PLUTONIUM LABORATORY
DECONTAMINATION EXPERIENCE

R. E. BARDSLEY
L. G. MERKER

SEPTEMBER, 1967

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DEVELOPMENT REPORT**

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ERRATA

Page 11, left column, line 25

"Washing alone . . ." should read "The washing step alone . . ."

Page 13, left column, line 38

". . . detection instruments removed from the laboratory were for decontamination . . ." should read ". . . detection instruments were removed from the laboratory for decontamination . . ."

Page 15, left column, last line

Delete second "if the"

Page 15, right column, line 10

After "another" add ", cutting the flow."

Page 23, right column, under General Electric, Pleasanton

E. A. Evans is now with Battelle-Northwest

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PLUTONIUM LABORATORY DECONTAMINATION EXPERIENCE

By

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FFTF Project

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PLUTONIUM LABORATORY DECONTAMINATION EXPERIENCE

R. E. Bardsley and L. G. Merker

INTRODUCTION

On Monday, August 23, 1965, there was an explosion and fire in a glove box, which resulted in a contamination spread of UO_2 - PuO_2 material, in the Plutonium Fuel Laboratory (308 Building) at Battelle-Northwest.

Although there have been numerous contamination spills and decontamination efforts of varying degrees at several nuclear sites during the past two decades, documentation of these efforts is rare. In many cases, the lessons learned have been lost through the lack of documentation. The equipment and techniques themselves are relatively simple, even crude. It is, in fact, the apparent simplicity of these procedures that is misleading to an observer and which may erroneously imply that the decontamination process itself is simple. The experience of the personnel in handling plutonium and their knowledge of decontamination techniques that are developed over a long period of time by trial and error can often reduce the time of decontamination by a significant factor.

The purpose of this report is to describe the decontamination of the Battelle-Northwest facilities so that

others may benefit, where applicable, by this experience. The report covers the general plan, some of the detailed procedures, special decontamination efforts, and recommendations.

DESCRIPTION OF EVENT

The explosion and resulting fire occurred in a glove box normally used to process mixed oxide for fuel elements. The bell jar for an outgassing furnace was being cleaned with a flammable solvent, acetone, when either a metal-to-metal spark or a discharge of static electricity ignited the solvent vapors. Most of the contamination was confined to two adjacent rooms. Eleven staff members were in the two rooms concerned at the time of the incident. No staff member was injured and maximum internal deposition of plutonium was <10% MPBB.*

Figure 1 shows the location of the incident (Room 113) with respect to the building floor plan, and Figure 2 shows the room in more detail.

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* MPBB - Maximum Permissible Body Burden is 0.04 μCi per "Recommendations of the ICRP, Pub #2," 1959.

FIGURE 1. Floor Plan of the Plutonium Fuels Laboratory

EXTENT OF CONTAMINATION

The force of the explosion blew off two of the gloves, ripped other gloves, and cracked one panel of the glove box. An undetermined amount of UO_2 -2 wt% PuO_2 was blown out of the glove box into the room air. The amount is believed to be less than two grams. Figure 3* is a picture of the glove box showing the two open glove ports, and other torn gloves. These pictures were taken after the cracked panel had been taped, but before the glove

ports were closed. One of the gloves blown from the glove box was burning when it fell to the floor and had to be extinguished.

Each room in the laboratory area of 308 building is considered to be a separate laboratory, and doors are normally closed. The air pressure in each lab is kept slightly negative to the hallway. Air is supplied to each room through overhead anemostats and exhausted through floor ducts fitted with high efficiency filters. Air flow within each lab provides one complete air change approximately every six minutes. Even with this amount of air flow, the explosion caused the plutonium contamination to be spread throughout the room. The door between Rooms 101 and 113 was open, and Room

* This photo and several others in this report were taken with a Polaroid camera under very poor conditions shortly after the incident. Consequently, good quality photographs could not be obtained.

*FIGURE 2. Floor Plan of Room 113
Showing Location of the Explosion and
Personnel at the Time of Explosion*

101 was also contaminated, but to a much lesser degree. The fact that the doors leading to the hallways were kept closed prevented further spread of contamination except for a small quantity tracked out during evacuation.

