ANL-95/32

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Equipment Decontamination: A Brief Survey of the DOE Complex

by C. Conner, D. B. Chamberlain, L. Chen, and G. F. Vandegrift

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March 1995

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EQUIPMENT DECONTAMINATION: A BRIEF SURVEY OF THE DOE COMPLEX

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ABSTRACT

Deactivation at DOE facilities has left a tremendous amount of contaminated equipment behind. In-situ methods are needed to decontaminate the interiors of the equipment sufficiently to allow either free release or land disposal. A brief survey was completed of the DOE complex on their needs for equipment decontamination with in-situ technology to determine (1) the types of contamination problems within the DOE complex, (2) decontamination processes that are being used or are being developed within the DOE, and (3) the methods that are available to dispose of spent decontamination solutions. In addition, potential sites for testing decontamination methods were located. Based on the information obtained from these surveys, the Rocky Flats Plant and the Idaho National Engineering Laboratory appear to be best suited to complete the initial testing of the decontamination processes.

I. INTRODUCTION

A program was funded in FY 1995 at Westinghouse Hanford Company (WHC) by EM-50 to develop a technology for in-situ decontamination of the interior surfaces of nuclear facility equipment (TTP RL452003). This project is part of EM-50's Decontamination and Decommissioning (D&D) focus area. In this program, technologies will be evaluated to (1) reduce equipment contamination levels (preferably below detection limits) to allow levels that would either free release of the equipment or land disposal, (2) minimize residues generated by the decontamination process, and (3) generate residues that are compatible with existing disposal technologies.

In support of this program, WHC funded Argonne National Laboratory (ANL) through Inter-DOE Work Order No. M5CHE01. Tasks being completed by ANL include the following three surveys: (1) decontamination requirements of the DOE complex, (2) applicable decontamination processes, and (3) plutonium liquids handling in the DOE complex. Other tasks include laboratory and engineering evaluations of selected decontamination processes and waste disposal issues. Some of the laboratory evaluations will be completed by the University of Illinois Nuclear Engineering Department. This report is the result of the survey of the DOE complex on decontamination requirements. Two related reports contain the results of the other DOE survey on plutonium liquids handling [CONNER] and the literature survey on decontamination methods [CHEN].

Deactivation at DOE facilities has left a tremendous amount of contaminated equipment behind. Contaminants are both radiological and hazardous; levels range from barely detectable to those requiring remote handling. A method is needed to decontaminate the interiors of the equipment sufficiently to allow either free release or land disposal. The decontamination method should also require only minimal system reactivation and be easily interfaced with existing systems. In addition, wastes generated from decontaminating the equipment should be minimized and must be compatible with future waste disposal activities (e.g., grout, vitrification).

A survey was completed on the types of contamination problems that exist within the DOE Complex, the decontamination process that are being used or are being developed within the DOE, and the methods that are available to dispose of spent decontamination solutions. A sample copy of this survey and cover letter are provided in Appendix B. In addition, this survey located suitable sites for testing prototype systems. Initially, we are looking for fairly simple systems (e.g., pipe runs, tanks with limited internals). This survey will focus the direction of laboratory work on specific decontamination processes and problem areas identified in the survey. Initial tests will be completed using standardized coupons to evaluate decontamination solutions. Once the most promising decontamination solutions have been identified, engineering aspects (e.g., application and removal, geometry) will be evaluated.

II. SELECTION CRITERIA FOR PROTOTYPE TEST SITES

Several criteria need to be considered when selecting potential sites for testing decontamination methods. The first criterion would be appropriateness; that is, the test site must have equipment that needs to be decontaminated. The initial testing of the decontamination method will be broken down into three different stages. The first will be actinide decontamination of a simple contact-handled system. A simple system would be a short pipe run (20-40 ft, 6.1-12.2 m) or a small tank (<50 gal, 189 L) with limited internals. In addition, it should be fairly easy to make external connections to the pipe or tank, and the facility should be able to handle the waste effluents. The second stage will be fission product decontamination of a simple remote-handled system. Finally, the third stage would be on a slightly larger remote-handled system (e.g., <500 gal, 1892 L, tank).

The second criterion is willingness to participate in the demonstration. This criterion is a little more subjective, but it can be somewhat quantified by the detail of the information provided in the survey. A non-quantifiable measure was also made during the survey process as each of the individual respondents was contacted. During this process a subjective measure was made for each respondent's willingness to cooperate.

The final criterion is the ability to complete the task. This criterion translates into a site's ability to actually supply appropriate personnel, have proper regulatory documentation, etc. With the current downsizing in the DOE complex, fewer people are available to do jobs that are not part of day-to-day operations. In addition, many highly experienced employees are retiring, which may make finding knowledgeable personnel difficult.

III. CONCLUSIONS AND RECOMMENDATIONS

In general, the sites surveyed need two different types of decontamination. The first is the decontamination of remote-handled systems from fission products. The activity in these systems does not necessarily need to be reduced to background, but it does need to be reduced to the point where contact cleaning can be done. However, this will require cleaning the surrounding cell area and the outside of the equipment as well. The surrounding cell area and equipment exteriors are outside the scope of this study and are being investigated by others.

The second type of decontamination needed is the decontamination of contact-handled systems from actinides, primarily uranium and plutonium. These systems handled mostly nitrate solutions in which the uranium or plutonium had been separated from fission products.

Most systems used in these operations are constructed of type 304L or type 347 stainless steel; however, some systems have more exotic materials (e.g., Hastelloy and titanium). Decontamination of these systems in the past has mostly been done using nitric acid and/or a combination of chemicals that includes nitric acid.

Based on the information obtained from these surveys, Rocky Flats Plant appears to be best suited for completing the first-stage testing, actinide decontamination of a simple contact-handled system. They have some fairly simple systems (several small tanks) contaminated with plutonium, and they seem willing to cooperate. For second- and third-stage testing, decontamination of simple and slightly more complex remote-handled systems, the Idaho National Engineering Laboratory seems better qualified. They filled out a very detailed survey and were very helpful during the entire survey process. However, as final design and testing of the decontamination method proceeds, more in-depth contact and cooperation will be needed with the test sites. In addition, specific details of the testing need to be determined.

IV. RESULTS

Unfortunately, surveys are limited in nature because they depend on the people responding to the survey. Most of the survey responses were good, but some are more thorough than others. Attempts were made to contact all of the DOE sites likely to have significant problems with contaminated equipment. However, given time and money constraints, appropriate personnel to complete the survey could not always be reached. In addition, these surveys concentrated on research and development laboratories and fuel reprocessing sites, because they are more likely to have a need for aqueous decontamination technology. Also, a dedicated effort is currently being made on the decontamination and decommissioning of gaseous diffusion plants, so these sites were not contacted. Sites that were contacted are listed in Table 1. Each site has many more facilities, but given the time and financial constraints, they could not all be surveyed. Complete responses, where applicable, to each survey listed in Table 1 are given in Appendix A.

A. Argonne National Laboratory - East

Argonne does not have any major facilities that are contaminated; therefore, most of their D&D efforts will be geared toward size reduction and shipment off site. The current D&D project

Table 1. Sites Surveyed

Survey No.	Site	Area
95-3-22-1	ANL-E	D&D
95-3-15-1	Brookhaven	
95-2-15-1	Hanford	PUREX
95-2-13-1	Hanford	PFP
95-3-14-1	Hanford	T Plant
95-3-8-6	Fernald	
95-2-21-7	INEL	ICPP
95-2-15-2	LBL	
95-2-21-8	Livermore	Pu Facility
95-2-21-9	Livermore	Bldg. 251
95-3-6-1	LANL	TA-21
95-3-7-1	LANL	TA-55
95-3-9-1	ORNL	CMT
95-3-7-2	RFP	Bldg. 779
95-2-20-4	Sandia	Hot Cell Facility
95-2-20-5	Sandia	
95-2-22-2	SRS	D&D

at Argonne involves 10 surplus retention tanks, which are scheduled for size reduction, packaging, and disposal as waste in FY 1995. Dose rates of 10-20 mR/h have been measured through the sides of the tanks.

B. Brookhaven National Laboratory

No response received.

C. Hanford

1. PUREX Plant

The PUREX plant was described in three main parts: the processing canyon, solution make-up, and solution handling for concentrated plutonium nitrate. In the main processing canyon, which is 1000-ft long x 100-ft tall x 30-ft wide (305 m x 30 m x 9.1 m), irradiated fuel was dissolved, and the uranium and plutonium were separated from the fission products using solvent extraction columns. This canyon contains approximately 40 vessels and processing equipment, mostly made of type 304L stainless steel. In general, the vessels and equipment are in good shape; however, moving parts (e.g., pumps, valves, and agitators) tend to deteriorate when not in use. The systems were deactivated in the years 1990-1995. Solutions transfers were made using steam jets (which leave water heels in tanks) or turbine pumps, and remotely operable jumpers were used for routing.

High levels of β/γ radiation are found throughout the canyon, but they are low enough at the west end so that manned entry is possible. However, high levels of alpha contamination require multiple layers of anti-contamination clothing and supplied air respirators for entry [CONNER]. Associated with the main canyon are support galleries: pipe/operating, sample, and crane. Smear tests on most of the pipe/operating gallery showed no activity. The sample gallery is classed as a surface-contamination area and has hot spots that read up to 5 mR/h. The crane gallery requires respiratory protection.

The nonradioactive, aqueous-make-up unit (AMU) was used to prepare solutions used in the fuel processing operations. Solutions are prepared in this unit and then pumped to process tanks outside the main building. This unit is not contaminated with radioactivity.

Concentrated plutonium nitrate solutions were sampled, temporarily stored, and then converted to plutonium oxide or loaded into shipping containers. To convert plutonium nitrate to oxide, the plutonium was precipitated as an oxalate, filtered, and calcined. The plutonium oxide was then blended, packaged, and shipped out of the plant. All of these processes were done in gloveboxes located two levels below grade [CONNER]. Most of the equipment used in the glovebox was criticality safe and made of type 304L stainless steel. During deactivation most of this equipment was flushed with nitric acid and disassembled. It is no longer in operable condition.

The interiors of the gloveboxes contain high levels of alpha contamination. It is estimated that 300-500 g of plutonium remain dispersed throughout the gloveboxes. Most of this activity has been fixed with paint. However, dose rates range from 1 to 80 mR/h.

In general, the PUREX plant has been flushed with solutions used during fuel reprocessing. During deactivation, the systems are being flushed with water until the pH exceeds 2. Currently, the canyon vessels are flushed by hooking up several tanks into a loop and recirculating water through them. Samples are taken at the end of the flushing operation and tested for both cadmium and chromium. These two elements are of special concern at the PUREX plant because of the potential for generating mixed waste.

2. <u>Plutonium Finishing Plant</u>

The Plutonium Finishing Plant has five sub-grade concrete-lined cells that hold 4200-gal (16-m^3) tanks made of type 347 stainless steel. Steam jets are used to move liquid in and out of these tanks. One of these tanks, TK-D6, failed in the mid-1970s after being service for ~20 years. Each of the cells is 17 ft x17 ft x17 ft (5.2 m x 5.2 m x 5.2 m) and has two access manholes. The radiation field in the cells is estimated to be 10-50 mR/h.

3. <u>T Plant</u>

No response received.

D. <u>Fernald</u>

No response received.

E. <u>Idaho National Engineering Laboratory</u>

1. <u>Fluorinel</u>

The Fluorinel Dissolution Process (FDP) was used to dissolve zirconium-based fuels. The system consists of three type C-4 Hastelloy dissolvers, three type C-4 Hastelloy complexer vessels, and one type 304L stainless steel product transfer vessel. The dissolver vessels are jacketed with external sparge legs and have a unique inverted cone-shaped bottom. There is also approximately 14,500 ft (4920 m) of piping, approximately 35% of which is type C-4 Hastelloy. Connections in the facility are mostly welded or use three bolt flanges. Reprocessing at Fluorinel was discontinued in 1991, and the system is currently in standby status.

