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TITLE: LOS ALAMOS DP WEST PLUTONIUM FACILITY DECONTAMINATION PROJECT

AUTHOR(S): Raymond Garde, E. J. Cox, and Allen M. Valentine

MASTER

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

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LOS ALAMOS DP WEST PLUTONIUM FACILITY DECONTAMINATION PROJECT

by

Raymond Garde, E. J. Cox, and Allen M. Valentine

ABSTRACT

The DP West Plutonium Facility operated by the Los Alamos National Laboratory, Los Alamos, New Mexico, was decontaminated between April 1978 and April 1981. The facility was constructed in 1944-45 to produce plutonium metal and fabricate parts for nuclear weapons. It was continually used as a plutonium processing and research facility until mid-1978.

Decontamination operations included dismantling and removing gloveboxes and conveyor tunnels; removing process systems, utilities, and exhaust ducts; and decontaminating all remaining surfaces. This report describes glovebox and conveyor tunnel separations, decontamination techniques, health and safety considerations, waste management procedures, and costs of the operation.

INTRODUCTION

The Plutonium Facility at DP West Site designated as Technical Area 21 (TA-21) at the Los Alamos National Laboratory, Los Alamos, New Mexico, was decontaminated during the period from April 1978 to April 1981. The overall objective was to decontaminate three entire buildings and portions of three others, a total of 5330 m^2 of floor space, to a level which would allow continued occupancy for nonplutonium research operations.

The Facility was a research and development facility with the capability to (1) produce metal and alloys of plutonium and other transuranic elements from nitrate solution feed stock; (2) fabricate these metals into precision shapes; (3) provide and install protective claddings; (4) measure the chemical and physical properties of these metals and alloys; and (5) permit recycling of scrap or materials used in experiments so that these materials could be reused rather than discarded.

Most of the buildings were constructed in 1944-1945 by moving in used metal warehouses which were placed on 1.1-m high concrete stem walls to provide the necessary overhead space inside the rooms (Fig. 1).

PROJECT PLAN

Before commencing the decontamination operation, a general plan was formulated and submitted to the Albuquerque Area Operations Office of the US Department of Energy (DOE) for approval. The approved final management plan[1] established decontamination criteria and described the scope of the operation. The decontamination criteria selected was no swipeable surface contamination and fixed contamination not to exceed 1000 dis/min/100 cm^2 alpha, or 1 mR/h beta-gamma at contact when measured with an open-shield Geiger-Müller (GM) detector.

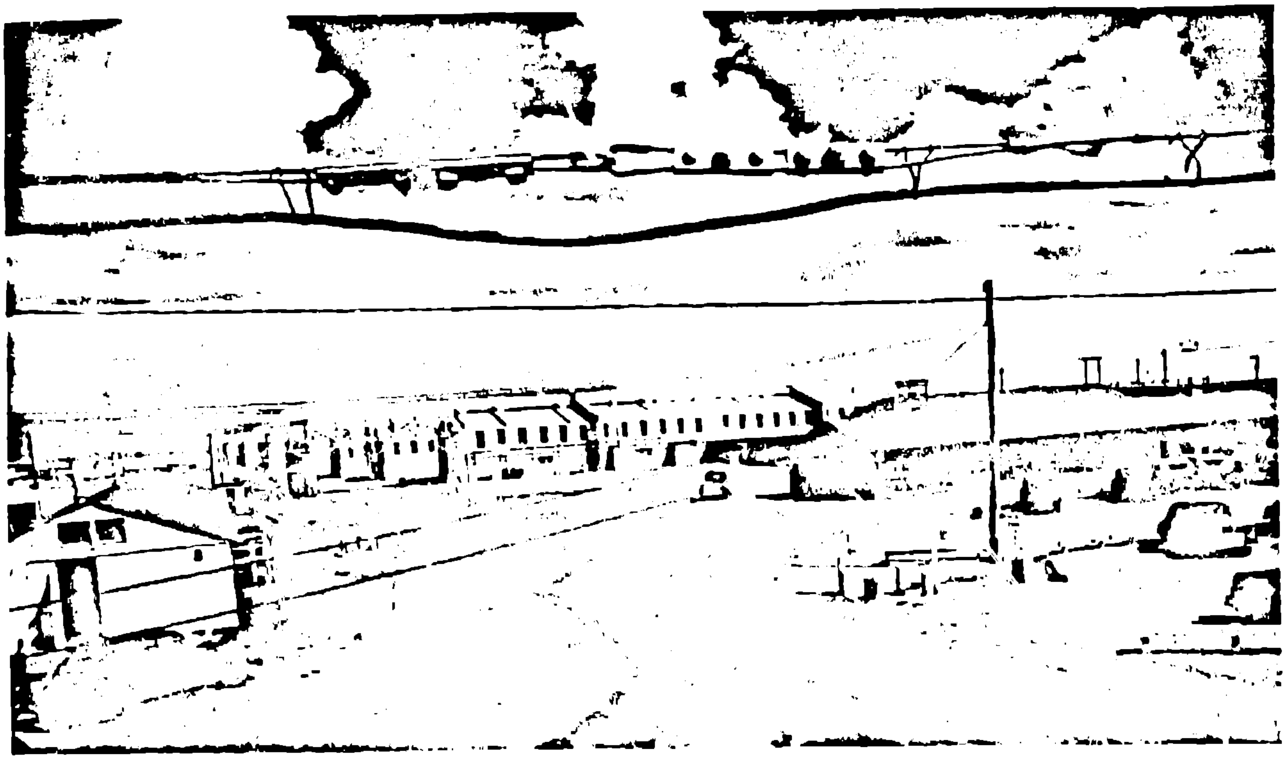

Fig. 1. DP West Plutonium Facility, 1947.

