Battelle
Columbus Laboratories

Report

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FINAL REPORT

on

DECONTAMINATION OF BATTELLE-COLUMBUS' PLUTONIUM FACILITY

to

U.S. DEPARTMENT OF ENERGY
CHICAGO OPERATIONS AND REGIONAL OFFICE

CONTRACT W-7405-ENG-92, TASK 57

November 12, 1984

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D&D PROGRAM MANAGEMENT

The D&D of Battelle-Columbus' Plutonium Laboratory was conducted under the direction of Dr. William J. Madia, Manager of the Nuclear Technology Section. Mr. David G. Freas, Associate Section Manager, supervised the BCL staff directly involved in the D&D effort while Mr. Joseph F. Dettorre had responsibility for radiological safety and nuclear materials management. As indicated by the Battelle-Columbus Radiological Safety Committee, the management and staff associated with the program are to be commended for their efforts in conducting a very difficult and potentially hazardous job with a high degree of efficiency and with an outstanding safety record.

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LIST OF MICROFICHE DOCUMENTATION IN THE BACK POCKET

Accession No.	Caption
83-01-0013	Plan for fully decontaminating the Battelle Plutonium Laboratory. To Department of Energy, by Battelle Columbus Division. May 1, 1978.
83-01-0015	Topical report on volume reduction experiment (I) at Battelle's Plutonium Facility. To U.S. Department of Energy, by J. F. Dettorre, D. G. Freas, and D. F. Stellrecht. February 23, 1979.
83-01-0016	Fiscal year 1978 summary report on decontamination of Battelle-Columbus' Plutonium Facility. To U.S. Department of Energy, Chicago Operations and Regional Office, by W. J. Madia, J. F. Dettorre, D. G. Freas, and D. Stellrecht. September 28, 1979.
83-01-0017	Environmental assessment, decommissioning and decontamination program, Battelle Plutonium Facility. To U.S. Department of Energy, Assistant Secretary for Energy, Washington, D.C., by Battelle Memorial Institute, Columbus Division, Madison County, Ohio. DOE/EA-0092. September, 1979.
83-01-0018	Environmental report for calendar year 1977 on radiological and non-radiological parameters. To U.S. Department of Energy, Chicago Office, by R. G. Evans.
83-01-0019	Environmental report for calendar year 1978 on radiological and non-radiological parameters. To U.S. Department of Energy, Chicago Operations Office, by R. G. Evans and J. C. Woodward.
83-01-0020	Addendum to the environmental monitoring for CY 1978, Contract No. W-7405-ENG-92. To U.S. Department of Energy, Chicago Operations Office, by R. G. Evans.
83-01-0021	Environmental report for CY 1979 on radiological and non-radiological parameters. To U.S. Department of Energy, Chicago Operations Office, by R. G. Evans and J. C. Heinlen.
83-01-0022	Environmental report for CY 1980 on radiological and non-radiological parameters. To U.S. Department of Energy, Chicago Operations Office, by R. G. Evans and J. C. Heinlen.

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Accession No.	Caption
83-01-0023	Addendum to the environmental monitoring report for CY 1980 Contract No. W-7405-ENG-92. To U.S. Department of Energy, Chicago Operations Office, by R. G. Evans.
83-01-0024	Environmental report for CY 1981 on radiological and non-radiological parameters. To U.S. Department of Energy, Chicago Operations Office, by R. G. Evans et al.
83-01-0025	Topical report on assaying of scrap generated during decontamination of Battelle's Plutonium Facility. To U.S. Department of Energy by D. E. Stellrecht, D. G. Freas, and J. F. Dettorre. April, 1979 DRAFT.
83-01-0026	Removal of special nuclear materials from the Plutonium Laboratory. By R. E. Snider. 6 December 1978 DRAFT.
83-01-0027	Quality assurance documents for packaging and transportation of nuclear materials.
83-01-0028	Quality assurance plan for packaging and transport of licensed radioactive materials.
83-01-0029	Quality assurance documents for Plutonium Laboratory decontamination procedures.
83-02-0183	Renewal application for combined special nuclear material & byproduct license. Pt. 2. Plutonium Laboratory. Comp. by the Staff of Battelle's Columbus Laboratories. Rev. September, 1977.
83-02-0184	Monthly quarterly BCL letter reports to COO 1978-1982.
83-02-0185	Topical report on decontamination of plutonium-contaminated glove boxes. To U.S. Department of Energy by D. E. Stellrecht, D. G. Freas, and J. F. Dettorre. June 1979.
83-04-0403	Quality assurance for low-level waste packaging and shipping at a research organization. By T. R. Emswiler. Paper presented to the American Nuclear Society Workshop on Low-Level Waste Packaging and Shipping, held in San Diego, California, 12-15 September 1982.

LIST OF MICROFICHE DOCUMENTATION IN THE BACK POCKET
(Continued)

Accession No.	Caption
83-04-0404	Radiological Safety Committee, Plutonium Laboratory Subcommittee annual audits - 1978-1982.
83-04-0405	Examples of BCL shipping records of LLW by truck and by rail. 1982.

EXECUTIVE SUMMARY

This is the final report, submitted by Battelle's Columbus Laboratories to the U.S. Department of Energy's Chicago Operations Office on the decontamination and decommissioning (D&D) of the Battelle-Columbus Plutonium Laboratory. The D&D was performed under DOE-BCL Contract W-7405-ENG-92, Task 57.

The Plutonium Laboratory, owned and operated by Battelle Memorial Institute's Columbus Division, was located in Battelle's Nuclear Sciences area near West Jefferson, Ohio, approximately 17 miles west of Columbus, Ohio. Originally built in 1960 for plutonium research and processing, the Plutonium Laboratory was enlarged in 1964 and again in 1967. With the termination of the Advanced Fuel Program in March, 1977, the decision was made to decommission the Plutonium Laboratory and to decontaminate the building for unrestricted use. Decontamination procedures began in January, 1978. All items which had come into contact with radioactivity from the plutonium operations were cleaned or disposed of through prescribed channels, maintaining procedures to ensure that D&D operations would pose no risk to the public, the environment, or the workers. The entire program was conducted under the cognizance of DOE's Chicago Operations Office. The building which housed the Plutonium Laboratory has now been decontaminated to levels allowing it to house ordinary laboratory and office operations. A "Finding of No Significant Impact" (FNSI) was issued in May, 1980.

All documentation for D&D of the Battelle-Columbus Plutonium Laboratory, including topical and environmental reports, are on microfiche in the back pocket of this report.

Procedures

The D&D program was conducted under the criteria and specifications set forth in ANSI Draft Standard 13.12 and NUREG-0436, dated March, 1978. Items in the Plutonium Laboratory that required decontamination were the glove boxes, the exhaust and auxiliary systems, and the drains, holding tanks, and autoclave.

Throughout the D&D efforts, the environment and the D&D personnel were monitored radiologically. The solid waste generated during D&D operations was shipped for disposal to DOE authorized burial sites.

Glove Boxes

Twenty-eight glove boxes were to be decontaminated. It was initially thought that the glove boxes could be decontaminated to levels permitting their disposal as low-level radioactive waste. This, however, was not possible, so the glove boxes were reduced in volume by cutting or sectioning. Staff performing volume reduction wore protective clothing and respirators and worked in controlled-atmosphere tents.

Before the glove boxes themselves could be volume-reduced for disposal, the equipment and special nuclear materials contained in them had to be removed through the bag ports, which are 14 inches in diameter. Items too large to fit through the bag ports were cut or ground to size, and sharp edges were taped over. Items connected inside the glove boxes, such as electrical wiring, were also removed.

Removing items from a glove box involved placing the items in PVC bags and making three hot seals with a sealer. The middle seal was then cut, removing the items from the glove box. The items were then put into two additional bags for triple containment and secured with metallic tape. Each package was labeled with the name of the item and the glove box identification number and identified as combustible or noncombustible. The packages were stored in 55-gallon drums which, when filled, were either taken directly to package assaying or sealed by bolting the lid.

By January, 1980, the waste generated from volume reduction of the glove boxes had been shipped to authorized sites for burial or retrievable storage.

Exhaust and Auxiliary Systems

Most of the auxiliary and exhaust systems were located in a 4-foot void space between the roof of the building and the false ceiling.

After the glove boxes had been removed, the electrical alarms and the utility services (water, gas, and electricity) were disconnected in the Plutonium Laboratory and the adjacent metallography laboratory. The walls, ceilings, and floors were cleaned and rinsed with high-pressure water. The rooms' surfaces were then painted with a grid, and each grid square was smear-surveyed to identify areas that were still contaminated. These areas were washed or cleaned with a Vacublast unit and smear-surveyed until they had reached an acceptably low level. The ceiling tiles were then removed from the laboratory and packaged for disposal.

The exhaust system was the last to be removed, since it had to deal with the particulates generated during the other D&D operations. All contaminated ducting and filters were removed. As much of the exhaust ducting as possible was decontaminated to acceptably low levels. The rest of the ducting, along with the exhaust system filters, was packaged and shipped to the burial site.

Drains, Holding Tanks, and Autoclave

A major task in the D&D program was the waste management of the contaminated drain and holding tank systems, and a 20' x 20' autoclave. The drainage lines consisted of 462 feet of four-inch cast iron pipe.

The two systems of holding tanks comprised volumes of approximately 4,000 gallons and 12,000 gallons. These had been buried outside the Plutonium Laboratory. Core samples of the soil around the holding tanks indicated that a leak had occurred sometime during their service life. The area was excavated, and the tanks and autoclave were removed by cranes. The contaminated soil and gravel were transferred to 55-gallon drums for shipment

to Richland for burial, along with containers holding the tanks and autoclave. The entire shipment required two railcars.

During the excavation to remove the autoclave, the groundwater level rose, filling the pit with some 50,000 gallons of water. This water was transferred to another storage tank for eventual dispersal on the site grounds.

Environmental and Personnel Monitoring

Environmental radiological conditions are regularly monitored and reported for the Nuclear Sciences Area and were monitored and reported throughout the operation and D&D of the Plutonium Laboratory. Monitoring includes samples of air, water, sediment, soil, fish, and grass/food crops. The radiological dose to the public is calculated from atmospheric and aquatic discharges from the site. Early in 1978, an environmental evaluation was started in support of the D&D program; this included the ground surface, soil, sediment, surface water, and biota. Although some relatively high readings were noted immediately outside two buildings on the site just before D&D began, no risk was found to exist to the public, the environment, or the on-site personnel either before D&D, during D&D, or since. All findings pertaining to the Nuclear Sciences area are regularly reported to county and city health officials, state radiological health and environmental officials, and the program director of the U.S. Environmental Protection Agency.

In addition to the normal precautions followed at the Nuclear Sciences area, personnel involved in D&D operations wore individual air samplers to monitor their exposure to particulates. Monitoring of inhalation and whole body dose indicates that exposures remained well within protection standards.

Results and Recommendations

The intention to decommission the Battelle Plutonium Laboratory and to decontaminate it to unrestricted-use levels has been fulfilled, and the D&D operations produced no significant impact on the public, the environment, or

the on-site personnel. The Battelle Radiological Committee commended the D&D staff for their skill, efficiency, and outstanding safety record in the D&D program.

The following recommendations result from the experience of decontaminating and decommissioning the Battelle Plutonium Laboratory:

(1) Once initiated continue diligent D&D operations.

(2) Establish barriers and conduct periodic surveys of the facility.

(3) Maintain continuous staff and management throughout the operation. This is difficult because D&D is a long-term task with few inherent rewards.

(4) Obtain technical writing assistance early in the program to facilitate reporting.

(5) Have a broad base of expertise on the planning team (e.g., include a radioecologist).

(6) Volume-reduce large, heavily-contaminated items (e.g., glove boxes) instead of attempting to decontaminate them.

1.0 SITE/FACILITY DESCRIPTION AT THE BEGINNING OF D&D (1978)

1.1 DESCRIPTION OF THE SITE

1.1.1. WEST JEFFERSON NUCLEAR SITE

The Battelle Plutonium Facility was owned and operated by Battelle Memorial Institute, Columbus Division. The facility was located at the Nuclear Sciences area which is a restricted area of about 10 acres located in a Battelle-owned tract of approximately 1,000 acres of farmed land. The site is located 17 miles west of Columbus, Ohio, and is 1-1/4 miles south of Interstate 70 on Ohio State Route 142 (Figure 1-1). West Jefferson, Ohio (population approximately 6,000), is the nearest village and is located 2 miles south of the site.

The site contains four research areas: Hot Cell Laboratory (JN-1), Critical Assembly Laboratory (JN-2), Retired Reactor Facility (JN-3), and the Plutonium Laboratory (JN-4) (Figure 1-2).

The environmental parameters of the area are described in annual reports prepared by Battelle (BCL) for the U.S. DOE, Chicago Operations Office (COO) and those for the years of 1977-1981 are reproduced on microfiche and appear in the back pocket of this report and contain the accession numbers of 83-01-0017 through 83-01-0024.