Personnel leaving Room 113 were contaminated to varying degrees: some had no detectable contamination, while one person was generally contaminated about his face and coveralls up to 200,000 dis/min as measured with a Juno survey instrument. Surface contamination was tracked by operating personnel and firemen from Room 113

to the hallway floor. From the hall floor, a small amount of the contamination was spread by air currents to the other rooms on the first floor. No contamination was detected on the second floor or the office area.

Approximately six hours after the fire and before decontamination was started, the contamination levels were as shown in Table I.

INITIAL ACTION

The immediate object was to prevent further spread of contamination to

+ Tape
placed on
after
explosion

*FIGURE 3. Appearance of Glove Box
Following Incident*

TABLE I. Contamination Levels Before Decontamination

<u>Location</u>	<u>Airborne Contamination</u>	<u>Surface Contamination</u>
Room 113	$2 \times 10^{-8} \text{ } \mu\text{Ci/cm}^3$	All exterior surfaces including walls. From 40,000 dis/min/cm ² to 200,000 dis/min/100 cm ² .
Room 101	$2 \times 10^{-8} \text{ } \mu\text{Ci/cm}^3$	All exposed surfaces including walls. From 5,000 dis/min/100 cm ² to 10,000 dis/min/100 cm ² .
Hallway	$1 \times 10^{-11} \text{ } \mu\text{Ci/cm}^3$	Spots. Up to 5,000 dis/min/100 cm ² .
Other rooms	from $<1 \times 10^{-12}$ to $1 \times 10^{-11} \text{ } \mu\text{Ci/cm}^3$	Spots near door. Up to 1,000 dis/min/100 cm ² . Spots on door louvres and thresholds. Up to 1,000 dis/min/100 cm ² .
Second Floor and Office Area	$<1 \times 10^{-12} \text{ } \mu\text{Ci/cm}^3$	No contamination

---

other parts of the building and to decontaminate the area exclusive of Rooms 101 and 113 sufficiently to allow unrestricted use of the rest of the building. One crew of technicians, engineers, and radiation monitors was assembled to enter Room 113, close the open glove box, and seal the room, while another crew decontaminated the hallway. A temporary "greenhouse" was constructed at the door between Room 113 and the hallway for contamination control between a highly contaminated area and a clean area.

At the beginning of the hallway cleanup, there was airborne contamination, but the concentration had not been determined. A portable air sampler was set up to measure the concentration and assault masks* were

worn until samples were consistently below $2 \times 10^{-12} \text{ } \mu\text{Ci/cm}^3$. Protective clothing worn by clean-up crews consisted of two pairs of coveralls, canvas hoods, two pairs of canvas shoe covers, and cotton gloves over surgeon's gloves.**

Loose contamination was removed by wet-mopping the hallway several times. Mops were wet with a solution of detergent (lauryl sulphate) in water. The contaminated water was disposed of through a contaminated liquid waste line and used mops were sealed in plastic bags for burial. After several moppings, the floor was allowed to dry and then checked with an alpha sensitive floor monitor. Spots were found where plutonium had been ground into the surface of the floor tile. These

---

* See Appendix A for limits and types of respiratory protection.

** See Appendix B for description of protective clothing.

spots were covered with pressure sensitive plastic tape and marked with the contamination levels for later cleanup so that construction of the greenhouse could be started. By this time respiratory protection was no longer required in the hallway.

While the greenhouse was being constructed, the remaining spots in the hallway were cleaned. In some cases the contamination came off the floor with the plastic tape, but in most cases it had to be scrubbed off with wet rags and scouring powder (See Figure 4). These same methods were used to remove spots of contamination from the louvres and door frames of the other rooms, where the flow of air from hallway to room had carried slight amounts of the oxide.

The first entry to Room 113 after the glove fire was extinguished was

made to seal the open glove box. Technicians used self-contained fresh air breathing units and were able to tape the crack in the face of the glove box* (see Figure 3) before running out of air. The next entry was made after the greenhouse was erected, using fresh air masks supplied from large tanks located in the hallway (Figures 5, 6, 7 and 8).^{*} Three layers of protective clothing were worn for entry into Room 113.

Sheet plastic was taped over the ruptured face of the glove box to seal the panel. Plastic was also used to cover a 20 in. diameter bag port on top of the hood which had been ruptured by the explosion.