The identified decontamination operations were: (1) separation and removal of gloveboxes and connecting tunnels; (2) removal of contaminated support process equipment such as piping, ventilation ductwork, and drain lines to the point where they exited the area being decontaminated; (3) removal of internally contaminated lines, ducts, etc., in areas such as utility tunnels or attics; (4) removal of walls, ceilings, and floors with contamination in excess of recommended levels; (5) installation of a new floor cover and repainting of all decontaminated wall and ceiling surfaces prior to release of an area; (6) removal of the industrial liquid waste sampling stations and wells; (7) disconnection of all services in the perimeter tunnels; and (8) documentation of final remaining surface contamination.

A Los Alamos project management team was formed with representatives from the Plutonium Chemistry and Metallurgy group, the Health Physics group, and the Site Engineering Construction group.

The Plutonium Chemistry and Metallurgy group was assigned overall project management responsibility because the project was considered to be the final step in the new Los Alamos Plutonium Facility (TA-55) construction project. The $4.46 million allocated for the decontamination work were part of the line-item construction funds for the new plutonium facility. The Chemistry and Metallurgy group also provided part-time support from individuals knowledgeable about each room or process.

The Health Physics group contributed experienced decontamination personnel who performed glovebox separation and removal operations and directed subsequent decontamination work as well as the personnel required to provide health physics support.

The Site Engineering Construction group provided an engineer to assist in planning the project and to coordinate the craft and equipment support required of the Zia Company, the [illegible]'s support contractor at Los Alamos.

The Zia Company assigned a full-time field engineer to work with the management team and to direct work performed by Zia Company work crews.

A full-scale startup during early phases of the operation was precluded until the process-by-process transfer of operations to the new plutonium facility was complete. Building utilities were operational during the decontamination period, even though many of the systems were not being used. For the first several months decontamination work was limited to a few selected gloveboxes and isolated rooms. As soon as all areas were available, the general plan was implemented and the decontamination and release of areas in an east to west direction began. This plan allowed systematic access control to rooms and building areas with a contaminated area-clean area interface (Fig. 2).

PREOPERATIONAL INVESTIGATION

Record Search

During the early stages of the decontamination operation, health physics surveys and occurrence records dating back to 1945 were removed from the archives and reviewed in an attempt to identify all potential residual contamination sources and locations. Lists of recorded spills or releases of contamination were compiled for each room. This information was very useful in deciding whether or not to remove internal walls, floors, building utilities, and soil.

Glovebox Decontamination

Consideration was given to decontaminating the gloveboxes to a level that would permit nonretrievable shallow trench disposal rather than the more costly 20-year storage required for transuranic (TRU) waste contaminated to levels greater than 10 nCi ^{239}Pu or 100 nCi ^{239}Pu per gram of waste. If successful, decontaminating the gloveboxes in place would provide additional benefits in that the boxes would be safer to separate and the lower plutonium levels would facilitate future size reduction operations. Known disadvantages were that the acid wash solutions used for the decontamination operation would require neutralization, solidification, and disposal/storage, and that washing would be a slow and hazardous process. Twenty gloveboxes were decontaminated with acids using the equipment shown in Fig. 3 to test the feasibility of in-place washing.[2]

Some of the more important information gained from washing operations included: (1) one acid wash-water rinse cycle removed approximately 85% of the plutonium in the gloveboxes; (2) the plutonium content in a glovebox that had not been washed, contained approximately nine times more plutonium than initially measured by NaI surveys; (3) after washing a glovebox once, the difference between the measured and actual plutonium amounts was reduced to a factor of five; and (4) glovebox contamination levels could be reduced to a nonretrievable level by numerous washes. However, it was concluded that the work should be performed in a well-equipped decontamination facility with proper liquid waste handling and ventilation systems.