Because of cell radiation levels of 0.2-250 R/h, most maintenance was done remotely. There are both fixed manipulators at windows and a set of manipulators mounted on a traveling bridge. High maintenance items are mounted on jumpers, which are connected with three-bolt flanges.

Criticality was controlled using soluble nuclear poisons (cadmium and/or boron). However, the equipment has been flushed internally and contains no uranium or hazardous components restricted by the Resource Conservation and Recovery Act (RCRA). The cell also has a 100-gal (379-L) slab tank for a sump.

Current disposal of solid and liquid waste is done on-site. Liquid waste is sent to the process equipment waste (PEW) evaporator for volume reduction and is then calcined for storage in bins. Solid waste is removed from the cell in waste boxes or shielded drums. The cell off-gas goes through a prefilter and three different sets of HEPA filters before being discharged.

2. Buildings CPP-601 and CPP-640

The CPP-601 and CPP-640 buildings contained equipment for electrolytic dissolution of stainless steel-, zirconium-, and aluminum-clad fuels, solvent extraction, and denitration of uranium product. The CPP-601 building has two rows of shielded cells separated by an operating corridor. The majority of the equipment in these cells is either type 347 or type 304L stainless steel. However, there is some boron stainless steel used for criticality control. Also, the dissolver in the electrolytic cell is made of titanium. Numerous tanks (>100) are in this facility, most of them criticality controlled, as well as associated processing equipment (e.g., extraction columns, fluidized-bed denitrator, hexone distillation column, evaporators). Most of the equipment is fairly old. Operation started in the 1950s and 1960s and was discontinued in the 1990s.

Criticality is generally controlled by geometry using either slab or tube tanks. However, the electrolytic dissolver used gadolinium as a soluble nuclear poison. One of the cells also has boron glass Raschig rings on the floor to prevent criticality in case of leaks.

In general, all of the cells are highly contaminated and have high radiation fields. A number of chemicals have been used to decontaminate the equipment in the past, but most were some combination of TURCO 4502, oxalic acid, and nitric acid. Liquid waste was sent to the process equipment waste evaporator, and solids were disposed of on-site in boxes or shielded drums.

The respondent indicated that J-cell would be especially applicable for a demonstration site. J-cell contains four vessels and associated piping. It is still hooked up to the plant waste systems, and contamination levels are low enough to allow personnel to enter. Originally, a test in this cell was planned, using chemicals and a portable decontamination pad inside the cell, but funding was cut at the last moment.

3. Waste Calciner Facility

The waste calcination facility was used to calcine high level waste. It was operated from 1963 to 1981 and has been replaced by the new waste calciner facility. The calciner is a continuous fluidized bed that operated at 500°C by in-bed combustion of kerosene. Solids from the calciner were pneumatically transferred to waste bins. The system also had a three-stage silica absorber (to collect ruthenium from the off-gas), two waste hold tanks, a feed tank, an evaporator, and a blend tank. Most of this equipment is constructed of either type 347 or type 304L stainless steel. Criticality was not a concern because of the low uranium levels. One option being considered for disposition of this facility is removing all of the loose items from the cells and then filling the cells with grout.

Dose rates in the calciner cell and silica-absorber cell range from ten to several hundred R/h. In the past, the calciner has been scrubbed with dolomite to remove calcine deposits, followed by a flush using hot 4-6M nitric acid/0.3M aluminum nitrate. Alternating acid and alkaline flushes have also been effective at decontaminating the calciner because the radionuclides are often bound to the surface by a combination of acid-soluble and alkali-soluble materials.

F. Lawrence Berkeley Laboratory

The respondent from Lawrence Berkeley Laboratory (LBL) did not think LBL could make a meaningful contribution to the survey.

G. Lawrence Livermore National Laboratory

1. Plutonium Facility

The respondent from the plutonium facility indicated that Lawrence Livermore would be doing their own decommissioning work.

2. Building 251

No response has been received.

H. Los Alamos National Laboratory

1. TA-21

The respondent indicated that TA-21 was not currently doing any decommissioning. Therefore, TA-21 did not have a need for decontamination and decommissioning activities.

2. TA-55

The respondent indicated that TA-55 was not currently doing any decommissioning. Therefore, TA-55 did not have a need for decontamination and decommissioning activities.

I. Oak Ridge National Laboratory - Chemical Technology Division

No response has been received.

J. Rocky Flats Plant - Building 779

The equipment, outlined in the response completed by RFP personnel, is contaminated primarily with plutonium. The three systems described are the process waste system, the acid leaching system, and the residue recovery system. The first system is used for the collection of acidic laboratory wastes, while the last two systems are for recovering plutonium. One criticality safe (pencil) stainless steel tank is associated with the process waste system. The acid leaching system and the residue recovery system together have five small stainless steel tanks in which criticality was controlled by limiting the amount of plutonium they contained. Some of the biggest concerns that RFP has in decontaminating this equipment include criticality safety, generation of secondary wastes, and generation of RCRA waste.

K. Sandia National Laboratories

1. Hot Cell Facility

The Hot Cell Facility (HCF) consists of a canyon with three steel confinement boxes (SCBs) and an attached glovebox laboratory. The facility is used mainly for the metallographic examination of highly radioactive samples. Work is done in the SCBs to reduce contamination in the actual canyon. Various equipment is kept in the SCBs for sectioning and polishing of samples for analysis (e.g., band saw, mill, lapidary wheel). One of the SCBs contains equipment for radiochemical analysis of samples (e.g., pipetors, spectrometer, pH meter). Transfers between the SCBs are done using 18-in. (0.5 m) pass-through ports.

Attached to the canyon is a glovebox laboratory that contains 11 gloveboxes. Two of the gloveboxes are located behind a steel shield wall and are accessible using remote manipulators [SASMOR]. The gloveboxes also contain equipment for conducting metallographic analysis (e.g., microscopes, polishing equipment).

In addition to the metallographic studies, a small project was conducted in the HCF to determine the source term for fission products in reactor safety studies. These activities involved only small amounts of aqueous solutions (10-100 mL) and some organics (<50 mL), mostly alcohols.

The SCBs and shielded gloveboxes are highly contaminated by fission products. Contamination levels range from 10,000 to 100,000 dpm (β/γ) in the remainder of the canyon and from 10,000 to 40,000 dpm (β/γ) in the unshielded gloveboxes. Criticality is controlled administratively by setting mass limits. However, there is some uranium contamination throughout the SCBs and gloveboxes.

The SCBs, canyon, and gloveboxes each have a dedicated HEPA filtration system that exhausts into a main stack. The main stack has a radiation monitor for radioactive particulate and gases. No liquid effluents are permitted from the HCF. However, solid waste can be disposed of.

2. Sandia National Laboratories - Miscellaneous

The respondent indicated that Sandia was not currently doing any decommissioning. Therefore, Sandia did not have a need for decontamination and decommissioning activities.

L. Savannah River Site - High Level Waste Tank Farm

The equipment described in the response is the (1H and 2H) high level waste (HLW) evaporators and the HLW tanks interconnecting piping. The evaporators are located in shielded cells. Each evaporator has a 2000-gal (7570-L) capacity and is 8 ft (2.4 m) in diameter and 15 ft (4.6 m) high with an internal steam bundle. These evaporators are made from type 304 stainless steel. Hanford connectors are used to link the evaporators to the rest of the systems, and a steam lift was used as the motive force for solution transfer. These units were in service for 1-5 years before being shut down for the last 1-3 years. They are highly contaminated (5-200 R/h), with the main gamma contribution from ^{137}Cs.

REFERENCES

CONNER

C. Conner et al., *Plutonium Bearing Solution Treatment: A Brief Survey of the DOE Complex*, Argonne National Laboratory Report ANL-95/32, in preparation.

CHEN

L. Chen et al., Argonne National Laboratory, unpublished information, 1996.

SASMOR

D. J. Sasmor et al., *Sandia Hot Cell Facility (HCF) Safety Analysis Report*, Sandia National Laboratories Report SAND87-2480 (1987).

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The authors would like to acknowledge George P. Miller, Westinghouse Hanford Company, for his support and advice in the preparation of these reports.

APPENDIX A.

SURVEY RESPONSES

Survey # 95-3-22-1

Argonne National Laboratory - East

Survey follows.

US DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY
PART II - ELEMENT DEFINITION

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<tr><td>11. BUDGET AND REPORTING NUMBER

EX-20-10-40-2</td><td colspan="3"></td></tr>
</table>

12. ELEMENT TASK DESCRIPTION

Site Description:

The Building 310 basement area contains numerous utility and service components. In the early years of the Laboratory's operations, there was a need in this area for a large storage capacity of liquid, low-level radioactive waste from operations in both Building 310 and Building 306. These wastes were directed to retention tanks which were located in the basement area or sub-basement areas of the main research facilities at Building 310. There are 10 of these retention tanks which require D&D as a result of there being no longer a need for them.

The tanks are in less than ideal physical condition. Some have liquids in them; others appear to be empty. The working space in the area is very limited and will require close working coordination with all involved parties when the hands-on D&D work is performed. Dose rates in the area around the tanks and through the sides of the tanks have been measured up into the 10-20 mR/h level.

The 10 surplus retention tanks will be emptied of any remaining liquids and/or sludge. The tanks will be size reduced, packaged, and shipped for disposal. The area/rooms where the tanks had been located will then be decontaminated, radiologically surveyed, and the area free released.

Contaminates and Sources:

The contaminants consist of mixed fission products and activation products as a result of the storage and processing of radioactive liquids.

Extent of Contamination:

The contamination is contained within tanks, piping, and components.

The program is currently estimating that the following wastes will be generated over the course of this project:

Contact-Handled Low Level Radioactive Waste	1,200 ft^3
Clean Landfill Waste and Scrap	100 ft^3

Remedial Strategy:

The remedial strategy to be utilized will require the disassembly, size reduction, packaging, and disposal of all radioactive materials associated with the facility. Upon completion of removal of the radioactive materials, the entire facility will be decontaminated to levels which will allow the release of the facility for unrestricted use for other laboratory programs.

Scope Elements:

17.1.2.2.3.1 Project Management/Support Operations

This control account involves the efforts required for the management and engineering functions required to support the project. These efforts include the preparation and management of project schedules and budgets, the preparation and submittal of funding requests, engineering and technical oversight of project activities, and reporting of project progress and status to DOE.

17.1.2.2.3.2 Surveillance and Maintenance

This control account defines the required effort to perform required surveillance and maintenance activities. These activities include radiological and environmental monitoring, and the performance of the preventive and corrective maintenance necessary to maintain the facility's support systems and equipment.

17.1.2.2.3.3 Initial Survey and Preparations

This element consists of the following tasks:

1. Complete preliminary survey.
2. Decontaminate/remove fixtures draining into piping runs.
3. Remove piping leading to and from retention tanks.
4. Remove pipe hangers in tank rooms.
5. Remove gauges mounted on wall by Tanks 6 and 7.

17.1.2.2.3.4 Tank and Drain Line Removal

This element consists of the following tasks:

1. Remove ten 3300-gal retention tanks.
2. Remove tank support stands.
3. Remove drain lines from Building 306 and seal tunnel.

17.1.2.2.3.5 Decontamination & Restoration

This element consists of the following tasks:

1. Remove ductwork over catwalk and survey ductwork outside of tank rooms.
2. Remove catwalk grating running along tank room walls.
3. Remove ladder rungs.
4. Decontaminate/remove light fixtures, PA system, and electrical conduit.
5. Decontaminate all floor, wall, and ceiling surfaces.

17.1.2.2.3.6 Project Closeout

This control account provides the efforts necessary to complete all requisite radiological survey and documentation criteria for the unrestricted release of the remaining structures and to provide all necessary final reports on the project completion.

