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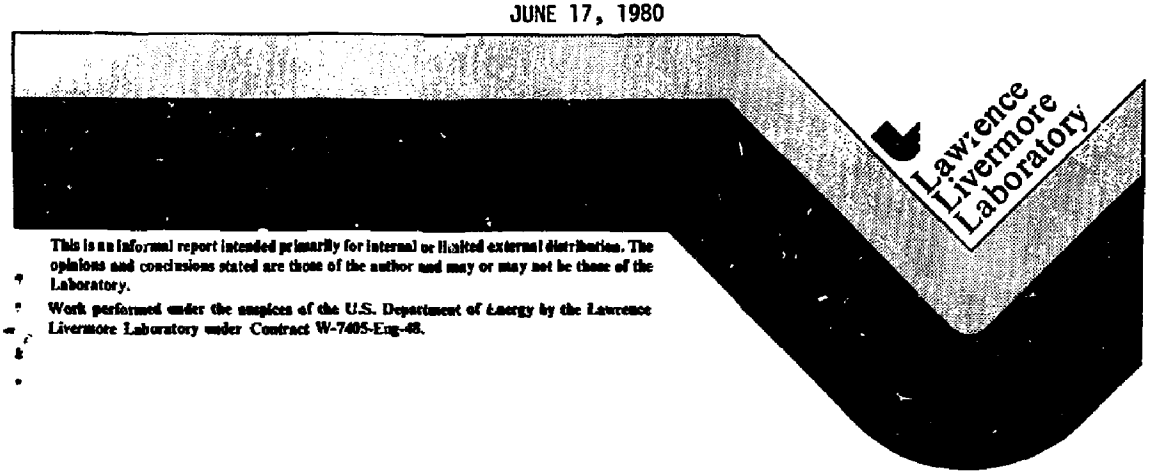
SAFETY ANALYSIS (SA) OF THE DECONTAMINATION FACILITY BUILDING 419 At THE LAWRENCE LIVERMORE NATIONAL LABORATORY

BYRON N. ODELL

JUNE 17, 1980



ABSTRACT

This safety analysis was performed for the Manager, Plant Services at LLNL and fulfills the requirements of DOE Order 5481.1 The analysis was based on field inspections, document review, computer calculations, and extensive input from Waste Management personnel.

It was concluded that the maximum quantities of radioactive materials that safety procedures allow to be handled in this building do not pose undue risks on- or off-site even in postulated severe accidents. Risk from the various hazards at this facility vary from low to moderate as specified in DOE Order 5481.1.

Recommendations are made for improvements that will reduce risks even further.

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SECTION 1 -- SUMMARY

This Safety Analysis (SA) addresses the Decontamination Facility, Building 419, at Lawrence Livermore National Laboratory (LLNL). The facility is operated by the Operational Waste Management Group under the Operational Safety Division of the Hazards Control Department. Replacement cost of this facility including major equipment is over $750,000 (major equipment are those items worth over $500 each).

This safety analysis fulfills the requirements of DOE Order 5481.1 and apprises the Manager, of Plant Services of the safety status of these operations. Included is a description of the facility, a discussion of the operations conducted in it, an evaluation of the hazards associated with those operations, and an evaluation of the maximum credible accident.

A systematic safety analysis was performed using field inspection, document review, and computer calculations as well as extensive input from the Waste Management personnel.

This analysis determined that, even after future planned modifications, insufficient quantities of radioactive materials will be handled to qualify this building as a nuclear facility as defined in DOEM 0531. Even in the event of a maximum credible accident, the off site dose will not exceed the 500 mrem annual effluent dose limit specified in DOEM 0524.

This facility is classified as a moderate risk facility by DOE Order 5481.1. This means that the facility may present significant on-site impacts to people or the environment, but, at most, only minor off-site impacts.

It is also determined from this safety analysis that the operations in this facility can be conducted according to existing codes, standards, and

regulations, and that there will be no undue or unusual risks to the health and safety of the public or LLNL employees.

To reduce risk from various energy sources to as low as practicable, several improvements have been identified and included in this document.

SECTION 2 -- FACILITY DESCRIPTION

BUILDING 419 AREA DESCRIPTION

General

In 1942, the U. S. Navy constructed this building as an airplane painting facility. The A.E.C. converted it into a decontamination facility.

