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LOS ALAMOS NATIONAL LABORATORY CASE STUDIES ON THE DECOMMISSIONING OF RESEARCH REACTORS AND A SMALL NUCLEAR FACILITY

by

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This training-course material presented at Argonne National Laboratory on March 26, 1998, as part of the International Atomic Energy Agency and Argonne National Laboratory Training Course on Decommissioning.

ABSTRACT

Approximately 200 contaminated surplus structures require decommissioning at Los Alamos National Laboratory. During the last 10 years, 50 of these structures have undergone decommissioning. These facilities vary from experimental research reactors to process/research facilities contaminated with plutonium-enriched uranium, tritium, and high explosives. Three case studies are presented:

- a filter building contaminated with transuranic radionuclides,
- a historical water boiler that operated with a uranyl-nitrate solution, and
- the ultra-high-temperature reactor experiment, which used enriched uranium as fuel.

1.0 INTRODUCTION

In 1989, the US Department of Energy (DOE) Office of Environmental Restoration and Waste Management was established and combined under the Office of Environmental Management, which is chartered to perform decommissioning of contaminated surplus structures. In 1991, DOE began to consolidate and reconfigure its weapons program at a national scale. The Defense Program began to identify surplus buildings for decommissioning.

Until 1992, decommissioning efforts at Los Alamos National Laboratory were limited to one project every two to five years. As part of the reconfiguration, more than 150 structures were identified in 1995 as surplus and contaminated.[1]

At present, approximately 200 contaminated surplus structures require decommissioning at the Laboratory. In the last 10 years, the Laboratory has decommissioned 50 such structures. These structures vary from experimental research reactors to process/research facilities contaminated principally with plutonium, enriched uranium, tritium, and high explosives. This report presents three case studies:

- a filter building contaminated with transuranic radionuclides,
- a historical water boiler that operated with a uranyl-nitrate solution, and
- the ultra-high temperature reactor experiment, which used enriched uranium as fuel.

2.0 LABORATORY HISTORY

In 1942, the US Army Manhattan Engineer District was established to develop the atomic bomb. The Army selected a remote site located in New Mexico as an appropriate location for conducting experimental work. Both privately owned and public land was acquired for the project. This new territory became known as the Los Alamos Site, which later became the Los Alamos Scientific Laboratory.

Los Alamos National Laboratory is predominately in Los Alamos County, which is located in north-central New Mexico. The 43-mi^2 (111-m^2) Laboratory site is situated on Pajarito Plateau, which consists of a series of finger-like mesas separated by canyons. The mesa-top elevations range from 6,200 ft to 7,800 ft. DOE controls the area within the Laboratory's boundary (Fig. 1) and the University of California manages and operates the Laboratory for DOE. Past and present Laboratory operations include nuclear and non-nuclear research and development for defense and civilian purposes.

3.0 DECOMMISSIONING PROCESS

3.1 Decommissioning Guidance under DOE EM

In the DOE Guidance 430.1.1 dictionary, decommissioning is defined as "the process of removing a facility from operation, followed by decontamination,

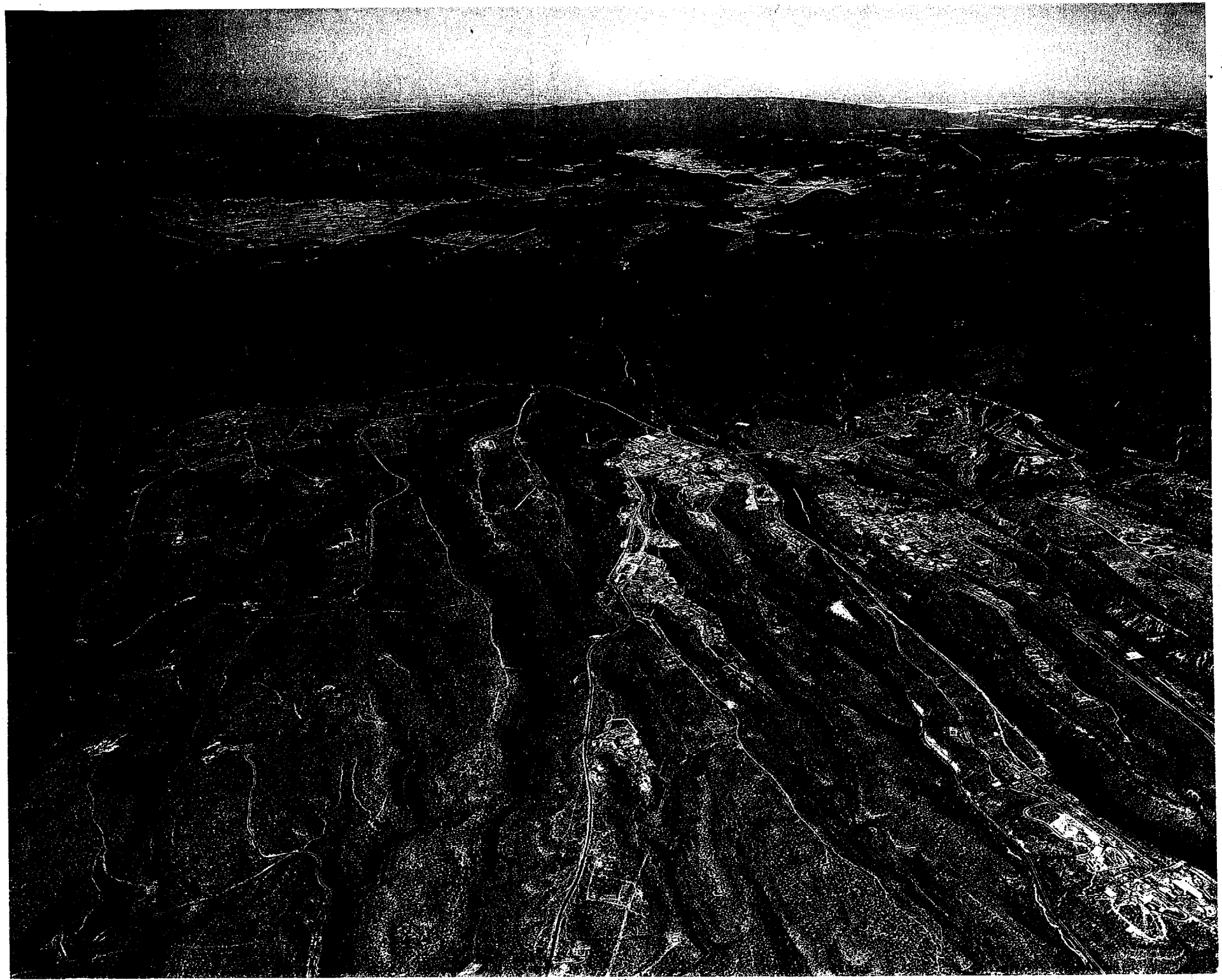

Fig. 1. Aeral view of Los Alamos.

entombment, dismantlement, or conversion to another use." It also defines decontamination as "the removal of hazardous material (typically radioactive or chemical material) from facilities, soils, or equipment by washing, chemical action, mechanical cleaning, or other techniques."

The abbreviation "D&D" is also loosely used to mean the same thing. The DOE process is being modeled to reflect the CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act) non-time critical removal actions. The Laboratory follows the DOE process.

In broad terms, decommissioning is divided into two phases: planning and operations. Deactivation or post-decommissioning activities to shut down operations are not discussed here but could be included in the process. The reason for excluding shut-down operations in the decommissioning process at Los Alamos is because funding is provided by a different DOE organization.

3.1 Planning

Planning involves collecting radiological, chemical, and physical data to design, evaluate, and assess environmental compliance, thereby ensuring that the decommissioning plan meets all applicable federal and state laws and regulations. These laws protect workers, the public, and the environment. The following factors are addressed during this phase: cost and schedules, project plans, specifications, and procurement processes.