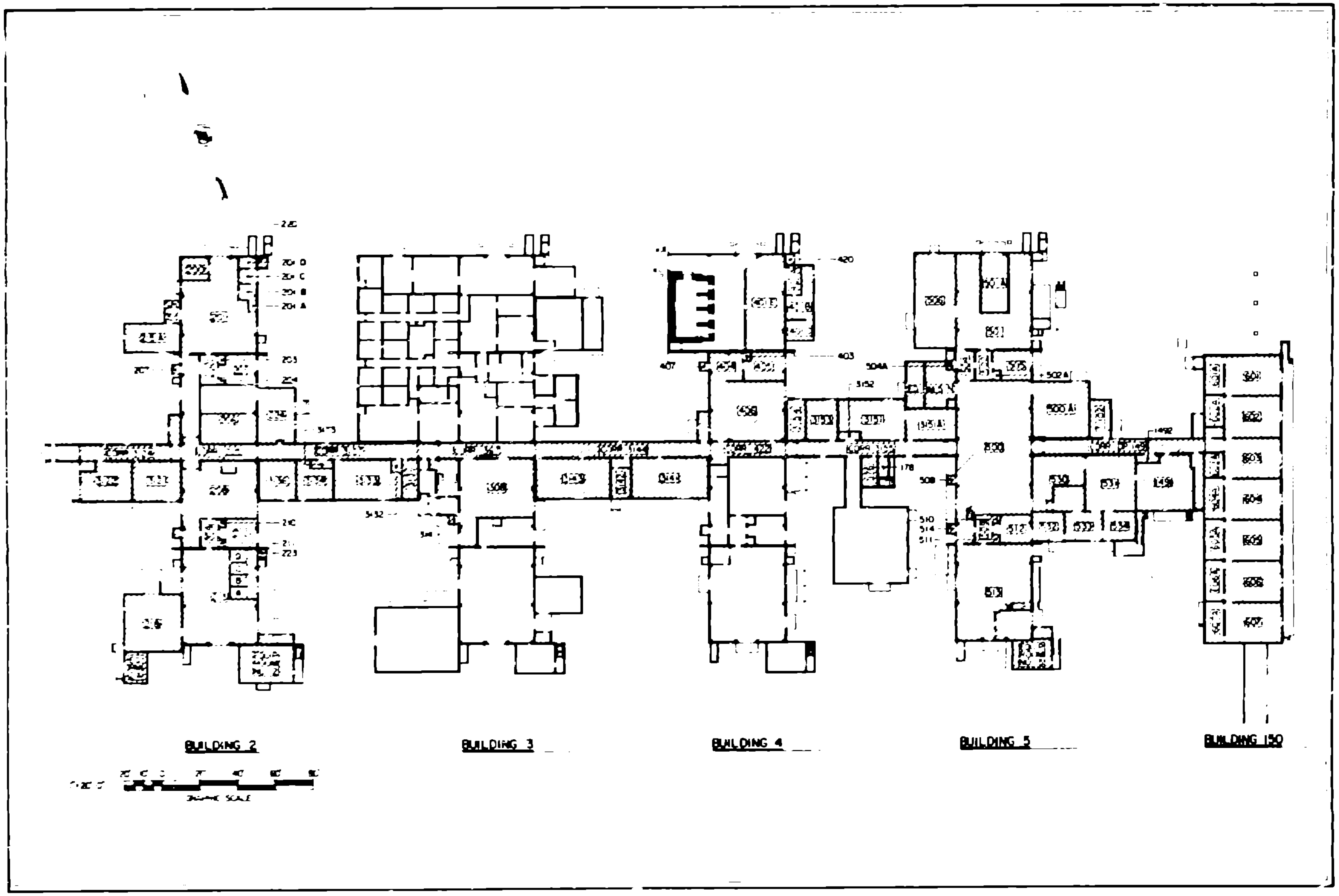

Fig. 2. DP West Facility, 1978.
Shaded areas were decontaminated.