The existing facility opens directly onto Laboratory streets and is surrounded by buildings that have very little in common with its operations. The other Waste Management facilities that have operations in common with Decon are located some distance away.

Building 419 Structure

Building 419 is a 512-m^2 structure that has reinforced concrete shear walls and a wood truss roof. It consists of three main areas that are assembled in a "T" configuration, see Fig. 2-1. Two of the three areas are approximately 18.6 m x 10.1 m with heights of 5.8 m. The third area, which is located in the middle, has plan dimensions of approximately 8.8 m x 15.5 m with the first floor height of 3.1 m and the roof at 5.8 m. These main areas are separated from each other by 25-cm-thick reinforced concrete walls. There are two rooms located between the first floor and the roof in the middle section.

The foundation of Bldg 419 has continuous spread footings. The connections of walls to foundation are made by the wall's reinforcing steel, which runs into the foundations. The concrete floors in the work areas are covered with linoleum tile except for the floors in Rooms 124, 150A, and 167 which are covered with epoxy paint to make decontamination easier. Vinyl

asbestos tile covers the floors in the offices, corridors, and toilet areas and the concrete walls in these areas are covered with gypsum wall board. The plastered walls in Room 124 has an epoxy coating, and the walls in the other work areas are painted with semi-gloss enamel. All floor drains in the radioactive materials area, except for the toilet areas, are connected to retention tanks. The floor drains in the toilet areas as well as the toilets are connected to the sanitary sewer. The roofing of the building is made of tar and gravel layers on top of 1.6-cm-thick plywood panels. A polyurethane foam has been added that covers two-thirds of the roof. This material is highly flammable and should be replaced.

Personnel and Environmental Protection

Heating and Cooling - Wet steam from the main steam plant provides building heat. The main steam lines are at 450 kPa. These steam lines run through the second floor areas where a steam regulator reduces the pressure to 100 kPa. Two air handler units located in the upper middle section, Room 200A, provide once through air. This air is forced over the steam pipes to heat the whole building. Evaporative cooling is also provided.

Walk-in Hoods and Glove Box Ventilation - These units are operated under negative pressure so that air flows from the room into these units. The blowers exhaust the air into roof mounted single-stage HEPA filters that are connected to stacks on the roof. These are classified as Type IIa workplaces per Hazards Control Manual Section RS-701, see Table 2-1.

Chemical Fume Hoods -- The chemical fume hoods are exhausted by roof mounted blowers. This protects the operator. Only low-level radioactive materials are handled in these hoods, which are presently classified as Type II workplaces per Hazards Control Manual Section RS-701, see Table 2-1. However, the two hoods located on the west side will soon be upgraded to Type IIa workplaces. Single stage high efficiency filters (99.97% for 0.3 micron particles) will be installed in these hood exhaust systems.

Personnel Controls - There are no physical personnel controls other than locks on the doors and fences. Signs indicate type of clothing to be worn and if there is a potential radiation hazard.

Lighting - Adequate Lighting is provided in all areas within the building. Exterior lighting is provided at the buildings main entrance.

Effluent Systems and Controls - Exhaust air from the walk-in hoods, shot blaster, and glove box is filtered with high efficiency filters (99.97% for 0.3 micron particles), which qualifies them as Type IIa workplaces per Hazards Control Manual Section RS-701, see Table 2-1. The walk-in hood in Room 124 has two additional HEPA filters located immediately adjacent to it that can be connected to the exhaust of a glove box that is being decontaminated. These HEPA filters collect the contaminants that are exhausted from the glove box. This reduces the possiblitiy of contaminating the ductwork for the large HEPA filters. The discharge from these stacks are sampled for radioactivity. Since LLNL wants to use these facilities to decontaminate items containing gram quantities of plutonium, plans are being generated to upgrade the ventilation to meet Type III workplace requirements. This would require adding another stage of in-line HEPA filters, a filter fire spray protection

system, and continuous air monitoring. This has been requested and it is estimated that it will be completed in 1981.

The oven located in Room 155 is used to remove mercury and tritium from contaminated items. There is a tritium monitor and a high level tritium alarm on this stack. The tritium bake out operation will soon be transferred to Bldg 331. An evaluation will be made by Industrial Hygiene this year to determine the amount of mercury released and charcoal filters will be installed if needed.

The floor drains in Rooms 124, 155, and 167 connect to two 1900 liter retention tanks that are located underground near the southwest corner of the building. The other floor drains as well as the shower and toilets connect to the sanitary sewer.

