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# Treatment of Plutonium-bearing Solutions: A Brief Survey of the DOE Complex

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



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A BRIEF SURVEY OF THE DOE COMPLEX**

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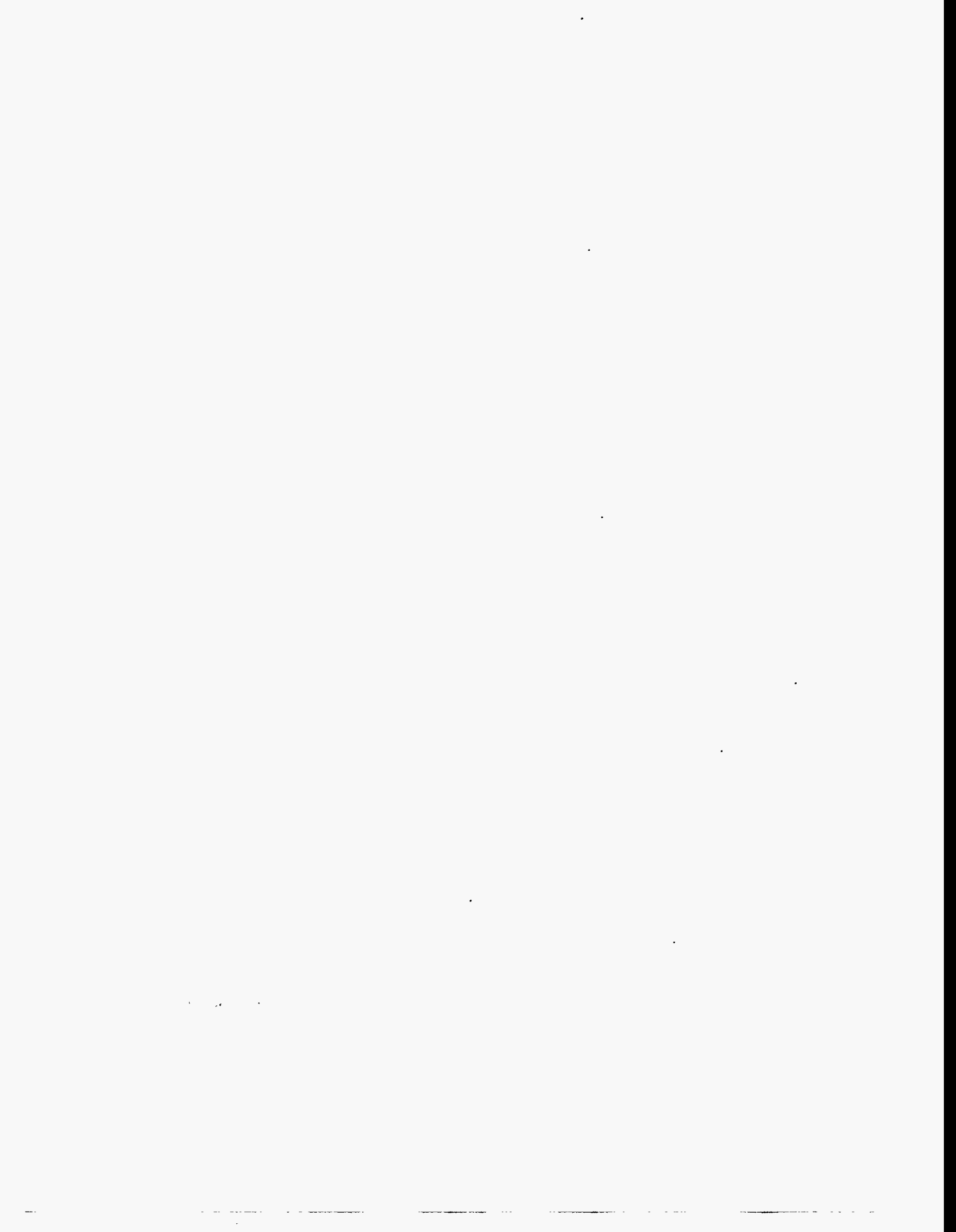
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# TREATMENT OF PLUTONIUM-BEARING SOLUTIONS: A BRIEF SURVEY OF THE DOE COMPLEX

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

## ABSTRACT

With the abrupt shutdown of some DOE facilities, a significant volume of in-process material was left in place and still requires treatment for interim storage. Because the systems containing these process streams have deteriorated since shutdown, a portable system for treating the solutions may be useful. A brief survey was made of the DOE complex on the need for a portable treatment system to treat plutonium-bearing solutions. A survey was completed to determine (1) the compositions and volumes of solutions and heels present, (2) the methods that have been used to treat these solutions and heels in the past, and (3) the potential problems that exist in removing and treating these solutions. Based on the surveys and on the Defense Nuclear Facilities Safety Board Recommendation 94-1, design criteria for a portable treatment system were generated.

