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The Decommissioning of a Tritium Contaminated Laboratory

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THE DECOMMISSIONING OF A TRITIUM CONTAMINATED LABORATORY

by

Johnny R. Harper and Raymond Garde

ABSTRACT

A tritium laboratory facility at the Los Alamos National Laboratory, Los Alamos, New Mexico, was decommissioned in 1979. The project involved dismantling the laboratory equipment and disposing of the equipment and debris at an on-site waste disposal/storage area.

The laboratory was constructed in 1953 and was in service for tritium research and fabrication of lithium tritide components until 1974. The major features of the laboratory included some 25 meters of gloveboxes and hoods, associated vacuum lines, utility lines, exhaust ducts, electrodryers, blowers, and laboratory benches.

This report presents details on the decommissioning, health physics, waste management, environmental surveillance, and costs for the operation.

I. INTRODUCTION

A tritium laboratory[1] was constructed at the Los Alamos National Laboratory in 1953 to handle kilocurie amounts of lithium tritide components. This laboratory was located in the basement of Building 2 in Technical Area (TA) 35. The laboratory occupied three basement rooms designated as A-12, A-12-A, and A-12-B (Fig. 1). It consisted of two glovebox lines totaling 25 meters in length (Figs. 2-3) and several equipment items such as heat exchangers, electrodryers, a refrigerator unit, a recombiner, and a gas blower (Fig. 4) that were interconnected with copper pipes (Fig. 5). The Laboratory had its own air supply and exhaust stack (Fig. 6).

The laboratory was retired in 1974 and became a candidate for decommissioning because the radioactive contamination and the sole use construction made it unsuitable for any beneficial occupancy.

In 1979 the gloveboxes in room A-12 were estimated to contain less than 100 curies of residual tritium oxide contamination whereas the two electrodryers and associated equipment in room A-12-B were estimated to each contain less than 1 000 curies of residual tritium, probably in the form of oxide. Preliminary surveys indicated nonfixed contamination (10^4 dis/s/cm^2) inside the gloveboxes and up to 250 dis/s/cm^2 on the laboratory floor and cabinets.

II. DECOMMISSIONING PROCEDURES

Decommissioning work began with the removal of work benches and utility lines. Existing electrical power was disconnected and temporary power was provided to only the lights, exhaust and ventilation blowers, and wall outlets to reduce the potential for electrical accidents. Thermal fire detectors were installed to alarm locally and to provide improved notification to the Los Alamos Fire Department in case of fire.

An asphalt gun (Fig. 7) was used to apply a layer of tar undercoating to the interiors of all gloveboxes and hoods to fix in place residual dust and particulate material (Fig. 8). A 5-meter deep pit was excavated to provide access to the removable portion of the south wall of room A-12-A. Reinforced concrete walls were poured to prevent shoring problems in the pit, a plywood door was installed between the excavated pit and room A-12-A, and a removable roof was installed on top of the pit. All equipment was removed through this pit for transfer to waste disposal. A 1.9- by 3.9- by 3.3-m trench was excavated in the base of pit number 10 at TA-54, the Laboratory's Waste Disposal Site, to receive the tritium contaminated debris (Fig. 9).

The removal of the more highly contaminated equipment items began with the copper pipes (Fig. 10), which were cut and capped with metal caps (Fig. 11). A portable exhauster was used during the pipe separations. Silicon rubber adhesive applied to the cap before insertion over the separated pipe ends provided an adequate seal to prevent spreading of contamination. After the adhesive had hardened (1-2 days), roofing tar was generously applied over the sealed pipe end (Fig. 12). The sections of pipe were placed into 1.3- by 1.3-

by 2.3-m Fiberglas Reinforced Polyester (FRP)-coated plywood boxes to protect the pipes against crushing.

The electrodryers were stripped of accessories and connecting copper pipes (Figs. 13-14). They were removed and sealed in a 1.9- by 2.3- by 3.2-m FRP-coated plywood container (Fig. 15).

The gloveboxes in Room A-12 were unbolted and separated into manageable sections. The sequence of removal can be best understood by referring to Fig. 1. Hoods number 11 and 20 were removed to provide space. Glovebox numbers 6 and 7 were removed as one unit. The sequence was then: transfer line number 25; box number 1A; box number 1B; transfer line number 22; hood number 4; box number 12; boxes numbers 13, 14, and 15; transfer line number 24; hood number 19; glovebox numbers 17 and 18. Glovebox number 16 (the hydraulic press box) was cut with a saber saw into three sections. The separation openings were sealed with sheet metal. Putty tape was used to seal between the sheet metal and glovebox edges. Roofing tar was then applied over the entire seal (Fig. 16), and around the windows (Fig. 17) and the metal sealed glove ports. Plywood was banded over the weaker portions of the gloveboxes (Fig. 18) such as windows and glove ports.