1.1.2 PLUTONIUM LABORATORY

The BCL Plutonium Facility was built in 1960 to house activities in plutonium research and processing. With the increased interest in plutonium research, an addition to the original facility was built in 1964 and another addition in 1967. These enlargements allowed for a high temperature gas pressure autoclave, a high temperature vacuum hot press, analytical chemical determinations, Pu-238 fabrication processing, improved machining capabilities, mechanical testing, and improved powder processing (Figure 1-3).

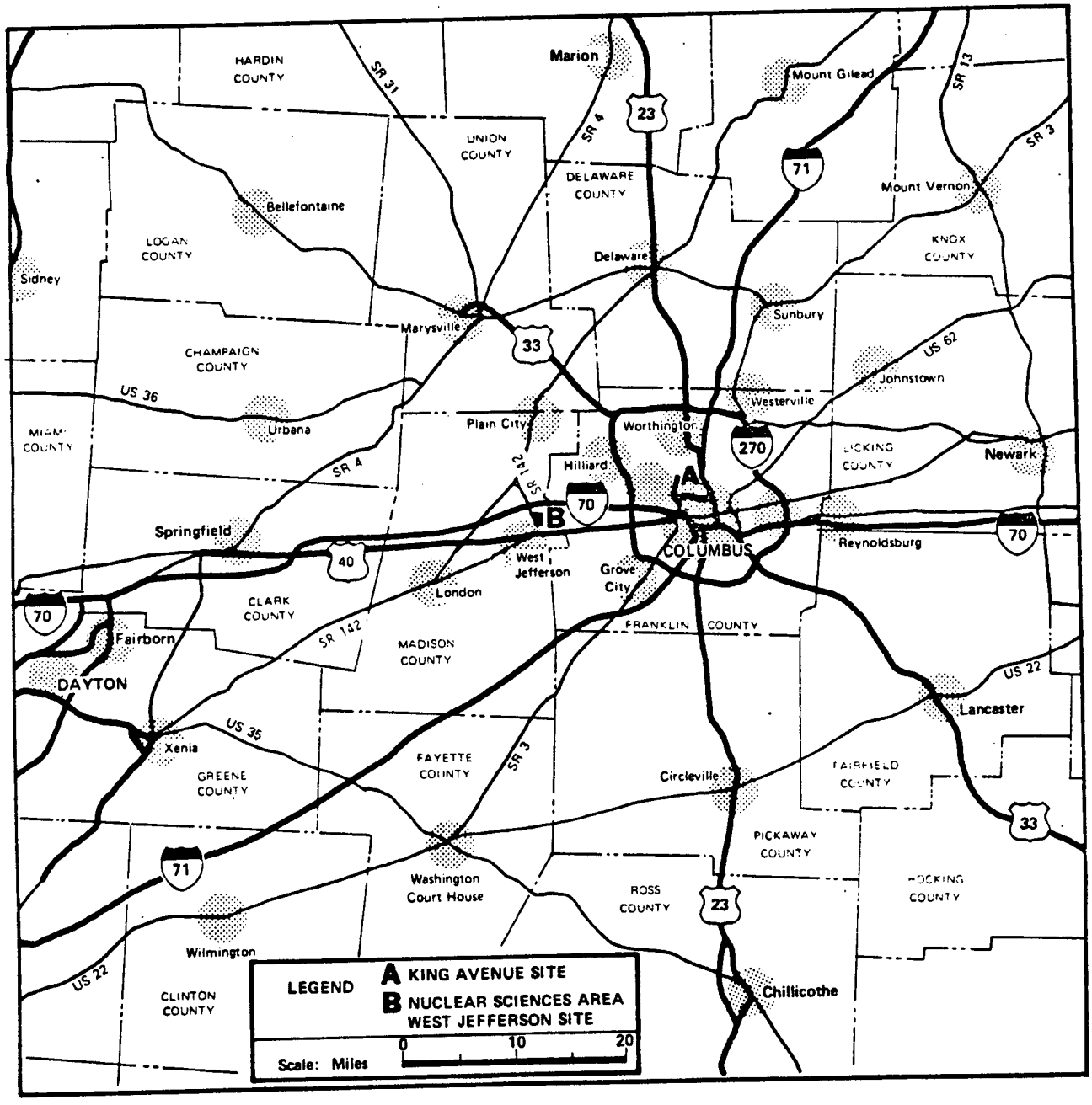
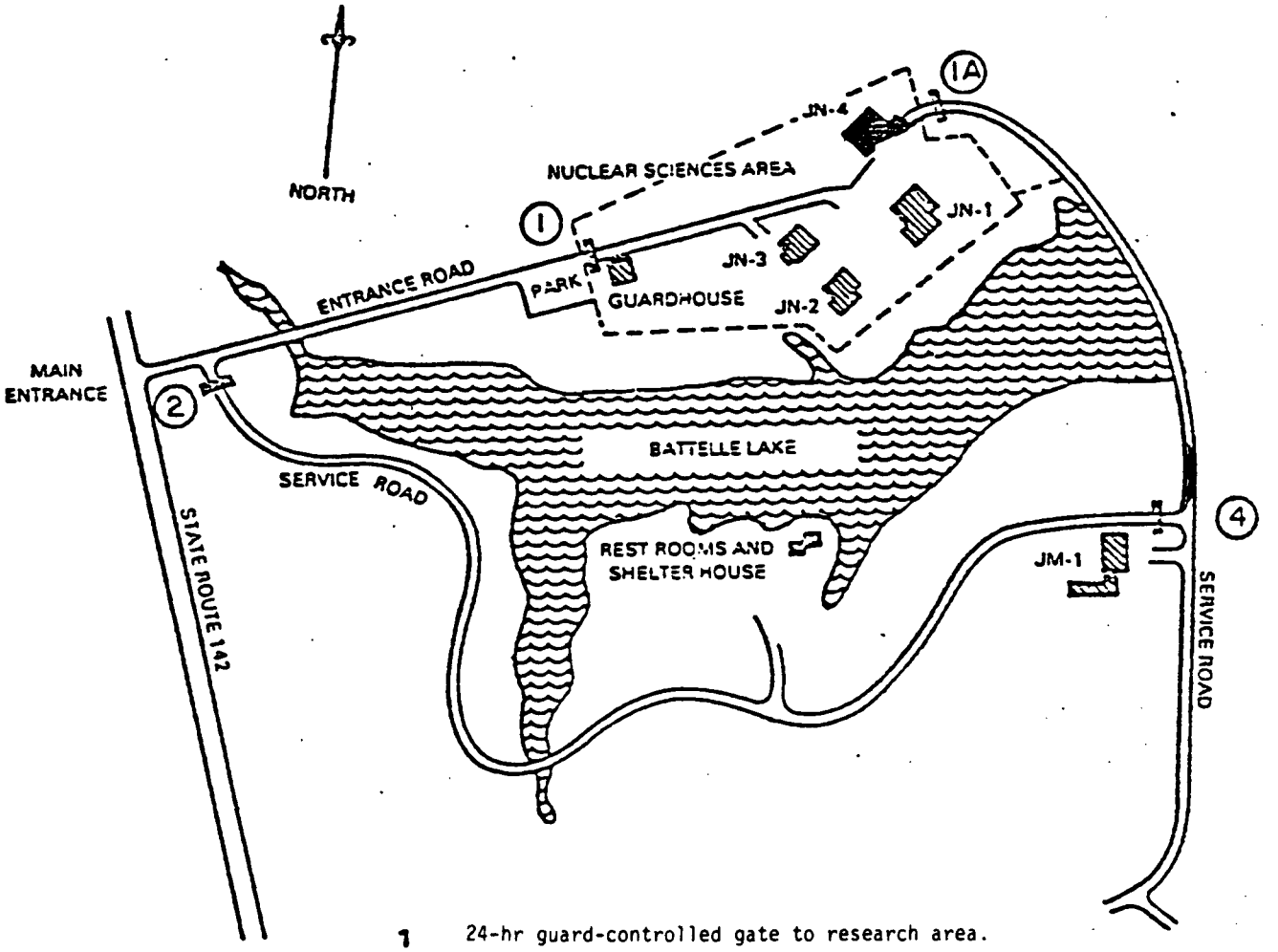


FIGURE 1-1. REGIONAL MAP FOR KING AVENUE AND WEST JEFFERSON SITES



1 24-hr guard-controlled gate to research area.

1A Emergency exit only from Nuclear Sciences Area.

2 Card-key-operated gate to Recreation Park.

4 Service gate to Recreation Park.

JN-1 Hot Laboratory
JN-2 Critical Assembly Laboratory
JN-3 Retired Reactor Facility
JN-4 Plutonium Laboratory

FIGURE 1-2. WEST JEFFERSON NUCLEAR SCIENCES AREA

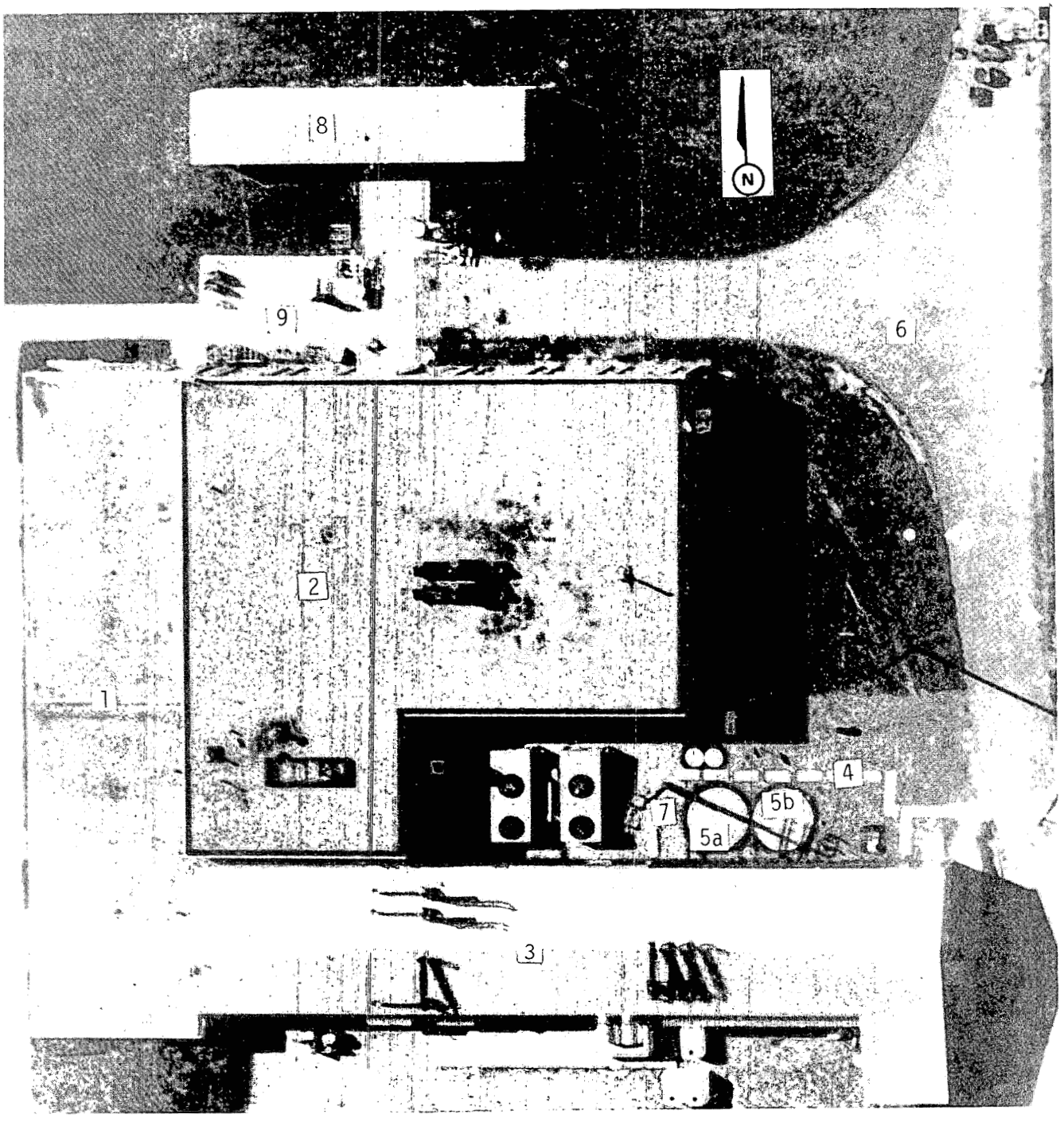


FIGURE 1-3. AERIAL PHOTO OF JN-4 AREA, AUGUST 17, 1978. Shadows are east-southeasterly. Scale: 1" = ca. 15'. 1. Office area. 2. Plutonium Laboratory. 3. Old Pu Laboratory (decommissioned). 4. Underground hot drain line location. 5a & 5b. West and east old holding tanks (decommissioned). 6. Road. 7. Electric power pole (removed). 8. Trailer for temporary storage. 9. Cylinder storage area for gases (H, N, O). Photo by Aerial Surveys Inc.

