LA-12356

Decommissioning the UHTREX Reactor Facility at Los Alamos, New Mexico

Los Alamos

Los Alamos National Laboratory is operated by the University of California for the United States Department of Energy under contract W-7405-ENG-36.

DISCLAIMER

Edited by Margaret E. Durbin, Group IS-11

LA--12356

DE93 002708

Decommissioning the UHTREX Reactor Facility at Los Alamos, New Mexico

Miguel Salazar
John Elder

This document is
PUBLICLY RELEASABLE
H. Kinser
Authorizing Official
Date: 2/3/05

MASTER

Los Alamos Los Alamos National Laboratory
Los Alamos,New Mexico 87545

Contents

Figures

Tables

Appendixes

DECOMMISSIONING THE UHTREX REACTOR FACILITY AT LOS ALAMOS, NEW MEXICO

by
Miguel Salazar and John Elder

ABSTRACT

The Ultra-High Temperature Reactor Experiment (UHTREX) facility was constructed in the late 1960s to advance high-temperature and gas-cooled reactor technology. The 3-MW reactor was graphite moderated and helium cooled and used 93% enriched uranium as its fuel. The reactor was run for approximately one year and was shut down in February 1970. The decommissioning of the facility involved removing the reactor and its associated components. Planning for the decommissioning operations included characterizing the facility, estimating the costs of decommissioning, preparing environmental documentation, establishing a system to track costs and work progress, and preplanning to correct health and safety concerns in the facility. Work to decommission the facility began in 1988 and was completed in September 1990 at a cost of $2.9 million. The facility was released to Department of Energy for other uses in its Los Alamos program.

1.0 INTRODUCTION

1.1 History of the Facility

The Ultra-High Temperature Reactor Experiment (UHTREX) facility was constructed for the Atomic Energy Commission in the late 1960s at Los Alamos, New Mexico. The reactor was operated by Los Alamos Scientific Laboratory (now Los Alamos National Laboratory) for approximately one year. Experiments were conducted to advance the state of gas-cooled reactors.

The 3-MW reactor was graphite-moderated. It used helium in the primary and secondary cooling loops (Fig. 1). The fuel was 93% enriched uranium. A unique feature was the rotating reactor core that could be fueled while in operation (Fig. 2). The coolant operating temperature ranged from 871° to 1316° C (1600° to 2400° F), and pressure ranged from 475 to 500 psi.

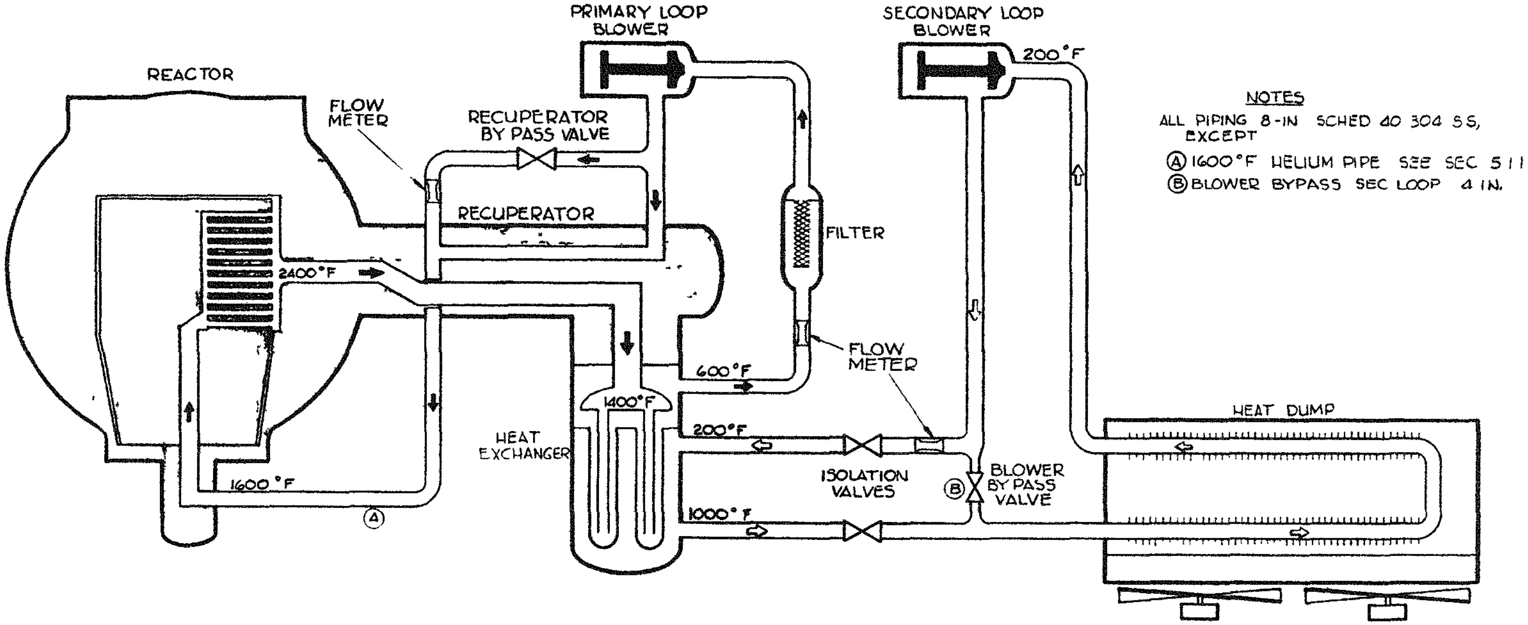


Fig. 1. UHTREX reactor coolant systems.

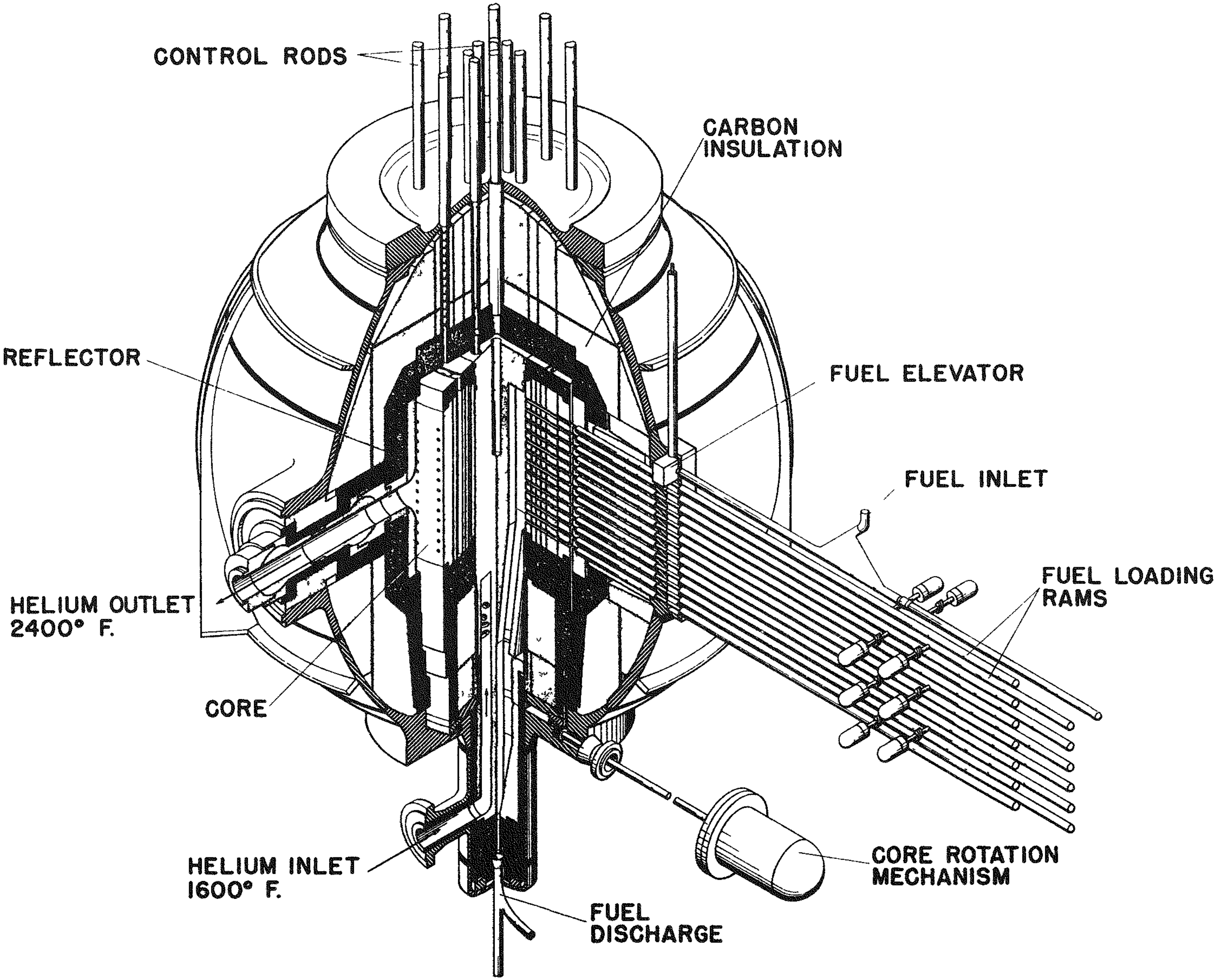


Fig. 2. UHTREX reactor.

In February 1970, the reactor was shut down and defueled. Some reactor-related equipment was removed at the time; the rest was secured in controlled areas to prevent radiation exposure to personnel. The reactor room, fuel discharge room, and hot cell rooms inside the secondary containment boundary were locked and posted to prevent accidental entry (Fig. 3). The rest of the building was used by Q Division (later N Division) and others as office and nonradiological experiment space.

1.2 Decommissioning Compliance Documents for the National Environmental Policy Act (NEPA)

Action Description Memorandum. The Laboratory submitted an Action Description Memorandum (ADM), ADM 86-37 (July 1988), for the UHTREX decommissioning to assess the potential environmental impact of the decommissioning operations. The ADM also described the proposed decontamination and decommissioning (D&D) activities. The ADM and its references in the Annual Surveillance Report[1] verified the overall lack of environmental impact by Laboratory operations and pledged adherence to the Los Alamos National Laboratory Environmental Impact Statement (EIS). The ADM was submitted to support a categorical exclusion for the UHTREX project.

Memorandum to File. Department of Energy (DOE) Headquarters approved a memorandum to file to comply with regulations of the National Environmental Policy Act (NEPA). It summarized the decommissioning plan and referenced the project management plan and ADM in support of approval.[2]

1.3 Project Authorization

Criteria in the DOE's Surplus Facility Management Program (SFMP)[3] require that Nuclear Energy (NE) programs be responsible for at least 50% of the contamination at a facility. Because the UHTREX facility was constructed to advance civilian nuclear research, all the radioactive contamination in the facility resulted from NE work. UHTREX D&D efforts were completely funded by the SFMP (DOE NE-20).

1.4 DOE and Laboratory Readiness Review

Before beginning decommissioning efforts, a readiness review meeting was held November 1, 1989, to assure DOE that all NEPA documentation was in order; cost and schedules were acceptable; controls for cost and schedules, quality assurance program, and a health, safety, and environment program were in place; and the scope of the work and cleanup criteria were well-defined. An additional readiness review meeting was held to discuss removing and transporting the reactor vessel.

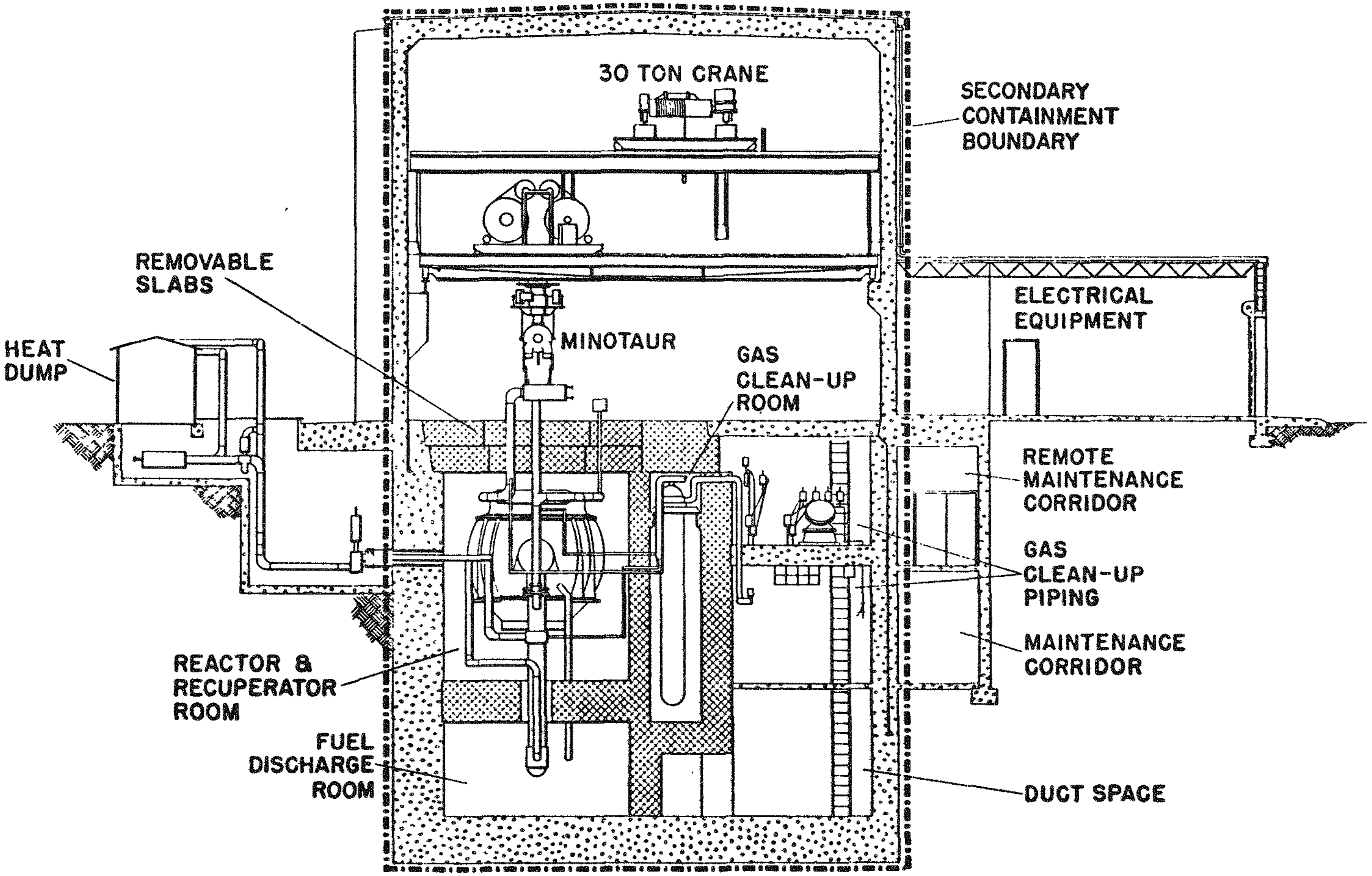


Fig. 3. Secondary containment area viewed westward.

2.0 FACILITY DESCRIPTION

2.1 Site

Layout. Los Alamos National Laboratory is located in Los Alamos County in north-central New Mexico approximately 40 km (25 miles) northwest of Santa Fe, the state capital. The Laboratory site covers an area of 111 km^2 (43 mi.^{2}). Adjacent Los Alamos communities are on the Pajarito Plateau. The plateau consists of finger-like mesas separated by canyons orientated east and west. Intermittent streams flow through the canyons. The mesa-top elevations range from 2400 m (7800 ft) close to the Jemez Mountains on the west to 1900 m (6200 ft) at the east end above the Rio Grande.

Location. The UHTREX facility is at Technical Area 52 (TA-52). It is approximately 4 kilometers (2.5 miles) southeast of downtown Los Alamos and 7.2 km (4.5 miles) west of White Rock (Fig. 4).

The townsite is mainly residential with some light commercial services and establishments that serve the local population or the Laboratory. Farming and ranching are limited and not considered of commercial importance to the Los Alamos area. Most of the area within Los Alamos is owned and controlled by the DOE. This land was originally acquired by the Atomic Energy Commission during the Manhattan Project in the early 1940s.

The DOE controls the area within the Laboratory. Access to most sites is restricted. TA-52 is open during normal working hours but is enclosed within a security fence and locked gate during nonworking hours and days. The DOE has the option to completely restrict access to TA-52.

Population. Los Alamos county has an estimated 1988 population of 19,400. About one-third of Laboratory employees commute from other counties. The Los Alamos townsite has approximately 12,200 residents, and White Rock has 7200 residents. The Laboratory employs approximately 7600 full- and part-time personnel, and its maintenance subcontractor, Johnson Controls, Inc. (JCI), employs approximately 1400.

Precipitation and Temperature. Los Alamos has a semiarid, temperate mountain climate. Average annual precipitation is about 45 cm (18 in). Thundershowers during July and August contribute to 40% of the precipitation. Winter snow averages 130 cm (51 in.) annually.

Summer temperatures usually reach a high of 32° C (90° F) during the day and can drop to below 15° C (59° F) at night. Winter temperatures typically range from -9° to -4° C (15°

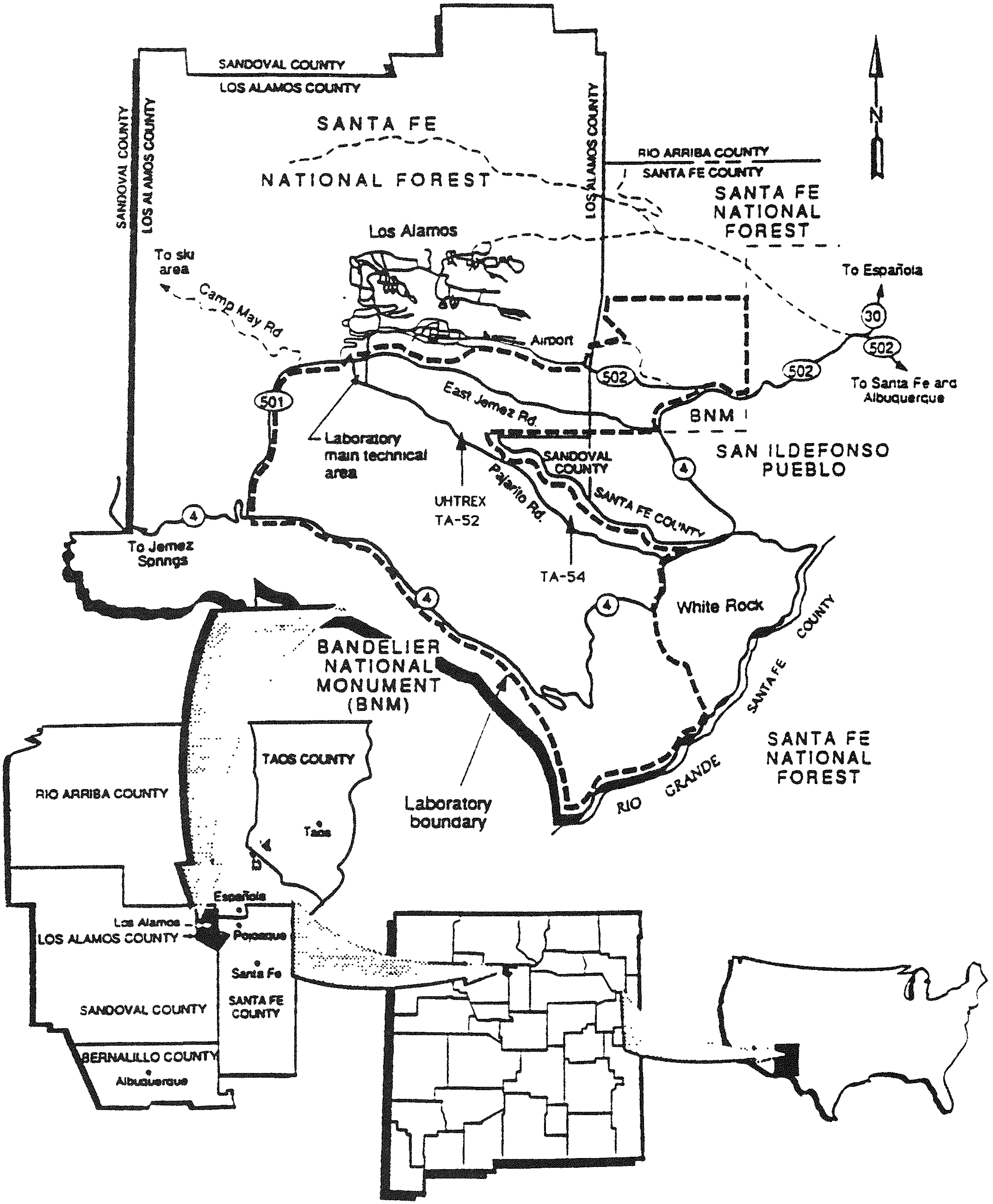


Fig. 4. UHTREX technical area and surrounding area.

to 25° F) at night and -1° to 10° C (30° to 50° F) during the day.

Hydrology and Geology. The main constituent of the Pajarito Plateau is Bandelier tuff, which is a solidified ashfall that was deposited from an erupting volcano over a million years ago. The nonwelded and welded tuff is over 300 m (1000 ft) thick on the west and 80 m (260 ft) on the east. The hydraulic conductivity of the tuff has been reported at 1.5×10^{-4} cm/day at 10% of saturation. The moisture in the soil varies from 2% to 8% at a depth of 0 to 3 m (0 to 10 ft), and below 3 m the soil moisture varies 0.5% to 2% by weight.[4]

Surface water flows intermittently in the canyons. Spring flow in the mountains does not provide enough water to prevent evaporation, transpiration, and infiltration losses from drying up the stream before it reaches the Rio Grande.

Groundwater in Los Alamos occurs as water in the shallow alluvium canyons from intermittent streams; perched water 37 to 60 m (120 to 200 ft) below the surface; and the main aquifer 180 to 360 m (600 to 1200 ft) below the surface.[4]

Erosion. Horizontal erosion rates have been reported at 1.4×10^{-2} cm/y (4.5×10^{-4} ft/y). Vertical down-slumping in the canyons has been estimated to occur at a rate of 5.8×10^{-3} cm/y (1.9×10^{-4} ft/y).

Seismicity. Laboratory-published reports indicating an earthquake of 5.5 magnitude (Richter) has a probability of 1 in 100 years. Active faulting has been reported in terms of rate of deformation as 0.008 cm/y. If an earthquake did occur, the ground would shift or crack with little or no vertical displacement. These cracks seal up with eroded materials.[5]

2.2 Project Facilities

The UHTREX facility includes the main reactor building (Reactor Development Building 1, RD-1, or TA-52-1). This building provided a gas-tight secondary containment enclosing the reactor, primary cooling system, and the gas cleanup system. Other space in the building housed auxiliary equipment, fuel-handling systems, utility systems, the control room, staff offices, and minor maintenance laboratories.

Outside structures of the facility included the neutralization/pump station, a 30.5-m (100-ft) high ventilation exhaust stack, a heat exchanger pump and heat dump building, a filter pit, and the contaminated waste lines that conveyed liquids to the pump station and then to the main radioactive waste liquid treatment plant at TA-50.

Detailed descriptions are provided in the project management plan.[2] See Fig. 5 for a general view.

The following describes the components of the work breakdown structure applied to decommissioning and decontamination of the UHTREX facility.

Outside Structures

Contaminated waste lines (Lines 65 and 66) - Approximately 975 m (3200 ft) of 10 cm (4 in.) diameter cast iron pipe were use to transfer low-level contaminated liquid wastes from the reactor building to the treatment plant at TA-50. These lines were buried at least 1.5 m (5 ft) below the surface (Fig. 6). Construction drawings indicated a drain line (66-A) from the pump station to daylight in the canyon. Excavation during the removal of the pump station revealed that it was never constructed.

Neutralization/Pump Station (RD-2) - A two-story neutralization/pump station or waste treatment building contained two concrete waste-holding tanks, various pumps, a metal storage tank for sodium hydroxide solution, and a metal mixing or neutralizing tank (Fig. 7). The aboveground masonry room housed assorted electronic and mechanical equipment and instrumentation.

Heat Dump Building and Heat Exchanger (RD-15 and RD-16) - A small metal building housed valves, pumps, instrumentation, mechanical equipment that monitored and regulated the coolant (helium) temperature in the secondary loop system between the heat exchangers (Fig. 8). The secondary loop consisted of 20-cm-diameter (8-in.) stainless steel pipe that was connected to a heat exchanger located off the heat dump building. The concrete pad for this heat exchanger (RD-15) was also called the heat dump pad. The loop entered a tunnel and then passed through the building wall into Room 310, the reactor room.

Filter Pit (RD-14) - A belowground reinforced concrete structure 3.3 m (11 ft) square and 3.7 m (12 ft) deep housed four high-efficiency particulate air (HEPA) filters and four charcoal absorber units. Air from the secondary containment portion of the UHTREX building entered on the side of the structure (pit), passed through the filters and absorbers to the bottom of the pit, and was routed by duct to Room 105 in RD-1. Then the air was either recirculated to the reactor room or, during shutdown periods, exhausted out the stack (Fig. 9).

Stack (RD-7) - A 30.5-m (100 ft) high steel stack with a 1.2-m (4-ft) diameter, 0.8-cm (5/16 inch) thick wall, and 2.6-m (8-1/2 ft) tapered base served as the stack (Fig. 10). A reinforced steel concrete foundation supported the stack.

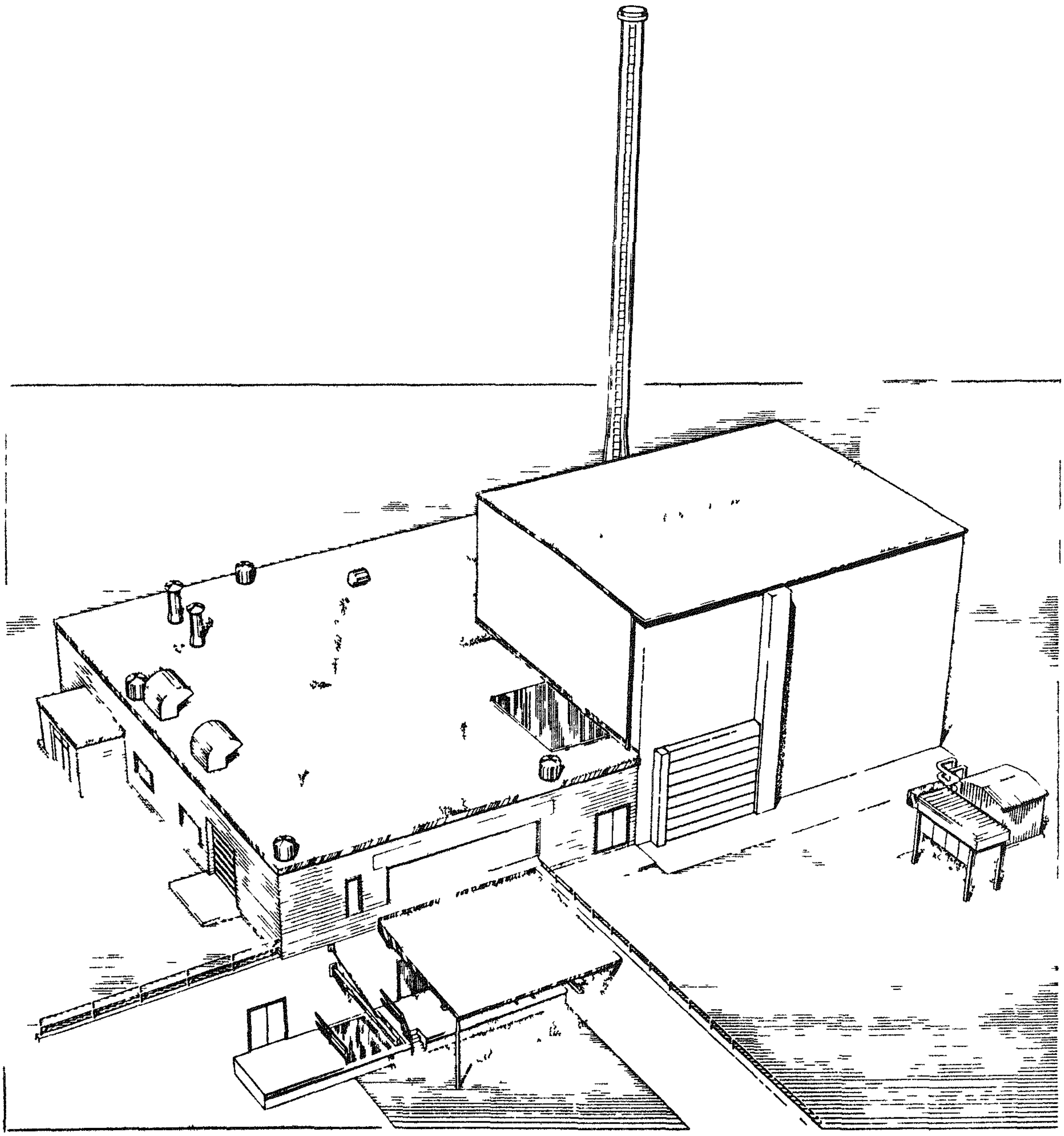


Fig. 5. Northward view of the UHTREX facility.