The gas blower, three heat exchangers, and the recombiner in room A-12-B were separated, sealed, and placed into 1.3- by 1.3- by 2.3-m fiberglass-coated plywood containers. The remainder of the copper lines were removed. The ventilation and exhaust ducts were removed, the exhaust blower was removed, and the base of the stack that entered Room A-12-B was sealed.

The tile was removed from the floors in all three rooms. Surveys of the rooms found up to 500 dis/s/cm^2 swipeable contamination. The rooms were rehabilitated by patching holes in the walls, painting the walls, and reinstalling tile on the floors (Figs. 19-20).

III. HEALTH PHYSICS

Workers used protective (anticontamination) clothing for all work. This included coveralls, gloves, hoods, and booties. Other protective items used, dependent upon the potential of exposure, were the following: (1) a 0.006 guage polyvinyl chloride supplied air suit consisting of a slip-over jacket with sealed-on hood and trousers with sealed-on boots (Fig. 21); (2) breathing air from compressors located outside the work area (Fig. 22); (3) self-contained breathing apparatus; and (4) arm length plastic gloves.

The highest airborne tritium concentrations occurred during the separation of the two heat exchangers and the recombiner in Room A-12-B. The levels were in the 10^5 $\mu Ci/m^3$ range. The highest concentrations measured during the removal of the electrodryers was 10^4 $\mu Ci/m^3$. During the removal of the copper pipes the levels were in the 200 $\mu Ci/m^3$ range. In each case the concentrations lasted only a few seconds.

Workers submitted urine samples after each potential exposure operation as well as on a weekly basis. Of the 15 workers who submitted routine and special urine samples each month over a 5-month period, seven individuals received a measurable tritium exposure. The highest single total exposure for the operation was 210 mrem.

Instrumentation included the Johnson Triton Model 755-B, the Los Alamos National Laboratory's Model 110 Tritium Sniffer, a Johnson Triton Model 1055-B, and a Kanne Chamber system installed on the exhaust stack.

IV. WASTE MANAGEMENT

All wastes generated by this operation were buried at the Laboratory's TA-54 Radioactive Waste Disposal/Storage Site in a 1.9-m-deep by 3.9-m-wide by 33-m-long trench at the base of pit #10 (Fig. 23). The pit is located 8 km from the decommissioning site. The $183 m^3$ of contaminated debris containing an estimated 6×10^3 curies of tritium were placed into the trench, which was covered with noncontaminated soil. The pit was then used to receive other routine low-level solid radioactive wastes. Wastes were transported in plastic-lined dump trucks covered with tarpaulins.

V. ENVIRONMENTAL SURVEILLANCE

The Laboratory's Environmental Surveillance Group monitored the operation with its routine air sampling network[2] and two additional on-site sampling stations. One of the on-site stations (Fig. 24) was at the base of the excavated pit by the base of the stack and the other was 9 meters away. Table I presents the results of the on-site special air samplers and Table II presents results of the routine air-sampling network. The data indicate some tritiated water vapor was released outside the tritium laboratory during the decommissioning. The concentrations, however, were 3 to 4 orders of magnitude less than the DOE airborne concentration limits for tritiated water vapor (DOE Manual Chapter 0524).

The Kanne Chamber system installed on the exhaust stack provided a record of the stack releases. Table III presents tritium release data for the period from 1975 through June 8, 1979.

TABLE I

ATMOSPHERIC TRITIATED WATER VAPOR AT TA-35

Sampling Period (1979)	Sampler[a]	Atmospheric Tritiated Water Vapor, pCi/m^3
April 3 - April 17	A	64 ± 10[b]
	B	46 ± 8
April 17 - May 1	A	270 ± 40
	B	73 ± 12
May 1 - May 15	A	121 ± 19
	B	91 ± 15
May 15 - May 30	A	180 ± 30
	B	29 ± 5
May 30 - June 11	A	190 ± 30
	B	76 ± 12

[a]Sampler A adjacent to pit (Fig. 2); sampler B 9-m distance.
[b]Results ± 2σ.

TABLE II

ATMOSPHERIC TRITIATED WATER VAPOR AT THE LABORATORY'S ELEVEN REGULAR ON-SITE AIR SAMPLERS DURING APRIL AND MAY 1979

Sampling Period (1979)	Atmospheric Tritiated Water Vapor, pCi/m^3
March 26 - April 30	7 ± 20[a]
April 30 - May 28	11 ± 40
May 28 - June 25	11 ± 43

[a]Results ± 2σ.

TABLE III

TRITIUM STACK RELEASES

Year	Total Ci Discharged	Volume of Air Discharged (m^3)	Average Concentration $\mu Ci/m\ell$
1975	2300	1.3×10^8	1.8×10^{-5}
1976	1700	1.2×10^8	1.4×10^{-5}
1977	790	1.1×10^8	7.1×10^{-6}
1978	520	9.9×10^7	5.3×10^{-6}
1979[a]	1300	5.6×10^7	2.9×10^{-5}

[a]Discharges ceased on June 8, 1979.

Of the 1300 curies released during 1979, approximately 1080 curies can be attributed to decommissioning activities.

