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OAK RIDGE NATIONAL LABORATORY

UNION CARBIDE

The Intermediate Level Waste Transfer Line Decommissioning Project

Final Report

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OPERATED BY
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CONTENTS

Page

LIST OF FIGURES v

LIST OF TABLES vii

ABSTRACT 1

1.0 INTRODUCTION 1

2.0 FACILITY DESCRIPTION 3

2.1 PHYSICAL DESCRIPTION AND OPERATING HISTORY 3

2.2 SITE CONDITIONS. 7

2.2.1 Leak Site No. 1 8
2.2.2 Leak Site No. 2 10
2.2.3 White Oak Creek Floodplain 14

3.0 PROJECT OBJECTIVES 18

4.0 PROJECT ACTIVITIES 20

4.1 PROJECT PLANNING 20

4.1.1 Site Characterization 20
4.1.2 Project Engineering 21
4.1.3 Safety Assessment 22
4.1.4 Quality Assurance Assessment 23
4.1.5 Environmental Assessment 23
4.1.6 Project Management 23

4.2 DECOMMISSIONING OPERATIONS 24

4.2.1 Site Preparation 24
4.2.2 Removal of Hydrofracture Test Line 26
4.2.3 Removal of the ILW Line at White Oak Creek . . . 26
4.2.4 Entombment of Leak Sites 38

4.3 PROJECT DOCUMENTATION 49

4.3.1 Reviews and Periodic Reporting 49
4.3.2 Site Certification 49
4.3.3 Final Reporting 52

5.0 WASTE MANAGEMENT 53

6.0 HEALTH PHYSICS 55

Page

7.0 PROJECT COST AND SCHEDULE 56

8.0 SUMMARY AND CONCLUSIONS 58

9.0 REFERENCES 63

LIST OF FIGURES

Figure		Page
1	Location map for the ORNL SFMP facilities - Melton Valley	3
2	Details of the ILW transfer line route	5
3	Beta-gamma survey results at Leak Site No. 1	9
4	Contour map showing location of ILW line and leak sites	11
5	Photograph of Leak Site No. 1 prior to decommissioning activities (looking southeast)	12
6	Photograph of Leak Site No. 2 prior to decommissioning activities (looking southeast)	13
7	Beta-gamma survey results at Leak Site No. 2	15
8	Photograph of White Oak Creek floodplain site (looking east)	16
9	Design details for the White Oak Creek floodplain site	25
10	Removal of hydrofracture test pipe	27
11	ILW line drainage pit just east of White Oak Creek	29
12	View of waste tank for collection of pipeline drainage	30
13	Lifting and sectioning of ILW line	31
14	Method used for collection of pipeline drainage at line breaks	32
15	View of stainless steel piping bundles and other miscellaneous wastes packaged for disposal	34
16	Carbon steel line on pipe racks ready for segmenting	35
17	Carbon steel pipe segments in TRU waste package	36
18	View of holes in carbon steel piping	37
19	Site plan for the North Leak Site	39
20	Site plan for the South Leak Site	40

Figure		Page
21	Planned boundaries of the North Leak Site asphalt cover. . .	41
22	Planned boundaries of the South Leak Site asphalt cover. . .	42
23	Capping of the ILW line at the leak sites.	43
24	Removal of vegetation over Leak Site No. 1	45
25	Application of earth fill over bentonite clay cap - Leak Site No. 1	46
26	View of Leak Site No. 1 with crushed stone base	47
27	Asphalt cover in place at Leak Site No. 1	48
28	Final site conditions at Leak Site No. 1	50
29	Final site conditions at Leak Site No. 2	51
30	Project schedule for the ILW Transfer Line Decommissioning Project	57

LIST OF TABLES

Table		Page
1	Analysis results of TRU activity levels in ILW pipe segments	19
2	Summary of the Waste Disposal Requirements for the ILW Transfer Line Decommissioning	54
3	Cost Summary for the ILW Transfer Line Decommissioning Project	59

THE INTERMEDIATE LEVEL WASTE TRANSFER LINE DECOMMISSIONING PROJECT

FINAL REPORT

A. A. Walls, W. G. Tatum, S. P. du Mont, T. E. Myrick

ABSTRACT

The Intermediate-Level Waste (ILW) transfer line at Oak Ridge National Laboratory (ORNL) was an integral part of the liquid radioactive waste disposal system, operating from 1952 until 1975. This line was used to transport ILW from the waste processing facilities in the Bethel Valley area at ORNL to final disposal sites in the adjacent Melton Valley. During the history of pipeline operations, approximately 45 million gallons of liquid waste, containing over 1.5 million curies of mixed fission products, were transferred through the line to waste disposal trenches and to the ORNL hydrofracture facility. Use of the line was discontinued in 1975 when a new, doubly-contained line was installed to service the expanded hydrofracture program.

Since 1976, the ILW line has been under the control of the ORNL Surplus Facilities Management Program (SFMP). Due to the presence of contaminated soil at two former leak sites along the line, and the potential for radionuclide migration from that portion of the abandoned line that traverses White Oak Creek and the floodplain, decommissioning of the ILW line was given a high priority by the ORNL SFMP. In 1979, plans were initiated for corrective action along those portions of the line. The decommissioning activities have now been completed, with the abandoned line being placed in a condition that significantly reduces the hazards associated with it. The portion of the line in the White Oak Creek floodplain was removed, and the two leak sites entombed. This report presents the results of the ILW line decommissioning project, outlining the scope of the effort, describing the decommissioning experiences, and summarizing the project costs and schedules.

1.0 INTRODUCTION

The inactive Intermediate-Level Waste (ILW) transfer line is one of 46 Oak Ridge National Laboratory (ORNL) facilities currently included in the Department of Energy's Surplus Facilities Management Program

(SFMP). The purpose and objectives of this national program are set forth in the SFMP Program Plan and include (1) the maintenance and surveillance of surplus radioactively contaminated facilities prior to initiation of facility decommissioning activities, (2) planning for the orderly disposition of these facilities, and (3) implementation of a program to accomplish the facility decommissioning in a safe, cost-effective and timely manner. The ILW line was accepted into the Surplus Facilities Management Program in 1976 and has progressed through each of these SFMP program steps since that time.

The ILW transfer line, located in the ORNL Melton Valley area in proximity to several other SFMP facilities as shown in Fig. 1, was first put into operation in 1952. The line was used for the transfer of liquid intermediate-level wastes from the waste treatment facilities in the ORNL Bethel Valley area to disposal sites in Melton Valley. The line was modified and extended several times during its operating life, ultimately serving the hydrofracture facility where deep-well injection of a grout waste form was accomplished. The transfer line was removed from service in 1975.

During the operation of the transfer line, waste leakage had been observed at various locations, principally associated with pipe joints and valves. These leaks had been repaired as required, with routine disposal of highly contaminated soil near the leaks. A radiological survey conducted in 1979, shortly after the line was abandoned, confirmed the location of two sites where leaks had occurred and surface soil

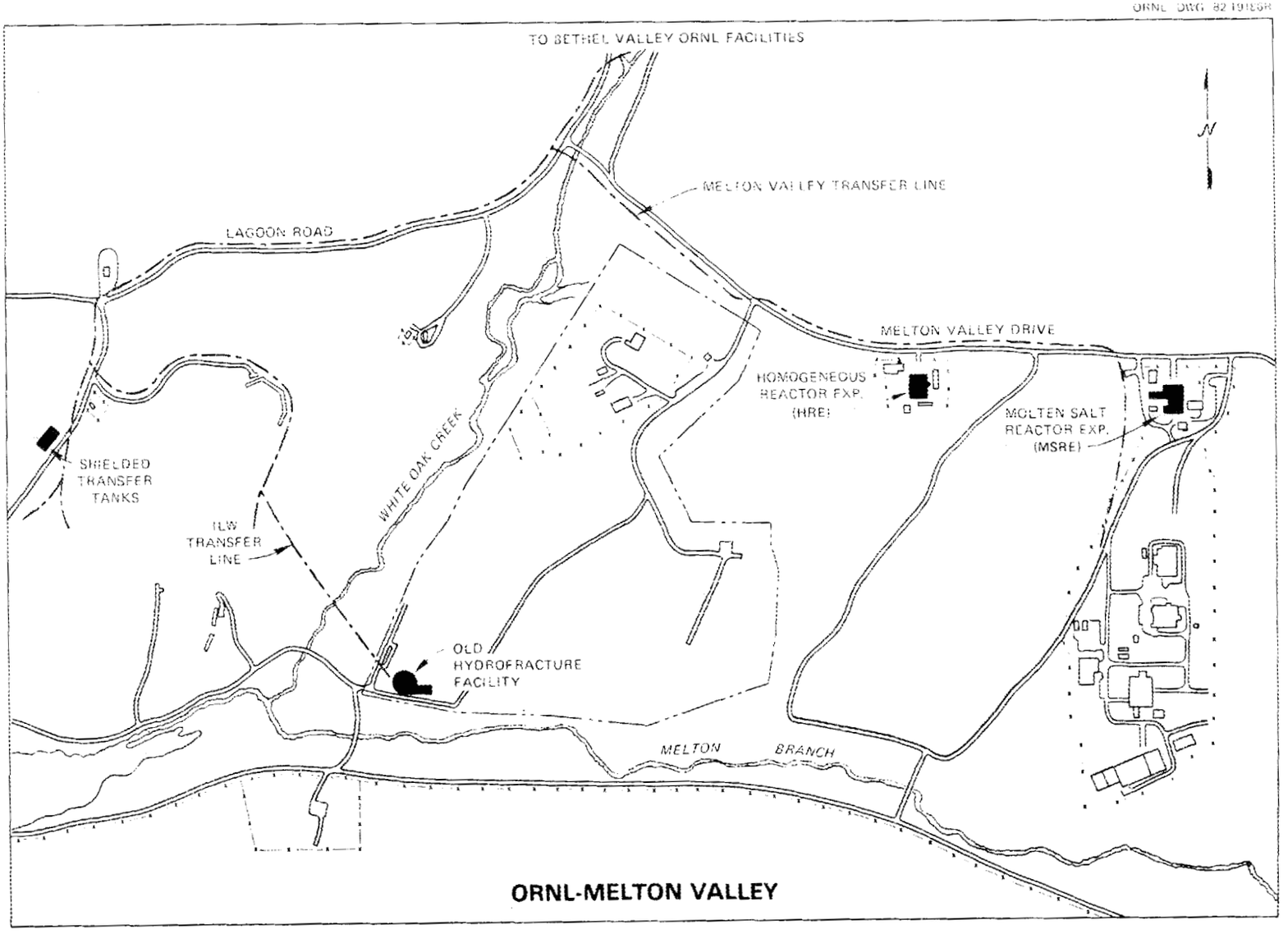

Fig. 1 Location map for the ORNL SFMP facilities - Melton Valley

contamination was present. In addition, although the line had been flushed with water and purged when it was retired from service, the interior surface of the piping was known to be highly contaminated.

Due to the presence of the contaminated soil at the two known leak sites and the internal contamination present within the line, there was concern that this residual radioactive material could migrate into the surrounding White Oak Creek watershed. In response to these concerns, the decommissioning of the ILW line was given a high priority by the SFMP, and in FY 1979, plans were initiated for disposition of the effected portions of the line. The decommissioning project has now been completed after five years of intermittent activity.

As outlined in the SFMP Program Plan, participating contractors are required to prepare a final report that documents the project activities, accomplishments, final facility status and project costs. This report has been prepared to satisfy this program need.