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^{*} See Appendix B for description of protective clothing

FIGURE 4. Minor Contamination Being Removed from Main Hallway

FIGURE 5. Temporary Greenhouse for Entry to Room 113 from Main Hallway

FIGURE 6. Preparations for Entry to Room 113 Through Greenhouse

FIGURE 7. General Preparations for Entry Through Greenhouse for Decontamination Showing Gas Tanks for Breathing Apparatus

FIGURE 8. Entry Through Greenhouse

After the glove box was sealed so that additional $\text{UO}_2\text{-PuO}_2$ could not be released to the room, the temporary greenhouse was taken down. The green-

house was constructed of sheet plastic over a conduit framework. This was a nonstandard method used only for expediency and was not a desirable

method of construction. The preferred method is to suspend a prefabricated plastic box inside a tubing framework. With this latter method, the box can be collapsed when the job is finished, the contamination contained and disposed of in a small container. The external plastic greenhouse, however, had to be rolled up outside of the framework, providing a potential for spreading contamination to other areas.

Plans for decontamination of Room 113 included a new greenhouse at the door between Rooms 101 and 113. To avoid spreading contamination from Room 113 to the hallway, this door was sealed by taping all openings. This is shown in Figure 9.

By the end of the day of the explosion, the building, with the exception of Rooms 101 and 113, was ready for normal work. This would not have been possible if there had not been provisions made for such an event at

the time the building was designed and built. Air flow from zones of low contamination potential to zones of highest potential and compartmentation of the building proved highly effective. The air flow was rebalanced to give a lower flow and higher negative pressure in Room 113.

Alternate equipment in other rooms was modified to perform functions normally done in Room 113 during the next four months while the room was being decontaminated. Research and development programs, including fabrication of fuel elements for the PRTR, proceeded on schedule.

GENERAL DECONTAMINATION

The day after the explosion, plans were made for starting the general decontamination of Rooms 101 and 113.

The operating group undertook the initial cleaning and removal of equipment for either decontamination or burial. After approximately one week's time a construction company (J. A. Jones, the CPFF contractor for the Hanford Works) was given the job of decontaminating Room 113. They were asked to do this portion of the work because of their extensive experience in decontamination work and their available manpower pool. The operating group continued both the decontamination effort in Room 101 and the decontamination of equipment from both rooms.

The general plan for Room 113 was:

1. To remove all movable equipment for recovery (cleaning) or burial.
2. Wash all exposed areas (walls,

FIGURE 9. Door to Room 113 Sealed with Tape and "On Mask"

pipes, ceiling, hoods, etc.) to remove loose contamination and reduce fixed contamination to <1000 dis/min/100 cm².

3. Cover all exposed surfaces with at least two coats of paint. The first coat was yellow; the finish coat was off-white. In any subsequent work, the yellow paint serves as a warning of fixed contamination should the outer layer of paint wear through.
4. Completely decontaminate or replace all items that could not be painted, e.g. hood faces, gloves, etc.

Most of the mixed oxide expelled from the glove box fell to the floor in front of the box. Two problems were apparent: first, if the oxide were walked on, it would become deeply imbedded in the floor tile and second, the air movement would spread the contamination to other parts of the room. A strippable coating (several

are commercially available) was selected as a means of "fixing" the oxide for later removal and possibly protecting the tile. The method of application was to soak large pieces of cheesecloth in the liquid coating solution, spread these on the floor, and then apply more of the coating with a paint brush or roller. Figure 10 shows the floor partly coated and also shows the new hood panel in place. The strip coating was only partly successful. It permitted removal of most of the oxide in a convenient manner, and it prevented spread of contamination, but it did not allow the tile to be reused. Apparently, the oxide was already ground into the tile by those who entered the laboratory prior to strip coating. Drying the coating was a problem that detracted from its value. In most cases, the strip coat was still "tacky" 24 to 36 hr after application.

FIGURE 10. Floor of Room 113 Showing Cheesecloth Soaked with Strippable Coating Applied to Floor

The use of strip coating was more successful in decontaminating some pieces of equipment. As an example, a specialized welding hood was one item returned to use. The hood was disconnected from the exhaust line, electrical leads were cut off, and the unit was wiped with rags wet with a detergent solution. After this preliminary cleaning, it was covered with plastic and moved to Room 101 where it was again cleaned with wet rags. Initial contamination was in excess of 40,000 dis/min/100 cm² and after the second cleaning the contamination level had been reduced to 500 to 5,000 dis/min/100 cm². Next, it was enclosed in plastic and moved to a clean room where final decontamination was done. As plastic was removed from an area of the glove box, that area was washed and then sprayed with a strippable coating from an aerosol can. Removal of this coating also removed the remaining contamination. Washing alone would not remove all contamination from grit-blasted surfaces. Two coats of paint (yellow, then grey) completed the decontamination effort. The only problem encountered with the sprayed-on strip coating was that occasionally a layer was too thin to be readily removed. Cleaning this hood required about 40 man-hours.