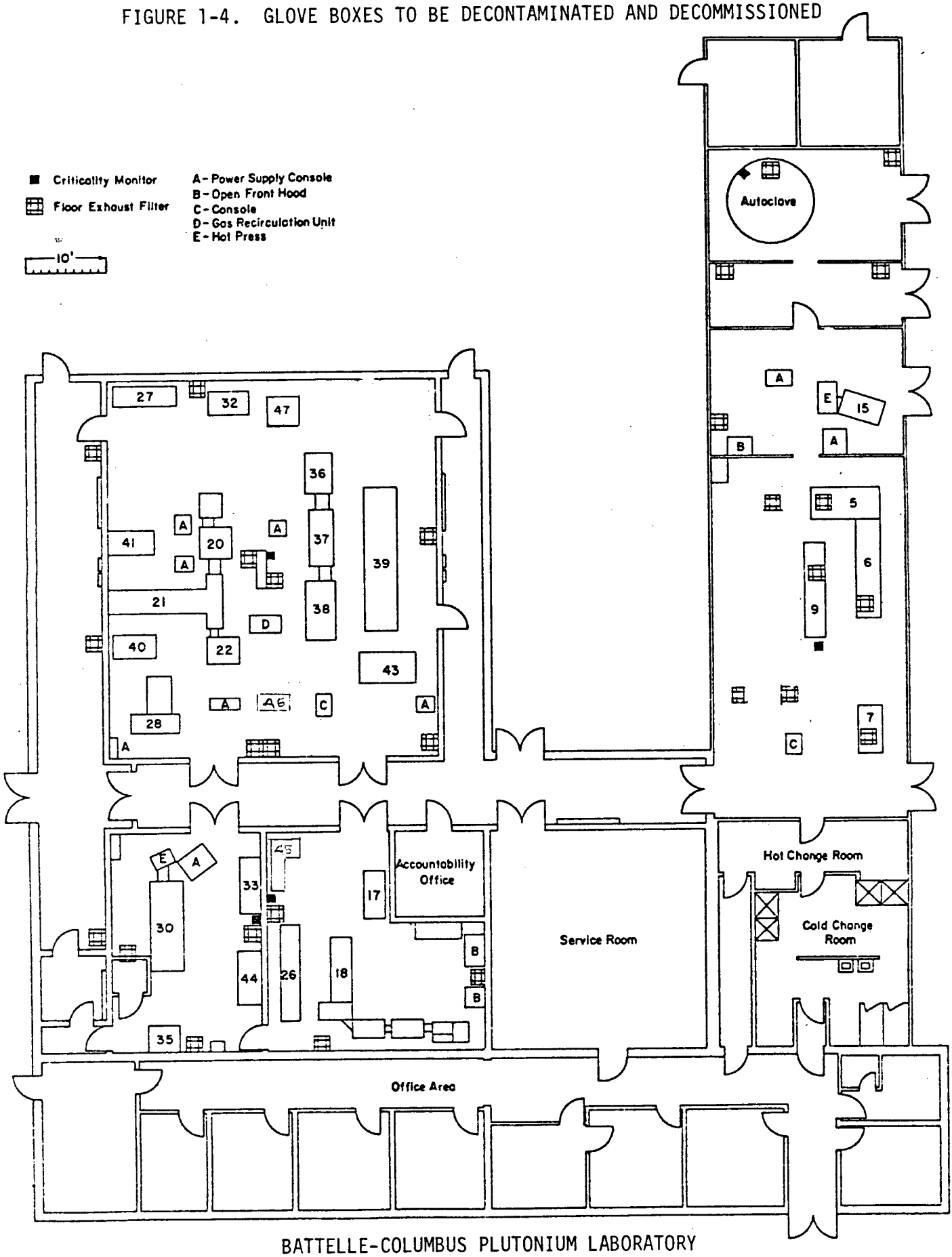
Over the years of operation the management of the laboratory, although changing periodically, directed the efforts of the facility in research and development for the advancement of plutonium technology for both industry and government. The staff of the facility was basically a stable group of highly skilled workers trained in the precautions for plutonium handling and the requirements for plutonium containment. Although the history of the facility has included several minor plutonium spills within the building, no release to the environment or severe exposure of personnel to airborne contamination was experienced. The management of the facility was organized to include the activities of health physics and special nuclear materials (SNM) management. Under this system, close communication and cooperation existed in maintaining safe operating conditions consistent with federal regulations.

A detailed report was prepared in 1977 by BCL for the U.S. Nuclear Regulatory Commission on Docket 70-8; SNM-7 and Byproduct License No. 34-6854-05, "Renewal Application for Combined Special Nuclear Material and Byproduct License." This report included the Plutonium Laboratory as Part 2 of the report. This part and the report table of contents is reproduced on microfiche and appears in the back pocket of this report (accession number 83-01-0183). In addition to a detailed description of the Plutonium Laboratory, it includes radiological safety (occupational exposure, radiation detection and alarm systems, and training program), operations procedures, personnel and safety procedures, and accountability procedures.

1.1.2.1 GLOVE BOXES

The glove boxes to be decontaminated and decommissioned (D&D) are indicated in Figure 1-4 and Table 1-1 lists the equipment and capabilities of the glove boxes. Actual D&D efforts were started in January, 1978, by removing all equipment from the glove boxes and laboratory areas. It was initially believed that the contamination of the glove boxes could be reduced to levels that would permit their disposal as low-level radioactive waste (LLW). However, failure to achieve this goal led to volume reduction (VR) operations which involved the actual cutting or sectioning of the glove boxes and

FIGURE 1-4. GLOVE BOXES TO BE DECONTAMINATED AND DECOMMISSIONED



BATTELLE-COLUMBUS PLUTONIUM LABORATORY

TABLE 1-1. PU LABORATORY GLOVE BOXES AND CAPABILITIES

(Boxes not listed were decommissioned prior to the start of the D&D Program.)

Box	Equipment and Capability
5.	Lathe and centerless grinder
6.	Rolling-mill and high temperature furnace
7.	Accountability storage container
9.	Arc-melt furnace
15.	Hot press and powder fabrication equipment
17.	Accountability storage containers
18.	Metallographic equipment
20.	High temperature furnace and powder processing equipment
21.	High temperature furnace and isostatic press
22.	Fuel pin loading and welding equipment
26.	Analytical chemistry equipment
27.	Analytical chemistry equipment
28.	Analytical chemistry equipment
30.	Pu-238 hot press
32.	Ultrasonic machining equipment
33.	Pu-238 welding equipment
35.	Pu-238 auxiliary glove box
36.	Powder processing equipment
37.	High temperature furnace and powder processing equipment
38.	Automatic powder press
39.	Lathe and fuel pellet characterization equipment
40.	Thermogravimetric balance
41.	Creep determination equipment
43.	Diffusivity and expansivity equipment
44.	Pu-238 powder processing equipment
45.	Analytical chemistry equipment
46.	Mass spectrograph
47.	Mass spectrograph

equipment into small pieces by operators, suited in protective clothing and respirators, working in controlled atmosphere tents.

Removal of items from the glove boxes prior to the D&D program was extensive. This process consisted of reducing the size of equipment so that it could be removed from the glove boxes through 14-inch bag ports. The length of some items had to be reduced to 32 inches to fit in 55-gallon drums. Some items also required volume reduction to meet the allowable size for packaging. This was done with hack saws, tubing cutters, and small electric grinders. Sharp edges present on cut or disassembled items were taped over with metallic tape to prevent cutting of the bags. In some cases sharp items were placed in old gloves left in a box after glove changes. Items connected to the insides of the glove boxes, such as electrical wiring, were removed.

After size reduction and taping of the sharp edges, all items were ready for bagout. This consisted of placing the items in one of the PVC bags attached to the glove box and making three hot seals with a thermal sealer. Scissors were used to cut in the middle of the seal, removing the item from the glove box. The item was then bagged two more times to provide triple containment. The second and third bags generally were securely sealed with metallic tape rather than heat sealing. The packages were then labeled combustible or noncombustible. The item name and glove box number were written on the package.

The packages were then placed in a temporary storage drum. These were new or used 55-gallon drums with or without liners. The package was also recorded on the drum item sheet. When filled these drums were either taken directly to package assaying or were sealed by bolting on the lid with a rubber or duct tape gasket and taken to the temporary waste storage area.

Items removed from each glove box are itemized and removal description is given in Table 1-2.

TABLE 1.2. GLOVE BOX HISTORY IN 1978, PRIOR TO D&D PROGRAM

Glove Box No.	Contents	Removal Description									
		Bagout	Disassembly	Cutting	Into Gallon Can	Break Up	Disconnection	Direct	Chisled	Partially Stripped	Solidify in Plaster of Paris	Mixed with Oil-Dry	Neutralize/Plaster of Paris
5	2 SNM containers	X											
	Centerless grinder	X	X										
	Lathe	X	E	X									
	Balance	X	X										
	Assorted hand tools	X											
	Rubber gloves, trash	X											
	Stainless steel floor overlay	X		X	X								
	Lead brick	X											
	Floor sweepings	X											
	Resistance furnace		E										
	Evaluation line and mechanical pump*							X					
	Tool box	X		X									
	Electrical wiring*	X	X										
6	Furnace*	X	X	X									
	Furnace	X	X	X									
	Resistance furnace in well		E			X							
	Rolling mill	X	E										
	Shelves	X	X	X									
	Sieves	X											
	Rubber gloves, trash, floor sweepings	X											
	Stainless steel floor overlay	X		X	X								
	Fluorescent light	X	X	X									
	Internal wiring and plumbing	X	X	X									
7	6 SNM containers	X											
	Securing rack for SNM containers	X	X	X									
	Evaluation line and mechanical pump*							X					
	Balance	X	X										
	Stainless steel floor overlay	X		X	X								
	Brass plate	X											
	Assorted hand tools	X											
	Seamless cans and trash	X											
9	Arc melt furnace	X	E	X									
	Balance	X	X										
	5 plates	X											
	Furnace	X	X	X									
	Hand shear	X	X										
	2 tool boxes	X											
	Nibbler	X											
	2 SNM containers	X											
	Assorted hand tools	X											
	Stainless steel floor overlay	X		X	X								
	Gallon and seamless cans, trash	X											
	Rubber gloves, trash, and sweepings	X											
	Power drill	X											
	Power saw (to another glove box)	X											
	Pumps, filters, gauges*							X					

TABLE 1.2. (Continued)

Glove Box No.	Contents	Removal Description											
		Bagout	Disassembly	Cutting	Into Gallon Can	Break Up	Disconnection	Direct	Chisled	Partially Stripped	Solidify in Plaster of Paris	Mixed with Oil-Dry	Neutralize/Plaster of Paris
15	Large shelf	X		X									
	Hot press coil	X	X										
	Assorted tools	X											
	Vacuum cleaner	X											
	Pumps and gauges*							X					
17	Balance and trash (most items were removed previously)	X											
18	Balance	X	X										
	Small crane*							X					
	10 electric boxes*							X					
	5 SNM containers	X											
	9 polishing wheels	X											
	3 vibrator polishers	X											
	4 splash rings	X											
	Rack for grinding discs	X	X	X									
	Buehler ultrasonic cleaner	X	X										
	Buehler mounting press with dies and supplies	X	X										
	Heating element for press	X											
	Rack for holding grinding paper	X	X	X									
	Grinding paper discs	X											
	Assorted hand tools	X											
	48 vibratory polishing specimen holders	X											
	2 vibratory engravers	X											
	40 polyethylene bottles	X											
	3 gallon cans	X			X								
	Plastic tray	X											
	Leveling press	X	X										
	Leity metallograph with camera on outside of box	X											
	4 hoses	X	X										
	Electro etching apparatus	X	X										
	Leity microscope with stand	X											
	2 tool boxes	X	X	X									
	Metal stand	X											
	3 micrometers	X											
	Metallographic specimens	X											
	6 tubes of Diamond compound	X											
	Assorted trash	X	X										
	Grinder	X	X				X						
	Polimet polisher	X	X	X									
	Hanging shelves	X				X							
	Epoxy layer on floor												
20, 21, 22													
26	Ainsworth balance	X	X										
	Balance weights	X											
	10 stainless sample holders	X											

TABLE 1.2. (Continued)