## 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 that (1) reduce equipment contamination levels to allow either free release of the equipment or land disposal (preferably below detection limits), (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) treatment of plutonium-bearing solution 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 DOE complex on plutonium liquids handling. Two related reports contain the results of the other DOE survey on decontamination requirements [CONNER-1995] and the literature survey on decontamination methods [CHEN-1995].

The abrupt shutdown of some DOE facilities has resulted in significant amounts of in-process material requiring treatment in the next 2-3 years [DNFSB 94-1]. However, it may not be possible to restart some of the systems containing this in-process material because the facilities

have deteriorated since the shutdown. Some of these in-process solutions contain plutonium and are of even greater concern. A modular portable system may be useful for treating these plutonium-bearing solutions. This system would produce a product suitable for interim storage until a decision is made on the final disposition of plutonium. In addition, flushing the equipment (e.g., piping, tankage, gloveboxes, ventilation ducts) in these facilities is expected to generate substantial quantities of liquids also containing accountable quantities of plutonium. These solutions are expected to have a variety of components, including acids, bases, and suspended solids. The portable system could also be used to treat these solutions.

A survey was completed to determine the composition and quantities of solutions and heels\* present, the methods that were used to treat them in the past, and the potential problems in removing and treating them. A sample copy of the survey form and the cover letter are provided in Appendix B. Information from this survey will be used to develop design criteria for a modular portable treatment system. The system must be able to interface with existing utilities and safety systems, maneuver in process areas, and meet criticality-safety constraints. The results of this survey are discussed below.

## II. CONCLUSIONS AND RECOMMENDATIONS

Several broad conclusions can be drawn from the surveys. A portable treatment system's access to canyons will be difficult because of both radiation fields and size constraints. In addition to aqueous solutions, some sites have organic sludges that contain significant quantities of plutonium. These sludges might prove very difficult to stabilize, but some sort of treatment is required. Also, secondary waste generation is an important issue, more so if the secondary waste is hazardous, as defined in the Resource Conservation and Recovery Act (RCRA). Finally, criticality safety is required when dealing with significant quantities of plutonium.

Based on the surveys and on the Defense Nuclear Facilities Safety Board (DNFSB) recommendation 94-1, several design criteria for a portable treatment system were generated:

- Criticality safe.
- Ability to produce oxide with LOI<sup>†</sup> <0.5%.
- Ability to stabilize organic solutions and sludges as well as aqueous solutions.
- Ability to maneuver in fairly tight process areas: minimum openings of 3-4 ft (0.9-1.2m).
- Ability to operate using no more than a 220 VAC power source.
- Ability to produce a final product that has no organics in close contact with plutonium [DNFSB 94-1].
- Ability to stabilize both plutonium and transplutonium elements [DNFSB 94-1].

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\* Residuals.

† Loss on ignition.



In addition to the surveys, the DOE/EH 0415 Plutonium Vulnerability Assessment [DOE] contains an inventory of plutonium throughout the DOE complex. A summary is shown in Table 1.

Table 1. Plutonium Inventory for Department of Energy [DOE] Sites

Site	Total Pu, kg	Pu in Solution, kg	Solution Vol, L	No. of Containers with Solution
RFP	12,800	98	30,000	431
Hanford	4,384	339	~4,000	474
LANL	2,600	—	—	—
SRS	2,100	—	370,000	19 <sup>a</sup>
ANL-W	3,900	—	—	—
LLNL	400	none	none	none
Mound	25.6	—	—	—
SNL	8.1	none	none	none
ORNL	5.5	0.33	—	—
NBL	1.77	—	—	—
ANL-E	1.15	—	—	—
LBL	0.325	—	—	—
Pantex	Classified	—	—	—

<sup>a</sup>Includes 14,000 L of solution in a tank containing 220,000 Ci of americium and curium.