Deliverables: Upon completion of this project the Bldg. 310 facility will be free of all radioactive materials and available for occupancy by other ANL programs on an unrestricted basis. The following reports will be issued to provide status of the project as it proceeds to completion:

1. Initial Survey & Preparations Completion Notification
2. Tank & Drain Line Removal Completion Notification
3. Decontamination & Restoration Completion Notification
4. Bldg. 310 Retention Tank D&D Project Completion Report/Closeout Package

Assumptions:

1. No regulatory changes are encountered.

2. DOE Order 5820.2A will be regulatory driver for the project.

3. Radioactive waste disposal is at the DOE Hanford site.

4. Selected D&D technologies will perform satisfactorily.

References:

"Decommissioning Cost Estimate for the Bldg. 310 Surplus Retention Tanks," September 1992.

Budget and Reporting - Numbers:

EX-20-10-40-2

Survey # 95-3-15-1

Brookhaven National Laboratory

No response has been received.

Survey # 95-2-15-1

Hanford Site - PUREX Plant

In addition to the completed survey the following information was obtained in a phone conversation with the respondent.

PUREX has flushed with the solutions used in the plant and left in columns, etc. (1991?). Basically just dilute nitric left. During deactivation flushing with H_2O to raise pH>2. Cadmium and chromium are big issues also because of RCRA. Cadmium used as a poison. To flush canyon vessels hooked up in a loop and solution pumped through them. Sample taken at end looking mainly for Cd and Cr.

EM-50 - D&D Focus Area Survey
In-Situ Chemical Decontamination

Site: Hanford **Date: 3/23/95**

Facility: PUREX Plant

Questions:

1. What are the major aqueous processes/systems associated with this facility?

	Name
Process/ System 1	The main canyon area contains tanks and solvent extraction columns for separating special nuclear materials from spent nuclear fuel.
Process/ System 2	Non-radioactive, aqueous make-up unit (AMU) where chemicals were mixed and sampled prior to transfer to the canyon processing area.
Process/ System 3	Gloveboxes which contain piping and vessels used for handling concentrated plutonium nitrate solutions.

2. Describe each process/system in general. What type of containment is there for each system (cell, canyon, glovebox, no containment)? How is maintenance performed on each system?

	Description
Process/ System 1	The canyon is roughly 1000' long, 100' tall, and 30' wide. The PUREX (Plutonium Uranium Extraction) process essentially flows from east to west with fuel being dissolved in nitric acid at the far east end. A continuous solvent (NPH/TBP) extraction process separates the special nuclear materials. Maintenance is performed primarily by remote crane.
Process/ System 2	Simple chemical make-up and sampling operations unit. There is no containment and maintenance is performed hands-on.
Process/ System 3	Concentrated plutonium nitrate solutions were sampled, temporarily stored, and then converted to plutonium oxide or loaded into shipping containers. Plutonium nitrate was converted to plutonium oxide by precipitating the plutonium as an oxalate, filtering off the precipitate, and calcining the precipitate. The plutonium oxide was then blended and packaged into sealed containers for shipment out of the plant. The processing equipment was contained in gloveboxes and maintenance was done through the gloveports.

3. What is the quantity and present condition of equipment?

	How much of each type of equipment is there (i.e. pipes, tanks)? Provide unit of measurement?	What is the current condition of the equipment? How long was it used? How long has it been deactivated?	Are there any solids or difficult-to-remove scales present?
Process/ System 1	22 - 5,000 gallon tanks 3 - 15,000 gallon tanks 3 - 4,000 gallon tanks 7 - 1,200 - 2,100 gallon tanks 14 - SX Columns 3 - 5,000 gallon Dissolvers 5 - large concentrators	The canyon vessels are nearly all type 304L stainless steel and in good condition. Pumps, agitators, remote valves, deteriorate when not used. The equipment was deactivated from 1990-1995.	There are 3 48"-bowl centrifuges which have a layer of Zr oxide solids on the inside of the bowl. The 3 dissolvers contain ~6" of Zr fuel cladding.
Process/ System 2	[No response provided.]		
Process/ System 3		The equipment that will be left in the gloveboxes will not be in operable condition. Equipment is mostly 304L SS, but pumps, valves, piping will be removed.	The equipment will be painted for contamination control.

4. Are any there any solid or liquid heels present in the system?

	What kind of system heels if any are present?	How much?	Can they be removed?
Process/ System 1	Water heels remain in many canyon vessels.	30-50 gallons per vessel.	No, they are jet or pump heels in vessels that do not have bottom drains.
Process/ System 2	None.		
Process/ System 3	Nitric acid was used to flush the equipment that handled plutonium nitrate. There is residual plutonium oxalate and plutonium oxide in calcining equipment.	All of the liquids will be removed. However, an estimated 300-500g of plutonium solids will remain distributed in gloveboxes.	Residual plutonium solids will be fixed to the interior of gloveboxes.

5. Are there any criticality concerns with this facility?

	Critically safe/critically favorable	By geometry (e.g., slab tank, pencil tank)?	By poison? What kind? How is it applied (e.g., Raschig rings, boric acid)?
Process/ System 1	The canyon has many large-diameter tanks, but the plutonium will have been flushed out of the equipment.	There are annular vessels and small diameter columns with annular or slab disengaging sections which were used for concentrated plutonium solutions.	Annular dissolvers have a cadmium jacket, concrete neutron moderator in the center. Concrete neutron moderators are also installed in the center of two other annular tanks.
Process/ System 2	N/A		
Process/ System 3	Most of the equipment was installed in the gloveboxes to be critically safe. However, plutonium accumulation outside equipment is a criticality concern.	Pencil tanks were used to handle plutonium nitrate solutions in the gloveboxes. The calciner through cross-section was only 3.5" in diameter. There are also annular blenders.	Plutonium oxide product blenders contained a center cone of boron carbide as a fixed neutron poison.

6. What chemicals were used in the system? Include the following if known: heavy metals, organics, reactive materials, pyrophorics, volatiles, toxics.

	What chemicals were used? What were their typical concentrations?
Process/ System 1	10$\underline{M}$ HNO_3 19$\underline{M}$ $NaOH$ 11$\underline{M}$ NH_4F 1$\underline{M}$ NH_4NO_3 7$\underline{M}$ KOH 1.7$\underline{M}$ $Al(NO_3)_3$ 30% Tributyl phosphate (TBP) in normal paraffinic hydrocarbon (NPH) 11$\underline{M}$ N_2H_4 1.5$\underline{M}$ $NH_3OH\text{-}NO_3$ 2.5$\underline{M}$ $NaNO_3$
Process/ System 2	Same as above
Process/ System 3	3$\underline{M}$ H_2O_2 0.9$\underline{M}$ Oxalic acid 1.2$\underline{M}$ HNO_3 12$\underline{M}$ HNO_3 1.7$\underline{M}$ $Al(NO_3)_3$ 0.3$\underline{M}$ HF

7. What are the contamination levels in the equipment?

	What kind (alpha, beta, gamma) and how much contamination is present inside the system? What is the dose rate from the equipment?	What methods have been used to decontaminate this equipment in the past? How effective were they?	What are the contamination levels of the surrounding area (alpha, beta, gamma, dose rate)?
Process/ System 1	There are high levels of beta-gamma radiation in most of the canyon. The far west end also contains high levels of alpha contamination, but beta-gamma is low enough to permit manned entry.	Flushing with water, HNO_3, oxalic acid have been used to decontaminate. Contact maintenance can usually be done on jumpers after they have been moved to a hot shop.	Most of the pipe/operating gallery has no smearable activity. The sample gallery is a surface contamination area with hot spots up to 5 mR/h at some samplers. The crane gallery requires respiratory protection.
Process/ System 2	Background.	N/A.	Background.
Process/ System 3	The interior of the gloveboxes contain high levels of alpha contamination that has been mostly fixed with paint. The dose rate at the gloveports ranges from 1-80 mR/h.	Tanks and piping were rinsed with nitric acid. Most of the tubing, valves, and pumps have been removed from the inside of the gloveboxes during the deactivation. The interiors of the glovebox surfaces have been wiped with damp rags.	The rooms that house the gloveboxes are surface contamination areas but respirators are normally not needed.

8. What are the materials of construction?

	What are the predominant materials of construction for the equipment?	Are there any seal/packing/lining materials? What are they made of?
Process/ System 1	Most of the canyon piping and vessels are made of type 304L stainless steel. Most dunnage, supporting structures, are made of carbon steel.	Jumper gaskets are TFE and the pump bushings are graphite.
Process/ System 2	Type 304L stainless steel tanks and piping	
Process/ System 3	The gloveboxes and most processing equipment are made of type 304L stainless steel. One calciner is made of titanium and there are several glass tanks.	The gloveboxes have glass windows with rubber gaskets.

9. What concerns are there with interfacing?

	How easy is it to interface and/or restart the equipment? Have external connections been made to this system before?	How are the processes/systems connected (e.g., flange, thread, weld, special connections)?
Process/ System 1	External connections were used to transfer product and waste out of the canyon. However, these routes will be blanked during deactivation.	Most connections are welded pipe with remotely installed jumpers between canyon vessels and from the pipe trench to the vessels. The pipe jumpers have crane-operated PUREX connectors.
Process/ System 2	The makeup tanks are connected by piping to bulk chemical storage tanks outside the main building.	There are flanged connections at valves and tanks.
Process/ System 3	Most of the process equipment inside the gloveboxes has been disassembled or removed. Restarting the remaining equipment/off-gas system would be difficult. The glovebox vent ducting leading out of building will be filled with a rigid foam.	The process lines leading to the gloveboxes are mostly butt weld connections with a few flanged valves. The glovebox vent ducting has flanged connections.

10. Are there any unique features for these processes/systems (e.g., freeze plugs, valve gallery, Hanford connectors, three-bolt flanges, flat bottom tanks, peculiar pumps, inert atmosphere)?

	Unique Features
Process/ System 1	Cold chemicals were added to canyon tanks from a pipe and operating gallery located beside the canyon. A hot pipe trench is located on the other side of the canyon for transferring radioactive solution between canyon vessels. Jumpers with PUREX connectors were used to connect canyon vessels to wall penetrations from both the pipe/operating gallery and hot pipe trench. Turbine pumps and steam jets were used for canyon transfers. The dissolvers have flat bottoms with grating to support fuel.
Process/ System 2	N/A
Process/ System 3	Most glovebox lines were made of tubing with compressing fittings (Swagelok™). The tubing will be removed during deactivation. Some flanged piping was used inside the gloveboxes, most of this will be left in place. The pumps and valves will be removed from most gloveboxes.

11. What are your current disposal capabilities?

HEPA filter exhaust

	HEPA System 1
Location. Service area.	Only the canyon exhaust HEPAs/blowers will remain in service. The building ventilation will be cascaded and exhausted through the canyon HEPAs.
Maximum flow rate.	35,000 SCFM. However, if the second exhaust blower is returned to service, can achieve 70,000 SCFM.
Condition.	The HEPA filtration system was installed in early 1980s. The blowers are old but will have new electrical supply control system.
What can be discharged to the system (e.g., NO_x, H_2O)?	If inlet air is heated, ~5 gpm water could be evaporated and released through the HEPA filters.
Can connections to the ventilation system be made?	[No response provided.]

Solid/Liquid Disposal

	Disposal System 1	Disposal System 2	Disposal System 3
Location. Service area.	There is a solid waste handling facility within 10 miles.	No liquid effluents will remain. Therefore, liquid waste will have to be trucked 1-2 miles to treatment facility or transfer line built.	Temporary storage area for drums of TRU waste and mixed waste. Low level burial trenches.
What feeds are acceptable and what are the limits?	[No response provided.]		

12. Miscellaneous:

-What else should we know about your facility?

[No response provided.]

-What other information do you think would be helpful to this survey? Do you have any or know of any reports that would be valuable for this survey?

[No response provided.]

-What do you feel is the most pressing problem in your area that could be addressed by in-situ decontamination technology? Do you have any sites that might be suitable for potential demonstrations?

[No response provided.]

-Who else should we talk to?

[No response provided.]

-What other systems do you have?