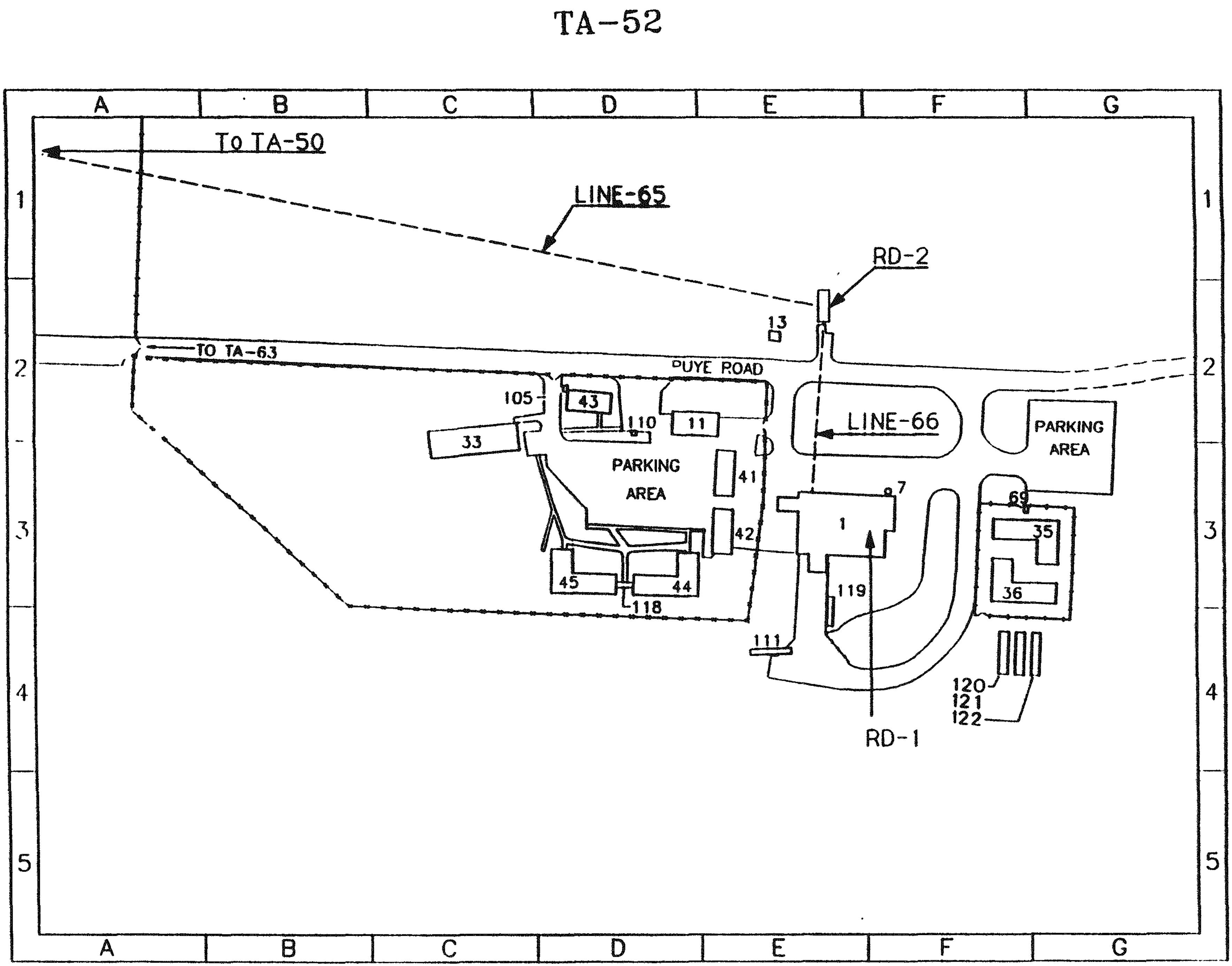
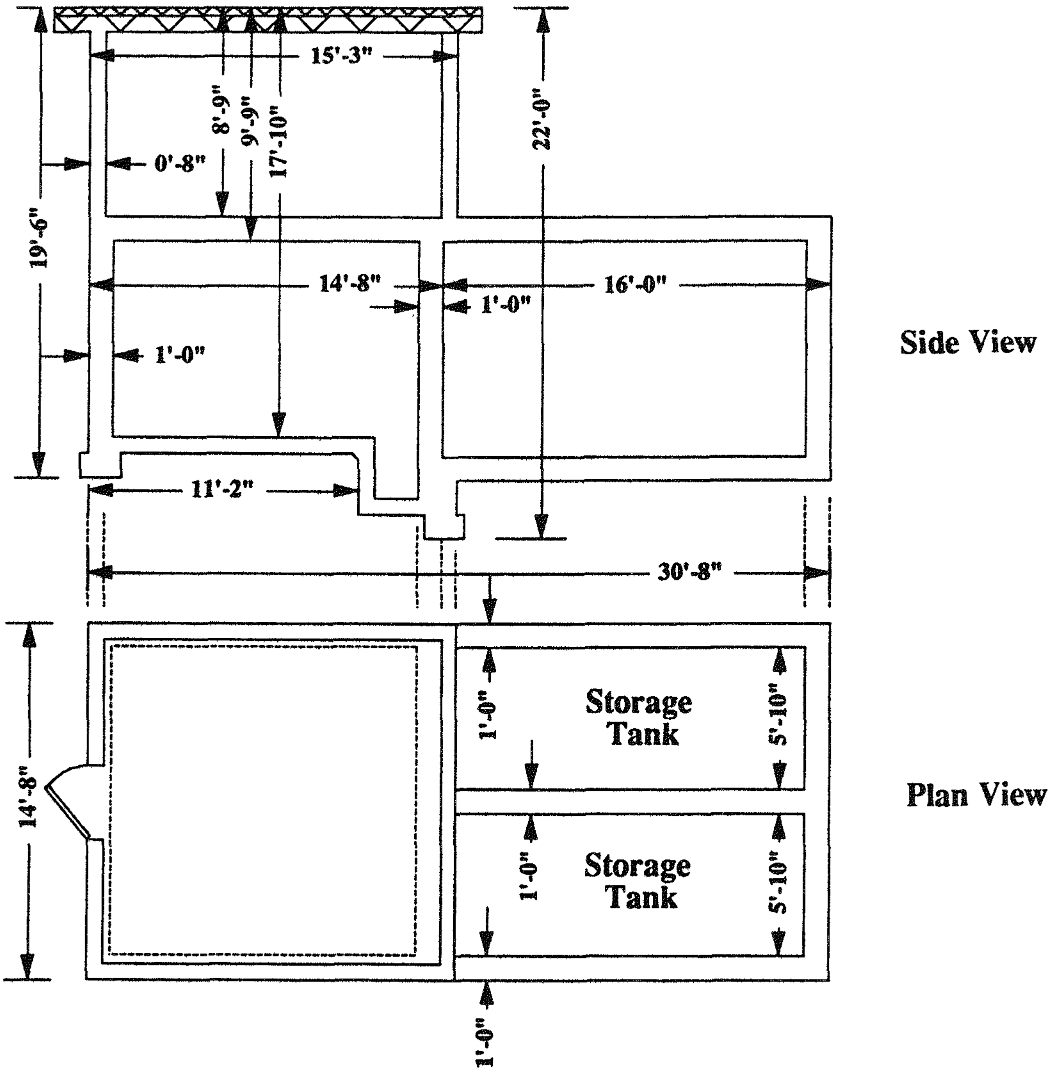
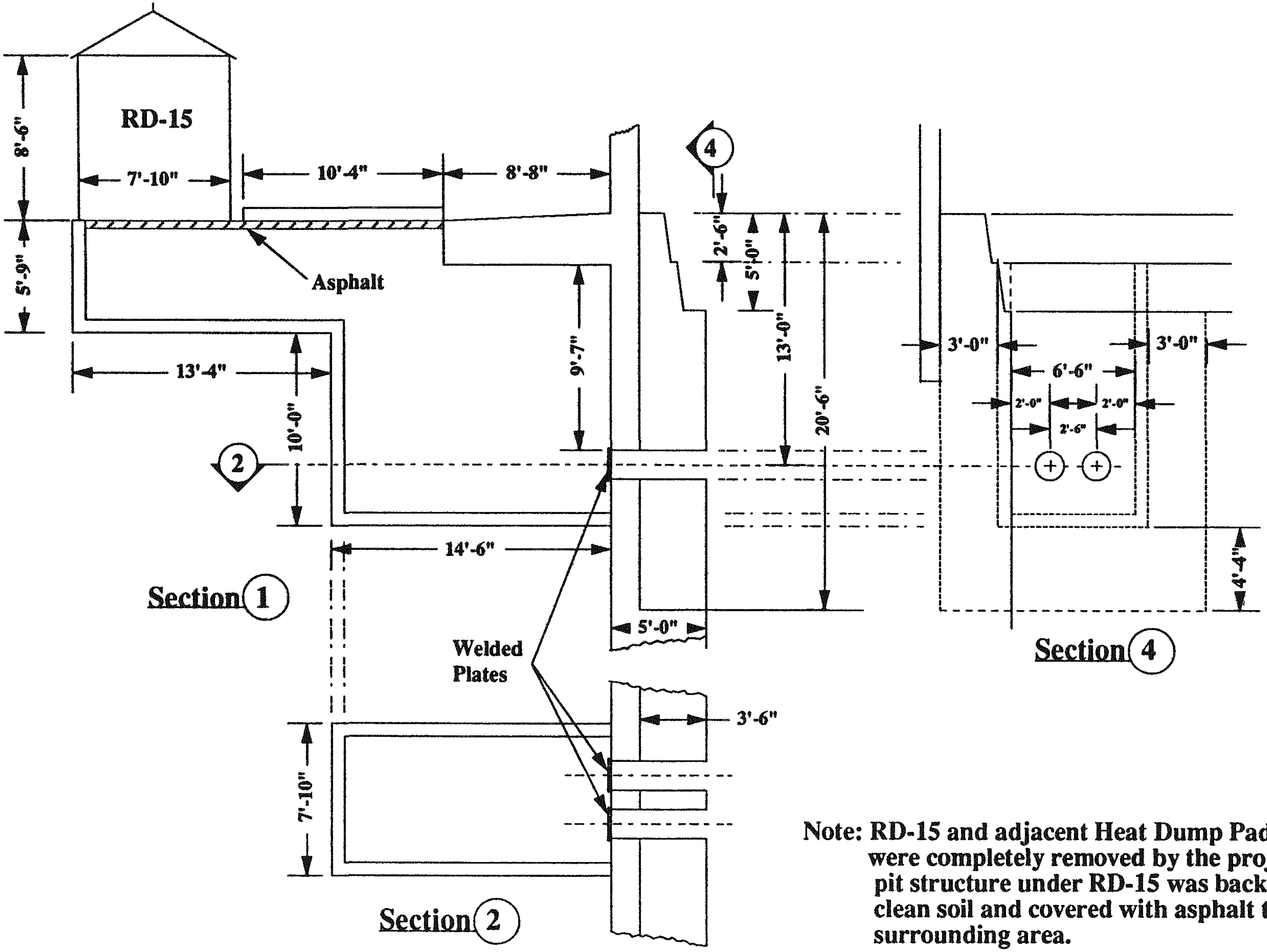


Fig. 6. Contaminated waste line, TA-50 to TA-52; lines 65 and 66.



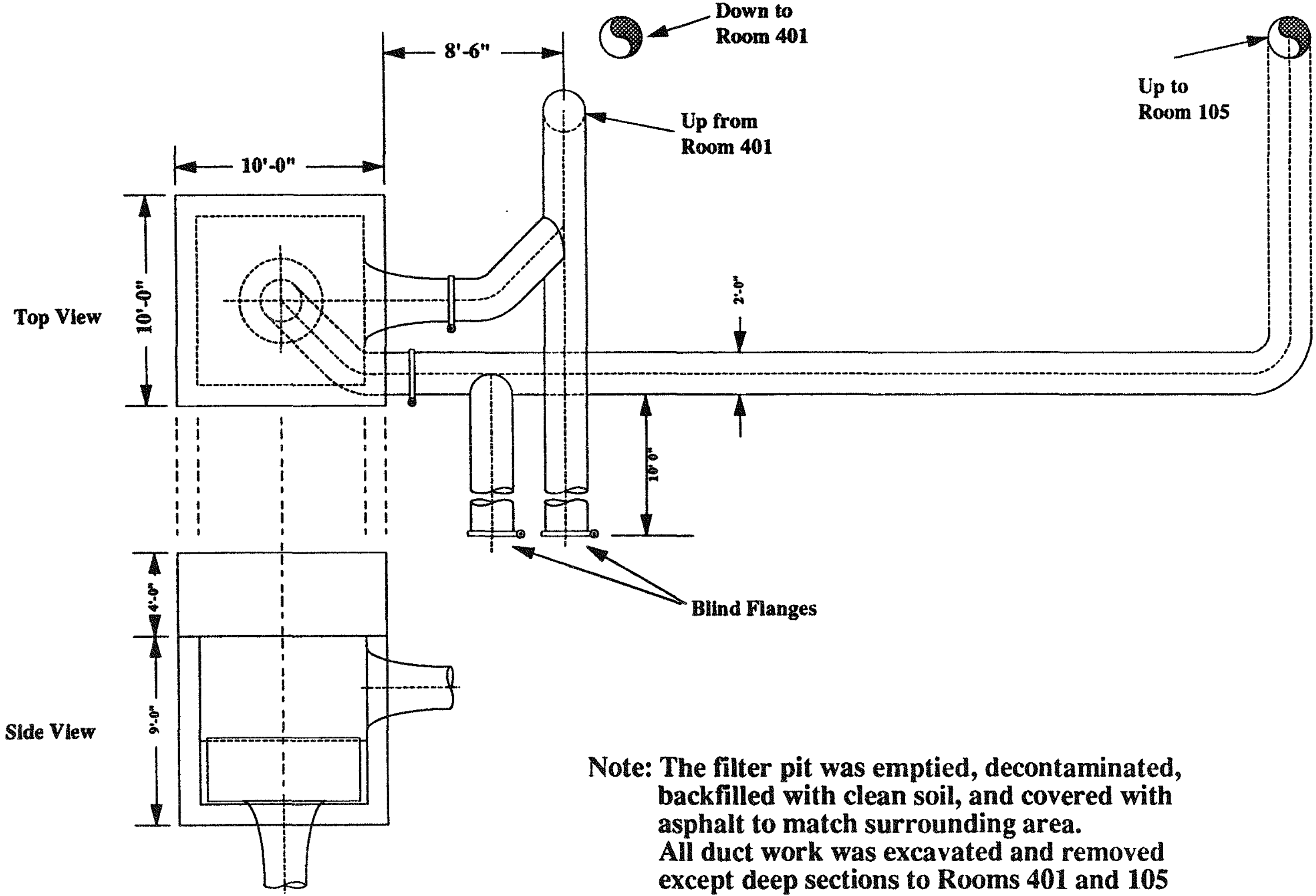
Note: RD-2 was completely removed by the project. The excavation was backfilled with clean soil and revegetated.

Fig. 7. Neutralization/pumping station (RD-2).



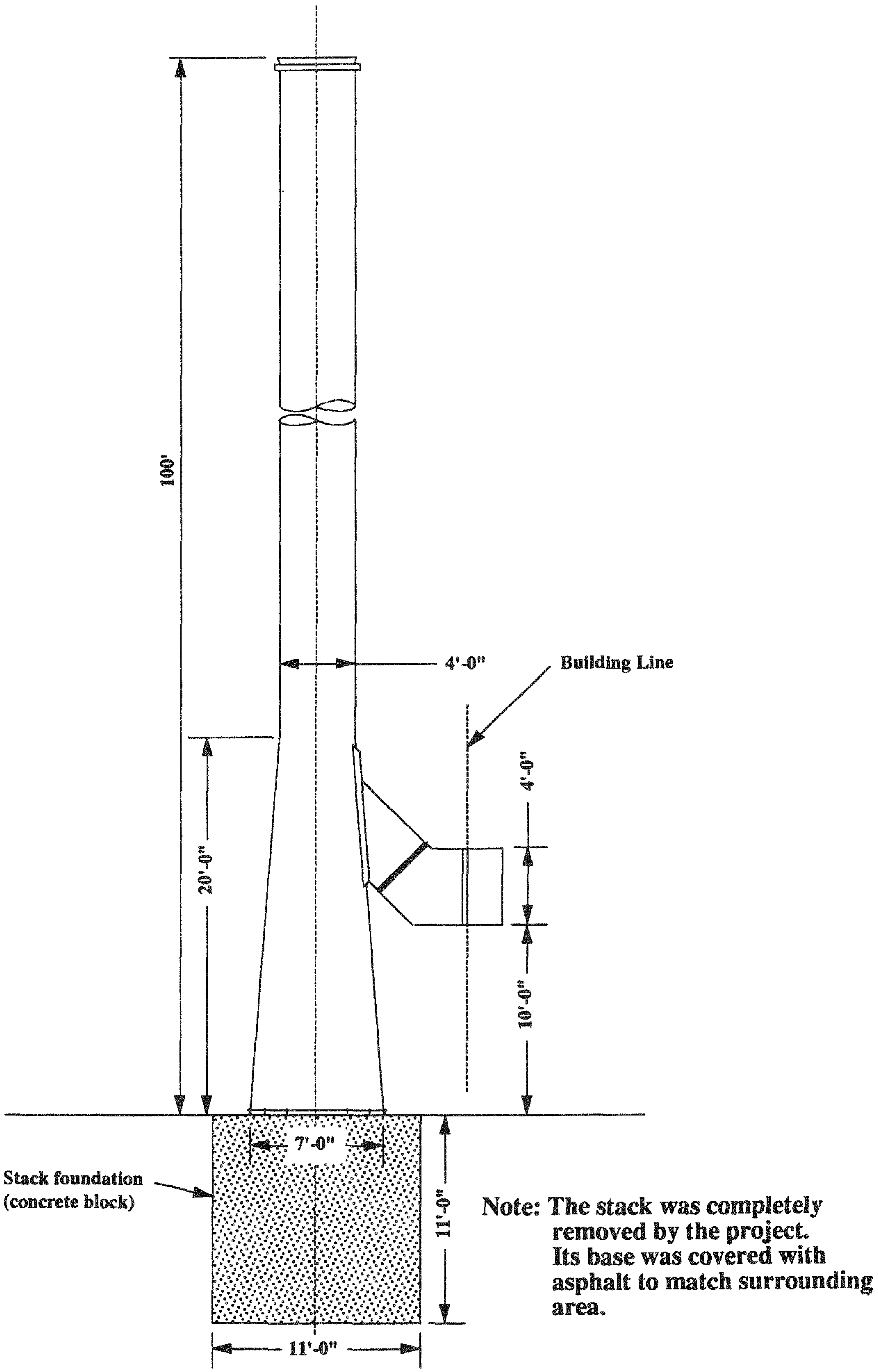
Note: RD-15 and adjacent Heat Dump Pad (RD-16) were completely removed by the project. The pit structure under RD-15 was backfilled with clean soil and covered with asphalt to match surrounding area.

Fig. 8. Heat dump building/heat exchanger (RD-15 and -16) before removal and backfill.



Note: The filter pit was emptied, decontaminated, backfilled with clean soil, and covered with asphalt to match surrounding area.
All duct work was excavated and removed except deep sections to Rooms 401 and 105 (see Section 4.3 and Appendix B).

Fig. 9. UHTREX filter pit (RD-14).



Note: The stack was completely removed by the project. Its base was covered with asphalt to match surrounding area.

Fig. 10. Side View of Stack, TA-52-7 (RD-7).

UHTREX Building (RD-1)

Reactor vessel and associated systems - The reactor vessel was in Room 310. It was a spherical carbon steel vessel 4 m (13 ft) in diameter with minimum wall thickness of 4.5 cm (1.75 in.). Dense carbon and graphite formed the inner core. It weighed approximately 100 metric tons (110 tons). The reactor was fueled or defueled by loading rams in Room 217; its indexing core was rotated by the core motor drive in Room 309. Twelve control rods entered the core vertically from above.

Associated systems consisted of the following (Fig. 11):

- the primary and secondary loops, consisting of 20-cm (8-in.) diameter stainless steel piping;
- a cylindrical recuperator 0.9 m (3 ft) in diameter and 4.6 m (15 ft) long with internal graphite material, and
- the heat exchanger vessel, 0.6 m (2 ft) in diameter and 6.1 m (20 ft) long.

The combined weight of the recuperator and heat exchanger was 15 tons.

Support systems - These systems consisted of nonradioactively contaminated equipment, instrumentation, control cabinets, air sampling lines, air supply fans, and filter housings. These materials and equipment were in various rooms of the facility.

Auxiliary systems - The reactor auxiliary systems consisted of radioactively contaminated equipment, instrumentation, and material used to support the reactor. All of these systems were in the secondary containment area.

Hot cells - The enriched uranium fuel elements were brought in and out through the hot cells (Rooms 212 and 213). The fuel elements were loaded in a cask that traveled by motorized cart into Room 212. The fuel was then transferred remotely with a manipulator from the cask to a dry box. Fuel was then transferred to the reactor on the fuel conveyor system, which consisted of a cable and tray that traveled inside an enclosed metal pipe. Spent fuel elements from the reactor traveled on the fuel conveyor system back to the dry box.

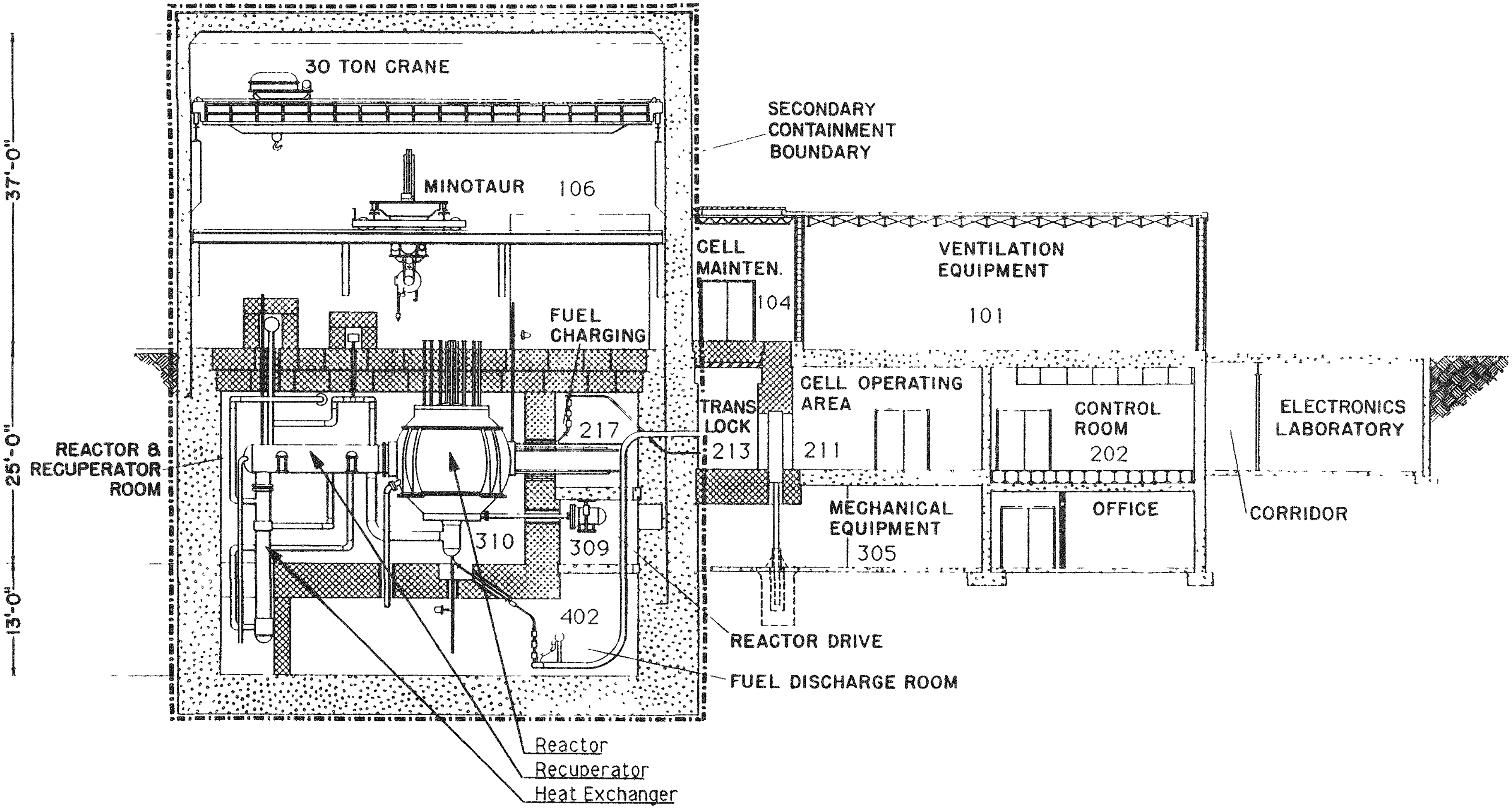


Fig. 11. Secondary containment and operating areas viewed southward.

2.3 Project Facilities Status Prior to Decommissioning

The reactor had been shut down since 1970. In the interim, the secondary containment boundary was restricted, and office areas were used by Laboratory personnel.

Initial radiological conditions - Before decommissioning operations, physical, radiological, and hazardous conditions of the facility were investigated. A summary of those conditions follows.

Most of the residual radioactive contamination was in the reactor vessel, recuperator, heat exchanger, primary loop, gas cleanup system, and the fuel loading system. Structural steel close to the reactor was activated. The main radionuclide contaminants were ^{90}Sr, ^{137}Cs, ^{60}Co and ^{235}U. Gases generated from the operation--argon-41, krypton, xenon, and tritium--had decayed or had been dissipated considerably and were therefore not detected inside the building. A tag on a compressor indicated previous tritium contamination. A survey with a Johnston Triton portable tritium detector indicated no tritium present. Europium-152 was found in the reactor and cooling loop during decommissioning operations. Exposure rates of up to 75 mR/h were found at contact with the vessel. Exposure rates varied from 5 to 10 mR/h inside the reactor room (Room 310).

Alpha activity up to 80,000 dpm/100 cm^2 was detected as surface contamination at the transition between the horizontal exhaust ventilation duct and the vertical stack. This alpha activity was near the exhaust duct of the fuel-handling cells 212 and 213.

Table I summarizes residual radioactivity amounts detected in the preliminary survey.

Hazardous materials - Approximately 48 metric tons (53 tons) of uncontaminated lead, mostly lead bricks, had been identified for removal from the facility. The lead bricks, lead shot, and lead wool had been used as shielding material in wall penetrations, instrument locations, and crevices under the reactor.

Although not classified as a hazardous material, asbestos used to insulate some reactor components was removed.

Soil samples from the waste line and surrounding building area, liquid samples from the reactor glycol cooling system and sump tank, and oil samples from the leaded glass shielding windows and cell door hydraulic system were submitted for analysis. They showed no known or suspected hazardous material present. See also Section 4.0, Work Performed.

Table I. Preliminary Radiological Survey Data.

		β-γ Contamination Level[a]	
Room[b]	Measurement	dpm/100cm^2	mR/h[a]
ground level			
101, 104, 107, 109, 109A	swipe, GM	No detectable activity (NDA) above background	
102, 103	swipe, GM	NDA	
105, 106	swipe, GM	NDA	
operating level			
200, 201, 202	swipe, GM	NDA	
202A, 203, 204, 205	swipe, GM	NDA	
206, 207, 208, 209	swipe, GM	NDA	
211A, 211, 214, 215	swipe, GM	NDA	
219, 221, 223, 225	swipe, GM	NDA	
212, 213	swipe	890	
216, 217	swipe, GM	756	

Table I. Preliminary Radiological Survey Data (cont).

Room[b]	Measurement	β-γ Contamination Level[a] dpm/100cm^2	mR/h
basement level			
301, 302, 304, 305	swipe, GM	NDA	
306, 311, 312, 313	swipe, GM	NDA	
314, 315, 316, 317	swipe, GM	NDA	
303	swipe, GM	NDA	
307	GM		190
308	swipe, GM	490	15
309	swipe	215	
310	swipe GM	7,500	43
subbasement level			
401	swipe	1,100	
402	TLD	not taken	6
403	swipe	NDA	
external structures			
RD-2	swipe, GM	96	
RD-7	swipe	56,000	

Table I. Preliminary Radiological Survey Data (cont).

		β-γ Contamination Level[a]	
Room[b]	**Measurement**	**dpm/100cm^2**	**mR/h**
RD-14	swipe	7,700	
RD-15	swipe	50	
RD-16	swipe	NDA	
line 65	swipe, GM	NDA	

[a] Maximum survey results.
[b] See Appendix D for room locations.

A 1000-l (300-gal.) metal tank was used to store sodium hydroxide solution in the pump station. This tank and its associated piping were rinsed before disposal.

3.0 DECOMMISSIONING OBJECTIVE AND WORK SCOPE

3.1 Goal

The goal of the project was to decommission and decontaminate (D&D) the UHTREX facility in a safe and cost effective manner in accordance with DOE Order 5820.2A, Chapter 5.[6] All work was to be accomplished in a manner that maintained worker dose as low as reasonably achievable (ALARA). The project freed space for use by other DOE projects. Approximately 1115 m^2 (12,000 ft^2) of previously unavailable space was made available for other Laboratory activities. The expense of continued surveillance and maintenance of the facility was eliminated.

3.2 Scope

Decommissioning activities included the following:

- removing contaminated components and equipment from the facility;
- decontaminating walls, floors, and accessible surfaces;
- removing hazardous materials from the facility associated with the reactor;
- removing excess reactor-related peripheral structures that were decaying and that represented an environmental and safety liability;
- removing reactor-related systems that would not have future use because of obsolescence or inability to meet current design criteria; and
- removing uncontaminated reactor support equipment that occupied reusable space or that had salvage value.

See also Section 4.0, Work Performed, for details of the scope of work.

3.3 Final Release Criteria

The objective of the D&D project was to leave the facility in a safe condition as defined by the following criteria.

Residual Soil Contamination Guidelines. As described in Subsection 5.2, results of soil sampling along the Line 65 station (RD-2), the filter pit (RD-14), and the heat dump (RD-15) demonstrated that radioactivity left in the top 1 m (3 ft) layer of soil did not exceed any of the following guidelines:

^{137}Cs	60 pCi/g
^{60}Co	13 pCi/g
^{90}Sr	405 pCi/g
^{234}U	1110 pCi/g
^{235}U	265 pCi/g
^{238}U	800 pCi/g
^{238}Pu	325 pCi/g
^{239}Pu	295 pCi/g

These guidelines were based on calculations using site-specific data in the RESRAD (**res**idual **rad**ioactivity) code,[7] as specified in DOE 5400.5.[8] The RESRAD code yields soil concentrations in surface soil that cause exposures no higher than 100 mrem/y to members of the public exposed to the soil under several scenarios of exposure pathway. The input parameters and output for the appropriate scenarios at Los Alamos are in Appendix A. These limits may appear to be high compared with other DOE sites; the RESRAD calculation shows only minor dose contribution from ingestion because of limited groundwater at the UHTREX site. However, the RESRAD exposure scenarios are largely academic because the Laboratory does not intend to release the site to the public soon and would not release it in the future without additional surveillance and certification.

Tritium in soil was a special case in which no soil guideline was estimated. The HSE-8 *de minimus* soil cleanup guideline for tritium is 100 nCi/l of soil moisture. Analysis for tritium was conducted on the same samples taken for other radionuclides. Tritium encountered at above-background levels is discussed in Subsection 5.2.

Residual Surface Radioactivity Guidelines. The predominant radionuclides detected on surfaces within the UHTREX facility were ^{137}Cs and ^{90}Sr. Cesium-137 is a fission product that emits a 0.51-Mev (maximum) beta and a 0.66-Mev x-ray; its radioactive half-life is 30 years. Strontium-90 is a fission product that emits a 0.55 Mev (maximum) beta; its radioactive half-life is 28 years. Guidelines for these radionuclides were taken from DOE Guidelines for Residual Radioactive Materials at Formerly Utilized Sites Remedial Action Program and Remote Surplus Facilities Management Program Sites (March 1987).[9] Surface contamination guidelines for ^{137}Cs and ^{90}Sr are taken from Table 1 of the report, which has been modified to show only Cs and Sr radionuclides (Table II). Where the activity ratio of ^{137}Cs and ^{90}Sr was unknown, the lower guideline (^{90}Sr) was used.