VI. TECHNIQUES AND LESSONS LEARNED

Use of the portable ventilation system proved to be extremely valuable and cost effective (Fig. 25-26). It reduced costs and time by eliminating the need to use supplied air suits. The suits cost over $30 each and posed problems such as limited maneuverability and increased tripping hazards. The donning and removal of the suits also reduced worker productivity.

Expanding polyurethane foam was introduced into some of the copper pipes before cutting them. The foam displaced tritium gases and created a filled dead area for pipe cutting. Air suits were not required for cuts on pipe sections filled with foam.

Roofing tar provided an excellent seal for tritium contamination as did putty tape and silicon rubber. Asphalt coating also proved effective in holding down particulates inside gloveboxes.

VII. COST

One hundred twenty-five working days were required to complete the project at a total cost of \$252 000. Subcontractor support for manpower and equipment (Table IV) costs were \$106 850 and Laboratory support operations costs were \$145 150.

TABLE IV

SUBCONTRACTOR CRAFT AND EQUIPMENT USAGE

CRAFT	1-79	2-79	3-79	4-79	5-79	6-79	7-79	8-79	Totals
Carpenters	53	39	137	34	16	6	92		377
Roofers	8	0	6	6					20
Painters	24	2					168	24	218
Masons		5	7				2		14
Laborers	196	160	224	434	527	361	395		2297
Teamsters	34	2	32	24	50	7	8		157
Operators		12	71	18	53	11	5		170
Ironworkers		102	104	66	150	47			469
Tinners	52	138	16	32	12	13			263
Fitters	111			8	10	13			142
Electricians	204	14		20	26	59	67		390
TOTALS									4517
EQUIPMENT HOURS									
Flat Bed Truck	10				15				25
Crane		2	7	15	19	8	1		52
Loader		4	8						12
Dump Truck			16	5	7				28
Forklift			2	2					4
Compressor						7	2		9

REFERENCES

1. T. B. Rhinehammer and P. H. Lamberger, "Tritium Control Technology," AEC Division of Operational Safety report WASH-1269 (Dec. 73).

2. Environmental Surveillance Group, "Environmental Surveillance at Los Alamos During 1979," Los Alamos Scientific Laboratory report LA-8200-ENV (April 1980).