[No response provided.]

Survey # 95-2-13-1

Hanford Site - Plutonium Finishing Plant Facility

The following survey was returned by the respondent, but when they returned it they indicated that they would complete response more thoroughly if they had time.

EM-50 - D&D Focus Area Survey
In-Situ Chemical Decontamination

Site: Hanford **Date: 2/22/95**

Facility: Plutonium Finishing Plant, 200 West Area

Questions:

1. What are the major aqueous processes/systems associated with this facility?

	Name
Process/ System 1	Radioactive mixed waste treatment and shipment. This activity supported PFP operation within the 241-Z facility as a means of shipping liquid waste to the Hanford tank farm system.

2. Describe each process/system in general. What type of containment is there for each system (cell, canyon, glovebox, no containment)? How is maintenance performed on each system?

	Description
Process/ System 1	The 241-Z facility consists of 5 sub-grade concrete-lined cells that hold ten-foot-diameter 4200-gal tanks. The tanks and cells are ventilated with HEPA filtration (2000-3000 SCFM). All tanks have interconnecting transfer piping (steam jet used as motive force). Each cell is 17'x17'x17' with 2 access manholes for maintenance, etc. A large door with overhead hoist is available within the covering building above the tank cells.

3. What is the quantity and present condition of equipment?

	How much of each type of equipment is there (i.e., pipes, tanks)? Provide unit of measurement?	What is the current condition of the equipment? How long was it used? How long has it been deactivated?	Are there any solids or difficult-to-remove scales present?
Process/ System 1	One tank, TK-D6, failed and is available for cleanup. The tank is 8'x10' in dia, holds 4200 gallons.	Tank TK-D6 failed in the mid-1970s. It was in service ~20 years before failing.	Potential for small amount of solids present in tank. Unsure if flushing took place after failure.

4. Are any there any solid or liquid heels present in the system?

	What kind of system heels if any are present?	How much?	Can they be removed?
Process/ System 1	Possible residues include: PuF_4, $Pu(OH)_4$, AlF_3, KF, KOH, NaOH	Unsure, but there is probably <400g Pu.	Doubtful.

5. Are there any criticality concerns with this facility?

	Critically safe / critically favorable	By geometry (e.g., slab tank, pencil tank)?	By poison? What kind? How is it applied (e.g., Raschig rings, boric acid)?
Process/ System 1	Tank TK-D6 is not critically safe. It had administrative limits set at <400g Pu.		

6. What chemicals were used in the system? Include the following if known: heavy metals, organics, reactive materials, pyrophorics, volatiles, toxics.

	What chemicals were used? What was there typical concentrations?
Process/ System 1	Chemicals used include: H_2O, HF, Cr, Ni, Fe, Am, Pu, NaOH, AlF_3, KOH, Na, tributyl phosphate (trace), CCl_4 (trace).

7. What are the contamination levels in the equipment?

	What kind (alpha, beta, gamma) and how much contamination is present inside the system? What is the dose rate from the equipment?	What methods have been used to decontaminate this equipment in the past? How effective were they?	What are the contamination levels of the surrounding area (alpha, beta, gamma, dose rate)?
Process/ System 1	Estimate radiation field to be 10-50 mR/h. There could potentially be up to 400g Pu inside tank interior but should be much less. Loose alpha activity is $>10^6$ DPM.	None.	Estimate radiation field to be 10-50 mR/h. Loose alpha activity is $>10^6$ DPM.

8. What are the materials of construction?

	What are the predominant materials of construction for the equipment?	Are there any seal / packing / lining materials? What are they made of?
Process/ System 1	Type 347 stainless steel.	None.

9. What concerns are there with interfacing?

	How easy is it to interface and/or restart the equipment? Have external connections been made to this system before?	How are the processes/systems connected (e.g., flange, thread, weld, special connections)?
Process/ System 1	Tank TK-D6 is isolated from PFP. Unaware of any other external connections	Bolted flanges on top of the tank in the cell.

10. Are there any unique features for these processes/systems (e.g., freeze plugs, valve gallery, Hanford connectors, three-bolt flanges, flat bottom tanks, peculiar pumps, inert atmosphere)?

	Unique Features
Process/ System 1	The tank has a sloped bottom with failure (hole) somewhere. Tank also has 7.5 hp agitator that could be removed.

11. What are your current disposal capabilities?

HEPA filter exhaust

	HEPA System 1
Location. Service area.	241-Z Building and tank TK-D6 Cell
Maximum flow rate.	3000 SCFM for 241-Z facility
Condition.	Operational.
What can be discharged to the system (e.g., NO_x, H_2O)?	Some chemical discharges allowed as long as they meet Washington state criteria. Small amounts of NO_x, H_2O are allowed.
Can connections to the ventilation system be made?	Connections can be made. However, the stack permit would need modification.

Solid/Liquid Disposal

	Disposal System 1
Location. Service area.	241-A
What feeds are acceptable and what are the limits?	Feeds can include: 2-10M NaOH containing <400g Pu, NO_3, NO_2, and iron solids.

12. Miscellaneous:

-What else should we know about your facility?

The 241-Z facility is RCRA permitted.

-What other information do you think would be helpful to this survey? Do you have any or know of any reports that would be valuable for this survey?

[No response provided.]

-What do you feel is the most pressing problem in your area that could be addressed by in situ decontamination technology? Do you have any sites that might be suitable for potential demonstrations?

[No response provided.]

-Who else should we talk to?

[No response provided.]

-What other systems do you have?

[No response provided.]

Survey # 95-3-14-1

Hanford Site - T Plant

No response was received.

Survey # 95-2-21-7

Idaho National Engineering Laboratory - Fluorinel, CPP-601 and CPP-640, and Waste Calciner Facility

Survey follows.

EM-50 - D&D Focus Area Survey
In-Situ Chemical Decontamination

Idaho National Engineering Laboratory (INEL)
Idaho Chemical Processing Plant (ICPP)

SYSTEM #1

1.0 Aqueous processes/systems associated with this facility:

The Fluorinel Dissolution Process (FDP) dissolved Zr-based fuels before discontinuation of fuel reprocessing.

2.0 Describe process/system in general. Include type of containment and how maintenance is performed.

The process had three dissolvers and complexing vessels for fuel dissolution. A product transfer vessel was used as a sampling/surge station in the process before solutions were sent to extraction systems. FDP is located in a shielded hot cell area, which has manned access and remote capabilities. Day-to-day maintenance was performed using manipulators, cranes, and viewing windows. If manned entry was required, cell decontamination was required to reduce fields.

3.0 Quantity and present condition of equipment. Include how much of each type of equipment there is, current condition of equipment, how long it was used, how long has it been deactivated, are there any solids or difficult to remove scales.

The equipment has been flushed internally (contains no uranium or RCRA hazardous components) and is in "standby" status. The outside of equipment has not been decontaminated. Reprocessing in FDP was started in about 1987 and discontinued in 1991 because DOE canceled this program. The equipment includes 3 dissolver vessels, 3 complexing vessels, and a product transfer vessels (PTV) (7 vessels total) with about 14,500 ft of interconnecting piping. Some solids are probably present in the complexer and PTV vessels.

4.0 Solid or liquid heels present in the system, type and quantity, and if they can be removed.

No liquid heels are in the system. A small amount of solids (AlF) is present in one of the complexer vessels.

5.0 Criticality concerns including critically safe/favorable equipment, by geometry or by poison (type and how applied).

Dissolutions were conducted with soluble nuclear poisons (Cd and boron). The cell sump transfers to a 100-gallon slab tank. Current status is all uranium has been removed and therefore no criticality potential.

6.0 Chemicals used in the system, including heavy, metals, organics, reactive materials, pyrophorics, volatiles, and toxics, and their typical chemical concentrations.

Dissolutions were completed with approximately 13M HF with $CdSO_4$. Complexing after dissolution was done with nitric acid and aluminum nitrate. The fuels contained uranium and fission products. Although the inside of the vessels have been verified clean of RCRA constituents, the outside and general cell area will still be contaminated with Cd.

7.0 Contamination levels in the equipment (alpha, beta, gamma) and how much in system, including dose rate. Methods used to decontaminate equipment in the past and how effective they were. Contamination levels of surrounding area (alpha, beta, gamma and dose rate).

Alpha, beta, and gamma are all present due to uranium and fission products. The current dose rate in the FDP cell is about 200 mR/h at the south end and 250 R/h at the north end where some spills/leaks are located. Decontamination has been done through flushing the vessel internals with hot aluminum nitrate. No external decontamination has been done although there is a spray wand for steam, water, and chemicals.

8.0 Materials of construction including any seal/packing/lining materials.

The dissolver and complexer vessels and associated equipment and piping are constructed of Hastelloy C-4. Other vessels are 304L SS. About 35% of the piping is Hastelloy.

9.0 Interfacing concerns including equipment restart and external connections to process. Process/system connections (flange, thread, weld, special connections).

Process is still connected to major plant waste systems. Connections are done mostly through flanged (three-bolt flanges) or welded connections.

10.0 Unique features (freeze plugs, valve gallery, Hanford connectors, three-bolt flanges, peculiar pumps, inert atmosphere).

For remote maintenance needs in cell, high maintenance items are on jumpers which are connected to vessel piping with three-bolt flanges. The Hastelloy dissolvers are jacketed and have external sparge legs for mixing and a unique inverted cone-shaped bottom. There is an in-cell bridge crane and auxiliary hoist as well as in-cell manipulators on a traveling bridge. There are 28 master-slave manipulators at 14 windows. Closed circuit TV is also installed.

11.0 Current disposal capabilities (gaseous, liquid, and solid).

The liquid waste goes to the Process Equipment Waste (PEW) Evaporator or directly to storage tanks depending on its concentration and constituents. The HLW is then calcined and stored onsite in bins. Currently a high level liquid waste evaporator is being installed which will allow concentration of waste solutions which could not be concentrated in the PEW evaporator.

The FDP cell has a cell off-gas system and a vessel off-gas system. Both were kept at a negative pressure to prevent spread of contamination. The cell off-gas is currently operating and goes through pre-filters and three different sets of HEPAs before being released. The vessel off-gas used to be scrubbed and sent through a demister and two stages of HEPA filters. Currently, the prefilters and filters have been removed and this system isolated. However, it would be possible to reactivate this system without a large expense.

Solids are removed in waste boxes or shielded drums (depending on activity) and currently disposed of at on site facilities. Currently, mixed waste is stored at the ICPP and has no permanent disposal plans. Mixed waste HEPA filters are currently stored but there are plans to process them through the Filter Leach Facility, which is located in the hot cell in the New Waste Calciner Decontamination Shop.

SYSTEM #2

1.0 Aqueous processes/systems associated with this facility:

CPP-601 and CPP-640 contain equipment for electrolytic dissolution of SS fuel, Zr and Al fuel dissolvers, solvent extraction columns for uranium purification, and a product denitrator.

2.0 Describe process/system in general. Include type of containment and how maintenance is performed.

The Main Process Building (CPP-601) consists of two rows of shielded cells separated by an operating corridor. Beneath the operating corridor are service and access corridors from which access to the processing cells is gained. Above the cells and operating corridor is a Process Makeup (PM) Area equipped with solution makeup tanks, storage tanks, pumps, addition funnels leading to vessels in the cells below, fuel-charging chutes, cell hatches, and miscellaneous equipment for operating, in-cell processes. Sampling corridors lie along the outside of the two rows of cells at the operating corridor level. Shielded caves equipped with recirculating samplers are located along these corridors for sampling the contents of various process vessels in the cells.

3.0 Quantity and present condition of equipment. Include how much of each type of equipment there is, current condition of equipment, how long it was used, how long has it been deactivated, are there any solids or difficult to remove scales.

In general, all equipment is scheduled for removal of uranium and flushing to remove RCRA components. No further mission for the equipment in this area is currently defined.