2.0 FACILITY DESCRIPTION

2.1 PHYSICAL DESCRIPTION AND OPERATING HISTORY

The ILW transfer line consisted of a singly contained pipeline that extended from the Gunite storage tanks (site 3507) at the ORNL Bethel Valley complex to waste disposal pits in Melton Valley. As shown in Fig. 2, the pipe route followed the north side of Lagoon Road after leaving the main ORNL site, with branches extending to waste pits 1-7 and across White Oak Creek to the Old Hydrofracture Facility. The total length of the line was approximately 2.4 km (1.5 miles). At the inter-

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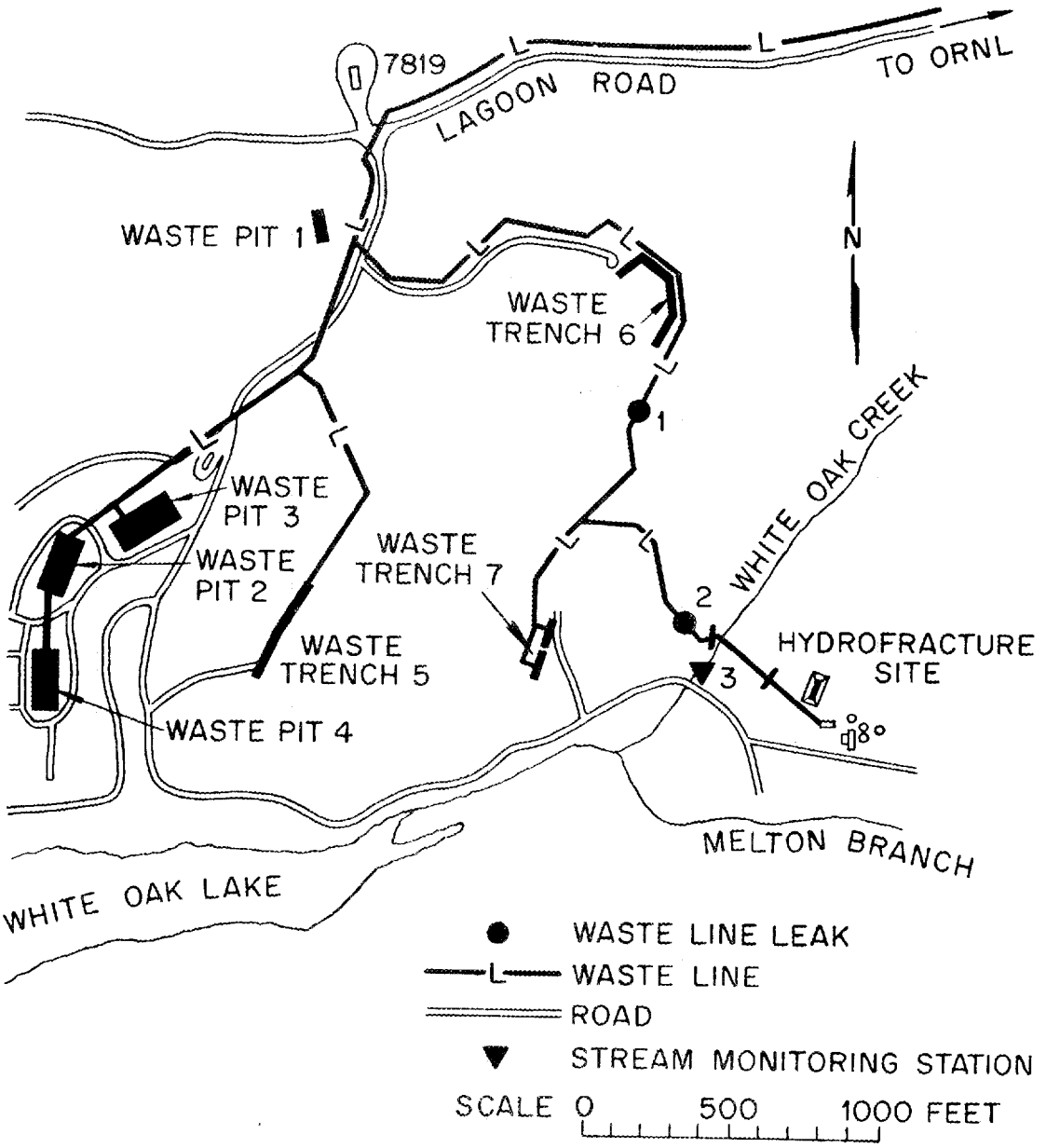

Fig. 2 Details of the ILW transfer line route

section of Lagoon Road and Melton Valley Drive, a tie-in existed between the ILW and Melton Valley transfer lines (see Fig. 1).

The ILW transfer line was used periodically from 1952 to 1975 to transport intermediate-level liquid waste to final disposal areas. The pipeline replaced a tank truck previously used to transport the liquid waste. The waste, arising from a variety of sources at the Laboratory, was routinely treated with NaOH to precipitate dissolved solids and was processed through an evaporation system to reduce liquid volumes. Over the operating lifetime of the transfer line, over 1.7×10^5 m^3 (45×10^6 gallons) of liquid waste containing some 1.5 MCi of mixed fission products (principally ^{90}Sr and ^{137}Cs) were transported to the Melton Valley disposal facilities.

The original pipeline leading to waste pit 2 (see Fig. 2) was constructed of 5 cm (2 in) diameter, flanged, cast iron pipe with Neoprene joint gaskets, buried at a nominal depth of 1 m (3 ft). In 1958, sections of this line developed corrosion leaks and were replaced with carbon steel flanged lines. By 1960, a 5 cm (2 in.) diameter carbon steel extension was added to transfer waste to waste trench 5. In 1961, a further extension of the line was used to service trench 6. By 1962, the line had been extended to trench 7, which was used between 1962 and 1965. The final extension of carbon steel and cast iron line reached the hydrofracture site in 1966. This final pipe section crossed White Oak Creek at a point approximately 150 m (500 ft) from the line termination point. In 1971, due to concern over the potential of line leaks into the creek along this section of the pipeline, a singly-contained stainless steel pipe run was installed to replace the carbon steel line.

The carbon steel line was left in the ground next to the stainless line at the time it was abandoned.

The main section of the ILW transfer line was taken out of service in November 1975 when it was replaced by a doubly-contained stainless steel line connecting the ILW evaporator system with the hydrofracture facility along a more direct route. At the time it was abandoned, the line was flushed with water, purged with air to remove as much of the remaining liquid as possible, and capped on both ends. The Melton Valley transfer line, however, remained operational, utilizing the shared portion of the pipeline north of Melton Valley Drive.

2.2 SITE CONDITIONS

Prior to the abandonment of the ILW line in 1975, a reconnaissance survey of the pipeline route was conducted by the Environmental Sciences Division at ORNL[2] in order to identify potential sources of contamination in the White Oak Creek watershed. This survey found two leak sites along the line, at locations depicted on Fig. 2. These leak sites were reported to the ORNL waste management system operators and appropriate action was taken to repair these leaks and remove some of the highly contaminated soil. After the line was removed from service, a second survey of the pipe route was conducted[3], this time by the Industrial Safety and Applied Health Physics Division (ISAHP) at ORNL. This survey located and documented the condition of the two known leak sites, and also highlighted an area of elevated activity adjacent to the White Oak

Creek. The results of these surveys and general site descriptions have been summarized for each of these three contaminated areas in the following sections.

2.2.1 Leak Site No. 1

Leak Site No. 1 (also referred to as the North Leak Site) is located along the ILW line some 45 m (150 ft) south of waste trench 6 (Fig. 2). At this location (ORNL coordinates N 18,363-E 27,976), the liquid waste had reached the ground surface and had spread laterally for several meters. Surface radiation surveys detected the movement of the contamination to the southwest, in the direction of surface runoff (Fig. 3). Beta-Gamma ($\beta - \gamma$) exposure rates measured at 1 m (3 ft) above the ground surface ranged from 240 mR/h up to 1 R/h, with the majority of the contamination localized in a 6 m x 6 m (20 ft x 20 ft) area.

Analysis of soil samples taken during the 1973 survey concluded that surface soil at and in the immediate vicinity of the leak site was significantly contaminated with mixed fission products. Radionuclide concentrations in nine samples taken from the site[2] ranged from 0.01 to approximately 50 μCi/g of $\beta - \gamma$ activity, with gross alpha activity levels of up to 1 nCi/g. The $\beta - \gamma$ activity was attributed primarily to ^{137}Cs and ^{90}Sr. The primary alpha contributor was ^{244}Cm, with minor amounts of ^{241}Am, ^{238}Pu, and ^{239}Pu present.

The depth to groundwater at this location is approximately 3.5 m (12 ft). Although no monitoring wells were drilled at this site, it is

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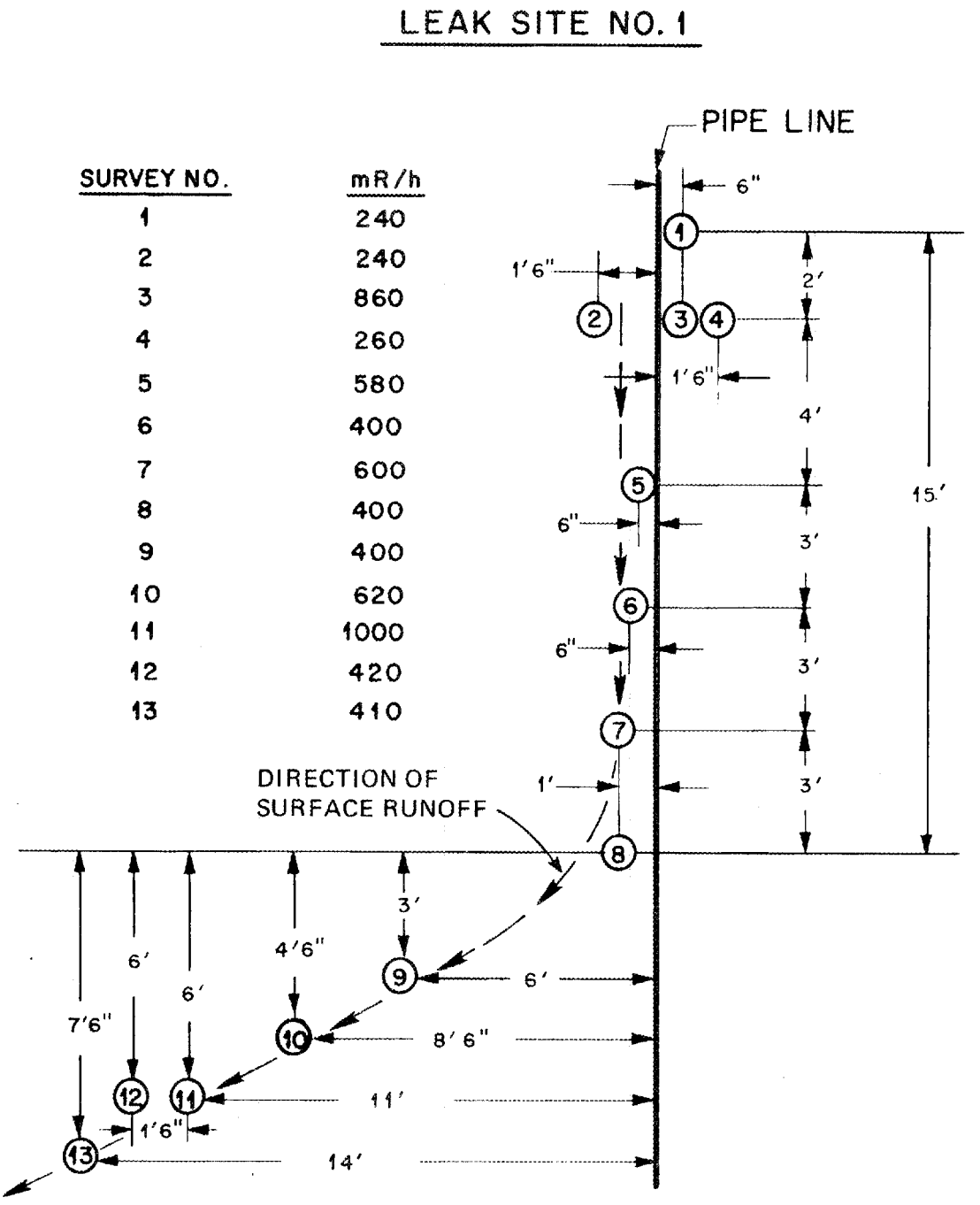

Fig. 3 Beta-gamma survey results at Leak Site No. 1

believed that groundwater contamination has probably occurred. The extent of this contamination would be difficult to determine since the nearby waste trench 6 is also a known source of groundwater contamination.

As indicated in Fig. 4, the North Leak Site is located in an area of gradual topographic relief. The site slopes to the southwest, with a drop of approximately 5 m (15 ft) over a distance of 30 m (100 ft). With the exception of the pipeline right-of-way, the area is heavily vegetated with a variety of trees and shrubs (Fig. 5).

