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SRP HIGH-LEVEL ALPHA ANALYTICAL FACILITY

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PREPARED FOR THE U. S. ATOMIC ENERGY COMMISSION UNDER CONTRACT AT(07-2)-1

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by

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ABSTRACT

A laboratory facility for the routine analysis of ^{238}Pu oxide was designed and built for the Works Technical Laboratories of the Savannah River Plant. The facility consists of a Dry Oxide Handling Laboratory and a Solution Analysis Laboratory separated by a Service Area. Enclosures for containing radioactive materials are interconnected stainless steel glove boxes, hoods, and radiobenches. Design criteria emphasized personnel safety, environmental protection, and operating efficiency and flexibility. Features of the facility include: effective contamination control; an efficient sample entry, transfer, and exit system; corrosion resistance; automatic fire detection and suppression; and ready access to all services. The entire facility occupies a space of only 24 x 24 ft. Construction required one year and cost $250,000.

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INTRODUCTION

Specification analyses of ^{238}Pu oxide are routinely made by the Works Technical Laboratories of the Savannah River Plant (SRP). A facility formerly used for these analyses had severely deteriorated from radiation damage and corrosion. A new facility was proposed, designed, and built as a replacement.

The new facility, consisting of 55 linear feet of hoods, glove boxes, and radiobenches, was designed to fit into the previously used 24 ft x 24 ft space (Figures 1, 2, and 3). Primary goals in the design included personnel safety, environmental protection, operating efficiency, and flexibility for adaptation to future needs. Operating experience during the past year has confirmed that these goals have been met. Features of the new facility include the following:

- Better contamination control.
- A more efficient sample entry, transfer, and exit system.
- Increased corrosion resistance.
- Automatic fire detection and suppression.
- Improved access to all services.

CONTAMINATION AND RADIATION CONTROL

The facility provides continuous containment during transfers between glove boxes. Additional contamination control is attained by using hoods and radiobenches to house all normal glove box access ports and by providing a complete operating area air change every one to two minutes.

Glove box exhaust air is filtered through three high efficiency particulate air (HEPA) filters in series and finally through a sand filter before discharge to the environment. All glove box inlet filters and gloves are cartridge-mounted and can be changed without breaking containment (Figure 4). Used gloves and inlet and outlet filters are removed from the glove box train through bag ports in hoods and radiobenches.