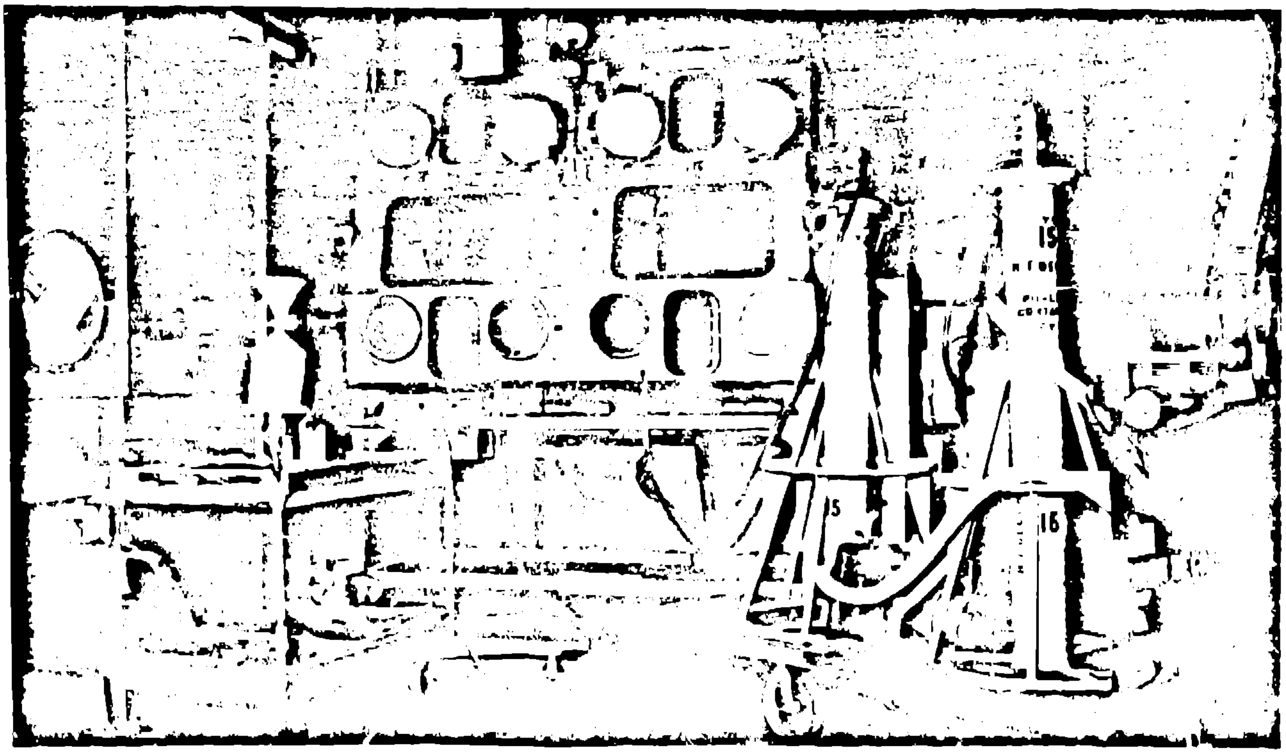

Fig. 3. Equipment used for washing gloveboxes.

The efforts required in decontaminating the 20 gloveboxes indicated that the decontamination project funding and schedule would not permit the in-place washing of all gloveboxes to nonretrievable levels. The decision was made to proceed with glovebox removal and storage as retrievable TRU waste. Three hundred and eighteen linear meters of gloveboxes and 109 linear meters of connecting conveyor tunnels were processed requiring 120 glovebox separations and 16 tunnel separations. No release of contamination occurred during the operation. Typical glovebox and conveyor tunnels are shown in Figures 4 and 5.

DECONTAMINATION TECHNIQUES

Laboratory decontamination personnel performed the high-level, high-risk glovebox and conveyor tunnel separations, and the decontamination of structures requiring use of specialized techniques or equipment. Decontamination activities involving low-level contamination and use of conventional cleaning techniques such as washing with soap and water or plaster removal were performed by Zia Company personnel.

Glovebox and Conveyor Tunnel Separation

The rationale for preparing gloveboxes and tunnels for separation was to complicate future size reduction operations as little as possible by minimizing painting, foaming, etc. After a few successful separations, cleaning and painting the separation area and the adjacent 30 cm in both directions

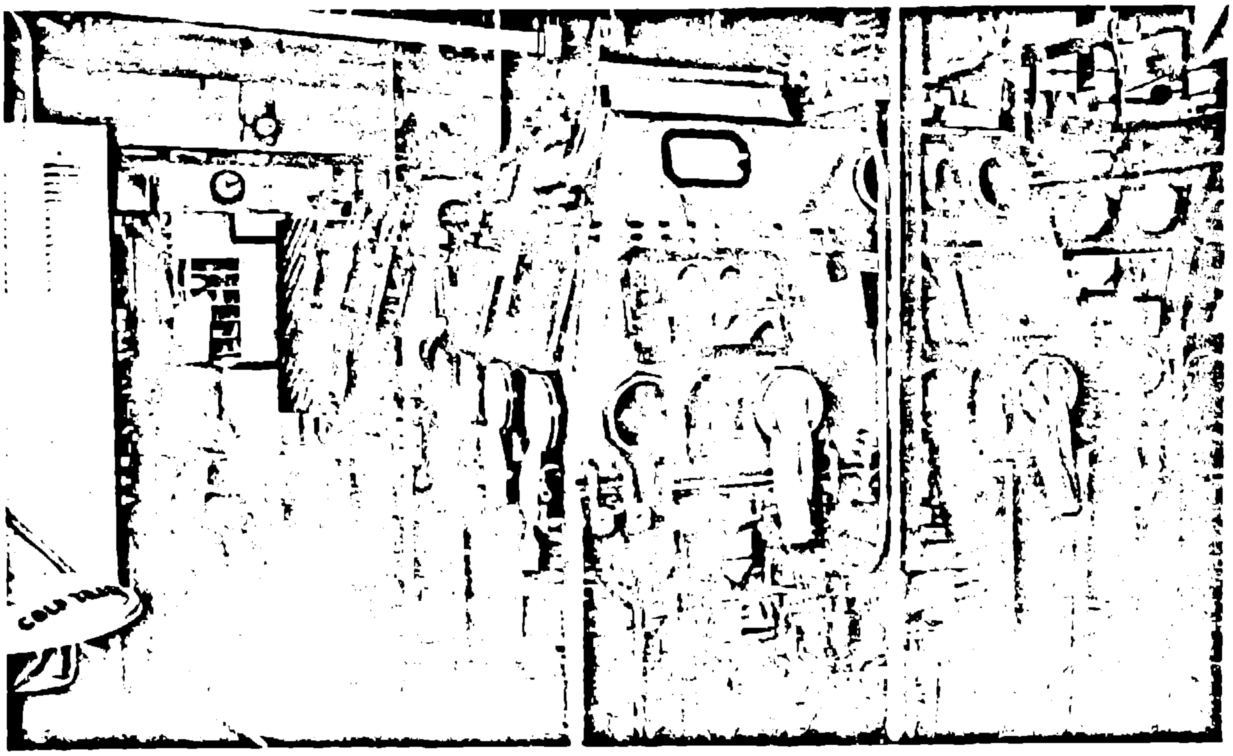

Fig. 4. Typical gloveboxes.