2.2.2 Leak Site No. 2

The South Leak Site (Site No. 2) is located along the cast iron pipe extension leading down to White Oak Creek, approximately 60 m (200 ft) west of the creek bank (ORNL coordinates N 17,680-E 28,000). At this location, the surface and groundwater drainage is in an easterly direction, paralleling the pipeline. Site relief (Fig. 4) is similar to the North Leak Site, with a drop of 5 m (15 ft) over a distance of about 30 m (100 ft). Vegetative growth is a mixture of trees and shrubs, adjacent to the line right-of-way (Fig. 6). At this site, as in the case of Leak Site No. 1, the liquid waste had seeped from a pipe coupling and had reached the ground surface where it spread laterally over a small area. Based on the 1973 survey of the site[2], surface soil contamination had been observed from the area of the leak all the way to the creek. Soil samples analyzed as part of this survey contained from approximately 2.0 nCi/g to 600 μCi/g of beta-gamma activity, with the highest levels observed right at the leak site. The highest total alpha concentration was 3.7 μCi/g, composed of ^{244}Cm, ^{241}Am, ^{238}Pu and ^{239}Pu.

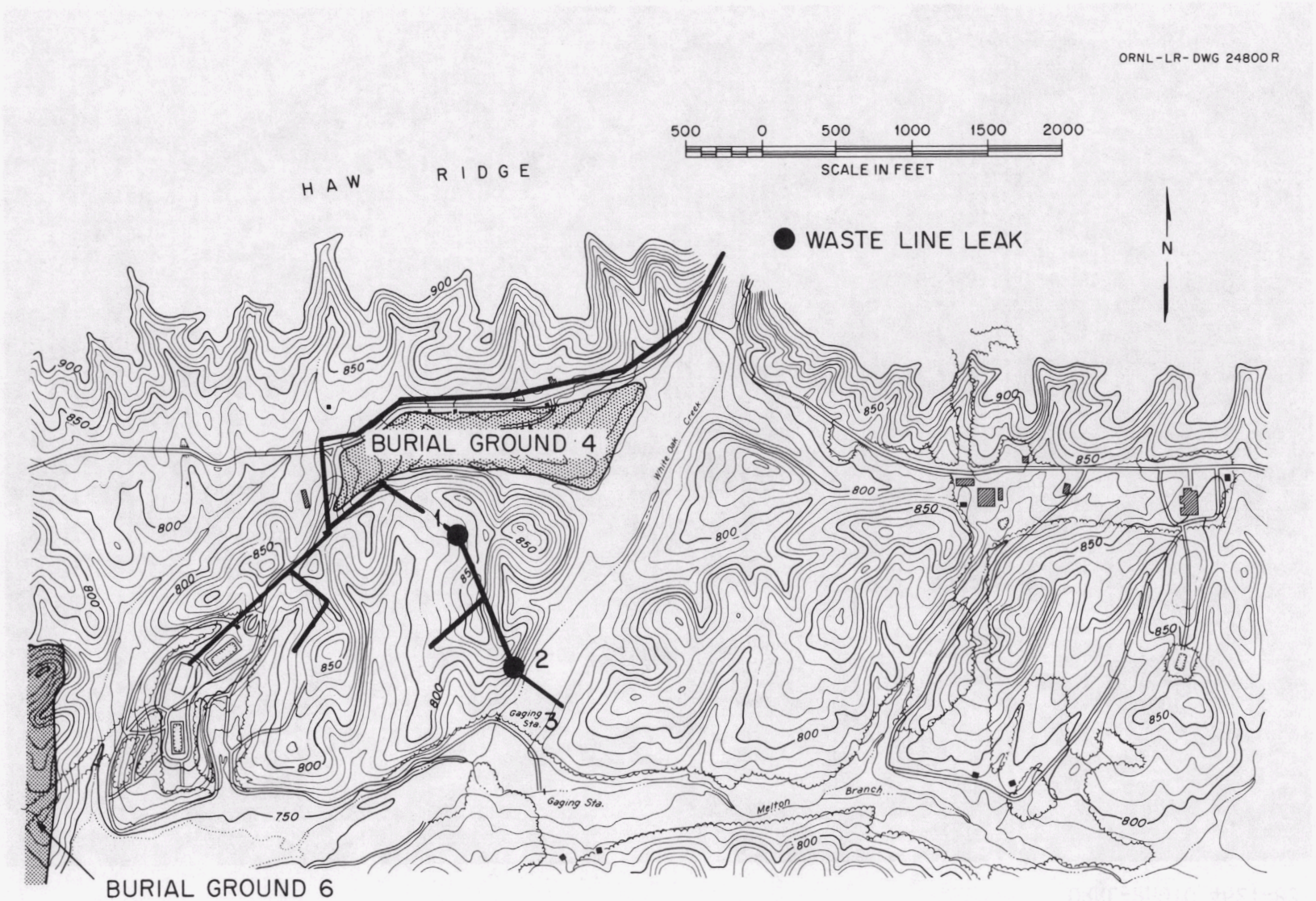

Fig. 4 Contour map showing location of ILW line and leak sites

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Fig. 5 Photograph of Leak Site No. 1 prior to decommissioning activities (looking southeast)

ORNL-PHOTO 4622-83

Fig. 6 Photograph of Leak Site No. 2 prior to decommissioning activities (looking southeast)

Three groundwater monitoring wells were installed along the creek bank in the vicinity of the leak site in order to establish whether groundwater contamination was occurring. Based on the results of approximately three months of water and sediment sampling, it was concluded that the leak was indeed contributing to groundwater contamination[2]. In late 1973, after a significant amount of contaminated soil (approximately 100 m^3) was removed and disposed of in SWSA 6, the measured radionuclide concentrations in the groundwater decreased markedly.

After the ILW line was abandoned, a second survey of the South Leak Site was conducted[3] which discovered that surface soil contamination still existed, due either to additional leakage after the initial cleanup, or to inadequate removal of contaminated soil. Beta-gamma exposure rates measured along the line ranged from 240 mR/h to 800 mR/h (Fig. 7) at one meter above the ground surface. Although elevated radiation levels were observed at some distances from the leak site, the most significant area of surface contamination was contained in an area of approximately 3 x 8 m (10 x 25 ft).

2.2.3 White Oak Creek Floodplain

The floodplain area (Site 3 on Fig. 2) is wooded with little topographic relief (Fig. 8), except on the west side of the creek where a gradual slope begins. The creek normally occupies a channel approximately 3 m (10 ft) wide, although under flood conditions, the entire floodplain (60 m width) could be underwater.

Along the floodplain section of the ILW line, elevated gamma radiation levels had been detected during the 1979 survey[3]. This section of line consisted of approximately 90 m (300 ft) of both stainless steel

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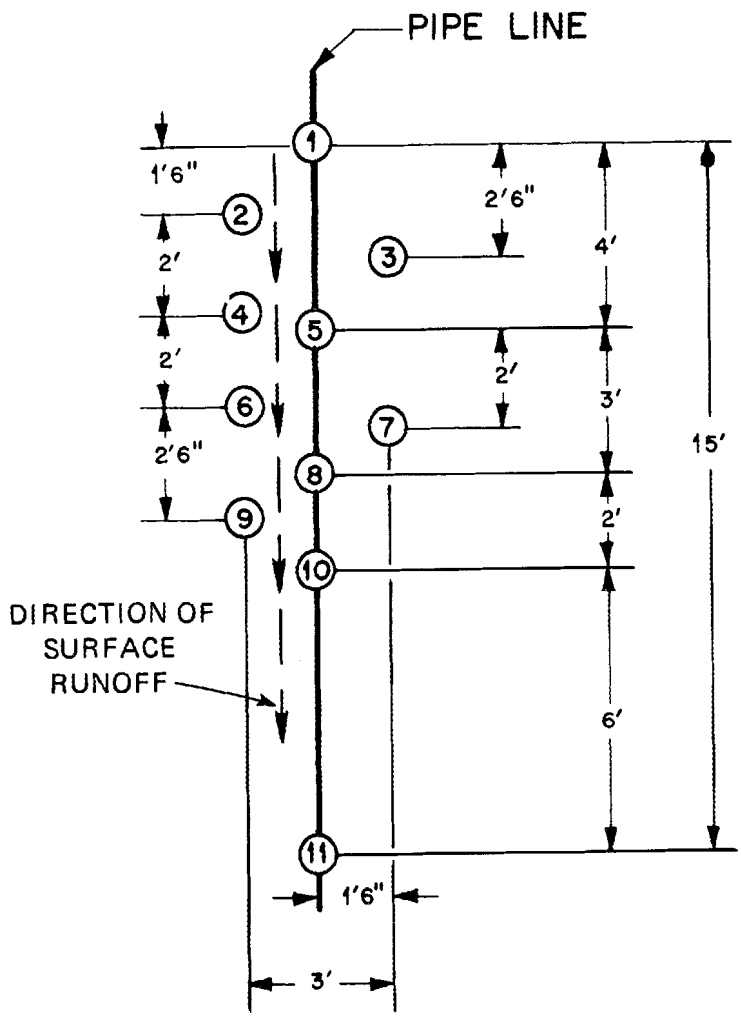
LEAK SITE NO. 2



SURVEY NO.	mR/h
1	290
2	250
3	610
4	240
5	800
6	240
7	290
8	270
9	250
10	410
11	240

Fig. 7 Beta-gamma survey results at Leak Site No. 2

ORNL-PHOTO 4618-83

Fig. 8 Photograph of White Oak Creek floodplain site (looking east)

and carbon steel piping and 15 m (50 ft) of cast iron line. Gamma radiation levels up to 3 mR/h had been detected along the line next to the creek, although the source of this radiation could not be directly attributed to the pipeline, since the floodplain had been previously contaminated by other ORNL operations. However, because the potential for groundwater interaction and transport of contamination from the abandoned lines in this location was so great, line removal was deemed appropriate and further investigations conducted.

In September 1981, characterization efforts were initiated to determine the extent of soil contamination surrounding the pipelines and the radiation hazard associated with the piping itself. The lines were uncovered on both sides of the creek, cut and tapped to remove entrained liquids, pipe samples were removed for analysis, the lines capped, and excavations filled. During this survey effort, contaminated soil was identified on the west side of the creek, with isolated areas exhibiting $\beta - \gamma$ levels of up to 10 mR/h. No such contamination was observed on the east side of the creek. The exposed pipe at both locations had surface radiation levels of 25-30 mR/h. Beta-gamma levels measured on the interior of the pipe were in the range of 8-10 R/h, indicating the presence of significant amounts of beta emitters.

Samples of water from both lines were obtained and analyzed for radionuclide content. Water from the stainless steel line was found to contain soluble ^{137}Cs in a concentration of 530 μCi/l, soluble ^{90}Sr at 160 μCi/l, and approximately 85 nCi/g of soluble ^{237}Np. Water from the carbon steel line had radionuclide concentrations a factor of 10^3 less. Beta-gamma exposure rates on the surface of the 1 liter water samples

ranged up to 30 mR/h. In addition, in order to obtain quantitative information on the TRU content of the pipe, one-inch sections of the carbon steel, stainless steel, and cast iron pipe were cut and sent to the ORNL Analytical Chemistry Division for analysis. The results of this analysis are presented in Table 1. In all three samples, the principal alpha emitters were ^{244}Cm and ^{238}Pu. Total computed alpha concentrations were 220 μCi/kg for the carbon steel pipe, 26 μCi/kg for the stainless steel piping, and 24 μCi/kg for the cast iron pipe. Based on these computed values and comparison with the draft guidelines for TRU classification under review at the time of the project (>100 μCi/kg, including ^{244}Cm), it was decided that for the purposes of this project, the carbon steel piping should be handled as TRU waste, while the stainless steel and cast iron lines could be disposed of as low-level waste.

3.0 PROJECT OBJECTIVES

The primary objective of the ILW transfer line decommissioning project was to place the abandoned portion of the line in a condition that would reduce the potential for significant migration of contamination associated with the line and eliminate the need for routine site-specific surveillance. The project objective was to be met through accomplishment of two primary tasks: (1) Removal of that portion of the line located in the White Oak Creek floodplain, and (2) Isolation and entombment of the two identified former leak sites. The remainder of the transfer line was to be left intact in the original abandoned condition. The Melton Valley transfer line, including the shared portion of the original ILW line, was specifically excluded from the scope of this project.

Table 1. Analysis Results of TRU Activity Levels in ILW Pipe Segments

Pipe Sample	Radionuclide	Measured Activity[a] (dpm)	Computed Concentration[b] (μCi/kg)
Carbon Steel	^{244}Cm	5.3×10^7	170
	^{238}Pu	1.6×10^7	50
Stainless Steel	^{244}Cm	6.8×10^6	20
	^{238}Pu	2.0×10^6	6
Cast Iron	Gross Alpha	7.3×10^6	24

[a] Alpha activity measured in sample was obtained by leaching the interior surface of one-inch section of pipe.