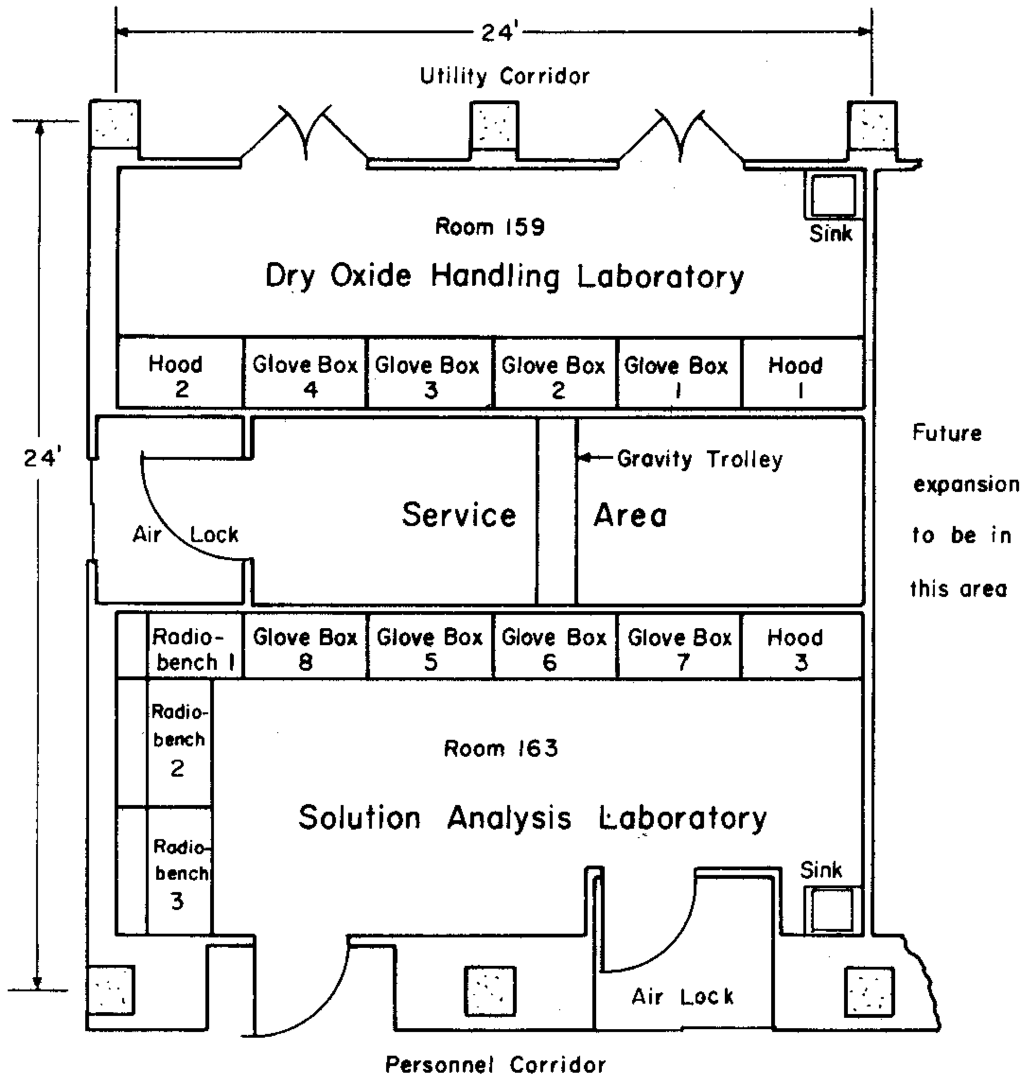

Figure 1. SRP High-Level Alpha Analytical Facility

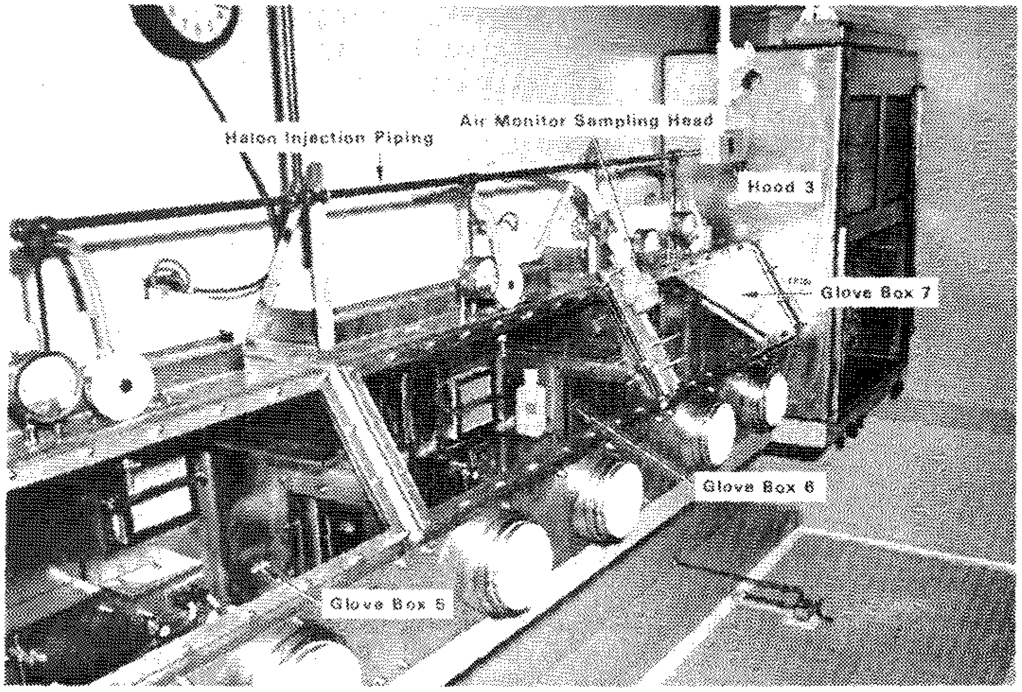

Figure 2. Solution Analysis Laboratory
(looking North)