Washing down walls and other exposed areas required the erection of scaffolding. The ceiling was to be washed first, then the decontamination would proceed downward to the floor. To make room for the scaffolding, all portable equipment was removed.

An estimate was made of the decontamination costs of several items and

this cost compared to replacement costs. An example is the cost of fluorescent lamp fixtures. Replacement cost was estimated to be approximately \$85.00 each, while decontamination was estimated to be approximately \$120.00. On the basis of these estimates, plus the consideration that ceiling decontamination would be easier with the fixtures out of the way, a decision was made to remove all light fixtures for disposal as the scaffolding was being erected.

During the first few days, a crew of technicians, engineers, managers, and radiation monitors was assembled to remove equipment. Only two men could go into Room 113 at a time, because of limited air supply equipment, but many others were needed to support this two-man crew. The room crew was changed every two hours. The support crew had to monitor everything that came out of Room 113, dispose of waste, and provide supplies for the inside decontamination crew.

Many on-the-spot decisions had to be made concerning disposition of equipment. One problem arose which involved the discarding of some movable capital equipment items without proper documentation of AEC identification numbers. This problem was discovered early and corrected by recording the identifying numbers as these items were removed from Room 113.

Wooden boxes were constructed for the disposal of bulky or heavy items such as machines and the light fixtures. The boxes were built in sections and delivered to the 308 Building for assembly in Rooms 113 or 101. (See Figures 11 and 12). Prevention of

*FIGURE 11. Prefabricated Box Sections,
Ready for Assembly*

*FIGURE 12. Loading Boxes on to Truck
for Removal to Burial Ground*

contamination spread outside the building was a primary consideration in the construction and use of the boxes.

They were ruggedly built, the corners sealed with caulking compound, and then the boxes were lined with plastic

sheet. Each item to be buried was sealed in clean plastic before being placed in a box. Each box was moved to and from the greenhouse on clean plastic sheet material which was later discarded. When a box was filled, the plastic liner was sealed across the top, a wood cover was nailed on, and the box was covered with plastic.

Small items and contaminated cleaning materials were bagged in plastic and then placed in standard, plastic lined cardboard waste cartons for burial.

Many items such as tools, dies, and fuel element subassemblies had been stored in closed cabinets. Contamination of these items was low level in most cases. These items were removed from the cabinets, placed in plastic bags, and moved to another room for decontamination in open faced hoods. The degree of contamination of the tools and parts often was influenced by the care taken in opening the cabinets.

The value of covering equipment was again proven by this incident. A calculator was beside the hood in which the fire took place. The plastic cover prevented gross contamination of the machine. Minor decontamination and replacement of the cord permitted reuse of the calculator.

Some of the larger items with complex electrical wiring such as alpha detection instruments removed from the laboratory were for decontamination, but there was a low probability of recovery. The conventional techniques of wiping and scrubbing could not remove contamination from crevices such as between wires, capacitors,

resistors, etc. As a last resort, one of the alpha detectors was totally immersed in a detergent solution agitated with steam, rinsed in clean water, and then dried in an oven. This method proved to be fairly effective--some components had to be discarded, but several of the instruments were repairable. The quick wash and quick drying prevented excessive corrosion.

The washing method could not be used on instruments and controls with forced draft cooling because of the amount of contamination. For example, the controller for the welder vacuum system was cooled by a blower which completely contaminated the relays, switches and other electrical components. Efforts to decontaminate the controller were unsuccessful and the controller had to be buried. The high efficiency filter that covered the air intake had previously been removed to increase air flow. Had it been in place, this equipment probably would have been saved.

FINAL CLEANUP

Decontamination by construction personnel was conducted as a two-shift operation until all loose contamination was removed. Once this was accomplished the remaining work, which could now be performed without protective masks, was continued on a one shift basis. Final cleanup of Room 113 including painting, installation of new floor tile, reinstallation of disconnected equipment, and removal of two special-purpose glove boxes that were no longer needed, was completed about four months after the explosion.