3.2 Operations

Operations consists of the actual field work required to decommission a facility (as described in the project-planning documents). This work includes decontamination, dismantlement, waste disposal, restoration, certification and verification, and final documentation.

DOE's Decommissioning Resource Manual[2] provides excellent guidance on performing decommissioning. Particular attention should be paid to the contents of the project plan found in the manual's Appendix G.

3.3 Environmental Safety and Health Strategy

The main strategy is to develop a generic health and safety plan (HASP) that protects workers, the public, and the environment. The HASP mirrors information provided in a technical plan; it identifies general hazardous and work procedures.

A site-specific health and safety plan (SSHASP) then tailors information to specific projects. A SSHASP is part of the bid documents from the contractor performing the work. The SSHASP provides flexibility to contractors regarding how to perform the work by allowing them to (1) conduct a task-hazard analysis of specific field activities and (2) write the procedures just before performing the work.

Environmental compliance is addressed during the National Environmental Protection Act reviews. Clean Air Act, Clean Water Act, and other applicable regulations are addressed and included in the project plan.

4.0 CASE STUDIES

4.1 TA-21-Filter Buildings (146, 324, and 329)[3]

4.1.1 Project Description

The filter-building project consisted of decommissioning three buildings that contained filters and ventilation systems. These systems were used in operating uranium and plutonium research and process laboratories located at the Laboratory's Technical Area, or TA, 21.

Initial air flow passed through the fire-screen plenum in Building 329 into the plenum in Building 146. This plenum contained a large, drum-shaped HEPA filter system. The drum diameter was approximately 92 in. (2.3 m), with a length of 96 in. (2.4 m). It contained 24 filters, with 3 filters arranged along each side of the 8-sided drum. The air flow then went to Building 324, which provided a second stage

of filtration. The flow in Building 324 passed through 20 parallel HEPA filters and exited the stack (Fig. 2).

Building 146 consisted of a concrete-block structure that measured 18 x 40 ft, with a height of 13 ft (5.5 x 12.2 x 4 m). Equipment in the building consisted of a stainless-steel rotary filter plenum, recovery dry boxes, loading hood, wall exhaust fan, electric unit heater, and two 30-hp electric exhaust fan motors and fans coupled to a 36-in- (91-cm-) diameter stack (Fig. 3).

Building 324 consisted of a concrete-block structure that measured 20 x 60 ft, with a height of 12 ft (6.1 x 18.1 x 3.6 m). It contained HEPA filters that vented to an exhaust stack (Fig. 4).

Building 329, which functioned the fire-screen plenum, housed a wall of metal-screen filters. The plenum was constructed of 16-gauge stainless-steel 10 x 15 x 10 ft (3x 4.6 x 3 m).

Building 146 and 342 provided process exhaust ventilation for all plutonium-processing and research activities at TA-21. At one point, approximately 1100 linear ft (33.5 m) of glove boxes connected to the system. At the beginning of this decommissioning project, only Buildings 3 and 4 North and Building 21 connected to the process system.

4.1.2 Hazards

Because of the ^{239}Pu holdup (residual material) in building 146, it was regarded as a Category 3 nuclear facility. Radioactivity was in millions of dpm/100 cm^2 (alpha) in both buildings. Beta/Gamma varied from 15 to 400,000 dpm/100 cm^2 (7000 Bq). Levels of ^{239}Pu in excess of 60 grams existed in Building 146.

4.1.3 Decommissioning Operations

4.1.3.1 Decontaminate Fire-Screen Plenum and Rotary Filter Plenum

Decontaminating both plenums reduced the source term below a Category 3 nuclear facility levels, which lead to the building being reclassified as a radiological

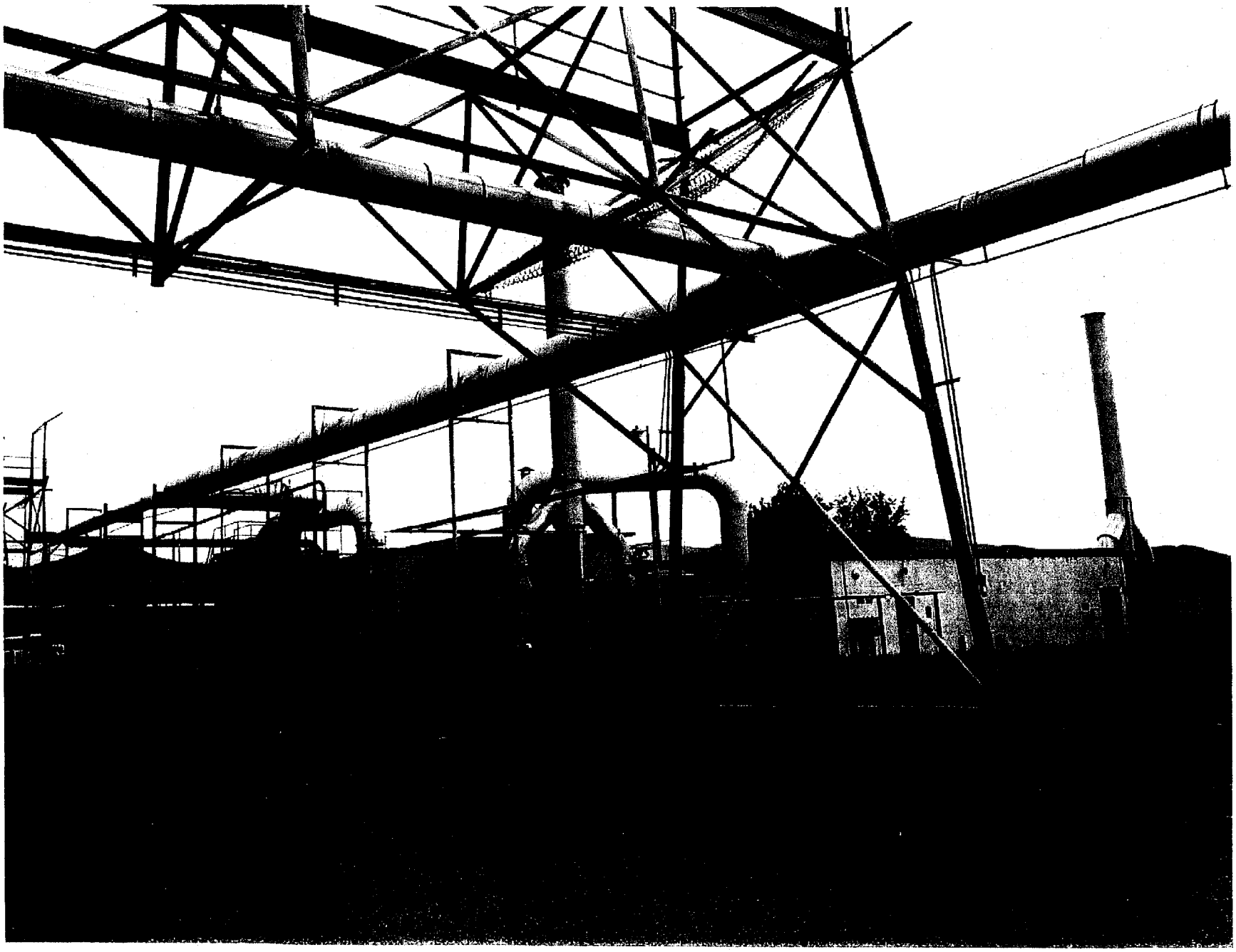

Fig. 2. Building 329, 146, and 324.