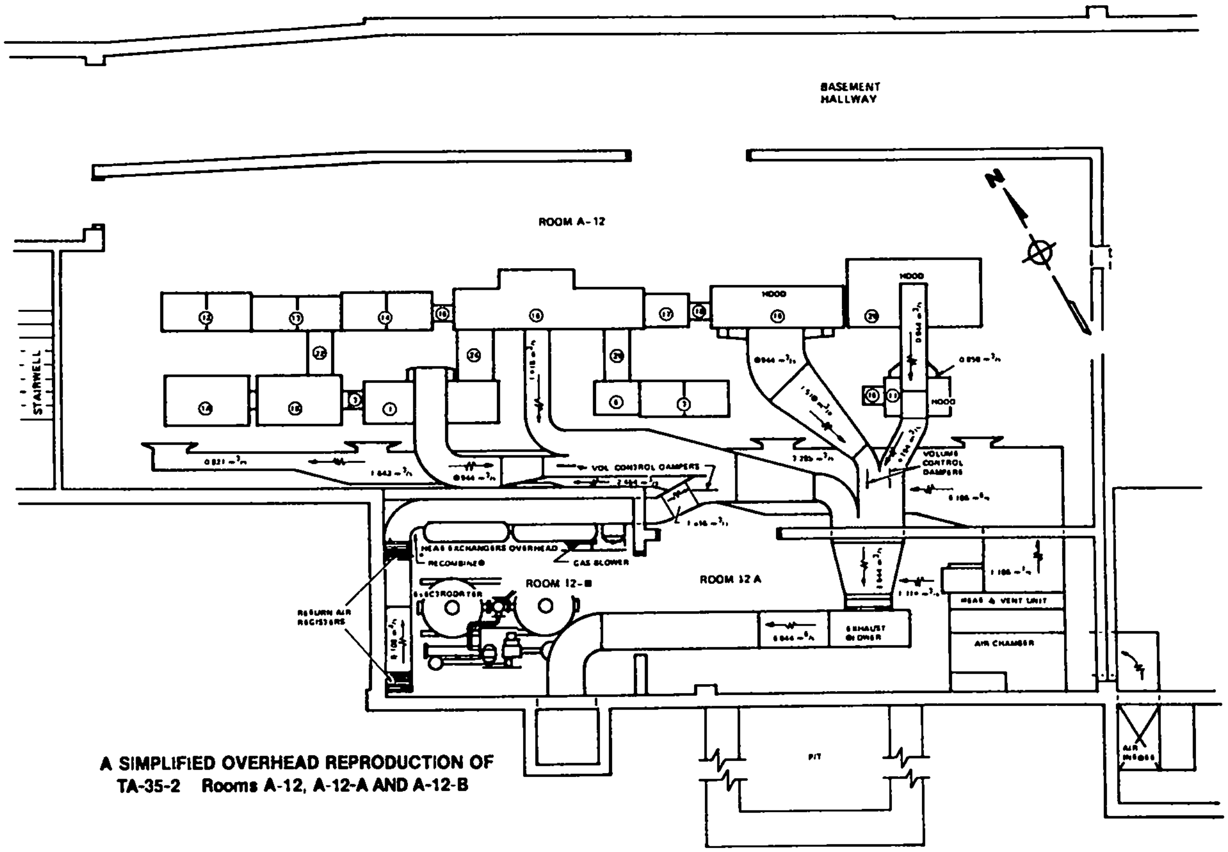

Fig. 1.
Rooms A-12, A-12-A, and A-12-B.

Fig. 2.
North glovebox line.

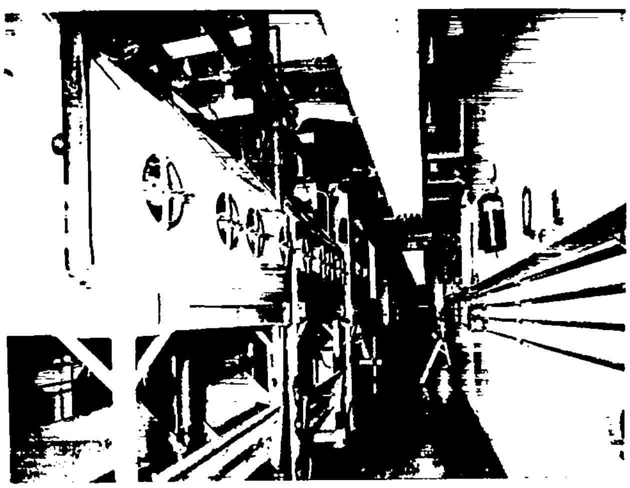

Fig. 3.
South glovebox line.

Fig. 4.
From left to right, electrodryer, heat exchanger, and recombiner.

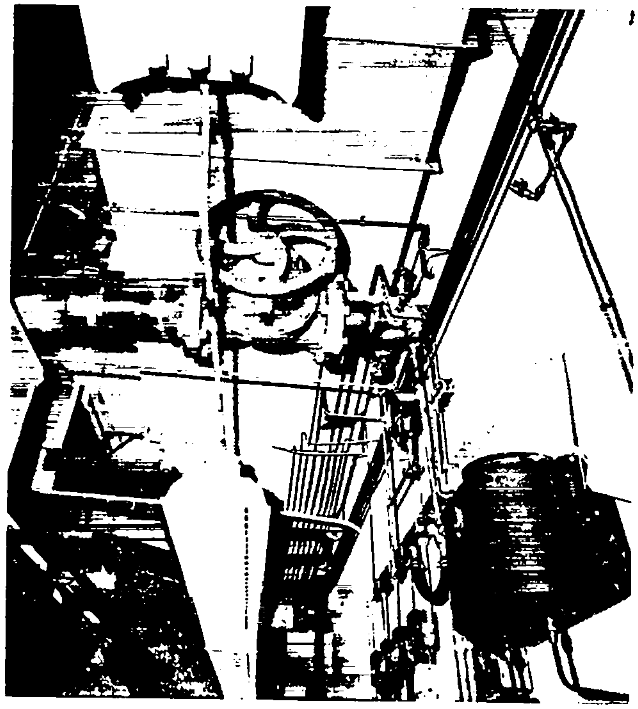

Fig. 5.
Typical copper piping.

Fig. 6.
Exhaust stack.

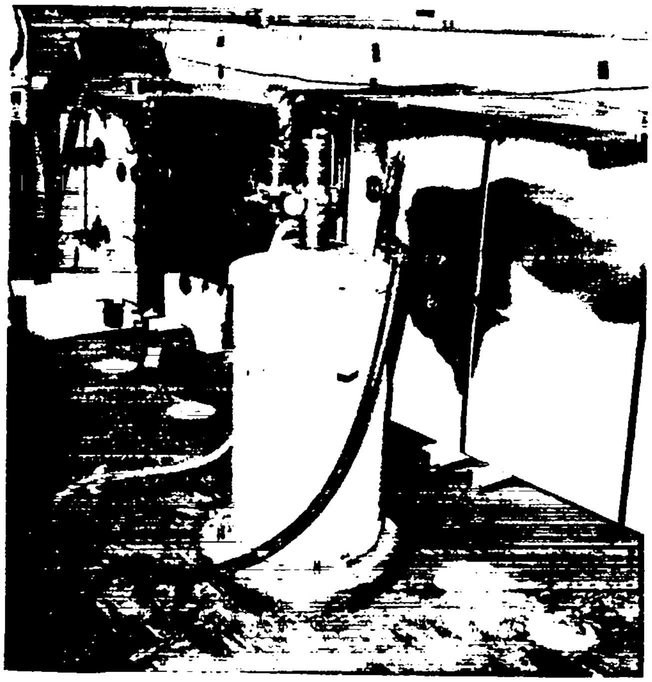

Fig. 7.
Asphalt gun.