Glove Box No.	Contents	Removal Description										
		Bagout	Disassembly	Cutting	Into Gallon Can	Break Up	Disconnection	Direct	Chisled	Partially Stripped	Solidify in Plaster of Paris	Mixed with Oil-Dry	Neutralize/Plaster of Paris
26	Sieves	X											
	SNM containers	X											
	Plastic fume hood	X	X	X									
	Glass water cooling condensers	X			X	X							
	Muffle furnace	X	X	X									
	Coulometer cells	X			X	X							
	Tool box and tools	X											
	Standard solutions	X			X			X					
	2 hot plates	X											
	Sample mixer	X											
	3 mortars	X											
	Glassware	X			X	X							
	Acids	X											X
	Water	X											X
	Vacuum and stopcock grease	X											
	Asbestos gloves	X											
	Pro pipettes	X			X	X							
	Epoxy layer on floor	X			X								
27	2 SNM containers	X											
	Vacuum sweeper	X											
	Hydrogen furnace	X	X										
	Ohaus balance	X	X										
	Spectograph sample holder	X											
	Pan	X											
	10 qts liquid	X			X						X		
	17 plastic bottles	X											
	Combustion tube	X				X							
	Combustion furnace	X	X	X									
	Glassware	X			X	X							
	Tools	X											
	Seamless cans	X											
	Bethleham balance	X	X										
	Balance stand	X											
	Ring stand	X	X										
	Orior probes	X											
	Magnetic stirrer	X											
	Furnace stand	X	X	X									
	Stainless steel sample holder	X											
	Copper tubing	X		X									
	Electric wire	X		X									
	Electric box	X											
28	Balance	X	X										
	Tools	X											
	Oxygen analysis standards	X											
	30 seamless cans	X											
	Vacuum cleaner	X											
	Oxygen analyzer	X	X										
	Stainless steel rack	X	X	X									
	Crucibles	X											

TABLE 1.2. (Continued)

Glove Box No.	Contents	Removal Description: Bagout	Disassembly	Cutting	Into Gallon Can	Break Up	Disconnection	Direct	Chisled	Partially Stripped	Solidify in Plaster of Paris	Mixed with Oil-Dry	Neutralize/Plaster of Paris
30	Hot press coil	X											
32	Ultrasonic machining tool	X	X	E									
	Water circulation system	X			X						X		
	Furnace	X	X										
	Hot plate	X											
	Pump plate	X		X									
	Electric motor	X											
	Mono pump	X	X										
	Ultrasonic abrasive	X											
	Tools and trash	X											
33	Balance	X	X										
	TIG welder and accessories	X	X										
	SNM containers	X											
	Vice	X											
	Exterior shielding of sheet lead, boronated polyethylene block, and angle iron supports**		X	X				X					
	Fluorescent light	X	X	X									
	Electric boxes								E				
	Tools	X											
	Bags and trash	X											
35	Exterior shielding of sheet lead, boronated polyethylene block, and angle iron supports**		X	X				X					
	SNM container	X											
	Welding head	X											
	Tools and gauges	X											
	Aluminum plate	X											
36	SNM container	X											
	Balance	X	X										
	Sieves	X											
	Hand tools	X											
	Bags and trash	X											
37	Brew furnace interior	X	X	X			X						
	Synthesizing furnace and welded stand	X	X	X									
	SNM container	X											
	Sieves	X											
	3 mortars and pestles	X											
	Carver press	X	X				X						
	10 punch and die sets	X											
	Powder handling tools	X											
	Hand tools	X											
38	Automatic pellet press	X	E										
	Crane	X	X	X									
	SNM container	X											
	5 used furnace heating elements	X											
	Vacuum cleaners	X											
	4 lead bricks	X											
	Hand tools	X											

TABLE 1.2. (Continued)

Glove Box No.	Contents	Removal Description: Bagout	Disassembly	Cutting	Into Gallon Can	Break Up	Disconnection	Direct	Chisled	Partially Stripped	Solidify in Plaster of Paris	Mixed with Oil-Dry	Neutralize/Plaster of Paris
39	Federal Gaging equipment with electronic balance	X	X				X						
	SNM containers	X											
	Bags and trash	X											
	Hand tools	X								X			
	Large lathe												
	Large Craftsman tool box	X	X	X									
	1/2-ton electric crane	X	X	X									
	Electric grinder	X											
	Lathe tools	X											
40													
41**	Creep cage	X	X										
	Furnace heating elements and heat drills	X											
	Furnace door												
	Bu bars	X	X	X									
	Creep gauges	X											
	Seamless cans and trash	X											
	Vacuum cleaner	X											
	Mechanical pump, diffusion pump, and furnace shield*							X					
43	Vacuum furnace	X	X	X						X			
	Ring stand												
	Balance	X	X										
	Tube furnace	X	X	X									
	Lead brick	X											
	Glass tube	X			X								
	Tools	X											
	SNM containers	X											
	Prism mirror	X											
	Water	X			X						X		
	Flashlight, hose, miscellaneous	X											
	Molybdenum thermal expansion specimen holder	X	X										
	Tungsten thermal expansion specimen holder	X	X										
44	2 balances	X	X										
	Internal water lines	X	X	X	X						X		
	Internal hydraulic lines	X	X	X	X							X	
	Hydro press	X	X		X							X	
	Furnace*	X	X										
	Exterior shielding of lead, boronated polyethylene block, and angle iron supports**		X	X									
45	Balance	X	X										
	Weights and sample holders	X											
	Hot plate	X											
	Fume hood	X	X	X									
	Glass cooling water condensers	X			X	X							
	Carbon analyzer	X	X										
	Semiautomatic buret	X	X										
	Buret stand	X	X	X									
	Kjeldahl apparatus	X	X	X	X	X							

TABLE 1.2. (Continued)

Glove Box No.	Contents	Removal Description											
		Bagout	Disassembly	Cutting	Into Gallon Can	Break Up	Disconnection	Direct	Chisled	Partially Stripped	Solidify in Plaster of Paris	Mixed with Oil-Dry	Neutralize/Plaster of Paris
45	Acids	X			X								X
	Water	X			X						X		
	Tools	X											
	Variable autotransformer												
	Pro pipettes	X			X	X							
	Glassware	X			X	X							
	Plasticware	X											
46	Sample drive for MS-7 mass spectrograph	X	X										
	Cans and trash	X											
	Tools	X											
47													

*Breachment (penetration of the containment of the glove box).

E = Extensive.

**Smeared and assayed with an alpha scintillation survey meter to determine that it was uncontaminated.

Prior to the D&D Program the following tasks were accomplished or started: removal of some of the glove boxes; removal of SNM, items from the glove boxes, external and internal items (breachment and nonbreachment); and some cleaning and VR of the glove boxes. Four detailed reports describing these activities appear in the back pocket of this report (accession numbers 83-01-0015, 83-01-0016, 83-01-0025, 83-01-0026, and 83-02-0185).

The D&D Program Plan (reproduced on microfiche which appears in the back pocket with accession number 83-01-0013) stated that all glove boxes would be removed and disposed of in commercial burial or placement in a DOE retrievable storage site, as determined by the levels of contamination within. Subtasks for glove box decontamination and removal are detailed in the Plan.

1.1.2.2 EXHAUST AND AUXILIARY SYSTEMS

After the glove box removals from the Pu Laboratory, decontaminating and removing the various utility services and exhaust systems would take place. Most of these systems were located in a 4-foot void space below the building roof and above a 12-foot high false ceiling.

Initially, the utility services (water, gas, electrical) were removed and assayed. A major effort would be the decontamination and removal of the glove box and Pu Laboratory exhaust systems. The exhaust ducting would be decontaminated by various methods to non-transuranic (TRU) waste (10 nCi/gm), an acceptable low specific activity level (SAL). All contaminated ducting up to the final facility filters will be removed and assayed. Details and drawings can be found in the Plan.

1.1.2.3 CONTAMINATED DRAINS AND HOLDING TANKS

The third major task in decontamination of the Pu Laboratory involved the removal of the contaminated drains and holding tanks. The internal drains measured 242 feet and the external drains 220 feet. The two systems of holding tanks comprised volumes of approximately 535 ft^3 (4000 gal.) and 1,605 ft^3 (12,000 gal.).

1.2.2 ENVIRONMENTAL

Environmental radiological conditions were reported and submitted annually to COO. The reports for 1977 and 1978 are reproduced on microfiche and appear in the back pocket of this report (accession nos. 83-01-0018 and 83-01-0019). The monitoring at the West Jefferson site included air, water, sediment, soil, fish, and grass/food crops. Evaluation of the radiological doses to the public were calculated from atmospheric and aquatic discharges from the site. The weighted average concentration during 1977 and 1978 for Pu-239 at the site boundary due to atmospheric emissions ranged from less than 0.0005 to 0.0013 percent of the RCG value. Other atmospheric nuclides monitored were also less than the RCG values, as were values obtained from the total environmental monitoring program. These reports were distributed externally to county and city health officials, state radiological health and environmental officials and program director at the U.S. Environmental Protection Agency.

1.2.3 RDD FUELS PROGRAM TERMINATION

March 1, 1977 was the effective date for terminating the Property Studies on the Advanced Fuel Program at Battelle. Three avenues for future action were considered: (1) continuation, (2) retrenchment, or (3) decontamination. Decontamination was selected.

Battelle's position with respect to termination of the ERDA-COO funded RDD Fuels Program required cost recovery from that program for the ensuing Pu Laboratory D&D. Battelle believed that D&D costs were either allowable as programmatic costs or payable as part of a termination settlement and they were prepared to explore every possible alternative.

In June, 1977, Battelle prepared a position paper regarding the termination of the RDD Fuels Program and submitted it to ERDA-COO. It stated: "Work with nuclear materials presents a unique set of problems in that laboratories and equipment have a zero or negative salvage value after completion of technical aspects of a program. This is because nuclear material causes radiological contamination which must be cleaned up at the end of the program."

In 1977 the problems associated with decontamination of facilities had not been addressed satisfactorily. The position paper addressed Battelle's position regarding unamortized value of equipment, disposal of ERDA-owned nuclear material, and estimated time and cost schedules.

After numerous meetings of BCL, RDD and COO, including legal consultation, the final Plan for D&D was submitted on May 1, 1978. See Accession No. 83-01-0013.

2.0 PROJECT SUMMARY

2.1 PROJECT OBJECTIVES

The original Plan for D&D of the Pu Laboratory was submitted to COO May 1, 1978 (microfiche reproduction in back pocket of this report, accession no. 83-01-0013) and included the following tasks:

- Glove box decontamination and removal,
- Auxiliary system decontamination and removal,
- Contaminated drains and holding tanks removal,
- Laboratory interior surface decontamination, and
- Packaging, transportation, and burial.

A sixth task was added in the 1978 summary report to COO on September 28, 1979 (fiche no. 83-01-0016). This task was titled, "Final Resurvey and Restoration", and would follow the first five tasks. Restoration of the building would allow for unrestricted use.

As the D&D work progressed it became necessary to add additional tasks to completely remove all contaminated materials. These tasks (from 1980 to 1982) were:

- Removal of "old" portion of the PU Laboratory (Figure 1-3),
- Removal of contaminated soil at the 22 foot depth of the autoclave basin,
- Excavation of the two holding tanks,
- Handling of additional waste material,
- Removal of contaminated water from the excavation,
- Excavate further to remove the concrete autoclave slab and contaminated soil beneath it,
- Package contaminated soil into drums,
- Arrange for disposal of the two 65-ton concrete holding tanks and two 3-ton sand traps,
- Decontaminate or dispose of two 6000-gal. fiberglass holding tanks,
- Restore the excavation site,
- Disposal of 50,000 gallons of very slightly contaminated water.

2.2 PROJECT PLANNING

2.2.1 DOCUMENTS PREPARED

The documents prepared during the program are listed in Table 2-1. They can be divided into five areas: (1) The Plan submitted to COO, (2) topical and fiscal reports prepared for COO, (3) an environmental assessment (released to the public in 1979), (4) drafts describing the removal of special nuclear materials and assaying of scrap generated during the program, and (5) environmental monitoring at the West Jefferson site. While the environmental monitoring documents are not a direct aspect of the Pu D&D Program, they do contain data showing that there was no release of radionuclides to the environment above background during the period of 1977-1981.

All of these documents prepared are reproduced on microfiche and appear in the back pocket of this report.

2.2.2 SUMMARY OF MONTHLY REPORTS

Monthly and/or quarterly letters reporting to COO started with the period of October 1 through December 31, 1978, and continued through September, 1982. The reports included review of progress, problems, and cumulative costs. A detailed tabulation of the progress is on microfiche no. 83-02-0184. Problems and costs are discussed in Section 2.4 and Chapter 3.

Reporting after September of 1982, was by informal phone conversations and letters which addressed specific problems.