Electrolytic	Equipment includes dissolver, surge tank, cooler and associated equipment. A PaR manipulator and electric hoist on overhead rails and two master-slave manipulators (adjacent to viewing window) are also included. Silica cell rectifier provided power. Solids and sludges may be present. Operated 1973-1981.
N-cell	Contains first cycle product storage (surge prior to second extraction cycle). 48 critically safe storage tanks for uranyl nitrate solution. Operated 1950s-1994.
J-cell	Process solution salvage vessels for any waste solution that may contain U. Contains 4 storage tanks with grids of boron-SS plates inside, an evaporator, manifold piping, and off-gas condensers. Operated 1960s-1984.
P-, Q-, & S-cells	Contain second and third extraction cycles (third cycle was usually by-passed). Equipment includes Clarkson feeder (constant level feed reservoir), two extraction columns (paced with SS Raschig rings), two stripping columns, a thermosyphon evaporator and associated equipment. Operated 1950s-1994.
Z-cell	Product solution storage contains 9 critically safe tube tanks and 2 pumps. Operated 1960s-1995.
Product Denitrator	Contains fluidized bed, a collection vessel, off-gas system, and glovebox. Operated 1970s-1994.
K-cell	Solvent cleanup contains hexone distillation column (100 bubble cap trays, in column over a horizontal reboiler) with associated condenser and phase separator, a steam distillation column which is packed with SS Raschig rings for kerosene and TBP-hydrocarbon cleanup with associated equipment (condenser, storage tank, etc.). Operated 1960s-1994.
U- and Y-cells	Second and Third cycle raffinate collection incudes 24 critically-safe storage tanks arranged in 3 banks and 2 batch evaporators and

condensers in U-cell and a batch evaporator, condenser, waste dilution tank, and 16 critically-safe storage tanks (8 for organic and 8 for aqueous). Operated 1950s-1994.

W-cell	Hexone Raffinate collection cell which contains a large solvent collection tank and 24 critically safe storage tanks arranged in 3 banks. Operated 1960s-1994.

4.0 Solid or liquid heels present in the system, type and quantity and if they can be removed.

Plans currently being pursued is the flushing of all systems to remove U and RCRA hazardous components. The liquids can be removed.

5.0 Criticality concerns including critically safe/favorable equipment, by geometry or by poison (type and how applied).

Electrolytic	Used gadolinium as a soluble nuclear poison in the nitric acid to maintain criticality safety.
N-cell	Criticality safety maintain by geometry with tube tanks. Floor of cell is covered with boron-glass Raschig rings as a nuclear poison in case of leaks.
J-cell	Tanks contain borated SS plates to maintain criticality safety.
P-, Q-, & S-cells	Most equipment critically safe by geometry.
Z-cell	Tanks are critically safe by geometry.
Product Denitrator	Critically safe by geometry.
K-cell	Critically safe by geometry.
U- and Y-cells	Critically safe by geometry.
W-cell	Critically safe by geometry.

6.0 Chemicals used in the system including heavy, metals, organics, reactive materials, pyrophorics, volatiles, toxics, and typical chemical concentrations.

Electrolytic	Nitric acid, gadolinium oxide, dissolved SS fuel, fission products.
N-cell	Uranyl nitrate solution, fission products, neptunium, plutonium, trace organic solvent degradation products and solids.

J-cell	Uranyl nitrate solution, nitric acid, complexed HF, hexone, kerosene, TBP-hydrocarbon.
P-, Q-, & S-cells	Uranyl nitrate solution fission products, hexone, $Al(NO_3)_3$, NH_4OH, $Fe(NH_2SO_3)_2$, HNO_3.
Z-cell	Uranyl nitrate with virtually all fission products and transuranics removed.
Product Denitrator	Granular UO_3.
K-cell	Hexone, kerosene, TBP-hydrocarbon, steam, caustic (NaOH), traces of fission products and uranyl nitrate, and also traces of solvent degradation products, U, Np, and Pu.
U- and Y-cells	Aqueous raffinate contained $Fe(NH_2SO_3)_2$, acid deficient $Al(NO_3)_3$, Np, Pu, hexone and fission products. Hydroxylamine sulfate may also have been added at some time.
W-cell	Hexone solvent with small amount of uranium ($<5x10^{-3}$ g/L) and traces of fission products, neptunium, plutonium, acid-deficient $Al(NO_3)_3$, and $Fe(NH_2SO_3)_2$.

7.0 Contamination levels in the equipment (alpha, beta, gamma) and how much in system, including dose rate. Methods used to decontaminate equipment in the past and how effective they were. Contamination levels of surrounding area (alpha, beta, gamma and dose rate).

Electrolytic	Mostly alpha present. Decontamination in past done with water sprays, heated 3<u>M</u> nitric acid, heated 6% NaOH/2% tartaric, heated 6% TURCO 4502 (alkaline permanganate)/10% oxalic/6<u>M</u> nitric (in succession). High contamination/high radiation.
N-cell	Gross beta 100 µCi/mL to 300 µCi/mL. Past decons with 6<u>M</u> HNO_3 followed by 10% oxalic, or 8% TURCO 4502/5% oxalic/3% HNO_3 (water rinses between chemicals, all are heated and sparged). High contamination/high radiation.
J-cell	Past decons with hot water, 3-6<u>M</u> HNO_3, 8% TURCO 4502/5% oxalic/3<u>M</u> HNO_3, (water rinses between chemicals all are heated and sparged). High contamination/high radiation.

P-, Q-, & S-cells Gross beta in P-cell 100-300 µCi/mL. Q- & S-cells < 10 µCi/mL. Past decons by steaming, 6% NaOH/2% tartaric followed by water flush. High contamination/high radiation.

Z-cell Uranium alpha activity. Past decontaminations with 3-6M HNO_3, and water (heated and sparged). High contamination/high radiation.

Product Denitrator

Uranium alpha activity. Manned access. Unit is not in shielded area.

K-cell Contamination levels in the vessels which handle the distilled hexone should be low enough so only rinsing is necessary. The dirty kerosene will have fission product activity on the order of 7000 d/s/mL and the waste TBP-hydrocarbon solvent may be as high as $2x10^5$ d/s/mL. Beta level in the distilled solvent is generally <0.1 µCi/mL and the Pu concentration is generally <3 µg/L. In past decons of the hexone system, all hexone was assumed to be previously removed. Internal decon was done with hot 6% NaOH / 2% tartaric acid treatments. If not effective, used 3M HNO_3, 0.9M oxalic acid, or a sequence of 8% TURCO 4502, 0.9M oxalic acid and 3M HNO_3. Don't use >3M HNO_3, because higher concentrations can form explosive mixtures with hexone. Decon of waste solvent stripping system started with flushes of 10% caustic solution, water, 3M HNO_3, and water. If drain line was plugged with organic crud, it was heated from the outside with a steam lance to soften the plug; hydrostatic pressure forced the plug through the line. If further decon needed, TURCO 4502/water/oxalic acid/nitric acid used followed by a 13M nitric acid treatment at boiling for 8 hours to remove plutonium deposits. High contamination/high radiation.

U- and Y-cells The gross beta activity in the aqueous raffinate entering U-cell is typically 20-60 µCi/mL. The gross beta activity in the aqueous raffinate entering Y-cell is generally less that 5 µCi/mL. Internal decon done with treatments of hot water and 3M nitric acid (again using <3M to prevent forming explosive mixtures). If needed, hot 10% oxalic acid was used to remove iron-bearing solids followed by a 3M nitric acid flush. If further decon needed, used one or two sequences of TURCO 4502/water/5% oxalic/3M nitric. High contamination/high radiation.

W-cell Decon with hot water and 6% NaOH/2% tartaric acid to remove residual hexone, water-soluble deposits, and organic deposits. Follow with 10% oxalic acid to dissolve iron-bearing solids deposits, then treat with 3M nitric acid. If needed, used one or two sequences of

8% TURCO 4502, water, 5% oxalic acid and 3M HNO_3. High contamination/high radiation.

8.0 Materials of construction including any seal/packing/lining materials.

Electrolytic	Titanium dissolver with niobium basket containing a platinum/iridium alloy sheet. Alumina ceramic spacers. All other equipment Type 347 or 304L SS.
N-cell	Vessels and piping Type 347 SS. Racshig rings on floor are boron-glass.
J-cell	Vessels and piping Type 347 or 304L SS. Plates in vessels are boron SS.
P-, Q-, & S-cells	Vessels, piping, and equipment Type 347 or 304L SS. SS Racshig rings in column.
Z-cell	Vessels, piping, and equipment Type 347 SS.
Product Denitrator	Vessels, piping, and equipment Type 347 or 304L SS. Glovebox contains rubber gloves and Plexiglas.
K-cell	Vessels, piping, and equipment Type 347 or 304L SS.
U- & Y-cells	Vessels, piping, and equipment Type 347 or 304L SS.
W-cell	Vessels, piping, and equipment Type 347 SS.

9.0 Interfacing concerns including equipment restart and external connections to process. Process/system connections (flange, thread, weld, special connections).

Most systems still connected to all waste processes and off-gas systems. Connection by welded or flanged connectors.

10.0 Unique features (freeze plugs, valve gallery, Hanford connectors, three-bolt flanges, peculiar pumps, inert atmosphere).

Covered in 3.0.

11.0 Current disposal capabilities (gaseous, liquid, and solid).

The liquid waste goes to the Process Equipment Waste (PEW) Evaporator or directly to storage tanks depending on its concentration and constituents. The HLW is then calcined and stored on-site in bins. Currently a high-level liquid waste evaporator is being installed that will allow concentration of waste solutions which could not be concentrated in the PEW evaporator.

Cell off-gas systems and vessel off-gas systems exist for all cells. All are kept at a negative pressure to prevent spread of contamination. The cell off-gas goes through pre-filters and 2-3 different sets of HEPAs before being released. The vessel off-gas is usually cleaned (scrubber, demister, etc.) and sent through at least two stages of HEPAs.

Solids are removed in waste boxes or shielded drums (depending on activity) and currently disposed of at on site facilities. Currently mixed waste is stored at the ICPP and has no permanent disposal plans. Mixed waste HEPA filters are currently stored but there are plans to process them through the Filter Leach Facility, which is located in the hot cell in the New Waste Calciner Decontamination Shop.

SYSTEM #3

1.0 Aqueous processes/systems associated with this facility:

The Waste Calcination Facility (WCF) is the original facility at the ICPP used to calcine high-level liquid waste. The process currently operating is the New Waste Calciner Facility (NWCF).

2.0 Describe process/system in general. Include type of containment and how maintenance is performed.

The WCF received radioactive waste solutions from the liquid waste storage tanks and converted the solutions to solid radioactive wastes by a continuous, fluidized-bed calcination process. The solid, granular product was pneumatically transferred to solid waste storage bins.

The arrangement of the facility is two rows of shielded cells separated by operating and access corridors. Decontamination equipment is at the ground-floor level, including solution makeup tanks, pumps and numerous addition funnels leading to various WCF vessels and lines which require decontamination.

3.0 Quantity and present condition of equipment. Include how much of each type of equipment, current condition of equipment, how long it was used, how long has it been deactivated, are there any solids or difficult to remove scales.

The WCF solidified approximately 4 million gallons of U fuel reprocessing waste from 1963 to 1981. When it was deactivated, no decontamination was done. This facility has remained a surplus facility for about 14 years. Minimal maintenance has been performed.

Current efforts are aimed at establishing a proper level of functional equipment needed to proceed with stabilization and floor cleaning. It is currently being evaluated for final disposition. One possible approach is to remove the solids and loose items on the floors of the cells and grout the whole rest of the facility in place. This approval requires special environmental permission and is not finalized. Some type of chemical cleanup of vessel internal and externals may be required.