Fig. 8.
Application of tar undercoating.

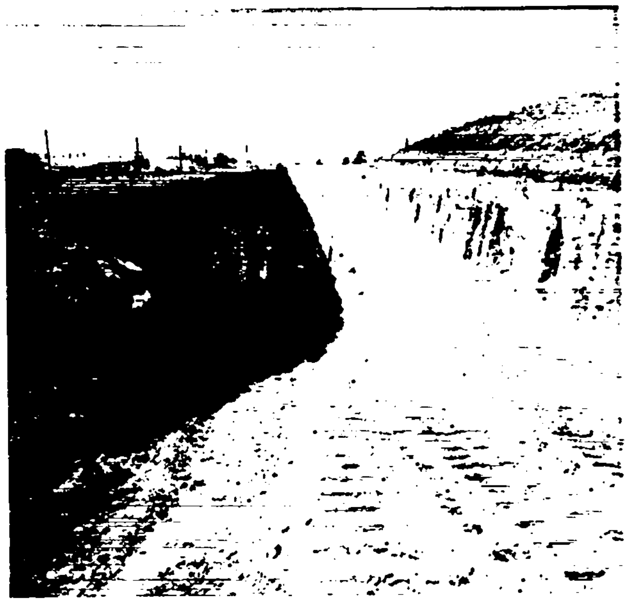

Fig. 9.
Tritium waste trench in waste pit
(left side).

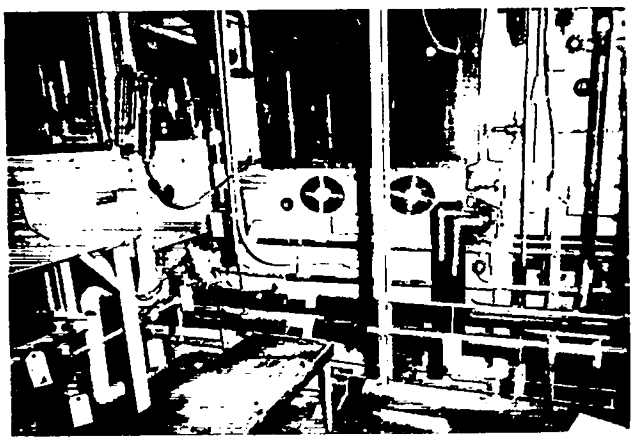

Fig. 10.
Copper piping prior to removal.

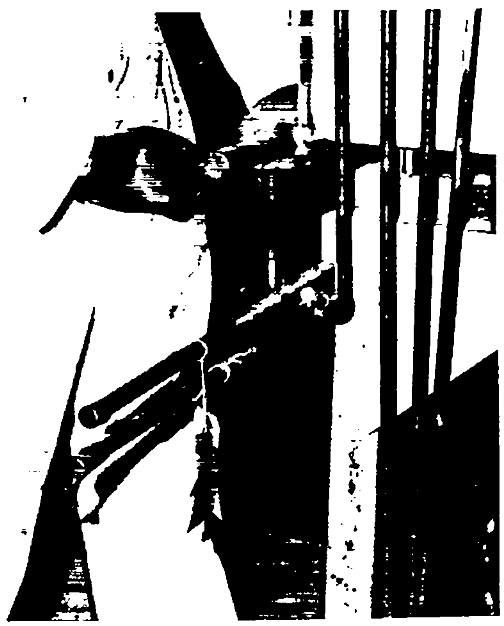

Fig. 11.
Metal seals on copper pipes.

Fig. 12.
Roofing tar on copper pipe ends.

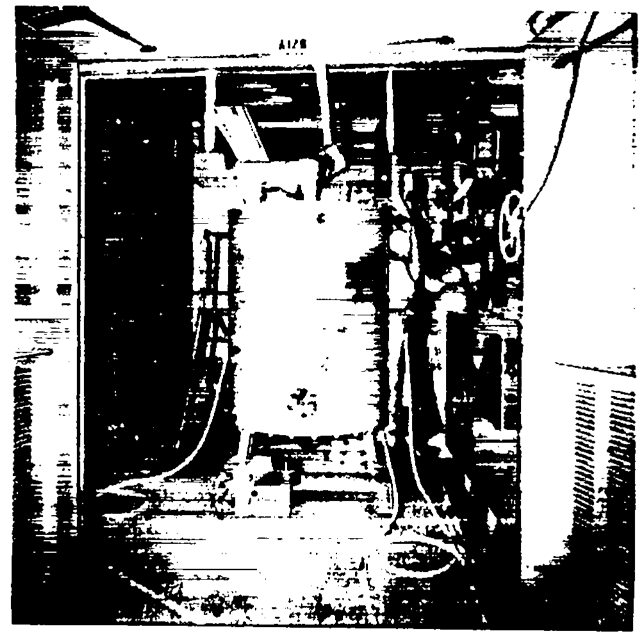

Fig. 13.
Disconnecting the electrodryers.

