DR-0376-X

DOE/NE/44139-41
(DE88002431)

DECONTAMINATION AND DECOMMISSIONING OF THE
CHEMICAL PROCESS CELL (CPC)

Topical Report for the Period January 1985—March 1987

MASTER

By
R. A. Meigs

July 1987

Work Performed Under Contract No. AC07-81NE44139

West Valley Nuclear Services Company, Inc.
West Valley, New York

DOE/NE/44139-41
E 1.99:
DE88 002431

DECONTAMINATION AND DECOMMISSIONING OF THE CHEMICAL PROCESS
CELL (CPC): TOPICAL REPORT FOR THE PERIOD JANUARY 1985—MARCH
1987. Meigs, R.A. (West Valley Nuclear Services Co., Inc., West Valley, NY
(USA)). Jul 1987. 55p. UNCLAS 70 4 EDB-052001

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

This report has been reproduced directly from the best available copy.

Available from the National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22161.

Price: Printed Copy A04
Microfiche A01

Codes are used for pricing all publications. The code is determined by the number of pages in the publication. Information pertaining to the pricing codes can be found in the current issues of the following publications, which are generally available in most libraries: *Energy Research Abstracts (ERA)*; *Government Reports Announcements and Index (GRA and I)*; *Scientific and Technical Abstract Reports (STAR)*; and publication NTIS-PR-360 available from NTIS at the above address.

DOE/NE/44139--41

DE88 002431

**DECONTAMINATION AND DECOMMISSIONING
OF THE CHEMICAL PROCESS CELL (CPC)**

Topical Report for the Period January 1985 - March 1987

**By
R.A. Meigs**

July 1987

Work Performed Under Contract No. DE-AC07-81NE 44139

**West Valley Nuclear Services Company, Inc.
West Valley, New York**

DECONTAMINATION AND DECOMMISSIONING
OF THE CHEMICAL PROCESS CELL (CPC)

January 1985 - March 1987

By

R.A. Meigs

July 1987

Work Performed Under Contract No. DE-AC07-81NE 44139

Prepared for

The U.S. Department of Energy

Prepared by

West Valley Nuclear Services Company, Inc.

West Valley, New York 14171

DECONTAMINATION AND DECOMMISSIONING
OF THE CHEMICAL PROCESS CELL (CPC)

TABLE OF CONTENTS

List of Figures and Tables	v
Abstract	vii
Summary	ix
1.0 Introduction	1
2.0 Facility Description	2
2.1 Physical Condition	2
2.2 Radiological Condition	3
3.0 Technical Objectives	4
4.0 Description of D & D Operations	5
4.1 Preparatory Work	5
4.2 Equipment Removal	10
4.2.1 Jumper Removal	11
4.2.2 Preparations for Vessel Removal	17
4.2.3 Vessel Removal	19
4.3 Sampling of Floor Debris	22
4.4 Vacuuming of Floor Debris	23
4.5 Foaming and Rinsing	26
4.6 20 Mg Concrete Core Removal	29
4.7 High-Pressure Water Decontamination	33
5.0 Cost and Schedule Data	37
5.1 Cost Data	37
5.2 Schedule Data	38
6.0 Waste Generated	39

TABLE OF CONTENTS (Cont.)

7.0 Personnel Exposure	42
8.0 Characterization of the Completed Area	43
9.0 Post D & D Status	44
10.0 Lessons Learned	47
11.0 Acknowledgments	48
12.0 References	48

LIST OF FIGURES

1.0	General Layout of The Reprocessing Facility	6
2.0	Equipment Layout in CPC - Plan	7
3.0	Equipment Layout in CPC - Elevation	8
4.0	View Into CPC Through the North Shield Window	9
5.0	Photograph of the CPC Waste Storage Area	13
6.0	Jumper Being Loaded Into a Container	14
7.0	Lowering a Dissolver Onto the Transfer Car	18
8.0	Radiation Survey in CPC Before Floor Vacuuming	25
9.0	Radiation Survey in CPC After Floor Vacuuming and Foam Wall Decon	28
10.0	Radiation Survey in CPC at the Completion of D&D	36
11.0	View into CPC Through the North Shield Window after D&D	45

LIST OF TABLES

1.0	Equipment Located in the CPC	3
2.0	Results of Foam Decontamination in the CPC	27
3.0	Depth of Penetration of Contamination into the CPC Wall	35
4.0	CPC Decontamination and Decommissioning Costs	38
5.0	Major Purchases to Support CPC D&D	39
6.0	Estimated Curie Content of Waste Removed from the CPC	40
7.0	Secondary Waste Generated During the Decommissioning of the CPC	41
8.0	Personnel Exposure to Support D&D of CPC	42

**THIS PAGE
WAS INTENTIONALLY
LEFT BLANK**

ABSTRACT

The purpose of this report is to document the Decontamination and Decommissioning of the Chemical Process Cell (CPC). The operations effort spanned a two year period and included removal of all jumpered piping and 11 vessels; vacuuming of the cell floor; decontamination of the ceiling, walls, and floor with foamed chemicals followed later by high-pressure washing of all surfaces. In addition, three 20 Mg (22.5 ton) concrete neutron absorbers were cut and removed using a high-pressure water/abrasive jet cutting system. All work was performed remotely using overhead cranes and an electromechanical manipulator. After decontamination, the cell will be converted into an interim High-Level Waste (HLW) storage area.

THIS PAGE
WAS INTENTIONALLY
LEFT BLANK

SUMMARY

To support interim storage of vitrified High-Level Waste (HLW) at the West Valley Demonstration Project, the shielded, remotely operated Chemical Process Cell (CPC) was decommissioned and decontaminated. All equipment was removed, packaged and stored for future size reduction and decontamination. Floor debris was sampled, characterized, and vacuumed into remotely handled containers. The cell walls, ceiling, and floor were decontaminated. Three 20 Mg (22.5 ton) concrete neutron absorber cores were cut with a high-pressure water/abrasive jet cutting system and packaged for disposal. All operations were performed remotely using two overhead bridge cranes which included two 1.8 Mg (2 ton) hoists, one 14.5 Mg (16 ton) hoist, and an electromechanical manipulator. Additional operations were performed by an industrial robot mounted on a mobile platform. Initial general area dose rates in the cell ranged from 1 to 50 R/hr. Significant reductions were accomplished. Target levels of less than 10 mR/hr general area readings were established before decontamination and decommissioning was initiated; due to the high degree of fixed contamination in the paint on the walls, general area dose rates between 200 mR/hr and 1200 mR/hr were obtained at the completion of the decontamination work.