The WCF feed system consisted of two waste hold tanks, a feed tank, evaporator, and blend tank. Solution was gravity fed into the calciner vessel. The calciner was a fluidized bed reactor maintained at 50°C by the in-bed combustion of kerosene. Solid product was pneumatically transferred to storage bins. Fines were carried into the off-gas stream and removed in a dry cyclone and sent to solids storage. The off-gas was scrubbed and demised, then sent to silica gel absorbers to remove the volatile ruthenium compounds. After the absorbers the off-gas was filtered (3 stages) before release. A hot sump tank collected waste solutions from cell floor drains and process vessels. This solution was sent to the PEW or directly to the high-level waste tanks. All systems are not currently operating and an evaluation would need to determine feasibility of repair.

4.0 Solid or liquid heels present in the system, type and quantity and if they can be removed.

Solids and items (tools, paper, etc.) on the floors of the cells. Asbestos cleanup was completed in operator-accessible areas. Clinkers (agglomerated solids) exist in the calciner. Sand-like silica gel fills the absorbers (7' dia. by 10' tall [213 cm x 305 cm]). Unburned hydrocarbons had tendency to form "gunk" that retained radioactivity on silica gel absorbers. Some solids (calcium fluorozirconate) may have settled in the bottom of the feed tanks and feed control valves and on external surfaces when leaks occurred. Solids of CaF_2 and ZrO_2 may be present in the off-gas system. Insoluble precipitates may have formed from a variety of solutions in the hot sump tanks.

5.0 Criticality concerns including critically safe/favorable equipment, by geometry or by poison (type and how applied).

Uranium levels not high enough to make criticality a concern.

6.0 Chemicals used in the system, including heavy, metals, organics, reactive materials, pyrophorics, volatiles, and toxics, and their typical concentrations.

Chemicals include aqueous acidic high-level liquid waste (zirconium/fluoride type, high-level stainless steel nitrate wastes, and intermediate wastes), nitric acid used for scrub solutions, calcium nitrate added Zr/F wastes.

7.0 Contamination levels in the equipment (alpha, beta, gamma) and in system, including dose rate. Methods used to decontaminate equipment in the past and how effective they were. Contamination levels of surrounding area (alpha, beta, gamma and dose rate).

Gross body fields range from 5 mR/h beta/gamma (in filter removal corridor and transport air blower cell) to >10,000 mR/h beta/gamma (in silica gel absorber cells). Hot spots in the calciner cell up to 200 R/h and in absorber off-gas cell to several hundred roentgens. Alpha contamination will also be present.

Hard dry calcine deposits on the inside surfaces of the calciner vessel were removed by the abrasive action of fluidized, inert bed material, such as Dolomite. Residual calcine was dissolved by hot 4-6M nitric acid solution with small amounts of 0.3M aluminum nitrate to aid in the dissolution of fluoride containing compounds. Calcium fluoro-zirconate deposits were most easily removed with hot nitric acid. Alkaline reagents were never used while ZrF compound still existed to prevent formation of polymeric zirconium hydroxides and/or oxides, which are soluble only in highly corrosive reagents containing H_2SO_4 or HF. High pressure water spraying (up to 10,000 psi) has also been done. After removal of all solids, decontamination was completed by removal of oxide films. Because the radionuclides are often bound to surfaces by combinations of acid-soluble and alkali soluble materials, alternating acidic and alkaline decontamination solutions generally will have a more beneficial effect than repeated use of one type of reagent. These methods included 6% TURCO 4502/water/0.9M oxalic acid/3M nitric acid; 6% TURCO 4502/water/1.5M HNO_3/0.3M HAS; 2% TURCO 4324 (low foam detergent), 1.5M NaOH (6%) followed by 0.15M tartaric (2%), 1.5M NaOH followed by EDTA, and others.

8.0 Materials of construction, including any seal/packing/lining materials.

The majority of WCF vessels and lines are made of 304L or 347 SS. Walls are concrete painted with acid-resistant epoxy. Most cells have SS floors and wainscots at least a few inches high on the cell wall.

9.0 Interfacing concerns including equipment restart and external connections to process. Process/system connections (flange, thread, weld, special connections).

The hot sump tank is still connected to the tank farm/PEW system. Most connections are welded. Some equipment/instrumentation upgrade would be required to restart system.

10.0 Unique features (freeze plugs, valve gallery, Hanford connectors, three-bolt flanges, peculiar pumps, inert atmosphere).

See section 3.0.

11.0 Current disposal capabilities (gaseous, liquid, and solid).

The liquid waste goes to the Process Equipment Waste (PEW) Evaporator or directly to storage tanks depending on its concentration and constituents. The HLW is then calcined and stored on-site in bins. Currently a high-level liquid waste evaporator is being installed that will allow concentration of waste solutions which could not be concentrated in the PEW evaporator.

Solids are removed in waste boxes or shielded drums (depending on activity) and currently disposed of at onsite facilities. Currently mixed waste is stored at the ICPP and has no permanent disposal plans. Mixed waste HEPA filters can be processed through the Filter Leach Facility which is located in the hot cell in the New Waste Calciner Decontamination Shop.

12.0 Miscellaneous:

Additional Facility Information

There is a decontamination facility at the ICPP for ex-situ decontamination of equipment for both maintenance and disposal. This facility uses a variety of techniques and includes a hot cell to decontaminate high rad-level items. This facility also includes the HEPA filter leach facility for the treatment of mixed waste HEPA filters.

In addition to past fuel reprocessing and waste solidification facilities, this location also has fuel storage basins. Fuel is being transferred out of one of these basins (CPP-603) because it does not meet current regulations for waste storage. This facility will also need decontaminated in the future.

Other Information for Survey - Reports

ARCHIBALD-1993
K. E. Archibald, "CO_2 Pellet Blasting Literature Search and Decontamination Scoping Tests Report," Westinghouse Idaho Nuclear Company Report WINCO-1180 (December 1993).

ARCHIBALD-1995
K. E. Archibald, "Concrete Decontamination Scoping Tests," Idaho National Engineering Laboratory Report INEL-94/0022 (January 1995).

DEMMER-1994A
R. Demmer, "Development of Simulated Contamination (SIMCON) an Miscellaneous Decontamination Scoping Tests," Westinghouse Idaho Nuclear Company Report WINCO-1188 (January 1994).

DEMMER-1994B
R. Demmer, "Testing and Evaluation of Eight Decontamination Chemicals," Westinghouse Idaho Nuclear Company Report WINCO-1228 (September 1994).

DEMMER-1994C
R. L. Demmer and R. L. Ferguson, "Testing and Evaluation of Light Ablation Decontamination," Idaho National Engineering Laboratory Report INEL-94/0134 (October 1994).

FERGUSON
R. L. Ferguson, "Liquid Abrasive Grit Blasting Literature Search and Decontamination Scoping Tests Report," Westinghouse Idaho Nuclear Company Report WINCO-1163 (October 1993).

TRIPP
J. L. Tripp, "Criteria and Evaluation of Three Decontamination Techniques," Westinghouse Idaho Nuclear Company Report WINCO-1187 (January 1994).

Most pressing problem in area that could be addressed by in-situ decontamination technology. Sites for potential demonstrations.

Any of the areas mentioned would be good locations for potential demonstrations. The decontamination development group is experienced at conducting hot demonstrations at this facility. Most of the areas listed would benefit from in-situ decon'amination to reduce the amount of handling and worker exposure from removing highly contaminated items from the shielded cells for an ex-situ decontamination.

The respondent indicated that J-cell would be especially applicable for a demonstration site. J-cell contains 4 vessels and associated piping. It is still hooked up to the plant waste systems and contamination levels are low enough to allow personnel entry. The had originally planned to do a test in this cell using chemicals and a portable decontamination pad inside the cell. However, funding was cut at the last moment.

Other contacts.

[Removed in the interest of anonymity.]

Other systems at the ICPP.

ROVER	Graphite fuel processing with dry burner system (some aqueous processes in later stages). Currently in design phases for uranium removal.
NWCF	Operating calcine facility, currently in turnaround.
Tank Farm	Underground waste storage tanks, don't meet currently RCRA regulations. Current agreement with state to be out of tanks by 2008 for one part and 2015 for another.

Fuel Storage Pools

Storage of Al- and Zr-based fuels. Also have some dry fuel storage. Liquid Effluent Treatment and Disposal System (LET&D) removes acid from evaporator overheads.

Process Equipment Waste Evaporator

Evaporates radioactive waste. Also currently installing a High Level Liquid Waste Evaporator that will be able to handle solutions which the current PEW cannot handle.

Several other small, old facilities are inactive and not listed here.

Survey # 95-2-15-1

Lawrence Berkeley Laboratory

The following information was obtained in a phone conversation with the respondent.

The respondent from Lawrence Berkeley Laboratory didn't think they could make a meaningful contribution to the survey and had no suitable sites for testing prototype equipment.

Survey # 95-2-21-8

Lawrence Livermore National Laboratory - Pu Facility

The following information was obtained in a phone conversation with the respondent.

The respondent indicated that they were planning to do their own decommissioning.

Survey # 95-2-21-9

Lawrence Livermore National Laboratory - Building 251

A copy of the survey was sent and we are still waiting for its return. However, the following information was obtained in phone conversations with the respondent.

Building 251 was used for working on heavy elements but also has a Pu glovebox. There is some einsteinium contamination in the building. This building was used a lot for making tracer sets for nuclear test shots. The respondent indicated that they had a lot of unique, interesting contamination problems. However, this facility is run only with a staff of 6 people to operate 30,000 sq. ft. and 100+ gloveboxes.

Survey # 95-3-6-1

Los Alamos National Laboratory - TA-21

The following information was obtained in a phone conversation with the respondent.

The respondent indicated that they were not currently doing any decommissioning and therefore did not need decontamination and decommissioning activities.

Survey # 95-3-7-1

Los Alamos National Laboratory - TA-55

The following information was obtained in a phone conversation with the respondent.

The respondent indicated that they were not currently doing any decommissioning and therefore did not need decontamination and decommissioning activities.

Survey # 95-3-6-1

Oak Ridge National Laboratory - Chemical Technology Division

No response was received.

Survey # 95-3-7-2

Rocky Flats Plant - Building 779

Survey follows.

EM-50 - D&D Focus Area Survey
In-Situ Chemical Decontamination

Site: Rocky Flats Plant **Date: 2/27/95**

Facility: Building 779

Questions:

1. What are the major aqueous processes/systems associated with this facility?

	Name
Process/ System 1	Process Waste System
Process/ System 2	Acid Leaching
Process/ System 3	Residue Recovery

2. Describe each process/system in general. What type of containment is there for each system (cell, canyon, glovebox, no containment)? How is maintenance performed on each system?

	Description
Process/ System 1	Process waste is (generally) acid based-liquid lab wastes. This system acts a collection and storage area, consisting of pipes and one storage tank.
Process/ System 2	Contaminated heavy metals are leached in any of these acids: sulfamic, sulfamic and nitric, hydrochloric and nitric.
Process/ System 3	Contaminated glass fiber filters, Ful-Flow filters, and combustibles are dissolved in hydrochloric and hydrofluoric acid to leach Pu from the filters.

3. What is the quantity and present condition of equipment?

	How much of each type of equipment is there (i.e. pipes, tanks)? Provide unit of measurement?	What is the current condition of the equipment? How long was it used? How long has it been deactivated?	Are there any solids or difficult-to-remove scales present?
Process/ System 1	There are 400' piping and 1 tank.	Equipment installed in 1975 and taken out of service in 1990.	No.
Process/ System 2	There are 3 small acid tanks.	Equipment taken out of service in 1993.	No.
Process/ System 3	There are 2 acid tanks.	Equipment taken out of service in 1994.	No.

4. Are any there any solid or liquid heels present in the system?

	What kind of system heels if any are present?	How much?	Can they be removed?
Process/ System 1	N/A	N/A	N/A
Process/ System 2	N/A	N/A	N/A
Process/ System 3	N/A	N/A	N/A

5. Are there any criticality concerns with this facility?

	Critically safe / critically favorable	By geometry (e.g., slab tank, pencil tank)?	By poison? What kind? How is it applied (e.g. Raschig rings, boric acid)?
Process/ System 1	System is critically safe.	Criticality prevented by using pencil tanks.	N/A
Process/ System 2	System is critically safe.	Criticality prevented by limiting volume and Pu concentration.	N/A
Process/ System 3	System is critically safe.	Criticality prevented by limiting volume and Pu concentration.	N/A

6. What chemicals were used in the system? Include the following if known: heavy metals, organics, reactive materials, pyrophorics, volatiles, toxics.