Eye Wash and Emergency Showers -- Adequate eye wash and emergency showers are provided in areas where chemicals are located. These locations are shown in Fig. 2-1.

Hand and Foot Counters - At present there are two hand and foot counters in Bldg 419. They are located at the entrance to the corridor which is an "intermediate" zone.

Fire Protection

A sprinkler system throughout Building 419 has sprinkler heads spaced at a maximum of 9 m^2/head. These nozzles are individually activated by heat and an automatic system transmits an alarm to the Fire Station when the sprinklers are activated. There are spray dampers on the exhaust of the walk-in hoods.

There are sufficient and adequate fire hydrants near the facility. The wood balcony area (located at the north end) and the wooden stairs (located on the west side) leading to the second floor lack sprinkler protection. The single exit from the second floor opens directly onto the wooden stairs. To enhance the safety of workers on the second floor, the fire doors and closures between Rooms 200 and 201A will be repaired, sprinklers will be installed under the wooden stairs leading to the exit from Room 200, and the excess combustibles will be removed from Room 200. It is estimated that this work will be completed in 1980.

Safety Alarm/Alert Systems

The facility contains telephones in Rooms 110, 124, 150A, 155, and 167. The disaster page alarm system has speakers in Rooms 155, 167, and the corridor. This system can be activated from the Emergency Control Center of the Fire Station or the Police Station. There is also an alarm on the oven exhaust that sounds when the tritium concentration in the duct exceeds 400 Ci/m^3.

Utilities

Electric Utilities - Electric power can be delivered to this facility by any one of three systems. Because of the ventilation requirements, an emergency generator located near Building 412 starts up automatically to provide power for Building 419 whenever the primary power sources fail.

Piped Utilities - City water is available at a number of hose bibs, in the rest rooms, and at the eye wash and emergency showers. The automatic fire-suppression sprinkler system uses city water and has a separate feeder line into the building.

Steam at approximately 450 kPa is supplied to this facility by the main LLNL steam generator plant. This steam is used directly for decontamination and is regulated to approximately 100 kPa to heat the building.

Compressed air is supplied at up to 700 kPa, and is used to operate hand tools such as impact wrenches.

Table 2-1. Radionuclide Workplace Classifications and Workplace Materials Limits in Building 419.

Radionuclide Workplace Classifications for Building 419*

	Classification		
	Type I	Type II	Type IIa
Room 124	X		
Walk-in Hood			X
Walk-in Shot Blast Unit			X
Room 155	X		
Chemical Fume Hoods		X	
Bake-out Oven		X	
Vapor Blast Unit		X	
Glove Box			X
Room 167	X		
Walk-in Hood			X

*Ref.: Hazards Control Manual, Section RS-701

Workplace Limits for Materials Commonly Handled* in Building 419

Radionuclide	Type I	Type II	Type IIa
^{3}H	1 mCi (10^{9} dpm)	10 mCi (10^{10} dpm)**	10 mCi (10^{10} dpm)
Fission Products	0.4 μCi (10^{6} dpm)	4 μCi (10^{7} dpm)	40 μCi (10^{8} dpm)
Natural Thorium	40 μCi (10^{8} dpm)	0.4 mCi (10^{9} dpm)	4 mCi (10^{10} dpm)
Natural or Depleted Uranium	0.1 mCi (10^{8} dpm)	1 mCi (10^{9} dpm)	10 mCi (10^{10} dpm)
Oralloy	10 μCi (10^{7} dpm)	0.1 mCi (10^{8} dpm)	1 mCi (10^{9} dpm)
^{239}Pu	0.05 μCi (10^{5} dpm)	0.5 μCi (10^{6} dpm)	5 μCi (10^{7} dpm)
^{241}Am	0.01 μCi (10^{4} dpm)	0.1 μCi (10^{5} dpm)	1 μCi (10^{6} dpm)

*If an operation could generate easily dispersible radioactive material (e.g., evaporating to dryness), the above limits should be divided by 10.

**Exception: The Health Physicists have determined that $\leq$1 Ci of ^{3}H may be handled in the bake-out oven in Room 155.