[b] Concentration based on nominal weight of pipe segment.

Due to the small quantities of radioactive material remaining in the abandoned pipe, and the isolated, controlled environment in which it will remain, there was little concern with leaving the pipe in-place. Long-term environmental monitoring of the waste disposal areas through which the transfer line passes will be conducted as part of the routine ORNL site surveillance.

4.0 PROJECT ACTIVITIES

The ILW transfer line decommissioning project activities can be broken down into three phases, (1) project planning, (2) decommissioning operations, and (3) project documentation, each phase consisting of several major tasks. Brief descriptions of these task activities are provided in the following sections, while overall summaries of project waste management requirements, occupational exposures, and project costs and schedules are included in following chapters.

4.1 PROJECT PLANNING

The project planning phase was initiated in 1979 when radiological surveys were conducted to characterize the existing site conditions. These planning activities continued throughout the life of the project in terms of engineering designs, safety, quality assurance and environmental assessments, and overall project management.

4.1.1 Site Characterization

As detailed in Chapter 3.0, site characterization efforts were conducted early-on in the project in order to define site boundaries,

determine radiation hazards and identify waste disposal requirements. Preliminary survey efforts were completed in 1973, prior to the abandonment of the pipeline. Subsequent surveys were conducted in 1979 and 1981 to define actual site conditions. In the 1979 survey[3], the surface gamma radiation field was measured along the pipeline route from the Old Hydrofracture Site to the connection with the Melton Valley transfer line. This survey identified the two leak sites of concern and highlighted the need for further investigation in the White Oak Creek floodplain. Gamma exposure rates up to 1 R/h were observed along the line, this activity being associated with the previous leakage areas. The 1981 survey involved excavation of the pipeline at two locations in the floodplain to obtain samples of the pipe and document the radiation characteristics of the bare line. Surface exposure rates associated with the pipe were found to be in the range of 20-30 mR/h, although the pipe interior exhibited levels up to 10 R/h.

In addition to the radiological surveys conducted as part of the site characterization, engineering surveys were also completed. Site boundaries were defined and topographical conditions were documented to aid in engineering designs.

4.1.2 Project Engineering

Based on the site characterization studies, an engineering assessment of the decommissioning options for the ILW line was performed by UCC-ND Engineering in 1980. This assessment concluded that the most cost-effective method of decommissioning the transfer line was to remove the section of line from the floodplain of White Oak Creek and entomb the two identified leak sites. Based on this assessment, a decommis-

sioning plan was prepared for the ILW line, outlining the objectives of the project and identifying the major tasks. This plan called for three major project phases, including (1) site preparation, (2) removal of the pipeline from the White Oak Creek floodplain, and (3) entombment of the two leak sites.

Upon approval of this plan by the SFMP, designs were prepared for each project phase. These designs included engineering drawings that detailed the scope of each task and outlined the activites to be performed. In addition to these drawings, detailed work procedures were defined and documented for directing the subsequent field operations. These procedures identified the specific steps involved in the decommissioning operations, as well as highlighted all pertinent health and safety precautions. The work procedures and engineering drawings were kept at the job site and were the primary control documents for on-site activities.

4.1.3 Safety Assessment

Safety assessments for the pipeline removal and leak site entombment project phases were prepared by UCC-ND Engineering and approved by the ORNL-SFMP and DOE in June 1982[5,6]. The assessments determined that no safety systems and no special administrative controls for safety would be required for the project. The operations would utilize normal ORNL plant safety procedures as defined in the ORNL Health Physics Manual[7] and ORNL Safety Manual[8], and be conducted under the supervision of the appropriate ORNL safety disciplines.

4.1.4 Quality Assurance Assessment

A Project Quality Assurance Assessment (PQAA) was prepared, reviewed, and approved for the ILW line decommissioning in June 1982[9]. This assessment addressed all project phases and identified task failure potentials, probabilities, and consequences. None of the identified tasks were classified as having a high probability of failure and/or significant failure consequences. The PQAA recommended that no additional quality assurance procedures be instituted. Acceptable project quality was to be assured through application of UCC-ND Engineering standard practices, supplemented by the quality assurance provisions of the ORNL QA Programs.

4.1.5 Environmental Assessment

An environmental assessment of the proposed decommissioning operations was conducted in 1981 to identify and briefly analyze the project alternatives[10]. This assessment, prepared by the ORNL Industrial Safety and Applied Health Physics Division, recommended that the proposed action of removal of critical pipeline sections and stabilization of the leak sites be utilized as the decommissioning mode. The environmental consequences of this action were determined to be minimal, with no special precautions needing to be addressed.

4.1.6 Project Management

A project management plan was prepared by the ORNL SFMP in 1980. In this plan, overall project management was to be provided by the ORNL SFMP through the Project Principal Investigator (PI). This responsibility was assumed by A. A. Walls of the Radioisotope Technology Group of the Isotopes Section of the Operations Division at ORNL. The Project PI directed the activities of all ORNL and UCC-ND support groups, managed

the project budget, and provided routine project reporting. All project engineering was provided by the UCC-ND Engineering Division, with S. P. du Mont acting as Project Engineer. Site construction was performed by Rust Engineering Co., the local Cost Plus-Award-Fee (CPAF) contractor, under the direction of DOE Engineering, with technical guidance provided by UCC-ND Engineering.

4.2 DECOMMISSIONING OPERATIONS

On-site decommissioning activities began in September 1981 and progressed over two years of intermittent activity. The project operations included the three primary tasks outlined in the engineering plan (site preparation, ILW line removal and leak sites entombment) as well as a secondary line removal task involving a transfer line from the Old Hydrofracture Facility to the New Hydrofracture Facility. Brief discussions of the decommissioning operations associated with each of these tasks are provided as follows.

4.2.1 Site Preparation

To provide access for the needed construction equipment, site preparation efforts were required at each of the project locations. At the floodplain site no vehicle access existed, so in March 1981 engineering designs were formulated for construction of an access road to parallel the transfer line and connect with an existing road at the Old Hydrofracture site. Approximately 110 m (360 ft) of standard gravel-bed road was constructed as shown in Fig. 9. An additional short (30 m) extension of an existing road was constructed on the west side of the creek to provide access at that end of the line. Due to the wooded

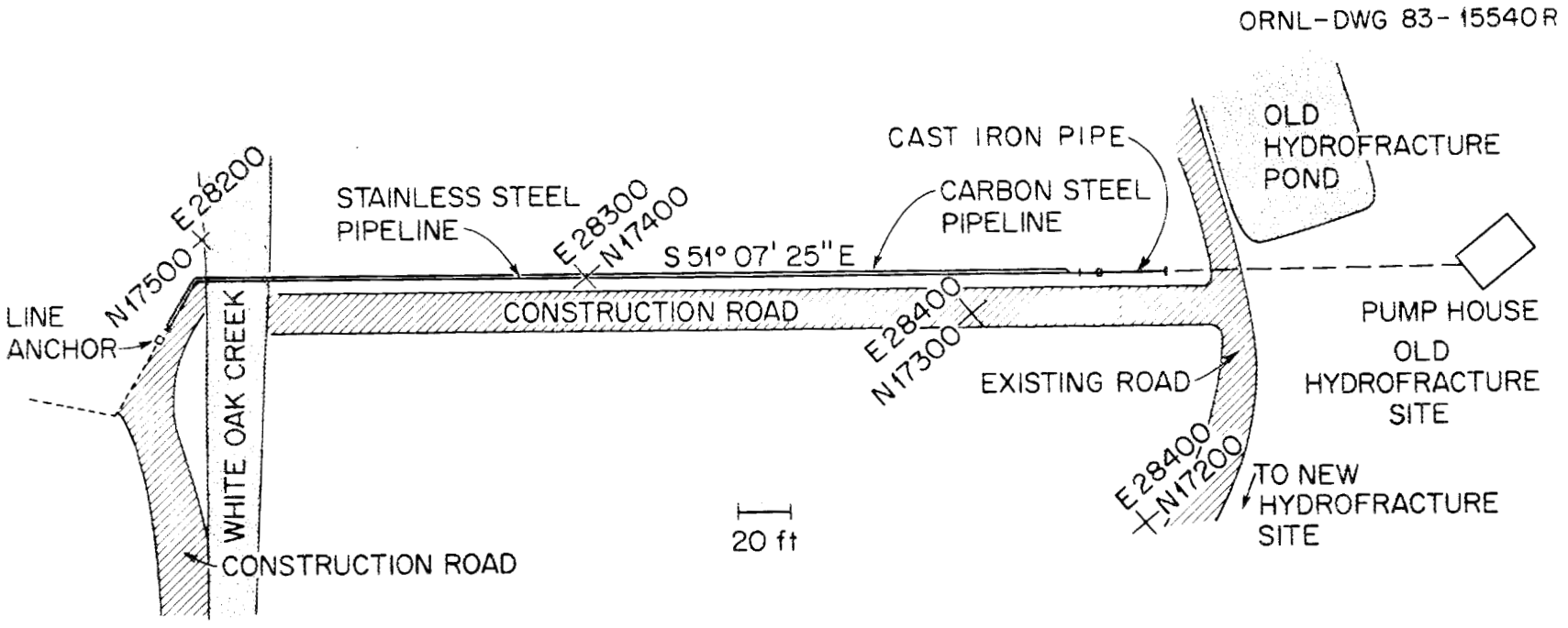


Fig. 9 Design details for the White Oak Creek floodplain site

environment of the site, extensive vegetation clearing was also required. At the two leak sites, existing roads were available to provide equipment access, although some minor clearing and road upgrading were required. All site preparation activities were completed by Rust Engineering by September 1981.

4.2.2 Removal of Hydrofracture Test Line

A 210 m (700 ft) segment of heavy-walled steel pipe connecting the Old Hydrofracture Facility to a test well at the New Hydrofracture site was removed in December 1981. This task, although not originally included in the scope of the ILW line decommissioning, was undertaken to remove the line from the floodplain of the nearby Melton Branch of White Oak Creek. This line was only slightly contaminated since only tracer quantities of radioactive material had been transported through the line during the hydrofracture tests. The pipe was installed above-grade except for short sections that passed underneath existing roadways.

The test line was dismantled by ORNL Plant and Equipment forces at the appropriate pipe joints, bundled and stored for potential reuse (Fig. 10). During the removal process, several isolated areas of surface contamination were located. These areas were excavated and the contaminated soil disposed of in ORNL Solid Waste Storage Area No. 6 (SWSA 6).

4.2.3 Removal of the ILW Line at White Oak Creek

Field activites on the White Oak Creek floodplain were initiated in July 1982. Originally scheduled for the first quarter of FY 1983, the line removal task was conducted ahead of schedule to avoid interference with an adjacent weir construction project on White Oak Creek.

ORNL-PHOTO 4619-83

Fig. 10 Removal of hydrofracture test pipe

The scope of this task involved the removal of the carbon steel, stainless steel and cast iron sections of the ILW pipeline from the floodplain. As indicated by the solid lines on Fig. 9, the stainless steel and carbon steel sections were approximately 105 m (350 ft) long, while the cast iron portion was only 15 m (50 ft) long. The floodplain portion of the ILW line extended from about ORNL coordinates (N 17,290-E 28,440) to (N 17,480-E 28,170). All line removal activites were performed by Rust Engineering forces.

On July 14, 1982, the pressure taps and valves installed as part of the site characterization studies were uncovered (Fig. 11) and the two lines were drained into a portable waste tank (Fig. 12). Approximately 15 m (50 ft) of the line was uncovered on the east end of the site and radiation surveys conducted. The beta-gamma exposure rates observed on the surface of the pipes were consistent with previous results of 25-30 mR/h, indicating that the specified line removal procedures would be adequate. The transition between the stainless steel pipe and the orginal cast iron line on the east end caused a vertical offset in the line, leaving residual contaminated water that could not be pumped out. The cast iron pipe was cautiously broken at the mechanical joints (Fig. 13), the water drained into containers for transfer into the on-site waste tank (Fig. 14), and the pipe segments handled for disposal in SWSA 6.