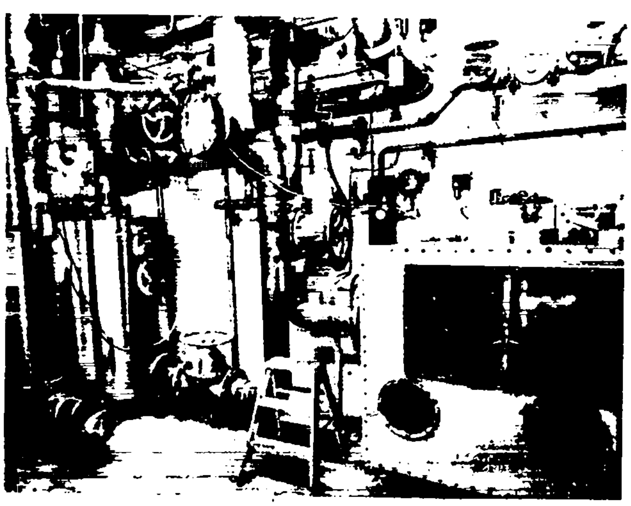

Fig. 14.
Room A-12-B after removal of electrodryers.

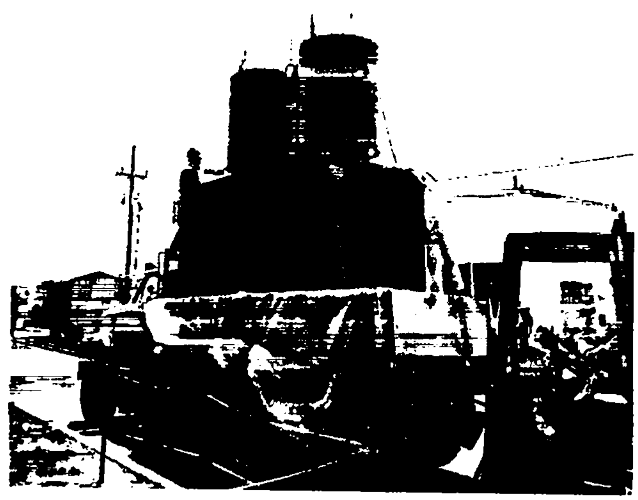

Fig. 15.
Placement of electrodryers in fiberglass-coated plywood box.

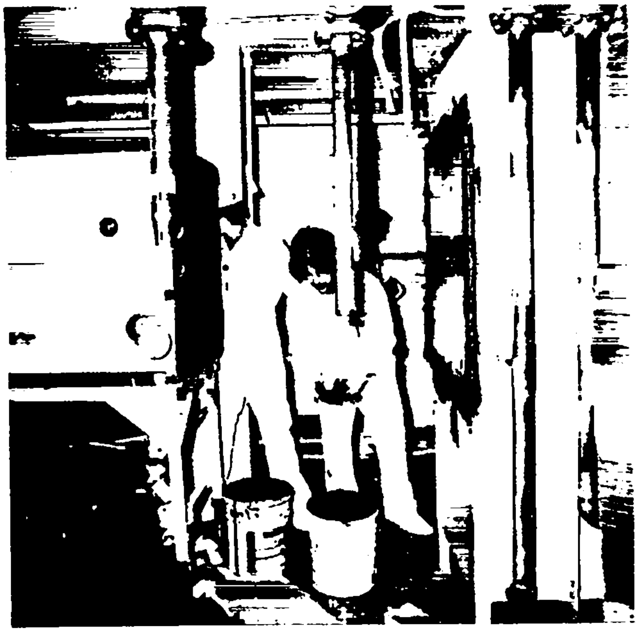

Fig. 16.
Application of roofing tar after a glovebox separation.

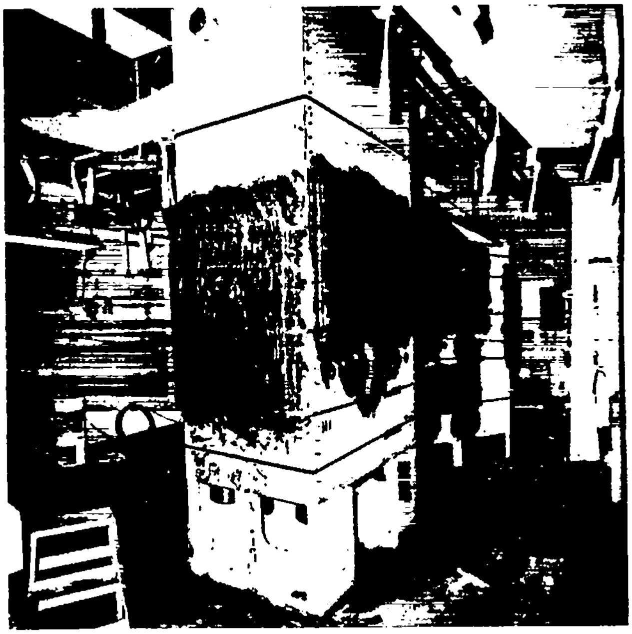

Fig. 17.
Roofing tar over windows and seals.