1.0 INTRODUCTION

This document is a final report on the decontamination and decommissioning activities, conditions, and results of the decontamination and decommissioning of the CPC at the WVDP.

The West Valley Demonstration Project is a congressionally mandated activity conducted through the U.S. Department of Energy, Idaho Operations Office. The operator of the Project is West Valley Nuclear Services Co., Inc., a subsidiary of the Westinghouse Electric Corporation.

The objective of the Project is the solidification of High-Level Waste (HLW) generated by commercial nuclear fuel reprocessing which was conducted at the site from 1966 to 1972. Site operations became a U.S. Department of Energy responsibility in 1982.

To support the interim storage of solidified HLW a large shielded cell is required. To minimize construction costs and maximize reuse of existing contaminated facilities, the Chemical Process Cell was selected as the interim storage area. Hence, the decontamination and decommissioning of the cell became a Contract Master Schedule milestone, well in advance of the anticipated solidification start date.

This report discusses the work required to complete the decontamination and decommissioning work in the CPC.

2.0 FACILITY DESCRIPTION

2.1 PHYSICAL CONDITION

The CPC is a remotely operated hot cell of the canyon type design. It is 28 m (93 Ft) long, 6.7 m (22 Ft) wide, and 13 m (43 Ft) high. Overhead bridge cranes provide maintenance and remote handling capability. The cell is constructed of reinforced concrete which is protected by Carbolenetm 305, phenolic paint. The floor and the first 0.5 m of the walls are covered with 304 stainless steel. Four lead glass, oil immersed viewing windows allow control of the cranes from the operating aisle. There are two separate bridge cranes on two sets of crane rails. A 14.5 Mg/1.8 Mg bridge passes overtop of a 1.8 Mg crane/power manipulator combination bridge. The cell was originally built as a fuel dissolution and HLW evaporator area. Chopped fuel was handled in baskets using the 1.8 Mg cranes. Dissolution was performed in two dissolver vessels weighing 11.8 Mg each. Operating dose rates in excess of 10E5 R/hr required concrete shielding walls 1753 mm (69 In) thick.

Support cells include the Equipment Decontamination Room (EDR), the Chemical Crane Room (CCR), and the Scrap Removal Room (SRR). The EDR is connected to CPC by a tunnel with a shield door partition. A rail type car allowed transfer of equipment between the EDR and

the CPC. The CCR allowed maintenance of the cranes behind a second shielding door in a low radiation field work area. The SRR was used to transfer leached cladding pieces (hulls) to a disposal area. Figures 1.0 through 3.0 show the layout of CPC in relation to the reprocessing plant and the layout of equipment inside the cell. Figure 4.0 is a photograph taken through the North Shield Window at the start of decommissioning operations in the CPC.

TABLE 1.0 EQUIPMENT LOCATED IN THE CPC

EQUIPMENT	DIA.	HEIGHT	WEIGHT
Fuel Dissolver	2.4	4.9	11.8
Fuel Dissolver	2.4	4.9	11.8
Accountability and Feed Adjust. Tank	2.1	2.4	4.8
Rework Evaporator	2.4	2.4	4.5
Low Level Waste Accountability Tank	1.8	2.7	4.5
High-Level Waste Accountability Tank	1.5	2.4	2.7
High-Level Waste Evaporator	1.5	2.4	2.5
Low Level Waste Evaporator	2.4	2.6	6.4
Accountability Tank Condenser	0.3	3.0	0.4
Dissolver Condenser	0.6	3.0	3.4
Dissolver Condenser	0.6	3.0	3.4
HLW Evaporator Condenser	0.22	3.0	0.3
LLW Evaporator Condenser	0.22	3.0	0.3
Cell Cooler	1.1 x 2.1	1.5	1.5
Cell Cooler	1.1 x 2.1	1.5	1.5
Cell Cooler	1.1 x 2.1	1.5	1.5

All dimensions are in meters.
All weights are in Mg.

2.2 RADIOLOGICAL CONDITIONS

Indications of gross leakage of several active solution transfer lines were obvious and boiling over of the dissolver vessels was a well documented occurrence. Failed vessels were removed during

reprocessing operations on three occasions with typical vessel contact dose rates of 100 R/hr.

At the outset of the decontamination and decommissioning work in the CPC, the dose rates in the CPC ranged from 12 to 56 R/hr, as measured during a remote survey performed in 1983. Smear samples taken during the surveys indicated smearable contamination levels in excess of $10E9$ dpm/100 cm² beta. A video inspection showed debris and equipment strewn across the entire cell.

3.0 TECHNICAL OBJECTIVES

The primary task objective was to provide a shielded, remotely operated interim storage area for vitrified HLW. The secondary objectives were as follows:

- Remove all equipment not necessary for storage operations.
- Lower radiation dose rates to less than 10 mR/hr or as low as reasonably achievable to allow contact work to support storage rack system installation.
- Reduce smearable contamination levels to less than 200 dpm/100 cm² beta and 20 dpm/100cm² alpha to minimize recontamination of HLW canister exteriors.
- Minimize radiation exposure to personnel performing the decontamination work to levels as low as reasonably achievable. (ALARA)

- O Minimize the volume of waste generated during the work.
- O Perform all work in a safe, efficient manner.

4.0 DESCRIPTION OF D&D OPERATIONS

4.1 PREPARATORY WORK

Prior work to support the decontamination and decommissioning of the CPC included decontamination and decommissioning of the EDR, the CCR, and the SRR. Results of these decontamination efforts are reported in References 1 through 3. In addition, the CPC cranes were overhauled extensively. Just prior to the start of the CPC work, the oil immersed shielding windows began to degrade significantly. The cost and schedule considerations for removal and total refurbishment led to an engineered, in-situ repair procedure developed at West Valley. Since the windows were in good condition until only recently, it was reasoned that chemical or radiolitic damage to the glass in the windows was not likely and that the cause of the visibility problem was limited to cloudy oil. Cloudy oil is typically caused by oxidization of the oil in the presence of air and moisture. The oil was drained and the windows were briefly filled with Freon-113. The Freon was drained and found to be free of radioactive contaminants. The windows were purged with nitrogen to remove air, moisture, and Freon; and the windows were refilled with new oil. Optical

FIG. 1.0 GENERAL LAYOUT OF REPROCESSING FACILITY

FIG. 2.0 EQUIPMENT LAYOUT IN CPC - PLAN

7

FIG. 3.0 EQUIPMENT LAYOUT IN CPC - ELEVATION

8

FIGURE 4.0 VIEW INTO CPC THROUGH THE NORTH SHIELD WINDOW

clarity approached that of a new window and has remained excellent for two years. The procedure was attempted on windows in another cell to support other decontamination and decommissioning work. These windows had degraded much earlier and results were unsatisfactory, most likely due to etching of the lead glass.