In August, the remainder of the transfer line was uncovered and pipe removal activities continued. The stainless steel line was lifted, starting at the east end near the hydrofracture site, and cut into 2.7 m (9 ft) sections using standard pipe cutters. As each piece was cut

ORNL-PHOTO 1798-83

Fig. 11 ILW line drainage pit just east of White Oak Creek

ORNL-PHOTO 4624-83

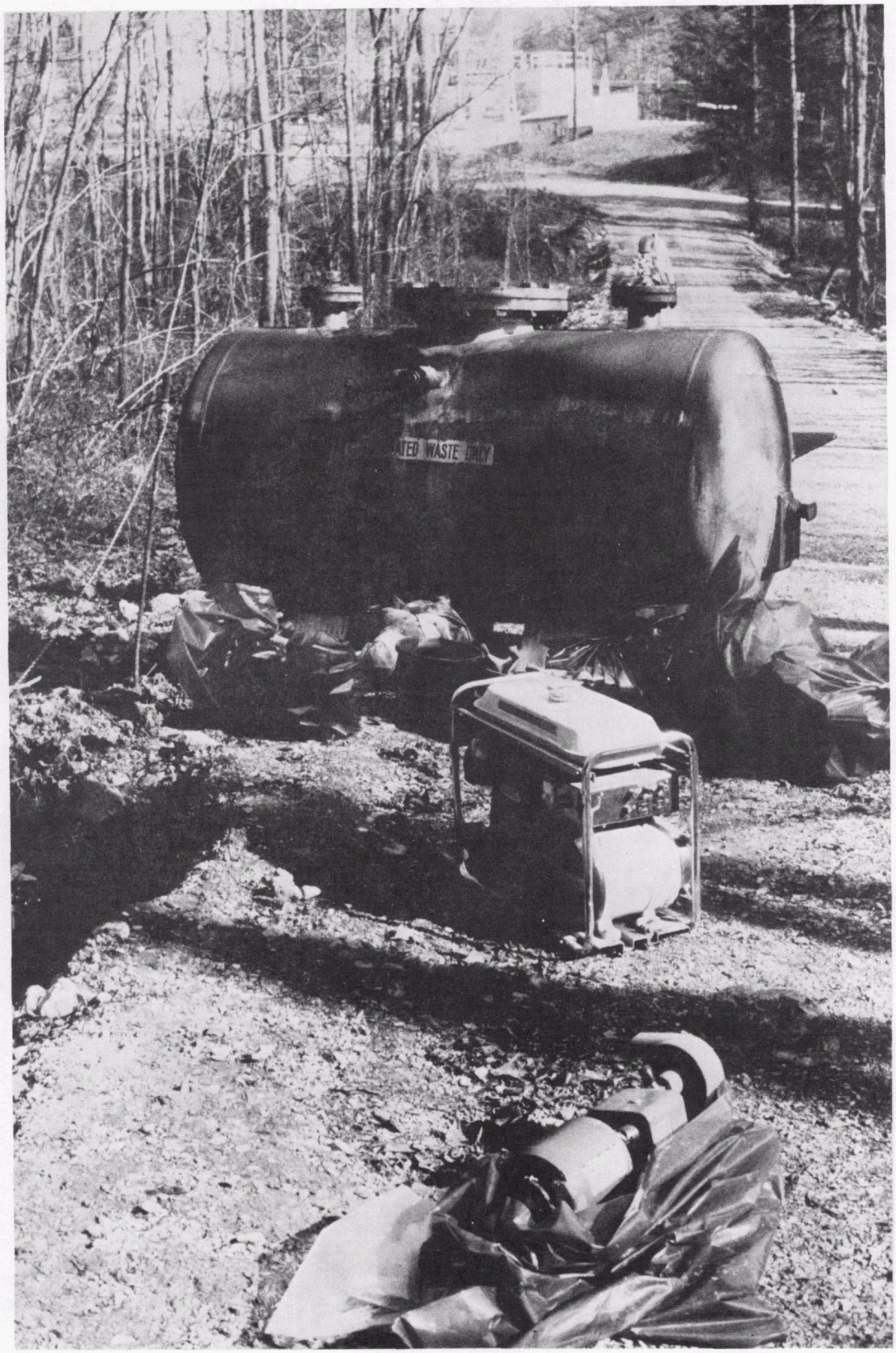


Fig. 12 View of waste tank for collection of pipeline drainage

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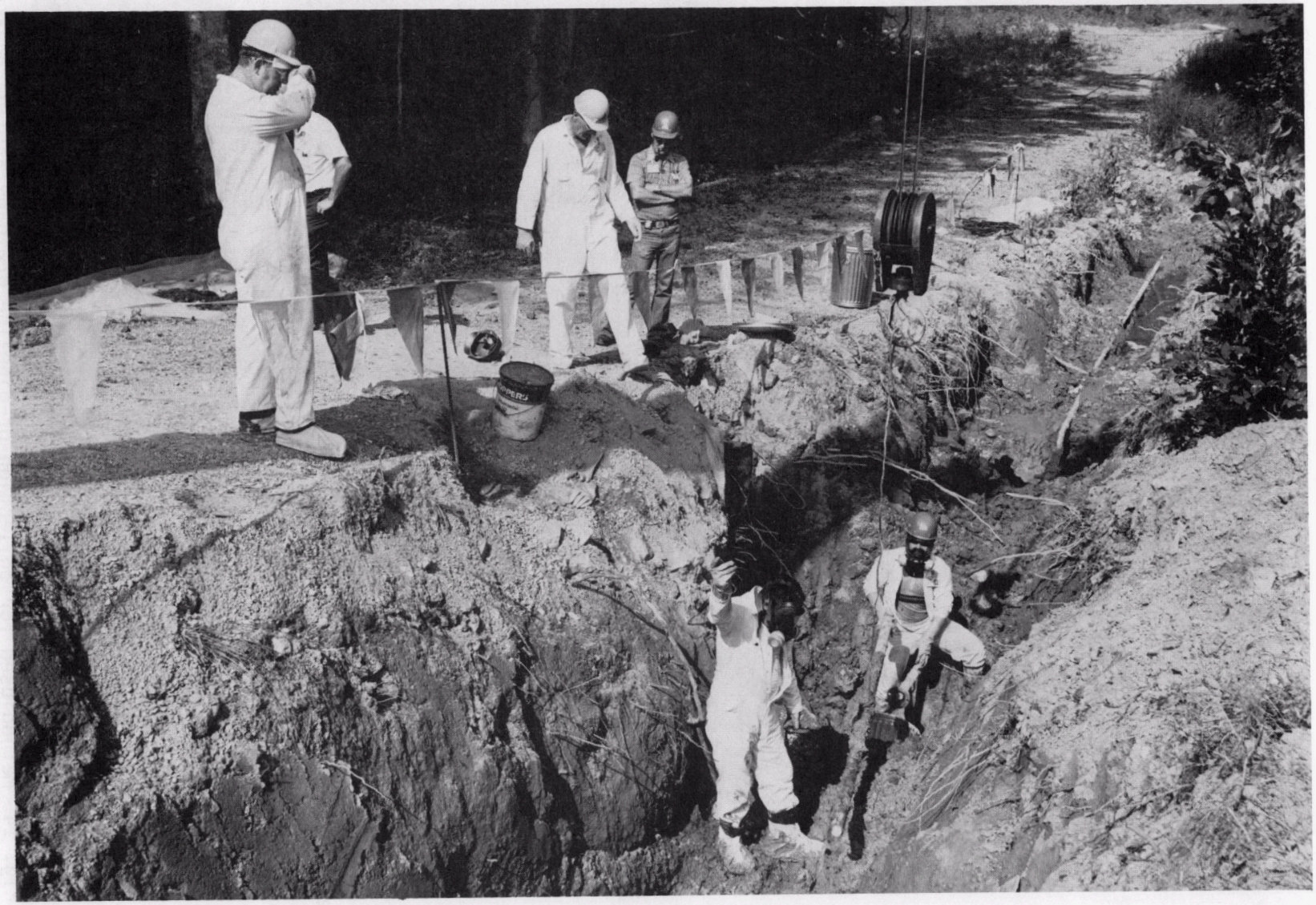

Fig. 13 Lifting and sectioning of ILW line

ORNL-PHOTO 3285-82

Fig. 14 Method used for collection of pipeline drainage at line breaks

loose, care was taken to control remaining liquids, the open ends were capped with wooden plugs and sealant, and the pipe sections placed in plastic sheeting. As ten pipe sections were collected, the piping bundles were banded and hauled to the ORNL SWSA 6 for burial as low-level waste (Fig. 15). Throughout this pipe removal phase, water drainage into the waste tank was provided at the west end drainage pit. The pipe removal continued according to this procedure until the drainage pit was reached.

The abandoned carbon steel line which paralleled the stainless steel line was removed in a similar manner. The pipe was lifted from the east end, cut in 6 m (20 ft) sections, ends plugged and segments placed on pipe racks for further cutting (Fig. 16). Due to the amount of alpha activity adhearing to the interior surface of the carbon steel line, this piping was handled as TRU waste (see section 2.2.3). The 6 m pipe lengths were cut into 76 cm (30 in) segments, ends plugged, and placed in standard 200 l (55 gal) stainless steel drums (Fig. 17) for retrievable storage in SWSA 5. This procedure was utilized up to the drainage pit area. As shown in Fig. 18, the carbon steel line had indeed corroded to the point that groundwater leakage into the line was occurring.

Both the carbon steel and stainless steel pipe sections, which extended from the drainage pit across White Oak Creek to the west project boundary were plugged, lifted as individual long sections, and relocated for sectioning. Both piping segments were appropriately cut and packaged for disposal.

After all of the piping was removed for storage or burial, the contaminated liquid in the on-site storage tank was transferred to the

ORNL-PHOTO 1800-83

Fig. 15 View of stainless steel piping bundles and other miscellaneous wastes packaged for disposal

ORNL-PHOTO 3295-82

Fig. 16 Carbon steel line on pipe racks ready for segmenting

ORNL-PHOTO 3535-82

Fig. 17 Carbon steel pipe segments in TRU waste package

ORNL-PHOTO 3510-82

Fig. 18 View of holes in carbon steel piping

ORNL ILW system for processing and disposal by the New Hydrofracture Facility. The excavations were then closed in September 1982 to complete this phase of the project.

4.2.4 Entombment of Leak Sites

The entombment efforts at the two leak sites were designed to restrict the movement of surface water through the leak areas. To accomplish this, the engineering plans called for the construction of two impermeable barriers over each site; a bentonite clay cap and an asphaltic-concrete pavement cover. These engineered barriers were to be installed according to the general plans shown in Figs. 19 and 20. As shown in these drawings, compacted earth fill was to be provided and contoured to insure controlled drainage from the asphalt surfaces. The planned areal extent of the asphalt cover and its designed contour are presented in Figs. 21 and 22. Changes in these plans were accommodated during field operations, due to site conditions.

Entombment operations at the two leak sites began in May 1983. The leak sites were first isolated by digging down to the lines on either side of the leak areas (see Figs. 21 and 22) and installing permanent pipe caps at these locations (Fig. 23). The lines were cut, short sections of piping removed, the entrained water collected for disposal in the ILW system, and the open ends sealed. The excavations were then closed. The leak sites and the immediate surrounding area were then cleared of all vegetation, including small seedlings and ground cover. In the areas directly over the leak sites, gamma exposure levels of up to 3-10 R/h were measured in the disturbed soil. Hence, to minimize personnel exposures during the vegetation removal operations, clean