ACKNOWLEDGEMENTS

The authors wish to extend their appreciation to the various members of the Materials Department who cooperated in providing the detailed information from which this report was written. Valuable contributions to the

original drafts were made by R. E. Olson.

We also thank D. McConnon, Radiation Protection Specialist, for assistance in the areas of contamination levels, respiratory equipment, and protective clothing requirements.

APPENDIX A

RESPIRATORY PROTECTION

APPENDIX A

RESPIRATORY PROTECTION

Three types of respiratory protection were used during this decontamination; assault masks, supplied fresh air breathing masks, and portable, self-contained air masks. An assault mask is a rubberized full face mask with a filtering canister capable of filtering 99.95% of the airborne particles greater than 0.3μ in size. This filtering efficiency assumes a perfect fit to a man's face which is not always achieved. The canister contains filters with high efficiency media. The wearer must force air through the filter when inhaling. Movement of the wearer is relatively unrestricted and visibility is fair. Figure 13 shows a technician wearing an assault mask.

The other two types of masks are alike except for the source of air which is supplied to the mask under pressure on demand. Fresh air is continuously forced out of any leak around the face. Protection against particle inhalation is assumed to be 100%. In one case air is furnished by hose from a breathing air compressor, or large tanks (D-type) at a remote location. In the other case air is supplied from a tank carried by the mask wearer. Figure 14 shows a technician wearing the mask and portable air supply. The portable unit provides mobility, but has the disadvantage of a limited air supply. One tank, rated as a thirty-minute supply, actually is exhausted after about 15 min if the wearer is

working hard. These are sufficient for a quick survey or rescue operation, but not suited to lengthy decontamination work. The main objection to the supplied air system (D-type tank or manifold) is that the wearer is encumbered by his supply line and the supply lines of others working with him. Occasionally one man will step on the air supply line of another. This problem was overcome by using heavier hose. There were perhaps five occasions when air supply lines parted at the connection to the body hose, forcing the wearer to evacuate the room rapidly. In these cases, the cause was either too much direct weight on the coupling or tugging at the body segment of the line above the coupling. Taping the supply hose to the body reduced this problem, but a more positive quick disconnect coupling would be preferred. Both types of fresh air masks have better visibility and are easier to adjust than the assault masks. Air is supplied under slight pressure so the wearer does not have to "pull" air as with the assault mask.

Approximate limits for respiratory protection at Battelle-Northwest are:

Below $2.0 \times 10^{-12} \mu\text{Ci Pu/cm}^3$ of air

No protection required

From 2.0×10^{-12} to 4.0×10^{-11}

$\mu\text{Ci Pu/cm}^3$ air

Assault masks required

Above $4.0 \times 10^{-11} \mu\text{Ci Pu/cm}^3$ air

Fresh air masks required

Respiratory protection requirements for a given situation may vary slightly and recommendations are made

by Radiation Monitoring after the potential for exposure has been determined.

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FIGURE 13. *View Showing Assault Mask*

Neg 0660250-5

FIGURE 14. *View Showing Mask with Portable Air Supply*

APPENDIX B

PROTECTIVE CLOTHING REQUIREMENTS

APPENDIX B

PROTECTIVE CLOTHING REQUIREMENTS

When working with radioactive materials, there is some given probability that the worker's skin or personal clothing will become contaminated with the material being handled. Since the probability varies with the work situation, the protective clothing requirements also vary. Different types of protection are:

1. Lab Coat and Shoe Covers

This minimal protection is generally considered adequate for casual observation trips through a laboratory where plutonium is being handled. It presupposes that the plutonium is contained in glove boxes or other suitable containers and that the potential for unconfined contamination is small. In an unusual case there may be some contamination on the floor or on equipment that may be brushed against by persons walking through the room.

2. Coveralls, Shoe Covers, Surgeon's Gloves Taped to the Coveralls and No Personal Outer Garments. (See Figure 15)

This protection is considered adequate for normal glove box work. The most probable source of contamination is a hole in one of the glove box gloves. The surgeons gloves act as a secondary protection. The same assumptions are made as above, i.e., that the lab is not contaminated.

