
Industrial Hygiene Manual
Plant and Equipment Safety Manual
Plant and Equipment Division Procedures Master List
ORNL Environmental Protection Manual
Hazardous Materials Manual
ORNL Emergency Manual
ORNL Respirator Program
Industrial Hygiene Analysis Manual
Health Physics Instrument Manual
Standard Practice Procedures
Radioactive Solid Waste Operations Manual
Quality Assurance Manual
Oak Ridge National Laboratory Shipping Containers for Radioactive Materials

APPENDIX IV
LIST OF ACRONYMS

Appendix IV

LIST OF ACRONYMS

ALARA	As-Low-As-Reasonably-Achievable
ANSI	American National Standards Institute
Bldg.	Building
CFR	Code of Federal Regulations
CG	Concentration Guide
D&D	Decontamination and Decommissioning
DOE	Department of Energy
DOE-HQ	Department of Energy Headquarters Office
DOE-OR	Department of Energy Oak Ridge Operations Office
DOE-RL	Department of Energy Richland Operations Office
DOE SFMP	Department of Energy Surplus Facilities Management Program
DOT	Department of Transportation
EPA	Environmental Protection Agency
FPDL	Fission Product Development Laboratory
FPPP	Fission Product Pilot Plant
FTP/A	Field Task Proposal/Agreement
FY	Fiscal Year
GCR	Gas Cooled Reactor
HEPA	High Efficiency Particulate Absolute
HRE	Homogeneous Reactor Experiment
ICRP	International Commission on Radiological Protection
LITR	Low Intensity Test Reactor
LLW	Low Level Waste
M&S	Maintenance and Surveillance
MMES	Martin Marietta Energy Systems, Inc.
MRF	Metal Recovery Facility
MSRE	Molten Salt Reactor Experiment
NCRP	National Council on Radiation Protection and Measurement
NEPA	National Environmental Policy Act
NRC	Nuclear Regulatory Commission
OGR	ORNL Graphite Reactor
OHF	Old Hydrofracture Facility
ORGDP	Oak Ridge Gaseous Diffusion Plant
ORNL SFMP	Oak Ridge National Laboratory's Surplus Facilities Management Program
ORNL	Oak Ridge National Laboratory

ORR	Oak Ridge Research Reactor
OSFM	Office of Surplus Facilities Management
OSHA	Occupational Safety and Health Administration
PCB	Polychlorinated biphenyls
PI	Principal Investigator
QA	Quality Assurance
R&D	Research and Development
SFMPO	Surplus Facilities Management Program Office
STT	Shielded Transfer Tank
SWSA	Solid Waste Storage Area
TEC	Total Estimated Cost
TRU	Transuranic
TVA	Tennessee Valley Authority
UNC	United Nuclear Corporation, Inc.
WBS	Work Breakdown Structure
WOCC	Waste Operations Control Center
WOC	White Oak Creek
X-10	Designation for Oak Ridge National Laboratory
Y-12	Designation for the Y-12 Production Plant

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30–33. C. E. Miller, Program Manager, Surplus Facilities Management Program, Richland Operations Office, U.S. Department of Energy, Post Office Box 550, Richland, WA 99352

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