ORNL–DWG 83-15537

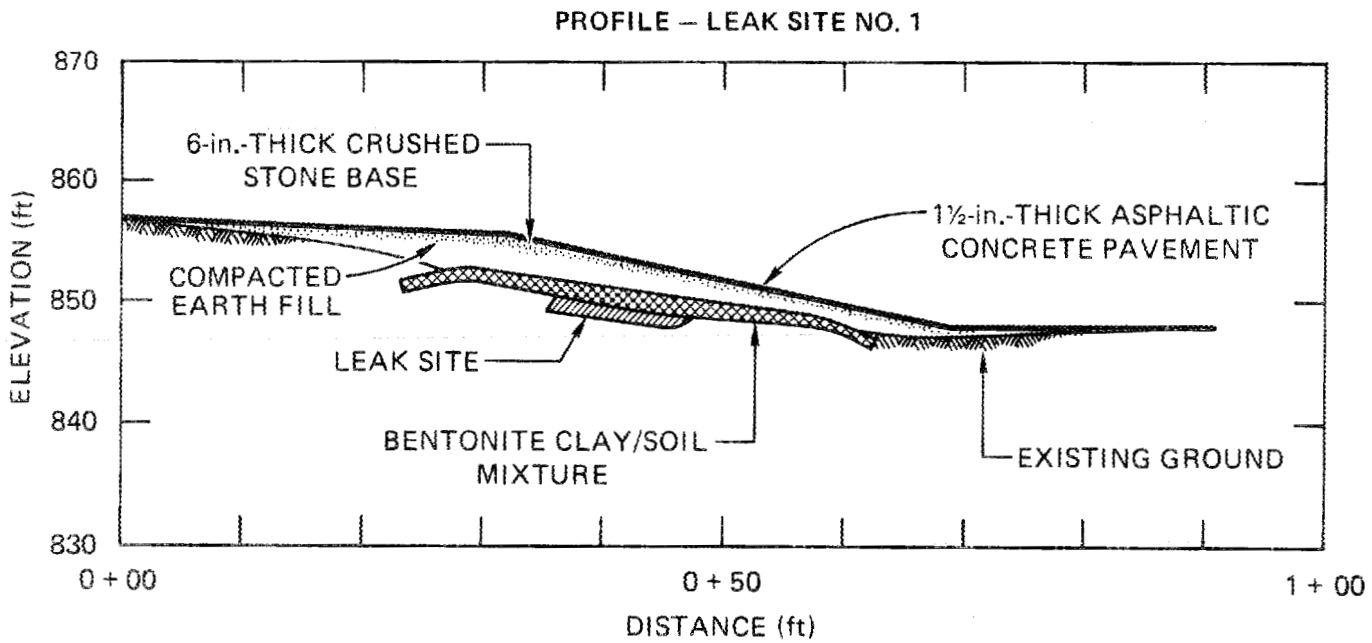

Fig. 19 Site plan for the North Leak Site

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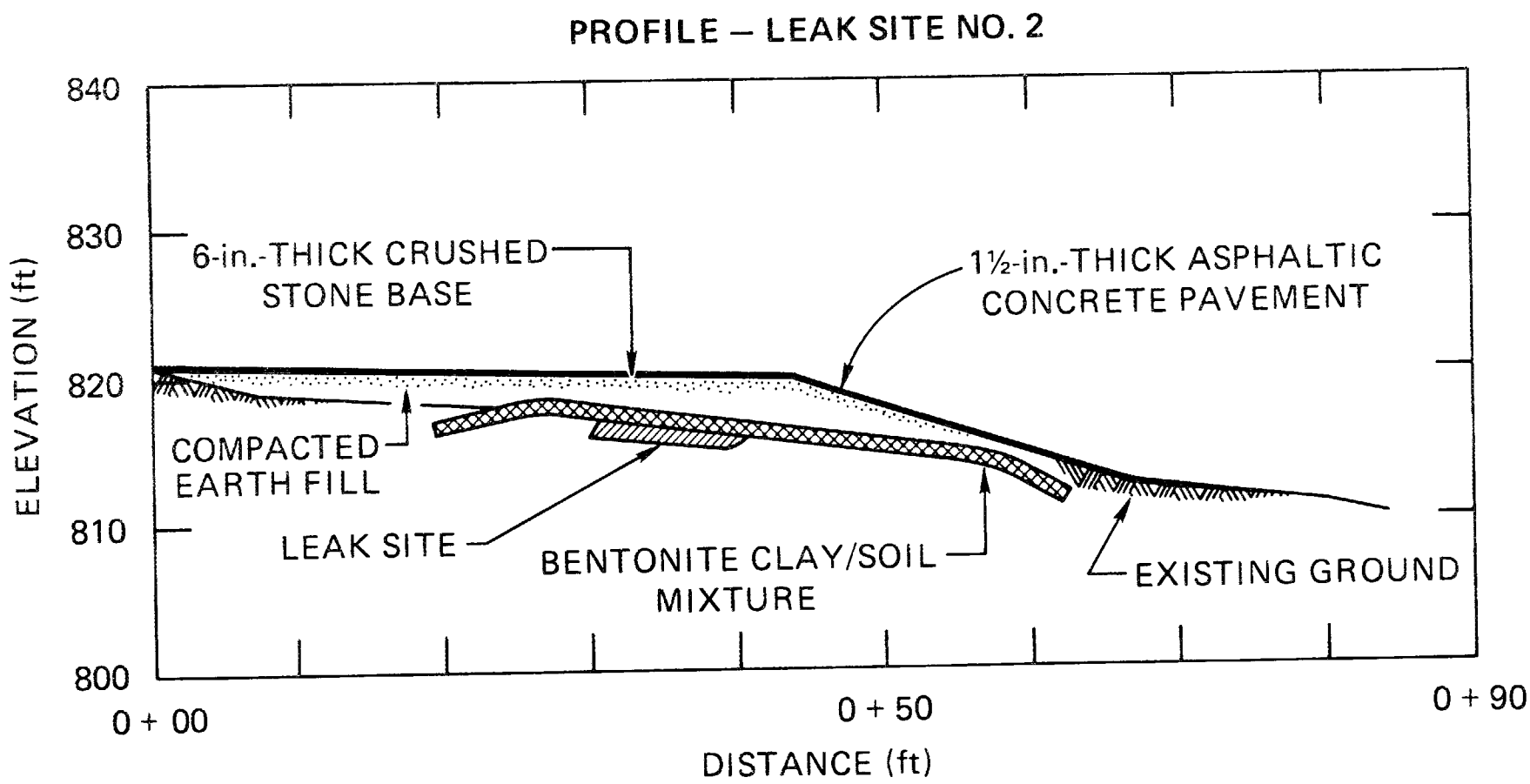
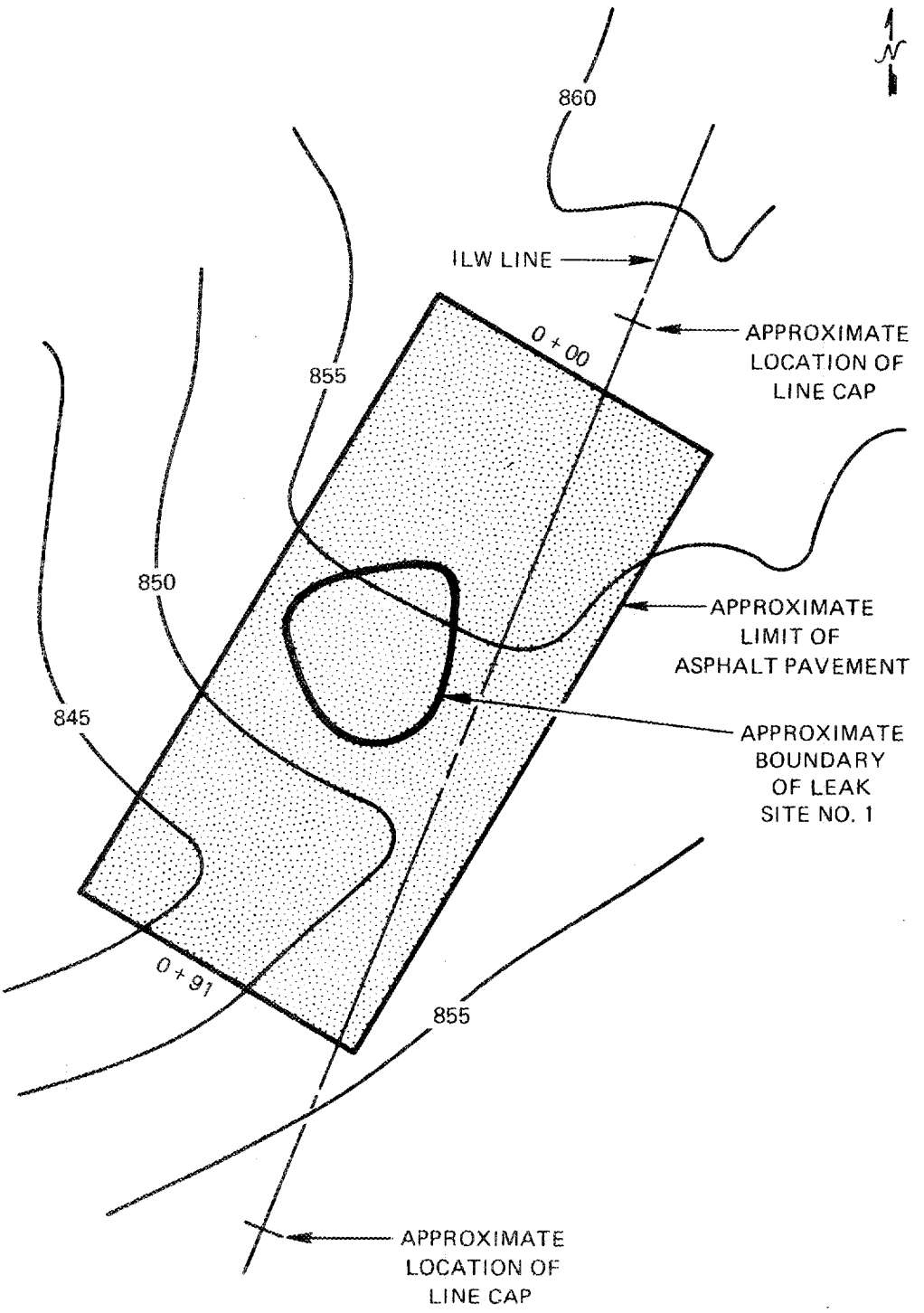


Fig. 20 Site plan for the South Leak Site

ORNL-DWG 83-15536



SCALE 1 in. ≅ 20 ft

Fig. 21 Planned boundaries of the North Leak Site asphalt cover

ORNL–DWG 83-15535

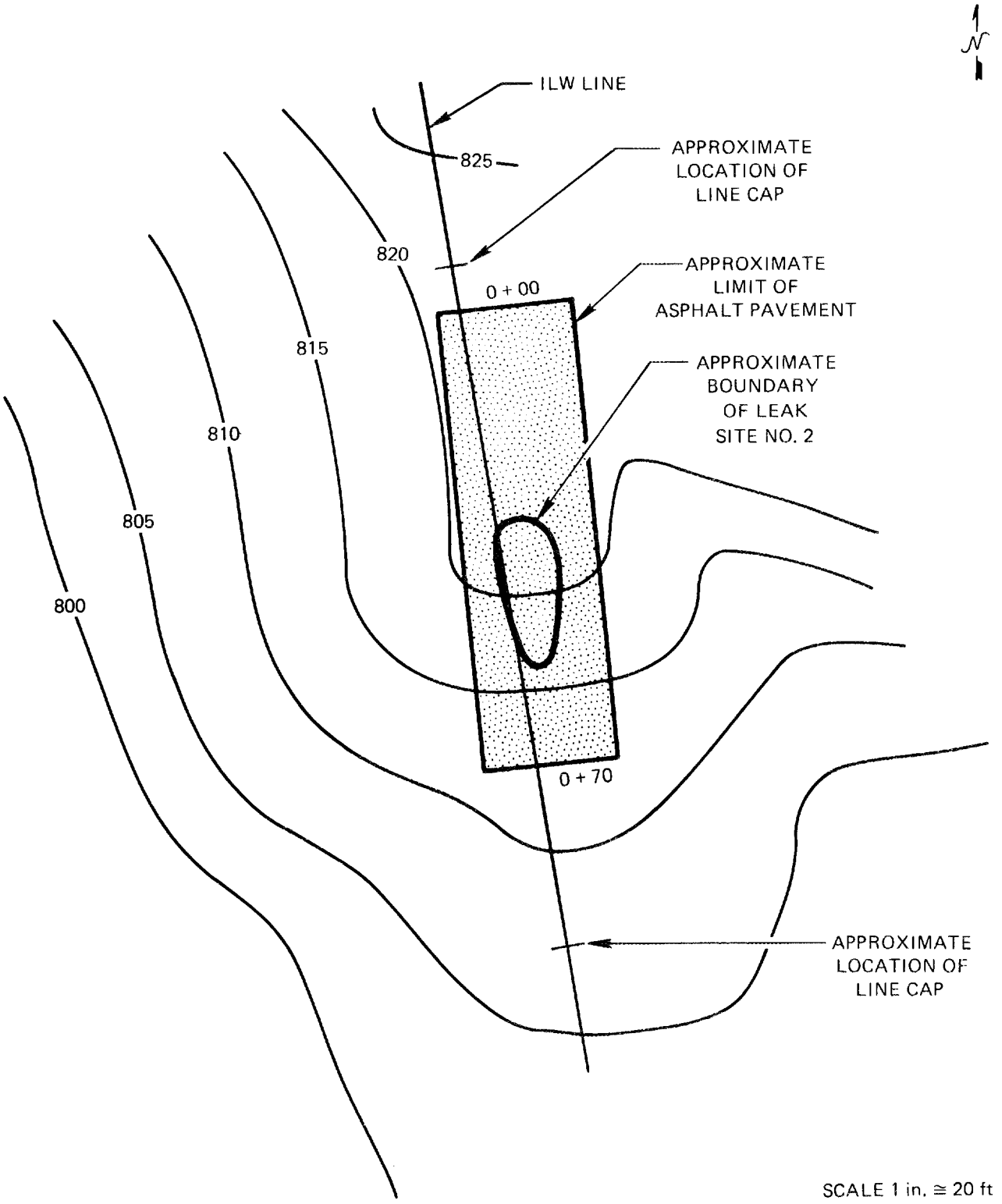


Fig. 22 Planned boundaries of the South Leak Site asphalt cover

ORNL-PHOTO 4623-83

Fig. 23 Capping of the ILW line at the leak sites

fill was hauled in and placed over the contaminated areas to reduce the radiation background while providing access for the removal equipment (Fig. 24). During this vegetation removal process, over 75 m^3 (100 yd^3) of vegetation and contaminated soil was excavated and disposed of as low-level waste in SWSA 6.