### III. RESULTS

Unfortunately, surveys are limited in nature because they depend on the people responding to the survey. Most of the responses to the surveys were good, but some responses are more thorough than others. Attempts were made to contact all of the DOE sites likely to have plutonium heels and residual solutions. However, given time and money constraints, appropriate personnel to complete the survey could not always be reached. Sites that were contacted are shown in Table 2. This list is just those places that were contacted. Each site has many more facilities, but, given the time and money constraints, they could not all be surveyed. Complete responses, where applicable, to each survey listed in Table 2 are given in Appendix A.

Table 2. Sites Surveyed

Survey No.	Site	Area
95-2-15-1	Hanford	PUREX
95-2-13-1	Hanford	PFP
95-3-14-1	Hanford	T Plant
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-55
95-3-9-1	ORNL	CMT
95-3-7-2	RFP	Bldg. 779
95-2-20-5	Sandia	
95-2-22-2	SRS	F & H Canyons

A. Hanford

1. PUREX Plant

An estimated 2-3 kg of plutonium in sludge lies on the floor of the west end of the main PUREX processing canyon. This sludge is thought to be mixture of  $\text{Pu}(\text{NO}_3)_4$  and Pu-TBP (tributyl phosphate) complex. It could be scraped from the canyon floor, but controls would be needed to prevent assembling a critical mass. The respondent indicated that they did not think that a portable treatment system would be the best alternative: The sludge should be scraped off the floor and packaged into drums as TRU waste. However, if the sludge was treated before disposal, they believed that  $\text{PuO}_2$  in crimp cans would be the best product to produce because storage facilities are available.

Any remaining plutonium-bearing solution in the facility will be slowly transferred to the tank farm because it needs to be diluted before it can be put into the waste tanks. The respondent indicated that a portable system for treating these solutions has been discussed, but it would require a large amount of regulatory work [e.g., National Environmental Protection Amendment (NEPA), Environmental Assessment (EA), and possibly an Environmental Impact Statement (EIS)]. In addition, the glovebox rooms are very crowded: 3-4 ft (0.9-1.2 m) clearance between gloveboxes might make transporting the portable unit difficult.

2. Hanford - Plutonium Finishing Plant

An estimated 12 kg of plutonium in sludge lies on the Process Reclamation Facility (PRF) canyon floor at the Plutonium Finishing Plant (PFP). This sludge is thought to be a mixture of  $\text{Pu}(\text{NO}_3)_4$  and Pu-TBP complex. In the past, this type of sludge has been hydrolyzed with NaOH to separate the organics from the plutonium, then calcinated at  $1000^\circ\text{C}$  to form plutonium oxide. Plutonium oxide produced in this manner should be adequate for interim storage, provided that the LOI is  $<0.5$  wt%. The respondent thought that a portable system would be useful in treating this plutonium sludge if it could fit through the air lock of the PRF canyon.

3. T Plant

No response was received.

B. Lawrence Berkeley Laboratory

The respondent from Lawrence Berkeley Laboratory reported that they could not make a meaningful contribution to the survey.

C. Lawrence Livermore National Laboratory

1. Plutonium Facility

The respondent from the Plutonium Facility reported that they would be doing their own decommissioning work.

2. Building 251

No response was received.

D. Los Alamos National Laboratory - TA-55

The respondent reported that they did not have a significant plutonium solution inventory and suggested that we look at DOE/EH 0415 Plutonium Vulnerability Assessment [DOE] for a fairly comprehensive inventory of plutonium solutions.

E. Oak Ridge National Laboratory - Chemical Technology Division

No response was received.

F. Rocky Flats Plant - Building 779

The response by the Rocky Flats Plant respondent related more to decontamination than treatment of plutonium-bearing solutions. However, the equipment outlined in the survey is contaminated primarily with plutonium, and solutions used to decontaminate this equipment will require treatment. Some of the biggest concerns in decontaminating this equipment are criticality safety, generation of secondary wastes, and generation of RCRA waste.