3. Double Coveralls, Double Shoe Covers, Double Gloves, Hood Taped to Coveralls, and Assault Mask

This protective clothing is used for work in a contaminated area, where the amount of loose contamination is relatively small. Figure 16 shows a technician with the second set of shoe covers, but only the single gloves and coveralls. Figure 17 shows the same man with the second set of coveralls and gloves, a hood taped to the coveralls, and an assault mask. He is completely covered by protective clothing, and the outer set can be removed when he leaves the contaminated zone.

4. Three Pairs of Coveralls, Triple Gloves, Triple Shoe Covers, Two Hoods, and Supplied Air Breathing Mask or Self-Contained Air Mask.

This protection is used in cases of gross contamination. (See Figure 18, 19, and 20). The third layer of clothing is removed when the man leaves the area of gross contamination, such as the greenhouse which separated Room 113 from Room 101. The second layer is normally clean, but may be contaminated and is removed at the step-off pad which separates the clean area (such as the hallway) from the potentially contaminated area (in this case Room 101).

Neg 0660250-1

FIGURE 15. Technician Dressed in Coveralls, Shoe Covers, Surgeon's Gloves Taped to Coveralls, and No Personal Outer Garments

Neg 0660250-2

FIGURE 16. Technician Dressed in Single Coveralls, Double Shoe Covers, and Single Gloves

Neg 0660250-3

FIGURE 17. Technician Dressed in Double Coveralls, Double Shoe Covers, Double Gloves, Hood Taped to Coveralls, and Assault Mask

Neg 0660250-4

FIGURE 18. Technician Dressed in Triple Coveralls, Triple Gloves, Triple Shoe Covers, Two Hoods, and Supplied Air Breathing Mask or Portable Air Breathing Mask

Neg 0660250-5

FIGURE 19. Technician Dressed in Triple Coveralls, Triple Gloves, Triple Shoe Covers, Two Hoods, and Portable Air Mask, Front View

Neg 0660250-6

FIGURE 20. Technician Dressed in Triple Coveralls, Triple Gloves, Triple Shoe Covers, Two Hoods, and Portable Air Mask, Side View

The second and third sets of clothing are bulky and the mask restricts the wearer's visibility. For these reasons, one or two men are required to help each man put on and tape his clothing (See

Figure 21). These men plus one radiation monitor also assist the man getting out of the clothing. The monitor surveys the man and his clothing as the second set is being removed.

*FIGURE 21. Assistance in Dressing
for Decontamination Work*

BNWL-464

APPENDIX C

GENERAL NOTES

APPENDIX C

GENERAL NOTESTILE

The floor tile at the time of the incident was vinyl asbestos installed over an abrasion and corrosion resistant phenolic floor coating. A heavy coating of industrial floor wax will usually allow decontamination of the floor tile, but the wax coating had become too thin to provide the necessary protection. The tile did protect the under coating, which can also be decontaminated when necessary, thus leaving a contamination free surface for the installation of new tile. Vinyl tile was used to replace the vinyl asbestos as it is more resistant to chemicals and will stand more physical abuse. It is usually the practice to cover the floor with paper or plastic until all other decontamination has been completed.

WALL COATINGS

The wall coating was an abrasion and corrosion resistant paint that should have been completely decontaminable. It was in bad repair due to the length of time it had been in service and consequently could not be completely decontaminated. It is much more desirable to have contamination-free surfaces, but the two coat paint system over a surface having fixed contamination is an acceptable operating practice.

EQUIPMENT FILTERS

Squirrel cage blowers with a mounting for an 8 x 8 x 6 in. high efficiency filter are commercially available. It is recommended that all cabinets containing electrical or electronic components be protected by this type of arrangement.

SMALL EQUIPMENT DECONTAMINATION

Small tools and equipment from rooms 101 and 113 were decontaminated in a standard open face hood by scrubbing with a detergent solution. A greenhouse was erected in front of the hood to serve as a contamination control area. No commercial decontamination products were used; however it may have been beneficial to do so.

Hand tools, small lathe chucks, and other items that could be easily handled by one person are examples of the items decontaminated. Operating supplies such as tape, paper products and other like items were discarded.

PRE-ESTABLISHED EMERGENCY PROCEDURES

Pre-established emergency procedures should reduce initial confusion to a minimum. Prompt action in a planned manner should reduce the probability, or amount of internal deposition.

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