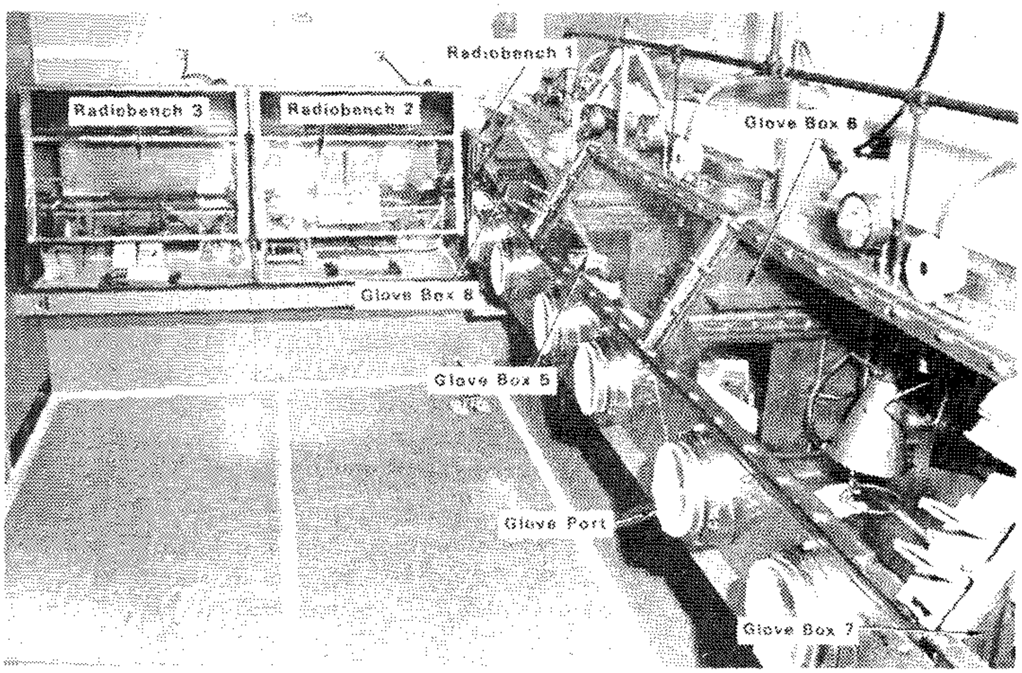

Figure 3. Solution Analysis Laboratory
(looking South)

Shielding for the soft X-rays from ^{238}Pu oxide is provided by 1/8-in. stainless steel glove box walls with 1/16-in. lead added to the fronts and bottoms of the boxes. Lead-impregnated gloves are provided where justified by the quantities of oxide handled. Internal shielding is used for temporary storage of more than one gram of oxide.

Air is continuously monitored for alpha activity at breathing level at five stations in the operating areas and near the exhaust duct in the service area. Contamination levels are recorded, and alarms* warn operating personnel when activity reaches designated limits.

SAMPLE ENTRY, TRANSFER, AND EXIT SYSTEM

Samples are introduced to the Dry Oxide Handling Laboratory (Room 159) through an isolation box in Hood 1 (Figure 5). Analytical balances and other large items are transferred into or out of Glove Boxes 1 or 4 and via Hoods 1 and 2 after removal of bolt-on plates on which door and bag ports are mounted.