4.2 REMOVAL OF EQUIPMENT

Due to the schedule requirement for early availability of the cell for conversion to an interim High-Level Waste storage configuration, an early decision was made to size reduce vessels at a dedicated size reduction facility rather than to attempt remote, in-place size reduction in the CPC. Two options were investigated for the removal of the vessels. The first included overpacking the vessels in shielded containers and storing them outside the facility. The second option was packaging in strong-tite containers without shielding and transporting the packages to a shielded storage area. Shielded containers were eliminated from consideration due to the expense, excessive weight, and the one-time-use nature of the containers. Instead, a multi-use storage area concept was developed. Concrete storage modules were used to store low dose rate, high density waste in a compound surrounding the vessel package laydown area. Forty-

five modules were required to surround the 6.7 m by 36.3 m (22 Ft by 120 Ft) area. The entire storage area was covered by a tensioned fabric structure which was mounted on wheels that ran in tracks on the ground. Overall dimensions for the structure are 57.3 m (188 Ft) long, 15.2 m (50 Ft) wide, and 7.6 m (25 Ft) high, at the peak. The structure is moved out of the way to allow crane handling of packages as large as 3.4 m x 3.4 m x 6.1 m with no overhead interference. Figure 5.0 is a photograph of the storage area.

4.2.1 REMOVAL OF JUMPERS

Remote removal of jumper piping connections was performed in a typical manner using a crane suspended impact wrench to loosen the Purex connectors. Purex connectors are remote handled connectors which resemble a three jawed gear puller with a gasketed pipe connection routed through it. Jumpers were loaded into containers on the transfer car, the containers were closed using the power manipulator, and then the car was transferred to the EDR. Figure 6.0 shows a jumper being lowered into a container. In the EDR the container was over-packed into an outer, contamination-free container. Prestaged wrappers were folded into the containers using the EDR cranes, the box lids were closed, and the boxes

were sealed using a small crane-handled impact wrench. A container radiation survey was performed using a probe on the EDR cranes and the sealed box was moved out of the plant to the storage area. All work was planned to keep personnel access requirements to a minimum. The closest approach by workers was a Radcon smear survey prior to removal of the container. On several occasions decontamination of a loaded container was needed. The contamination was probably caused by dusting from the crane cables on the EDR crane. Total group exposure for these decontamination efforts was as high as 0.5 ManRem. Fig. 6.0 is a photograph of a container being loaded with a jumper.

During movement of the first container of jumpers, great difficulty was encountered with the hinged rail sections that span the gap at the CPC/EDR shield door. The original design for these rails used air powered actuators to raise and lower the rails. No lowering rate control was possible with the design so the rails were slammed to the floor each time they were lowered. A weld on one of the rails failed due to the impact of lowering the rails. A repair was made by welding the failed weld in a 100 mR/hr

FIGURE 5.0 PHOTOGRAPH OF THE CPC WASTE STORAGE AREA

FIGURE 6.0 JUMPER BEING LOADED INTO A CONTAINER

radiation field. It was later found that carbon steel shims used to level the rail actuators had corroded away, leaving the rails out of alignment. This prevented the rails from lowering all the way, thus trapping the transfer car in CPC. The temporary fix was to totally loosen the rails so that there was no alignment problem.

The first container was moved across this temporary fix, while a quick design and procurement was initiated for a new rail set to span the door area. The new rail design used the EDR crane to raise and lower the rails and employed a slotted hinge arrangement to avoid horizontal alignment problems. The rails also included channels for a remote controlled, mobile robot to pass into the CPC from EDR. The new rails proved to be sufficient for decommissioning use, however, they are not adequate for HLW canister storage operations and will be replaced in the future with a fixed section of track. The entire CPC/EDR shield door will be raised 20 cm to provide room for the fixed rails and shielding will be added to fill the gap under the door.

Additional problems were encountered during handling of waste containers through EDR with the transfer car power cable. A spring rewind cable

reel on the North wall in EDR provides power to the transfer car. The power cable was routed between the transfer car rails and was intended to slide across the EDR and CPC floors. This design continually moved contamination out of CPC into EDR and put the cable in a vulnerable position. The cable was cut twice by the hinged rails. On both occasions the transfer car was close enough to the EDR/CPC shield door to allow manual winching back to EDR. To remedy this situation, the power cable was moved near the East wall of EDR and a roller was mounted on the EDR wall to catch the cable at the door each time the transfer car passed by. Thus, the cable no longer drags on the floor and is close enough to the wall that is not vulnerable to accidental damage.

Size reduction of jumpers in the CPC was kept to a minimum by using large containers and preplanning how to load long jumpers. Size reduction was performed using a 36 cm abrasive saw mounted on a base that included two air cylinder powered clamps to grip the jumper on each side of the cut. The saw was raised and lowered using the 1.8 Mg crane. Audio feedback through the CCR intercom proved to be very helpful for operator control of the saw. Contact

dose rates on jumper containers was typically 2 R/hr with hot spots as high as 78 R/hr. The highest hot spot was associated with a low spot in an HLW transfer jumper. Seven 1.8 m x 1.8 m x 3.6 m boxes were required to remove the 150 jumpers.

4.2.2 PREPARATIONS FOR VESSEL REMOVAL

After removal of jumpers and some miscellaneous equipment, preparations for vessel removal began. External surfaces of vessels were cleaned using 1.14 KPa (150 psi) live steam from a wand in the power manipulator grip. Steam was used to circumvent a criticality concern from addition of rinse water to uncharacterized floor debris. After steam cleaning, the vessels received a clear fixative coating, the vessel internals were inspected using a crane suspended video camera, vessel heel dewatering was performed if needed with an air operated jet, and all cooling water nozzles were sealed with rubber plugs. Vessel inspections showed most vessels to be relatively clean inside. The exceptions were the recycle evaporator and the low level waste accountability tank, both of which had a layer of sludge about 0.3 m (1 Ft) thick. Dissolvers were free of any accumulation of cladding.