Table II. Surface Contamination Guidelines.

Allowable Total Residual Surface Contamination (dpm/100 cm^2)[a]

Radionuclide[b]	**Average**[c,d]	**Maximum**[d,e]	**Removable**[d,f]
^{90}Sr	1000	3000	200
^{137}Cs	5000	15000	1000

[a] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute measured by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[b] Where surface contamination by both alpha- and beta-gamma-emitting radionuclides exists, the limits established for alpha- and beta-gamma-emitting radionuclides should apply independently.

[c] Measurements of average contamination should not be averaged over an area of more than 1 m^2. For objects of less surface area, the average should be derived for each object.

[d] The average and maximum dose rates associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h and 1.0 mrad/h, respectively, at 1 cm.

[e] The maximum contamination level applies to an area of not more than 100 cm^2.

[f] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and measuring the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. The numbers in this column are maximum amounts.

Limits on External Gamma Radiation. The DOE guideline for gamma radiation rates (average area exposure rates) of 20 μR/h above background was not to be exceeded.

Limits on Nonradiological Contaminants in Soils. Cleanup criteria for nonradiological contaminants in soils have not been provided by DOE for implementation. Soil samples for chemical analysis were taken along the Line 65 excavation route and external structure locations. Results are discussed in Section 6.0, Hazardous Chemical Conditions after Decommissioning.

3.4 Restoration

Major repairs or refurbishment were beyond the scope of this project. Restoration to the facility consisted of the following minor work:

- the roof was repaired over Room 104 to prevent water leaks after the removal of the roof hatch;
- a few walls were painted to restore their general appearance where panels or miscellaneous items were removed;
- minor repairs were made to the hot-cell door to make it operational;
- life safety codes were met by repairing and installing emergency and exit fixtures; and
- safety hazards were eliminated by repairing floors to prevent tripping hazards.

4.0 WORK PERFORMED

The work breakdown dictionary (Appendix A) and the task list (Appendix B) in the UHTREX project management plan (PMP) provide details of the work performed.

The following discussion summarizes the work performed under the PMP. Deviations are documented under Configuration Control Board (CCB) action in Subsection 10.2.

4.1 Project Management

Project management was split into two work breakdown structures (WBS). Laboratory management personnel costs were tracked under Project Support. These full-time personnel included one construction project manager, one construction inspector, and one field D&D management coordinator. Part-time personnel from engineering design, procurement, safety, environmental protection, and industrial hygiene worked on the project as needed.

Management personnel by the contractor were tracked under Construction Support: the project field superintendent, the clerk-typist, the part-time computer and time keeper, the draftsperson, and the labor foreman. Time for training the contractor's field personnel was also included under this management activity. See the organizational chart in Fig. 12.

4.2 Planning Phase (Phase I)

The project planning phase consisted of obtaining radiological surveys, hazardous material surveys, and building and room utility identification. After these characterization surveys were completed, work plans and estimates were produced. From these plans and estimates, critical path schedules were determined. From all these activities a cost and schedule baseline was developed.

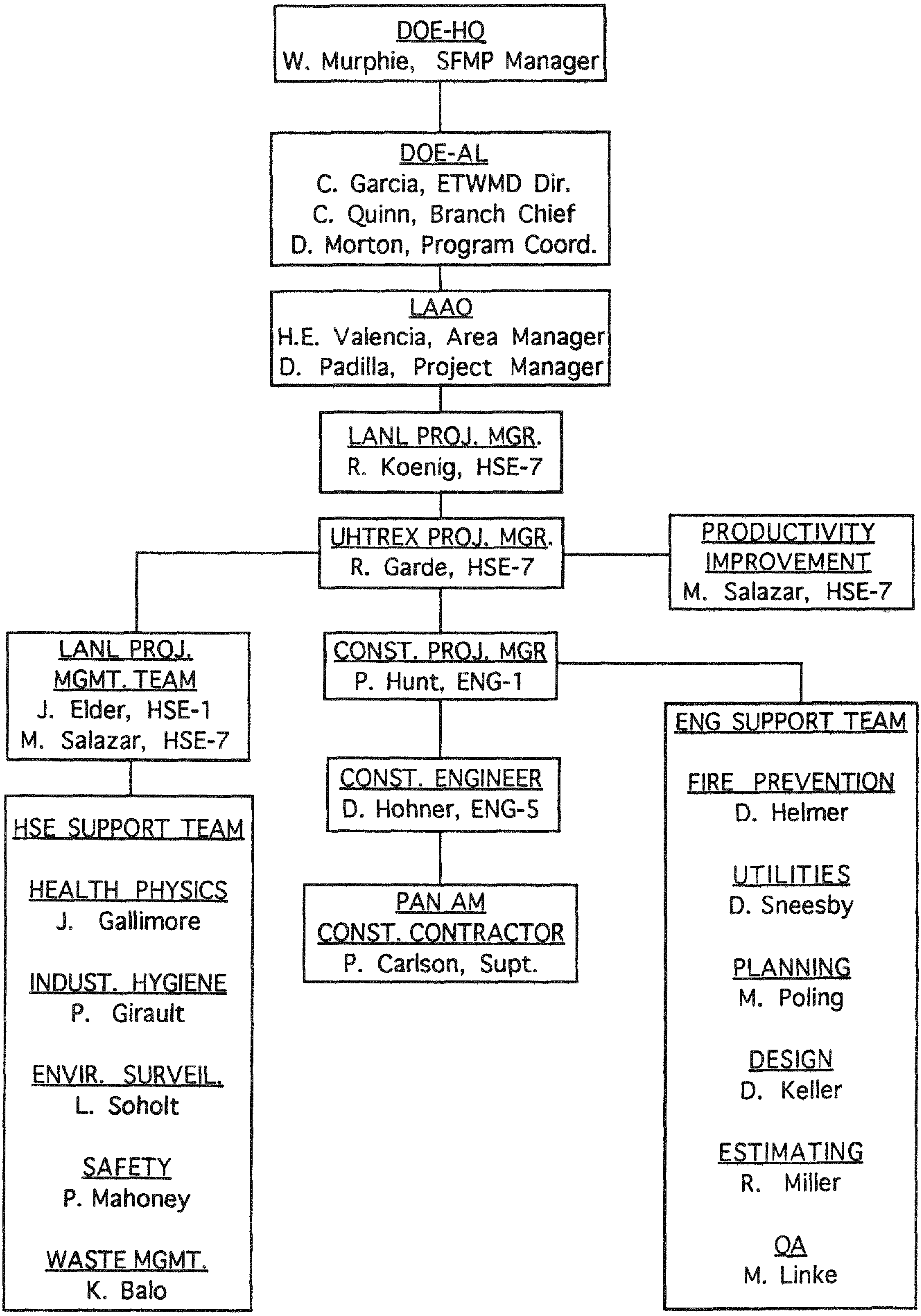
The planning phase began in May 1989 with the preparation of the project management plan and ended in January 1990 when major D&D operations began.

Characterization Surveys. Work performed included initial radiological and hazardous materials surveys. Preliminary identification of required health, environmental, and safety operating procedures was made. Sequences and concepts for performing the work were prepared. The facility was physically assessed to determine the condition of the utilities and other facility systems.

Plans and Estimates. Based on the characterization surveys, detailed work plans and estimates were made. Each room generally had its own work plan and estimate, which were combined with similar activities to define a work breakdown structure (WBS) element. The work plans and estimates were used to develop the critical paths method (CPM) for the WBS elements. Costs, resources, materials, and CPMs were then used with a computer management program to develop the project cost and schedule baseline. Leveling of personnel (optimizing personnel by minimizing demand and short work loads) was done, and appropriate work was scheduled that would depend on other factors, such as contract documents, work sequence, or material or equipment procurement.

Project Plans. A project management plan (PMP) was developed to establish the project scope, technical performance requirements, costs and schedule, levels of responsibility and authority, organizational interfaces, and quality control requirements.

Engineering. During the Phase I planning, no engineering work was done other than preparing estimates, schedules, and scope of work.


DOE-HQ
W. Murphie, SFMP Manager
DOE-AL
C. Garcia, ETWMD Dir.
C. Quinn, Branch Chief
D. Morton, Program Coord.
LAAO
H.E. Valencia, Area Manager
D. Padilla, Project Manager
LANL PROJ. MGR.
R. Koenig, HSE-7
UHTREX PROJ. MGR.
R. Garde, HSE-7
PRODUCTIVITY IMPROVEMENT
M. Salazar, HSE-7
LANL PROJ. MGMT. TEAM
J. Elder, HSE-1
M. Salazar, HSE-7
CONST. PROJ. MGR
P. Hunt, ENG-1
CONST. ENGINEER
D. Hohner, ENG-5
PAN AM CONST. CONTRACTOR
P. Carlson, Supt.
HSE SUPPORT TEAM
HEALTH PHYSICS
J. Gallimore
INDUST. HYGIENE
P. Girault
ENVIR. SURVEIL.
L. Soholt
SAFETY
P. Mahoney
WASTE MGMT.
K. Balo
ENG SUPPORT TEAM
FIRE PREVENTION
D. Helmer
UTILITIES
D. Sneesby
PLANNING
M. Poling
DESIGN
D. Keller
ESTIMATING
R. Miller
QA
M. Linke

A typical approach to decommissioning work was first to remove the greatest hazard or source of contamination to limit the potential of airborne or direct radiation exposure to personnel. The approach revolved on scheduling the removal and transport of the reactor vessel. The greatest amount of time was spent preparing the necessary bid documents, soliciting, reviewing, and accepting the bid. Procurement took about a year. Removing and transporting the vessel took six weeks.

Other considerations included removing complete systems in a room. Equipment and piping removal could occur concurrently in separate rooms where craft personnel would not interfere with each other. Adequate lighting, ventilation, access to each room, and an alternate emergency exit route had to be provided and maintained.

Outside work was scheduled during the spring, summer, and fall to eliminate potential problems in cold weather or with snow.

Environmental Compliance. An ADM and memo to file (see Section 1.2) were issued in compliance with NEPA regulations.

Procurement. Equipment literature searches and possible contractors listings were made to provide future input for procurements. No procurements chargeable to the project were made during the planning phase. The Laboratory bought a computer software management program for general and ongoing Laboratory work that had applications at UHTREX.

4.3 Decommissioning Operations (Phase II)

After a DOE readiness review, approval was given to remove the contaminated waste lines. Work began in fall 1989 with excavation of these lines. Traditional backhoe excavation methods were used.

Before work began inside the facility, the existing building ventilation for the secondary containment was made operational. The building's HEPA filters in RD-14 (9000 cfm) (256 m^3/min.) were changed, and the system was tested. Portable HEPA-filtered exhaust units (500-1000 cfm) (14-28 m^3/min.) provided primary ventilation control to reduce airborne release at a work area.

Outside Structures

Contaminated waste lines (Lines 65 and 66) - Line 65 from the pump station to the holding tank WM-3 at TA-50 was completely removed. WM-3 was also removed as a separate project of the treatment plant maintenance program at TA-50.

Line 66 from the neutralization/pump station (RD-2) to the UHTREX building (RD-1) was removed. Accessible sections within the building were also removed. Sections under the building floor slabs leading to the sump in Room 303 were left in place. No contamination was found at either end of this pipe (Appendix H). All ends were plugged with concrete.

Engineering drawings showed a short section of pipe, Line 66A, from the pump station to the canyon; it was not found. Exploratory excavating along the sides of the pump station did not reveal any pipe. The excavated trench was backfilled and the area graded and revegetated with native grasses.

Neutralization/pump station (RD-2) - This structure was completely demolished with a backhoe and wrecking ball. It was excavated below the foundation to solid tuff and all materials were disposed of. The area was backfilled, graded, and revegetated with native grasses.

Heat dump building (RD-15) and heat dump pad and exchanger (RD-16) - Both structures and the concrete foundation pad for the heat exchanger were removed. The concrete tunnel from the heat dump building to the main building was left in place after surveys indicated no radioactive contamination (Fig. 8). The tunnel walls were removed 15 cm (6 in.) below grade before backfilling began. The disturbed areas were graded and paved with asphalt to match the existing area.

Unnumbered instrumentation sheds - Two small cinder block sheds attached to the east and south side of the building (TA-52-1) were removed. The concrete foundations, wiring, and equipment for these sheds were also removed.

Stack (RD-7) - The exhaust stack north of the building was removed and disposed of. The foundation was broken to a depth of six inches below the surface (Fig. 10). The area was then repaved to match the existing parking lot.

Filter pit (RD-14) - Approximately 9.1 m (30 ft) of the duct from the side wall of the pit leading to Room 401 at the elbow was removed (Fig. 9). Part of the elbow and approximately 10.7 m (35 ft) of the duct on the side wall next to Room 401 was left in place. The exhaust duct leading from the pit floor to Room 105 was left in place. No contamination was detected from the pit floor to the duct leading to Room 105. The duct to Room 401 showed minor contamination. See Appendix C for the duct exception.

The inside of the filter pit was decontaminated below RESRAD guidelines and backfilled. The area was asphalted.

Manifold (RD-17) - The manifold was a reinforced concrete dock, approximately 6 m long and 1.2 m high (20 ft long and 4 ft high), that provided support to the helium lines and gas manifold. Transport tube trailers had been connected to the dock to deliver gas to the gas cleanup system. This wall and associated piping were completely removed. The area was asphalted to match the existing area.

Removal of Hazardous Materials

All hazardous materials associated with the UHTREX facility were removed. Most material, including lead, was recycled within the Laboratory. Small amounts of lead were sent to the Laboratory's hazardous waste storage facility at TA-54. A small quantity of mercury from pressure switches and thermostats was also sent to TA-54.

All asbestos in the UHTREX building secondary containment boundary (Rooms 106, 216, 217,307, 308, 309, 401, 402, and 403) and all asbestos used on the reactor support or auxiliary equipment was removed. Asbestos used in other parts of the building on water lines was left in place to be included in the Laboratory's ongoing asbestos removal program.

The lead windows and oil reservoirs were left in place in Rooms 212, 213, and 216. Analysis of the oil indicates PCB levels less than 1.5 ppb.

Removal of support systems and equipment - Uncontaminated equipment in Rooms 101, 102, 103, 105, 107, 202, 214, 215, 303, 304, 305, and 306 was removed, except for a return duct and heating and coil pressure vessel (heating and cooling coils) and fans E-1 and E-2 in Room 105. The sump tank and connecting drain lines in Room 303 was decontaminated and left in place (Fig. 13).

Decommissioning the hot cell area - All manipulator equipment, dry box, crane, and miscellaneous equipment were stripped from Rooms 212 and 213 and sent to TA-54 for disposal. The cell doors were deactivated and the interlocks bypassed. The cell doors can be used only by activating the electrical and hydraulic controls in Room 305.

Removing auxiliary systems - These systems were in Rooms 106, 216, 307, 401, 402 and 403. All rooms were stripped of equipment. Operation equipment for the 30-ton crane in Room 106 was left intact. The floor in Room 402 was scabbled to reach RESRAD guidelines. Most light fixtures were removed, but minimal lighting was left in place to provide entry visibility.

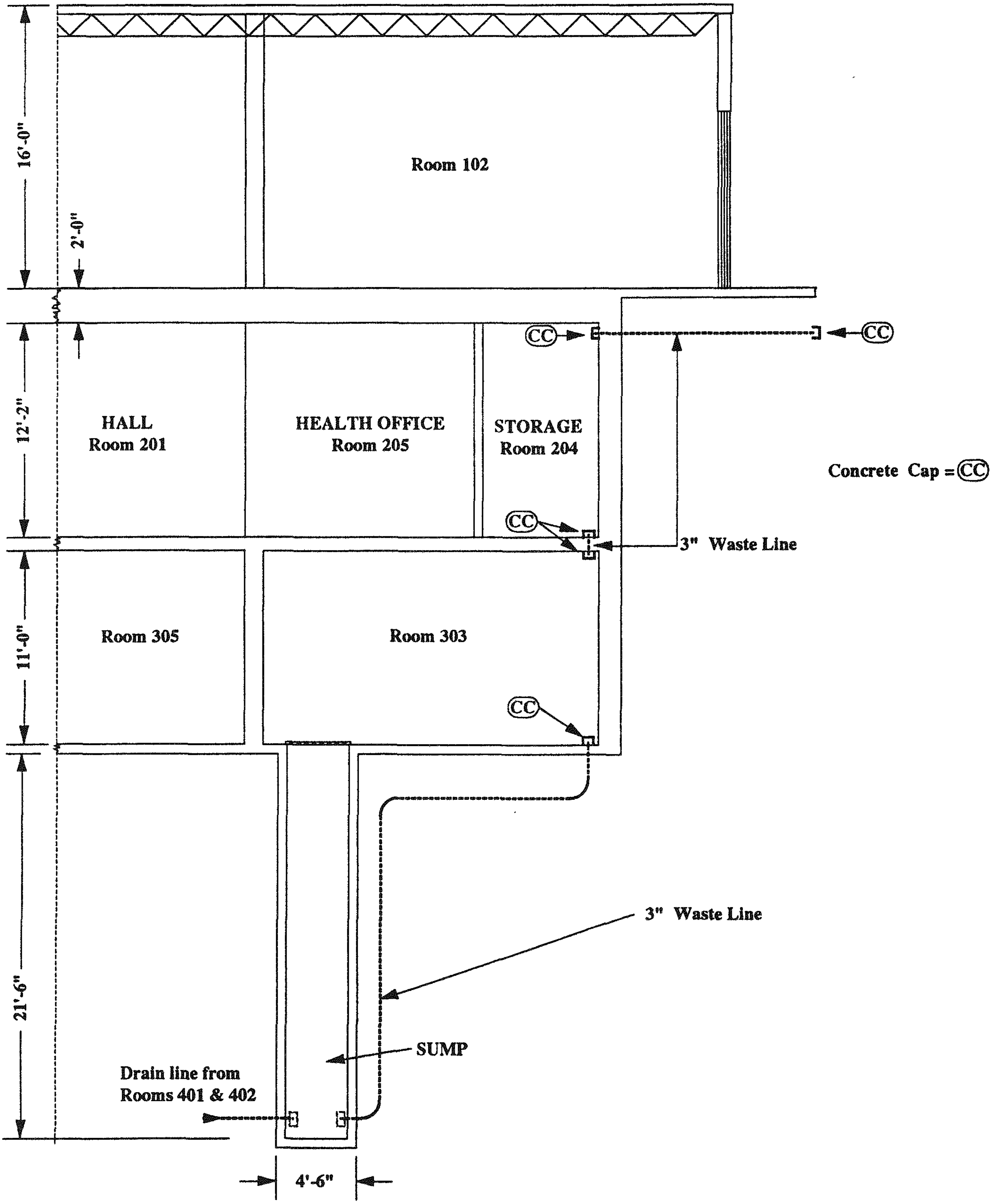


Fig. 13. Lines under UHTREX building and sump in Room 303.

4.4 Removing the Reactor Vessel

The reactor vessel, reactor heat exchanger, and recuperator were removed from Room 310. The primary loop system and part of the secondary loop system, cooling panels, and lead bricks lining the east and south walls also were removed. The fuel-loading rams, fuel-loading system, and a small fan were removed from Room 217. The reactor core indexing motor and some associated components were removed from Rooms 309 and 217.

Removing the Reactor, Heat Exchanger and Recuperator. This activity provided the greatest challenges.

Dismantling the reactor, heat exchanger, and recuperator posed the greatest potential for radioactive contamination and exposure to personnel. Background exposure rates in Room 310 (reactor and recuperator room) varied from 5 to 10 mR/h. The radiation field came from the activation of ^{60}Co in the reactor steel, magnetite concrete, and steel reinforcement in the concrete walls. The surface exposure rates at contact with the reactor vessel walls varied from 15 to 75 mR/h. Maximum surface exposure rates on the heat exchanger and heat recuperator were 43 mR/h and 19 mR/h, respectively. Loose external beta-gamma surface contamination was 100-2000 dpm/100 cm^2 in Room 310.

Metal samples were obtained from the reactor vessel wall and the metal wall liner adjacent to the vessel. Laboratory analysis of both samples showed ^{60}Co as the only significant activation product. The calculated total radioactivity of other radionuclides in the vessel was estimated to be

- 215 μCi ^{137}Cs,
- 2.2 Ci ^{60}Co,
- 7 mCi ^{14}C, and
- 1230 μCi ^{90}Sr/^{90}Y.

The analysis confirmed the initial classification of the vessel containing low specific activity for transportation.[10, 11] This classification allowed using the vessels themselves as transport containers, provided that all openings were sealed.

Vessel Preparation. Physical preparations consisted of removing all piping and auxiliary equipment attached to the vessels. The control rods, fuel-loading rams, reactor core indexing motor, and shaft were cut near the surface of the reactor with a band saw. Metal caps were then welded to the openings to seal the reactor, heat exchanger, and recuperator. When possible, the flanged connections were unbolted, and blind flanges were bolted on to seal the openings. When the vessel was installed, all large flanged connections had been sealed with welded C-section rings that were difficult to cut with saws. These rings were cut with an oxygen acetylene torch. Enclosures and local ventilation prevented spreading contamination during the cutting and burning operations.

A wood/plastic sheet enclosure was constructed over the reactor and recuperator connection before separation. This joint was unbolted, the C-ring cut, and the vessel separated enough to expose the internal carbon and graphite parts. A two-person handsaw was used cut the carbon material neatly. Heavy metal covers were bolted over the open flanges.

Precleaning the vessel surfaces brought loose surface contamination levels well below the transportation limits of 1000 dpm/100cm^2 beta-gamma and 20 dpm/100 cm^2 alpha.

Vessel Safety Documents. A separate internal standard operating procedure (SOP) was written and submitted for approval, according to procedures outlined in the *Environment, Safety, and Health Manual* (*ES&H Manual*), Chapter 1 of the Laboratory Manual. This SOP provided guidance on removal and transportation of the reactor, heat exchanger, and recuperator vessel.

The heat exchanger and recuperator were removed and transported as a unit to reduce time and occupational exposure. This composite unit was transported to TA-54 on a lowboy trailer pulled by a truck.

A traffic plan was written for transporting the reactor vessel. The SOP for transport operation was submitted to the Laboratory's Radioactive Materials Transport (RAM) officer for review and approval to transport the vessel.

Transportation Contract for the Reactor Vessel. The 110-ton vessel required special transportation methods. Personnel in the Facilities Engineering Division and various Health, Environmental, and Safety personnel provided the scope of work, safety requirements, schedules, and assistance in the bid preparation and evaluation. A bid of $129,000 was accepted for the transportation contract issued: removing the vessel from the reactor room and UHTREX facility, transporting the vessel from the UHTREX facility to the active disposal site (6.4 km or approximately 4 miles), and placing the reactor vessel into a disposal pit.

The contract was a Uniform Tender of Rates and/or Charges for Transportation Services, which is common to the commercial transportation system. This contract allowed a flexible timetable for the contractor to perform the work within specific time frames. This contract also shifted the burden to the contractor to visit the site and determine the method for performing the work.

Removing, Transporting, and Disposing of the Reactor Vessel. The moving contractor welded a circular lifting bracket on one side of the reactor vessel. This bracket and the protruding circular connection to the vessel/recuperator flange were lifting points. A lifting and rigging tower that could travel on tracks and with a lifting capacity of approximately 250 tons was erected. The vessel was lifted from Room 310 and then rotated 90° onto its side. The vessel was lowered and welded onto a prefabricated metal skid similar to a sled. The vessel on the skid was then pulled from the building through the 5 m x 5 m (16 ft x 16 ft) opening in the south wall of Room 106 (Fig. 14-15).

The rigging and lifting tower was then disassembled from inside the building and reassembled twice more to lift the vessel onto the transportation trailer and unload it at TA-54 (Fig. 16).

The roadway between TA-50 and TA-54 was closed for about an hour on Saturday, March 31, 1990, to transport the vessel. The closure eliminated potential road hazards and allowed personnel to work unhampered if a problem occurred. The vessel was transported without difficulty on a multi-tired Scheuerle platform trailer (Fig. 17). The trailer distributed the load to comply with AASHTO HS20 highway loading. Each axle on the trailer could be independently steered for sharp cornering. The trailer, or load platform, also adjusted itself to provide a continuous horizontal and level platform for the load. Maximum grade was approximately 4 percent (4 ft vertical per 100 ft horizontal) with one sharp turn into a side road. The trailer negotiated a reverse curve of approximately 30-ft radius.

The reactor vessel was unloaded at the entrance to the disposal pit. One tractor/bulldozer pulled the vessel on its skid and another tractor/bulldozer pushed it down the 4:1 (4 ft horizontal, 1 ft vertical) entrance ramp. The reactor was placed at the bottom of the pit and eventually was covered with approximately 7 m (23 ft) of soil. Its burial location as noted on the Laboratory's Radioactive Solid Waste Disposal form, RSWD 902546, is Pit 37, position north, between post markers 32 and 34 (Fig. 18).

4.5 Waste Disposal

All radioactively contaminated solid waste was buried at the Laboratory's active solid waste disposal site, TA-54. Each load was documented with a Radioactive Solid Waste Disposal (RSWD) form that indicates the load volume, weight, waste description, radionuclide contamination, and record of

Fig. 14. The reactor vessel after removal from Room 310.

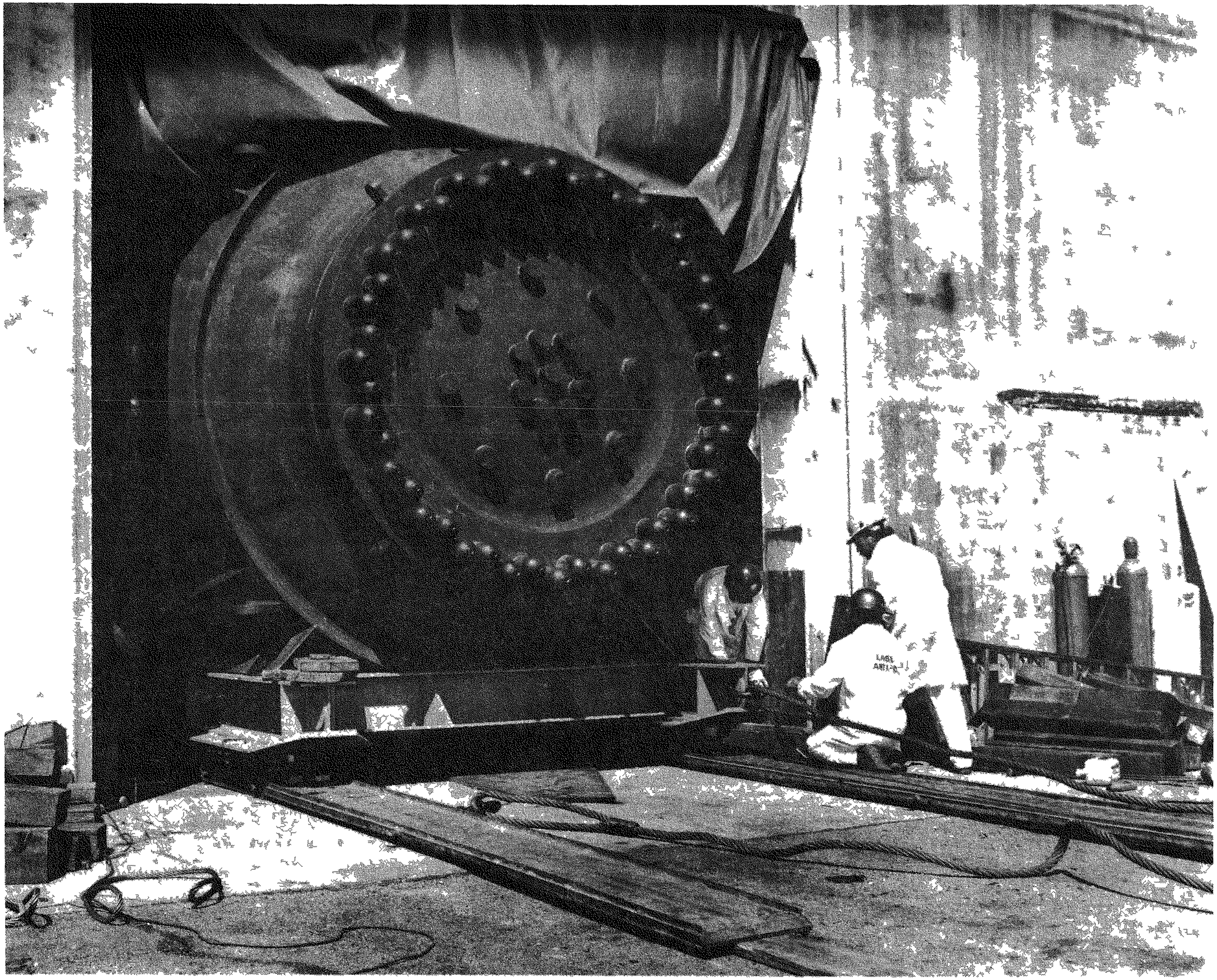


Fig. 15. Reactor vessel being removed from Room 106.