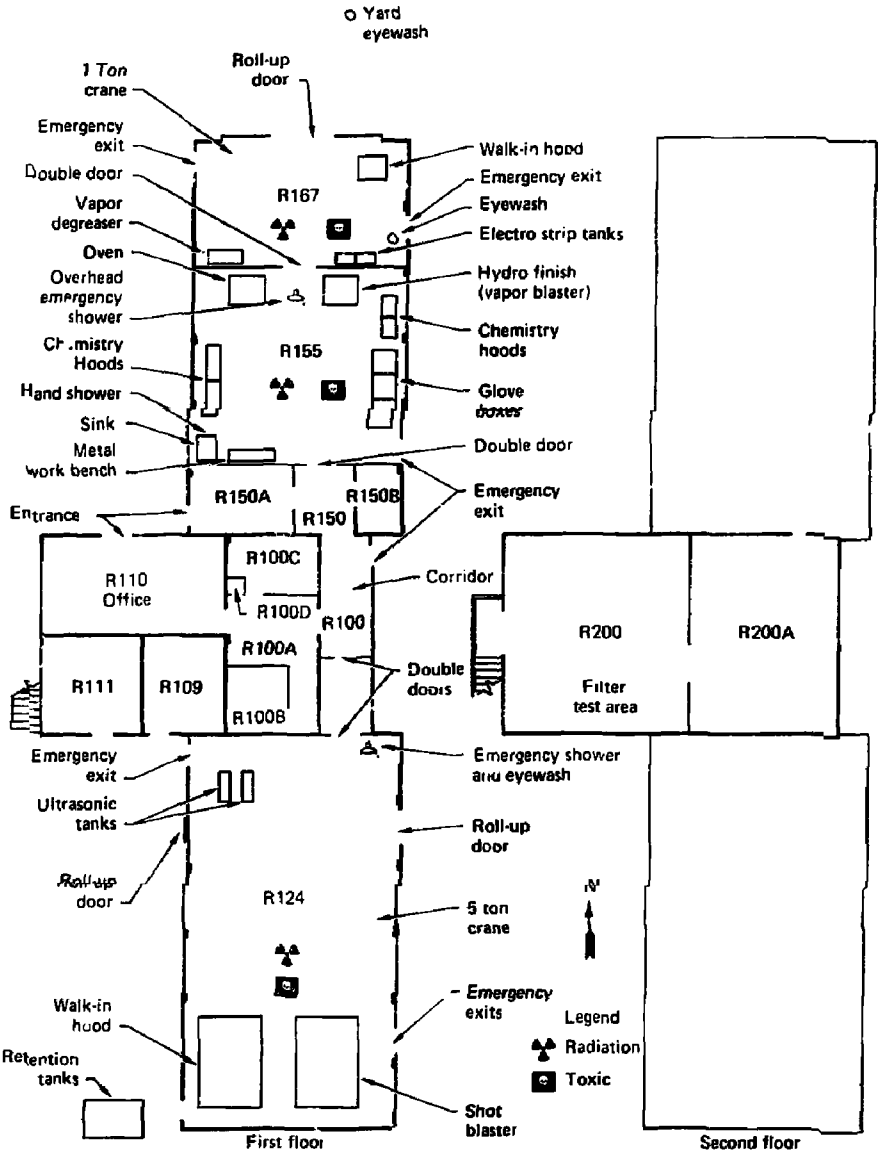

Fig. 2-1. Building 419 Floor Plan

SECTION 3 -- DESCRIPTION OF OPERATIONS

GENERAL

This facility is operated under a contamination control zone concept where the building is separated into "cold", "intermediate", and "hot" zones. (See Fig. 2-1 for a floor plan of the facility.) In the cold zone, Rooms 109, 110, 111, and 150A, free access is permitted. Rooms 100, 100A, 100B, 100C, 100D, 150 and 150B are normally designated "intermediate" zones while the remainder of the building is designated as "hot" zones. The various work areas have signs stating what control zones are in effect and the type of protective clothing required.

Before any decontamination work is started, an estimate of the level of contamination is determined using radiation meters in addition to the information on the identifying tag. If the contamination level exceeds that specified in the Facility Safety Procedure, the item is rejected and returned to the sender. Otherwise, the item is placed in the appropriate location within the facility. This location will depend on the size, amount of contamination, and the decontamination method to be used. The physical locations of the various decontamination equipment are shown in Fig. 2-1.