Fig. 5. Typical conveyor tunnels.

became standard procedure. The lack of gloveport openings in some long sections of conveyor tunnels necessitated lowering the tunnel in one large section, fabricating an end plate that would accommodate an exhaust duct, and then separating the tunnel into smaller sections at floor level. At the selected separation point, a 15-cm diameter hole was made and decontamination and painting were accomplished with long-handled brushes and tools. The hole was later used as an exhaust port for the next separation. The separations were complicated because conveyor track supports located internally in the conveyor tunnel did not always butt together at the separation point; hence, several tunnel sections had to be partially unbolted and separated enough to allow sawing the supports with a hacksaw blade (Fig. 6).

Glovebox separation areas were cleaned with a commercial spray detergent introduced into the glovebox system in a 1-ℓ, plastic spray bottle. After cleaning, the surface was spray-painted with four coats of enamel which was introduced into the glovebox in spray can containers.

Large bagout ports were sealed by introducing a steel plate into the box then using a bolt to tighten the plate to another external plate. Silicon rubber was used as a sealant between the box surface and the plate.

The need to allow gloveboxes and conveyor tunnels to vent with temperature changes resulted in the design of a gloveport venting device that served as an exhaust port for sections which had no connection to the process exhaust. A variac-controlled vacuum cleaner motor and a high efficient particulate air (HEPA) filter were used to adjust the vacuum on the box. When the glovebox was isolated, the device then became a filtered vent for the glovebox, allowing the box to go through temperature changes during temporary storage without becoming pressurized and releasing plutonium contamination.

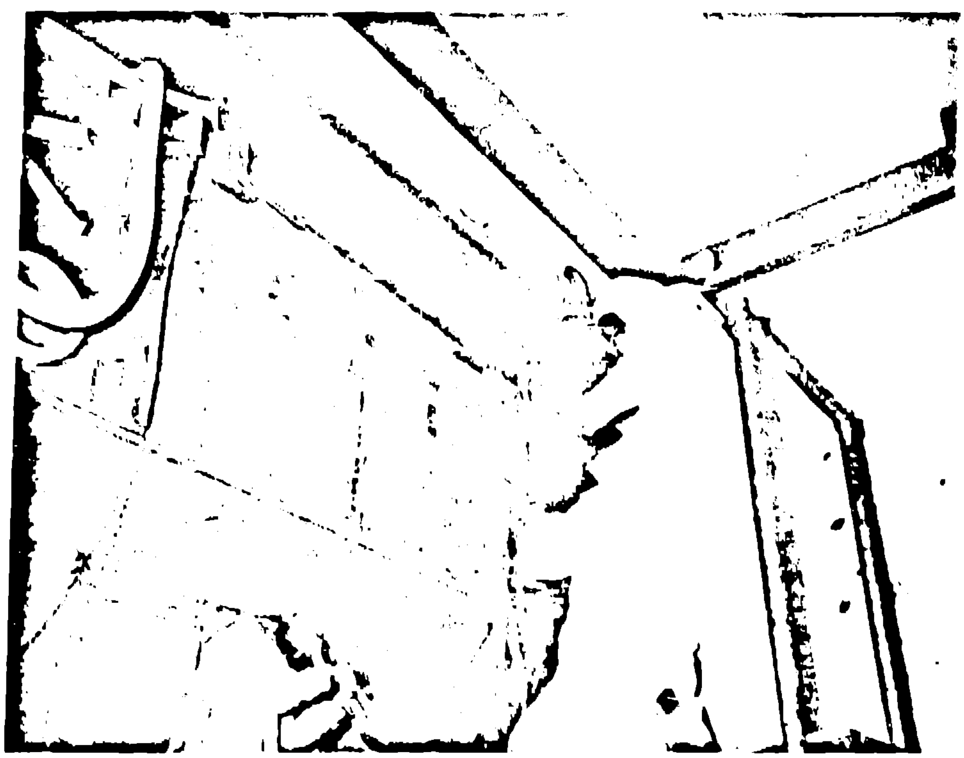

Fig. 6. Sawing support rail inside conveyor tunnel.

Concrete Surfaces

The project required decontamination of 3500 m^2 of concrete slab floors. Since Los Alamos experience was primarily limited to using acids, paint removers, and small pneumatic chippers on small areas, new techniques had to be developed for large areas.

Early in the project, hand-held and floor-type pneumatic scarifying tools were purchased and experimentation began in isolated areas. To eliminate the possible spread of contamination, an enclosed HEPA-filtered confinement chamber was constructed using a glovebox section (Fig. 7).