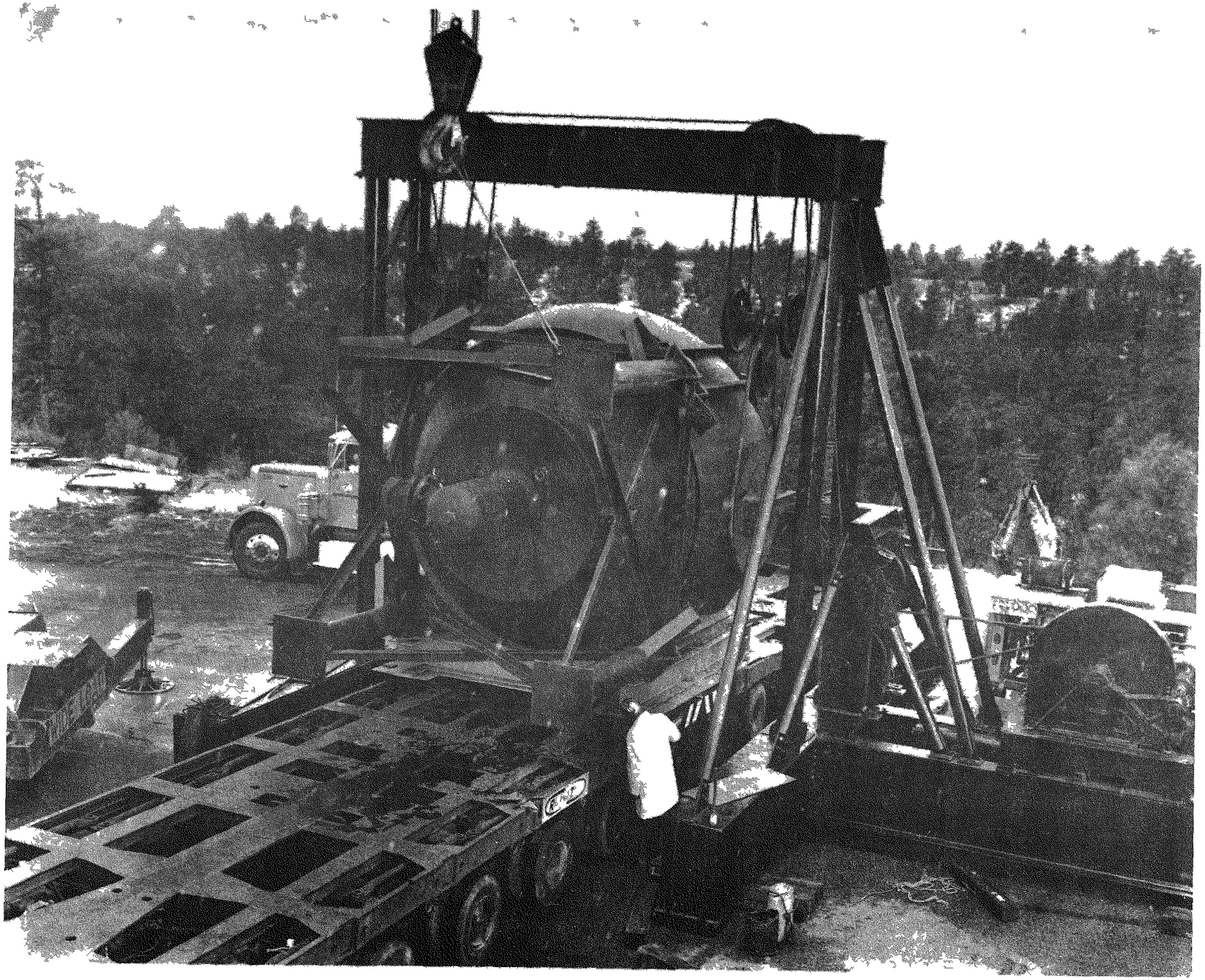


Fig. 16. Loading the reactor vessel.

Fig. 17. Reactor vessel traveling on the road.

Fig. 18. Final disposal location.

disposal. All waste was classified as Class A, defined in 10 CFR 61.55.

4.6 Transportation

Guidelines for the on-site transportation of radioactive waste were obtained from the Laboratory's *On-site Transportation Manual*[12] and the Laboratory's *Environment, Safety, and Health Manual.*[13] All waste was classified as LSA, low specific activity. Waste with specific activity less than 2 nCi/g was treated as contaminated and the same precautions were taken as for LSA amounts.

5.0 POST-DECOMMISSIONING RADIOLOGICAL SURVEY PROCEDURES AND RESULTS

5.1 Surface Monitoring

Surface residual radioactivity measurements for the final survey were taken on a grid layout, which typically fit the following criteria. Floor plans appear in Appendix D.

Rooms with known fixed or removable surface contamination

Grid: 1-m grid with measurements taken at the approximate center and at four other locations midway to the corners from the center of each grid block

Rooms: 105, 106, 212, 213, 216, 217, 307, 308, 309, 310, 401, 402, 403

Rooms with potential surface contamination but likely well below limits

Grid: 2-m grid at least one wall typical of surface most likely to have received contamination; at least five other random readings were taken on all other surfaces.

Rooms: 104, 107, 211, 214, 215, 303, 305, 306

Rooms with low potential for surface contamination:

Grid: No grid; documented μR meter surveys and large-area swipes.

Rooms: offices, utility rooms, mechanical and electrical equipment rooms unrelated to the reactor operation, and lunch rooms: 100, 101, 102, 103, 108, 109, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211A, 219, 221, 223, 225, 301, 302, 304, 311, 312, 313, 314, 315, 316, 317

Removable Surface Activity Measurements. The results of removable surface activity measurements appear in Table III. Removable radioactivity surveys were performed with standard swipes over a nominal 100 cm^2 area. Final survey swipes were taken at the center of each grid block. These swipes were analyzed by the Laboratory's Health Physics Analysis Laboratory (HPAL). Swipes from the final survey were counted for both alpha and beta-gamma activity. The approximate number of swipes taken in the final survey was 3800.

Fixed Beta-gamma Surface Measurements. Results of the fixed beta-gamma surveys appear in Table III. All locations met Table II guidelines except those described in the Exception Memo, Appendix C. Approximately 10,000 fixed radioactivity measurements were taken in the final survey for comparison with the residual radioactivity guidelines in Table II. Approximately 1600 person-hours of radiation protection technician (RPT) time went into the final survey. This total does not include the analysis effort by the analysis laboratory.

Instrumentation - Beta-gamma measurements of fixed surface activity were done with Eberline ESP-1 instruments and HP-260 Geiger-Müller pancake probes. The scalar capability of the ESP-1 permitted additional sensitivity by extended count times, one minute for the UHTREX measurements. The area of the HP-260 probe was 15 cm^2. Measurements were taken within 1 cm of the surface.

Calibration - These ESP-1 instruments were calibrated at least twice annually to yield 100% efficiency for the true surface emission rate from an NBS-traceable ^{36}Cl source; disintegrations per minute were converted to dpm/100 cm^2 by multiplying by 13.3, the ratio of 100 cm^2 standard area to 15 cm^2 probe area, times a factor of 2, which converts surface emission rate from a 2 pi measurement to a 4 pi measurement. Conversion yields dpm/100cm^2, which is compatible with the guideline unit for residual activity.

Source checks - Source checks were done at least once daily by taking 10-min. counts of a ^{90}Sr standard source; if the count agreed with reference counts within ±20%, the instrument was placed into service.

Background measurements - Background measurements varied somewhat with time of day because of cosmic ray activity and with location in the facility. Background was most affected by normal radioactivity constituents in cinder block walls, a common building material in the support portion of the building. Average background applied to ESP-1/HP-260 measurements was 144 dpm (SD 19 dpm); background ranged from 120 cpm to 223 dpm.

Table III. UHTREX Final Beta-gamma Survey Results.
A. Rooms occupied, not contaminated, and requiring no decontamination.

Location			Residual radioactivity			Area gamma (μR/h)		Remarks
			fixed (dpm/100 cm^2)		removable (dpm/100 cm^2)			
Room	Grid	Surface[1]	Max[2]	Avg[2]	Max[3]	Max	Avg	
100	None	FL	107	48	2	28	16	
100A	None	FL	83	36	7	28	19	
109	None	FL	119	48	7	5	<5	
109A	None	FL	95	36	7	10	<10	
200	None	FL	107	36	7	10	<10	
201A	None	FL	83	24	9	6	<6	
205	None	FL	72	54	4	22	14	
206	None	FL	119	48	7	10	<10	
207	None	FL	60	36	4	22	17	
208	None	FL	107	36	89	20	11	
208A	None	FL	95	60	12	12	<12	
209	None	FL	95	60	12	28	19	
211A	None	FL	95	60	9	4	<4	
215A	None	FL	72	60	39	6	<6	

Table III. UHTREX Final Beta-gamma Survey Results (cont).
A. Rooms occupied, not contaminated, and requiring no decontamination.

Location			Residual radioactivity			Area gamma (μR/h)		Remarks
			fixed (dpm/100 cm^2)		removable (dpm/100 cm^2)			
Room	Grid	Surface[1]	Max[2]	Avg[2]	Max[3]	Max	Avg	
219	None	FL	131	48	67	13	<13	
221	None	FL	131	36	2	15	<15	
223	None	FL	167	60	13	15	9	
225	None	FL	119	36	12	14	5	
301	None	FL	179	72	9	19	9	
302	None	FL	83	36	2	18	9	
302A	None	FL	119	72	7	6	<6	
304	None	FL	143	36	29	10	<10	
311	None	FL	238	119	7	22	18	
312	None	FL	95	36	7	18	12	
313	None	FL	119	36	9	22	11	
314	None	FL	119	60	7	22	15	
315	None	FL	119	60	82	20	14	
316	None	FL	119	60	7	18	13	
317	None	FL	143	83	7	11	10	

Table III. UHTREX Final Beta-gamma Survey Results.
B. Rooms occupied, no known contamination; D&D of reactor related systems

Location			Residual radioactivity			Area gamma (μR/h)		Remarks
			fixed (dpm/100 cm^2)		removable (dpm/100 cm^2)			
Room	Grid	Surface[1]	Max[2]	Avg[2]	Max[3]	Max	Avg	
101	None	FL	131	60	18	20	7	
102	None	FL	143	48	2	20	7	
103	None	FL	143	60	7	20	8	
107	None	FL	119	60	7	28	17	
108	None	FL	83	36	2	20	11	
201	None	FL	143	36	*	14	<14	*Data not available
202	None	FL	119	48	*	10	<10	*Data not available
203	None	FL	119	36	*	18	7	*Data not available
204	None	FL	107	36	*	22	16	*Data not available
210	None	FL	48	36	7	25	18	
214	None	FL	107	60	13	22	6	

Table III. UHTREX Final Beta-gamma Survey Results (cont).
B. Rooms occupied, no known contamination; D&D of reactor related systems

Location			Residual radioactivity			Area gamma (μR/h)		Remarks
			fixed (dpm/100 cm^2)		removable (dpm/100 cm^2)			
Room	Grid[6]	Surface[1]	Max[2]	Avg[2]	Max[3]	Max	Avg	
104	2m	FL	665	<665	37	10	<10	
104	2m	EW	851	<851	*	8	<8	*Data not available
211	2m	FL	1184	818	17	6	<6	
211	2m	EW	186	<186	*	4	<4	*Data not available
215	2m	FL	705	<705	12	5	<5	
215	2m	EW	359	<359	4	18	<18	
303	2m	FL	545	<545	9	2	<2	
303	2m	EW	359	<359	7	4	<4	
303	2m	SW	399	<399	4	4	<4	
305	2m	FL	998	80	15	15	3	
305	2m	EW	865	239	7	20	15	
306	2m	FL	665	<665	9	4	<4	
306	2m	SW	612	<612	14	4	<4	
306A	none	FL	155	60	24	22	9	See note 2.

Table III. UHTREX Final Beta-gamma Survey Results.
C. Rooms decontaminated and decommissioned because of direct radiation and surface contamination.

Location			Residual radioactivity			Area gamma ($\mu R/h$)		Remarks
			fixed (dpm/100 cm^2)		removable (dpm/100 cm^2)			
Room	Grid[6]	Surface[1]	Max	Avg	Max	Max	Avg	
105	2m	FL	1357	718	15	5	1	
105	2m	WW	3086	2774	5	10	8	See note 7.
106	1m	SW	732	<732	297	20	<20	
106	1m	FL	1623	800	255	5	<5	
106	2m	CL	372	<372	10	12	<12	
106	2m	EW	NDA[8]	NDA[8]	39	8	<8	
106	2m	WW	652	200	47	8	<8	
106	2m	NW	1566	NDA[8]	7	10	<10	
212	1m	CL	NDA[8]	NDA[8]	18	10	<20	See note 4.
212	1m	FL	133	<133	19	9	<20	See note 4.
212	1m	NW	NDA[8]	NDA[8]	10	8	<20	See note 4.
212	1m	WW	NDA[8]	NDA[8]	9	20	<20	See note 4.
212	1m	SW	NDA[8]	NDA[8]	7	12	<20	See note 4.
212	1m	EW	NDA[8]	NDA[8]	4	15	<20	See note 4.

Table III. UHTREX Final Beta-gamma Survey Results (cont).
C. Rooms decontaminated and decommissioned because of direct radiation and surface contamination (cont).

Location			Residual radioactivity			Area gamma (μR/h)		Remarks
			fixed (dpm/100 cm^2)		removable (dpm/100 cm^2)			
Room	Grid[6]	Surface[1]	Max	Avg	Max	Max	Avg	
212 213	1m 1m	west window	2700	2431	0	20	<20	High reading on lead glass window
213	1m	CL	NDA[8]	NDA[8]	18	10	<10	See note 4.
213	1m	FL	NDA[8]	NDA[8]	19	9	<9	See note 4.
213	1m	NW	NDA[8]	NDA[8]	13	9	<9	See note 4.
213	1m	WW	NDA[8]	NDA[8]	9	20	10	See note 4.
213	1m	SW	NDA[8]	NDA[8]	7	7	<7	See note 4.
213	1m	EW	NDA[8]	NDA[8]	4	18	11	See note 4.
216	2m	FL	330	92	64	10	<10	See note 5.
216	2m	NW	330	95	28	10	<10	See note 5.
216	2m	EW	330	133	38	10	<10	See note 5.
216	2m	SW	330	<330	19	10	<10	See note 5.
216	2m	WW	330	74	25	10	<10	See note 5.
217	1m	CL	971	<970	10	14	<20	See note 4.
217	1m	FL	958	<960	10	28	<20	See note 4.

Table III. UHTREX Final Beta-gamma Survey Results (cont).
C. Rooms decontaminated and decommissioned because of direct radiation and surface contamination (cont).

Location			Residual radioactivity			Area gamma (μR/h)		Remarks
			fixed (dpm/100 cm^2)		removable (dpm/100 cm^2)			
Room	Grid[6]	Surface[1]	Max	Avg	Max	Max	Avg	
217	1m	NW	625	<625	10	14	<14	See note 4.
217	1m	WW	333	<333	10	16	<16	See note 4.
217	1m	SW	386	<386	28	8	<8	
217	None	NE corner duct	NDA[8]	NDA[8]	0	20	<20	Metal cap on duct going to Rm 402
217	None	SW corner duct	NDA[8]	NDA[8]	10	16	13	Metal cap on duct going to Rm 402
217	None	EW	891	<891	28	8	1	Metal plate cover between opening to Rm 310

Table III. UHTREX Final Beta-gamma Survey Results (cont).
C. Rooms decontaminated and decommissioned because of direct radiation and surface contamination (cont).

Location			Residual radioactivity			Area gamma (μR/h)		Remarks
			fixed (dpm/100 cm^2)		removable (dpm/100 cm^2)			
Room	Grid[6]	Surface[1]	Max	Avg	Max	Max	Avg	
217	1m	EW	27	<27	10	18	12	
307	1m	CL	1131	468	32	20	15	
307	1m	FL	1667	142	32	20	17	
307	1m	NW	492	<492	13	22	17	
307	1m	WW	559	<559	*	20	15	*Data not available
307	1m	SW	NDA[8]	NDA[8]	27	14	<14	
307	1m	EW	718	13	50	20	15	
308	2m	FL	250	<250	266	<30	<20	See note 5.
308	2m	NW	250	<250	10	<30	<20	See note 5.
308	2m	EW	250	<250	17	<30	<20	See note 5.
308	2m	SW	250	<250	179	<30	<20	See note 5.
308	2m	WW	166	<166	36	<30	<20	See note 5.
309	1m	CL	359	<359	10	16	<16	
309	1m	FL	984	559	10	12	<12	
309	1m	NW	NDA[8]	NDA[8]	10	2	<2	

Table III. UHTREX Final Beta-gamma Survey Results (cont).
C. Rooms decontaminated and decommissioned because of direct radiation and surface contamination (cont).

Location			Residual radioactivity			Area gamma (μR/h)		Remarks
			fixed (dpm/100 cm^2)		removable (dpm/100 cm^2)			
Room	Grid[6]	Surface[1]	Max	Avg	Max	Max	Avg	
309	1m	WW	612	<612	10	14	<14	
309	1m	SW	638	<638	10	14	<14	
309	1m	EW	NDA[8]	NDA[8]	10	2	<2	
310	1m	FL	*	*	18	*	*	*See Appendixes B and C.
310	1m	WL	*	*	7	*	*	
310	none	CL	*	*	4	*	*	
310	none	NW	*	*	14	*	*	
310	none	EW	*	*	14	*	*	
310	none	SW	*	*	5	*	*	
401	1m	CL	599	<599	42	20	15	
401	1m	FL	2248	171	10	22	15	
401	1m	NW	1769	814	10	22	18	
401	1m	WW	638	<640	89	20	17	
401	1m	SW	466	<470	59	18	<18	

Table III. **UHTREX Final Beta-gamma Survey Results (cont).**
C. **Rooms decontaminated and decommissioned because of direct radiation and surface contamination (cont).**

Location			**Residual radioactivity**			**Area gamma (μR/h)**		**Remarks**
			fixed (dpm/100 cm^2)		**removable (dpm/100 cm^2)**			
Room	Grid[6]	Surface[1]	Max	Avg	Max	Max	Avg	
401	1m	EW	1330	769	10	<20	<20	
401	none	Duct EW	NDA[8]	NDA[8]	NDA	<20	<20	Metal cap
401	none	FL Drain	NDA[8]	NDA[8]	NDA	<20	<20	Concrete cap over drain
402	none	CL/duct	NDA[8]	NDA[8]	NDA	<20	<20	Metal cap on duct to Rm 217
402	none	SW/duct	NDA[8]	NDA[8]	NDA	<20	<20	Metal cap on duct to Rm 212
402	none	FL drain	NDA[8]	NDA[8]	NDA	<20	<20	Concrete cap over drain
402	none	FL drain	NDA[8]	NDA[8]	NDA	<20	<20	
402	none	CL	970	<970	NDA	<20	<20	Metal over opening to Room 310 east side
403	none	FL Drain	NDA[8]	NDA[8]	NDA	<20	<20	Concrete cap over drain

Table III. UHTREX Final Beta-gamma Survey Results (cont).
C. Rooms decontaminated and decommissioned because of direct radiation and surface contamination (cont).

Location			**Residual radioactivity**			**Area gamma (μR/h)**		**Remarks**
			fixed (dpm/100 cm^2)		**removable (dpm/100 cm^2)**			
Room	Grid[6]	Surface[1]	Max	Ave	Max	Max	Avg	μR readings incl. background
402	1m	CL	387	<387	142	25	<20	μR readings incl. background
402	1m	FL	1051	104	27	15	<20	μR readings incl. background
402	1m	NW	173	<173	10	15	<20	μR readings incl. background
402	1m	WW	48	<48	10	20	<20	μR readings incl. background
402	1m	SW	1133	255	160	20	<20	μR readings incl. background
402	1m	EW	1144	570	39	10	<20	μR readings incl. background
403	2	CL	133	<133	14	*	*	*Data not available
403	2	FL	306	<306	19	21	18	*Data not available
403	2	NW	306	<306	9	21	17	*Data not available
403	2	WW	27	<27	19	21	17	*Data not available
403	2	SW	333	<333	49	19	17	
403	2	EW	505	<505	34	21	17	

Table III. UHTREX Final Beta-gamma Survey Results.
D. Filter pit survey.

Location			**Residual radioactivity**			**Area gamma ($\mu R/h$)**		**Remarks**
			fixed (dpm/100 cm^2)		**removable (dpm/100 cm^2)**			
Pit	Grid[6]	Surface[1]	Max	Avg	Max[3]	Max	Avg	
Pit	1m	FL	*	*	NDA	NDA	NDA	Background was 60 $\mu R/h$; *Data not available
Pit	1m	NW	692	58	NDA	NDA	NDA	reading was taken outside
Pit	1m	EW	640	<640	NDA	NDA	NDA	with no overhead shielding
Pit	1m	SW	1013	290	NDA	NDA	NDA	
Pit	1m	WW	1010	645	NDA	NDA	NDA	

Notes

[1] FL = Floor; EW = east wall; SW = south wall; WW = west wall; NW = north wall; CL = ceiling

[2] Beta floor scan using large area beta floor monitor, background included.

[3] Removable beta survey (in dpm) by large area (>>100 cm^2) random swipes

[4] μR reading includes background. Low readings are due to background reduction by heavy shielding.

[5] Maximums and averages of fixed radioactivity measurements in Rooms 216 and 308 were derived by comparing data from Ludlum Model 14 (15 cm^2 pancake probe) and the ESP-1/HP-260 standard instrument used later in remaining rooms; Ludlum Model 14 data required a correction factor of 1.25.

[6] Survey extended 2 m up walls on 2-m grid survey; 1-m grid extended up to ceiling.

[7] Cinder block wall was removed. High background readings are due to the radon content in the pumice.

[8] No detectable activity (NDA) above background. Background in the room may vary from 500 to 1000 dpm/100 cm^2.

Fixed Alpha Surface Measurements. Fixed alpha activity was not routinely measured because above-background readings were seldom detected in preliminary surveys. Alpha activity was measured routinely by counting all swipe samples for alpha activity. Because the alpha activity was insignificant, the data were not included in this report. Alpha emitters fixed on surfaces were measured with the Eberline ESP-1 and AC 3-7 probe. The verification surveys performed by Oak Ridge Associated Universities confirmed the absence of alpha contamination.

Area Gamma Radiation Measurements. Gamma radiation measurements were taken on approximately the same grid system as the fixed readings but at 5-6 cm distance from the surface. Results of these measurements appear in Table III. Room 310 contained readings obviously above the 20 μR above-background limit and are addressed in the Exception Memo (Appendix C). Several readings were marginally above the limit but were believed to result from natural background fluctuations, not from contamination that could be addressed with further cleaning.

Instrumentation - The μR meter measurements were taken with the Ludlum 12S or 19S gamma scintillation detector. Where gamma radiation levels exceeded the range of the μR meter, such as in Room 310, an Eberline R03 pressurized ionization chamber detector was used. See also Appendix B DOE Exception Approval Memo.

Calibration - The Ludlum μR meters were calibrated against a ^{226}Ra source. Later comparison with ^{60}Co and ^{137}Cs sources indicated the μR meter readings were approximately 50% of what they should have been for ^{60}Co; for ^{137}Cs, 81%. All μR meter readings above background were adjusted for these differences and were doubled before comparing with the 20-μR limit.

Background - Meter readings for μR in uncontaminated areas ranged from 16 to 26 μR/h. An average background of 20 μR/h was applied to μR meter readings. Comparison measurements from other facilities were consistent with these values. Some variation in background with location and time of day was noted.

5.2 Soil Sampling

Soil samples of approximately 70 g for alpha and beta and 500 g for gamma were taken at 6-m (20-ft) intervals along the route of Lines 65 and 66. These samples were generally taken from the bottom of the excavation; the samples were designated surface samples if they were taken in the top 1.5 m (5 ft) of soil and subsurface if they were taken deeper than 1.5 m.

Soil monitoring results - Appendix F shows the locations of the 173 soil samples taken along Line 65 (between RD-2 and TA-50-3) that were removed by excavation with a backhoe. Depth of the excavations ranged from 1.5 m to 2 m.

Analyses were performed at the laboratory at HSE-8, Environmental Protection, according to procedures described in "The HSE-8 Plan for Environmental Sampling."[14] Average and maximum results among the 173 samples taken were as follows:

	Average (SD) (pCi/g)	**Maximum (pCi/g)**
Gross alpha	10 (24)	125
Gross beta	-10 (28)	182
Gross gamma	0.57 (0.28)	3.0

Tritium in Soil. No unusual concentration of tritium was found in the soil excavated for removal of Line 66 or under structures RD-2, RD-14, or RD-15. Five soil samples from the Line 65 route were randomly selected for tritium analysis. One of these samples had a higher reading: 42,000 pCi per liter of soil moisture, compared with the average of the four other samples, 15,000 pCi/l. Although this reading appears to be significantly above the 2600 pCi/l ±2300 background, the *de minimus* level given by HSE-8 for soil cleanup is 100,000 pCi/l soil moisture. The National Drinking Water Standard for tritium is 20,000 pCi per liter. Because it is unlikely that UHTREX operations contributed to the tritium concentration at that location, further investigation or soil removal was considered unwarranted.

Alpha Emitters in Soil. Alpha-emitter concentrations in soil above background and above the 25 pCi/g *de minimus* cleanup concentration were found at several locations along Line 65 between Building RD-2 and the Liquid Waste Treatment Site at TA-50. Background concentrations are 0.007 pCi/g average for ^{239}Pu, ^{240}Pu and 2.6 $\mu g/g$ for total uranium.[15] Although alpha spectrometry of soil samples from these areas was not performed (these samples were disposed of early, as described in Section 9.0), regardless of which alpha emitter contributed the activity, the lowest site-specific residual activity guideline (267 pCi/g) for alpha emitters (^{238}Pu, ^{239}Pu, ^{235}U, and others) developed by RESRAD modeling was not exceeded. See also the RESRAD results in Appendix A. The maximum among the 12 samples above 25 pCi/g among 173 total samples was 126 pCi/g; the average was 67 pCi/g.

Alpha-counting of soil samples taken at the sites of external facilities showed no activity above the residual radioactivity guidelines.

Beta-gamma Emitters in Soils. The 173 soil samples were also analyzed for gross beta and gross gamma emitters. None of gamma-screening counts detected any gamma emitters that exceeded the lowest of the guidelines in Subsection 3.3. Only three samples exceeded 1.0 pCi/g gamma emitter; the maximum was 3.0 pCi/g. The sensitivity of the counting method was adequate to detect the ^{137}Cs x-ray well below its guideline. Beta screening showed none of the 173 samples exceeded the guidelines. Of these, the maximum activity was 183 pCi/g. The sensitivity of the counting method was adequate to detect the ^{90}Sr beta well below its guideline. Beta and gamma screening of soil samples at external facilities showed no samples exceeding the guidelines.

6.0 HAZARDOUS CHEMICAL CONDITIONS AFTER DECOMMISSIONING

Soil samples were also analyzed for toxic chemicals on the Hazardous Substances List (HSL) of the Environmental Protection Agency (EPA). These analyses were done with the cooperation of the Environmental Restoration (ER) program and its subcontractor, Weston, Inc. Samples were collected from a background area and from three sites along Line 66. The background area was located immediately east of the abandoned TA-5, which is approximately 2.4 km (1.5 mi.) east of TA-52, RD-1.

The analyses for metals found several metals--Ba, Cr, Mg, Ni, V, and Zn--were above background at the waste line locations, especially near RD-2. However, all but vanadium were found to be within the range of background found at other Los Alamos areas by non-UHTREX sampling programs. The concentrations of vanadium were considered common to this area and not high enough to be a cause for any remedial action. In any case, there is no reason to suspect that the above-background concentrations were related in any way to operations at the UHTREX facility.

The analyses for organics found that all but four of the HSL organics were undetectable or detectable but unquantifiable at all stations. Tetrachloroethene was quantifiable (5 ppb by weight) at the background station. Di-n-butylphthalate was quantifiable at all locations but was also found in the analytical blank; levels in the UHTREX samples ranged from 360 to 910 ppb above the blank levels, with the higher levels being found along the Line 65 route. Methlylene chloride (16 ppb maximum) and acetone (13 ppb maximum) were also quantifiable.

These quantities were all considered low and indicated that toxic chemical contamination did not need to be addressed by the UHTREX D&D project.

7.0 COST AND SCHEDULES

Budgeted costs of work scheduled, actual cost of work scheduled, and budgeted costs of work performed methods and formulation are summarized below. Project totals are noted in Fig. 19 and Appendix E. Waste disposal costs are noticeably missing from the major cost elements. The project was fortunate to be billed only for the pit space required by waste management operations. The costs associated with packaging and transportation of the wastes were considered part of the dismantling costs.

7.1 Tracking Methods

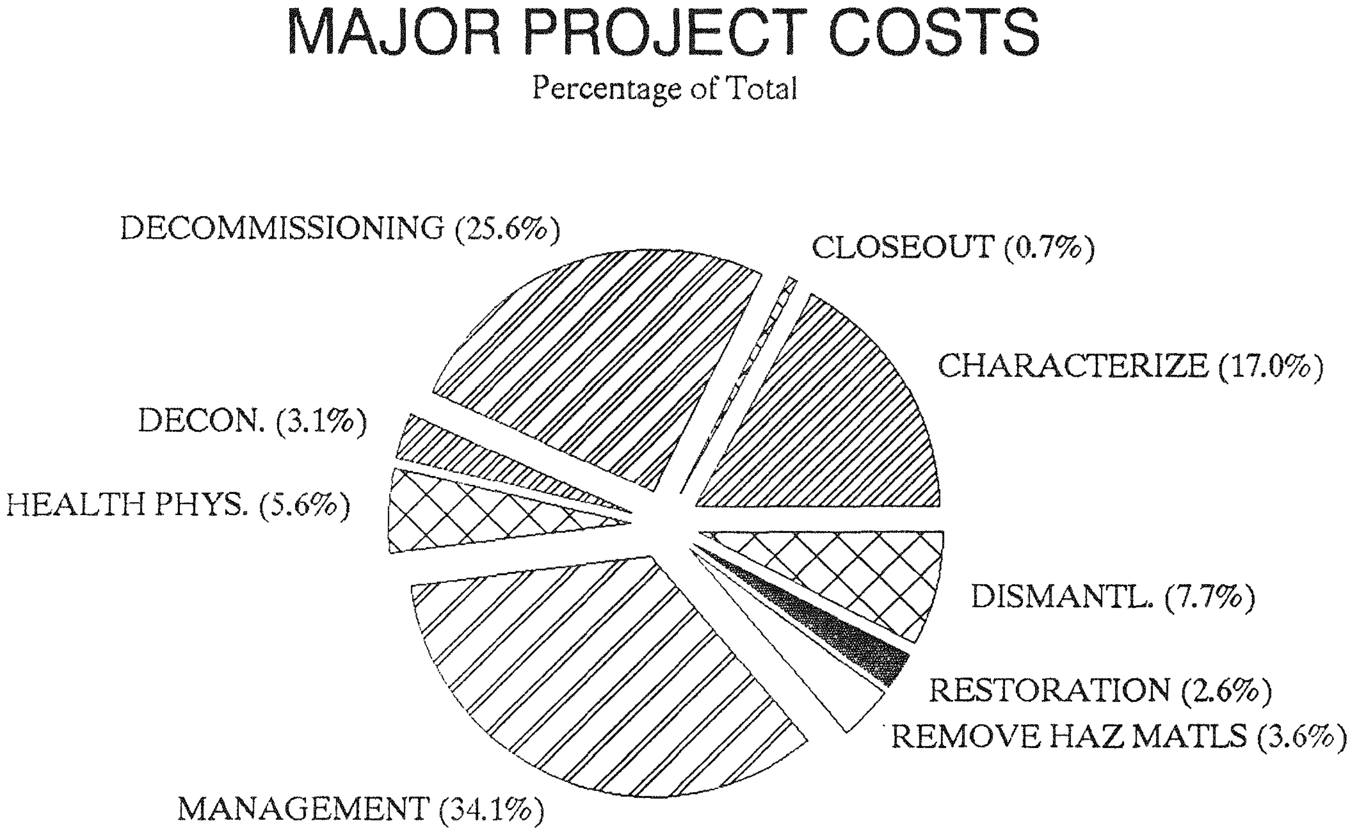
Budgeted Costs. Estimated cost for each work breakdown structure (WBS) was determined at the beginning of the project. Each WBS element described a block of work that would be performed and was reported (Appendix E).