2.2.3 INTERNAL SAFETY REVIEWS

For the control of potential radiological hazards in research activities Battelle operates under its Radiological Safety Committee (RSC) Charter (1979 edition). The Pu D&D Program operated under guidance of three of its Subcommittees: Radioactive Materials, Nuclear Safety, and Plutonium

TABLE 2-1 DOCUMENTS PREPARED DURING THE PROGRAM

	Date	Title	Author	Rept. No.	Fiche No.
1. The Plan	May 1, 1978	Plan for Fully Decontaminating the Battelle Plutonium Laboratory. To the U.S. Dept. of Energy, COO	Battelle Columbus Div.	--	83-01-0013
2. Topical and Fiscal	Feb. 23, 1979	Topical Report on Volume Reduction Experiment (I) at Battelle's Plutonium Facility. To U.S. Dept. of Energy, COO	J. F. Dettorre, D. G. Freas, and D. E. Stellrecht	--	83-01-0015
	Sept. 28, 1979	Fiscal Year 1978 Summary Report on Decontamination of Battelle-Columbus' Plutonium Facility. To U.S. Dept. of Energy, COO	W. J. Madia, J. F. Dettorre, D. G. Freas, and D. Stellrecht	--	83-01-0016
3. Environmental Assessment	Sept. 1979	Environmental Assessment, Decommissioning and Decontamination Program, Battelle Plutonium Facility. To U.S. Dept. of Energy, COO	Battelle Memorial Inst.	DOE/EA-0092	83-01-0017
4. Drafts	Dec. 6, 1978	Removal of Special Nuclear Materials from the Plutonium Laboratory	R. E. Snider	--	83-01-0026
	Apr. 1979	Topical Report on Assaying of Scrap Generated During Decontamination of Battelle's Plutonium Facility. To U.S. Dept. of Energy, COO	D. E. Stellrecht, D. G. Freas, and J. F. Dettorre	--	83-01-0025
	June 1979	Topical Report on Decontamination of Plutonium-Contaminated Glove Boxes. To U.S. Dept. of Energy, COO	D. E. Stellrecht, D. G. Freas, and J. F. Dettorre	--	83-02-0185
5. Environmental Monitoring		Environmental Report for Calendar Year 1977 on Radiological and Non-Radiological Parameters. To U.S. Dept. of Energy, COO	R. G. Evans	--	83-01-0018
		Environmental Report for Calenday Year 1978 on Radiological and Non-Radiological Parameters. To U.S. Dept. of Energy, COO	R. G. Evans and J. C. Woodward	--	83-01-0019
		Addendum to the Environmental Monitoring Report for CY 1978 Contract No. W-7405-Eng-92. To U.S. Dept. of Energy, COO	R. G. Evans	--	83-01-0020
		Environmental Report for Calendar Year 1979 on Radiological and Non-Radiological Parameters. To U.S. Dept. of Energy, COO	R. G. Evans and J. C. Heinlen	--	83-01-0021
		Environmental Report for Calendar Year 1980 on Radiological and Non-Radiological Parameters. To U.S. Dept. of Energy, COO	R. G. Evans and J. C. Heinlen	--	83-01-0022
		Addendum to the Environmental Monitoring Report for CY 1980 Contract No. W-7405-Eng-92. To U.S. Dept. of Energy, COO	R. G. Evans	--	83-01-0023
		Environmental Report for Calendar Year 1981 on Radiological and Non-Radiological Parameters. To U.S. Dept. of Energy, COO	R. G. Evans et al.	--	83-01-0024

Laboratory. The scope of each Subcommittee is definined in the following paragraphs.

RSC-1, Radioactive Materials. The potential radiological hazards of operations with radioactive materials except criticality and the specific responsibilities assigned the Plutonium Laboratory Subcommittee are within its scope.

RSC-2, Nuclear Safety. All potential criticality hazards of operations with fissile materials are within its scope.

RSC-3, Plutonium Laboratory. All potential radiological hazards, except criticality, associated with the D&D activities of the Pu Laboratory are within its scope. This includes such categories as radioactive waste management; release of radioactivity to the environment; residual radioactivity remaining when D&D activities are completed; control of laboratory materials and equipment which may be released for controlled or uncontrolled use; control of exposure of persons involved in D&D activities; and the procedures developed and implemented for the operations in each of these categories. This Subcommittee will dissolve when the Pu Laboratory D&D activities are considered concluded by the Subcommittee.

The RSC-3 Subcommittee met in the Spring of 1978 (before the D&D Program started) to address the problem of storage of excess Pu-contaminated water. The holding tank space was not adequate for the planned D&D Program.

The RSC-3 Subcommittee considered 13 cases, however, several were put together and treated as a unit case, so actually there were ten cases.

Case 1. Storage space of Pu waste drums in JN-3.

Case 2. Use of underground reactor pool water storage tank versus "solidification" in urea-formaldehyde and shipment offsite by Chem-Nuclear Systems, Inc.

Case 3. Glove box Volume Reduction experiment (approved October, 1978).

Case 4. Treatment and transfer of JN-4 waste water to Hot Cell storage pool.

Case 5. Modification and use of JN-4 for research involving toxic and hazardous substances.

Case 6. Proposed glove box operation at JN-3 (approved September, 1980).

Case 7. Transfer of waste water from JN-4 to the JN-3 storage tank (15,000 gallons; approval granted July, 1980).

Case 8. Additional storage space in JN-3 for drums and bins.

Case 9. Criticality safety review of Pu repackaging operations in JN-3.

Case 10. Transfer of slightly contaminated water from excavations at the end of JN-4 to the holding tank at JN-3.

These cases are described and reviewed in the annual audits by the Pu Laboratory Subcommittee for the years 1978-1982 and are reproduced on microfiche no. 80-04-0404.

2.2.4 QUALITY ASSURANCE DOCUMENTS

Many quality assurance (QA) documents were prepared and some revised during the D&D Program for the procedures followed, including the packaging for transportation of the generated nuclear materials. QA NS-NS-19.3 (Exhibit 2-1) is an example of how the transfer of contaminated water on the site was handled for storage. The list that follows is an index to the QA documents relating to the program. These are reproduced on microfiche as nos. 83-01-0027 through 83-01-0029.

QUALITY ASSURANCE DOCUMENT

NS-NS-19.3
Revision 0

TRANSFER OF CONTAMINATED WATER FROM JN-4 EXCAVATION SITE TO THE JN-3 UNDERGROUND STORAGE TANK

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

Prepared by

D. G. Freas

6-18-82

APPROVED BY 6-18-82

APPROVED BY 6/21/82

APPROVED BY 6/18/82

APPROVED BY 6/22/82

1. Scope

This document contains the administrative controls and physical procedures for transferring radiologically contaminated water from the JN-4 excavation site to the underground storage tank at JN-3.

2. Purpose

The purpose of this document is to establish administrative controls and procedures for assuring a safe and coordinated transfer of radiologically contaminated water from JN-4 to JN-3.

3. Reference Documents

Memo from H. L. Toy to C. W. Townley dated 6-10-82.

4. Equipment Requirements

4.1 Hose from the sump pump.

4.2 Filtration system attached to the sump pump hose. Filtration will be adequate to remove foreign matter and purge particulates from the water. Solid collected matter and filters will be treated as solid waste and shall be disposed of by standard practice.

4.3 5/8" water hose from filtration system to JN-3 underground tank.

5. Waste Water Transfer Procedure

5.1 Position the 5/8" hose from the filter outlet to the JN-3 storage tank inlet.

5.2 Arrange a protective device for the transfer hose where it crosses the roadway to guard against damage from passing vehicles. If heavy trucks are expected, it may be necessary to interrupt transfer operations temporarily and remove the transfer hose from the roadway, to prevent damage.

5.3 Check the transfer hose at all unions and joints to assure that leakage does not occur. Leaks will be attended immediately upon discovery.

5.4 Initiate pumping operations and continue until no further water can be pumped from the sump.

5.5 Upon completion of water transfer, disconnect the hose at the first union above the pump and drain the hose into the JN-3 storage tank by gravity draining.

5.6 Remove the filters from the system and dispose as solid waste.

6. Safety Precautions

6.1 Health Physics will be notified of each transfer operation and will maintain cognizance of the radiological safety considerations of anticipated and on-going transfers.

6.2 Health Physics will be notified of any spills.

6.3 The waste water transfer operation shall be attended by at least one person at all times water is being transferred.

6.4 After the initial pumpdown of the water in the sump and the excavations each time additional water must be transferred, a water sample will be analyzed for gross alpha and beta concentrations and compared with the original data to ensure against any unusual increase in activity possible from excavation activities.

TABLE 2-2. LIST OF QUALITY ASSURANCE DOCUMENTS

PLUTONIUM LABORATORY DECONTAMINATION PROCEDURES

Microfiche No. 83-01-0029

Pu-DP-1.4, Rev. 0	Stripping Paint from the Interior of Glovebox
Pu-DP-1.5, Rev. 1	Preparation of Items to be Assayed Using the Random Source Interrogation System
Pu-DP-1.6, Rev. 1	Retrievable TRU-Contaminated Waste Packaging in Molded Polyethylene-Lined DOT 17C Steel Drums
Pu-DP-1.7, Rev. 1	Operation of the Random Source Interrogation System
Pu-DP-1.8, Rev. 0	Detergent Cleaning and Rinsing of the Interior of Gloveboxes
Pu-DP-1.9, Rev. 0	Fixation of Residual Radioactive Contamination on Glovebox Interior Surfaces
Pu-DP-2.4, Rev. 1	Loading of TRU-Contaminated Waste in DOT 7A Steel Boxes (ANL-M-III)
Pu-DP-3.2, Rev. 2	Operation of the Davidson 1056 Multichannel Analyzer for Assaying Contaminated Gloveboxes
Pu-DP-4.1, Rev. 0	Construction of Glovebox Volume Reduction Tents
Pu-DP-4.1, Rev. 1	Same
Pu-DP-4.2, Rev. 0	Removal of Packaging of Glovebox Exhaust Filters
Pu-DP-4.3, Rev. 0	Disconnection of Gloveboxes from Stands
Pu-DP-4.4, Rev. 1	Health Physics Procedures for Entering Tent Area III for Volume Reduction of Gloveboxes
Pu-DP-4.5, Rev. 0	Procedures for Exiting Glovebox Volume Reduction Tent Areas III, II, and I
Pu-DP-4.6, Rev. 1	Air Sampling During Volume Reduction of Gloveboxes
Pu-DP-4.7, Rev. 0	Glovebox Volume Reduction Sectioning Procedures
Pu-DP-4.8, Rev. 0	Handling and Packaging of Glovebox Sections for Disposal

TABLE 2-2. (Continued)

Pu-DP-4.9, Rev. 0	Procedures for Removal and/or Cleaning of Glovebox Volume Reduction Tent
Pu-DP-7, Rev. 0	Ceiling Tile and Supporting Framework Removal and Packaging as Low Level Radioactive Waste
Pu-DP-8, Rev. 0	Glovebox Exhaust System Removal and Packaging as Low Level Radioactive Waste
Pu-DP-9, Rev. 0	Gas and Liquid Supply and Electrical Systems Removal and Packaging as Low Level Radioactive Waste
Pu-DP-10, Rev. 1	Monitoring Requirements for the JN-4 Walls, Ceiling, and Floor Surfaces for Radioactive Contamination
Pu-DP-10.1, Rev. 0	Establishment of Surface Grid for Walls, Floors, and Ceilings for Detailed Radiological Survey
Pu-NS-7, Rev. 5	Procedures for the Collection of Soil Core Samples at the Site of the Plutonium Laboratory Liquid Waste Holding Tanks
Pu-NS-21, Rev. 1	Label Air Monitoring System for Radioactive Particles
Pu-WC-1.5, Rev. 1	DOT 7A Steel Box (ANL-M-III) Acceptance Review Check List
Pu-WC-4.0, Rev. 0	Glovebox Volume Reduction Tent Inspection Check List
Pu-WC-10, Rev. 0	Radioactive Contamination Monitoring Data (Building-Structural Surfaces)

PACKAGING AND TRANSPORTATION OF NUCLEAR MATERIALS

Microfiche No. 83-01-0028

BCL-NSP-2, Rev. 0	Plan for Packaging and Transport of Licensed Radioactive Materials

Microfiche No. 83-01-0027

NS-MS-5. Rev. 1	Standards Preparation for Random Driven Plutonium Monitor Calibration (Standards Pu, RDS-1, -2, -3, -4)

TABLE 2-2. (Continued)

NS-MS-8, Rev. 1	Standard for Construction of Wood Liners for Type M-III Waste Storage Bins
NS-MS-9, Rev. 0	Specifications for Glovebox Volume Reduction Tent
NS-MS-12, Rev. 0	Standard for DPT 7A Wood Shipping Box 4 x 7 x 4 ft.
NS-MS-31, Rev. 0	Packaging Standard for Transporting Radioactive Material Based on Type of Radionuclide and Curie Quantities
NSm-MS-31, Rev. 0	Limited Quantities Radioactive Materials Package and Shipment
NS-PI-5, Rev. 0	Packaging of Licensed Low Level Radioactive Waste for Disposal

OTHER

Microfiche No. 83-01-0027

HL-NS-1, Rev. 0	Disposal of Contaminated Liquid Waste from Holding Tanks
NS-NS-9, Rev. 0	Routine Environmental Radiological Monitoring Schedule
NS-NS-19, Rev. 0	Transfer of Processed JN-4 Water to Storage Pool
NS-DNS-19, Rev. 0	Documentation of Waste Water Transfer from JN-4 to the JN-1 Water Storage Pool
NS-NS-19.1, Rev. 0	Transfer of Waste Water from JN-4 Holding Tanks to the JN-1 Holding Tank
NS-NS-19.2, Rev. 0	Transfer of Waste Water from JN-4 Holding Tanks to the JN-3 Outside Storage Tank or to JN-1 for Evaporation Processing
NS-NS-19.3, Rev. 0	Transfer of Contaminated Water from JN-4 Excavation Site to the JN-3 Underground Storage Tank
	Index of Calibration Procedures

An explanation of quality assurance for low-level waste packaging and shipping was prepared at a 1982 American Nuclear Society Workshop (Emswiler, microfiche no. 83-04-0403). This paper describes BCL's Quality Assurance Organization; packaging of LLW, numbers and kinds of coding systems for QA documents; and an example of QA control on a single waste package from the initial purchase through shipment with LLW for disposal.