Removable plates at the rear of Glove Boxes 3 and 5 allow entry of items greater than the 10 in. x 12-1/2 in. glove box door opening (Figure 4). For these entries, the glove boxes can be ventilated at rates up to a maximum of 1000 cfm by opening the transfer doors to the hoods.

Air flows continuously into the isolation box from the hood via an HEPA filter and then flows into Glove Box 1 through dust-stop filters. The air flow decreases contamination levels in the isolation box, and the filters avoid large decreases in glove box differential pressures during entry. Full exhaust capacity of the eight glove boxes (>200 cfm) may be used to avoid airborne contamination when transfers are made from glove box to hood.

Bag ports of 4-in. and 10-in. diameter for solid waste and recoverable oxide are provided. Bag-out operations are done in Hood 2 to control any possible spread of contamination. Liquid waste flows by gravity from stainless steel cup sinks in the containment units to tanks in the shielded areas below the room.

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* W. J. Woodward. *An Improved Air Monitor in a Standard Nuclear Instrument Module.* USAEC Report DP-1260. E. I. du Pont de Nemours and Company, Savannah River Laboratory, Aiken, South Carolina (1971).

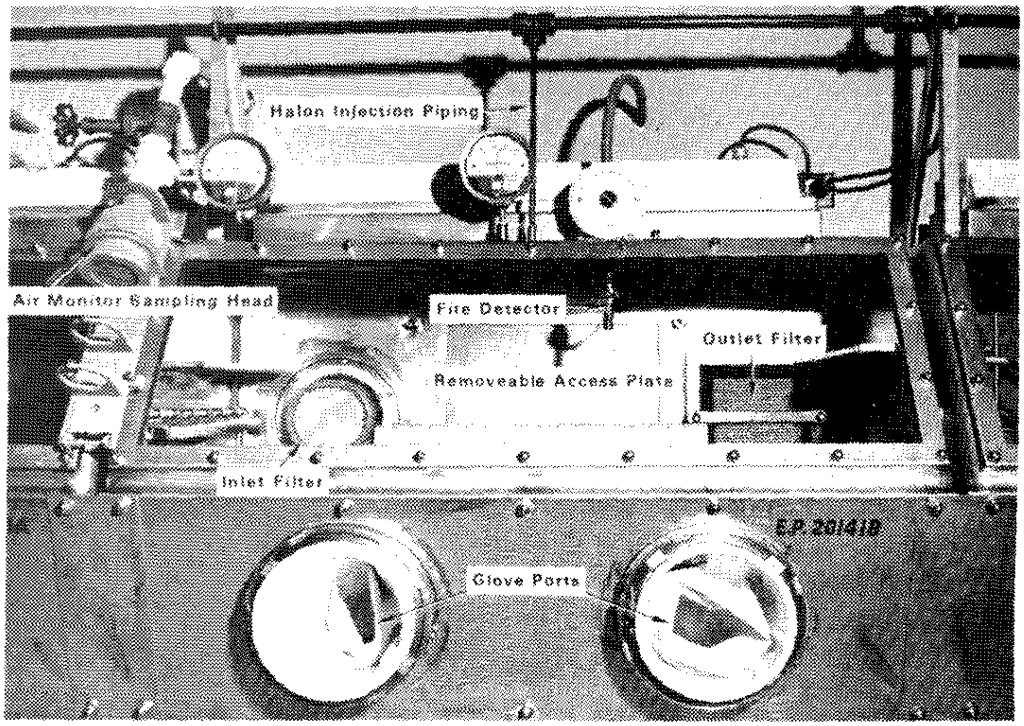

Figure 4. Typical Glove Box

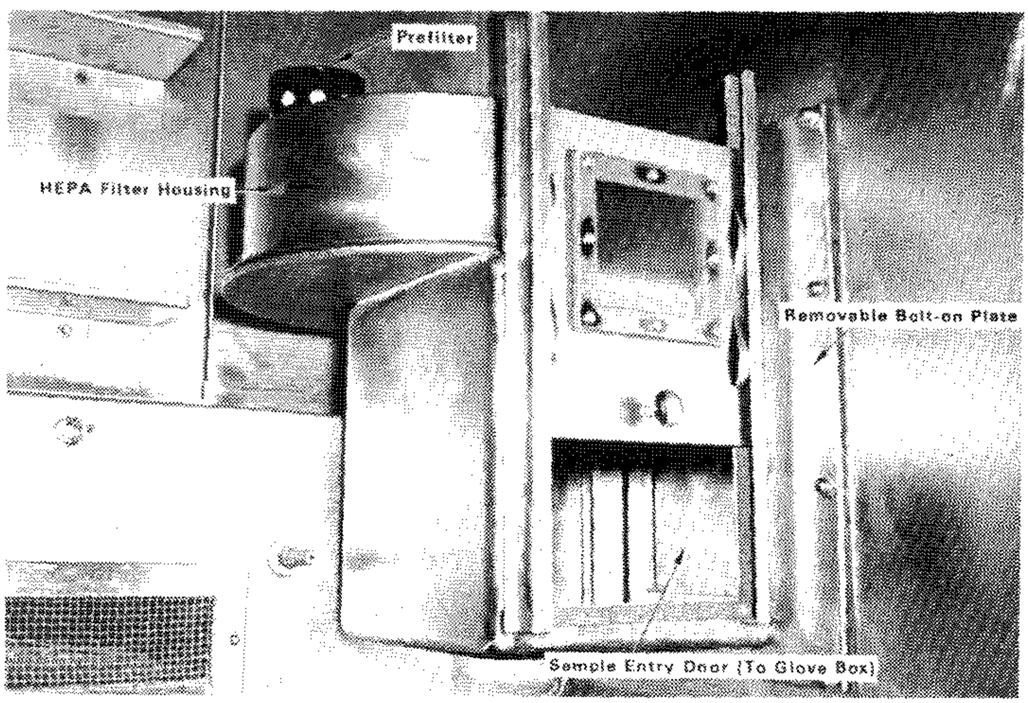

Figure 5. Isolation Box (Transfer Air Lock) - Hood 1

Solutions of plutonium are transferred to the Solution Analysis Laboratory (Room 163) for wet chemical analysis by a gravity-powered trolley (Figure 6). The stainless steel, ball-bearing trolley and track are removable for servicing or replacement. The trolley is more reliable and less costly than battery-powered carts used previously. Additional access to the solution analysis glove boxes in Room 163 is provided from Hood 3 and the radiobenches.