These estimated costs and schedule reflected the budgeted cost of work scheduled (BCWS). This information was input to the Lotus spreadsheet software program to generate the baseline.

Actual Costs. Actual cost of work performed (ACWP) was tracked by several systems. Laboratory charges were recorded by the Laboratory's accounting group and reports submitted once a month. The D&D subcontractor, Johnson Controls, had its own internal accounting section that reports personnel cost on a weekly report and a monthly report that included personnel, materials, and equipment. From these two monthly reports, the data were input to Lotus. Another method of tracking the actual cost is described below in "Computer Tracking Methods."

Work Performed Costs (Earned Value). - Budgeted costs of work performed (BCWP) represent the value attached to the work performed. This value was obtained by estimating the actual physical work completed and attaching a percentage to that work. If 50% of the line was removed, then 50% of the budgeted cost for line removal was used as the BCWP. For a WBS that included several rooms, the physical work completed per room was estimated and then the BCWP per room was rolled up to determine the total BCWP for that WBS element reported. The method to determine the physical work completed required a subjective estimate and agreement between the Laboratory and the contractor management teams. This value was within ±5%.

Cost and Schedule Variances. BCWSs for the project life were determined before beginning work. BCWP and ACWP were determined monthly and input to the computer program. Cost and schedule variances were reported monthly and explanations noted when the variance exceeded 10%, either



Dismantlement is removal of outside structures.
Decommissioning includes inside removal work.

Fig. 19. Major project costs.

favorable or unfavorable. The program then automatically determined the cost and schedule variance.

$$\%\ \text{schedule variance} = \frac{(\text{BCWP} - \text{BCWS})}{\text{BCWS}} \bullet 100$$

$$\%\ \text{cost variance} = \frac{(\text{BCWP} - \text{ACWP})}{\text{BCWP}} \bullet 100$$

Variances for the month and for the project as a whole were tracked.

Computer Tracking Methods. Viewpoint (VP) software used on construction projects established the project baseline and generated critical-path diagrams. This program helped optimize the workforce and work schedules.

Hourly wages, equipment costs, etc., can be input. However, because these costs are not fixed but may vary within a craft, the monthly VP report can give only an approximation of the true cost. Laboratory and Johnson Controls accounting reports reconciled differences.

After months of use, this method of determining BCWP was found to be too difficult to use. A full-time person was required to adequately track the input data and reconcile planned work schedule from actual work schedules. The contractor could not provide adequate support. The Laboratory project manager did not feel justified in continued use of the system.

8.0 WASTE VOLUMES, WEIGHTS, AND CURIES

8.1 Radiological Waste

All of the UHTREX radioactive waste was determined to be Class A waste for burial purposes or to contain LSA quantities for transportation purposes. Table IV summarizes quantities transported to the disposal area at TA-54.

Table IV. Summary of Contaminated Waste.

Calendar year	Volume		Curies
	m^3	ft^3	
1988	230	8,121	0.96
1989	378	13,347	2.2
1990	171	6,038	6.1

Historical data, assays of samples, and field measurement were used to determine the waste classification. Radionuclides present included ^{60}Co, ^{137}Cs, ^{90}Sr, ^{235}U, ^{241}Am, and ^{152}Eu. The U, Am, and Eu were found in very small quantities inside the reactor and primary loop.[16]

8.2 Hazardous Waste

One uncontaminated lead shield block enclosed in a steel liner and approximately 200 ml of uncontaminated mercury from thermostats and pressure switches, in glass vials, were sent to the Laboratory's hazardous waste storage facility at TA-54.

8.3 Mixed Waste

Approximately 1.8 metric tons (2 tons) of lead bricks, lead shot, lead wool, and odd-shaped lead and steel containers contaminated mainly with ^{137}Cs and ^{60}Co were sent to the mixed waste storage facility at TA-54 for future disposal. Volumes and contaminants were documented on the Laboratory's Radioactive Solid Waste Disposal (RSWD) Form.

8.4 Sanitary Landfill Waste.

Approximately 25 m^3 (883 ft^3) of clean waste was sent to the sanitary landfill for burial, including construction debris and unsalvageable items from the building. This waste was surveyed to ensure that it was free of contamination.

8.5 Salvage Material

Approximately 8.2 metric tons (9 tons) of clean lead bricks of assorted sizes, lead wool, and lead shot were sent to the Johnson Controls salvage center for resale. The lead was surveyed and swipes taken to verify that it was not contaminated. Items salvaged included electronic equipment, metal cabinets, and miscellaneous metals. Property transfer forms documented the surveys and transfer.

8.6 Recycled Material

Approximately 38 metric tons (42 tons) of clean bricks were recycled within the Laboratory. Most of the lead was transferred to TA-53 Meson Physics for use in a radiological controlled area. Property transfer forms documented the surveys and transfer.

9.0 HEALTH, SAFETY, AND ENVIRONMENTAL REQUIREMENTS

9.1 Occupational Exposure

Personnel Monitoring. Personnel monitoring was addressed by continuous assignment of one or more radiation protection technicians (RPTs) to the D&D activities at UHTREX. When such an assignment to each of several work locations was not possible, personnel monitoring was provided at a level in proportion to the potential for contamination spread. Self-monitoring was used when the potential for contamination spreading was low.

Personnel monitoring was done with portable GM survey meters or ionization chambers. All personnel assigned to the project wore thermoluminescent dosimeter badges, which were returned monthly to the Radiation Protection Group for evaluation. Self-reading dosimeters were used to keep exposures as low as reasonably achievable (ALARA) in areas of higher direct radiation, such as Room 310, when large components were removed.

The results of occupational dosimetry measurements appear in Table V. The maximum total body dose was 0.85 rem to a laborer accumulated over the 24-month term of D&D operations at UHTREX. The average dose was 0.49 rem to seven regular crew members. This average excludes the RPT, who received 0.24 rem total, and other workers, such as riggers, who participated only occasionally. Integrated exposure of all crew members over the 24 months of active D&D work was 4.99 person-rem. No worker received more than the 1 rem/y ALARA goal established for the project.

9.2 Airborne Activity Monitoring

Potential airborne releases in work areas were monitored by fixed continuous beta-gamma air monitors (CAMs) in Rooms 106 and Room 310. A fixed-filter sampler (giraffe) with an air pump was run routinely near work locations and the filter counted at the end of the day to check for releases.

The stack was monitored with a 0.057-m^3/min. (2-cfm) fixed-filter sampler that was analyzed each week for beta-gamma and alpha emitters. No releases of radioactivity above normal background occurred.

9.3 Environmental Compliance

Strict segregation, packaging, and transportation of waste were adhered to provide proper waste management. All loads were checked for radiological contamination with field instruments, swipes, or both. Hazardous material was identified by previous surveys or, occasionally, additional laboratory analysis. All waste liquids generated were collected in steel drums, sampled and analyzed for gross alpha and gross beta/gamma activity, and sent to the radioactive liquid treatment plant or the sanitary treatment plant. Radioactive contaminated solid waste was documented on a Solid Radioactive Waste Disposal form and a Radioactive Materials Transfer Tag. Material sent to Johnson Controls salvage was documented with an Equipment/Material Pickup/Transfer form. Recycled waste to other Laboratory groups was documented with the Property Transfer Slip. All

Table V. UHTREX Dose Records (Whole Body Exposures in Rem), July 1989 to September 1990.

Craft	Contractor	Cumulative rem
teamster	rigging and transportation	0.10
iron worker	rigging and transportation	0.07
superintendent	rigging and transportation	0.11
superintendent	rigging and transportation	0.03
ironworker[a]	rigging and transportation	0.41
ironworker	rigging and transportation	0.27
ironworker	rigging and transportation	0.03
operator	rigging and transportation	0.00
oiler	rigging and transportation	0.03
laborer	in-house maintenance	0.06
laborer	in-house maintenance	0.85
laborer	in-house maintenance	0.80
laborer	in-house maintenance	0.10
laborer	in-house maintenance	0.14
laborer	in-house maintenance	0.45
laborer	in-house maintenance	0.56
laborer	in-house maintenance	0.01
operator	in-house maintenance	0.08
ironworker	in-house maintenance	0.64
office	in-house maintenance	0.01
radiation protection technician (RPT)	LANL	0.24
TOTAL		**4.99**

Rigging and transportation contract personnel worked two months to rig, lift, and transport the reactor vessel.

[a] Certified welder who welded lifting devices and skid plate to the reactor vessel. Radiation dose rate 1 m from the reactor surface varied from 3 mR/h to 10 mR/h. Surface dose rate varied from 25 mR/h to 75 mR/h.

transportation of hazardous and mixed waste was documented on a Hazardous Materials On-Site Transfer form.

10.0 FINAL FACILITY OR SITE CONDITION

10.1 Facility Systems

Heating and Ventilating. The heating and ventilation system was left in place to serve the inhabited portion of the building. The stack was replaced with a new exhaust duct. The exhaust ventilation system for the secondary confinement area was completely removed.

Lighting. Most of the light fixtures in the contaminated areas were removed. Some lighting was left to assist entry to the rooms in the secondary confinement boundary. No other changes was made.

Fire Protection. The exit signs and emergency lights were maintained and left operable. Some portable emergency lights were placed in Room 307 and 402. No change was made to any of the heat detectors.

Utilities. Electrical breakers in panels that served equipment were removed, closed off, and labeled as spares. No change was made to the water system or sanitary system.

10.2 Configuration Control Board

A Configuration Control Board (CCB) was established to review cost underruns or overruns and changes in the scope of work (Appendix G). CCB reviewed and approved variances in cost and schedule at Level 2 in the project. The SFMP required additional review and approval for changes to the cost and schedule baseline and the project management plan. Membership of the board included the following: the Laboratory Construction Project Manager, the Laboratory Health Physics Representative, the Laboratory Program Manager, and DOE/LAAO Construction Project Manager.

Approved submittals for technical changes to the board are summarized below.

> Change Proposal 1: Abandon the heat dump tunnel in place after verifying that it meets criteria in Table I. Underrun $11,000.
>
> Change Proposal 2: Change to increase the funding of WBS 1.4.6 (Remove Reactor Auxiliary Systems) to accomplish additional work as follows: clean up unknown mercury contamination present in Room 106, drain liquid from gas cleanup vessels in Room 308, fabricate and install flanges in various rooms, remove

piping in Room 308, upgrade paging system, and provide support to HPT. Overrun $47,396.

Change Proposal 3: Change to increase the funding of WBS 1.4.6 (Remove Reactor Auxiliary Systems) to accomplish additional work as follows: fabricate and install guard rails and hand rails in addition to those planned, remove extra wiring and piping in Rooms 401 and 402, decontaminate Room 403, drain water in electrical conduit, remove lead shot in Room 307, prepare for DOE inspection, perform subbasement work that took twice the effort. Overrun $57,637.

Change Proposal 4: Change to increase the funding of WBS 1.4.3 (Remove Hazardous Materials) to accomplish additional work. The work included removing the liner and lead bricks in Rooms 310 and 402. Overrun $79,463.

Change Proposal 5: Change to increase the funding of WBS 1.4.8 (Construction Support) to extend the work activity period by two months, August and September 1990. Overrun $35,000.

Change Proposal 6: Increase the funding of WBS 1.1 (Project Support) to extend work activity period by three months, July, August, and September 1990. Overrun $75,000.

Change Proposal 7: Increase the funding of WBS 1.3 (Decontamination) for additional decontamination work. Overrun $30,000.

10.3 Supplemental Guidelines/Exceptions

The Laboratory requested an Exception (Appendix B) for the reactor-recuperator room (Room 310); the ducts from Room 217 to Room 402; the duct from Room 401 to the filter pit; and the floor drains in Rooms 401, 402, and 403. The fixed-surface activity exceeded the residual radioactivity guidelines noted in Section 3.3. DOE approved this request (Appendix C). Two other as-left conditions are described in memorandums: a section of uncontaminated piping (part of Line 66) and two uncontaminated ducts left under the UHTREX building (Appendix H).

10.4 Independent Verification Contractor (IVC)

Oak Ridge Associated Universities (ORAU) was the independent verification contractor (IVC). The ORAU verification report will be submitted to DOE/Headquarters. A copy will be retained and archived with UHTREX documentation when it becomes available.

The IVC made several site visits. The Laboratory and the IVC used telephone conversations and written communication to exchange requests or furnish data for review.

10.5 Data Package

The project data package is archived under the Laboratory's Job Number 9530-52 with the Facilities Engineering Division. This package consists of correspondence data, drawings, and any written documentation that came to the project office.

10.6 Record of Completion

This report is the record of completion.

10.7 The Laboratory As-Left Drawings

The construction as-built drawings (Laboratory Drawings ENG-C 31833-31932) have been marked and referenced as the D&D as-left drawings. These have retained by the Planning Group, ENG-2.

11.0 LESSONS LEARNED RECOMMENDATIONS

11.1 Technical Problems

More detailed preliminary surveys and engineering studies before finalizing baselines might have allowed the specific problems discussed below to be avoided. The project began unexpectedly when SFMP allocated the resources at mid year FY87. The unexpected opportunity to begin the project and the knowledge that contamination levels were generally very low resulted in some characterization shortcuts. By expanding the surveys and characterization, the Laboratory and the SFMP can make informed decisions in the planning stage. The project could have been improved by the following.

100% Scanning. Many advantages could have been gained in the preliminary and final surveys by scanning with large probe survey instruments. Some isolated hot spots were not discovered until the IVC final survey. The IVC performed almost 100% scans with large surface area gas-flow proportional counters. These instruments maintain their accuracy for several hours without a recharge of P-10 gas. This feature allows greater portability than was thought possible with the gas-flow proportional counter and provides greater sensitivity and speed of scanning.

Identification of Radionuclides. The radionuclides present should be completely characterized well before preparation of the project management plan (PMP). Identification of both ^{137}Cs and ^{90}Sr might have alleviated an unrecognized problem earlier in the project.

Pre-D&D characterization of residual radioactivity on surfaces in UHTREX rooms was done using beta spectrometry. These measurements were made from swipes from drains in Room 402 and from swipes taken directly from the primary loop.[16] An apparent predominance (>90%) of ^{137}Cs over other radionuclides present led to including the residual activity guidelines of only ^{137}Cs in the PMP. Only after the IVC demonstrated the contribution of another beta emitter on the floor of Room 402 (Subsection 11.2) did it become apparent that the lower guideline of ^{90}Sr should be in force.

Core Sampling of Activated Surfaces. Core sampling of Room 310 surfaces would have shown the level of activation of the walls, floor, and slabs at an earlier stage of the project, allowing better scheduling of the extra effort required (Appendix B). It is unlikely that the date of completion of the project would have differed significantly but, as with the ^{90}Sr contamination problem, the PMP could have addressed these issues at an earlier date.

Sample Archiving. Soil surveys at TA-52 and along the pipeline routes were extensive and required careful sample management. However, most of the soil samples were unintentionally disposed of earlier than intended. It was intended to archive the soil samples for at least one year after the final report was issued; however, HSE-8 understood the date to be one year after taking the samples and disposed of them in August 1990.

11.2 Unusual Safety Problems

Gas Explosion in a Stagnant Cooling Water System. A gas explosion (possibly deflagration of methane or hydrogen sulfide) occurred in Room 305 during gas torch cutting of piping. The piping served the wall-cooling panel system in the reactor-recuperator room (Room 310) and was an uncontaminated cooling water system. The source of the gas appeared to have been microbial generation of gas in stagnant water in the system. Although the system had been drained long ago, enough water apparently remained to cause collection of gas. The event could have injured the worker doing the cutting; however, no one was injured, and no property was damaged. A Lessons Learned report was submitted to SFMP for inclusion in the Information Exchange Bulletin.

Fire in Room 402. A small fire was accidentally started in Room 402 in potentially contaminated cleaning rags awaiting disposal. The resulting smoke led to prompt evacuation of the building and summoning of the Fire Department. No one was injured; no airborne contamination was detected at the CAM in Room 106 above Room 310; surface contamination was detected only on the floor and walls in Room 402 near the site of the fire. No property was lost.

The fire was started by slag from a torch cutting operation in Room 310 falling through an opening in the floor and rebounding into a pile of rags stored in the southeast corner of Room 402.

Investigation of the causes indicated no negligence by the fitter doing the cutting; the rags were not in sight from his location. The event was addressed as a housekeeping issue, with instructions issued to the crew not to allow combustibles to collect anywhere in the building unless they were stored in covered metal drums.

11.3 General Comments

Productivity. Using an on-site maintenance contractor provided quick response and flexibility to varying decontamination efforts. The on-site contractor could readily provide additional staffing from many crafts; the contractor could also accommodate reduced staffing. Thus, trained and experienced personnel were available for decommissioning efforts. Because of the varied equipment available to the contractor, the contractor was able to use and charge for equipment on as-needed basis during nonradiological operations or when the potential for contamination was minimal.

Reporting. The earned value system tracks costs and schedules and provides a measurement of work performance, which is used as a management tool. The usefulness and the detail required versus the implementation requirements deserves serious evaluation by the project management team. The system should not indiscriminately drive the field work when field work will be performed only to keep up with the planned cost and schedules. Large and small cost and schedule variances are expected to occur in decontamination and decommissioning work.

The computer program for tracking costs for the UHTREX management incorporated detailed estimates, plans, and schedules. Daily craft hours and equipment usage was input to the computer program. At the end of each month, the computer output data were reconciled with the accounting reports from the Laboratory and Johnson Controls. Two separate systems (computer program and accounting) were used. After the first year, the computer program was eliminated, and the weekly and monthly accounting reports were used to do the earned value reporting. Essentially, the work breakdown activities were reported at a higher level. This system was easier and required less manpower to perform earned value.

Equipment. Laboratory-owned equipment dedicated to D&D operations was used extensively in this project: portable HEPA filters, backhoe, Bobcat with front loader, scissor lift, and self-articulating lift. The only costs incurred were for minor maintenance, fuel, and upkeep of the equipment. This system eliminated the Laboratory's liability should rented equipment become contaminated during D&D.

A portable power hacksaw provided a way to reduce personnel exposure during pipe-cutting in the facility. A simple bag enclosure for this small piece of equipment avoided spreading of contamination.

A hand-held electric band saw quickly cut pipes, metal angles, and assorted metal hangers or connections.

Small portable lead-lined blankets covered sections of the reactor and fuel transfer line to reduce radiation exposure. The blankets were suspended with rope or draped over the area being worked on.

Lead Guideline. Although the DOE asks for a chemical survey, a hazardous material survey is more appropriate. The survey should include materials, such as asbestos, that may not be regulated by the Resource Conservation and Recovery Act (RCRA). Currently no federal or state surface guidelines exist for acceptable residual lead. Guidelines would be helpful for future projects.

Decontaminating Surfaces in Room 402. Room 402 presented the most challenging decontamination problem encountered in the project. It had been the site of several spills of fuel/fission product when UHTREX was operating. Troubleshooting the problems in the fuel transfer system caused the system to be opened several times at the gas lock valves and conveyor at the reactor fuel discharge. Spills were cleaned in 1969. However, contamination had apparently penetrated the paint, and although contamination could be washed from the painted surfaces, it remained under the paint. Strontium-90 was detected in Room 402, primarily at broken patches of paint. Further removal of paint uncovered more contamination. Contamination was removed by extensive paint removal and scabbling.

12.0 CONCLUSIONS

The UHTREX D&D Project released the facility for reuse without radiological restriction. An exception was requested and granted by DOE/Headquarters for the reactor room and for a few ventilation ducts and floor drains embedded in the concrete surfaces.

The site and the facility will be under DOE control and will be used by the Laboratory for ongoing DOE-sponsored programs. Access to the facility will be controlled by the Laboratory's N Division. The Laboratory Siting and Space Control Committee will review change of user groups.

References

1. Environmental Surveillance Group, "Environmental Surveillance at Los Alamos during 1987," LA-11306-ENV (May 1988).

2. J. C. Elder, "TA-52 UHTREX Reactor Decommissioning Project Management Plan," Los Alamos National Laboratory Project Plan, DAD-HSE-7-PMP-01, R00 (February 1989).

3. United States Department of Energy, Office of Nuclear Energy, *Resource Manual, Surplus Facilities Management Program* (Draft) (April 1989).

4. W. D. Purtymun and W. R. Kennedy, "Geology and Hydrology of Mesita del Buey," Los Alamos National Laboratory report LA-4660 (May 1971).

5. D. B. Slemmons, "Fault Activity and Seismicity Near the Los Alamos Scientific Laboratory Geothermal Test Site, Jemez Mountains, New Mexico," Los Alamos National Laboratory report LA-5911-MS (April 1975).

6. "Hazardous and Radioactive Mixed Waste Management," DOE Order 5820.2A (September 1988).

7. T. L. Gilbert, M. J. Jusko, *et al.*, "A Manual for Implementing Residual Radioactive Material Guidelines: a Supplement to U. S. Department of Energy Guidelines for Residual Radioactive Material at Formerly Utilized Sites Remedial Action Program and Remote Surplus Facilities Management Program Sites," (January 1988).

8. "Requirements for Radiation Protection of the Public and the Environment," DOE Order 5400.5 (February 1990).

9. DOE Guidelines for Residual Radioactive Materials at Formerly Utilized Sites Remedial Action Program and Remote Surplus Facilities Management Program Sites (March 1987).

10. "Table of Activity Limits--Excepted Quantities and Articles," 49 CFR 173.423.

11. "Transportation Requirements for Low Specific Activity (LSA) Radioactive Materials," 49 CFR 173.425.

12. Los Alamos National Laboratory, *On-Site Transportation Manual* (October 1988)

13. Los Alamos National Laboratory, *Environment, Safety, and Health Manual*, Chapter 1 of the *Laboratory Manual*.

14. L. Soholt, "HSE-8 Plan for Environmental Sampling: Removal of the Industrial Waste Line Between TA-52 and TA-50 and Decontamination of the Former Ultra-High Temperature Reactor Experiment (UHTREX) at TA-52," Los Alamos National Laboratory document (November 1988).

15. W. D. Purtymun, R. J. Peters, *et al.*, "Background Concentrations of Radionuclides in Soils and River Sediments in Northern New Mexico, 1974-1986," Los Alamos National Laboratory report LA-11134-MS (November 1987).

16. R. Martin, "Analysis of TA-52 Cloth Swipe," HSE-1 internal memorandum RPM-8, (January 4, 1990).

Other Useful References

Environmental Surveillance Group, "Environmental Surveillance at Los Alamos during 1988," Los Alamos National Laboratory report LA-11628-ENV (June 1989).

K Division staff, "Ultra-High Temperature Reactor Experiment (UHTREX) Facility Description and Safety Analysis Report," Los Alamos Scientific Laboratory report LA-3556 (rev. April 1967).

M. Wheeler, A. Gallegos, *et al.*, "Transuranic Solid Waste Management Programs, July-December 1974," Los Alamos National Laboratory report LA-6100-PR (October 1975), pp. 15-38.

Acknowledgments

The authors gratefully acknowledge major contributions to this report by Phil Hunt, ENG-1, and John Longer, HS-1.

Other project participants whose major contributions to the project should be recognized are David Padilla, DOE/LAOO; Michele Landis, ORAU; Ray Garde, EM-7; Darrell Hohner, ENG-5; Peter Carlson, JCI; and Gilbert Garcia, HS-1.

Thanks are also due to Lloyd Wilkerson, Clovis, New Mexico, for archival support and technical advice, and to Diana Lovato, EM-7, for record-keeping and word processing support.

APPENDIX A

RESRAD SUMMARY

APPENDIX A

RESRAD SUMMARY

```
Residual Radioactivity Program, Version 3.121       09/19/90
Summary : UHTREX GENERIC SCENARIO Co/Cs/Sr/U/Pu WITH NO COVER
File    : UHTREX1.DAT

                Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i)
                 and Pathways (p), mrem/yr
                                                 At t =     0 years

                  Water Independent Pathways
Radio-  áááááááááááááááááááááááááááááááááááááááááááááááááááááá
Nuclide   Ground       Dust      Plant       Meat       Milk             Total
ááááááá áááááááááá áááááááááá áááááááááá áááááááááá áááááááááá       áááááááááá
Co-60   7.425E+00  9.692E-05  2.128E-03  5.247E-06  3.099E-06        7.427E+00
Cs-137  1.645E+00  2.068E-05  8.724E-04  6.497E-05  1.279E-05        1.646E+00
Pu-238  3.950E-04  2.972E-01  8.446E-03  1.107E-04  6.539E-10        3.062E-01
Pu-239  2.233E-04  3.295E-01  9.557E-03  1.253E-04  7.399E-10        3.394E-01
Sr-90   0.000E+00  8.400E-04  2.436E-01  1.799E-04  1.063E-03        2.457E-01
U-234   4.140E-04  8.400E-02  5.667E-03  7.023E-05  9.954E-06        9.016E-02
U-235   2.911E-01  7.754E-02  5.449E-03  6.753E-05  9.571E-06        3.741E-01
U-238   4.140E-02  7.754E-02  5.449E-03  6.753E-05  9.571E-06        1.245E-01
ëëëëëëë ëëëëëëëëëë ëëëëëëëëëë ëëëëëëëëëë ëëëëëëëëëë ëëëëëëëëëë       ëëëëëëëëëë
  Total 9.404E+00  8.668E-01  2.812E-01  6.915E-04  1.108E-03        1.055E+01
```

```
Residual Radioactivity Program, Version 3.121       09/19/90
Summary : UHTREX GENERIC SCENARIO Co/Cs/Sr/U/Pu WITH NO COVER
File    : UHTREX1.DAT


                Single Radionuclide Soil Guidelines G(i,t) in pCi/g
                    Basic Radiation Dose Limit = 100 mrem/yr

Nuclide
  (i)    t=        0           1          10         100        1000       10000
ááááááá  áááááááááá  áááááááááá  áááááááááá  áááááááááá  áááááááááá  áááááááááá
Co-60     1.346E+01   1.536E+01   5.017E+01   6.947E+06  *1.131E+15  *1.131E+15
Cs-137    6.074E+01   6.215E+01   7.646E+01   6.065E+02  *8.652E+13  *8.652E+13
Pu-238    3.266E+02   3.292E+02   3.535E+02   7.208E+02  *1.711E+13  *1.711E+13
Pu-239    2.946E+02   2.946E+02   2.947E+02   2.960E+02  *6.203E+10  *6.203E+10
Sr-90     4.070E+02   4.174E+02   5.239E+02   5.082E+03  *1.380E+14  *1.380E+14
U-234     1.109E+03   1.110E+03   1.117E+03   1.186E+03  *6.233E+09  *6.233E+09
U-235     2.673E+02   2.675E+02   2.689E+02   2.791E+02  *2.160E+06  *2.160E+06
U-238     8.034E+02   8.040E+02   8.091E+02   8.623E+02  *3.360E+05  *3.360E+05
ëëëëëëë  ëëëëëëëëëë  ëëëëëëëëëë  ëëëëëëëëëë  ëëëëëëëëëë  ëëëëëëëëëë  ëëëëëëëëëë
*At specific activity limit
```

```
Residual Radioactivity Program, Version 3.121       09/19/90
Summary : UHTREX GENERIC SCENARIO Co/Cs/Sr/U/Pu WITH NO COVER
File    : UHTREX1.DAT

                 Site-Specific Parameter Summary (continued)

        R015 ° Unsat. zone 2, total porosity                ° 4.000E-01 ° 4.000E-01
        R015 ° Unsat. zone 2, effective porosity            ° 2.000E-01 ° 2.000E-01
        R015 ° Unsat. zone 2, soil-specific b parameter     ° 5.300E+00 ° 5.300E+00
        R015 ° Unsat. zone 2, hydraulic conductivity (m/yr) ° 1.000E+02 ° 1.000E+02
             °                                              °           °
        R016 ° Distribution coefficients for Co-60          °           °
        R016 °   Contaminated zone (cm**3/g)                ° 1.000E+03 ° 1.000E+03
        R016 °   Unsaturated zone 1 (cm**3/g)               ° 1.000E+03 ° 1.000E+03
        R016 °   Unsaturated zone 2 (cm**3/g)               ° 1.000E+03 ° 1.000E+03
        R016 °   Saturated zone (cm**3/g)                   ° 1.000E+03 ° 1.000E+03
        R016 °   Leach rate (/yr)                           ° 0.000E+00 ° 0.000E+00
             °                                              °           °
        R016 ° Distribution coefficients for Cs-137         °           °
        R016 °   Contaminated zone (cm**3/g)                ° 1.000E+03 ° 1.000E+03
        R016 °   Unsaturated zone 1 (cm**3/g)               ° 1.000E+03 ° 1.000E+03
        R016 °   Unsaturated zone 2 (cm**3/g)               ° 1.000E+03 ° 1.000E+03
        R016 °   Saturated zone (cm**3/g)                   ° 1.000E+03 ° 1.000E+03
        R016 °   Leach rate (/yr)                           ° 0.000E+00 ° 0.000E+00
             °                                              °           °
        R016 ° Distribution coefficients for Pu-238         °           °
        R016 °   Contaminated zone (cm**3/g)                ° 2.000E+03 ° 2.000E+03
        R016 °   Unsaturated zone 1 (cm**3/g)               ° 2.000E+03 ° 2.000E+03
        R016 °   Unsaturated zone 2 (cm**3/g)               ° 2.000E+03 ° 2.000E+03
        R016 °   Saturated zone (cm**3/g)                   ° 2.000E+03 ° 2.000E+03
        R016 °   Leach rate (/yr)                           ° 0.000E+00 ° 0.000E+00
             °                                              °           °
        R016 ° Distribution coefficients for Pu-239         °           °
        R016 °   Contaminated zone (cm**3/g)                ° 2.000E+03 ° 2.000E+03
        R016 °   Unsaturated zone 1 (cm**3/g)               ° 2.000E+03 ° 2.000E+03
        R016 °   Unsaturated zone 2 (cm**3/g)               ° 2.000E+03 ° 2.000E+03
        R016 °   Saturated zone (cm**3/g)                   ° 2.000E+03 ° 2.000E+03
        R016 °   Leach rate (/yr)                           ° 0.000E+00 ° 0.000E+00
             °                                              °           °
        R016 ° Distribution coefficients for Sr-90          °           °
        R016 °   Contaminated zone (cm**3/g)                ° 3.000E+01 ° 3.000E+01
        R016 °   Unsaturated zone 1 (cm**3/g)               ° 3.000E+01 ° 3.000E+01
        R016 °   Unsaturated zone 2 (cm**3/g)               ° 3.000E+01 ° 3.000E+01
        R016 °   Saturated zone (cm**3/g)                   ° 3.000E+01 ° 3.000E+01
        R016 °   Leach rate (/yr)                           ° 0.000E+00 ° 0.000E+00

        R016 ° Distribution coefficients for U-235          °           °
        R016 °   Contaminated zone (cm**3/g)                ° 5.000E+01 ° 5.000E+01
        R016 °   Unsaturated zone 1 (cm**3/g)               ° 5.000E+01 ° 5.000E+01
        R016 °   Unsaturated zone 2 (cm**3/g)               ° 5.000E+01 ° 5.000E+01
        R016 °   Saturated zone (cm**3/g)                   ° 5.000E+01 ° 5.000E+01
        R016 °   Leach rate (/yr)                           ° 0.000E+00 ° 0.000E+00
             °                                              °           °
        R016 ° Distribution coefficients for U-238          °           °
        R016 °   Contaminated zone (cm**3/g)                ° 5.000E+01 ° 5.000E+01
        R016 °   Unsaturated zone 1 (cm**3/g)               ° 5.000E+01 ° 5.000E+01
        R016 °   Unsaturated zone 2 (cm**3/g)               ° 5.000E+01 ° 5.000E+01
        R016 °   Saturated zone (cm**3/g)                   ° 5.000E+01 ° 5.000E+01
        R016 °   Leach rate (/yr)                           ° 0.000E+00 ° 0.000E+00
             °                                              -
```

```
Residual Radioactivity Program, Version 3.121       09/19/90
Summary : UHTREX GENERIC SCENARIO Co/Cs/Sr/U/Pu WITH NO COVER
File    : UHTREX1.DAT

                        Site-Specific Parameter Summary

Menu °                      Parameter                      °  Used     °  Default
áááááéáááááááááááááááááááááááááááááááááááááááááááááááááééáááááááááááééáááááááááá
R011 ° Area of contaminated zone (m**2)                    ° 1.000E+02 ° 1.000E+04
R011 ° Thickness of contaminated zone (m)                  ° 1.000E+00 ° 1.000E+00
R011 ° Length parallel to aquifer flow (m)                 ° 1.000E+02 ° 1.000E+02
R011 ° Basic radiation dose limit (mrem/yr)                ° 1.000E+02 ° 1.000E+02
R011 ° Times for calculations (yr)                         ° 1.000E+00 ° 1.000E+00
R011 ° Times for calculations (yr)                         ° 1.000E+01 ° 1.000E+01
R011 ° Times for calculations (yr)                         ° 1.000E+02 ° 1.000E+02
R011 ° Times for calculations (yr)                         ° 1.000E+03 ° 1.000E+03
R011 ° Times for calculations (yr)                         ° 1.000E+04 ° 1.000E+04

R012 ° Initial principal radionuclide (pCi/g):  Co-60      ° 1.000E+00 ° 0.000E+00
R012 ° Initial principal radionuclide (pCi/g):  Cs-137     ° 1.000E+00 ° 0.000E+00
R012 ° Initial principal radionuclide (pCi/g):  Pu-238     ° 1.000E+00 ° 0.000E+00
R012 ° Initial principal radionuclide (pCi/g):  Pu-239     ° 1.000E+00 ° 0.000E+00
R012 ° Initial principal radionuclide (pCi/g):  Sr-90      ° 1.000E+00 ° 0.000E+00
R012 ° Initial principal radionuclide (pCi/g):  U-234      ° 1.000E+00 ° 0.000E+00
R012 ° Initial principal radionuclide (pCi/g):  U-235      ° 1.000E+00 ° 0.000E+00
R012 ° Initial principal radionuclide (pCi/g):  U-238      ° 1.000E+00 ° 0.000E+00


R013 ° Cover depth (m)                                     ° 0.000E+00 ° 0.000E+00
R013 ° Density of contaminated zone (g/cm**3)              ° 1.800E+00 ° 1.600E+00
R013 ° Contaminated zone erosion rate (m/yr)               ° 1.000E-03 ° 1.000E-03
R013 ° Contaminated zone total porosity                    ° 4.000E-01 ° 4.000E-01
R013 ° Contaminated zone effective porosity                ° 3.000E-01 ° 2.000E-01
R013 ° Contaminated zone hydraulic conductivity (m/yr)     ° 1.000E+01 ° 1.000E+01
R013 ° Contaminated zone b parameter                       ° 5.300E+00 ° 5.300E+00
R013 ° Evapotranspiration coefficient                      ° 8.000E-01 ° 6.000E-01
R013 ° Precipitation (m/yr)                                ° 4.000E-01 ° 1.000E+00
R013 ° Irrigation (m/yr)                                   ° 0.000E+00 ° 2.000E-01

R014 ° Saturated zone hydraulic conductivity (m/yr)        ° 3.000E+01 ° 1.000E+02
R014 ° Saturated zone hydraulic gradient                   ° 2.000E-02 ° 2.000E-02
R014 ° Saturated zone b parameter                          ° 5.300E+00 ° 5.300E+00
R014 ° Distance from surface to water table (m)            ° 3.010E+02 ° 5.000E+00

R015 ° Unsat. zone 1, thickness (m)                        ° 2.000E+02 ° 4.000E+00
R015 ° Unsat. zone 1, soil density (g/cm**3)               ° 1.500E+00 ° 1.600E+00

R015 ° Unsat. zone 2, thickness (m)                        ° 1.000E+02 ° 0.000E+00
R015 ° Unsat. zone 2, soil density (g/cm**3)               ° 1.800E+00 ° 1.600E+00
```