After clearing the sites, the entombment boundaries were re-established based on the observed conditions. Radiation surveys indicated that the contaminated areas were larger than originally perceived, due primarily to additional radionuclide migration since the previous planning surveys (1979). The engineering plans were modified accordingly and site entombment operations continued.

A herbicide (sodium borate) was applied to the areas to be paved and several days allowed for absorption into the soil. Adequate rainfall provided for herbicide transport into the soil at the north site, while at the south site (due to differences in herbicide application schedules) water had to be hauled in and applied. After the herbicide was applied, clean clay fill was brought in and placed over the leak sites. Bentonite clay was then mixed into the fill with a standard garden tiller at a rate of approximately 20 kg/m^2 (4 lb/ft^2). Earth fill was applied over the bentonite clay cap and contoured to engineering specifications (Fig. 25). The fill was then covered with a 15 cm (6 in) crushed stone base (Fig. 26) and topped with a minimum of 5 cm (1.5 in) of asphaltic concrete (Fig. 27) and sealed. The entombed areas were fenced with 3-strand barbed wire, additional gravel rip-rap applied around the base

ORNL-PHOTO 4616-83

Fig. 24 Removal of vegetation over Leak Site No. 1

ORNL-PHOTO 4617-83

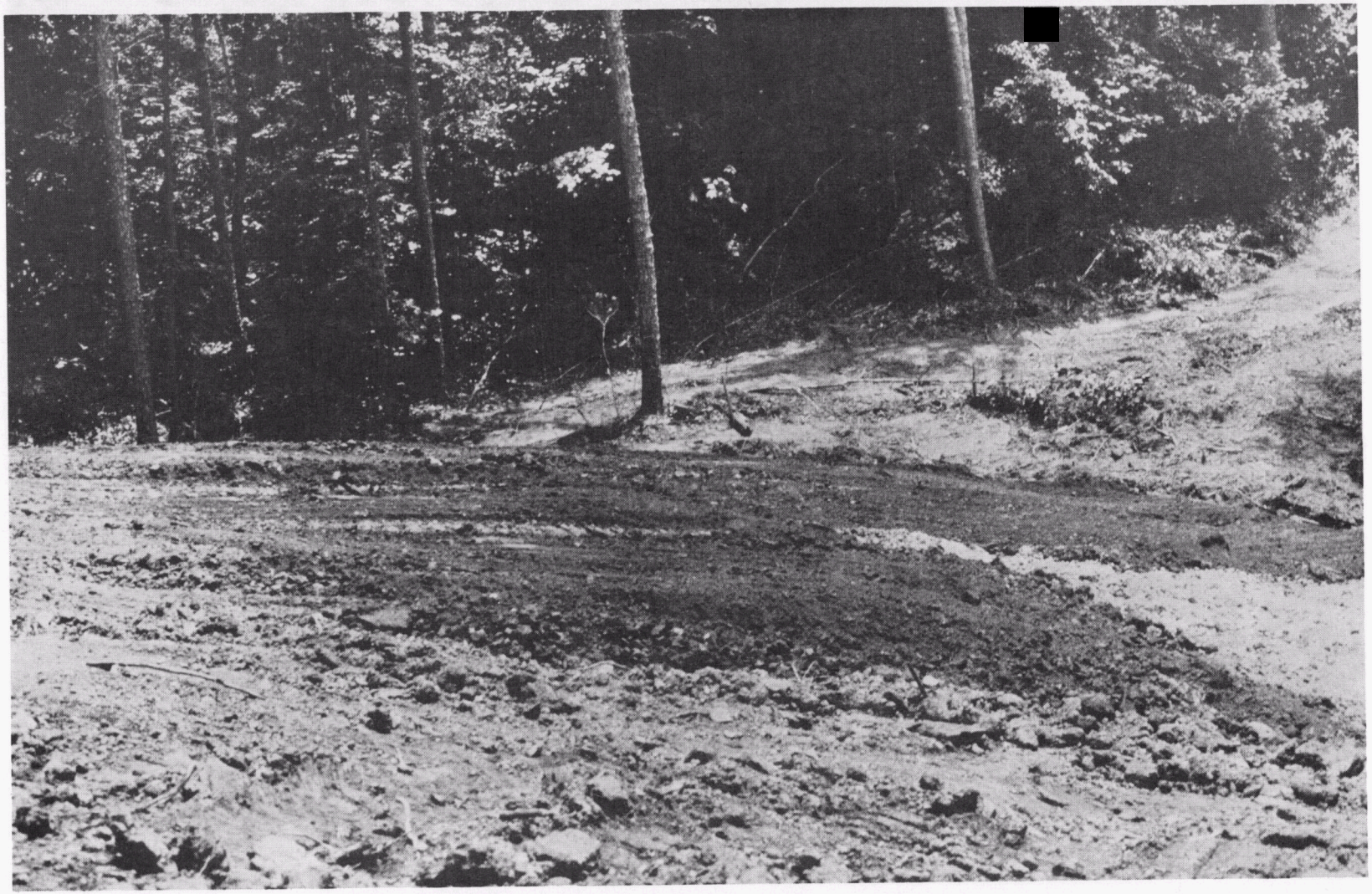


Fig. 25 Application of earth fill over bentonite clay cap - Leak Site No. 1

ORNL-PHOTO 4620-83

Fig. 26 View of Leak Site No. 1 with crushed stone base

ORNL-PHOTO 4625-83

Fig. 27 Asphalt cover in place at Leak Site No. 1

of the asphalt, and the remaining disturbed areas seeded and stabilized. Figures 28 and 29 show the entombed leak sites at the end of the operations phase of the project.

4.3 PROJECT DOCUMENTATION

4.3.1 Reviews and Periodic Reporting

Project review and reporting was provided on a periodic basis throughout the life of the project. Monthly project status reports were made by the Principal Investigator to the ORNL SFMP Office for inclusion in the program report to DOE[11]. These reports provided information on the technical progress during the month, the planned activities for the coming month, and highlighted project milestones completed or identified changes to the project schedules. An annual report of the project accomplishments was issued at the end of each fiscal year[12,13].

Safety and quality assurance reviews of the ILW decommissioning operations were periodically conducted, according to normal ORNL procedures. Project reviews and status reports were given to DOE representatives and special audit or review committees as requested.

4.3.2 Site Certification

Upon completion of each project phase, final site conditions were documented by the ORNL ISAHP Division[14]. Due to the scope of the project and nature of the environment surrounding the project sites, the criteria established for site certification was that observed radiation levels be in the range of normal background for the area. Since the ILW line traverses through ORNL waste disposal areas that exhibit elevated radia-

ORNL-PHOTO 4708-83

Fig. 28 Final site conditions at Leak Site No. 1

ORNL-PHOTO 4711-83

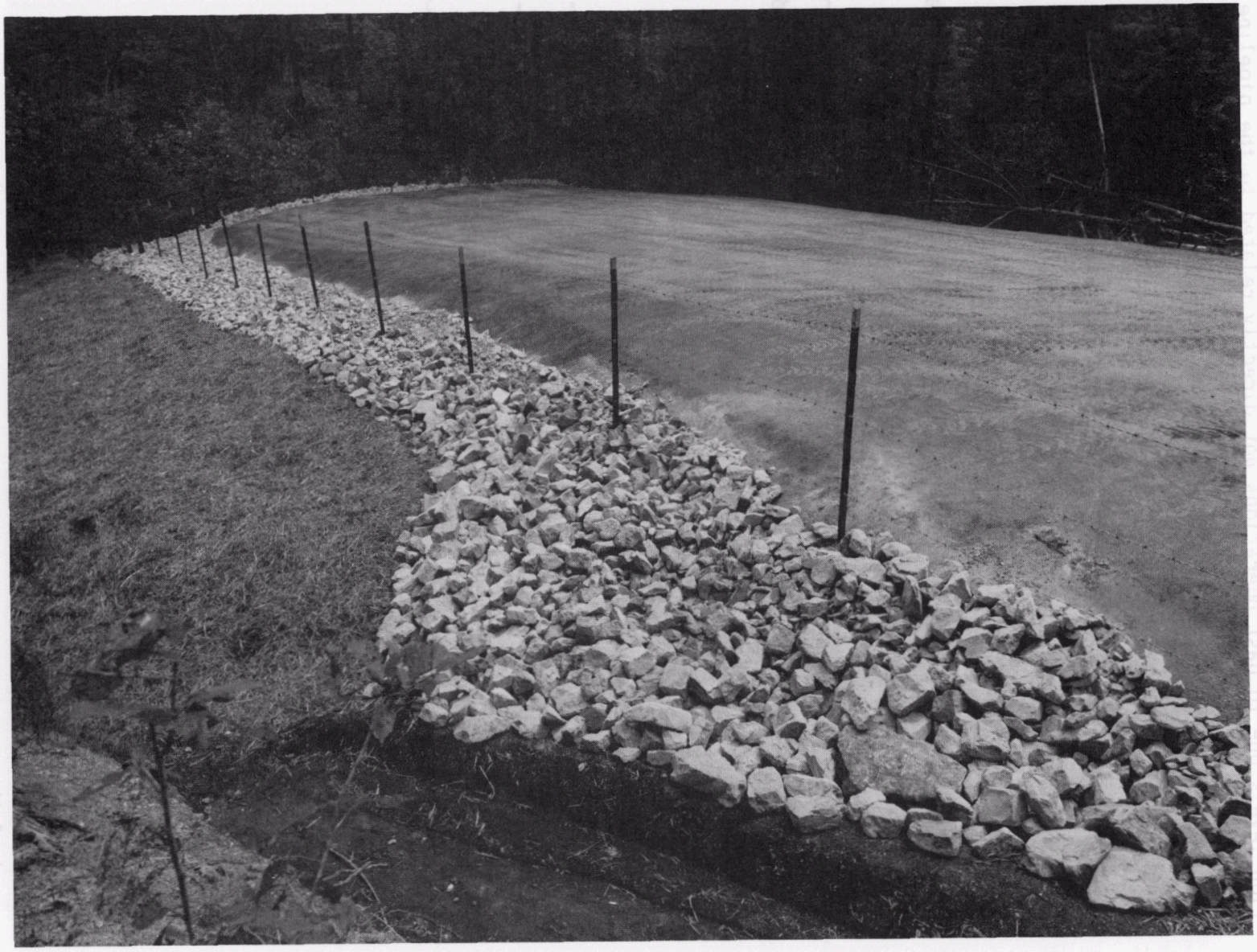


Fig. 29 Final site conditions at Leak Site No. 2

tion levels due to past operations not directly related to the pipeline, it was not considered reasonable to require clean-up of these sites to unrestricted release levels. Hence, background levels at each project location were used for comparison with the final site conditions.

After the decommissioning efforts along the White Oak Creek floodplain, surface gamma radiation levels were in the range of normal background for the area. Gamma exposure rates away from the creek bed ranged from 0.15 to 0.3 mR/h, while near the contaminated stream, measured rates were no greater than 0.5 mR/h. At the two leak sites, gamma exposure rates over the entombed structure as well as the immediate surrounding areas off of the asphalt cover were within the range of background for the sites (0.1 - 1 mR/h). Several isolated areas exhibiting gamma exposure rates from 5 mR/h up to 100 mR/h were located in the vicinity of the leak sites, primarily associated with contaminated soil and vegetation from previous line operations. No attempt was made to decontaminate these areas due to the isolated nature of the radioactivity and the remote site location. The radiation hazard associated with these isolated areas and the remainder of the abandoned line is considered insignificant in comparison with the surrounding burial grounds.