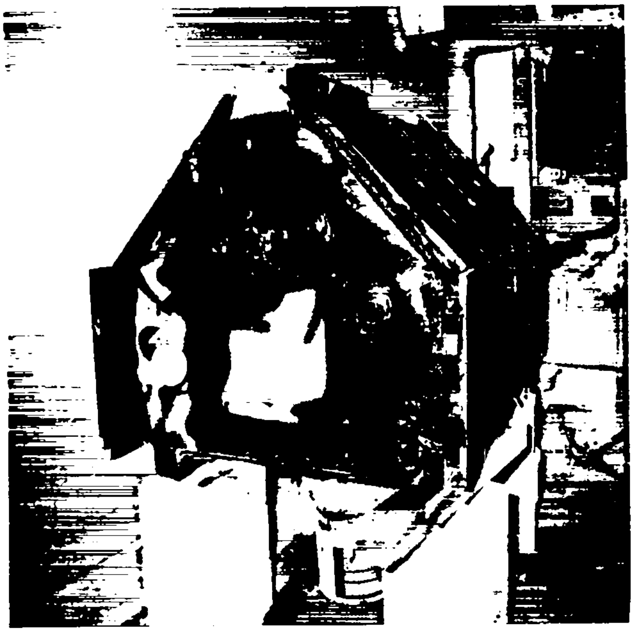

Fig. 18.
Plywood protected windows and sealed glove ports.

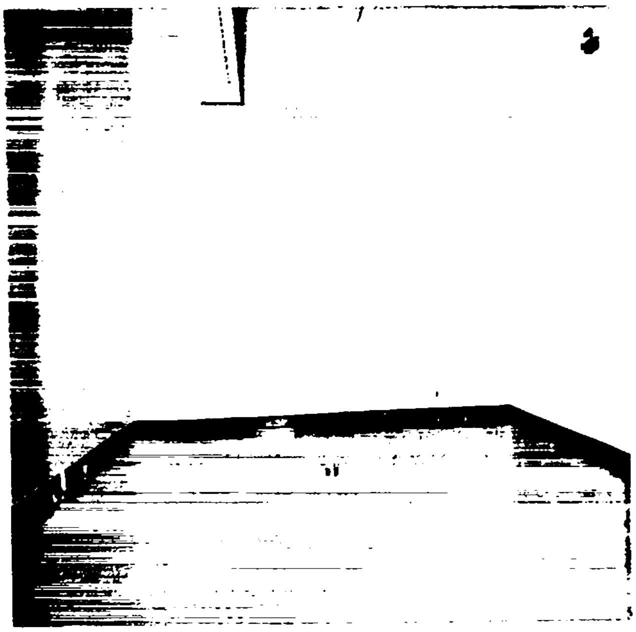

Fig. 19.
Rehabilitated room A-12-B.

Fig. 20.
Rehabilitated room A-12.

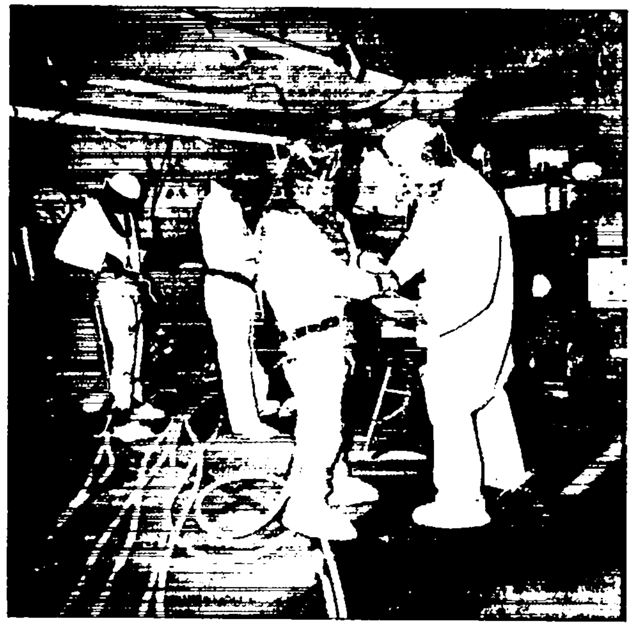

Fig. 21.
Supplied air suits.