CORROSION RESISTANCE

The fiberglass containment units in the old facility were replaced by units constructed entirely of 1/8-in.-thick sheets of 304L stainless steel. 304L stainless steel was also chosen for all exhaust ducts and piping because of its proven corrosion resistance in the production facility and in labware used at SRP. Fire resistance, X-ray shielding, and structural strength were also factors in favor of its selection.

Corrosive atmospheres in the glove boxes are minimized by the large air flow (>15 cfm per box). Doors are installed between glove boxes to isolate corrosive fumes. To avoid corrosion of metal surfaces and etching of glass windows by hot HNO_3-HF fumes during dissolution of PuO_2, air flow is increased to approximately 30 cfm, and the acid fumes are directed to the exhaust system by a replaceable stainless steel canopy hood within the glove box (Figure 6).

FIRE DETECTION AND SUPRESSION SYSTEM

Detectors in each glove box (Figure 6) respond to a set temperature rise and automatically actuate a pressurized Halon 1301 injection system. Audible and visible alarms are transmitted to operating and Fire Department personnel.

Manual operation of the system from outside the operating area, but still within view of the glove boxes, is also provided. The system was tested by estinguishing an alcohol fire. The fire was extinguished in less than five seconds after detector response. The extinguishing agent was discharged for more than thirty seconds, and the pressure differential in the glove boxes was lowered from 0.5 in. to 0.2 in. (H_2O). The two glove box trains are on separate detection and suppression systems, and each system has main and reserve Halon sources. Heaters are provided for testing the response of each detector periodically.