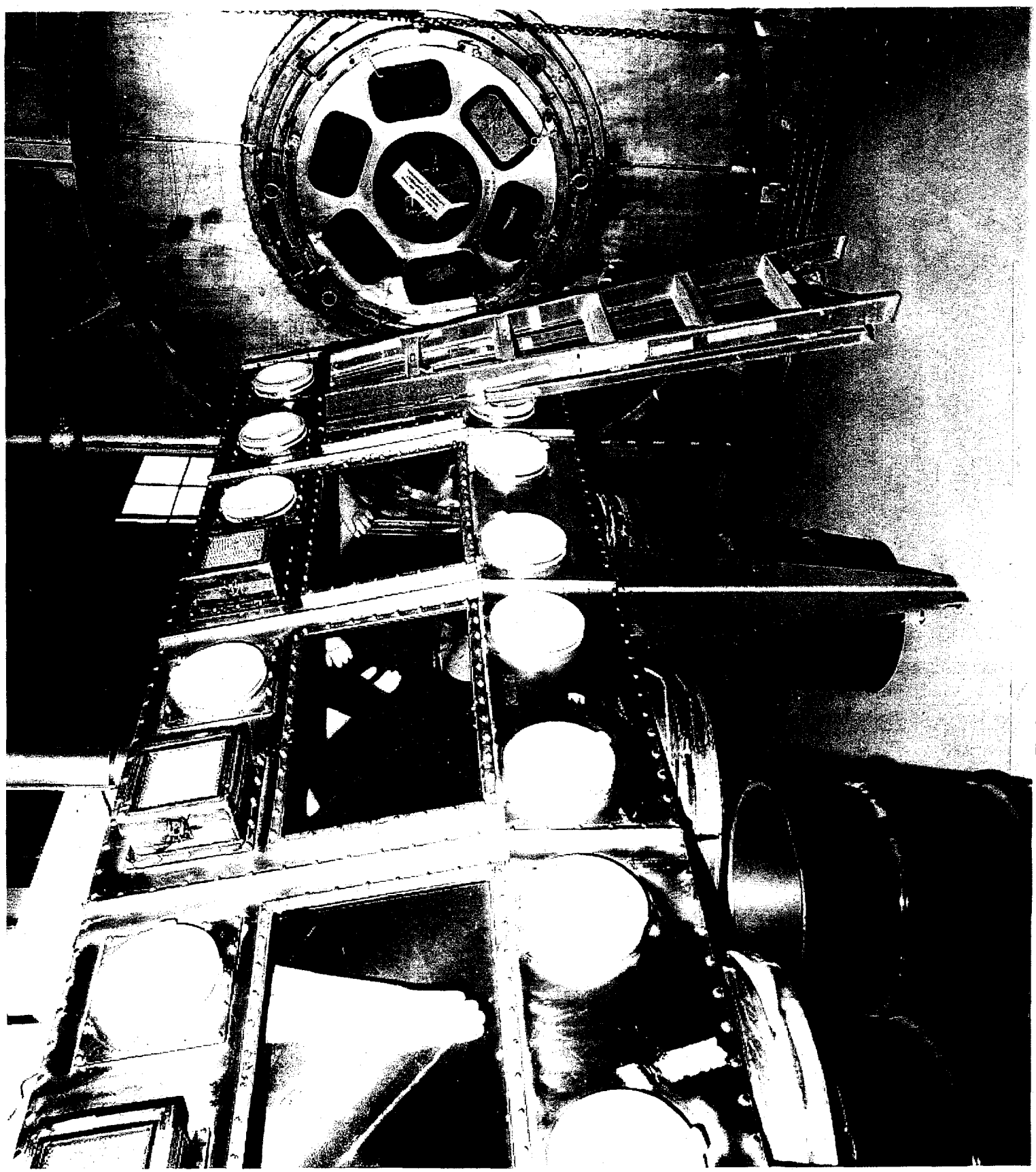

Fig. 3. Building 146, rotary plenum and glove boxes.

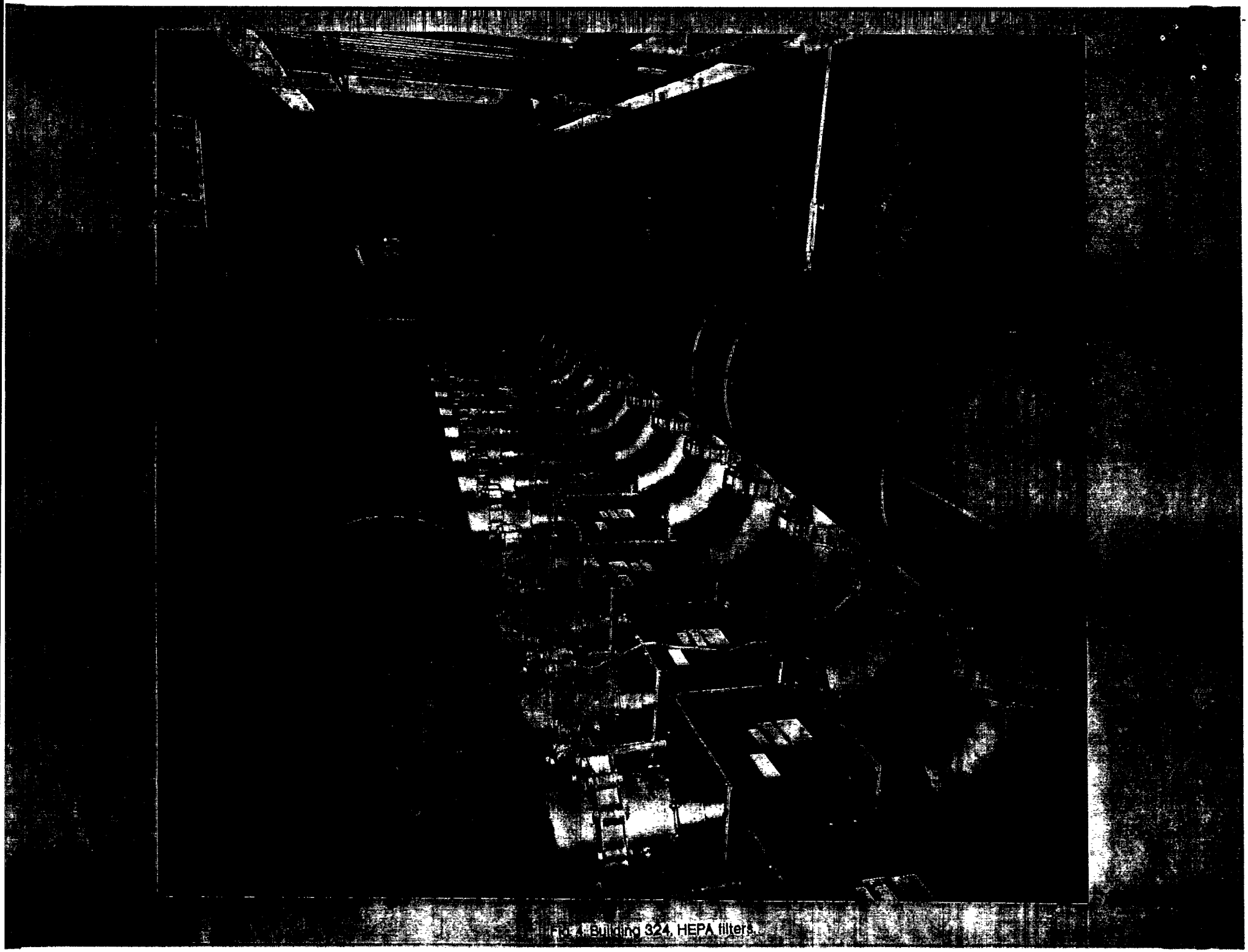

Fig. 1 Building 324, HEPA filters.

facility. Special containment was constructed around both plenums. A louvered damper was installed near the exhaust fans on Building 324. This modification supplied clean makeup air to help vary the negative pressure in the plenums. Large plastic tents with gloves extending outward (called "body gloves") were erected inside the plenums (Fig. 5). Using supplied-air respiratory protection, workers entered the body gloves, vacuumed the plenum interiors, and applied and removed strippable fixatives to decontaminate the structures. Workers also applied fixative to the fire screens; they were removed and packaged as TRU (transuanic) waste.