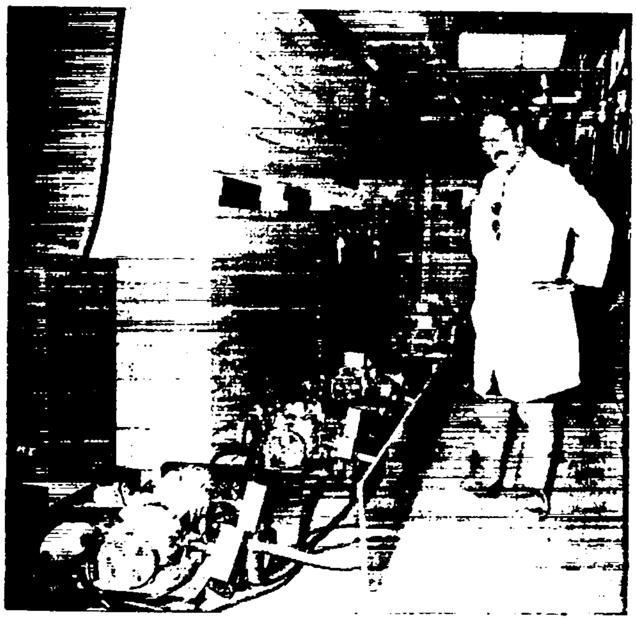

Fig. 22.
Breathing air compressors.

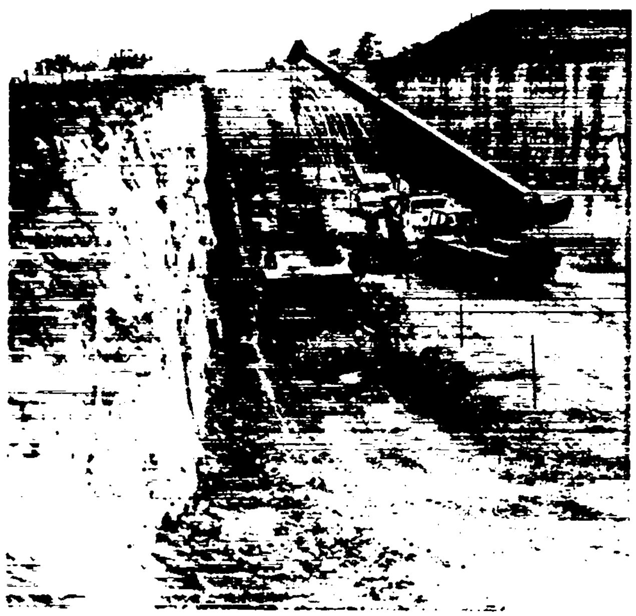

Fig. 23.
Disposal of tritium waste.

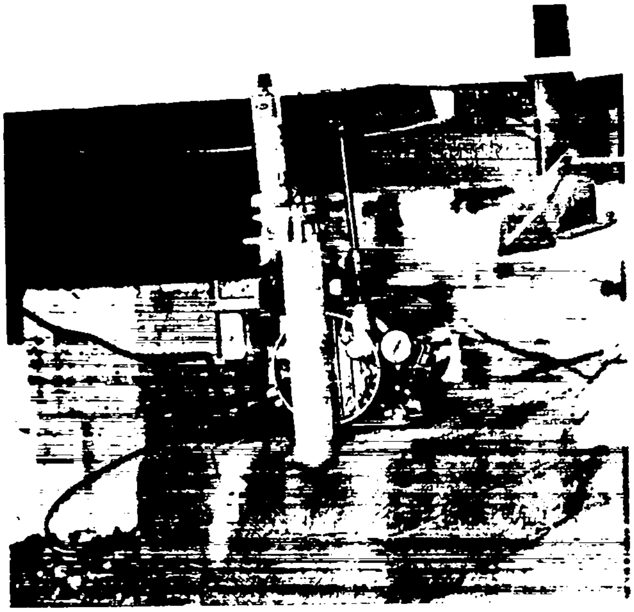

Fig. 24.
Environmental air sampler.

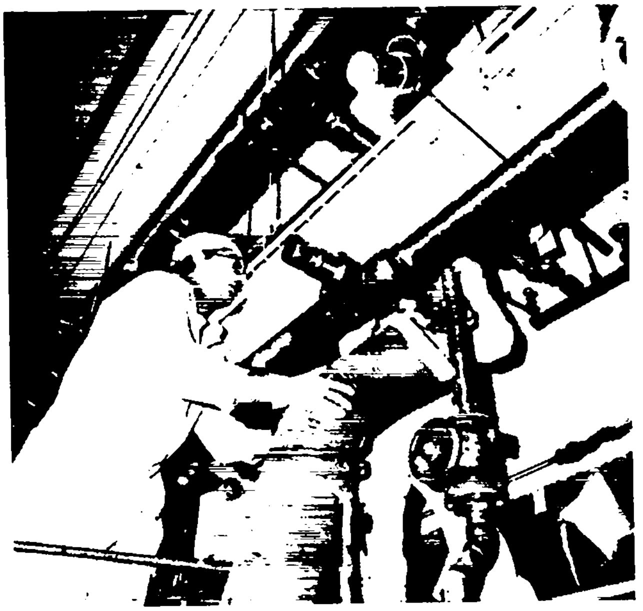

Fig. 25.
Portable ventilation duct in use during pipe cutting.

Fig. 26.
Portable ventilation duct in use while inserting polyurethane foam.

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