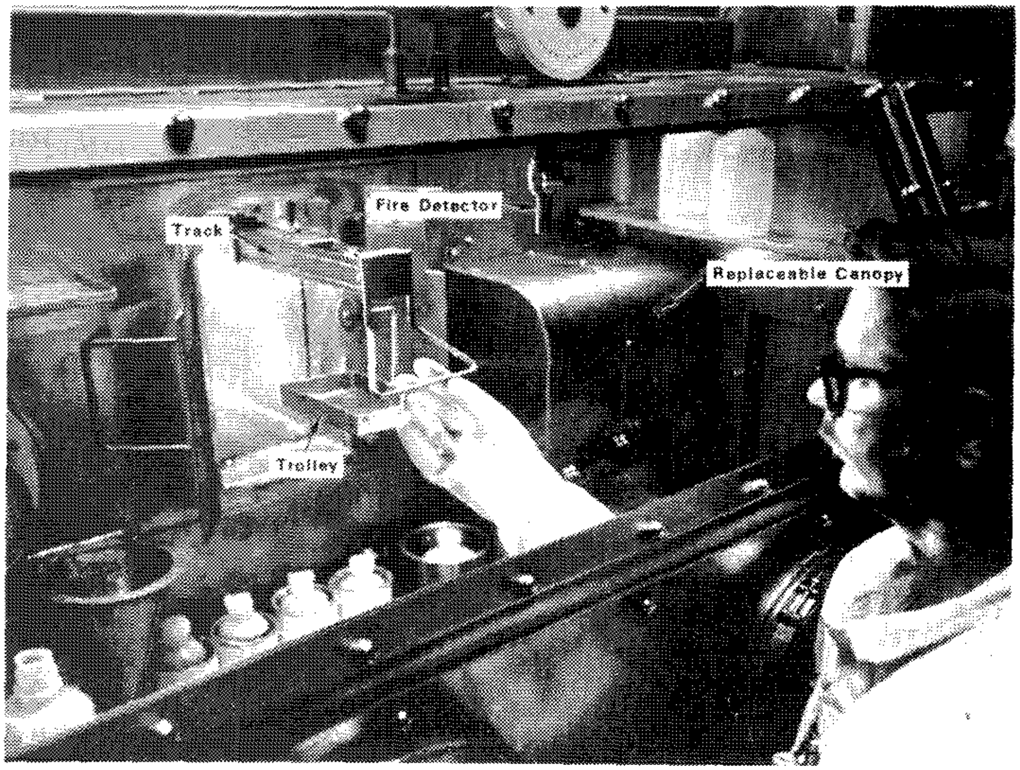

Figure 6. Gravity-Powered Trolley

Safety plate glass in viewing and lamp windows gives added fire resistance, and PuO_2 does not adhere to it. Wire mesh imbedded in the lamp windows protects against shattering.

SERVICE ACCESS

Services, such as high-level drains, exhaust pipes, ducts, vacuum and water lines, are isolated from the operating areas for personnel protection in the event of contamination leakage (Figures 7 and 8). Repairs and modifications are easily made without disrupting analytical operations. All glove box air inlet filters are in this area for additional contamination control and uninterrupted operation during filter changes.

COST

The entire facility was constructed in two existing laboratory modules. Construction required one year, and the facility cost $250,000.