4.1.3.2 Remove Hoods, Glove Boxes, and Process Exhaust System

All systems tied into the process exhaust system were disconnected at the flanged connections, if possible, or with nibblers to avoid producing sparks. Glovebags were used at all locations to contain contamination. Metal below 1 nCi/g (37 Bq/g) of activity was packaged for shipment to a metal recycler.

4.1.3.3 Remove Fire-Screen Plenum and Associated Ductwork

After removing all process exhaust that led to the fire screen, fixative was applied to the interior of the fire screen to eliminate removable contamination. Holes were drilled into the large crossover piece and fixative applied to again lock down contamination. The crossover piece was disconnected using glovebags and nibblers, with the piece lifted off with a crane. The fire screen was moved to a controlled area and the empty space filled with low-level waste. The structure was shipped to a low-level burial area.

4.1.3.4 Remove HEPA Filters from Building 146

The existing glove-box system was used to remove the filters inside the rotary drum. Fixative was sprayed onto the filters, which were then wrapped and placed inside TRU-standard-waste boxes. The glove box was modified by removing the east end plate and fabricating a bag-out system to transfer the filters to the waste box.

Fig. 5. Body Gloves.

4.1.3.5 Decontaminate Plenum and Rotary Drum in Building 146

Using supplied-air respirator protection, workers entered the main plenum to apply fixative and lock down any removable contamination. Radiological surveys were performed to confirm that the plenum was below the TRU waste threshold.

4.1.3.6 Demolish Buildings

After power and interior equipment was removed from Buildings 146 and 324, the decontamination operation began. A shot-blast system was used to decontaminate portions of the floor. Surveys were performed to confirm that release limits met non-radiological facility criteria. The structures were then demolished with a trackhoe. The block walls and concrete slab were removed and crushed and used as backfill. The site then underwent grading.

4.1.3.7 Decontaminate Package and Transport

Ductwork and other items that had the potential to generate an airborne contamination level in excess of 100 derived-air concentration (DAC) were decontaminated in a central, controlled room at the site. Two temporary cells with backup power, redundant ventilation, and redundant contamination controls were built.

Ducts were decontaminated with circular metal brushes that could be retracted into end caps. Coupons were cut from the ducts for assays to ensure material was below TRU limits. Smaller pipe was not decontaminated, but assays showed it was below TRU limits. Sectioning and size reducing of the ductwork was performed inside the removed glove boxes. The glove boxes were modified to permit continuous introduction of the duct from the box sides, and a portable negative-air machine provided system exhaust.

Strippable fixatives proved effective in decontaminating glove boxes and hoods. The bottom of glove boxes remained the only TRU waste. The rest of the glove box was sectioned and disposed as low-level radiological waste.

4.1.4 Cost and Schedule

The project took approximately 1-3/4 years to complete from planning through operations, with a cost of approximately $2.3 million. The initial estimate was $2.5 million. The work was performed on a cost/plus contract by a Laboratory subcontractor, with the Laboratory providing direct management and health and safety support.

4.1.5 Lessons Learned

The project was completed in an efficient manner because the Laboratory adhered to the project plan, health and safety plan, and existing hazard. Critical operations were discussed with risk management experts who assisted in eliminating unnecessary documentation .

The safety record was good. No radiological incident or worker injuries occurred. Active involvement of the entire project team, particularly the workers, resulted in thorough task-hazard analysis and the development of sound work procedures. Daily safety meetings introduced and reinforced safety topics.

Duct decontamination proved difficult. Different alternatives were considered but discarded because they introduced new hazards or were not cost effective. At first, strippable fixatives were sprayed inside the pipe, but these peeled during cutting operations and caused airborne contamination. This process was replaced by using metal brushes and constructing engineering controls. TRU waste was reduced to save on disposal costs. Glove boxes proved easier to decontaminate and size reduce.

4.2 Water Boiler[4]

4.2.1 Description

Enrico Fermi advocated constructing at Los Alamos what became the world's third reactor and the first homogeneous liquid fuel reactor fueled by uranium enriched in ^{235}U. Three versions were built, all on the same principle and code named "Water Boiler." In the higher power versions, the fuel solution appeared to

boil because hydrogen and oxygen bubbles were formed in the solvent by the energetic fission products. The first Water Boiler was assembled in 1943 in a building that still exists today. This reactor's fuel consumed the country's total inventory of enriched uranium (14% ^{235}U). Two machine-gun posts were located at the site for security.

This first reactor was called LOPO (low power, which was virtually zero). In May 1944, this reactor went critical. It served in determining the critical mass of a simple fuel configuration in a reactor and tested a new reactor concept.

In 1944, a second reactor became operational; it was called HYPO (high power at 5.5 kilowatts) and provided a strong source of neutrons. A massive concrete shield was built around the core. Many key neutron measurements were obtained to help design the early atomic bombs.

By 1951, extensive modifications to the second reactor had been made to increase the power to 35 kilowatts. This third version of the reactor was called SUPO (super power, which provided desirable neutron fluxes and operated until 1974). It was an 89% enriched uranium homogeneous reactor consisting of a 1-ft. (0.3-m) stainless-steel sphere filled with a solution of uranyl nitrate and surrounded by a graphite neutron-reflector. It included a concrete biological shield 15 ft x 15 ft x 11 ft high, two thermal columns, various access ports, and a gas recombination system.

A recombination system was added in 1951 to recombine hydrogen and oxygen radiolytically dissociated by reactor operations. The system reduced the hydrogen-explosion hazard, as well as the quantity of radioactivity contaminated gas requiring discharge to the atmosphere (Figs. 6 and 7). The gases flowed through an underground line to a 150-ft (46-m) stack.

4.2.2 Facility Description

The Laboratory's Omega site (TA-2) is located in Los Alamos Canyon. The Los Alamos Canyon Road is the only direct access. Room 122 housed the Water Boiler