APPENDIX B

LANL EXCEPTION REQUEST

APPENDIX 3

LANL EXCEPTION REQUEST

Los Alamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

DATE December 20, 1990
IN REPLY REFER TO HSE-7C-90-180
MAIL STOP E518
TELEPHONE (505)665-3454

David Padilla
Los Alamos Area Office
US Department of Energy
Los Alamos, NM 87544

SUBJECT: REQUEST FOR APPROVAL OF AN EXCEPTION AT UHTREX: ROOM 310 AND DUCTS AND DRAINS IN ROOMS 401, 402, AND 403

Dear Mr. Padilla:

Reference 1: DOE Guidelines for Residual Radioactive Material at Formerly Utilized Sites Remedial Action Program and Remote Surplus Facilities Management Program Sites, Revision 2, March 1987.

Reference 2: UHTREX Project Management Plan, February, 1989, Document Control Number DAD-HSE-7-PMP-01, ROO.

Reference 3: Los Alamos Environment, Safety, and Health Manual Administrative Requirement AR 3-8 (draft), ALARA Program, and Technical Bulletin 302, ALARA Guide.

Reference 4: Los Alamos Environment, Safety, and Health Manual Administrative Requirement AR 3-7 (draft), Radioactive Contamination Control.

SUMMARY

An Exception is requested to allow leaving small quantities of fixed radioactive contamination in the UHTREX Reactor-Recuperator Room (Room 310) and in several ventilation ducts and floor drains in other locations. These quantities exceed DOE residual radioactive materials guidelines but are low in quantity and difficult to access. Eliminating the minor hazard associated with the fixed contamination in these locations does not justify the estimated cost required to meet the guidelines.

INTRODUCTION

DOE residual radioactivity guidelines (Ref. 1) can be met at the UHTREX facility except for small quantities of fixed activation products in Room 310 walls, shielding slabs, and floor; fixed fission products in Rooms 401, 402, and 403 floor

An Equal Opportunity Employer/Operated by University of California

drains; and fixed fission products in ventilation ducts between Rooms 217 and 402 and between Room 401 and the Filter Pit (see Figure 1). The need for an Exception according to Section F of Ref. 1 is described in this request.

Room 310, The Reactor-Recuperator Room

We are requesting your approval to complete the UHTREX project with this Exception imposed on future use of Room 310 in Building TA-52-1.

Activation by neutrons of impurities in iron and steel in the concrete walls, floor, and shield slabs overhead in Room 310, the reactor-recuperator room, has caused ^{60}Co radiation levels which are low (see Table 1) but above the residual radioactivity guidelines in Ref. 1. as adopted for the Ultra High Temperature Reactor Experiment (UHTREX) decommissioning project (see Ref.2). Contact dose rates of 0.2 mrad/h (average) and 1.0 mrad/h (maximum) and general area exposure rates of 20 micro R/h above background are exceeded. Because this radiation source cannot be reduced without extensive removal of structural material or addition of extensive shielding, we request an exception.

Adequate protection of workers, the environment, and the public can be maintained under an Exception. Room 310 has been left in a safe condition (described later) and the Exception under which future occupancy of the room would be restricted is being submitted in accordance with Section F of Ref. 1.

Room 310 does not qualify as a radiation area by the DOE 5480.11 definition; however, access control will be implemented to ensure that as low as reasonably achievable (ALARA) guidelines under AR-3.8 (Ref. 3) are observed.

The conditions requiring this exception are expected to persist for an extended period. The radioactive decay of ^{60}Co (halflife 5.3 y) would yield an average contact reading within the 0.2 mrad/h guideline after approximately 15 years and within the 20 micro R/h guideline after approximately 35 years. Other activation products with longer halflives (e.g., ^{59}Ni) were not present in detectable quantities; their contribution to dose after ^{60}CO has fully decayed is not expected to be significant.

Ducts and Drains in Rooms 401, 402, and 403

Residual fixed fission product activity (mostly ^{90}Sr) above guidelines remains in several locations within ducts and drains which cannot be accessed for direct decontamination without major concrete removal and concrete repair. The level

TABLE 1

SUMMARY OF RADIATION MEASUREMENTS IN ROOM 310

	ION CHAMBER AT CONTACT (mR/h)*		**ION CHAMBER AT 1 METER (mR/h)***		**TLD (LiF) AT CONTACT (mrad/h)**	
	Mean (SD)	**Max.**	**Mean (SD)**	**Max.**	**Mean**	**Max.**
North Wall	1.95(1.30)	5.5	1.64(0.88)	3.6	1.58	3.60
East Wall	0.39(0.15)	1.0	0.41(0.08)	0.6	0.35	0.42
South Wall	0.93(0.42)	2.3	0.99(0.48)	2.2	0.78	1.07
West Wall	2.16(0.69)	3.5	1.93(0.59)	3.3	1.42	1.61
Floor	1.17(0.45)	1.7	0.98(0.37)	1.6	0.97	1.31
Shield Slabs	1.89(0.96)	3.3	1.47(0.62)	2.4	1.46	1.90

*Units of exposure rate (mR/h) and absorbed dose rate (mrad/h) from photon radiation can be considered equivalent.

of radioactivity does not pose a hazard to workers under any circumstances of intrusion, due to the inaccessibility of the locations. Extensive decontamination efforts have removed all removable activity to the extent that water flow or other postulated means could not accidently cause radioactivity to leave the ducts and drains.

Table 2 summarizes the fixed contamination on the ducts and drain. Figures 1 through 4 show the locations listed in the table.

EXCEPTION

Room 310

The average and maximum contact (1 cm) exposure rates in Room 310 are 1.3 mR/h and 5.5 mR/h, respectively. Maximum area exposure rate is approximately 200 micro R/h. These exposure rates indicate its occupancy must be restricted to limit exposure of Laboratory personnel. This Exception further dictates that Room 310 in its present condition should continue to be used for Laboratory purposes and not be released to the public.

Mechanisms are in place for conducting Laboratory activities in the facility under this Exception. Durable signs stating entry requirements are posted on the upper surface of the bottom layer of shielding slabs above Room 310 (only the bottom layer received any activation) and on the metal covers over the floor opening from Room 402. Posting of Room 310 follows DOE 5480.11 guidelines in accordance with AR 3-7 (Ref. 4). Future occupants will be required to establish an operating condition statement describing how access to the room will be controlled to limit personnel exposure to levels that are ALARA. Radiation exposure during routine access thereafter will be monitored by the Radiation Protection Group, through normal dosimeter requirements.

The restrictions associated with this Exception are expected to protect any worker who may enter Room 310. The residual activity allowed by the Exception causes no hazard to the public or to personnel working outside this room.

Ducts and Drains in Rooms 401, 402, and 403

Small quantities of fixed fission product activity (37,000 dpm/100cm^2 maximum) will be left in place in seven locations within ducts and drains at UHTREX (see Table 2). Extensive decontamination effort has failed to bring the fixed residual activity within the 3000 dpm/100cm^2 guideline for ^{90}Sr. The fixed contamination is concentrated along the welded seams that joined sections of ductwork. As a remedial action, the

TABLE 2

DUCTS AND DRAINS WITH ABOVE-LIMITS ^{90}Sr RESIDUAL ACTIVITY

ITEM	CONNECTING	LOCATION	CLOSURE	MAX FIXED RADIOACTIVITY (DPM/100 CM^2)
1. Air Duct (25 cm Dia., 9 m; 10 in Dia., 30 ft)	Rm 402 to Rm 217	402/SW Corner	Welded Steel Plate	333
2. Air Duct (25 cm dia, 6 m; 10 in Dia., 20 ft)	Rm 402 to Rm 217	402/NW Corner	Welded Steel Plate	4,400
3. Air Duct (0.6 m Dia., 9 m; 24 in Dia., 30 ft)	Rm 401 to RD-14 (filter pit)	401/E Wall	Welded Steel Plate	9,700
4. Floor Drain	Rm 402 to Rm 303 (sump tank)	402/West	Concrete Plug	5,719
5. Floor Drain	Rm 402 to Rm 303 (sump tank)	402/East	Concrete Plug	36,908
6. Floor Drain	Rm 401 to Rm 303 (sump tank)	401/West	Concrete Plug	3,086
7. Floor Drain	Rm 403 to Rm 303 (sump tank)	403/Center	Concrete Plug	3,232

Note: Drain pipes inside the sump in Room 303 have been welded shut; no radioactive contamination was found at this location. Swipeable radioactivity was within guidelines.

ducts were sealed at both ends with welded steel plates. The drains were plugged with concrete. Metal tags were placed at these sealed locations to mark them as radioactively contaminated. The locations were marked on as-left engineering drawings.

BASIS OR JUSTIFICATION

Room 310

Most of the radiation in Room 310 is fixed activity from ^{60}Co, a product of activation of small quantities of natural cobalt in steel or iron ore in the shield walls which surrounded the reactor. Determinations of the ^{60}Co source were made with gamma spectrometry instrumentation at multiple locations. The high iron content of the magnetite concrete is producing most of the radiation; the steel reinforcing bars in the concrete walls are 5 cm (2 in.) below the surface and were not significantly activated.

Only after removal of the reactor vessel, the major source of radiation in the room, was it possible to properly determine the level of other radiation sources in the room. Direct radiation was measured using thermoluminescent dosimeter chips and ion chamber instruments. Figure 5 and Figure 6 show the locations and quantities of radiation on the north and west walls, both of which were constructed with magnetite concrete. The south and east walls were constructed with normal reinforced concrete and exhibited lower levels of activation. Table 1 summarizes the average, standard deviation, and maximum measurements. The highest levels appear along the north wall (3.6 mR/h at 1 meter and 5.5 mR/h at contact).

Incidental to the radiation in Room 310, localized areas of elevated radiation existed in the room below it (Room 402), due to shine through one major opening and four smaller openings in the floor of Room 310. These openings were covered with steel plates which reduced the radiation levels in Room 402 below the guideline exposure rate of 20 micro R/h.

Two layers of removable shielding slabs, each 0.76 m (2.5 ft) thick, separate Room 106 from Room 310. These slabs will not be removed permanently because they will be needed to prevent the residual radiation guideline of 20 micro R/h being exceeded in Room 106. Normal care will be used to limit exposure of personnel in Room 106 when these shield slabs are removed for access to Room 310.

Ducts and Drains in Rooms 401, 402, and 403

Removal of the contaminated ducts and drains would require major breakup of the reinforced concrete floor 1.37 m (4.5 ft thick) along the drain line and removal of a reinforced concrete wall approximately 0.61 m (2 ft) thick and up to 9.15 m (30 ft) long and extensive concrete repair to gain only a minor reduction of a minor hazard.

COST/BENEFIT ANALYSIS

Room 310

Additional cost to the project to reduce dose rates in Room 310 and bring it up to all safety requirements for normal occupancy is prohibitive. To add approximately 26 cm. (12 in.) of normal concrete shielding to the magnetite surfaces would cost approximately $74,000; cost to remove two or more inches of the activated surfaces would exceed $74,000. Even after the elimination of the dose rates, other modifications would be necessary for normal occupancy. These include life safety improvements (lighting, dual egress, fire protection, ventilation, and possibly others); their cost should be passed on to future occupants.

The loss to the Laboratory due to restricted occupancy times in the room is difficult to estimate; the Exception would allow 500-1000 hours/year of occupancy by Laboratory workers. This occupancy would be consistent with use of Room 310 as a storage area for actively-used contaminated equipment or as an operating area for radiation-producing equipment or sources which would not require continuous attendance.

Ventilation Ducts and Floor Drains

Removal of the two ventilation air ducts imbedded in the concrete wall between Room 402 and 217 6 to 9 m (20 to 30 ft) runs and the air duct in Room 401 leading to the filter pit would cost over $100K. Repair of the walls would be required afterwards.

Removal of the floor drains and drain lines 1.37 m (4.5 ft) below the concrete floor) in Rooms 401, 402, and 403 might be accomplished for $100K. However, complete removal of the drain pipe from these rooms to Room 303 (sump room) would be a major task. This pipe travels approximately 4.58 m (15 ft) below the floor in Room 305. Cost of this work could exceed $200K.

Again, the same health and safety improvements noted for Room 310 will be required; the costs would be similar.

Controls

The site (TA-52) and the facility is under DOE control and is utilized by the Laboratory for ongoing DOE-sponsored programs. The site is inside a fenced area and locked after working hours. Access to the facility is controlled by the Laboratory Group N-DO through the issuance of numbered keys. Usage of the rooms is reviewed and granted by the user group. Change of user groups is also reviewed by the Laboratory Siting and Space Control Committee. Refurbishment of rooms is accomplished by initiation of a work order control document that is reviewed by the Radiation Protection and Engineering Groups. Major renovations to a facility are also reviewed by appropriate groups in Health, Safety and Environmental Division and Engineering and Facility Division. Thus, current ongoing Laboratory administrative procedures restrict usage of the facility.

Entry to the sealed ducts would require heavy metal cutting tools or methods. The floor drains are plugged and could only be opened by concrete removal.

In summary, we feel this Exception is the most feasible course of action to take for this facility, and ask for your concurrence. Copies of this memorandum are being distributed to all interested parties simultaneously, to expedite a quick formal DOE response. Delays will preclude the completion of the final report resulting in unnecessary use of contigency funding. Department of Energy denial of this Exception will require additional FY91 funding to remove the radiation sources and will seriously impact Laboratory plans to utilize the facility for waste container testing in the very near future.

Sincerely,

Ray Garde

Ray Garde,
Project Manager
Waste Management Group

RG:ls

Cy w/attachment:
M. Salazar, HSE-7, MS E518
J. Elder, HSE-3, MS J566
L. Andrews, HSE-1, MS K483
T. Buhl, HSE-8, MS K490
D. Hohner, ENG-5, MS M713
D. Gutierrez, ENG-1, MS M721
R. Sena, DOE-AL
M. Landis, ORAU
J. Tureck, DOE/Weston OTS

J. Hansen, N-DO, MS E547
N. King, HSE-3, MS G726
M. McCorkle, ENG-5, MS M713
L. Madrid, Siting and Space Committee, MS K319

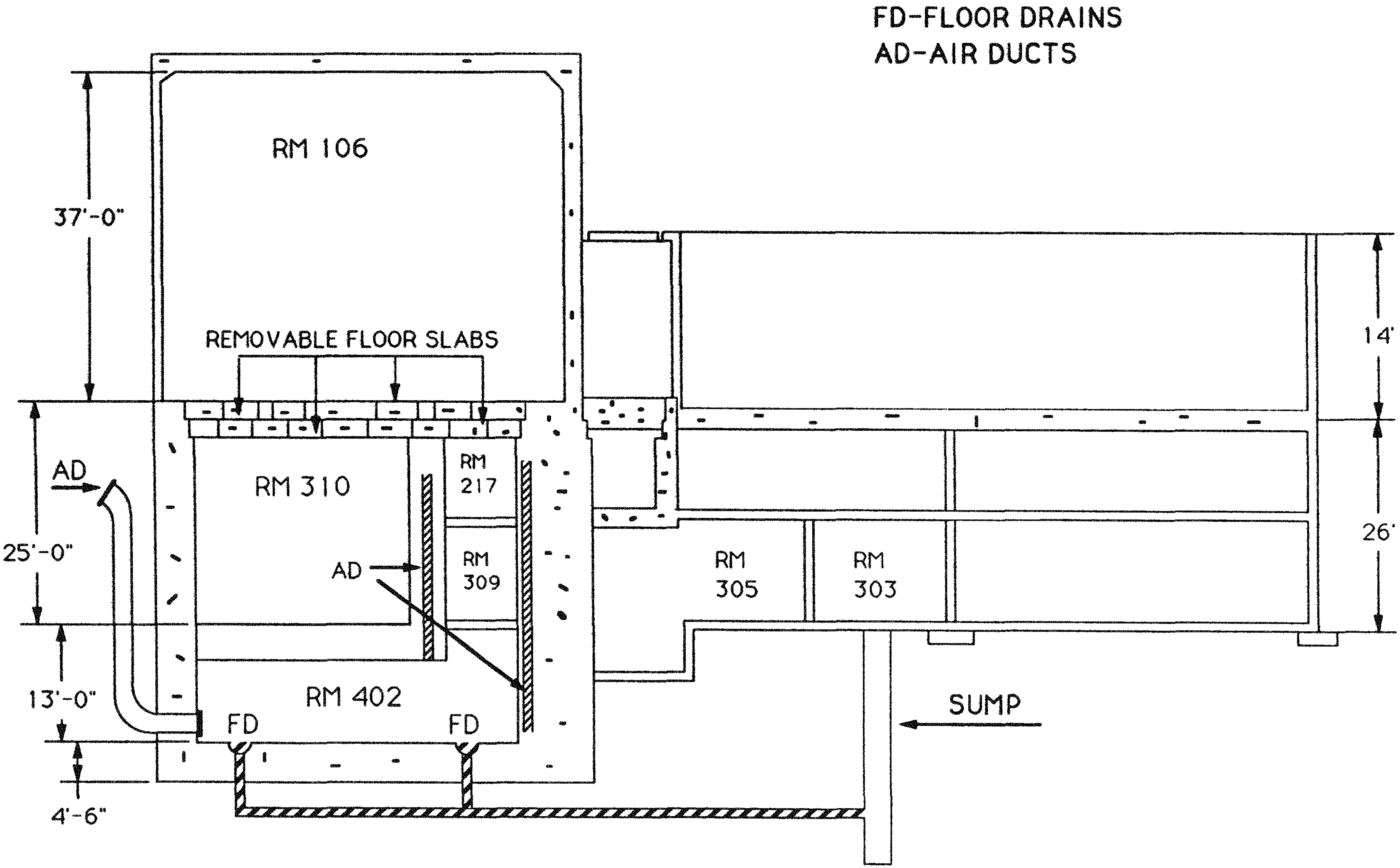


Figure 1. UHTREX cross-sectional view of floor drains and air ducts (hatched areas).

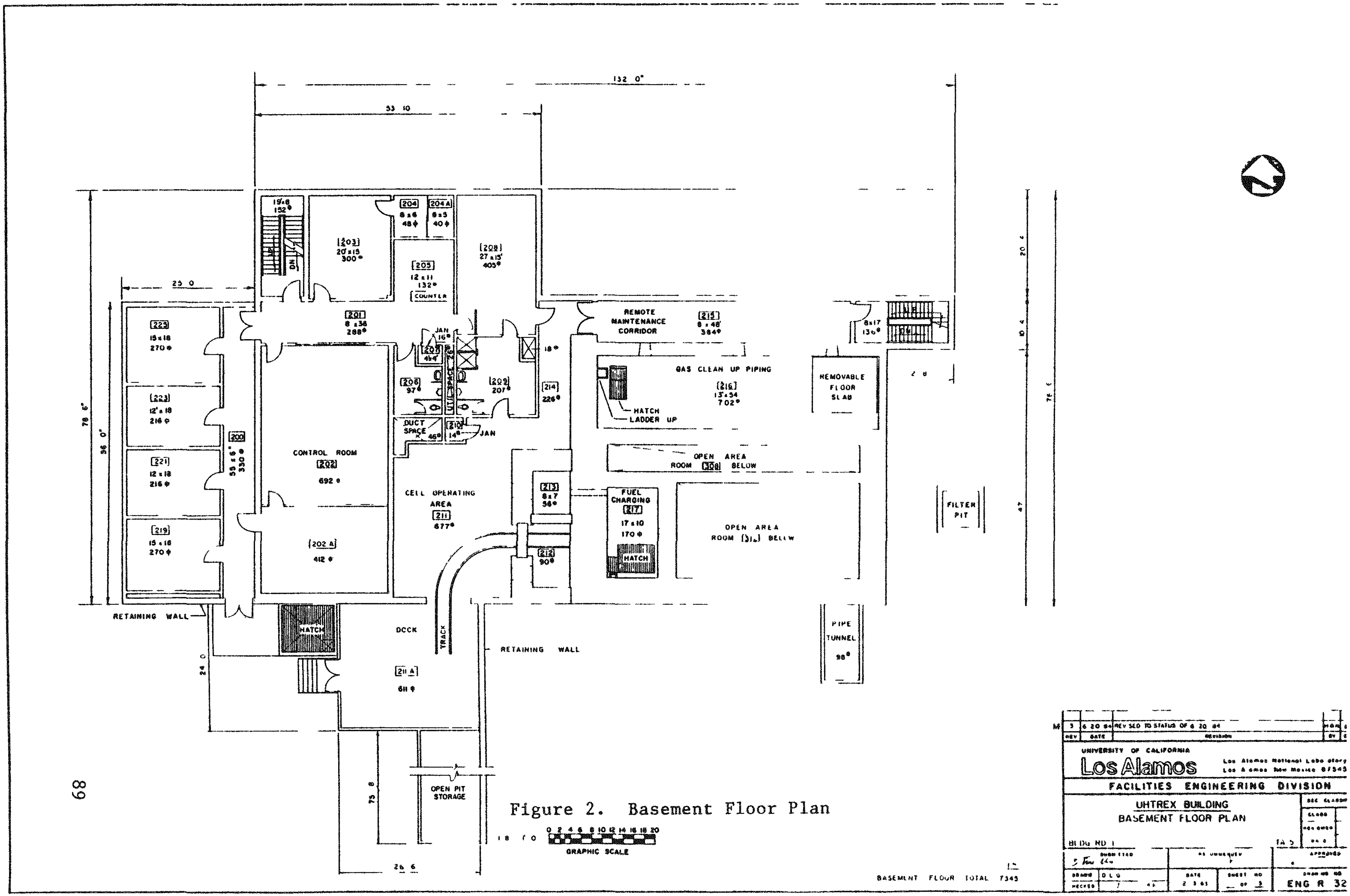


Figure 2. Basement Floor Plan

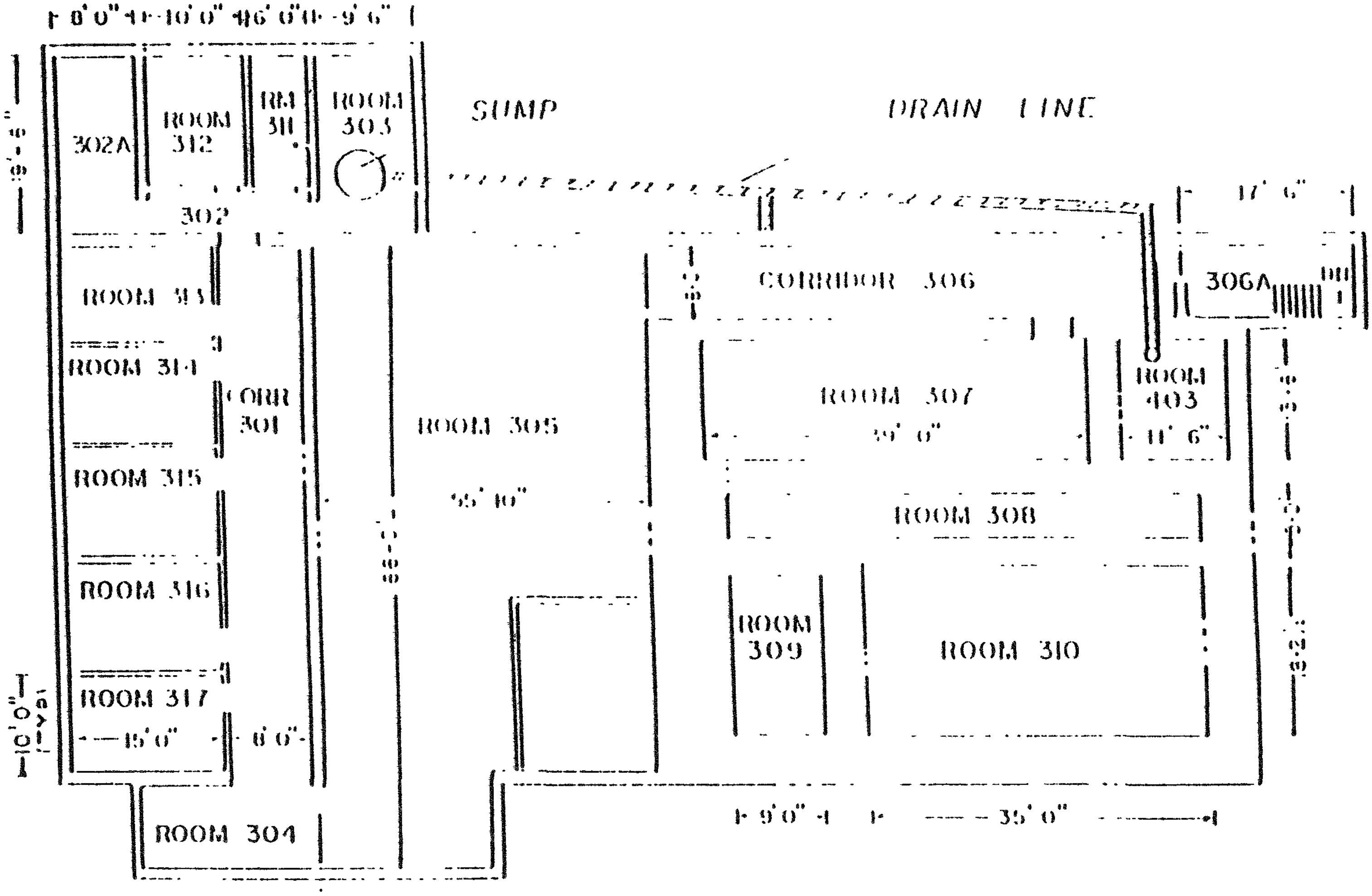


Figure 3. UHTREX floor plan of third level with drain line layout.