In February, 1983, the PU Laboratory QA procedures were reviewed and the obsolete ones were transferred to an inactive file.

2.3 MAJOR PROJECT OPERATIONS

2.3.1 TASK 1. GLOVE BOXES

In order to complete the history of glove box item removal (see Section 1.1.2.1), Boxes 17, 20-22, and 40 had their contents removed and bagged out. Box 18 had its camera box portion disconnected, removed, and placed into an M-III, 4x5x6' bin and packaged as HLW.

The attempts to clean the glove box interiors included conventional scrubbing, paint scraping, chemical cleaning, use of foam cleaning equipment, disposal of cleaning liquids, and coating of interior surfaces. Details of these operations are described for glove boxes 5 and 33 (fiche no. 83-01-0016 and 83-02-0185), as are also the details for volume reduction and removal. QA documents (fiche nos. 38-01-0027 through 38-01-0029) give the procedures used.

The disposition of the glove boxes can be summarized as follows:

(1) Storage on the site (Nos. 26, 45, and 47),
(2) Crated and shipped to Barnwell, S.C. (No. 41),
(3) Packaged in III-M bins and shipped to INEL (Nos. 7, 15, 20, 22, 30, 35, 40, and 46), and
(4) Volume reduced tent areas and shipped to Richland, WA (Nos. 5, 33, 44, 9, 6, 17, 43, 28, 18, 21, and 27).

By January, 1980, all of the glove boxes were removed from the facility. The remaining three slightly contaminated glove boxes have been retained by BCL in accordance with the Task 57 agreement.

2.3.2 TASK 2. AUXILIARY SYSTEMS DECONTAMINATION AND REMOVAL

Early in 1980, after removal of the glove boxes, decontamination of the auxiliary systems was completed (microfiche no. 83-04-084). All electrical alarms were disconnected and the auxiliary systems were removed from the Pu-238 and Metallography Laboratories. After the walls, ceilings, and floors were cleaned and rinsed with high pressure water, the rooms' surfaces were gridded, smeared and surveyed to identify contaminated areas requiring further remedial action. Areas that required remedial action were further washed or cleaned with a Vacublast unit. The ceiling tiles were removed from the main laboratory corridor and packaged for disposal.

2.3.3 TASK 3. DECOMMISSIONING OF "OLD" PU LABORATORY

Figures 2-1 through 2-4 show the interior and exterior of the "old" Pu Laboratory after the glove boxes and auxiliary systems were removed. Figure 2-1 shows where the hot drain system was located. The disassembly operations were contractor-assisted.

2.3.4 HOLDING TANKS AND AUTOCLAVE REMOVAL AND RESTORATION OF THE SITE

In order to evaluate the level of plutonium contamination existing in the soil around the holding tanks and autoclave, extensive core samples were taken. The analyses of the core samples revealed contamination that had occurred sometime during the 16-year use. Figures 2-5 through 2-20 show the sequence of activities and events from the beginning of excavation to the loaded containers of radioactive waste ready for transport by rail to Richland, WA.

FIGURE 2-1 EXPOSED PU-CONTAMINATED DRAIN LINE IN LABORATORY AFTER REMOVAL OF GLOVEBOXES. The removed glazed tiles were 2' x 4" x 1/2" and sealed at each join with tar. The depth of the line at the hot change room west of the Pu Lab was one foot under the floor and sloped to the depth of 3'. Contamination of the soil was highest underneath the tile joints. The soil was removed to 55 gallon drums. Date: September 11, 1981.

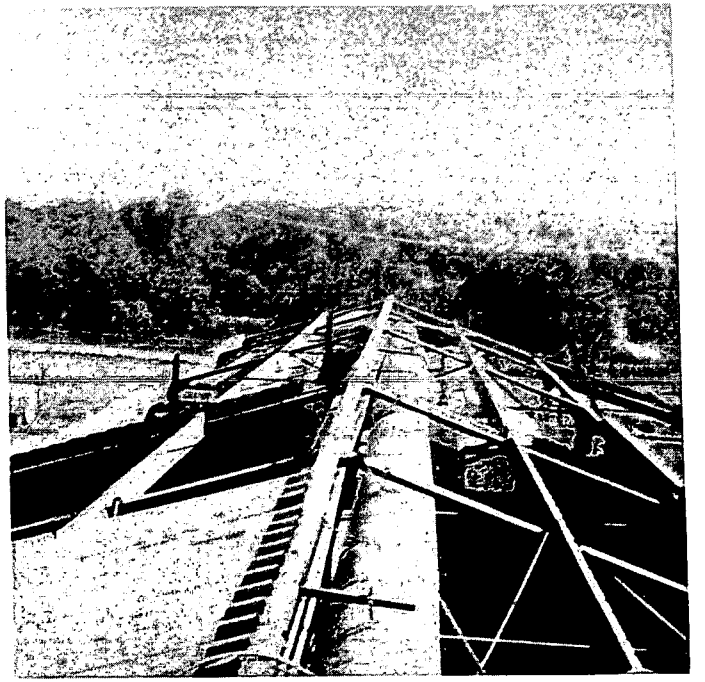


FIGURE 2-2 EASTERLY VIEW OF PU LAB AFTER ROOF REMOVAL SHOWING HEAT SUPPLY AIR DUCT. Date: September 11, 1981.

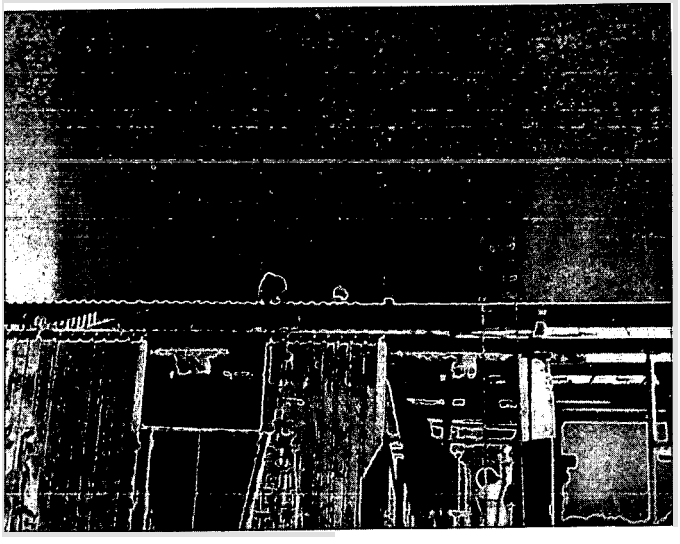


FIGURE 2-3 SOUTH SIDE OF PU LAB SHOWING THE REMOVAL OF 12' x 2' RIBBED PANELS WITH WORKMEN ON THE ROOF AND GROUND. Date: September 11, 1981.

FIGURE 2-4 NORTH SIDE OF PU LAB SHOWING CONTINUATION OF ROOF AND PANEL REMOVAL. Date: September 11, 1981.

FIGURE 2-5 EXCAVATION OF EXPOSED CONTAMINATED DRAIN PIPES LEADING TO THE NEW HOLDING TANKS. At the tie joint a new 4" fiber glass pipe 10' long was added. It emptied into new holding tanks of 6,000 gallon capacity. Date: October 28, 1981.

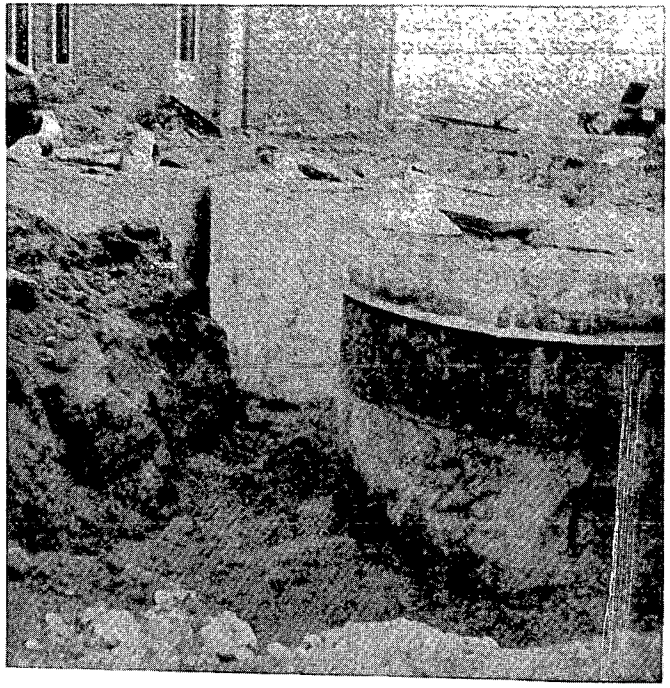


FIGURE 2-6 EXCAVATION OF WEST AND EAST HOLDING TANKS AND AUTOCLAVE (from left to right). Date: November 1981.

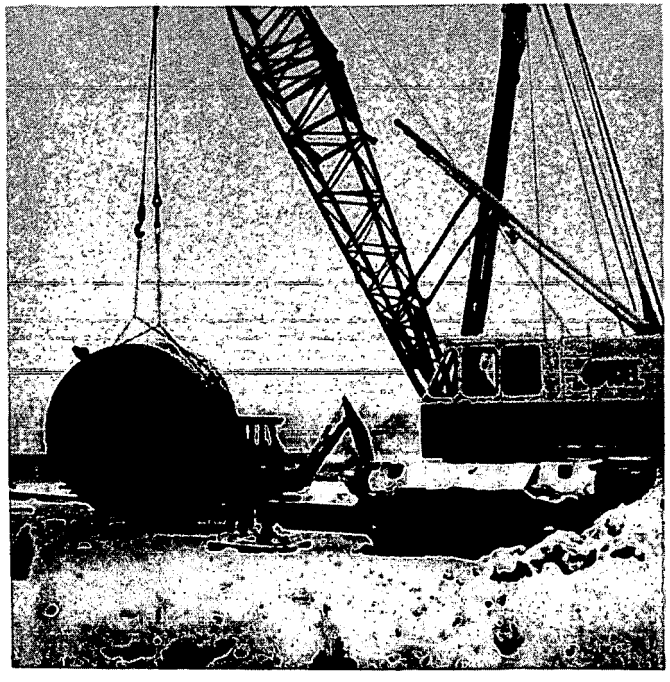


FIGURE 2-7 EXCAVATED EAST HOLDING TANK AFTER REMOVAL BY 100 TON CRANE. Date: December 1981.

FIGURE 2-8 EXCAVATED HOLDING TANK PLACEMENT NEAR THE WEST HOLDING TANK. Date: December 1981.

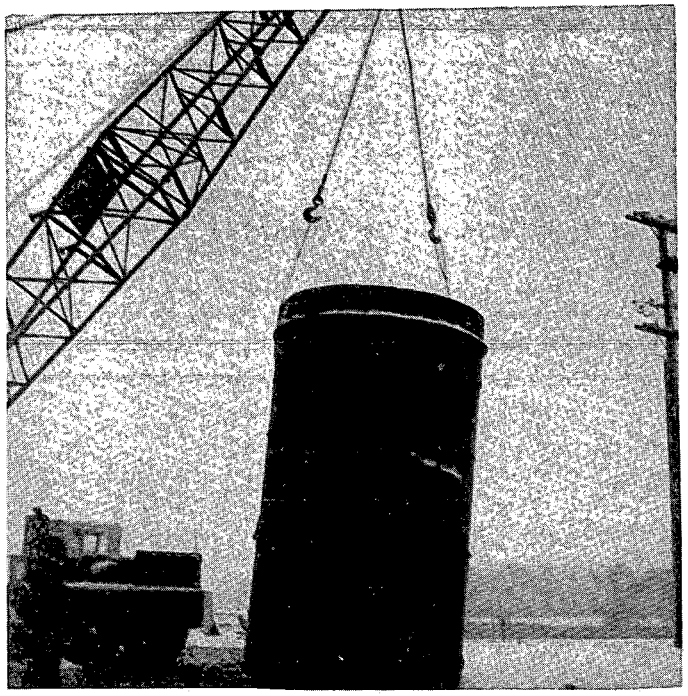


FIGURE 2-9 LIFTING THE 20' X 20' AUTOCLAVE. Date: December 1981.

FIGURE 2-10 EXCAVATION SITE OF TANKS AND AUTOCLAVE SHOWING SUMP PUMP WELL CASING AND PUMP ON TOP. Contractor's Bobcat in the pit. Date: August 10, 1982.

FIGURE 2-11 ENLARGING EXCAVATION SITE TO PREVENT CAVE-IN. Date: August 10, 1982.