TRAINING

Part of the operation at Decon includes training of personnel. Some of this is achieved by hiring personnel that have already obtained certain skills that apply to this operation. Additional skills are obtained by personnel attending various classes sponsored by Hazards Control. However, much of this training is obtained on the job by learning while under the supervision of a previously qualified person.

BUILDING 419 OPERATIONS

This building is used primarily to decontaminate material and personnel. However, one of the upper rooms (R 200, is used for filter testing. Since this is not part of the Decon operations, the filter test operation will not be described here.

Decontamination is accomplished by using several different pieces of equipment and a lot of physical effort. The maximum quantities of the various radioactive materials that can be handled in each piece of equipment are listed in Table 2-1. Operation of this equipment is described under the section for the room in which it is located. The position of this equipment in each room is shown in Fig. 2-1.

Rooms 124

Large items that are contaminated are brought into the center of the room on a fork lift. Those that are only slightly contaminated can be taken care of right there by using steam or an all purpose cleaner that is sprayed on the contaminated areas and Kimwipes to remove the contamination. The floor drains to the two retention tanks located outside of the building.

Items that are more highly contaminated are treated using the appropriate equipment.

Walk-In Hood - Highly contaminated items, such as glove boxes, are placed in this hood. The operator, dressed with the appropriate protective clothing, might use an acid wash to loosen contamination and collect the solution in a carboy. In other cases the operator might use an all purpose cleaner or hot water to remove the contaminants. The floor drain of the hood is connected to the retention tanks.

Shot Blaster - Metal beads are hurled at supersonic velocity against the surfaces of the item that is being decontaminated. This rapidly removes the surface and is used where deep penetration of contamination has occurred.

Ultra Sonic Tanks - High frequency sound waves are used to decontaminate items such as wrenches and screwdrivers.

Crane - A 4500 kg crane is used to move heavy items around the room and in and out of the various decontamination chambers.

Room 155

Hydro Finish (Vapor Blaster) - A slurry comprised of water and fine sand is sprayed on contaminated items at a high velocity. The glove ports are used to move items about as well as to control the position of the nozzle.

Glove Boxes - Items contaminated up to the maximum allowed in these glove boxes by the Facility Safety Procedure are handled in these three glove boxes, which are bolted together. Parallel connected HEPA filters on the exhaust trap at least 99.97% of 0.3 micron particles. The discharge stack is sampled for radioactivity during use.

Chemical Fume Hoods - Chemicals are used in these unfiltered hoods to decontaminate items up to the maximum allowed in these hoods by the Facility Safety Procedure. Also, items contaminated up to these same levels are sealed in plastic bags and are temporarily stored in these hoods.

Oven - About once a week, items contaminated with mercury and tritium are baked in this oven for 24 hr. This oven is also used for drying and can be operated up to 430°C. A blower exhausts the vapors out through an unfiltered stack, which is monitored for tritium. A tritium alarm that alarms above 400 $\mu Ci/m^3$ is on this stack. The tritium bake out operations will soon be transferred to Bldg. 331. Mercury emissions from the stack will be evaluated by Industrial Hygiene by the end of the year. If it is determined that the amount of mercury released exceeds acceptable limits, charcoal filters will be placed on the exhaust stack to trap the mercury.

Sinks And Metal Work Bench - A sink is connected to the retention tanks and a metal work bench is also provided.

Room 167

Vapor Degreaser - The vapor degreaser contains 1,1,1 - trichloroethane which is used to remove grease from metal. Items such as vacuum pumps are suspended from the 900 kg crane into these vapors for a few minutes then the metal parts are placed on the floor where they are wiped with Kimwipes and sprayed with WD-40 to prevent rust.

Walk-In Hood - Highly contaminated items to be cleaned are placed in this hood. The exhaust is single-stage HEPA filtered. The operator can perform similar operations in this hood as presently performed in the hood in Room 124, which has been described earlier in this section.

Crane - A 900 kg crane is available to move equipment around inside the room.

Electro Strip Tank - An electrolyte fluid in this tank is used to deplate (strip) contaminated metals from items placed in this tank.

Room 150B

This room is used for decontamination of personnel. The radioactive or toxic material is removed from the skin or hair using the mildest treatment that will remove the contamination. Since the shower drains to the sanitary sewer, only trace levels of contamination can be removed here. More severe contamination requires a facility where decontaminating agents can be collected, such as the showers in Bldgs 251 and 332 or 20 liter carboys.