G. Sandia National Laboratories

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

H. Savannah River Site - F & H Canyons

The response from the Savannah River Site covered the F and H canyons. The F canyon was used for the PUREX process and currently contains ~80,000 gal (~300 m<sup>3</sup>) of plutonium-bearing solutions. The H canyon was used for the heavy metal (HM) process and contains ~8,700 gal of plutonium-bearing solutions. Current plans are to convert this solution into a stable oxide or metal using the existing canyon equipment. However, subsequent flushing operations might be amenable to treatment with a portable system. Unfortunately, direct access to the canyons may be difficult. However, many other areas at Savannah have handled plutonium solutions that are not covered in this survey. These solutions probably have some plutonium residuals and heels, which could be treated with a portable treatment system.

## REFERENCES

### CONNER

C. Conner et al., *Equipment Decontamination: 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.

### DNFSB 94-1

Defense Nuclear Facilities Safety Board, "Recommendation 94-1 to the Secretary of Energy" (May, 1994).

### DOE

Department of Energy (DOE) Plutonium Working Group Report, *Environmental, Safety and Health Vulnerabilities Associated with the Departments Plutonium Storage*, Department of Energy Report DOE/EH-0415 (1994).

## ACKNOWLEDGMENTS

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APPENDIX A.  
SURVEY RESPONSES

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.

*The PUREX plant still contains some plutonium solutions that also contain quite a bit of uranium. Current plans are to dispose of these solutions directly to the tank farm. However, they can only be disposed of slowly because of the required dilution. A portable treatment system has been considered but would require a lot of regulatory work (e.g., NEPA, EA, and possibly EIS).*



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

**Site: Hanford**

**Date: 3/23/95**

**Facility: PUREX Plant**

**Questions:**

1. Do you have any processes/systems that have plutonium-bearing solutions/heels? If so in which processes/systems are they present? Please provide a brief description of each process/system containing the solutions/heels.

	Name
Process/ System 1	Main canyon area, which contains tanks and solvent extraction columns for separating special nuclear materials from spent nuclear fuel.
Process/ System 2	Non-radioactive aqueous make-up area where chemicals were mixed and sampled.
Process/ System 3	Gloveboxes which contain piping and vessels for handling concentrated plutonium nitrate solutions.

2. How much solution/heel is present and what is the composition of the solutions/heels?

	How much?	What composition?
Process/ System 1	There is 2-3 kg of plutonium on the floor at the far west end of the canyon.	The plutonium is contained in a film of degraded tri-butyl phosphate (TBP), normal paraffinic hydrocarbon (NPH), and plutonium nitrate.
Process/ System 2	None.	
Process/ System 3	All plutonium-bearing solutions will be removed. The gloveboxes will contain a total of 300-500 g of residual plutonium solids distributed throughout the gloveboxes.	Residual plutonium will be mostly PuO <sub>2</sub> powder with small amounts of plutonium oxalate and dried plutonium nitrate. The plutonium will be fixed to the interior of the gloveboxes using paint (Bartlett Polymeric Barrier System).

3. Is there a current treatment method for these solutions/heels? If so what is it?

The film of degraded organic (TBP/NPH) could be manually scraped from the canyon floor and packaged in TRU waste drums for disposal. Administrative controls would be needed to prevent assembling a critical mass.

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

4. Can the solutions/heels be removed? If so, are there any problems removing the solutions/heels (e.g., safety concerns, permitting requirements)?

The film of plutonium nitrate and organics could be scraped from the canyon floor and packaged in TRU waste drums. Criticality prevention controls would be needed to ensure a critical mass is not assembled. Entering the cell would require multiple layers of anti-contamination clothing and supplied air respirators.

The best way to remove the residuals from the gloveboxes would be to remove the gloveboxes.

5. Would a portable treatment system be useful/needed? What concerns are there with operating portable treatment system (e.g., safety concerns, permitting requirements)?

A portable treatment systems is probably not the best alternative. The plutonium has no value as a product.

NEPA documentation and permits for any new air releases would be needed.

6. What would be a good product to produce (e.g., PuO<sub>2</sub>, cement) from a treatment system? What would be a good container for storing the product (e.g., crimp can, sch. 80 pipe)?

Plutonium oxide contained in a crimp can would be the best product because storage facilities are already available.

7. What concerns are there with interfacing to a portable treatment system?

	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	[No response was provided.]	
Process/ System 2	[No response was provided.]	
Process/ System 3	[No response was provided.]	