FIGURE 7.0 LOWERING A DISSOLVER ONTO THE TRANSFER CAR

To reroute plant waste solutions from decon operations and routine operation of the plant, four temporary jumpers were designed and purchased. The temporary jumpers were made with Purex connectors welded to flexible stainless steel hose so that alignment problems would be eliminated and interference with future activities could be minimized. These jumpers bypassed the tanks in CPC which were previously used to transfer waste. An unused vessel in the Liquid Waste Cell, adjacent to CPC, was used to replace the High-Level Waste Accountability and Neutralizer Tank to allow continued transfer of waste to the underground HLW storage tanks.

4.2.3 VESSEL REMOVAL

Vessels were lifted using the original remote handling strong-backs and were tipped over onto the transfer car. Figure 7.0 shows a dissolver being lowered onto the transfer car. To minimize the number of adjustments to the lifting equipment and transfer car support stands, the vessels were removed in order of size from largest to smallest since the strongbacks were already set at the largest position. The vessels were moved to the EDR and packaged in a manner similar to jumper containers. Ten vessels were

loaded into nine boxes. Due to difficulties encountered with differences between as-built drawings and interpretations of vessel vendor drawings (ie-the orientation of the vessel legs was not shown accurately), rework of all the specially built vessel containers was required. The problem was not discovered until an attempt was made to load a fuel dissolver into its container and did not fit. During the attempt to close the container lid onto the dissolver, the lid was damaged. The dissolver was returned to the CPC and remedial actions were initiated. A new lid was designed and built for the box, while the box itself was decontaminated and prepared for the new lid. Over one month of schedule time was lost due to the additional work required. The dissolver was then loaded into the box without incident. Contact dose rates on the packaged vessels ranged between 100 mR/hr for the dissolver condensers to 110 R/hr for one of the fuel dissolvers.

During movement of the first dissolver, the transfer car failed in the EDR/CPC tunnel. Video inspections revealed that the driver section was driving, but lacked the tractive force to drag the load bearing section, which apparently was not driving. Since the load bearing section

includes a worm drive speed reducer it was assumed that the drive coupling between the driver and the load bearing section had somehow failed and the clutch on the load bearing section would have to be disconnected to allow the transfer car to be moved into EDR.

The dose rate in the tunnel area was over 1 R/hr, so any repair efforts had to be remotely performed. A 20 cm hole was core drilled from the aisle above the tunnel through 1 m of concrete to gain access to the clutch. A camera was used through the hole to monitor work and a long handled tool was built to actuate the clutch handle. After disengaging the clutch, the transfer car was successfully moved to EDR.

After the vessels were removed, three additional 1.8 m x 1.8 m x 3.6 m boxes were loaded with cut-up racks, non-jumpered piping, and miscellaneous equipment which was found to have fallen under the vessels. Size reduction was performed with an ordinary industrial abrasive chop saw modified to fit the power manipulator. Blade changes were performed manually in the crane maintenance area. Several saws were set up to allow cutting to continue after blade failure. Chop saw power cables were routed through the crane room into the cell and required constant attention to

prevent tangling on in-cell equipment. A cable handling system would have increased productivity significantly. After transfer of all jumpers and vessel boxes to the storage area, temporary shielding was placed over the boxes with the highest dose rates to reduce external dose rates. General area dose rates below 10 mR/hr were achieved outside of the tent structure.

4.3 SAMPLING OF FLOOR DEBRIS

Once the vessels and excess piping were removed, an industrial robot mounted on a mobile platform was moved into the cell to support sampling and floor vacuuming work. Floor debris was sampled using a vacuum cleaner motor in a specially fabricated housing. The vacuum cleaner was handled by the robot and was used to pick up a sample cartridge from an ordered rack. The cartridges were made from Lucite 25mm air sampling filter housings. The pressure differential through the filters was sufficient to hold the cartridge onto the vacuum cleaner housing without any further mechanical device. The robot moved the sample cartridge to the floor and obtained a debris sample by a preprogrammed routine. It was quickly found that the variations in the debris and floor levels interfered with totally automated sampling, so the program was modified to include a

pause for the operator to manually control the robot to obtain a sample. Analytical results indicated typical Uranium concentrations were 0.1% by weight. One sample, obtained near the dissolvers, was as high as 8.0% Uranium. Isotope ratios indicated that the debris were primarily spent fuel in nature.

In addition to floor sampling, a thorough radiation survey was performed using a radiation probe suspended from a crane handled bail. Results of the survey are shown in Figure 8.0. The survey showed the results of spillage from the dissolvers approximately one-third of the way down the cell from the North wall and the habitual leakage from the low level waste evaporator at the south end of the cell.

4.4 VACUUMING OF FLOOR DEBRIS

To vacuum the debris remotely a 22.5 Kw (30 Hp), positive displacement vacuum system was used in conjunction with specially designed, remotely handled vacuum containers. The containers were 558 mm (22 In) OD and 1067 mm (42 In) high with 6.35 mm (1/4 In) thick carbon steel walls. A Goretex cartridge air filter with 0.74 m² (8 SqFt) of filter area was mounted inside each container.

An air pulse system was used to back pulse the filter to maintain low pressure differentials under high dust loading conditions. Neither the robot or the power

manipulator were capable of handling the pick-up nozzle in the tight confinement near vessel mounting pads. In addition, it was found that the clear fixative which was used on the vessels had formed an extremely tough crust layer with the floor debris. After a week of minimal progress, it was decided that vacuuming would be delayed until all vessel mounting pads were removed and the fixative crust layer could be broken up.

Two weeks of cutting operations were required to remove the 30 vessel mount pads by cutting through the 38 mm (1.5 In) dia. stainless steel mounting studs with the abrasive saw. After packaging the floor mounts in a 1.8 m x 1.8 m x 3.6 m container and treating the fixative with a 1.0 molar NaOH solution, vacuuming was resumed. A significant increase in productivity was noted and the operation was completed successfully; however, the following development work is needed before remote vacuuming is optimized:

- 0 Remote handled hose connections are needed to speed up plugged hose changes.
- 0 A quality swivel is needed to prevent hose twist from back-driving the manipulator.
- 0 Nozzle design must be improved to ensure better removal of stubborn debris and to prevent hose plugging.