SECTION 4 -- RISK ANALYSIS

INTRODUCTION

A review of the hazardous materials handled in this facility showed that under current and planned facility operations there will be insufficient quantities of radioactive materials to qualify it as a nuclear facility per DOEM 0531. However, this review did show that the hazards are of the types and magnitude not routinely encountered and/or accepted by the public as defined in DOE Order 5481.1 and this document was written to satisfy a requirement of that order for a systematic safety assessment.

This section discusses these various hazards and mitigating features and potential accidents caused by earthquake and human error.

Risks of these hazards vary from low to moderate depending on the probability of an accident occurring and its consequences.

HAZARDS AND MITIGATING FEATURES

The Decontamination Facility and the operations conducted in it have been assessed as to the various hazards (energy sources) and the existing mitigating feature (barriers). All of the existing energy sources and barriers considered appropriate for this facility are listed in Tables 4-1 and 4-2, respectively. Appendix 4A summarizes these energy sources and existing barriers and identifies the additional barriers needed (this is accomplished by referring to the barriers listed in Table 4-2). In addition, Appendix 4A contains brief comments as to what is inadequate. These primarily involve fire safety improvements and the upgrading of Room 124 to meet the requirements of a Type III workplace as defined in Section RS-701 of the Hazards Control Manual.

SEISMIC SAFETY

The building meets or exceeds the seismic requirements of the Uniform Building Code (UBC), which is an appropriate code for this structure since it is not a nuclear facility, see Ref. 4-1.

HUMAN ERROR AND ACTS OF NATURE

The most common hazards that may be encountered during operation of this facility are from industrial type accidents. These occur primarily because this is a "hands on" type of operation. In addition, there exists a remote possibility for the exposure of LLNL personnel and the public to radioactivity and to toxic chemicals. Of the possible accidents, the one having the severest off-site consequences is a fire that releases radioactivity at ground level in conjunction with or subsequent to a seismic event which destroys the buildings containment.

The maximum credible release is assumed to result from a fire that burned the entire inventory of ^{239}Pu (1.3 Ci or 13 g). (This will be the maximum amount of material allowed in the facility after the planned ventilation upgrade). Calculations included in Appendix 4B indicate that the fence-line dose will not exceed the 500 mrem guide value specified in DOEM 0524. The maximum on-site dose will not exceed 5 rem.

Building 419 is sprinkled. Portable fire extinguishers are appropriately located in the building and fire hydrants are readily accessible to this facility. The response time for the Fire Department upon receiving an alarm is two minutes. The potential fire problems in the 419 area are the chemicals, solvents, radioactive materials, and the cluttered area in the upper room.

Table 4-1. List of Energy Sources (Hazards)

Electrical

Wiring
Service Outlets and Fittings
Pumps
Motors
Heaters
Power Tools
Small Equipment

Nuclear

Radiation

Thermal Radiation

Ovens
Steam Lines
Hot plate
Welding, Burning, Soldering Equip
Electric Wiring and Equipment

Kinetic-Rotational

Motors
Pumps
Gears
Shop Equipment (Grinders, Saws, Brushes, etc.)

Corrosive

Acids
Caustics
Oxidizers
Reducers
Decon Solutions

Flammable Materials

Rags
Gasoline (Storage and in Vehicles)
Lube Oil
Coolant Oil
Paint Solvent
Buildings and Contents
Grease
Gases - Other
Spray Paint
Solvent Vats

Toxic/Pathogenic

Mercury
Lead
Decon Solutions
Sandblast Compounds
Asphyxiants (tanks)
Lithium hydride
Beryllium

Kinetic-Linear

Trucks
Fork Lifts
Carts
Dollies
Surfaces
Crane Loads in Motion
Power Assisted Driving Tools

Acoustical Radiation

Equipment Noise
Ultrasonic Cleaners

Mass, Gravity, Height

Human Effort
Stairs
Lifts
Cranes
Bucket and Ladder
Trucks
Slings
Hoists
Scaffolds and Ladders
Pits
Vessels

Pressure-Volume/K-Constant-Distance

Gas Bottles
Pressure Vessels
Coiled Springs
Compressed Air
Hydraulic Systems

Explosive Pyrophoric

Dusts

Table 4-2. List of Barriers (Mitigating Features)