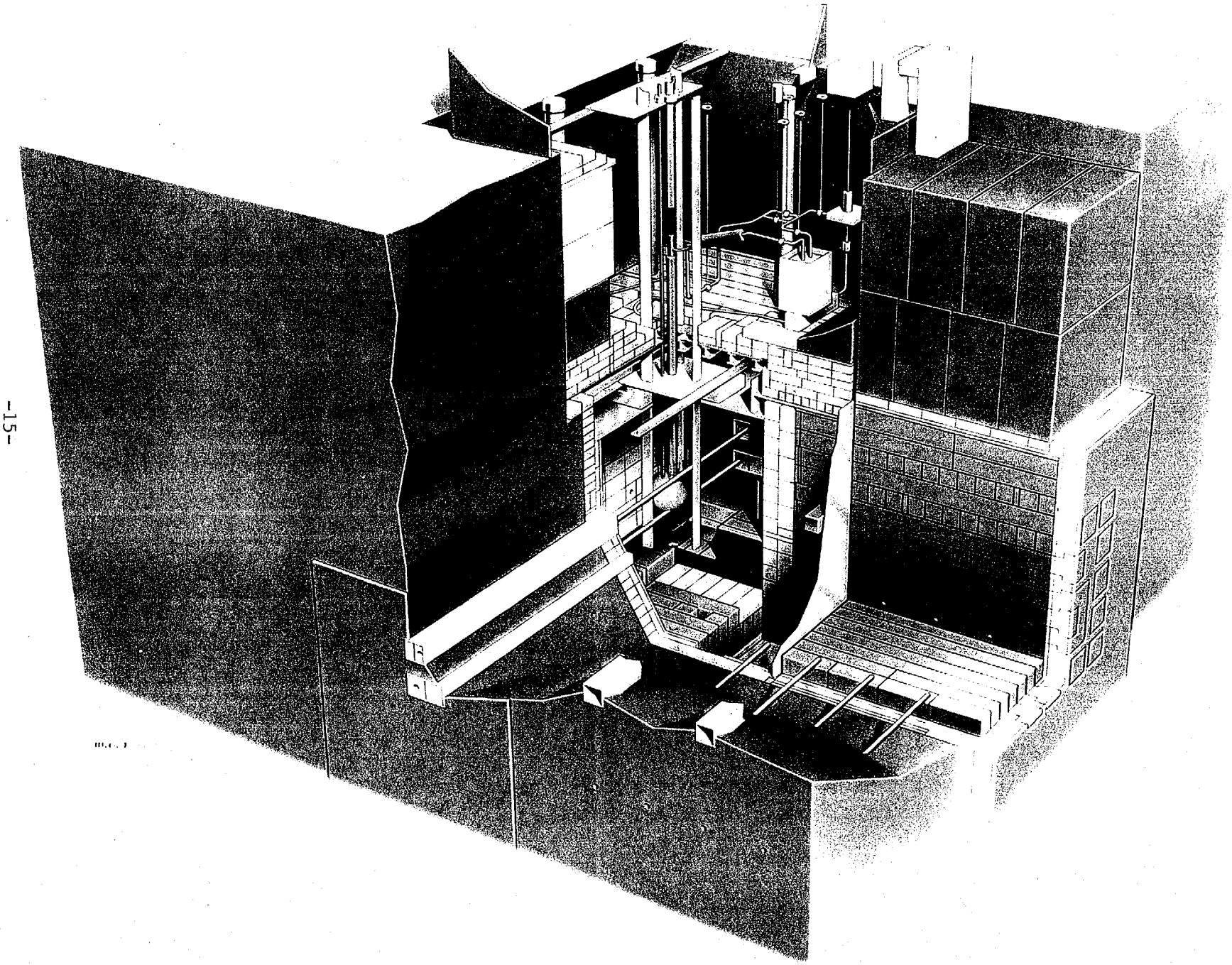

Fig. 6. Water Boiler reactor.

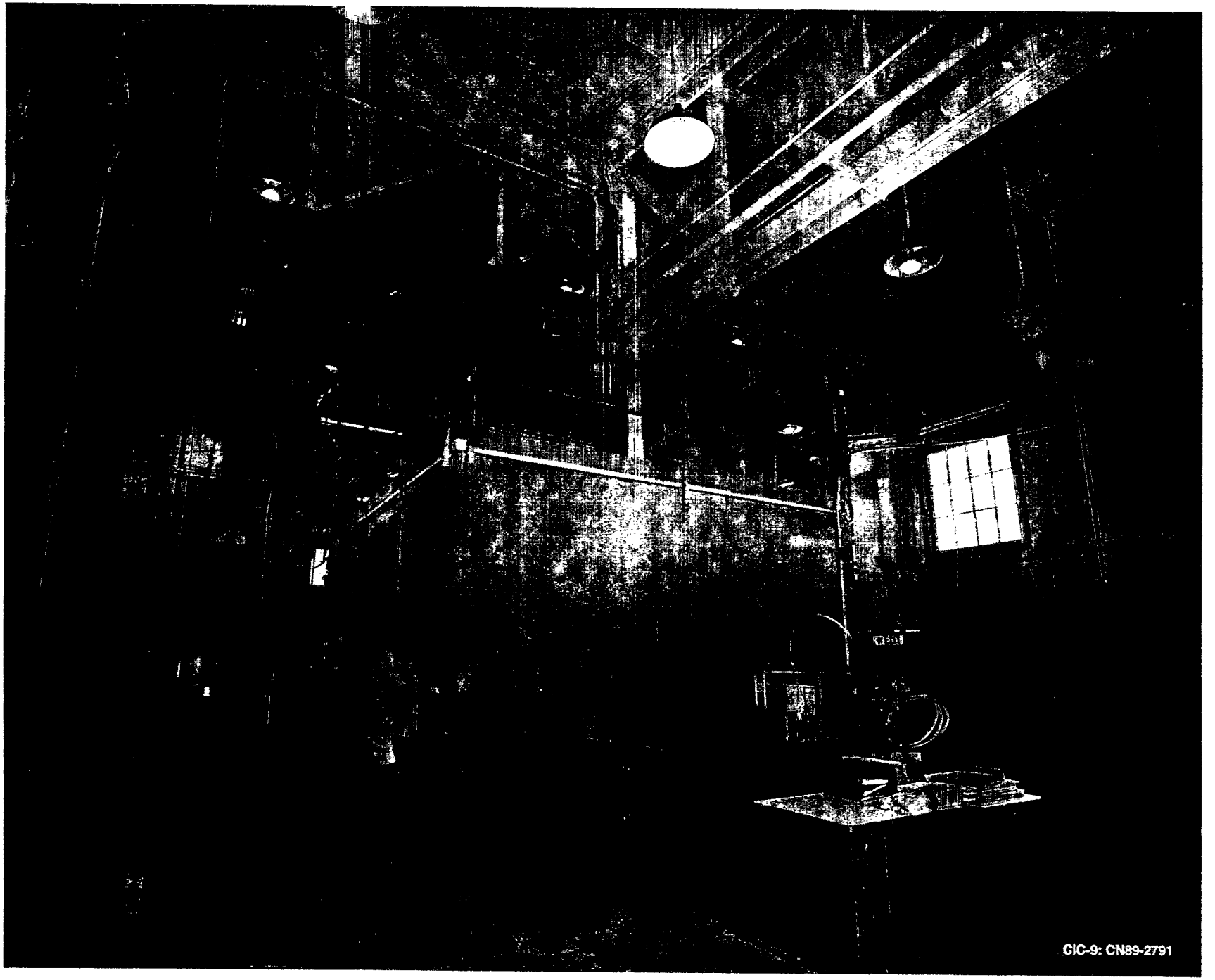

Fig. 7. Water Boiler reactor prior to decommissioning.

Reactor. The reactor and control room were housed in a frame building approximately 60 x 60 x 26 ft (18 x 18x 8 m).

4.2.3 Work Scope

In 1985 and 1986, decommissioning activities consisted of dismantling of the exterior facilities associated with the stack line. In 1989, the reactor, its biological shield, and some remaining piping were removed. Detailed engineering for the physical decommissioning for the project began in July 1988; it was completed in June 1989. The on-site subcontractor conducted the decommissioning operations under the management, direction, and support of Laboratory's Waste Management Group.

At first, a physical, chemical, and radiological assessments of the site were conducted. Decommissioning operations included removing the contaminated filter plenum and unstacking the pier in the graphite thermal columns, as well as removing borax paraffin cans, paraffin, and 4-in lead. The recombiner assembly, reactor vessel, and remaining shielding materials were then removed.

4.2.3.1 Remove Recombiner (Catalyst)

The catalyst was a stainless-steel rectangular can with inside dimensions of approximately 6 x 6 x 5 in. (15 x 15 x 13 cm). Its primary function was to improve heat distribution. The dose rate at contact on this component was 30 R/h (approximately 30 rad or 0.3 Gy). Removal was difficult because all the shielding materials encompassed the disconnection points. Lead blankets and long-handled tools were used to reduce doses to the workers. After the recombiner was removed, it was sent to a hot cell at the Laboratory to remotely remove the lead shielding before final disposal.

4.2.3.2 Remove Reactor Vessel

The reactor vessel consisted of a 1-ft- (30-cm-) diameter sphere that had a contact dose rate of 18 R/h (approximately 0.2 Gy). A magnet was used to remove large sections of the steel shielding around the vessel. Two 6-ft (1.8-m) extensions for a drill bit were used to remove the graphite that encircled the reactor vessel.

4.2.3.3 Remove Concrete Biological Shield

Temporary plastic walls were constructed to contain airborne contamination to one room. A star drill was used to bore holes at systematic intervals; holes were filled with "s-mite," an expanding medium used to break the concrete. The attempt failed because of the presence of reinforced steel. Three jackhammers were then used. Airborne contamination was mitigated by painting all accessible surfaces with a light water spray. This method was labor intensive (Fig. 8).

4.2.4 Hazards

Fission and activated products existed throughout the system The reactor vessel and components had dose rates of 1R/h to 150 R/h (approximately 150 rad or 0.15 Gy) at contact. Lead was the only Resource Conservation and Recovery Act (RCRA) hazardous material.