FIGURE 8.0 RADIATION SURVEY IN CPC BEFORE FLOOR VACUUMING

CHEMICAL PROCESS CELL PRE-VACUUMING

RAD SURVEY (UNSHIELDED) MARCH 3, 1986

		DATA POINTS																						
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
		0.79	1.08	1.36	1.06	0.80	1.30	1.09	0.72	0.83	0.52	0.65	0.92	1.51	1.62	1.49	1.46	1.41	1.40	2.04	1.14	3.00	10.60	14.20
A EAST WALL		0.79	1.08	1.36	1.06	0.80	1.30	1.09	0.72	0.83	0.52	0.65	0.92	1.51	1.62	1.49	1.46	1.41	1.40	2.04	1.14	3.00	10.60	14.20
B		1.75	0.94	1.19	1.45	1.11	0.38	6.00	0.66	0.44	1.08	3.25	3.66	3.31	2.72	2.18	1.92	1.98	1.77	7.75	10.30	5.64	14.70	
C		1.17	0.93	1.74	3.65	3.94	2.34	9.93	4.64	5.90	5.80	6.69	7.19	5.47	3.65	2.77	2.28	2.00	1.97	5.24	4.95	7.19	2.43	12.20
D		1.60	2.26	2.51	2.74	4.04	6.33	14.70	20.30	20.60	17.00	11.70	6.17	3.86	3.60	2.77	2.36	2.03	2.15	3.12	2.12	2.79	1.85	8.36
E		1.38	2.50	2.40	2.28	2.58	3.68	5.26	10.30	14.70	17.80	12.90	6.62	4.43	4.18	3.06	2.35	1.90	2.17	1.33	1.44	1.42	1.75	8.04
F WEST WALL		0.79	1.30	2.10	1.73	2.01	2.65	3.78	4.34	6.69	10.50	9.59	5.56	3.70	1.20	3.12	2.40	1.82	2.23	1.12	1.19	1.21	1.67	2.54

- O Manipulator force feed-back would also aid the manipulator in avoiding obstacles.
- O A means of remotely detecting debris level inside of a vacuum container is needed.

The debris collected weighed 180 Kg (398 Lb). The original estimate for the quantity of floor debris was 1800 Kg (4000 Lb). The difficulty in estimating the mass of debris lies in the loose, fluffy nature of the atmospherically deposited dust. An estimated 5000 Ci of total activity was collected in the three containers used. Dose rate measurements on the containers indicated 15 R/hr at 1.5 m (5 Ft). The debris containers were transferred to the General Purpose Cell (GPC) which is located directly below the CPC.

4.5 FOAMING AND RINSING

After floor vacuuming was completed, all surfaces in the cell were decontaminated using foamed alkaline detergents. The foam was applied with a wand on the power manipulator or from nozzles attached to the 16-ton trolley to clean the ceiling. The foam was allowed to work for 15 to 30 min. and was rinsed with 4900 KPa (700 psi) water at 138°C. Several passes were made using the alkaline detergents before the chemicals were switched to 0.1 M HNO₃. During foaming of the cell immediate visible results were obvious.

In cell light levels increased and white streaks were seen as the rinse solutions ran down the walls. A single decon pass on the cell took two work shifts and generated 3785 l of spent decon solution. Decontamination factors were measured using a shielded probe. Decon results are shown in Table 2.0.

TABLE 2.0 RESULTS OF FOAM DECONTAMINATION IN THE CPC

Loc.	Initial	After Foam	DF	After Acid Foam	DF	TOTAL DF
1	585	350	1.67	152	2.30	3.85
2	667	355	1.88	195	1.82	3.42
3	643	307	2.09	210	1.46	3.06
4	641	512	1.25	380	1.35	1.69
5	690	437	1.58	569	.77	1.21
6	855	531	1.61	629	.84	2.60
7	977	668	1.46	680	.98	1.44
8	1260	708	1.77	631	1.12	2.00
9	822	564	1.46	438	1.29	1.88
AVE.	793	492	1.62	432	1.33	2.35

All measurements are in mR/hr, gamma only, as measured by a high intensity GM tube with an Eberline ESP-1 instrument. The probe was shielded from the CPC floor by a 100 mm x 100 mm lead cube. Locations were randomly selected, but repeatable positions throughout the cell. Some measurements may have been affected by the location of some high dose rate equipment (vacuum cleaner hoses) at the time of the survey.

A thorough radiation survey was performed after foaming and rinsing. Results of the survey are shown in Figure 9.0. The grid pattern for the first radiation survey was repeated as closely as possible. The survey showed that the spill in front of the dissolver was cleaned up, but the bulk of the activity

FIGURE 9.0 RADIATION SURVEY IN CPC AFTER FLOOR VACUUMING
AND FOAM WALL DECON

in the cell remained in the vacuum cleaner containers which were located at the south end of the cell.

4.6 20 Mg CONCRETE CORE REMOVAL

The fuel dissolver vessels in the CPC were designed as an annular ring tank with six fuel basket ports arranged on a 2.1 m (7 Ft) dia. To provide neutron interaction control a borated concrete core was built as a cast-in-place structure under each dissolver. There were two full-size cores weighing 20 Mg each and one 4.5 Mg short base which was provided for a future dissolver. To provide sufficient storage space in the CPC, removal of the cores was necessitated. Removal of these cores presented two major engineering challenges. First, unlike the remainder of the equipment in CPC, the cast-in-place cores were not designed for remote removal. In addition, the 20 Mg weight of the cores exceeded the CPC cranes lifting capacity. Since the West Valley Demonstration Project has significant experience in high-pressure water abrasive jet cutting operations, this cutting method was evaluated and finally selected for removal of the cores.

A tracking device was designed to allow tracking of the 240 MPa (35,000 psi) water jet nozzle around the base of the cores. The tracking device was remotely positioned over the core and each core was cut off at

its base. Each cut required 8 hrs of cutting time, used 10,220 l of water, and consumed 450 Kg of garnet abrasive grit.

An hydraulic cylinder system was built to fracture any remaining concrete in the central portion of the core. The two cylinder, 90 Mg (100 ton) capacity jack was suspended on a crane hook and positioned between the CPC wall and each core. The high-pressure water supply from the abrasive jet cutting system was used to activate the cylinders. The cores were easily cracked and tipped up slightly before releasing the water pressure.