Barriers

1. Adequate Management
2. Administrative Controls and Procedures
3. Supervision
4. Training
5. Audits
6. Quality Assurance
7. Monitoring (Health and Safety Techs)
8. Professional Advice
9. Inspection and Maintenance
10. Inventory and Mass Control
11. Adequate Time for Job
12. Minimum Storage to Disposal Time
13. Spill Team
14. Instrument Monitoring
15. Instrument Verification
16. Labeling (quantities and type of materials, chemicals, switches, etc)
17. DOE Safety Codes
18. Proper Design of Facilities
19. Remote Operation
20. Constructed to Codes (electric, plumbing, UBC, etc)
21. Material segregation
22. Proper Equipment (tools, tanks barrels, forklifts)
23. Protective Devices (guards, radiation shields, blast shields, interlocks, lock and tag, limit switches, shorting bars, fences)
24. Warning Devices (signs bells, horns, lights)
25. Ventilation, Hoods, Filters
26. Syphoning and Pumping
27. Hand and Foot Counter
28. Air Sampler
29. Nonsparking Tools and Equipment
30. Fire Department Sprinklers, Water Availability, Fire Extinguishers
31. Protective Clothing (hard hats, safety shoes and glasses, booties and gloves, flack vests, ear plugs)
32. Respirators
33. Local Radiation Alarms
34. Remote Alarms (at Fire or Police Stations)
35. Security
36. Retention Tanks

REFERENCES

4-1 Dave Coats, Interdepartment memo "Review of Building 419 for UBC Seismic Force Levels," SM 80-090, April 14, 1980

SECTION 5 -- SUMMARY OF FINDINGS AND RECOMMENDATIONS

This section summarizes the findings of the safety analysis for the Decontamination Facility. These findings have been discussed with the Waste Management group leader. Where corrective actions has been instituted or planned, that action is summarized. Where no action is planned, the reason for no action or a recommended action is given. It is the responsibility of the authors of this safety analysis to see that responsible LLNL management is aware of the findings of this analysis and all actions (or inactions) taken as a result.

FINDINGS

- No area in Bldg. 419 meets the requirements for a Type III workplace per Hazards Control Manual Section RS-701. This severly limits the usefulness of the facility. Room 124 will be upgraded to meet these requirements by providing an extra stage of in-line HEPA filters as well as filter fire spray protection and continuous air monitoring. When the upgrade is completed, more highly contaminated articles will be accepted. For example, the limit for Pu contamination will change from 5 μCi to 1.3 Ci. This work has been requested and it is estimated that it will be completed in 1981.

- The workers in the laboratory area on the second floor lack adequate fire protection. Their safety as well as the buildings fire protection will be enhanced by repairing of the firedoor and closure between Rooms 200 and 200A, installing sprinklers under the wooden

stairs leading to the exit from Room 200, and by limiting the combustibles that are stored in Room 200. It is estimated that the work will be completed in 1980.

- The oven exhaust in Room 155 is unfiltered. Industrial Hygiene will check this within the year to determine if the amount of mercury exhausted requires that charcoal filters be installed.

- The chemical hood exhausts in Room 155 are unfiltered. The two hoods located on the west side will soon be upgraded to Type IIa work places by installing single stage high efficiency filters (99.97% for 0.3 micron particles) in their exhaust systems.

- This facility is classified as a moderate risk facility by DOE Order 5481.1. This means that the facility may present significant on-site impacts to people or the environment, but at most only minor off-site impacts.

RECOMMENDATIONS TO FURTHER MINIMIZE RISK

- Construct a separate shipping and receiving area to prevent cross contamination.

- Build a new Decon facility in a different location. This should also include the Waste Management Facilities that are presently located at Buildings 514 and 612. The present Decontamination Facility is located in the maintenance and stores area of LLNL. It is separated from the other waste management operations. A combined waste management facility would achieve economics of personnel and money, as well as reduce risk from the separate operations. This new facility should be able to handle any waste or decontamination project generated at LLNL.

- Replace the polyurethane foam on the roof with some waterproof, non-flammable coating since the present material is highly flammable.