Numerous tests were conducted with a floor-type scarifier. By covering the floor with a thin layer of water or water-detergent mixture and vacuuming immediately after scarifying, very high levels of plutonium contamination (10^6 dis/min/100 cm^2) could be scarified without spreading contamination or creating an airborne problem.

The effectiveness of scarifying was compared to using abrasives, acid solutions, and paint removers. Scarifying proved to be the safest and most cost effective.[3] Identifying highly contaminated areas with the phoswich detector, scarifying them with the hand held scarifying tool, then scarifying the entire floor using the floor model soon became standard practice. Each pass removed approximately 0.5 cm. Except for areas with cracks or bolt holes, two or three passes usually removed all contamination. Removal of bolt anchors used for supporting gloveboxes and other equipment required removal with a handheld air chisel. In one room, six hundred anchors were removed. Approximately 125 m of metal stripping used to cover expansion joints in the concrete floors were also removed. The ends were loosened with a pneumatic

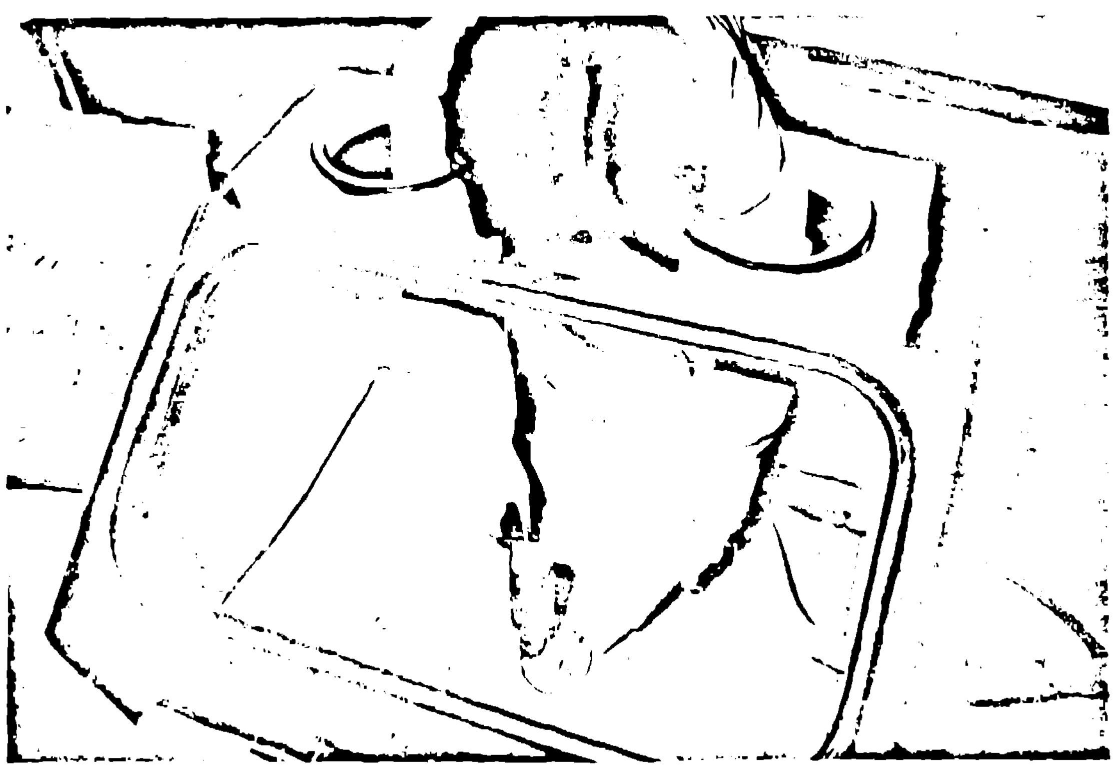

Fig. 7. Confinement chamber for hand-held scarifier.

chisel and pried loose with a crowbar. The remaining cracks were usually highly contaminated; hence, they were spray painted and cleaned with a hand-held scarifier.

Metal Surfaces

Relatively clean nonprocess areas such as attics were damp mopped or wiped using water and detergent solution. Metal wall partitions with fixed contamination were decontaminated when possible by using paint removers or dilute hydrochloric acid solutions with abrasive cleaners. Generally, for fixed contamination, detergents were ineffective, paint remover somewhat effective, and HCl solutions and abrasives very effective, removing approximately 80% of the contamination. Highly contaminated walls were removed to save time and costs, to be more complete, and to minimize injuries such as acid burns and cut fingers.

Plaster Walls and Ceilings

Most of the 30,000 m^2 of wall and ceiling surfaces were plaster on metal lath. Early in the project, paint remover was used to try to save the plaster, but the many steps required to apply the remover, scrape it off, check the surfaces, and then repeat this process several times made it easier and more economical to remove and replace the plaster. Paint was removed from a total of 270 m^2 of wall surface and 427 m^2 of plaster were removed.

A very useful contamination control aid used while scarifying or chipping contaminated plaster and paint was a filtered vacuum cleaning system which could be positioned to collect chips and dust from the operation. The 200-ℓ (55-gal) drum which served as a trap was later sealed and used as the primary waste disposal container (Fig. 8). The vacuum cleaner was a commercially available, air operated, HEPA-filtered system.