Each core was decontaminated by removing the painted concrete surface layer using a manipulator held high-pressure water rotary lance. After decontamination, a tipping fixture was positioned over each core. Clamp bolts were tightened using a canyon impact wrench normally used for Purex connector removal. Once the fixture was tightened, the 14.5 Mg crane was used to tip the cores onto a specially designed high capacity transfer car. Tipping the cores was required due to the 14.5 Mg weight limitation on the crane in the CPC. By tipping the cores, rather than lifting them directly, the load to the cranes was limited to half the weight of the core.

The design of the tipping fixture was intended to take

advantage of some guide plates which were shown on the construction drawings of the cores. When the fixture was placed on the first core, it was noted that the guide plates had been omitted in the field. A decision was made to try the lift depending on a friction clamp only. During the initial lift the fixture shifted up approximately 100 mm before binding caused the fixture to grip tightly. The lift was continued, however, the downward shift in the center of gravity in the fixture prevented the completion of the tipping since the center of gravity was behind the plane of the hoist at the top dead center of the lift. Repeated attempts were made to complete the tipping, but no combination of trolley and hoist movement was successful. A 1.8 Mg hook was attached to the rearmost part of the tipping fixture in an effort to boost the core over center. The location of the hook caused the clamps of the tipping fixture to loosen, allowing the core to slip half out of the fixture and come to a rest on the floor at a 30° angle. The core remained halfway in the tipping fixture with the 14.5 Mg crane preventing the fixture from slipping.

Recovery efforts were concentrated on core drilling a hole into the wall of the cell at the centerline of the core so that an hydraulic jack could be used to push the core over into the fixture and onto the transfer car. A three-week schedule delay resulted

from the recovery operations. The clamping band was replaced on the tipping fixture and the second core was tipped without incident. The third smaller core was picked up directly using a fixture designed specifically for it.

Each core was moved into the EDR and loaded into a heavy-duty container. Contact dose rates were 10 to 50 mR/hr. The container was moved out of the EDR, loaded onto a trailer, and moved to a hardstand area where it was surrounded by other waste containers to reduce the exposed radiation levels.

The garnet abrasive on the floor of the CPC was wet vacuumed into canisters using a nozzle with a spray tip, initially, and later with a shrouded high-pressure water decon tool suspended from a 1.8 Mg crane hook. While vacuuming abrasive, a twisting motion on the power manipulator evidently caused one of its telescoping tubes to jump its guide track which was not noticed from outside the cell. When the manipulator was raised, several guide blocks inside the tubes jammed against each other, causing the telescoping tube hoist cable to fail, allowing the manipulator to fall to the floor. The manipulator was recovered with the 1.8 Mg hoists and moved on the transfer car to the EDR for repairs. A one-month delay to the decontamination and decommissioning

schedule resulted from the recovery work.

4.7 HIGH-PRESSURE WATER DECONTAMINATION

After removing the abrasive from the CPC, a 1.8 m x 1.8 m x 3.6 m container was filled with miscellaneous debris which had accumulated during the previous operations. A steady build up of small parts was observed throughout the decontamination and decommissioning work. This was primarily due to the large amount of time required to pick up the small parts. To allow this slow work to go on, independent of the loading of large containers, two baskets made from expanded carbon steel plate were sent into the cell. Small parts were loaded into the baskets whenever a manipulator operator was available and no other work was planned in the cell. Once the baskets were filled they were decontaminated to decrease the possibility of a hot spot on the container they were loaded into. This concept is currently being evaluated as a primary handling method for the equipment that will be removed from the remainder of the smaller head end fuel handling cells.

A dose rate survey after removal of the last container of debris showed that the general area gamma exposure had decreased to 300 to 900 mR/hr. A decontamination test was performed using high-pressure water with a manipulator held rotary lance. A water flow of 11.4 l

and 240 MPa (35,000 psi) was used to remove the paint and an estimated 4 mm of fine cement. Dose rate measurements were taken at three test locations, using a shielded high intensity GM tube, both before and after the decon passes. The decon factor (DF) was between 1.1 and 1.3 for the tests performed. The results of the decon test were much lower than desired or what was required to reach the original target goal of 10 mR/hr general area dose rates throughout the CPC. A further investigation was performed by drill sampling the wall to determine the depth of penetration of contaminants. Holes were drilled into the wall allowing the drilling dust to slide down a funnel into a vertical vinyl tube. The dust was thus stratified by depth of origin. The analytical lab analysis showed that the contamination was largely confined to the first 13 mm layer. Comparison of the specific activity of the first 13 mm layer with the specific activity of some paint chip samples from the CPC showed that most of the contamination found in the 13 mm layer could be attributable to the paint contamination alone. The analytical results of the sampling are presented in Table 3.0.

Since these results did not back-up the results of the in cell decon test it is presumed that the shielding configuration of the shielded GM tube was somehow altered, generating misleading results. Testing

TABLE 3.0 DEPTH OF PENETRATION OF CONTAMINATION INTO THE CPC WALL

PENETRATION	SAMPLE 1	SAMPLE 2	SAMPLE 3
0mm-10mm	3.64E-2	1.37E-2	1.47E-1
10mm-20mm	2.19E-4	1.61E-3	1.67E-3
20mm-30mm	<3.50E-5	<4.71E-4	1.34E-3
30mm-40mm	<4.46E-5	<3.18E-5	1.58E-3
40mm-50mm	1.18E-3	1.02E-4	3.19E-3

All numbers are in microcuries Cs-137 per gram.

performed on paint chips indicates that the paint is badly contaminated and is difficult to decontaminate. Upon soaking some chips in 6 M HNO₃ for 24 hours at room temperature the DF for Cs-137 and Pu was approximately 9 and 1.5 respectively. Thus, any further chemical decontamination efforts were not expected to be fruitful. The high levels of contamination in the paint and the inability to leach it out leads to the conclusion that the paint was very porous. This may be a result of poor curing conditions present at the time the paint was applied, as records indicate the cell was painted before the plant ventilation system was operational.