FIGURE 2-12 SHADING OF THE VERTICAL WALL DEPICTS THE BLUE AND BROWN CLAY LOAM SOILS. The ladder shows depth of site to be approximately 18'. Date: August 17, 1982.

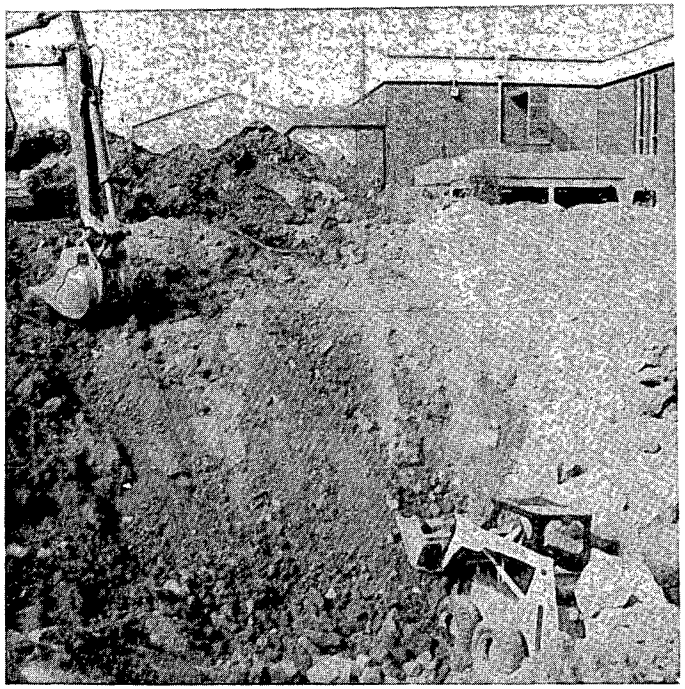


FIGURE 2-13 NEARING THE COMPLETION OF THE EXCAVATION SITE SHOWING BUCKET CRANE. The site was approximately 70' in diameter and 25' deep. Date: August 1982.

FIGURE 2-14 BOBCAT TRACTOR NEAR FINAL STAGE OF GRAVEL REMOVAL. The workers are taking samples of contaminated gravel where the autoclave and cement pad were. Date: August 13, 1982.

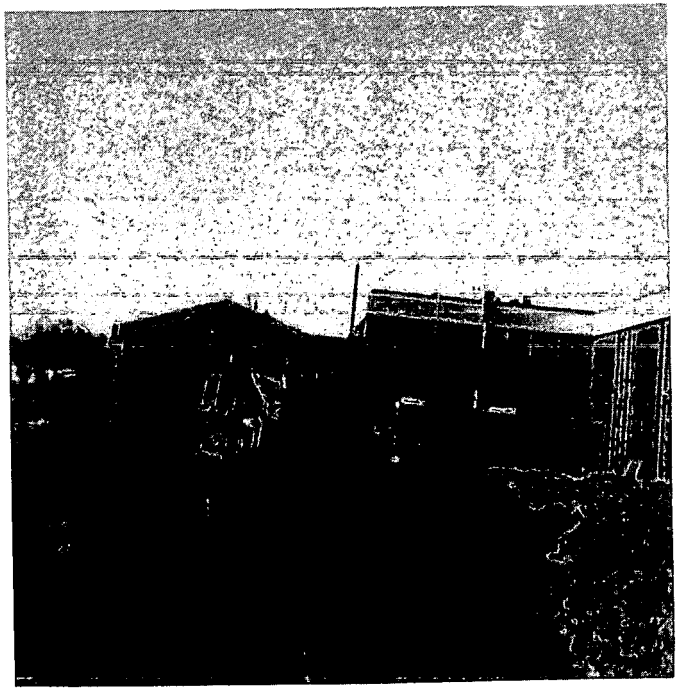


FIGURE 2-15 BULLDOZER BACKFILLING THE EXCAVATED SITE (see Figure 13). Date: October 13, 1982.

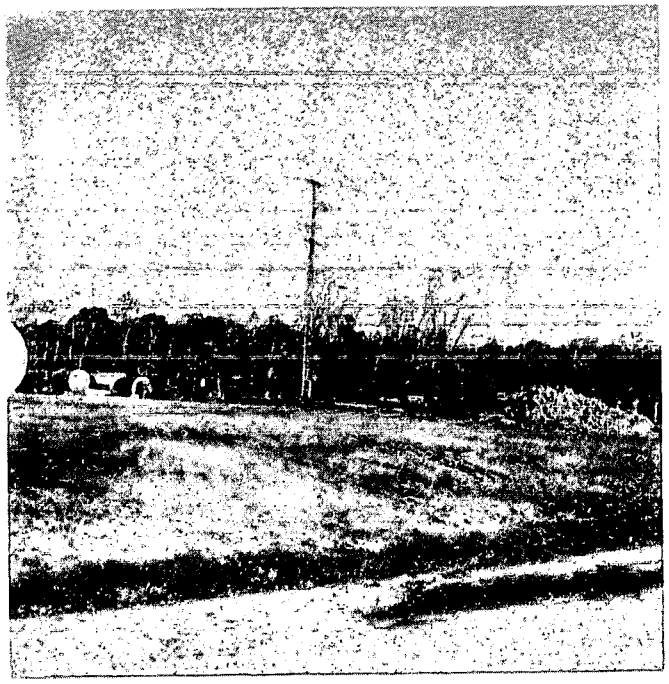


FIGURE 2-16 PORTION OF OLD WEST HOLDING TANK (FAR LEFT) AND UNCONTAMINATED SOIL FROM EXCAVATION OF SITE FOR NEW HOLDING TANKS (FAR RIGHT) IN THIS EASTERLY VIEW. Date: October 14, 1982.

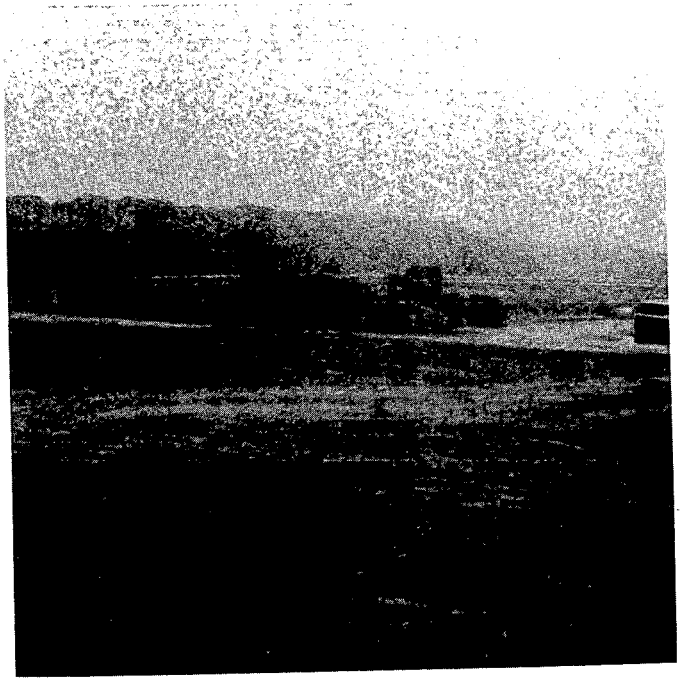


FIGURE 2-17 BEYOND THE BACKFILLED SITE IS A MOUND OF CONTAMINATED SOIL. Date: October 14, 1982.

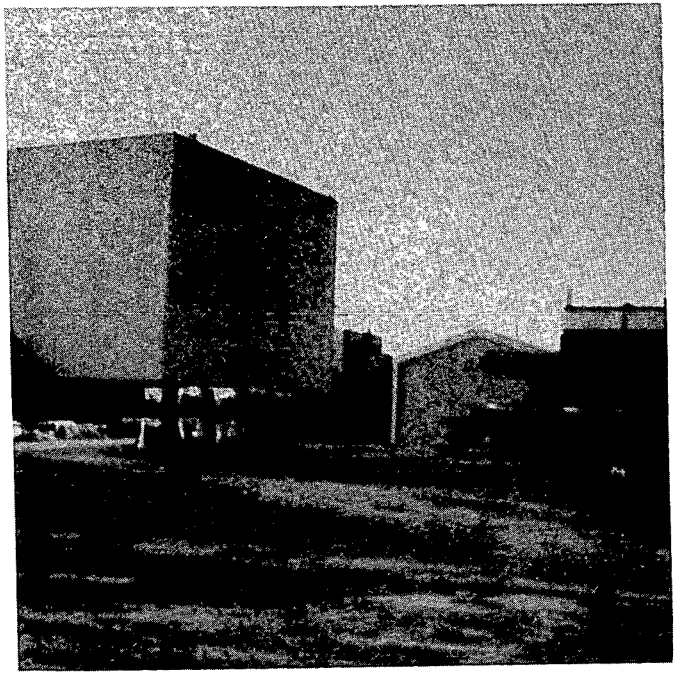


FIGURE 2-18 55 GALLON DRUMS CONTAINING THE CONTAMINATED SOIL SHOWN IN FIGURE 17. Hot Cell Lab (left) and D&D Pu Lab (right) with soil in the foreground to be revegetated. Date: October 14, 1982.

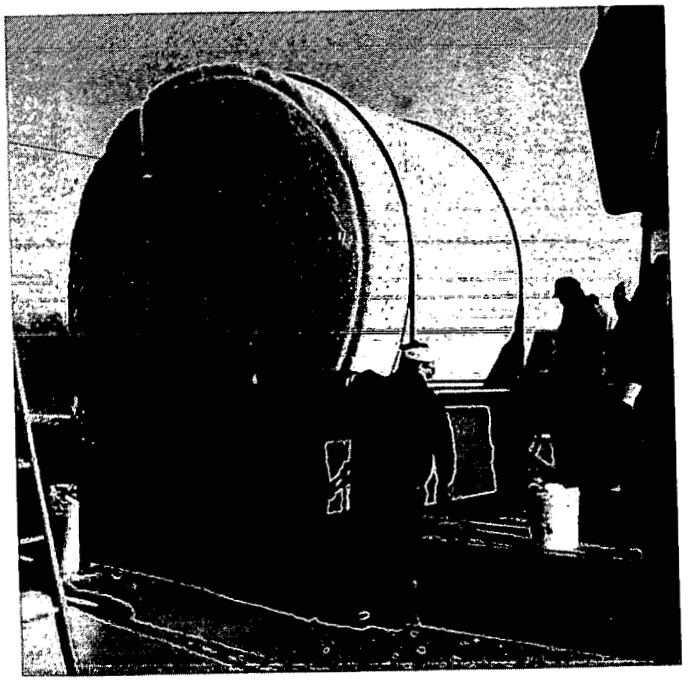


FIGURE 2-19 LOADING PROCESS OF OLD WEST HOLDING TANK ON TRUCK AND STRAPPING WITHIN THE CONTAINER. Date: December 13, 1982.

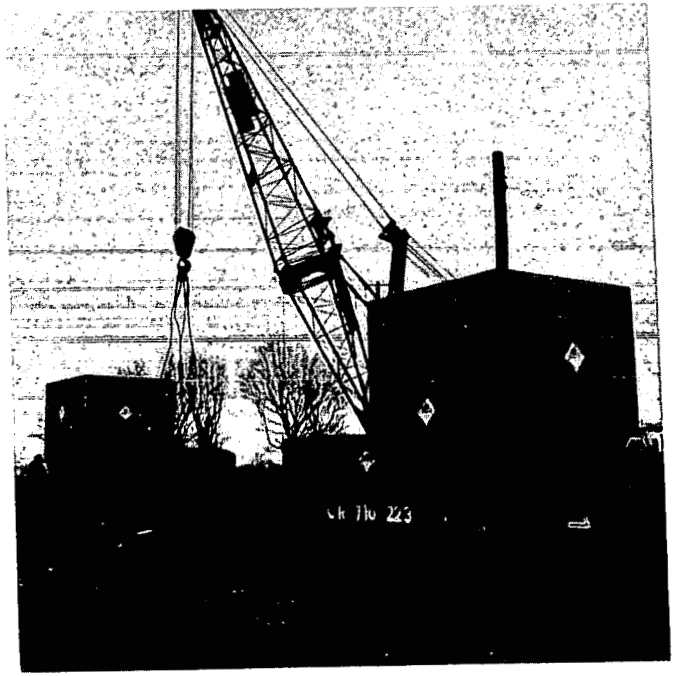


FIGURE 2-20 LOADING CONTAINERS OF OLD EAST AND WEST HOLDING TANKS AS WELL AS THE NORTH AND SOUTH SANDTRAPS ON FLAT CARS. Transport to Richland, WA, was by rail. Date: December 14, 1982.