Outside Areas

The project also involved the removal of five industrial liquid waste collection and sampling wells which were approximately 4.65 meters deep and 1.5 meters in diameter.

Four of the five wells were removed in one piece by exposing them as much as possible with a backhoe then pulling them out with a crane. All surfaces were then sprayed with asphalt and the structures were wrapped in plastic and tarpaulins for disposal. One well collapsed during removal and was disposed of as rubble.

HEALTH PHYSICS

Health Physics Group was responsible for providing radiation protection, final area release surveys, and for establishing procedures for transferring decontaminated areas to new occupants.

Radiation Protection

Before being assigned to the project, workers were required to submit a plutonium bioassay (urine) sample, have an *in vivo* measurement for plutonium, and be quantitatively fitted for full-face respirators. On assignment to the project, workers attended a Health Physics indoctrination lecture. Among the

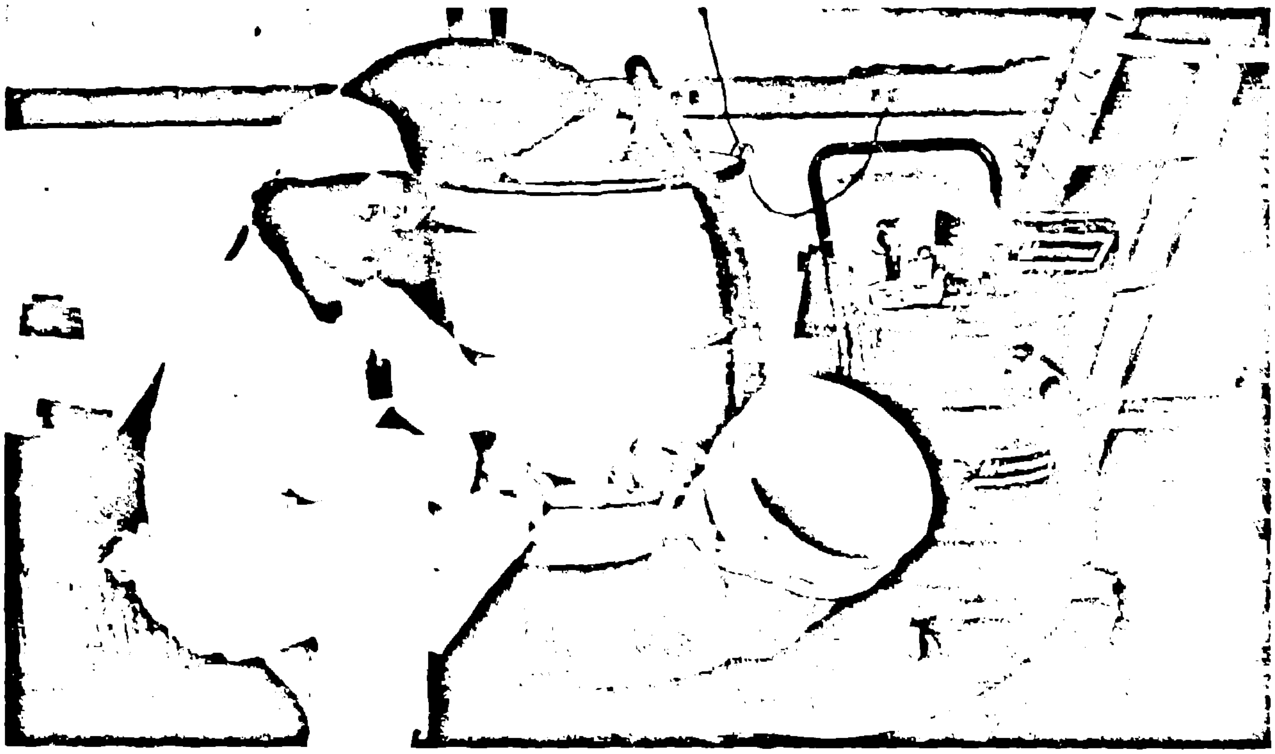

Fig. 8. Filtered vacuum system used for paint and plaster removal.

topics addressed were (1) clothing requirements, (2) dosimetry badges, (3) respiratory protection, (4) eating and smoking regulations, (5) contamination control, (6) use of self-monitoring instruments at exits from radiation areas, (7) nasal smears, (8) wound counting, and (9) site and work area alarms.

Special personnel monitoring procedures included wound counting[4] and fecal sampling.[5] Seventy-five minor wounds occurred during the operation. None contained a measurable amount of plutonium. On six occasions, personnel were requested to submit fecal samples because of a nose swipe in excess of 500 dis/min. Levels in these fecal samples were less than the minimum detection level for plutonium and americium.

Final Release Surveys and Transfer Procedures

The Health Physics Group also assumed responsibility to ensure that the decontamination effort met release criteria and that any remaining contamination was documented. Final survey reports were prepared for each room and building.

When contamination levels in an area met pre-determined release criteria, new flooring was installed, the walls were painted orange to alert future occupants of possible contamination, a final condition report was prepared for each room and building, and the transfer meeting was held with the new occupants.