Final wall and ceiling decontamination was performed using a rotary lance 240 MPa (35,000) psi spray system. Special fixtures were designed and built to allow the 14.5 Mg trolley to move the spray system to cover the ceiling and upper walls. Steady motion was required at all times to prevent excessive erosion of

FIGURE 10.0 RADIATION SURVEY IN CPC AT THE COMPLETION OF D&D

the wall surfaces. The lower wall surfaces were decontaminated using a crane hook handled, shrouded sprayer which allowed vacuum containment of the water and all removed debris. Hot spots and difficult-to-reach spots were decontaminated using a manipulator held rotary spray lance. All the rotary spray lances used hydraulically driven high-pressure rotary unions to supply water to a manifold of sapphire jewel nozzles. Water use ranged from 5.7 l/min to 15 l/min depending upon which rotary lance was in use.

The final decontamination effort used 27,630 l of water and generated 2120 l (75 Ft³) of class C waste which may be TRU in some containers. The waste is presently stored inside the CPC for future stabilization processing.

A final radiation survey was taken at this point to determine the results of all the decontamination and decommissioning work done in CPC. Results of the survey are shown in Figure 10.0. The survey shows greatly reduced radiation levels in relation to the levels recorded in the initial survey.

5.0 COST AND SCHEDULE DATA

The work force dedicated to the decontamination and decommissioning of the CPC was organized into an engineering group consisting of two to four engineers depending upon the work load and an operations group

typically consisting of two supervisors and ten decontamination technicians. Engineering work began approximately six months before the planned start of decommissioning work. The organization of the operations group changed depending upon the type of work being done in the CPC. During remote operations, with no ongoing waste removal work, two shifts of five people were used. A three shift schedule was tried briefly, but it was found that work actually slowed down since only day shift could make entries into the CCR and the EDR to support the remote operations. When waste containers were scheduled to be moved, the group was organized into one shift to support the man-power needs of container handling.

5.1 COST DATA

Table 4.0 shows the costs associated with CPC D&D for each fiscal year.

TABLE 4.0 CPC DECONTAMINATION AND DECOMMISSIONING COSTS

ITEM	FY-85 COST	FY-86 COST	FY-87 COST
Engineering	194,719	438,200	147,501
Operators	87,829	324,660	290,902
Management	302,507	26,263	56,582
Labor Subtotal	694,925	807,080	523,072
Materials/supplies	855,514	580,529	269,354
Total per FY:	1,550,439	1,387,609	792,426

Grand total for CPC D&D: \$3,730,474

Table 5.0 is a listing of major purchases that were required to support CPC D&D.

TABLE 5.0 MAJOR PURCHASES TO SUPPORT CPC D&D

ITEM	COST
Concrete Shield Containers	101,660
Tensioned Fabric Structure	99,410
Storage Pad	99,210
HI-VAC tm Vacuum System	53,374
Vessel Storage Containers	69,691
Jumper/Debris Containers	70,406
Mobile Crane Rentals	100,278

5.2 SCHEDULE DATA

The master schedule for the project allowed 24 months for the completion of decontamination and decommissioning work in the CPC. The start date was to be in January of 1985. Due to delays in the deliveries of waste containers and the sprung structure storage area, the actual start date was delayed until March of 1985. During the decontamination and decommissioning work in the CPC there were four major schedule delays. The first was a one month loss while repairing vessel containers which did not fit the vessels properly. The second and third delays were the inability to vacuum floor debris as quickly as planned and the dissolver core falling to the CPC floor. The final delay was the result of the electromechanical manipulator falling to the CPC floor. Throughout the work in the CPC there were numerous and persistent delays caused by failures

of the cranes, the electromechanical manipulator, the transfer car, and various other equipment.

6.0 WASTE GENERATED

During the course of decommissioning of the CPC, 22 remotely handled containers were loaded in the EDR and transferred to the CPC waste storage area. Total volume of this "primary" decommissioning waste was over 850 m³ (30,000 cubic feet). The total Curie content of the containers is estimated as listed in Table 6.0.

This estimate is based on a Quadmodetm computer calculation for Cs-137 content for a uniform 1.5 R/hr container which was then scaled up and down with actual dose rates for each container. The remaining isotopes are based on a site-specific, reference spent fuel isotope distribution (Ref. 4).

TABLE 6.0 ESTIMATED CURIE CONTENT OF WASTE REMOVED FROM THE CPC

ISOTOPE	EST. CURIES
Cs-137	245
Sr-90	235
Am-241	5
Pu-TOTAL	212

In addition to the primary waste removed from CPC there was a significant quantity of secondary waste generated as a result of support and maintenance activities in the EDR and

CCR. Table 7.0 summarizes the secondary waste generated during the Decontamination and Decommissioning of CPC.

TABLE 7.0 SECONDARY WASTE GENERATED DURING THE DECOMMISSIONING OF THE CPC

WASTE FROM THE EDR								
CLASS	2.5 m ³ BOXES			DRUMS			TOTAL	
	QUANT	WT	VOL	QUANT	WT	VOL	WT	VOL
A	41	37740	103	23	4590	16	42330	119
B	22	19541	55	3	537	1	20079	55
C	0	0	0	3	147	1	147	1
TOTAL	63	57281	158	29	5274	18	62556	175

WASTE FROM THE CCR								
CLASS	2.5 m ³ BOXES			DRUMS			TOTAL	
	QUANT	WT	VOL	QUANT	WT	VOL	WT	VOL
A	0	0	0	192	23184	40	23184	40
B	0	0	0	4	588	1	588	1
C	0	0	0	4	451	1	451	1
TOTAL	0	0	0	200	24223	42	24223	42

GRAND TOTAL	63	57281	158	229	29497	60	86779	217
-------------	----	-------	-----	-----	-------	----	-------	-----

All volumes are in m³
All weights are in Kg

From these tables it is apparent that the bulk density of the waste removed from EDR and CCR was 362 Kg/m³ for 2.5 m³ boxes and 492 Kg/m³ for drums with an overall density for all secondary waste of 399 Kg/m³. The lower density for 2.5 m³ boxes reflects the large quantity of Herculitetm plastic packaged in these containers and the difficulty of effectively packing this material. Secondary waste

accounted for approximately 20% of the total volume of waste generated during the Decontamination and Decommissioning of the CPC.

7.0 PERSONNEL EXPOSURE

During the course of Decontamination and Decommissioning work in the CPC radiation exposure to personnel was accrued during repair, set-up, and decon work in the EDR and CCR. This exposure to personnel is summarized in Table 8.0.

Entries into EDR and CCR typically involved two people inside the controlled access area with anti-contamination clothing and supplied air respiratory protection, one backup person in the airlock dressed for immediate entry into the area and one or two people outside of the airlock as backups.