4.2.5 Cost and Schedule

The project began in June 1989 and ended in April 1990. The higher dose rates extended the project seven months. The estimated decommissioning costs were $500,000, with the final cost at $623,000.

4.2.6 Lessons Learned

Commercially available tools and equipment can be readily bought and used. The DOE Decommissioning Handbook is extremely useful and lists a range of tools and equipment. Modifications of tools lowered doses to workers. Decommissioning

Fig. 8. Biological shield being dismantled.

of a highly contaminated experimental reactor can be performed efficiently, safely, and cost effectively by using current technology.

4.3 Ultra-High-Temperature Reactor Experiment (UHTREX)[5]

4.3.1 Introduction (History)

Constructed for the Atomic Energy Commission in the late 1960s, the UHTREX reactor operated for approximately one year. The 3-MW reactor was graphite moderated. Helium was used in the primary and secondary cooling loops. A rotating reactor core could be fueled with enriched uranium while in operation. Operating temperatures ranged from 871 to 1316 ^{0}C, with pressures from 475 to 500 psi (3.3 to 3.4x10^6 Pa). The reactor was shut down in 1970 and defueled (Fig. 9).

4.3.2 Facility Description

Housed in room 310, the reactor consisted of a spherical carbon-steel vessel 4 m in diameter with a minimal wall thickness of 4.5 cm. Dense carbon and graphite formed the inner core. It weighted approximately 100 metric tons. The loading rams and core motor drive were located in different rooms. Twelve control rods entered the core vertically from a high-bay room above. The primary and secondary loops were fabricated of 20-cm-diameter stainless-steel piping. The cylindrical recuperator and heat exchanger were also in room 310 (Figs. 10 and 11).

A hot cell served to load and unload fuel elements from a cask to a conveyor system. This conveyor system moved the fuel from the hot cell to the loading rams.

Several outside structures are associated with the reactor:

- a buried 10-cm-diameter cast-iron pipe that carried low-level radioactive liquid wastes;
- a two-story neutralization/pump station that contained two concrete waste-holding tanks, pumps, and other equipment and instrumentation;
- a small metal building that housed valves, pumps, and equipment that monitored and regulated the secondary loop system;
- a heat exchanger located outside the heat dump building was connected to the secondary loop:

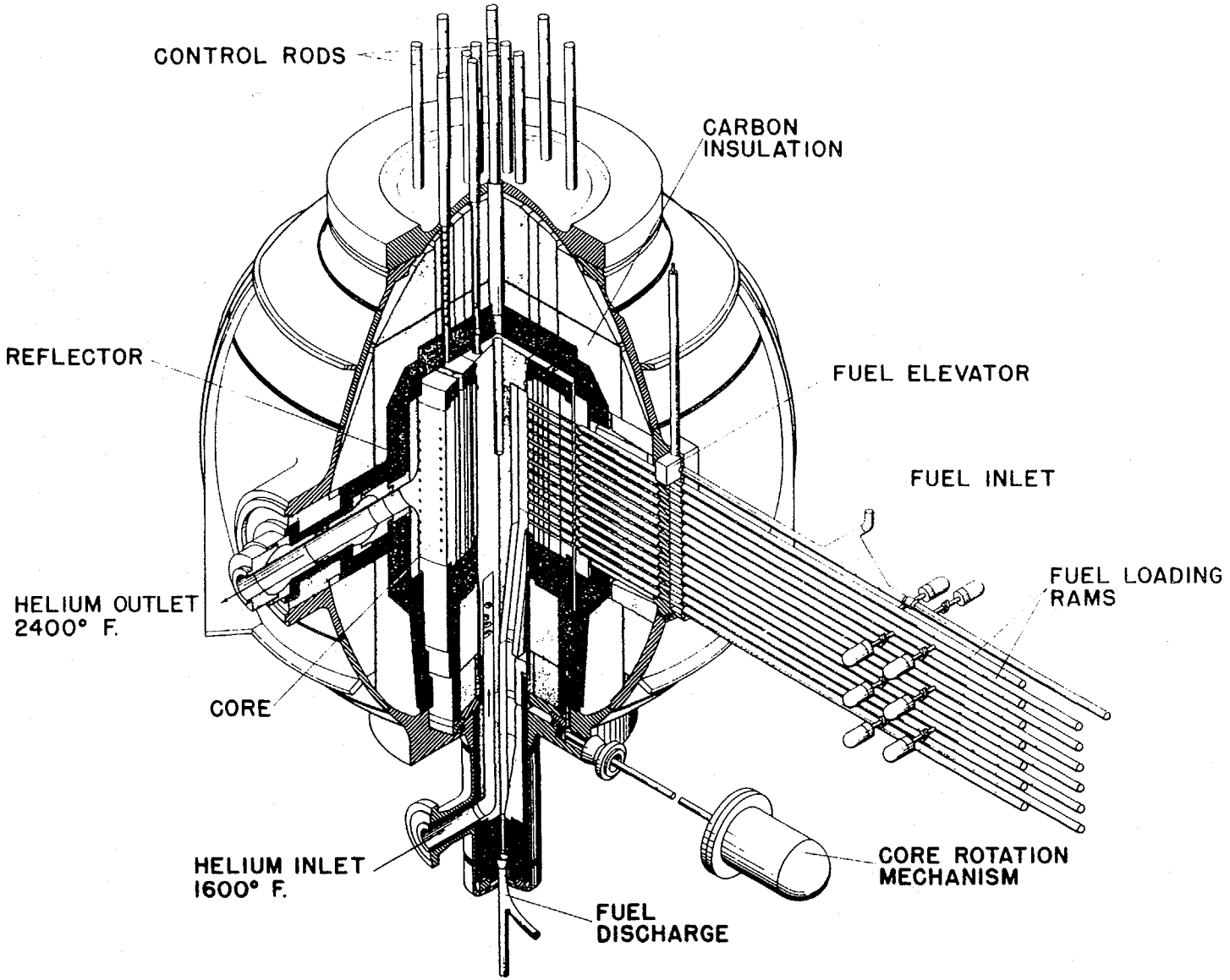

Fig. 9. UHRTREX reactor.