	What chemicals were used? What was there typical concentrations?
Process/ System 1	Acids were used including: hydrochloric, nitric, hydrofluoric, and sulfamic. Heavy metals and VOCs could also be present.
Process/ System 2	Acids were used including: hydrochloric, nitric, and sulfamic.
Process/ System 3	Acids were used including: hydrochloric and hydrofluoric.

7. What are the contamination levels in the equipment?

	What kinds (alpha, beta, gamma) and quantities of contamination are present inside the system? What is the dose rate from the equipment?	What methods have been used to decontaminate this equipment in the past? How effective were they?	What are the contamination levels of the surrounding area (alpha, beta, gamma, dose rate)?
Process/ System 1	System contaminated with Pu-239 and U-235; the radiation field is <5 mR/h.	This system has never been decontaminated.	Background.
Process/ System 2	System contaminated with Pu-239; the radiation field is <1 mR/h.	Hand wiping has been used to reduce the activity levels to <50,000 DPM.	Background.
Process/ System 3	System contaminated with Pu-239; the radiation field is <1 mR/h.	Hand wiping has been used to reduce the activity levels to <50,000 DPM.	Background.

8. What are the materials of construction?

	What are the predominant materials of construction for the equipment?	Are there any seal/packing/lining materials? What are they made of?
Process/ System 1	Stainless steel (probably Type 304).	N/A
Process/ System 2	Stainless steel (probably Type 304).	N/A
Process/ System 3	Stainless steel (probably Type 304).	N/A

9. What concerns are there with interfacing?

	How easy is it to interface and/or restart the equipment? Have external connections been made to this system before?	How are the processes/systems connected (e.g. flange, thread, weld, special connections)?
Process/ System 1	The system won't be restarted because of concerns with mixed waste generation.	Flanged connections.
Process/ System 2	This process is no longer needed.	Separate vessels.
Process/ System 3	This process is no longer needed.	Separate vessels.

10. Are there any unique features for these processes/systems (e.g. freeze plugs, valve gallery, Hanford connectors, three-bolt flanges, flat bottom tanks, peculiar pumps, inert atmosphere)?

	Unique Features
Process/ System 1	Sump pumps.
Process/ System 2	N/A
Process/ System 3	N/A

11. What are your current disposal capabilities?

HEPA filter exhaust

	HEPA System 1	HEPA System 2	HEPA System 3
Location. Service area.	4 zone HEPA Filter.	4 zone HEPA Filter.	4 zone HEPA Filter.
Maximum flow rate.	2" header with a 3/4" water column vacuum	2" header with a 3/4" water column vacuum	2" header with a 3/4" water column vacuum
Condition.	Operational.	Operational.	Operational.
What can be discharged to the system (e.g. NOx, H_2O)?	Acid fumes may be discharged.	Acid fumes may be discharged.	Acid fumes may be discharged.
Can connections to the ventilation system be made?	Yes.	Yes.	Yes.

Solid/Liquid Disposal

	Disposal System 1	Disposal System 2	Disposal System 3
Location. Service area.	Building 774.	Building 374.	Building 374.
What feeds are acceptable and what are the limits?	Maximum of 3 g/L Pu containing no organics.	Can contain a maximum of 0.5 g/L Pu.	Can contain a maximum of 0.5 g/L Pu.

12. Miscellaneous:

-What else should we know about your facility?

[No response provided.]

-What other information do you think would be helpful to this survey? Do you have any or know of any reports that would be valuable for this survey?

[No response provided.]

-What do you feel is the most pressing problem in your area that could be addressed by in-situ decontamination technology? Do you have any sites that might be suitable for potential demonstrations?

Biggest concerns
-criticality safety
-recycling of spent solutions
-generation RCRA/Rad waste

-Who else should we talk to?

[No response provided.]

-What other systems do you have?

Pu metal recovery
Ion exchange columns

Survey # 95-2-20-4

Sandia National Laboratories - Hot Cell Facility

Survey follows.

EM-50 - D&D Focus Area Survey
In-Situ Chemical Decontamination

Site: Sandia National Laboratories — Date: 3/29/95
Facility: Technical Area V Hot Cell Facility

1. Description of aqueous processes/systems associated with the facility

   The Hot Cell Facility (HCF) comprises a hot cell (canyon), three steel confinement boxes (SCBs) located in the hot cell, and a glovebox laboratory. The facility is used for the assembly/disassembly of experiment packages, preparation and examination of radioactive and nuclear materials, handling and packaging of radioactive materials, and preparation of samples for metallographic examination requires the sectioning, mounting, and polishing of samples. Very limited amounts of aqueous solutions are used in the polishing process (less than 1 liter) or as cutting lubricant (less than 100 mL). There are no other aqueous systems or processes in use.

2. Description of each system in general

   The hot cell is a canyon, approximately 10 ft wide, 100 ft long, and 16 ft high, with a wall thickness of 3.5 ft of reinforced concrete. The canyon is used for the large scale handling of irradiated/radioactive packages during the assembly and disassembly of reactor experiments. The hot cell has a dedicated ventilation system with in-line HEPA filtration. Master-slave manipulator systems are used to handle the packages. There are dedicated hoists and an elevator system in the hot cell.

   The steel confinement boxes (SCBs) are located in the canyon. The boxes are connected in line and are accessed through pass-through ports. The boxes are used for the machining, cutting, and polishing of highly radioactive materials used in the reactor related experiments. The boxes provide a level of confinement for preventing release of materials due to the operations in the boxes. The SCBs are serviced by a separate HEPA filtered ventilation system.

   The glove laboratory is located in an area adjacent to the hot cell. The laboratory contains eleven gloveboxes: two shielded and nine unshielded boxes. The laboratory is used for the small scale assembly and disassembly of components and experiment hardware and for the preparation of metallographic samples. Eight of the gloveboxes are interconnected for movement of materials from one box to another. Three gloveboxes are in a stand-alone configuration and were used in support of a specific experiment program. The gloveboxes are exhausted into a dedicated HEPA-filtered ventilation system.

   Maintenance on the hot cell SCBs and glove boxes is performed by facility personnel. The ventilation systems are serviced and maintained by plant personnel and annually tested (DOP) by a contractor.

3. Quantity and present condition of equipment

Steel Confinement Boxes

The SCBs are located in the hot cell serviced by master-slave manipulators and viewed by two leaded glass windows mounted in the shield wall. Two boxes (SCB- 1, SCB-3) are approximately 16 ft long, 8 ft high, and 6 ft deep. One box (SCB-2) is 8 ft long, 8 ft high, and 6 ft deep. SCB-1 contains standard machine shop equipment including a band saw, drill press, small lathe, small mill and associated tools. A portable hoist (1/4 ton) is mounted to a trolley/rail system to provide a lift capability in the box. The SCBs are contaminated with high levels of removable and fixed contamination. The contaminant is primarily uranium oxide particulate (from cutting/machining/polishing activities), and mixed fission product.

SCB-1 is used for the cutting, machining, and assembly of nuclear materials for reactor experiments. The equipment in the box is serviceable.

SCB-2 is used to polish highly radioactive materials for metallographic analysis. The box contains a hoist, lapidary wheel, and associated hardware. All equipment is serviceable.

SCB-3 was used to conduct radiochemistry analyses in support of an experiment program. The box contains chemical processing equipment (pipettors, dispensers, etc.) necessary for manually chemical preparations. The box also contains analytical balances, hot plates, a pH meter, spectrometer, and miscellaneous tools and support equipment. The items in the SCB are no longer serviceable.

Hot Cell

The hot cell contains two dedicated hoists, a six-ton transporter cart, a below-grade elevator platform, and the SCBs. The hot cell is contaminated by moderate levels of mixed fission product.

Gloveboxes

The gloveboxes contain various equipment, optical microscopes, metal sample polishing equipment, tools, saws, etc. Two shielded boxes are approximately 6 ft. long, 3 ft high, and 2.5 ft deep. One box is 9 ft long, 8 ft high, and 2.5 ft deep. Two boxes are 16 ft long, 3 ft high, and 2.5 ft deep. Two boxes are 4 ft long, 3 ft high, and 2.5 ft deep. The three shielded gloveboxes are highly contaminated with mixed fission products, and mixed oxide fuel residues. The unshielded boxes are contaminated lightly to moderately with uranium residue and mixed fission products.

4. Liquid or solid heels present in the system

Limited amounts of accountable SNM are in the boxes. The majority of nuclear/radioactive material is in the form of dispersed contaminants due to the operations conducted in the different locations. All accountable materials will be removed before any D&D operations commence.

5. Criticality Concerns

Criticality safety is administratively controlled. Mass limits are established for each work location. Since there have not been any fuel fabrication or processing activities conducted in the facility, and since only solids are used in the facility, there are no significant quantities of fissile material held up in the facility systems. Activities that involve significant quantities (experiments) are individually reviewed and specific controls are enacted during the conduct of that operation.

6. Chemicals Used

Very limited amounts of chemicals have been used in the HCF. The majority of the experiments conducted or handled in the facility involved the mechanical disassembly of the equipment, or the cutting, sawing, or polishing of solids. The rest were a series of experiments conducted to determine the source term of fission products for reactor safety studies. The wet chemistry involved bench quantities (10-100 mL) of aqueous solutions (acids and bases, chemical carrier, etc.). Very limited amounts of organic solutions were used in any of the activities (<50 mL), typically alcohols. Freon-TF has been used as a cutting lubricant and cleaning agent.

7. Contamination Levels

<u>Steel Confinement Boxes</u>

Contamination levels in the SCBs are in the range of 1,000,000 DPM β/γ or higher, mostly mixed fission product. There are minute amounts of uranium and transuranics (nanocurie levels) from the operations conducted in the boxes.

<u>Hot Cell</u>

Contamination levels in the HC vary from 10,000-100,000 DPM β/γ mixed fission product.

Gloveboxes

Two gloveboxes are heavily contaminated with mixed fission products and uranium/transuranic material. Contamination levels cannot be determined due to activity. The remaining seven boxes are contaminated 10,000-40,000 DPM removable contamination, mostly fission product, with very low levels of uranium.

8. Materials of Construction

Steel Confinement Boxes and Glove Boxes

The SCBs and GBs are of steel construction. The SCB interior is epoxy painted. The glovebox material is polished stainless with less than 10% painted surfaces.

Hot Cell

The Hot Cell is painted concrete walls and floor.

9. Interfacing

Access to the SCBs is made through 18" pass-through ports. The SCBs are connected in a linear fashion. Each box is serviced with electrical and pneumatic lines to support various types of mechanical and electrical equipment. The Hot Cell is accessed through pneumatically operated doors, two sets, which form an air lock. The cell is also serviced with electrical and pneumatic lines for the same applications as the SCBs. The gloveboxes are accessed through pass-through ports. Electrical service is supplied to the boxes (110 VAC).

10. Unique Features

There are no other unique features other than those described.

11. Current Disposal Capabilities

The SCBs, Hot Cell, and gloveboxes each have a dedicated HEPA filtered ventilation system that exhausts into a single main exhaust stack. There are at least two stages of HEPA filtration for each system and a third HEPA filter bank before the exhaust exits the stack. The exhaust is monitored for radioactive particulate and radioactive gases. A single charcoal filter housing is in the main exhaust line; however, the unit is not in use.

There are no liquid effluents permitted from the Hot Cell Facility. Floor drains are present in the facility which drain to a holding tank. The floor drains are present only for a catastrophic failure of a water line or flooding.