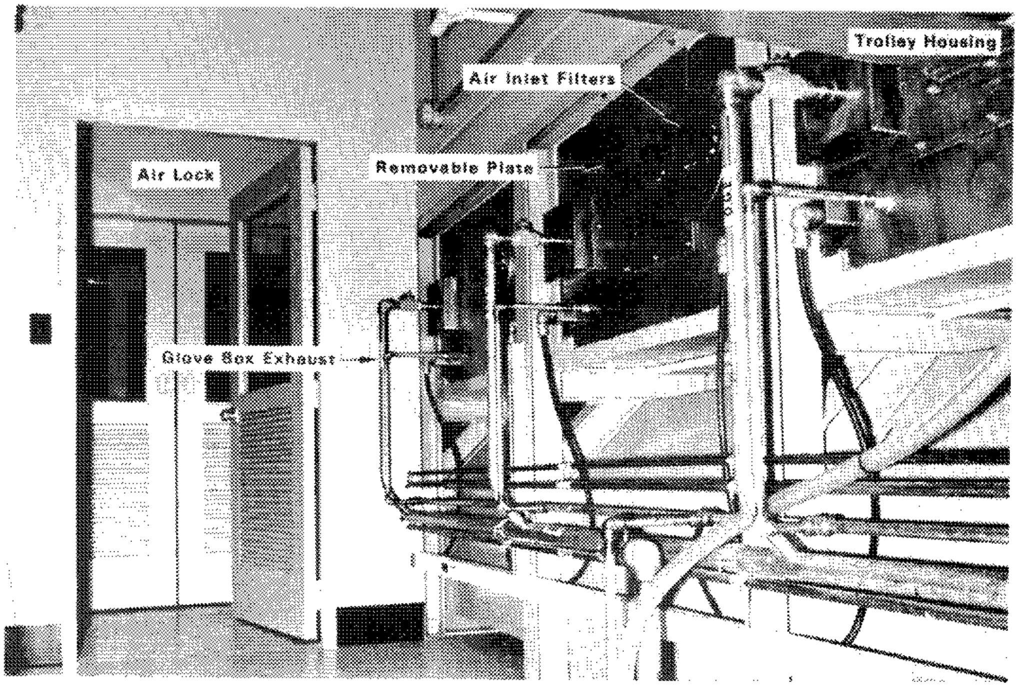

Figure 7. Service Area (looking South)

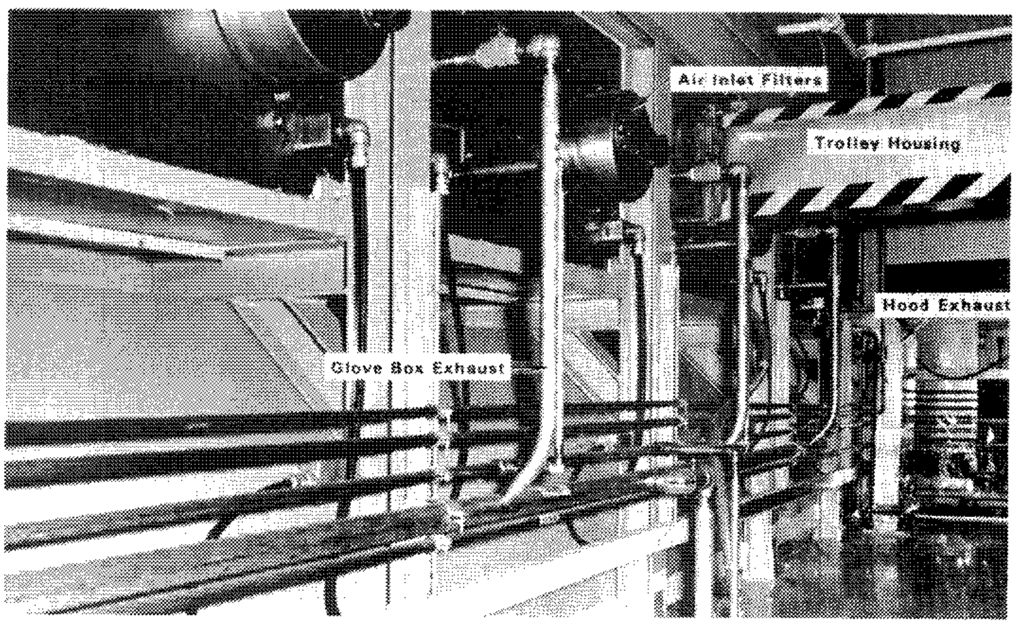

Figure 8. Service Area (looking North)