4.3.3 Final Reporting

This document serves as the Project Final Report for the SFMP ILW decommissioning task, ONL-WD13. This report meets the requirements set forth for final project reporting as defined in the SFMP Program Plan. Upon completion of the project and issuance of this Final Report, a record of the completed action will be provided to DOE. In addition, as soon as final engineering drawings of the construction activities

are completed, a project data package will be collected for permanent archiving at ORNL. An itemized listing of this data package will be provided to DOE to complete the project records.

5.0 WASTE MANAGEMENT

Radioactive waste was generated during each phase of decommissioning operations. This waste was principally in the form of contaminated piping, soil, and water drainage from the pipe. Other wastes included miscellaneous solid wastes (plastic, gloves, clothing) and contaminated vegetation. All waste forms were appropriately packaged prior to transport to the ORNL Solid Waste Storage Areas (SWSA) for disposal or burial. SWSA 6 was utilized for all solid wastes requiring permanent disposal, while all TRU wastes were transferred to the SWSA 5 storage area for retrievable storage. Contaminated piping was packaged in either 200 l (55 gal) drums for TRU retrievable storage, or in plastic-wrapped bundles for LLW disposal. Contaminated soil and vegetation were loaded directly into plastic-lined dump trucks for transport to the appropriate disposal trench. Remaining solid wastes were packaged in standard ORNL waste cans or plastic bags for normal processing (compaction if appropriate). Liquid wastes were collected into an on-site portable waste storage tank and then transferred into the ORNL ILW system according to normal ORNL procedures.

The waste disposal requirements for the ILW transfer line decommissioning are summarized according to project activity in Table 2. Approxi-

Table 2 Summary of the Waste Disposal Requirements for the ILW Transfer Line Decommissioning

Project Task	Waste Material	Waste Classification	Waste Volumes (m^3)	(ft^3)
1. Removal of Hydrofracture Test Line	Soil	LLW	17	600
	Misc. Solid Wastes	LLW	0.1	5
2. Removal of ILW Transfer Line from Floodplain	Stainless Steel Pipe	LLW	1.1	40
	Carbon Steel Pipe	TRU	0.7	24
	Cast Iron Pipe	LLW	0.2	5
	Pipe Drainage	ILW	0.4	15
	Misc. Solid Wastes	LLW	0.3	10
3. Entombment of Leak Sites	Soil and Vegetation	LLW	82	2900
	Pipe Drainage	ILW	< 0.1	< 1
	Misc. Solid Wastes	LLW	0.3	10
TOTAL	Solid Waste (LLW)		100	3570
	TRU Waste (TRU)		0.7	24
	Liquid Waste (ILW)		0.4	15

mately 90% of the solid radioactive waste disposed of (100 m^3) was in the form of contaminated soil. Liquid and TRU wastes were generated in minimal quantities, only 0.4 m^3 and 0.7 m^3, respectively.

6.0 HEALTH PHYSICS

The ILW transfer line decommissioning project was carried out in accordance with the ORNL radiation protection procedures, as specified in the ORNL Health Physics Manual[7]. Trained health physics personnel provided radiation protection reviews and surveillance of all activities, including:

1. Evaluation of engineering plans and procedures to assure that operations would be conducted according to ORNL guidelines for radiation exposures, contamination control, and radioactive material handling, transport and disposal;

2. Conduct of on-site radiation surveillance of decommissioning operations to ensure that personnel exposures and spread of contamination were maintained as low as reasonably achievable (ALARA); the results of on-site radiation surveys were used extensively as decision points in the progression of work activities;

3. Maintenance of records of survey results, sample results and operating personnel exposures throughout the life of the project; and

4. Documentation of final site conditions for comparison with the project performance criteria.

This health physics coverage was provided by the Industrial Safety and Applied Health Physics Division at ORNL, as part of their routine plant health physics program.

Personnel monitoring and protective equipment were provided for all of the project work force, according to standard ORNL procedures. Single or double layers of protective clothing (coveralls and shoe covers)

and respirators were used as required for the activities conducted during this project. Personnel dosimeters were distributed and evaluated daily during site operations for exposure control and to determine possible improvements in work procedures to ensure exposures remained ALARA.

Over the life of the project, the operating personnel involved varied as particular talents were required or as construction manpower became available. As described in Chapter 4.0, ORNL work forces were supplemented by CPAF contractor personnel (Rust Engineering), who did the majority of the site operations. Radiation exposures to this work force were maintained below the ORNL administrative limit of 20 mrem/day. The highest exposures were observed during removal of vegetation from the two leak sites, but even then, the highest individual exposure did not exceed 15 mrem/day.

7.0 PROJECT COST AND SCHEDULE

A summary of the ILW transfer line decommissioning project schedule is presented in Fig. 30. This schedule, broken down by major project phases as defined in Chapter 4.0, reflects the complete time span of ORNL SFMP activities. The decommissioning efforts extended over a period of approximately five years, although actual D&D activities occurred only intermittently during that time. In particular, on-site construction work was necessarily conducted during time periods when weather conditions were favorable for outdoor activities. Actual D&D operations required approximately two weeks for site preparation, two weeks for removal of the hydrofracture line, two months for removal of the ILW line, and four months for entombment of the leak sites.

ORNL DWG 83-15539

ILW TRANSFER LINE DECOMMISSIONING PROJECT

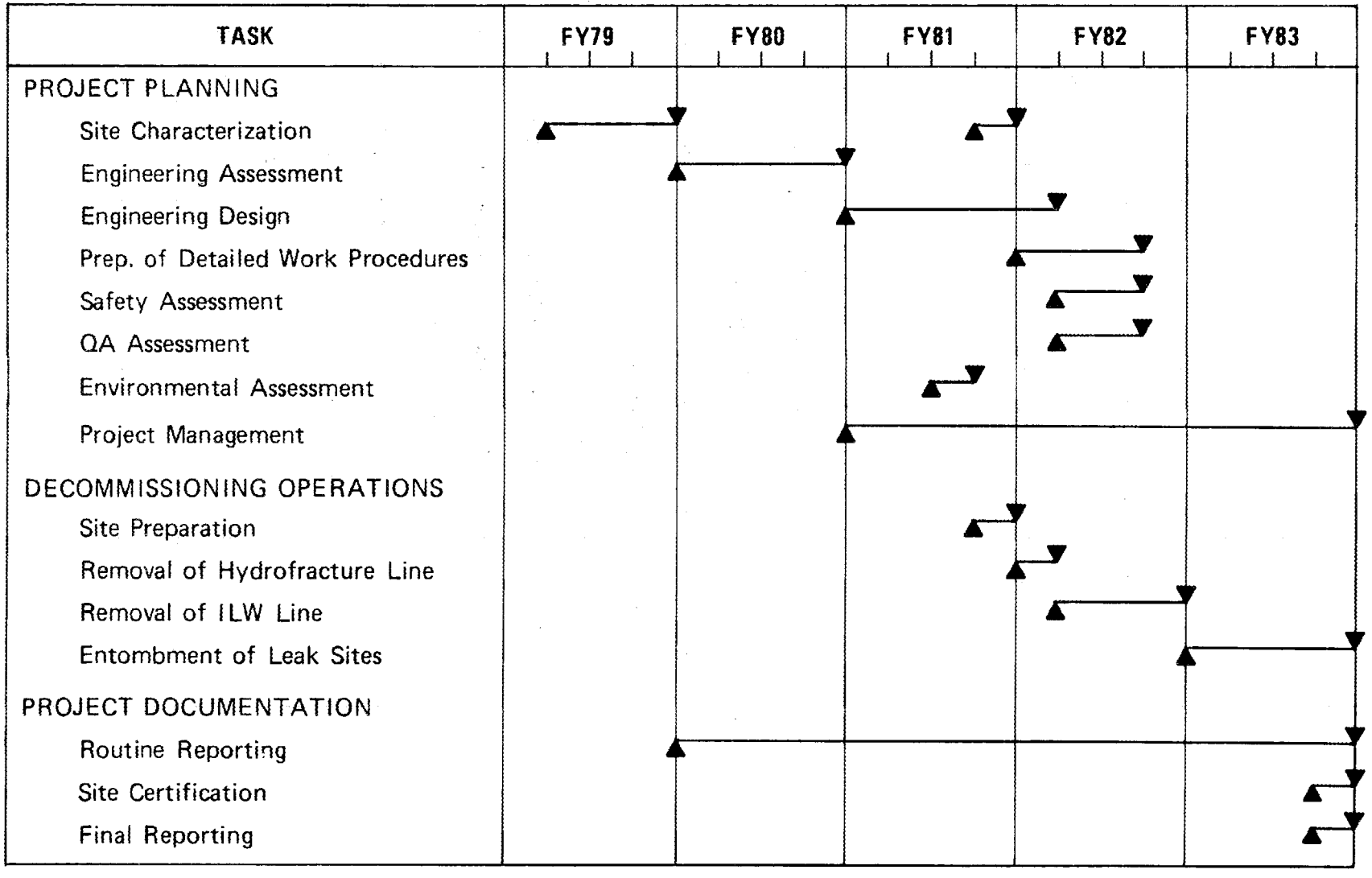


Fig. 30 Project schedule for the ILW Transfer Line Decommissioning Project

The project costs were tracked throughout the life of the project as part of the normal ORNL cost and budget reporting system. As summarized in Table 3, the actual total project cost was $550,000. The original estimated projected costs were $700,000, with the majority of the savings attributable to reduced construction costs and changes in work scope. A total of approximately 3 man-years of ORNL forces and 1.8 man-years of CPAF contractor personnel were expended over the duration of the effort.

8.0 SUMMARY AND CONCLUSIONS

The decommissioning of the ILW transfer line was completed on schedule, under budget and without major problems. This project, funded as part of the DOE's Surplus Facilities Management Program, accomplished the stated objectives by placing the abandoned pipeline in a condition that significantly reduced the hazards associated with the line. That portion of the ILW line that traversed the White Oak Creek floodplain was removed to prevent potential groundwater interaction with the contaminated piping, and the two known leak sites associated with the line were entombed to minimize the spread of contaminated soil. The remainder of the pipeline was left intact in the original abandoned condition.

In the present state, the ILW line represents only a minor potential source of radionuclide release to the environment. Due to the small quantities of residual radioactivity remaining in the abandoned pipeline and the isolated, controlled area in which it will remain, there is

Table 3 Cost Summary for the ILW Transfer Line Decommissioning Project

Activity	Project Costs ($1000) FY 79	FY 80	FY 81	FY 82	FY 83	Total Project Cost
Project Management	-	7	40	20	30	97
Engineering	-	12	16	22	10	60
ORNL Construction Forces	-	-	5	22	5	32
Health Physics Costs	19	-	5	7	10	41
Waste Disposal	-	-	-	8	20	28
CPAF Contractor	-	-	10	46	65	121
Materials and Misc. Costs	-	-	10	22	20	52
Overhead Charges	6	6	24	33	50	119
TOTAL	25[a]	25	110	180	210	550

[a] Survey work was funded under routine ORNL overhead. No SFMP funding was required.

little justification for further remedial actions along the line. Only when plans are made for long-term burial ground stabilization at ORNL should the ILW line be considered as a candidate for further actions.

Based on the TRU waste management guidelines in effect at the time of the project, some 0.7 m^3 (24 ft^3) of carbon steel piping was packaged and disposed of as TRU waste. However, according to current guidance (DOE 5820), this waste (composed primarily of 18 yr half life ^{244}Cm) would not be classified as TRU and could be removed from retrievable storage and disposed of as LLW in the ORNL burial grounds. Analysis of this waste will be conducted as part of the routine assay program of previously stored ORNL TRU wastes, and appropriate action taken.

During the conduct of this decommissioning project, valuable experience was gained and several lessons learned. As is the case with most D&D activities, the historical records of past ILW line operations were incomplete or inaccurate. Engineering drawings of line locations were generally adequate, although they had not been updated to document past line removal efforts. Similarly, although previous radiation surveys had outlined the scope of the problem, significantly larger areas and higher dose rates were uncovered as the leak site entombment phase progressed. Work procedures had to be altered to adequately protect the personnel, and the original site engineering drawings and work scope were revised to accommodate the larger areas. Final site certification also became a learning experience as numerous disciplines were called in to assess the final site conditions. Unanticipated additional minor

site work was required based on this final review, highlighting the need for more thorough review and definition of site certification criteria much earlier in the project planning phases.

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