Solid waste is categorized as either radioactive waste, mixed waste, or industrial waste. Industrial waste is disposed of in a sanitary landfill operated by the City of Albuquerque. Radioactive and mixed wastes are disposed of through a SNL organization.

12. A copy of the current Safety Analysis Report is provided for your information.

SASMOR

D. J. Sasmor et al., Sandia Hot Cell Facility (HCF) Safety Analysis Report, Sandia National Laboratories Report SAND87-2480 (1987).

Survey # 95-2-20-5

Sandia National Laboratories - Miscellaneous

The following information was obtained in a phone conversation with the respondent.

The respondent indicated that they were not currently doing any decommissioning and therefore did not need decontamination and decommissioning activities.

Survey # 95-2-22-2

Savannah River Site - High Level Waste Tank Farms

Survey follows.

EM-50 - D&D Focus Area Survey
In-Situ Chemical Decontamination

Site: Savannah River Site **Date: 2/3/95**

Facility: HLW Tank Farms

Questions:

1. What are the major aqueous processes/systems associated with this facility?

	Name
Process/ System 1	1H & 2H High Level Waste Evaporator - High Level Waste Supernatant Evaporator
Process/ System 2	Tank Farm process transfer line between high level waste tanks

2. Describe each process/system in general. What type of containment is there for each system (cell, canyon, glovebox, no containment)? How is maintenance performed on each system?

	Description
Process/ System 1	Evaporators are located in cells located outdoors. Maintenance done by remote handling crane.
Process/ System 2	Transfer lines are jacketed. Lines are small in diameter (approx. 3 in.) and up to 2000 ft long. Access to lines is through diversion boxes by remote means.

3. What is the quantity and present condition of equipment?

	How much of each type of equipment is there (i.e., pipes, tanks)? Provide unit of measurement?	What is the current condition of the equipment? How long was it used? How long has it been deactivated?	Are there any solids or difficult-to-remove scales present?
Process/ System 1	There are 2 evaporators. For each evaporator: 2000 gal capacity, approximately 8 ft diameter, 15 ft high, internal steam bundle.	Evaporators currently out of service for 1 - 3 years. Units were operating at time of shutdown. Units were in operation for 1 - 5 years.	Scale deposits.
Process/ System 2	Several thousand feet of lines.	Transfer lines are in service for 30+ years.	Scale, oxide, salt deposits.

4. Are any there any solid or liquid heels present in the system?

	What kind of system heels if any are present?	How much?	Can they be removed?
Process/ System 1	None known.		
Process/ System 2	None known.		

5. Are there any criticality concerns with this facility?

	Critically safe / critically favorable	By geometry, (e.g., slab tank, pencil tank)?	By poison? What kind? How is it applied (e.g., Raschig rings, boric acid)?
Process/ System 1	None.	None.	None.
Process/ System 2	None.	None.	None.

6. What chemicals were used in the system? Include the following if known: heavy metals, organics, reactive materials, pyrophorics, volatiles, toxics.

	What chemicals were used? What was there typical concentrations?
Process/ System 1	Units have never been cleaned. Similar evaporators were cleaned with a mixture of NaOH (caustic) and $KMnO_4$ (potassium permanganate) followed by nitric acid. Traces of mercury may also be present.
Process/ System 2	Lines have never been decontaminated except for flushing.

7. What are the contamination levels in the equipment?

	What kind (alpha, beta, gamma) and how much contamination is present inside the system? What is the dose rate from the equipment?	What methods have been used to decontaminate this equipment in the past? How effective were they?	What are the contamination levels of the surrounding area (alpha, beta, gamma, dose rate)?
Process/ System 1	^{137}Cs is the main contaminate. Others are minute.	None (see Item 6).	5 - 200 R/h
Process/ System 2	$^{134\&137}Cs$, Ba, Ru, Tc, Selenium, ^{60}Co, ^{90}Sr. Others are minute.	None.	10 - 500 R/h

8. What are the materials of construction?

	What are the predominant materials of construction for the equipment?	Are there any seal/packing/lining materials? What are they made of?
Process/ System 1	Type 304 stainless steel.	None.
Process/ System 2	Type 304 stainless steel.	Pumps and valves may have packing or other materials of concern.

9. What concerns are there with interfacing?

	How easy is it to interface and/or restart the equipment? Have external connections been made to this system before?	How are the processes/systems connected (e.g., flange, thread, weld, special connections)?
Process/ System 1	Unit out of service for 1 - 3 years with no maintenance. Utilities still hooked-up but system would require refurbishment prior to restart. Unit not scheduled for restart, so connections could be made by cutting and capping lines to unit.	Hanford connectors.
Process/ System 2	Access to lines must be at diversion boxes and by remote means. Some lines are closed loop and can be isolated. Others open directly to waste tanks.	Hanford connectors.

10. Are there any unique features for these processes/systems (e.g. freeze plugs, valve gallery, Hanford connectors, three-bolt flanges, flat bottom tanks, peculiar pumps, inert atmosphere)?

	Unique Features
Process/ System 1	Hanford connectors. Inlet and outlet are at top of vessel. Outlet operated by steam lift. To circulate/remove cleaning solutions from unit, steam would be required to operate steam lift or solutions would have to be pumped from unit.
Process/ System 2	Hanford connectors.

11. What are your current disposal capabilities?

HEPA filter exhaust

	HEPA System 1
Location. Service area.	Cell is HEPA filtered.
Maximum flow rate.	[Not given.]
Condition.	[Not given.]
What can be discharged to the system (e.g. NO_x, H_2O)?	Anything that can be filtered by a HEPA and exhausted directly to the atmosphere.
Can connections to the ventilation system be made?	Yes.

Solid/Liquid Disposal

	Disposal System 1	Disposal System 2
Location. Service area.	High level waste tanks.	All material goes to high level waste tanks.
What feeds are acceptable and what are the limits?	No organics or acids.	No organics or acids may go to waste tanks.

12. Miscellaneous:

-What else should we know about your facility?

There are numerous systems, drains, tanks, etc., at SRS that may require decontamination in the future. In-situ chemical decon may be appropriate for these systems.

-What other information do you think would be helpful to this survey? Do you have any or know of any reports that would be valuable for this survey?

[No response provided.]

-What do you feel is the most pressing problem in your area that could be addressed by in-situ decontamination technology? Do you have any sites that might be suitable for potential demonstrations?

Decontamination of concrete used in buildings and structures (floors, walls, ceilings, pads, supports, etc.) Numerous possible locations for demo.

Slurry pumps and transfer pumps used in waste tanks in tank farm. (Possible demo location)

-Who else should we talk to?

[No response provided.]

-What other systems do you have?

[No response provided.]

APPENDIX B.

CHEMICAL DECONTAMINATION SURVEY AND COVER LETTER

ARGONNE NATIONAL LABORATORY
Chemical Technology Division Building 205
9700 South Cass Avenue, Argonne, Illinois 60439-4837

Telephone: 708/252-1945
Fax: 708/252-5246

Date

Name
Address
City, State Zip

Dear

SUBJECT: D&D Focus Area Survey on a Chemical Decontamination

In-situ chemical decontamination is being evaluated for decontaminating the equipment in DOE facilities that have been deactivated. Contaminates include radiological and hazardous components and the levels range from barely detectable contamination to levels requiring remote handling. A method is needed to decontaminate the interiors of the equipment sufficiently to allow either free release or land disposal. The decontamination method should also require only minimal system reactivation and be easily interfaced with existing systems. In addition, wastes generated from decontaminating the equipment should be minimized and need to be compatible with future waste disposal activities (e.g. grout, vitrification).

In this project, an initial survey will be completed to better understand the types of contamination problems that exist within the DOE complex, determine what decontamination process are being used or being developed within the DOE and nuclear industries, and determine what methods are available to dispose of spent decontamination solutions. In addition this initial survey will locate suitable sites for testing prototype systems. Initially we are looking for fairly simply systems (e.g. pipe runs, tanks with limited internals). This survey will focus the direction of laboratory work on specific decontamination processes and problem areas identified in the survey. Initial tests will be completed using standardized coupons to evaluate decontamination solutions. Once the most promising decontamination solutions have been identified then engineering aspects (e.g. application and removal, geometry) will be evaluated.

As we discussed on the phone I am sending you a copy of the survey for your examination. I will be contacting you in a few days for any answers you can provide. Once the survey is completed I will return a copy of it to you so that you may verify that the information is accurate. In addition your survey will be referenced by number only; your name will not be published. Thank you for your cooperation.

Sincerely,

Cliff Conner
Separation Science and Technology Section
Chemical Technology Division

CC/dkt

Enclosure

EM-50 - D&D Focus Area Survey
Pu Heels Treatment

Site: ______________________ **Date:** __________

Facility: ______________________

Questions:

1. What are the major aqueous processes/systems associated with this facility?

	Name
Process/ System 1	
Process/ System 2	
Process/ System 3	

2. Describe each process/system in general. What type of containment is there for each system (cell, canyon, glovebox, no containment)? How is maintenance performed on each system?

	Description
Process/ System 1	
Process/ System 2	
Process/ System 3	

EM-50 - D&D Focus Area Survey
Pu Heels Treatment

3. What is the quantity and present condition of equipment?

	How much of each type of equipment is there (i.e. pipes, tanks)? Provide unit of measurement?	What is the current condition of the equipment? How long was it used? How long has it been deactivated?	Are there any solids or difficult-to-remove scales present?
Process/ System 1			
Process/ System 2			
Process/ System 3			

4. Are any there any solid or liquid heels present in the system?

	What kind of system heels if any are present?	How much?	Can they be removed?
Process/ System 1			
Process/ System 2			
Process/ System 3			

5. Are there any criticality concerns with this facility?

	Critically safe / critically favorable	By geometry (e.g. slab tank, pencil tank)?	By poison? What kind? How is it applied (e.g. Raschig rings, boric acid)?
Process/ System 1			
Process/ System 2			
Process/ System 3			

6. What chemicals were used in the system? Include the following if known: heavy metals, organics, reactive materials, pyrophorics, volatiles, toxics.

	What chemicals were used? What was there typical concentrations?
Process/ System 1	
Process/ System 2	
Process/ System 3	

7. What are the contamination levels in the equipment?

	What kind (alpha, beta, gamma) and how much contamination is present inside the system? What is the dose rate from the equipment?	What methods have been used to decontaminate this equipment in the past? How effective were they?	What are the contamination levels of the surrounding area (alpha, beta, gamma, dose rate)?
Process/ System 1			
Process/ System 2			
Process/ System 3			

8. What are the materials of construction?

	What are the predominant materials of construction for the equipment?	Are there any seal / packing / lining materials? What are they made of?
Process/ System 1		
Process/ System 2		
Process/ System 3		

9. What concerns are there with interfacing?

	How easy is it to interface and/or restart the equipment? Have external connections been made to this system before?	How are the processes/systems connected (e.g., flange, thread, weld, special connections)?
Process/ System 1		
Process/ System 2		
Process/ System 3		

10. Are there any unique features for these processes/systems (e.g. freeze plugs, valve gallery, Hanford connectors, three-bolt flanges, flat bottom tanks, peculiar pumps, inert atmosphere)?

	Unique Features
Process/ System 1	
Process/ System 2	
Process/ System 3	

11. What are your current disposal capabilities?

HEPA filter exhaust

	HEPA System 1	HEPA System 2	HEPA System 3
Location. Service area.			
Maximum flow rate.			
Condition.			
What can be discharged to the system (e.g. NO_x, H_2O)?			
Can connections to the ventilation system be made?			

Solid / Liquid Disposal

	Disposal System 1	Disposal System 2	Disposal System 3
Location. Service area.			
What feeds are acceptable and what are the limits?			

12. Miscellaneous:

What else should we know about your facility?

What other information do you think would be helpful to this survey? Do you have any or know of any reports that would be valuable for this survey?

What do you feel is the most pressing problem in your area that could be addressed by in-situ decontamination technology? Do you have any sites that might be suitable for potential demonstrations?

Who else should we talk to?

What other systems do you have?

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