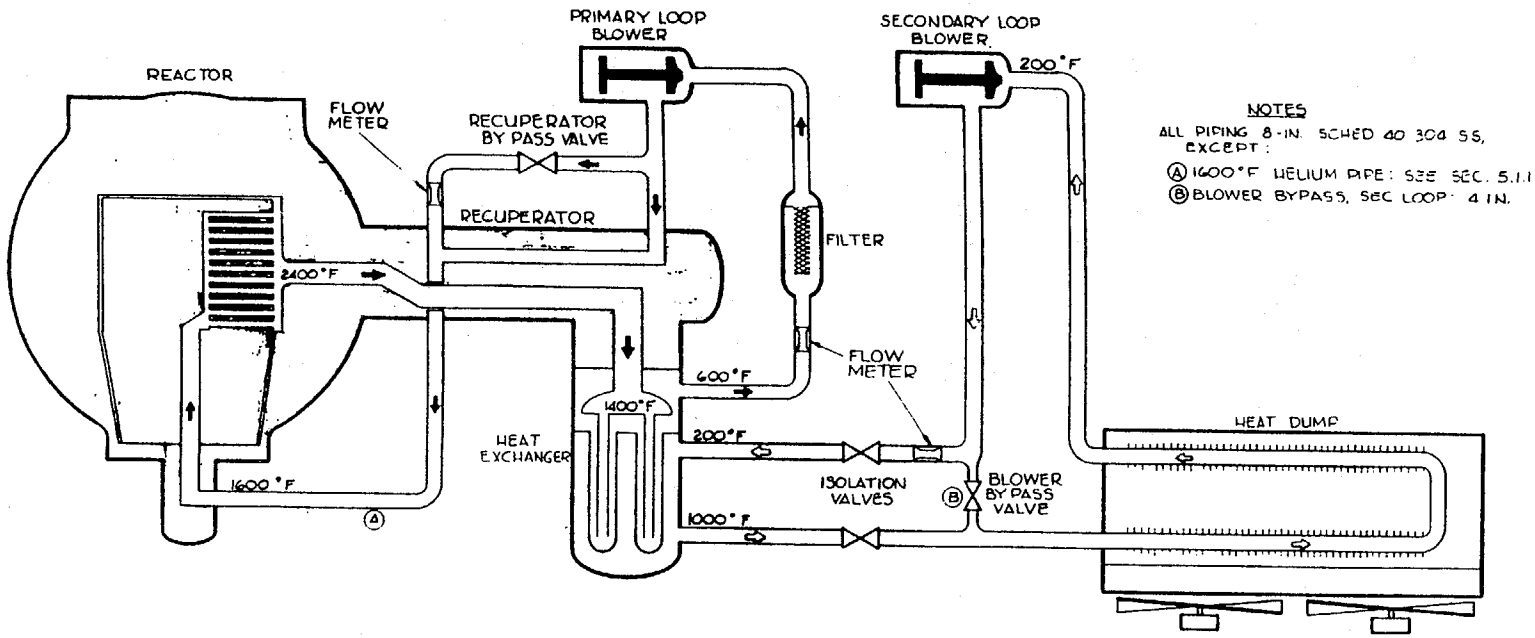

Fig. 10. UHRTREX reactor coolant system.

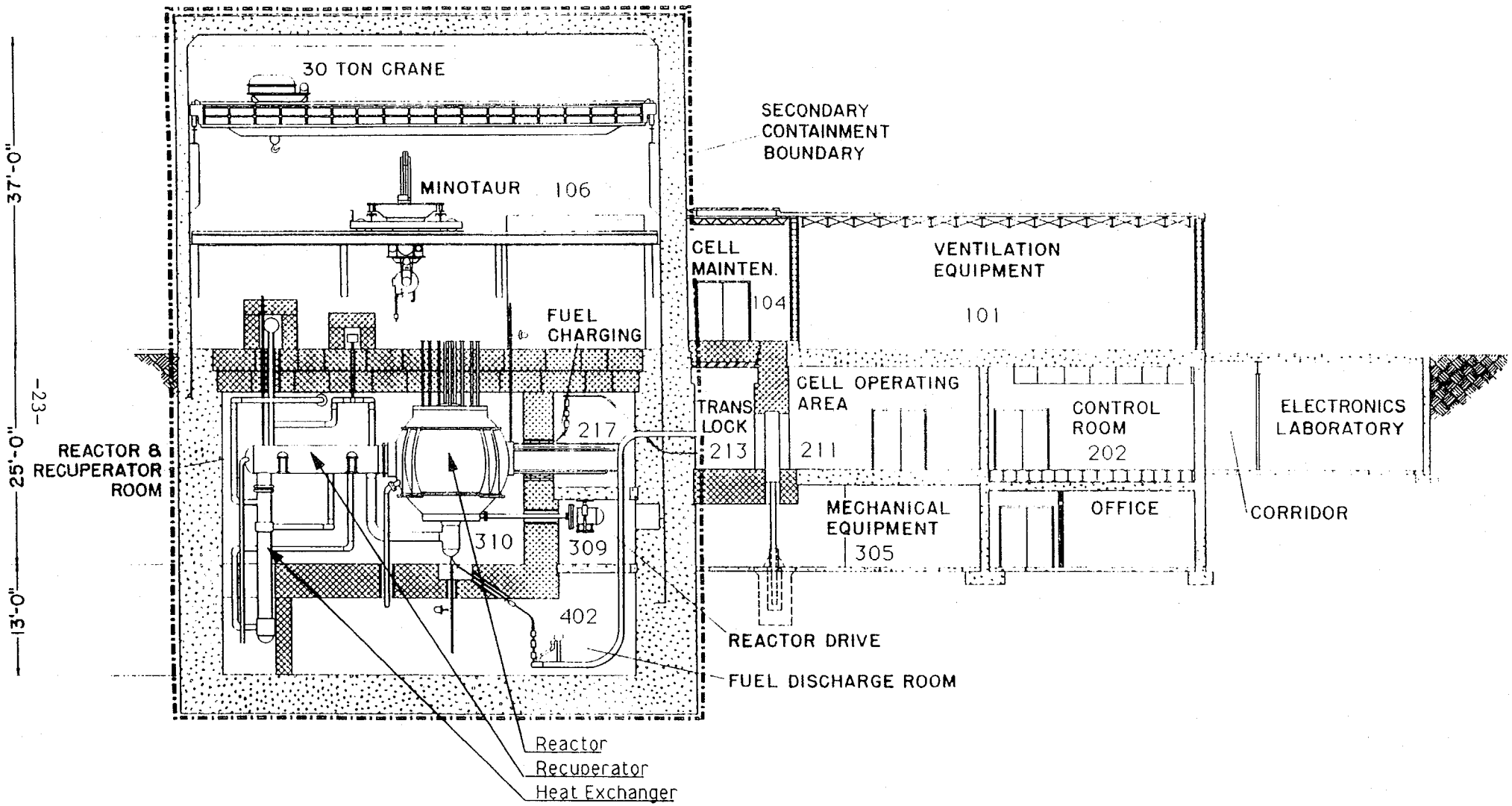

Fig. 11. Secondary containment and operating areas viewed southward.

- a below-ground reinforced concrete structure 3.3 m square and 3.7 m deep housed high-efficiency particulate air filters and four charcoal filters (air from the secondary loop passed through this filter and either reintroduced or vented from a stack); and
- a 30.5-m-high steel exhaust stack with a 1.2 m diameter was located outside the reactor building.

4.3.3 Hazards

Most of the residual radioactive contamination was in the reactor vessel, recuperator, heat exchanger, primary loop and gas cleanup system, and the fuel-loading system. ^{90}Sr, ^{137}Cs, ^{60}Co, and ^{235}U were the main contaminants. Exposure rates varied from 5 to 10 mR/h inside the reactor room. Alpha activity up to 80,000 dpm/ 100 cm^2 was detected inside the exhaust ventilation system, where it jointed the stack. RCRA material consisted of activated lead bricks used for shielding inside the reactor room.

4.3.4 Work Scope

The work scope consisted of two phases: planning and operations. Planning consisted of obtaining radiological surveys, conducting materials surveys, and identifying equipment, utilities, and buildings. Work plans and estimates were then produced based on this information.

Characterization surveys were used to develop work plans, estimates, and schedules. Work break-down activities were identified room by room. This allowed tracking of work by room. A critical path analysis was performed after the cost and schedule baseline was done. Detailed information on some of the reactor components was deferred because of lack of accessibility. Assumptions were made regarding activity and contamination levels to allow planning to proceed. The plan was to procure services in two phases. Initial work started on the waste lines. Next, the reactor components and associated support structures were removed. This isolated the reactor vessel for last and allowed its removal. Bid documents were being prepared to remove the reactor as work proceeded. The reactor bid documents

took almost a year complete. The removal and transport of the reactor took six weeks.

4.3.5 Decommissioning Operations

After a DOE readiness review, approval was given to remove outside waste lines. Traditional backhoe methods were used. The existing facility ventilation system was checked and repaired to allow use during decommissioning operations. HEPA filters were changed, systems tested, and additional portable HEPA units were acquired to supplement ventilation control.

4.3.5.1 Remove Neutralization/Pump Station

The neutralization/pump station had light contamination easily cleaned by using rags and cleaning solutions. Equipment and instrumentation were removed before demolishing the structure by using a wrecking ball attached to a backhoe.

4.3.5.2 Remove Stack

The exhaust stack was lightly contaminated. The ventilation connections were separated and the bottom was unbolted from the foundation. A crane was used to lower the 100-ft (31m) stack to the ground. The ends were capped with plastic. A portable HEPA unit was connected on one end to allow the stack to be cut into transportable sections on the ground.