Appendix 4-A

Summary of Energy Sources, Barriers, and Comments

Appendix 4A-1. Summary of Energy Sources, Barriers, and Comments

Energy Involved	Existing Barriers	Additional barriers needed	Comments
A. Electrical	1-6,8,9,11, 15-17,19,20,22-24		
B. mgh	1-4,8,9,11, 17-20,22-24,31		
C. pv-kd	1-4,8,9,11, 17-20,22-24,31		
D. KE-linear	1-4,8,9,11, 17-20,22-24,31		
E. KE-rotational	1-4,8,9,11, 16-20,22-24,31		
F. Corrosive	1-13,16-26, 30-32		
G. Explosive-pyrophoric	1-13,16-25, 29-31		
H. Toxic-Pathogenic	1-9 11-13,16-25, 29-32,36		

Appendix 4A-1. Summary of Energy Sources, Barriers, and Comments - (continued)

Energy Involved	Existing Barriers	Additional barriers needed	Comments
I. Flammable	1-13,16,20,22-24, 26,29-31,34	17,18,21	Certain improvements will be made to enhance the fire safety of workers in Room 200 until a more suitable location is found. These consist of of repairing the firedoors and closures between Rooms 200 and 200A, extending the automatic sprinkler system to the area under the wooden stairs leading to the exit from Room 200 and limiting the combustibles in Room 200.
J. Thermal	1-4,8,9,11,16-18, 20,22-24,30,34		
K. radiation	1-8,10-16,20,21-27, 28,30-33,35,36	17,18,25	Items containing more than 5 Ci of plutonium should be in a Type III workplace. Existing Bldg. 419 does not meet these requirements. Present plans are to upgrade Room 124 to a Type III workplace. At that time the Bldg. limit will be 1.3 Ci of Pu.
L. Acoustical radiation	1-4,8,9,11, 17,20,22,31		

Appendix 4-B

^{239}Pu Limit for Building 419

Interdepartmental letterhead

Mail Station L 385

Ext. 29045/29046

March 4, 1980

TO: Lee Partlow/Ross Wilson

FROM: Byron Odell/Art Toy

SUBJECT: ^{239}Pu Limit for Building 419

We calculated the maximum amount of ^{239}Pu that could be involved in a maximum credible accident at Bldg 419 and still not exceed either the fence line radiation dose limits or the off-site soil contamination limits. In both of these analyses, we assumed that an accident breached the integrity of the building, so that no credit is taken for any confinement or any upgrading of the building to meet the requirements for a critical facility. The results of our findings are as follows:

- 1.3 alpha curies of ^{239}Pu (approximately 13 grams) burned without confinement in Building 419 could give a radiation dose of 500 mrem at the nearest fence line
- 8 alpha curies of ^{239}Pu (approximately 80 grams) burned without confinement in Building 419 could give an off-site soil contamination of 0.2 $\mu Ci/m^2$.

The following assumptions and constants were given to perform the off-site radiation dose calculations:

- The maximum permissible fence-line radiation dose is 500 mrem (from DOEM 0524)
- The maximum ratio of release to air concentration is 5×10^{-3} s/m^3 (from DOE/EIS-0028-D)
- The standard man breathing cycle is 2×10^{-2} m^3/min (from Radiological Health Handbook)
- The rem dose to the lung is 470 rem/μCi (from Health Physics, 12, 173)
- The maximum fraction of plutonium airborne in a serious accident is 5×10^{-4} (from BNWL-SA-3379)

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It follows that,

$$A = \frac{.5 \text{ rem} \times 60 \text{ s}}{5\times10^{-3} \text{ s/m}^3 \times 2\times10^{-2} \text{ m}^3/\text{min} \times 1 \text{ min} \times 4.7\times10^{8} \text{ rem/Ci} \times 5\times10^{-4}}$$

$$= 1.3 \text{ Ci}$$

The following assumptions and constants were given to perform the off-site soil contamination calculations:

- The EPA proposed soil contamination limit will be the off-site soil contamination limit allowed for a worst case situation. The limit is 0.2 $\mu Ci/m^2$ (from Federal Register, 42, #230, 60956-60959, 1977)
- The ratio of soil contamination to air concentration will be 10^{-2} m/s (from WASH-1400)
- The maximum ratio of release to air concentration is 5×10^{-3} s/m^{-3} (from DOE/EIS-0028-D)
- The maximum fraction of plutonium airborne in a serious accident is 5×10^{-4} (from BNWL-SA-3379)

It follows that,

$$A = \frac{(2 \times 10^{-7} \text{ Ci/m}^2)}{(10^{-2} \text{ m/s})\ (5 \times 10^{-3} \text{ s/m}^3)\ (5 \times 10^{-4})} = 8 \text{ Ci}$$

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