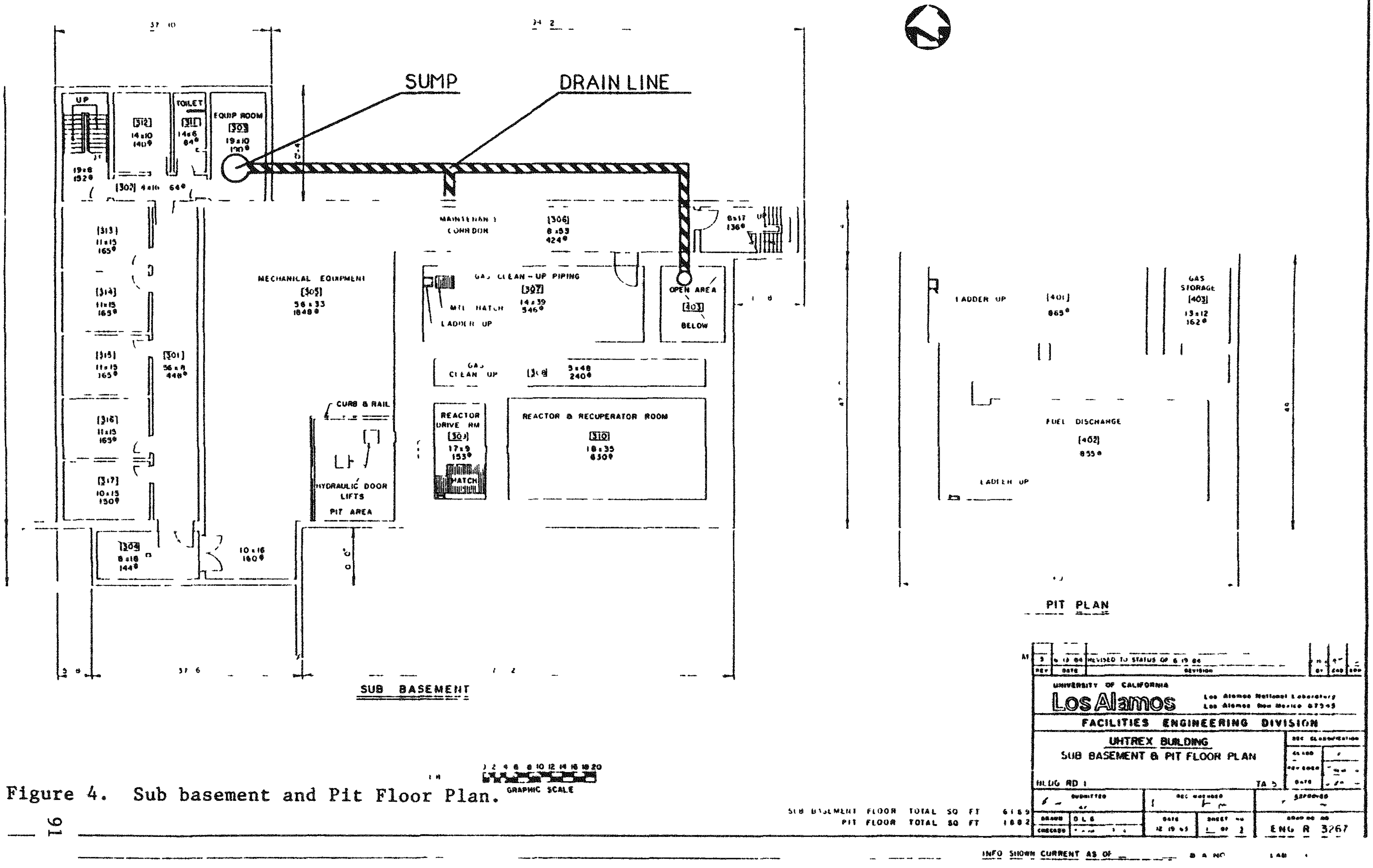
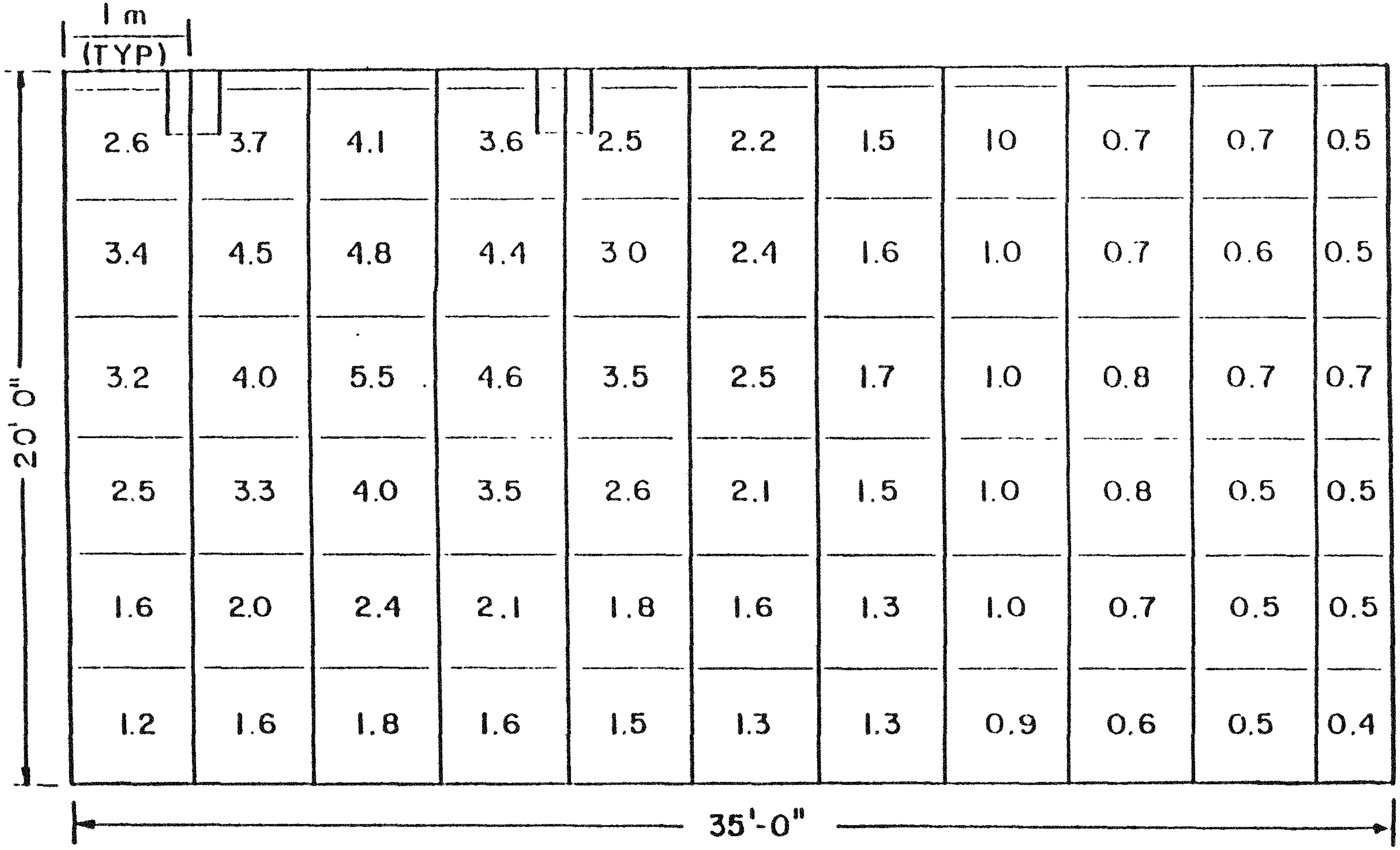


Figure 4. Sub basement and Pit Floor Plan.

FIXED RADIOACTIVITY SURVEY - UHTREX TA-52 BLDG. 1 ROOM 310

NUMBERS IN MILLI R/HR AT CONTACT

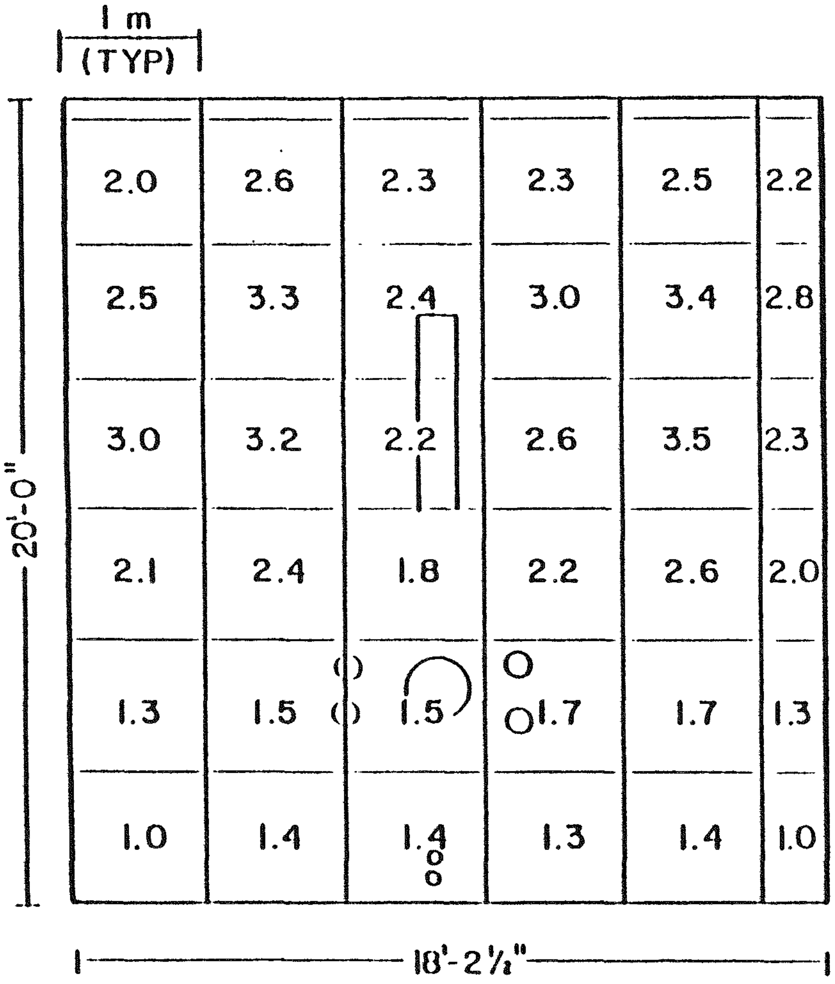


2.6	3.7	4.1	3.6	2.5	2.2	1.5	10	0.7	0.7	0.5
3.4	4.5	4.8	4.4	3 0	2.4	1.6	1.0	0.7	0.6	0.5
3.2	4.0	5.5	4.6	3.5	2.5	1.7	1.0	0.8	0.7	0.7
2.5	3.3	4.0	3.5	2.6	2.1	1.5	1.0	0.8	0.5	0.5
1.6	2.0	2.4	2.1	1.8	1.6	1.3	1.0	0.7	0.5	0.5
1.2	1.6	1.8	1.6	1.5	1.3	1.3	0.9	0.6	0.5	0.4

Figure 5. Contact dose rate at north wall in Room 310. Units of exposure rate (mR/h) and absorbed dose rate (mrad/h) from photon radiation can be considered equivalent.

FIXED RADIOACTIVITY SURVEY - UHTREX* TA-52 BLDG. 1 ROOM 310

NUMBERS IN MILLI R/HR AT CONTACT



2.0	2.6	2.3	2.3	2.5	2.2
2.5	3.3	2.4	3.0	3.4	2.8
3.0	3.2	2.2	2.6	3.5	2.3
2.1	2.4	1.8	2.2	2.6	2.0
1.3	1.5	1.5	1.7	1.7	1.3
1.0	1.4	1.4	1.3	1.4	1.0

Figure 6. Contact dose rate at west wall in Room 310. Units of exposure rate (mR/h) and absorbed dose rate (mrad/h) from photon radiation can be considered equivalent.

APPENDIX C

DOE EXCEPTION APPROVAL

DOE F 1325.8
8-89)
EFG (07-90)

United States Government **Department of Energy**

memorandum

DATE: MAY 10 1991

REPLY TO ATTN OF: EM-45 (J. Sands, 353-8192)

SUBJECT: Approval of an Exception at the Ultra High Temperature Reactor Experiment Facility

TO: R. Sena, AL

I have reviewed the "Request for Approval of Exception at the Ultra High Temperature Reactor Experiment Facility (UHTREX): Room 310 and Ducts and Drains in Rooms 401, 402, and 403" dated December 20, 1990. Although these areas are not intended for public access, the cleanup criteria were based upon the guidelines for the general public as given in "U.S. Department of Energy (DOE) guidelines for Residual Radioactive Material at Formerly Utilized Sites Remedial Action Program and Remote Surplus Facilities Management Program Sites" dated March 1987 and also contained in DOE Order 5400.5. Therefore, the procedures in DOE Order 5400.5 for requesting an exception are appropriate.

I agree with the request that the cost of removing the small quantities of residual contamination in these areas is not justified and, therefore, approve this request for the exception. This approval is based on maintaining adequate protection of workers using Room 310 by restricting access to and controlling future use of the room. In addition, the approval for the use of Rooms 401, 402, and 403 is based on the inaccessibility and marking of ducts and drains in these areas. The potential doses to the public are insignificant since the contamination in all the areas is fixed and both UHTREX and the entire Los Alamos National Laboratory have access controls.

Access to Room 310 will be limited and restricted to radiation workers as defined in DOE Order 5840.11. The exposure limits for these workers will be based on the guidelines given in DOE Order 5840.11 using the average and maximum contact readings of 1.3 mR/h and 5.5 mR/h, respectively, and the maximum area exposure rate of 200 urad/h. These readings are documented in the request of exception.

The request did not specifically provide the dose as a result of the contamination in the floor drains and ducts. However, post radiological surveys on the sealed ducts and drains show that all locations are at or below background. These surveys are reproduced in the UHTREX Final Report.

APPENDIX C

DOE EXCEPTION APPROVAL

The approval of this exception is also based on strict compliance with all the requirements for an exception as given in DOE Order 5400.5 including those for control of residual radioactive material as set forth in Paragraph IV.6. This paragraph specifies the controls of residual radioactive material including those requirements of Chapter II of the order. In addition, Paragraph IV.6 discusses the requirements for operations and controls, interim storage, interim management, and long-term management of the excepted areas.

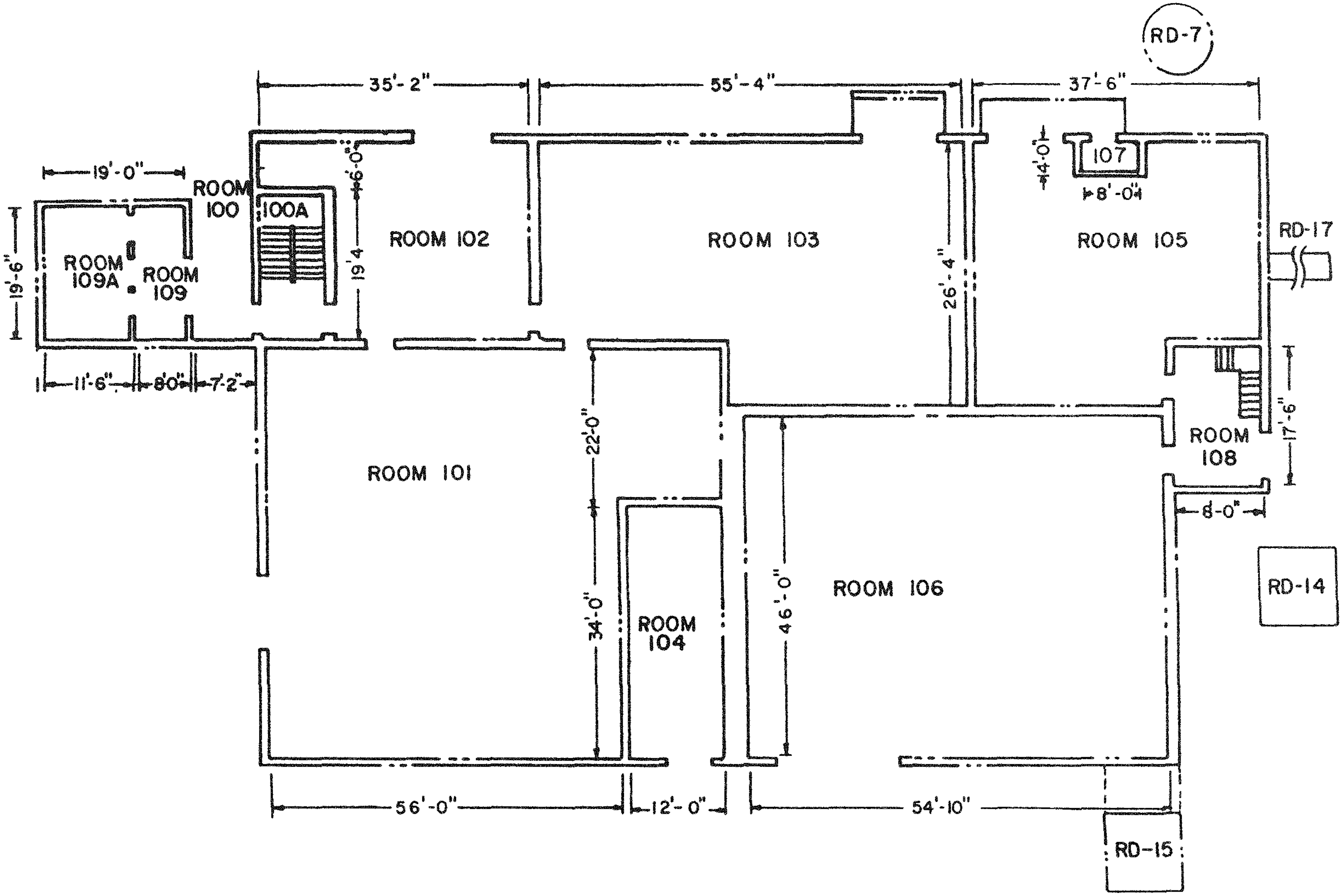
If you have any questions, please call me or J. Sands of my staff at FTS 233-8192.

Raymond W. Greenberg
for Ralph G. Lightner
Director
Division of Southwestern Area Programs
Office of Environmental Restoration

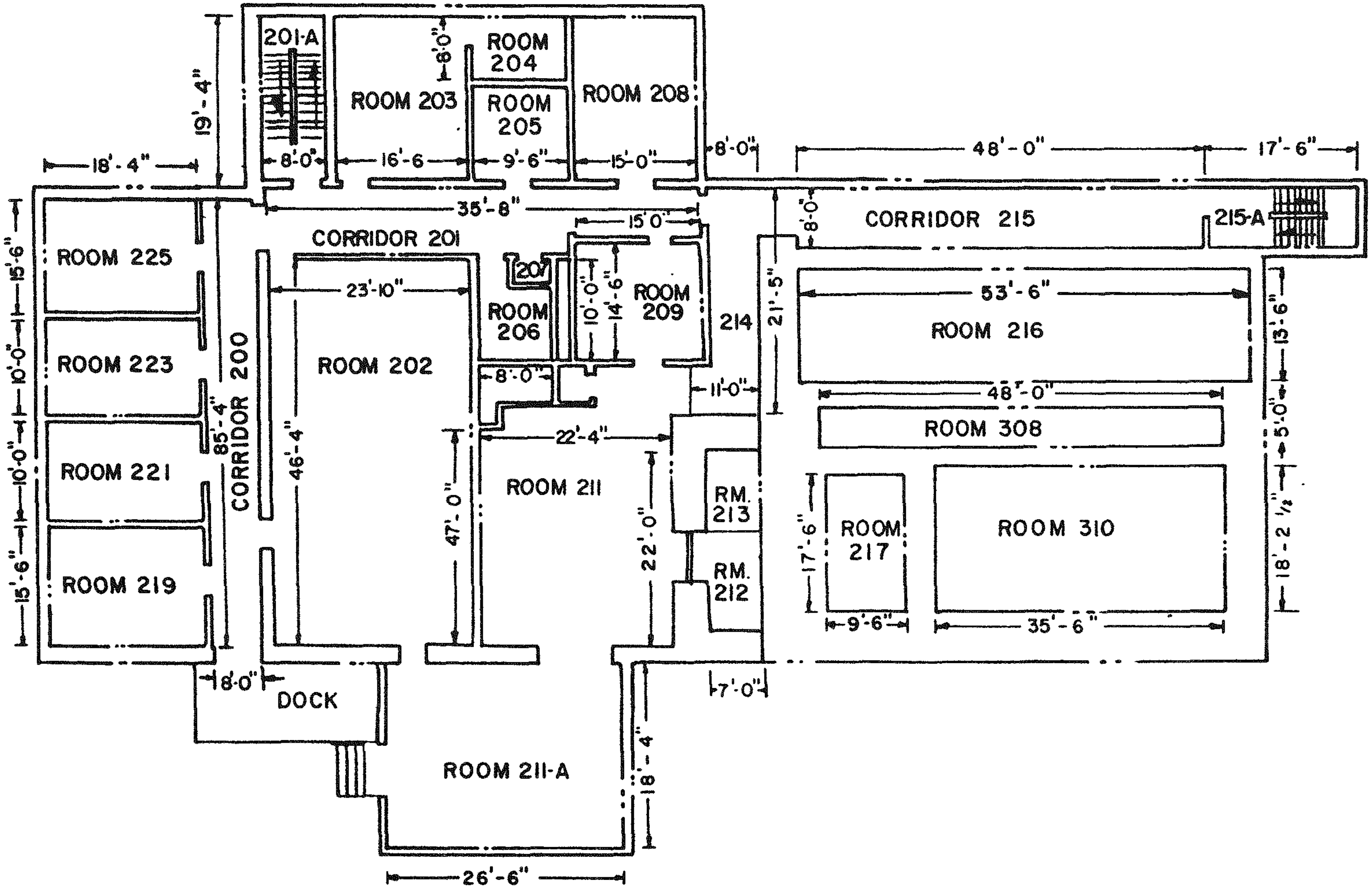
cc:
D. Padilla, LAAO
R. Kaiser, AL
S. McBee, AL
R. Garde, LANL