2.3.5 WASTE SHIPMENT

LLW waste was shipped by truck and train to the burial sites in compliance with U.S. NRC (1982). Two examples of truck and rail transportation shipping records of non-TRU waste are reproduced on microfiche (No. 83-04-0405) in the back pocket. The first one is for a truck shipment to Rockwell Hanford Operations, Richland, Washington, of 55 gallon drums. The records include: radioactive shipment and receipt record; straight bill of lading; waste shipment final checklist; confirmation letter to DOE Richland with carbon copy to COO; solid waste burial record - non-TRU; smear survey reports for trailer, cab, and 54 drums; QA for "Work Completion Traveler for Preparation and Shipment of Radioactive Waste to a Licensed Waste Disposal Site"; activity/isotope weight calculations for Pu-239 and Am-241; and freight invoice.

The example of rail shipment records include two sets of forms: (1) transfer to the Conrail Yard via Atlas Transfer, Scioto-Darby Road, Hilliard, OH; and (2) transfer from Hilliard to Rockwell Hanford Operations. Two railcars (Figure 2-20) were necessary to ship the containers enclosing the holding tanks and sand traps. The record keeping for rail transport is similar to that for transport by truck, however, the packages shipped by rail had a greatly larger volume than the 55 gallon drums and required more radiological analysis. The four containers shipped were less than 11 nCi/gm avg. wt., considerably lower than allowable acceptance level of less than 100 nCi/gm TRU (as non-TRU).

Details of QA documentation for LLW packaging and shipping are reproduced on fiche Nos. 83-01-0027, 83-02-0028, and 83-04-0403.

The program's waste shipment data for burial is summarized in Table 2-1.

TABLE 2.3 PLUTONIUM LABORATORY D&D PROGRAM WASTE SHIPMENT DATA[a]

Year	Disposal Site	Number of Shipments	TRU	Non-TRU	Number of Containers						Curies	Disposal		
					55 Gal Drums	Wood Boxes	M-III Bins	Water Tanks	HT/ST[b]	Misc.		Weight lbs	Volume cu ft	Volume cu meter
1978	DOE/Hanford	1	X		42						5.73	7,150	315	89
	DOE/Idaho	2	X		76						14.60	20,229	570	161
	Chem Nuclear/Barnwell	6		X	87			9			0.11	153,158	3,353	949
1979	DOE/Idaho	5	X				30				15.11	26,452	3,600	1,019
	Chem Nuclear/Barnwell	2		X	31	11				1	0.01	37,620	2,477	701
1980	DOE/Idaho	2	X				12				14.92	34,000	1,440	407
	Chem Nuclear/Barnwell	5		X	160	28					0.0004	133,994	5,271	1,492
1981	DOE/Idaho	5	X				30				121.68	74,189	7,895	2,234
1982	DOE/Hanford	20		X	967	15			4		0.24	1,202,571	14,293	4,045
1983	DOE/Hanford	10		X	520	5	3				0.07	353,640	4,888	1,382
	TOTAL	58			1,883	59	75	9	4	1	172.47	2,043,003	44,102	12,481

(a) Through May 11, 1983.

(b) Holding tanks and sand traps (2 each).

2.3.6 CONTAMINATED WASTE WATER DISPOSAL

When the Program Plan was written, the generation of contaminated waste water was not identified as a significant factor in decontamination. In the fall of 1981, during the excavation necessary to remove the autoclave, the high groundwater level at the time caused the hole to fill with water. This water became slightly contaminated and some 50,000 gallons were removed, filtered, and transferred to an underground storage tank at JN-3.

2.4 PERSONNEL RADIATION EXPOSURE AND ENVIRONMENTAL MONITORING

2.4.1 INHALATION MONITORING

Breathing zone air concentrations were based on data obtained from individually worn air samplers. The equipment and data collection details can be found in the QA documents reproduced on microfiche No. 83-01-0029 (Pu-DP-4.6, Rev. 1; Pu-DP-10, Rev. 1; and Pu-NS-21, Rev. 1).

2.4.2 WHOLE BODY DOSES

Data were reviewed with regard to external penetrating whole body radiation doses to the staff and visitors to the facility for the inclusive period of 1976 to the conclusion of the program. All individual annual doses were significantly less than 5 rem per year.

2.4.3 EXHAUST VENTILATION SYSTEM EFFLUENT DISCHARGE AND EXPOSURE TO OFF-SITE INDIVIDUALS

Concentration levels of gross alpha activity in exhaust effluents were based on samples collected continuously for one-week periods. The recorded measurements for Pu Laboratory exhaust effluents during the D&D operations, 1977 through 1981, show that the annual average for all stack emissions did not exceed 3.6 percent of the maximum permissible concentration (soluble ^{239}Pu) for unrestricted areas. The highest annual average concentration for an individual exhaust effluent, during the same period, did not exceed 8.9

percent of the MPC. The stack sample counting system has an MDA level of 1.0×10^{-16} uCi/cc for the weekly stack samples, which is equivalent to 0.2 percent of MPC.

Based on the concentrations of plutonium alpha activity measured, the maximum dose rate increments to an off-site individual, as a result of inhalation of plutonium discharged from the Pu Laboratory during decommissioning, were calculated as 0.01 mrem/yr to the lungs if the plutonium were all in an insoluble form and 0.04 mrem/yr to the bones if the plutonium were all in a soluble form. Based on the conditions defined above, the total airborne discharge of plutonium alpha activity averaged 0.29 uCi/yr from the Pu Laboratory. A comparison of the lung dose rate increments of 0.01 mrem/yr for the period 1977 through 1981 with the annual dose of 0.02 mrem calculated for 1976 (the year prior to D&D activities), and the annual dose of 0.02 mrem calculated for 1982 (the year following the final D&D activities) indicate that there was no impact to the off-site environment as a result of the Pu Laboratory D&D operations.

2.5 INFORMATION EXCHANGE

2.5.1 CONTACT WITH OTHER LABORATORIES

Prior to DOE funding of the program and submittal of the Plan, numerous contacts and discussions were held with Mound Laboratory, Rocky Flats, Los Alamos, Rockwell-Hanford, Atomics International, and Lawrence Livermore Laboratories. Three BCL personnel attended a D&D meeting held at Atomics International. BCL also visited Rocky Flats for related discussions. In April, 1978, a BCL Health Physicist attended a conference on electropolishing technology for radiological decontamination at Battelle Pacific Northwest Laboratories. A tour through a recently decontaminated plutonium facility was included. It was confirmed that the team of craftsmen had years of experience in working with highly contaminated materials.

2.5.2 REFERENCES CONSULTED

The following listing of references relate to D&D and environmental monitoring. Two bibliographies on D&D were published in 1982 (DOE/TIC-3391, and ORNL-EIS-199).

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ANSI N326 (proposed). Control of Radioactive Surface Contamination on Materials, Equipment, and Facilities to be Released for Uncontrolled Use. Secretariat, Health Physics Society. (ANSI 13.12).

ARH-CD-353, Rev. 3. Design Criteria: Transuranic Dry Waste Burial Containers (Steel and Reinforced Concrete. by J. E. Hammond. Atlantic Richfield Hanford Operations, Richland, WA. September, 1976.

ARH-SA-223. Demolition and Removal of Plutonium-Contaminated Facilities at Hanford. by M. N. Raile. Atlantic Richfield Hanford Co., Richland, WA. May, 1975.

ARH-SA-248. In Situ Measurement of Residual Plutonium. by C. H. Kindale. Atlantic Richfield Hanford Co., Richland, WA. 16 pp. June, 1976.

ARH-ST-141. Decommissioning of Division of Military Application (DMA) Equipment at Hanford - Summary Report. by M. N. Raile. Atlantic Richfield Hanford Operations, Richland, WA. 1977.

BNWL-1917. Decontamination and Decommissioning of Nuclear Facilities - A Literature Search. Battelle Pacific Northwest Laboratories, Richland, WA. 1975.

BNWL-2187. Radiological Design for Hanford D&D Operations. by D. A. Waite et al., Battelle Pacific Northwest Laboratories, Richland, WA. 105 pp. September, 1977.

BNWL-2245. Electropolishing as a Decontamination Technique. by R. P. Allen et al. Battelle Pacific Northwest Laboratories, Richland, WA. pp 12.5. In: Nuclear Waste Management Quarterly Report, October-December, 1976. April, 1977.

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IDO-10074. Rev. 1. Criteria for Packaging Transuranic Waste for Receipt at the Idaho National Engineering Laboratoriy, Radioactive Waste Management Complex, Offsite Generated Waste. by B. C. Anderson. Draft. April, 1980.

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LA-9513-MS. Los Alamos DP West Plutonium Facility Decontamination Project 1978-1981. by R. Garde et al. Los Alamos National Laboratory, Los Alamos, NM. 30 pp. 1982.

LA-UR-78-87. A Germanium Detection System for the Detection of Transuranics at Low-Activity Concentrations in Soil. by L. West et al. Los Alamos Scientific Laboratory, Los Alamos, NM. 13 pp. Submitted to 11th Midyear-Symposium of the Health Physics Society on Radiation Instrumentation, San Diego, California, January 16-19, 1978.

MLM-2239. A Report on the Decontamination and Decommissioning of the Technical (T) Building at Mound Laboratory. by K. V. Gilbert et al. Mound Laboratory, Miamisburg, OH. 1976.

MLM-2324. Certification of Packagings: Compliance with DOT Specification 7A Packaging Requirements. by D. A. Edling. Mound Laboratory, Miamisburg, OH. 1976.

MLM-2228 & Suppl. 1. Certification of ERDA Contractors' Packaging with Respect to Compliance with DOT Specification 7A Performance Requirements. Phase II Summary Report. by D. A. Edling and J. F. Griffin. Mound Facility, Miamisburg, OH. June, 1975, April, 1976.

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2.6 PUBLICITY

In May, 1980, it was decided by BCL and DOE/COO to issue press releases announcing a "finding of no significant impact" (FNSI) to the public or environment in connection with the decontamination and closing of Battelle's Plutonium Research Laboratory. The DOE FNSI was issued after on-site visits in 1979 and after reviewing the Environmental Impact Assessment (microfiche No. 83-01-0017). One short article appeared in the 'Columbus-Citizen Journal' on May 13, 1980. BCL received no telephone calls from the news media or the public.

3.0 PROJECT COSTS

The funding for DOE's share of the total costs associated with the D&D program was established in Modification 11, Amendment No. A005 to the BCL-DOE ENG-92 contract and further identified as Task 57. DOE's share of the costs was $4,485,546 which included $350,589 for the remaining book value of BCL-owned equipment. A cost breakdown of DOE's share is on file with the Contracts Department of the Chicago Operations Office.

4.0 FINAL PU LABORATORY CONDITION

In February, 1981, BCL received letter confirmation that the Plutonium Facility Rooms 4116, 4117, and 4118 were below the prescribed radiation levels as presented in the following documents: EPA 520/4-77-019, "Proposed Guidance on Dose Limits for Persons Exposed to Transuranium Elements in the General Environment"; NRC Regulatory Guide 1.86, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of License for Byproduct, Source or Special Nuclear Material"; and ANSI 1312, "Draft American National Standard Control of Radioactive Surface Contamination on Materials Equipment and Facilities to be Released for Uncontrolled Use". It was further concluded that Rooms 4116, 4117, and 4118 can be made available for unrestricted use.

5.0 CONCLUSIONS

According to the RSC-3 Committee (microfiche No. 83-04-0404), its conclusions were that it had observed a very successful and unique project over the past six years. The staff proved to be highly skilled, resourceful, and meticulous in conducting a very difficult, and potentially hazardous job with a high degree of efficiency, and with an outstanding safety record. The Health Physicists provided excellent service in radiological monitoring and assistance.

All items which had come into contact with radioactivity from the plutonium operations were cleaned or disposed of through prescribed channels, maintaining procedures to ensure that D&D operations would pose no risk to the public, the environment, or the workers. The entire program was conducted under the cognizance of DOE's Chicago Operations Office. The building which housed the Plutonium Laboratory has now been decontaminated to levels allowing it to house ordinary laboratory and office operations. A "Finding of No Significant Impact" (FNSI) was issued in May, 1980.

6.0 RECOMMENDATIONS

6.1 MAJOR PROCEDURES

The Plan states: "A comprehensive final report detailing specific operations, problems encountered, methods attempted, etc., will be prepared at the end of the program". It is recommended that BCL and COO management be more uniform. A program of this nature does not lend itself naturally to the goals of research scientists and technicians. Consequently the management and staff during the 6-7 years of planning to completion migrated to other programs in the nuclear field which would be more rewarding. Continuous management would have maintained regular monthly reporting and the draft reports to COO would have become final reports. Technical writing assistance would have helped with the clarification and accuracy of the reports and Quality Assurance documents generated.

It is recommended that the planning team be broad. The 1978 Plan made no mention of contamination beyond that within the Pu Facility. This problem would have been considered if a radioecologist had been part of the planning team. It became evident after much time was spent unsuccessfully to attempt to eliminate or remove contamination that the direct volume reduction procedure be followed.

The Plan also did not mention the details in D&D of dismantling the old Pu Laboratory, removal of the holding tanks, and excavation of soil.

6.2 ALTERNATIVE PROCEDURES BASED ON EXPERIENCE GAINED

Never close down.

Establish barriers and conduct periodic surveys of the facility.