4.3.5.3 Remove Heat Exchanger, Recuperator and Vessel

All piping and auxiliary equipment attached to the vessel was removed. 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 openings. Flanged connections were unbolted and blind flanges bolted on. Some c-section rings on connections were cut with an oxygen-acetylene torch. Enclosures and local ventilation prevented the spreading of contamination during the

cutting and burning operations. A two-person hand saw was used to cut the graphite connecting the reactor and recuperator.

The 110-ton vessel required removal from a confined room and transportation to disposal area 4 mi (6.4 km) away. Bids were solicited that required the contractor to submit methods of removal and transportation. The successful bidder proposed an erector-lifting system that would lift the vessel out and turn it over on its side onto a specially built skid. The vessel would then be rolled out the building and the erector dismantled, moved outside of the building, and reassembled to lift the reactor onto a special multi-tired trailer (Figs. 12 and 13). This trailer had individual axle steering and leveling capabilities that could negotiate sharp turns and keep the platform level. The reactor was unloaded at the disposal area; tractor bulldozers pulled and pushed the reactor on its skid down the incline into the pit.

4.3.5 Cost and Schedule

The planning phase for this project began around June 1998. The operational phase began in November 1998 and ended in September 1999. Characterization cost $489,000 and operations cost $2,385,000, for a grand total of $2,874,000.

4.3.6 Lessons Learned

It is important to sufficiently bound the characterization before decommissioning operations begin. The UHTREX project began early because unexpected funds became available. The decision was made to start work before characterization was completed because contamination levels were known to be generally low and the scope of work was sufficiently bounded. Activation levels were not adequately bounded. Some isolated contaminated areas were discovered during the actual operation phase.

Identification of ^{90}Sr as a contaminant should have been apparent because it is a byproduct of fission reactors but was not confirmed until the end of the project by an

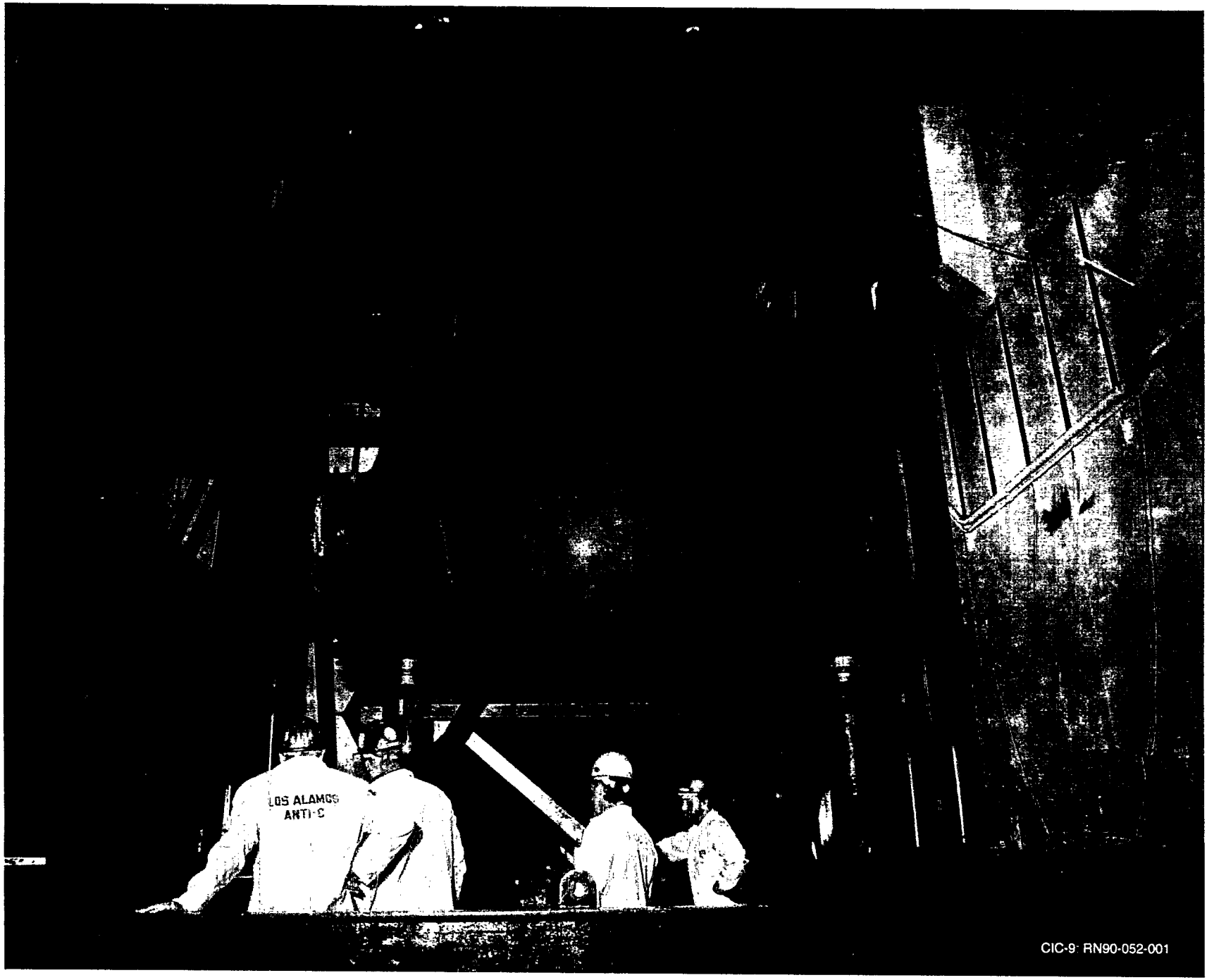

Fig. 12. Lifting reactor.

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independent verification contractor. This led to additional cleanup to meet the lower cleanup levels.

Core sampling of the steel-reinforced concrete/magnetite floor and walls in the reactor room would have shown the extent of activation products, particularly ^{60}Co. This information would have been addressed in the project plan instead of the close-out documents.

The buildup of a methane pocket in the stagnant cooling-water system should have been obvious. A small gas explosion occurred when oxygen/acetylene torch was used to cut the connecting bolts in an elbow connection. Fortunately, no injury occurred. Using fire or spark-producing equipment should have been prohibited to cut pipe containing stagnant water.

A small fire was accidentally started when contaminated cleaning rags bundled for disposal caught slag generated from cutting operations in a room above. The rags were not in sight of the workers. All combustible waste was then placed in metal, covered containers and quickly removed from the site. Fire and spark-producing equipment was replaced by nibblers. Oxygen/acetylene torches are allowed but only when other means are not available and only after elaborate safety preparations and characterization.

Use as many remote operations as possible. The portable hacksaw that could be clamped on pipes and left to run by itself reduced exposures to personnel.

A floor was decontaminated using a floor scabbler; the interior of the room was lined with plastic to control dust. Dust control was not effective and particles spread outside the plastic onto the walls. Ventilation systems are now attached to the scabbler to vent the air, and the floors are now misted with water to avoid airborne contamination.

5.0 CONCLUSIONS

Decommissioning can be successfully performed on experimental reactors and nuclear facilities using today's technology and methods. Success is due to many factors. The general technical process of planning and execution is universal. The different laws and regulators that apply specifically to you to address different political issues and will require different approaches to implement decommissioning activities. The flexibility of fixed price and time and materials contracting also have also been demonstrated. This flexibility has allowed the Laboratory to perform decommissioning safely and cost effectively.

Another important factor not discussed but implemented has been to assign and empower individuals to be responsible for all decommissioning activities on a project-by-project basis. Future technology can accelerate and improve decommissioning activities. The decommissioning regulatory arena can also assist in protecting the workers, public, and environment, but it must not become a bureaucracy focused on following or building a process that adds no value. The challenge is to work with regulators to achieve balanced results.

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