APPENDIX D

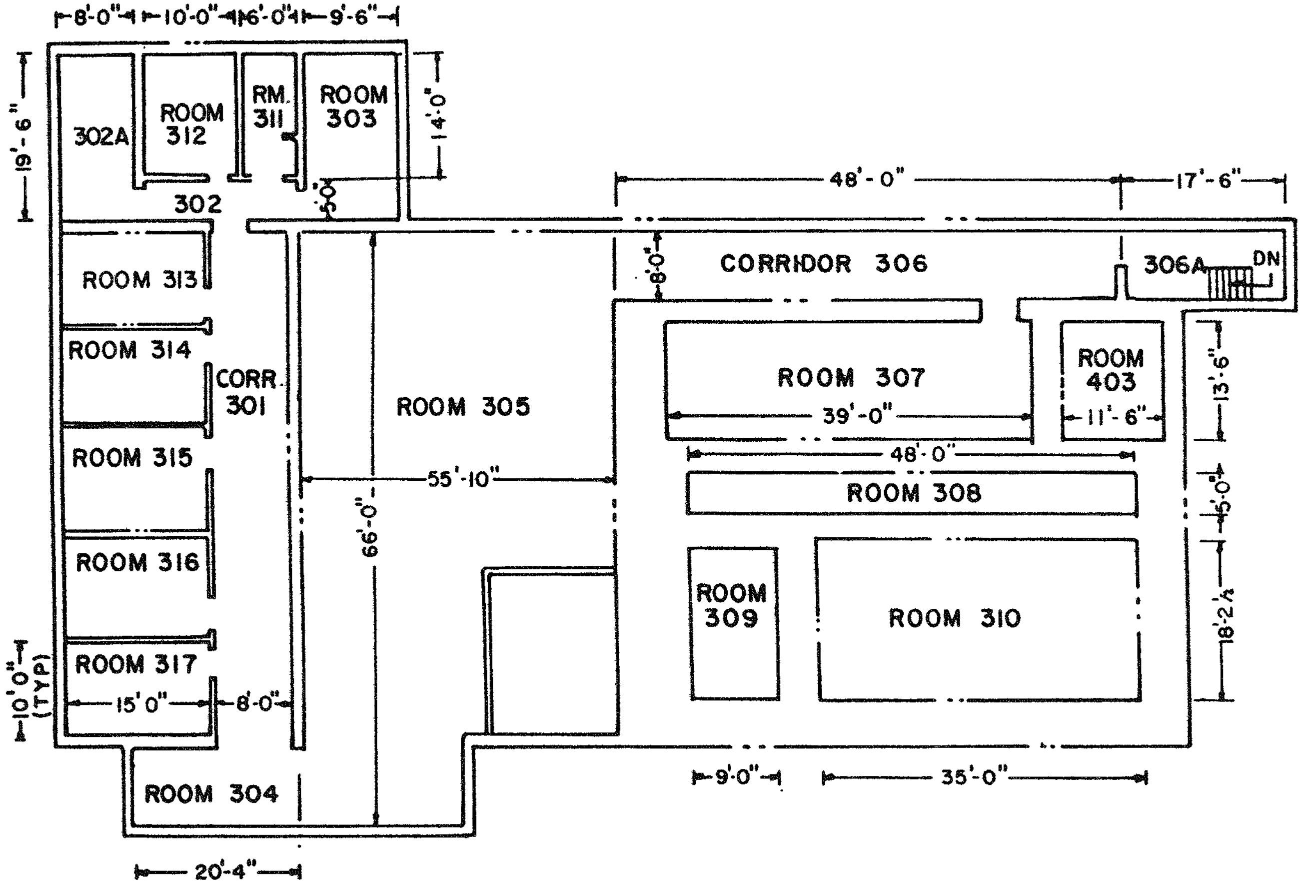
UHTREX BUILDING FLOOR PLANS



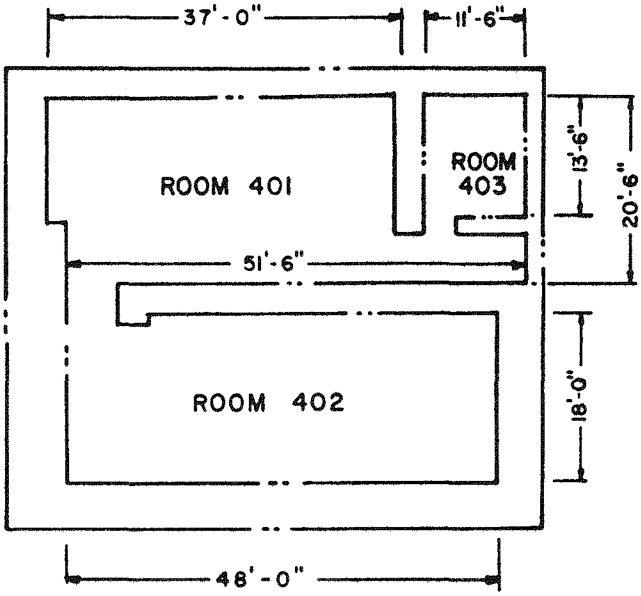
UHTREX Groundfloor Level Floor Plan



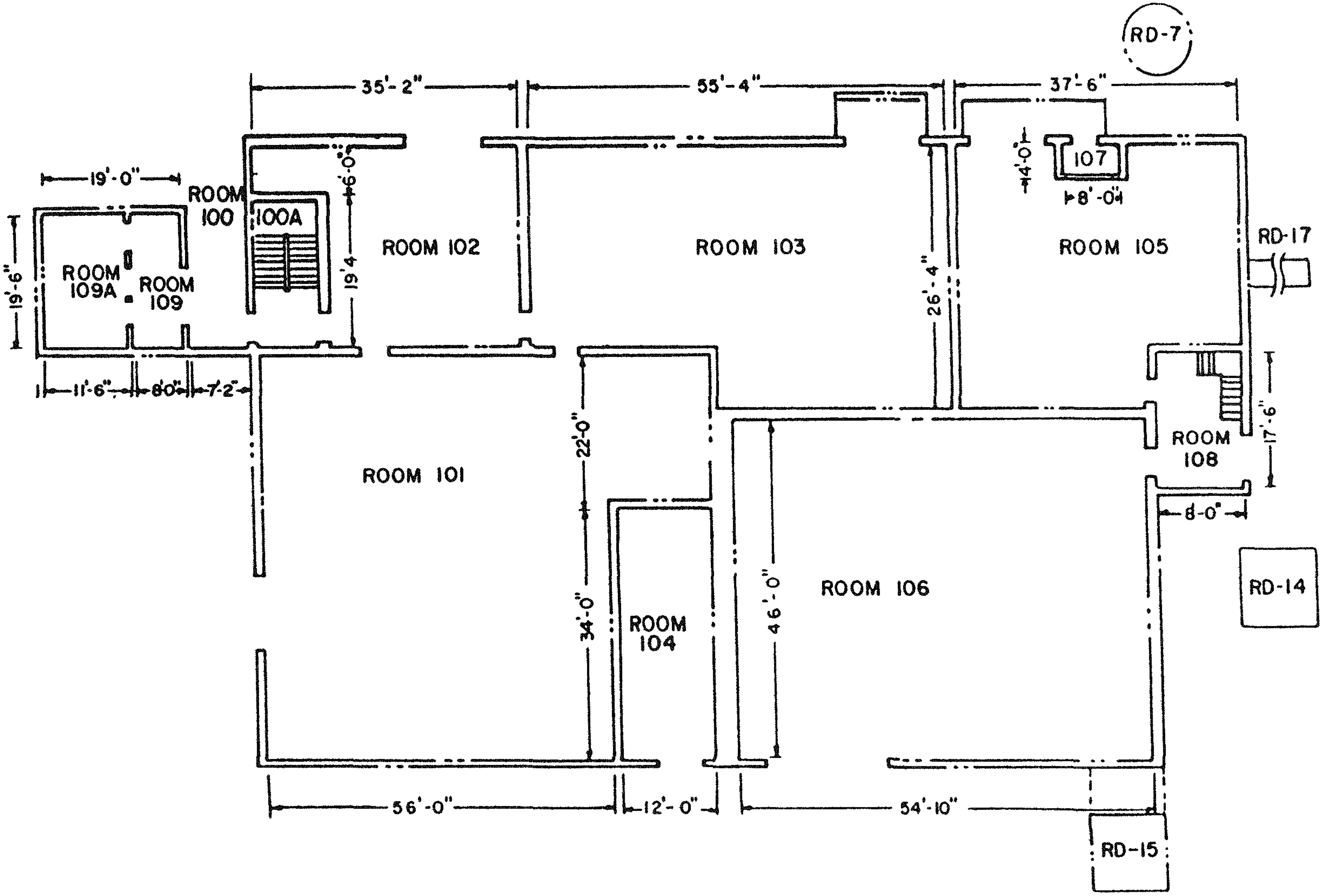
UHTREX Control Room Level Floor Plan



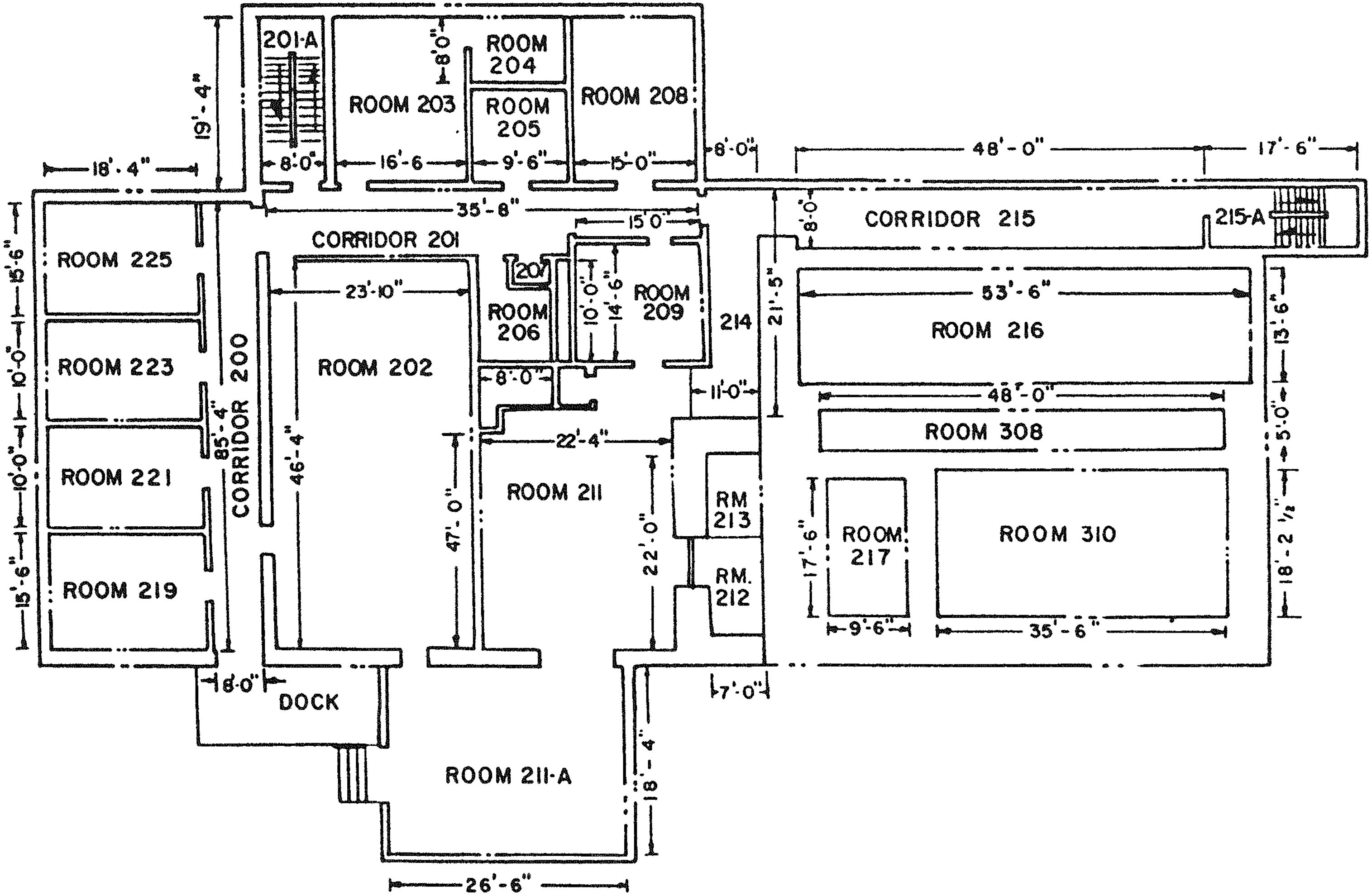
UHTREX Basement Floor Plan



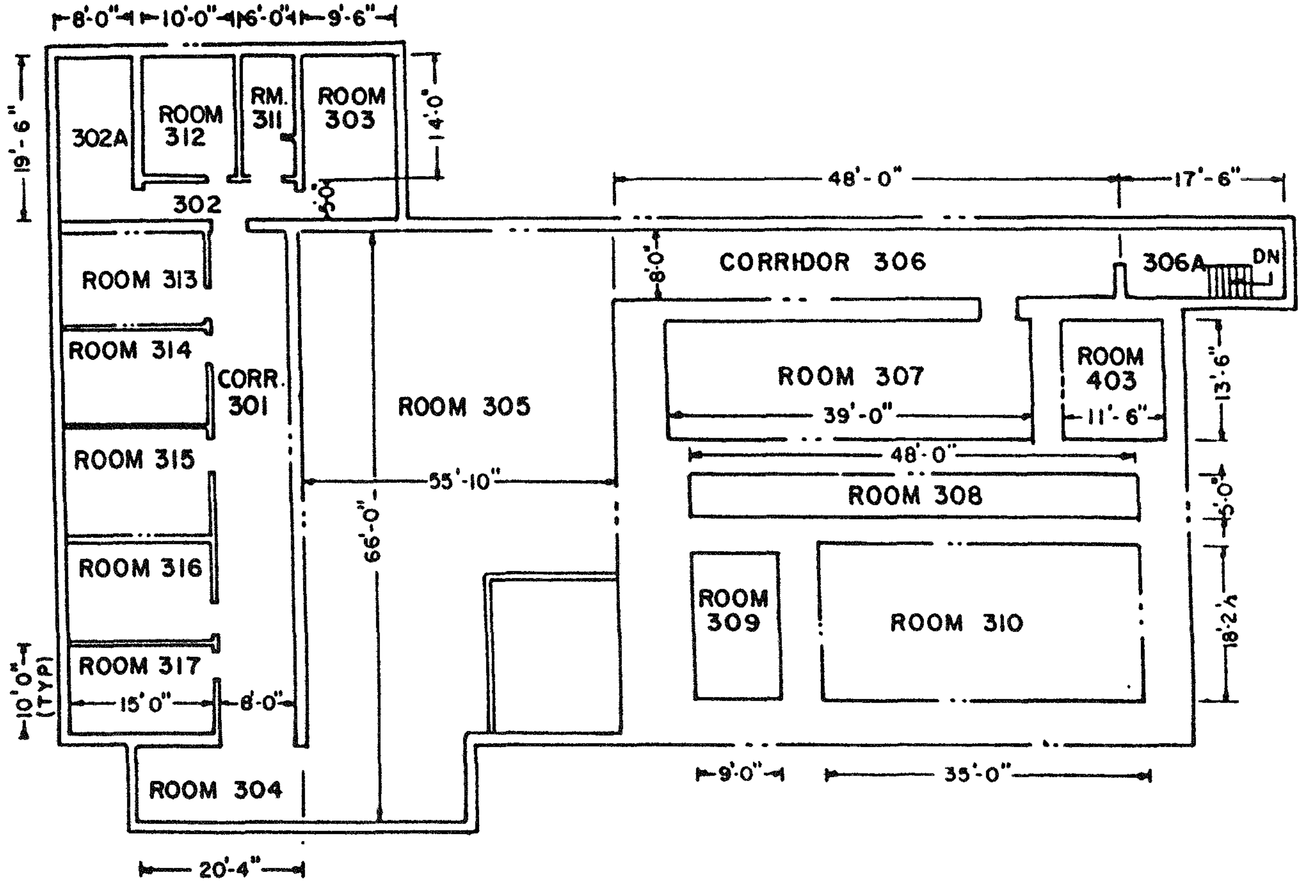
UHTREX Subbasement Floor Plan



UHTREX Groundfloor Level Floor Plan



UHTREX Control Room Level Floor Plan



UHTREX Basement Floor Plan

APPENDIX E

LOTUS RUN OF UHTREX BASELINE TRACKING

APPENDIX E

LOTUS RUN ON UHTREX BASELINE TRACKING

```
BASELINE COST VERSES SCHEDULE  FY88           UHTREX FAC. DECOMM. SYM:9530EV1.WK1 FY89                                                    *
******************************************************************************************************************************************************
MONTH (W/O MANAGEMENT RESERVE)                         OCT     NOV     DEC     JAN     FEB     MAR     APR     MAY     JUN     JUL     AUG     SEP
******************************************************************************************************************************************************
WBS      ACTIVITY                              X $1000
******************************************************************************************************************************************************
1.1      PROJECT SUPPORT                                     25.00   25.00   25.00   25.00   25.00   25.00   25.00   25.00   25.00   25.00   25.00
1.3      DECONTAMINATION
1.4.1    SITE DISMANTLEMENT                                  20.69   97.02   45.55
1.4.2    CHARACTERIZATION                            76.00   22.25   20.00   11.34
1.4.3    REMOVE HAZ MATERIALS
1.4.4    REM SUPPORT SYSTEMS                                                  9.00   53.53   48.10    1.62
1.4.5    DECOM HOT CELL AREA                                                                         12.64   16.64    1.74
1.4.6    REM REACTOR AUX SYS                                                                                         25.59   23.36   31.17   15.80
1.4.7    REM REACTOR & COMPON.
1.4.8    CONSTRUCTION SUPPORT                                12.40   12.40   13.27   17.70   22.13   17.70   17.70   22.13   17.70   22.13   14.16
1.5      WASTE DISPOSAL        **
1.6      HEALTH PHYSICS                                       9.00    9.00    9.00    9.00    9.00    9.00    9.00    9.00    9.00    9.00    9.00
1.8      RESTORATION
1.9      CLOSEOUT
******************************************************************************************************************************************************
MO BUD COST FOR WORK SCH(BCWS)       0.00    76.00   89.34  163.42  113.16  105.23  104.23   65.96   68.34   83.46   75.06   87.30   63.96
ACCUMLATIVE MONTHLY COST             0.00    76.00  165.34  328.76  441.92  547.15  651.38  717.34  785.68  869.14  944.20 1031.50 1095.46
******************************************************************************************************************************************************
MONTH (MANAGEMENT RESERVE)                             OCT     NOV     DEC     JAN     FEB     MAR     APR     MAY     JUN     JUL     AUG     SEP
******************************************************************************************************************************************************
1.1      PROJECT SUPPORT          10%                         2.50    2.50    2.50    2.50    2.50    2.50    2.50    2.50    2.50    2.50    2.50
1.3      DECONTAMINATION          10%
1.4.1    SITE DISMANTLEMENT       10%                         2.07    9.70    4.56
1.4.2    CHARACTERIZATION         10%                         2.23    2.00    1.13
1.4.3    REMOVE HAZ MATERIALS     10%
1.4.4    REM SUPPORT SYSTEMS      10%                                         0.90    5.35    4.81    0.16
1.4.5    DECOM HOT CELL AREA      10%                                                                 1.26    1.66    0.17
1.4.6    REM REACTOR AUX SYS      10%                                                                                 2.56    2.34    3.12    1.58
1.4.7    REM REACTOR & COMPON. *10/30%
1.4.8    CONSTRUCTION SUPPORT     10%                         1.24    1.24    1.33    1.77    2.21    1.77    1.77    2.21    1.77    2.21    1.42
1.5      WASTE DISPOSAL
1.6      HEALTH PHYSICS           20%                         1.80    1.80    1.80    1.80    1.80    1.80    1.80    1.80    1.80    1.80    1.80
1.8      RESTORATION              10%
1.9      CLOSEOUT                 10%
******************************************************************************************************************************************************
MONTHLY MANAGEMENT RESERVE (MR)                       0.00    9.84   17.24   12.22   11.42   11.32    7.49    7.73    9.24    8.41    9.63    7.30
ACCUMLITIVE MONTHLY MR                                0.00    9.84   27.08   39.30   50.72   62.04   69.53   77.26   86.50   94.91  104.54  111.84
******************************************************************************************************************************************************
ESTIMATED MONTHLY BUDGETED COST                              99.18  180.66  125.38  116.65  115.55   73.45   76.07   92.70   83.47   96.93   71.26
ACCUMLATIVE MONTHLY TOTAL COST     365.00    76.00  175.18  355.84  481.22  597.87  713.42  786.87  862.94  955.64 1039.11 1136.04 1207.30
*1.2.7.3 REM REACTOR/SUBCON 30%
1.4.7.2  ROOM 217          10%
1.4.7.3  ROOM 310          30%
1.4.7.6  ROOM 309          10%
** $5/WASTE DUMP FEE. PAID
DURING CHARACTERIZATION
BUD COST OF WORK PERFORM.(BCWP)                                                                       FY89                                       *
******************************************************************************************************************************************************
MONTH  (W/O MANAGEMENT RESERVE)                        OCT     NOV     DEC     JAN     FEB     MAR     APR     MAY     JUN     JUL     AUG     SEP
******************************************************************************************************************************************************
WBS      ACTIVITY                              X $1000
******************************************************************************************************************************************************
1.1      PROJECT SUPPORT                                     25.00   25.00   25.00   25.00   25.00   25.00   25.00   25.00   25.00   25.00   25.00
1.3      DECONTAMINATION                                                                                                                  5.00
1.4.1    SITE DISMANTLEMENT                                  14.88   71.94   32.60   49.66   10.23
1.4.2    PLANNING & ESTIMATING                       76.00   22.25   20.00   11.34
1.4.3    REMOVE HAZ MATERIALS                                                                                                            11.00    5.00
1.4.4    REM SUPPORT SYSTEMS                                          3.31   27.50   18.16    4.25    8.04    6.07   11.50   14.96   18.46
1.4.5    DECOM HOT CELL AREA                                                                 12.02    6.63    1.78    5.59    5.00
1.4.6    REM REACTOR AUX SYS                                                                 22.33   46.87   10.53    6.55   13.20   21.85
1.4.7    REM REACTOR & COMPON.                                                                                        6.68    5.80    3.52   22.50   38.67
1.4.8    CONSTRUCTION SUPPORT                                12.40   12.40   13.27   17.70   22.13   17.70   17.70   22.13   17.70   22.13   14.16
1.5      WASTE DISPOSAL
1.6      HEALTH PHYSICS                                       9.00    9.00    9.00    9.00    9.00    9.00    9.00    9.00    9.00    9.00    9.00
1.8      RESTORATION
1.9      CLOSEOUT
******************************************************************************************************************************************************
MO BUD COST FOR PERF (BCWP)          0.00    76.00   83.53  141.65  118.71  119.52  104.96  113.24   76.76   85.57   88.38  134.94   91.83
ACCUMLATIVE MONTHLY COST             0.00    76.00  159.53  301.18  419.89  539.41  644.37  757.61  834.37  919.94 1008.32 1143.26 1235.09
******************************************************************************************************************************************************
ACT COST OF WORK PERF (ACWP)                                                                          FY89                                       *
******************************************************************************************************************************************************
MONTH (W/O MANAGEMENT RESERVE)                         OCT     NOV     DEC     JAN     FEB     MAR     APR     MAY     JUN     JUL     AUG     SEP
******************************************************************************************************************************************************
WBS      ACTIVITY                              X $1000
******************************************************************************************************************************************************
1.1      PROJECT SUPPORT                                     19.10   22.90   22.88   26.50   19.90   23.40   24.80   13.00   31.22   28.70   37.50
1.3      DECONTAMINATION                                                                                                                  2.71    0.31
1.4.1    SITE DISMANTLEMENT                                  14.45   57.61   29.33   21.88    8.83            3.55    2.93    0.88            0.41
1.4.2    PLANING & ESTIMATING                        76.00   22.25   19.29    4.13    2.46
1.4.3    REMOVE HAZ MATERIALS                                                                                                             5.98    5.16
1.4.4    REM SUPPORT SYSTEMS                                          4.40   22.20   14.13    9.01    2.55    9.71   12.23   10.02   23.00
1.4.5    DECOM HOT CELL AREA                                                                 15.34    1.09    3.56    4.89    0.38
1.4.6    REM REACTOR AUX SYS                                                                 25.07   62.00   49.02   45.96   13.75   12.85    0.25
1.4.7    REM REACTOR & COMPON.                                                                                        1.30    7.86   12.50   15.73   41.27
1.4.8    CONSTRUCTION SUPPORT                                12.70    8.40   18.36    8.13   21.35   16.29   28.46   35.63   15.30   12.65   21.91
1.5      WASTE DISPOSAL
1.6      HEALTH PHYSICS                                       8.90   10.50    9.10    6.30    9.20    8.10    9.00    6.00    5.80    6.10    5.70
1.8      RESTORATION
1.9      CLOSEOUT
10.0     DELTA                                                                                                                   3.45   10.58    0.69
******************************************************************************************************************************************************
MO ACT COST OF WORK PERF (ACWP)      0.00    76.00   77.40  123.10  106.00   79.40  108.70  113.43  129.40  128.50   93.30  118.30  113.20
ACCUMLATIVE MONTHLY COST             0.00    76.00  153.40  276.50  382.50  461.90  570.60  684.03  813.43  941.93 1035.23 1153.53 1266.73
```

APPENDIX E

LOTUS RUN ON UHTREX BASELINE TRACKING

FY90 FY90

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	FY88	FY89 TOT	FY90 TOT	TOTAL
25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00					275.00	225.00	500.00
						9.23	15.39	19.24	14.85				0.00	58.71	58.71
						22.93	37.47	17.98					163.26	78.38	241.64
													129.59	0.00	129.59
					33.05	14.17							0.00	47.22	47.22
													112.25	0.00	112.25
													31.02	0.00	31.02
28.52	7.40												95.92	35.92	131.84
	39.11	45.18	48.20	104.42	106.11	13.88							0.00	356.90	356.90
17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70				189.42	177.00	366.42
													0.00	0.00	0.00
9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00			99.00	99.00	198.00
							16.67	16.67	16.67				0.00	50.01	50.01
						7.67	7.67	7.67	7.67	7.67	7.67		0.00	46.00	46.00
80.22	98.21	96.88	99.90	156.12	190.86	119.58	128.90	113.26	65.89	16.67	7.67	0.00	1095.46	1174.14	2269.60
1175.68	1273.89	1370.77	1470.67	1626.79	1817.65	1937.23	2066.12	2179.38	2245.27	2261.93	2269.60				

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP			
2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50				27.50	22.50	50.00
						0.92	1.54	1.92	1.49			0.00	5.87	5.87
						2.29	3.75	1.80				16.33	7.84	24.17
												5.36	0.00	5.36
					3.31	1.42						0.00	4.73	4.73
												11.22	0.00	11.22
												3.09	0.00	3.09
2.85	0.74											9.60	3.59	13.19
	9.01	13.56	14.46	31.33	31.83	4.16						0.00	104.35	104.35
1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77			18.94	17.70	36.64
												0.00	0.00	0.00
1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80		19.80	19.80	39.60
							1.67	1.67	1.67			0.00	5.01	5.01
						0.60	0.60	0.60	0.60	0.60	0.60	0.00	3.60	3.60
8.92	15.82	19.63	20.53	37.40	41.21	15.46	13.63	12.06	7.33	2.40	0.60	111.84	194.99	306.83
120.76	136.58	156.21	176.74	214.14	255.35	270.81	284.44	296.50	303.83	306.23	306.83			
89.14	114.03	116.51	120.43	193.52	232.07	135.04	142.53	125.32	73.22	19.07	8.27			
1296.44	1410.47	1526.98	1647.41	1840.93	2073.00	2208.04	2350.56	2475.88	2549.10	2568.16	2576.43	1207.30	1369.13	2576.43

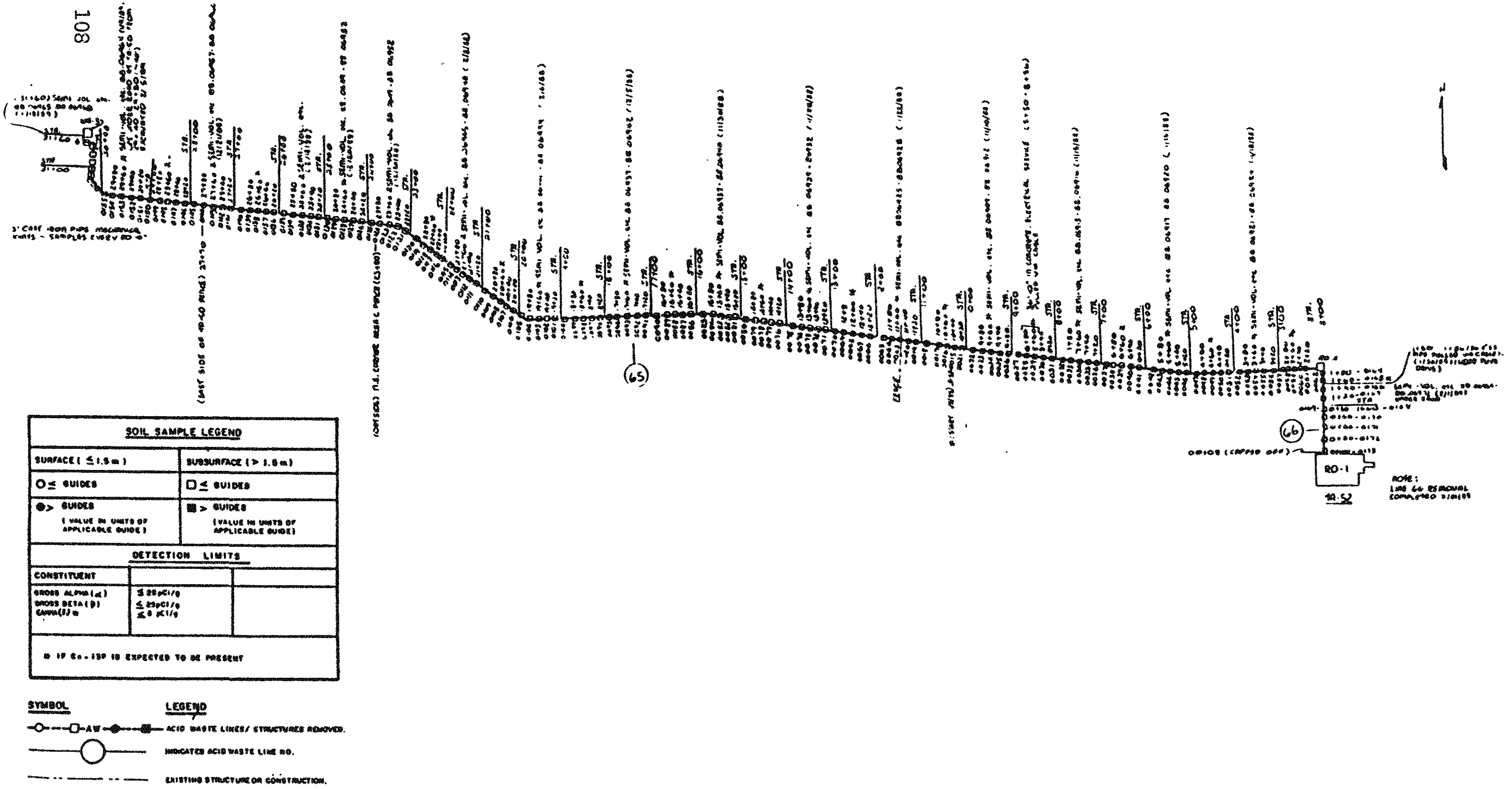
FY90 FY90

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	FY88	FY89 TOT	FY90 TOT	TOTAL
25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00				275.00	250.00	525.00
			0.29		7.00	0.90	10.00	12.00	20.50				5.00	50.69	55.69
						20.00	36.00	5.00	1.33				179.31	62.33	241.64
													129.59	0.00	129.59
	8.00			20.00	6.34	18.00	9.00	10.00	0.87				16.00	72.21	88.21
													112.25	0.00	112.25
													31.02	0.00	31.02
		5.00	2.62										121.33	7.62	128.95
24.57	20.00	39.63		20.00	161.65	0.10	10.00	5.00	0.00				77.17	280.95	358.12
17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70	17.70				189.42	177.00	366.42
													0.00	0.00	0.00
9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00				99.00	90.00	189.00
													0.00	0.00	0.00
										9.00	10.00		0.00	19.00	19.00
76.27	79.70	96.33	54.61	91.70	226.69	90.70	116.70	83.70	74.40	9.00	10.00	0.00	1235.09	1009.80	2244.89
1311.36	1391.06	1487.39	1542.00	1633.70	1860.39	1951.09	2067.79	2151.49	2225.89	2234.89	2244.89				

FY90 FY90

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	FY88	FY89 TOT	FY90 TOT	TOTAL
20.40	19.40	23.40	65.30	16.40	29.50	20.00	23.73	20.90	30.40	11.36	5.11		269.90	285.90	555.80
			0.29		6.69	0.87	9.34	12.20	20.50	34.40	1.14		3.02	85.43	88.45
0.20	0.10	0.32	0.14	0.16		19.24	24.95	30.17	5.19	0.97			139.87	81.44	221.31
												365.00	124.13	0.00	489.13
0.96	8.27	0.88	14.65	29.71	6.34	17.23	8.62	3.05	0.81	0.00	1.13		11.14	91.65	102.79
													107.25	0.00	107.25
													25.26	0.00	25.26
		17.78	10.27	0.16	12.08	0.10		1.35					208.90	41.74	250.64
26.83	28.38	27.50	0.51	5.68	25.29	141.00	3.87	4.72	8.57	2.10			78.66	274.45	353.11
10.83	12.32	17.12	10.84	18.49	20.84	13.16	25.49	30.72	20.33	18.13	12.19		199.18	210.46	409.64
													0.00	0.00	0.00
6.20	6.40	6.20	6.60	6.50	6.60	6.20	6.80	6.20	6.60	7.00	6.20		84.70	77.50	162.20
										23.44	50.63		0.00	74.07	74.07
											20.00		0.00	20.00	20.00
													14.72	0.00	14.72
65.42	74.87	93.20	108.60	77.10	107.34	217.80	102.80	109.31	92.40	97.40	96.40	365.00	1266.73	1242.64	2874.37
1332.15	1407.02	1500.22	1608.82	1685.92	1793.26	2011.06	2113.86	2223.17	2315.57	2412.97	2509.37				

APPENDIX F



Contaminated Waste Lines 65 and 66 and Soil Sample Survey

APPENDIX G

CONFIGURATION CONTROL BOARD CHARTER

CONFIGURATION CONTROL BOARD (CCB)

A CCB shall be established for each Line Item project. The CCB will review and approve changes as described below from Title I through the completion of construction. All changes that affect the Design Criteria or the construction documents must be reviewed by the Construction Project Manager (CPM) for Design Review Record (DDR) applicability with respect to Engineering, Health Safety and Environment (HSE), Operational Security and Safeguards (OS), user, and specific disciplines. The CPM presents the change to the CCB and assures coordination with affected organizations prior to CCB presentation. The CCB meets as frequently as needed to provide change control and to accomplish management of the project baselines.

TYPE I CHANGE

Type I changes are those changes that deviate from the requirements set forth in the Congressional Project Data Sheet (CPDS) or exceed the fiscal limits imposed by the CPDS.

Type I changes are also those changes that exceed $100,000 or extend the approved schedule more than 30 days, and do not effect the CPDS. Implementation of Type I changes require the full approval of the CCB.

TYPE II CHANGE

Type II changes are any changes that are less than $100,000 but more than $5,000, does not require a change in the CPDS, and imposes a delay in the approved schedule of less than 30 days. Type II changes require review by the entire CCB and approval by the majority of the CCB.

TYPE III CHANGES

Changes that are $5,000 or less and do not effect the CPDS or schedule require the approval of the CPM.

Appendix G

CONFIGURATION CONTROL BOARD ACTION DOCUMENTATION

AUTHORIZATION NO. AND TITLE: ______________________________

CHANGE TYPE AND TITLE: ____________________ DATE: __________

SERIAL NO.: ______ CHANGE PROPOSAL: ______ MODIFICATION ID: ______

DESCRIPTION: ______________________________

JUSTIFICATION: ______________________________

GOVERNMENT ESTIMATE: ______________________________

SCHEDULE IMPACT: ______________________________

DISPOSITION: ______________________________

PCB ACTION:

SIGNATURE	APPROVED	DISAPPROVED	COMMENT
CCB MEMBER	[ ]	[ ]	
CCB MEMBER	[ ]	[ ]	
CCB MEMBER	[ ]	[ ]	

File L.J. ____-__, MS M703
File ENG-1, MS K721

APPENDIX H

LINE LEFT UNDER UHTREX

Appendix H

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO Ray Garde, HSE-7, MS E518

DATE May 15, 1989

FROM John Elder, HSE-1 Radiation Protection Programs Acting Section Leader

MAIL STOP/TELEPHONE K483/7-3366

SYMBOL HSE-1-89-298

SUBJECT SECTION OF LINE 66 LEFT UNDER BUILDING RD-1 AT TA-52

Line 66, a 4-inch stainless steel pipe between RD-1 and RD-2, has been removed except for a 36-ft section under a slab north of RD-1 and under the building itself. Contamination in this section of pipe has been shown to be under residual radioactivity guidelines by swipe samples at either end. This memo is provided for documentation of its location and justification for not removing it with the balance of the pipeline.

Removal of Line 66 was accomplished without difficulty up to the point where it went under a concrete apron at the roll-up door entering Room 102. Depth of the pipe at this point was 4 ft; however, within 2 ft of the subsurface building wall, the pipe turns vertically downward for approximately 22 ft, then turns southward for approximately 12 ft under the base pad of the building where it enters the sump tank in Room 303. It is this long vertical leg and 12-ft horizontal leg (36 ft total remaining) that was left after plugging the end of the pipe outside the building and backfilling the trench.

Health physics surveys of the pipe showed no detectable activity at either end of the pipe by large area swipe. Had the pipe exhibited a high level of contamination, it might have been justifiable to remove the concrete apron and remove as much of the vertical leg as possible. However, removal of the vertical leg (22 ft) would have required shoring a very deep hole or opening up a very large hole in the asphalt parking lot to allow safe excavation. Removing the horizontal leg under the building would have required either tunneling under the building or cutting through the base pad, either option very expensive and involving significant safety hazards. Leaving the pipe in place causes no identified hazard.

Results of the large area swipes inside the pipe are on file at the HPAL and with the HSE-1 radiation protection technician. The verification contractor at ORAU (Michele Landis) has been notified by phone of this decision. Lab Drawings ENG-C-31835 (Layout and Utility Plan) and -31894 Section Views will be updated to reflect the status of Line 66.

JE:ib

xc:
- M. Salazar, HSE-7 MS K556
- D. Hohner, ENG-5, MS M713
- L. Soholt, HSE-8, MS K490
- C. Garcia, HSE-1, MS K556
- D. Tonkay, Weston OTS, Germantown
- D. Padilla, LAAO, MS A316
- J. Berger, CRAU, Oak Ridge
- CMR(2), MS A150
- HSE-1 File

*U.S. Government Printing Office: 1992-673-036/67029