RADIATION INSTRUMENTS USED FOR FINAL SURVEYS

Alpha Survey Instruments

Since weapons-grade plutonium, ^{238}Pu and ^{241}Am were the primary contaminants, alpha detection instruments played a major role in the final release surveys. The two portable instruments used were the Eberline Portable Alpha Counter Model 7 (PAC-7) and the Ludlum Model 139.

Beta and Gamma Survey Instrument

Beta-gamma surveys were made using the Eberline Portable G-M Counter E-112B to verify that surface radiation levels were less than 1.0 mR/h. Levels were found to be below the detection capabilities of this counter. Since the laboratory areas were to be released for occupancy by nonradiation workers, long-term thermoluminescent dosimetry badge exposures were made to demonstrate that beta-gamma levels were below 0.25 mrem/h or 500 mrem/year based on a 40 hour per week, 50 weeks per year occupancy factor. Thermoluminescent dosimetry badge results showed beta-gamma radiation levels were not significantly different than natural background levels for the area.

Neutron Survey Instruments

Neutron surveys were performed to measure neutron radiation levels throughout the facility. These surveys were performed using an Eberline Portable Neutron REM Counter, Model PNR-4. In addition to making surveys with this counter, the detector which is a 22.9 cm- (9-in) diameter, cadmiumloaded polyethylene sphere with a BF_3 detector in the center was used with a scaler system to make fixed location measurements throughout the facility. This system was capable of measuring much lower neutron radiation levels than was the PNR-4 and results of these measurements verified that neutron levels were not significantly above background levels in the area.

"Phoswich" Detector

A Los Alamos-developed "phoswich" (phosphor sandwich) detector,[6] which consists of a NaI crystal backed by a CsI crystal, and measures low-energy photon radiation, such as plutonium x rays, was used extensively throughout the operation to detect plutonium surface and subsurface sources.

Because the phoswich is very sensitive to scattered radiation, it could not be used to detect low plutonium levels in areas housing plutonium gloveboxes and process equipment items or in a highly contaminated area. Once contamination levels were reduced, it became extremely useful in locating hot spots such as those in cracks or under paint on concrete floors. The "phoswich" system was capable of measuring about 10,000 dis/min of plutonium per 100 cm^2 area through 5 layers of paint.

WASTE ASSAY AND MANAGEMENT

Plutonium radiation levels in gloveboxes were determined by using 19-mm diameter by 3-mm thick NaI scintillation detector for detecting the low energy photons emitted during the decay of the transuranic radionuclides. For plutonium assay, the decay of x rays (energies approximately 17 keV) are monitored. For ^{241}Am decay, the 60 keV gamma ray is detected. The entire system remains external to the glovebox and measurements are made by placing the probe into a clean unleaded glove and aiming it at the surface of interest. Photon transmission through the glove is better than 70% for photon energies above 15 keV.

Waste management aspects of the operation were directed by an on-site representative from the Laboratory's Waste Management group.

When practical, room trash was packaged in 0.05-m^3 cardboard boxes and surveyed for retrievability in a Multiple Energy Gamma Assay System Counter.[7] Low level, nonretrievable TRU waste totaling 7426 m^3 was packaged and sent to the on-site solid radioactive waste management site in plastic-lined, tarpaulin-covered trucks or via Dempster Dumpster waste containers.

Waste with over 10 nCi ^{239}Pu or 100 nCi ^{238}Pu per gram of waste was packaged and placed in approved TRU storage containers and trucked to an on-site radioactive solid waste management site. Retrievable waste generated by this operation consisted of 1488 m^3 of gloveboxes and conveyor tunnels, 166 m^3 of pipe, duct, etc., and 104 m^3 of soil.

One hundred and two cubic meters of gloveboxes were temporarily packaged in bolted metal containers for future size reduction studies.

Liquid wastes were treated at an on-site industrial waste treatment plant. The industrial waste collection systems in the individual buildings were used for collection until they had to be decommissioned. Wastes were then transported to the treatment plant in a tank trailer.

COSTS

The project required three years and $4,418,400 to complete. A breakdown of costs to the Laboratory and Zia Company is shown in the following table.

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TABLE I

SUMMARY OF COSTS FOR THE DP WEST PLUTONIUM DECONTAMINATION PROJECT

	Costs in Thousands of $s					
	1977	1978	1979	1980	1981	TOTAL
LOS ALAMOS NATIONAL LABORATORY						
Health Division; Health, Safety and Decontamination Support	1.3	148.5	473.6	416.1	93.0	1132.5
Chemistry and Metallurgy Division; Personnel and Supplies	0.0	43.5	164.4	180.3	5.9	394.1
Engineering	0.0	1.7	68.2	62.3	1.4	133.6
Zia COMPANY						
Labor & Services	0.0	144.8	767.9	1190.4	110.7	2213.8
MATERIAL						
General Supplies	19.7	55.7	66.7	50.6	63.2	255.9
Fiberglass Boxes	0.0	0.0	98.8	169.1	20.6	288.5
Totals	21.0	394.2	1639.6	2068.8	294.8	4418.4