TABLE 8.0 PERSONNEL EXPOSURE TO SUPPORT D&D OF CPC

ITEM	EDR	CCR	TOTAL
Total entry time	2107 hr	1078 hr	3185 hr
Number of entries	1430	961	2391
Ave. entry time	88.4 min	67.3 min	80 min
Ave. entry dose	11.6 mR	9.7 mR	10.9 mR
Exposure to Operators	14718 mR	7751 mR	22469 mR
Exposure to Rad-Techs	1924 mR	1539 mR	3463 mR
Exposure to Back-ups	765 mR	552 mR	1317 mR
Total Exposure	17407 mR	9842 mR	27249 mR

Most of the radiation exposure was accrued during waste

container handling in the EDR/North Yard and for crane repairs in the CCR. The maximum exposure during a single entry was 73 mR in the CCR while changing high-pressure water decon tools and 158 mR in the EDR during the handling of a fuel dissolver. There were 12 skin contamination incidents in the EDR and 13 skin contamination incidents in the CCR. Typically, skin contamination incidents were caused by contact with wet surfaces or sweat soaked anti-c clothing causing migration of contaminants through the clothing. Skin contamination is treated with window cleaner and wipes. None of the contamination incidents resulted in inhalation or ingestion of contamination.

8.0 CHARACTERIZATION OF THE COMPLETED AREA

The conditions in the CPC after Decontamination and Decommissioning were as follows:

- O All unnecessary equipment was removed.

- O Smearable contamination:

- Walls.....50,000-300,000 dpm/100 cm² Beta

- Floor.....100,000-950,000 dpm/100 cm² Beta

- O Dose rates ranged from 250-1200 mR/Hr Gamma.

- O All equipment supports were cut to within 10 cm of the floor.

- O Purex nozzles that connected to unnecessary lines were removed.

- O Wall penetrations that were interconnected to plant vessels were sealed using cam operated expanding plugs.

- O The transfer car built to remove the concrete cores was left for future use.
- O The power manipulator and bridge cranes are usable, but require significant repair work.
- O Only four of the original twelve in-cell lights are functional.
- O Ten canisters of remote handled sludge and three drums of debris that were shoveled with the power manipulator remain in the cell for future processing.

9.0 POST D&D STATUS

The CPC will be converted into a storage area for vitrified High-Level Waste (HLW). The following work will be performed in the near future to support the conversion of the CPC into an HLW storage area:

- O A backflow damper will be placed on the CPC/GPC hatchway to prevent recontamination in the event of ventilation flow interruption.
- O Cell walls and ceiling will be painted with white Amerontm 400 epoxy paint using remote controlled painting equipment. This effort will reduce smearable contamination levels low enough for storage of HLW.
- O In-cell lighting will be replaced.
- O The shield window inside gasket flange will be retorqued remotely to stop oil leakage into the cell.
- O The EDR/CPC tunnel will be decontaminated using high-pressure water.

FIGURE 11.0 VIEW INTO CPC THROUGH THE NORTH SHIELD WINDOW
AFTER D&D

- O The cranes and power manipulator will be repaired.
- O New sump jetting jumpers and level probes will be installed.
- O The floor will be leveled using sand or gravel and then covered with plate to provide a storage surface for vitrified HLW.
- O New cell coolers will be installed to remove decay heat from the HLW.
- O A radiation hardened video camera system will be installed to support HLW handling.
- O The EDR/CPC shield door will be modified such that no hinged rail sections are required between the two cells.

10.0 LESSONS LEARNED

1. Tool power cabling and hoses were one of the biggest hindrances to work. A cable and hose handling system could have saved many manned entries into the CCR and the EDR to repair broken cables and hoses. A cable carrier system is under evaluation for use in other remote cell decontamination and decommissioning work at West Valley.
2. A decon pass prior to equipment removal would have reduced exposure during waste handling and decreased the contamination control concerns significantly. Sampling of high pH decon solutions which had come in contact with fissile materials indicates there is no criticality concern as long as slab geometries are maintained until the solids have settled.
3. An on-bridge video system would be extremely helpful during remote decontamination and decommissioning work.
4. A mock-up electromechanical manipulator that would allow testing of all manipulator held tools could help to minimize rework of equipment in contaminated areas, thereby reducing exposure and saving schedule time.
5. An abrasive saw has proven to be a useful manipulator held tool.
6. The addition of one set of master-slave manipulators could have saved a significant amount of time and exposure to perform tasks that the electromechanical manipulator could not perform such as replacement of saw blades.
7. A transfer port for small equipment would also reduce manned entry requirements.
- 8.0 Development work is needed on remote vacuuming systems.
- 9.0 High-pressure water cutting and decontamination equipment has proven to be very helpful.
- 10.0 Outside storage of waste packages exceeding 1 R/hr must be evaluated for sky shine potential and adequate measures must be preplanned to keep storage area dose rates to acceptable levels.

11.0 ACKNOWLEDGMENTS

This work could not have been performed without the help of the following individuals and groups:

D.J. Sawyer	Superintendent of D&D Operations
P. Vlad	D&D Operations Supervisor
D. Wiltse	D&D Operations Supervisor
T. Russillio	D&D Operations Supervisor
D. Tharnish	Radiation Safety Supervisor
J.A. Sage	Schedule and Cost Engineer
The entire D&D Operations Work Crew	
The entire Radiation Safety Work Crew	
The entire Maintenance Department	
The entire Plant Systems Operations Department	

12.0 REFERENCES

- 1) Meigs, R.A.: Initial Decontamination of the Equipment Decontamination Room at the West Valley Demonstration Project, December 1985: DOE/NE/44139-2(DE86010128).
- 2) Phillips, E.C. and Golden, M.P.: Decontamination and Renovation of the Master/Slave Manipulator Repair Shop and the Chemical Crane Room at the West Valley Demonstration Project, January 1986: DOE/NE/44139-4 (DE860101531).
- 3) Bridenbaker, W.A. and Clemons, L.: Decontamination of the Scrap Removal Room at the West Valley Demonstration Project, February 1987: DOE/NE/44139-33 Distribution Category UC-70.
- 4) West Valley Demonstration Project Safety Analysis Report, Volume II, Existing Plant and Operations; Table B.8.2-2, "Radionuclide Inventory in Reprocessed Spent Fuel" (1985).