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

8. Are there any pressing constraints to the system?

	Low floor loading limits?	Minimal passageway or door widths	Others?
Process/ System 1	None.		
Process/ System 2	N/A		
Process/ System 3	None.	The glovebox rooms are crowded. Only a 3-4 ft aisle separates the gloveboxes.	The glovebox area is two levels below grade.

9. What are your current utility/disposal capabilities?

### Utility connections

	What utilities are typically available (e.g., 110V 1 $\phi$ power, 220V 3 $\phi$ power, compressed air, water, steam)?
Process/ System 1	Water and steam supplies to the building have been isolated but nearby steam and water lines will remain active. All electrical power will be isolated from the building except lighting circuits. The 220V and 110V power to the exhaust fans and stack monitoring will remain active.
Process/ System 2	Same as above.
Process/ System 3	Same as above.

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

### 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. 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 <sub>x</sub> , H <sub>2</sub> O)?	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?	

### Solid/Liquid Disposal

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

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

10. Miscellaneous:

What else should we know about your facility?

[No response was 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 was provided.]

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

[No response was provided.]

Who else should we talk to?

[No response was provided.]

Survey # 95-2-13-1

Hanford Site - Plutonium Finishing Plant

The following survey was returned by the respondent, who indicated that they would respond more thoroughly if they had the time.

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

**Site: Hanford**

**Date: 2-22-95**

**Facility: Plutonium Finishing Plant**

**Questions:**

1. Do you have any processes/systems that have plutonium-bearing solutions/heels? If so in which processes/systems are they present? Please provide a brief description of each process/system containing the solutions/heels.

	Name
Process/ System 1	Plutonium Reclamation Facility (PRF): This system supported PFP operation in the 236-Z facility with a continuous solvent extraction process. The floor of the 236-Z process canyon has a large amount of plutonium sludges.

2. How much solution/heel is present and what is the composition of the solutions/heels?

	How much?	What composition?
Process/ System 1	The PRF canyon floor is estimated to contain 12 kg of plutonium as a wet sludge [(Pu(NO <sub>3</sub> ) <sub>4</sub> / Pu-tributyl phosphate (TBP) complex].	Pu(NO <sub>3</sub> ) <sub>4</sub> , Pu-TBP complex, AlF <sub>3</sub> , Pu(OH) <sub>4</sub> .

3. Is there a current treatment method for these solutions/heels? If so what is it?

Sodium hydroxide hydrolysis separates the organics from the plutonium followed by calcination at 1000°C to PuO<sub>2</sub> in a batch-loaded muffle furnace.

4. Can the solutions/heels be removed? If so, are there any problems removing the solutions/heels (e.g., safety concerns, permitting requirements)?

The sludge can be removed by scraping. However, there is a radiation field of 100 mR/h.

5. Would a portable treatment system be useful/needed? What concerns are there with operating portable treatment system (e.g., safety concerns, permitting requirements)?

Yes, a portable treatment system would be appropriate. A large double-door airlock is available on the south side of the 236-Z building for entry.

6. What would be a good product to produce (e.g., PuO<sub>2</sub>, cement) from a treatment system? What would be a good container for storing the product (e.g., crimp can, sch. 80 pipe)?

PuO<sub>2</sub> calcined at 1000°C that has a LOI <0.5 wt% is a good product. For storage, follow the new DOE standard for 50-year storage.

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

7. What concerns are there with interfacing to a portable treatment system?

	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	Could the portable system fit in air-lock? Would you want the portable unit back?	No special considerations, just get the sludge off the floor.

8. Are there any pressing constraints to the system?

	Low floor loading limits?	Minimal passageway or door widths	Others?
Process/ System 1	No.	~8-10'	

9. What are your current utility/disposal capabilities?

### Utility connections

	What utilities are typically available (e.g., 110V 1 $\phi$ power, 220V 3 $\phi$ power, compressed air, water, steam)?
Process/ System 1	Available: 480V (3 $\phi$ ), water, compressed air, steam, 220V (3 $\phi$ ), 220V (1 $\phi$ ), 120V (1 $\phi$ ).

### HEPA filter exhaust

	HEPA System 1
Location.	236-Z canyon exhaust.
Service area.	
Maximum flow rate.	~36,000 SCFM.
Condition.	Operational.
What can be discharged to the system (e.g. NO <sub>x</sub> , H <sub>2</sub> O)?	Discharges must meet WA state air permit criteria. Some NO <sub>x</sub> and H <sub>2</sub> O are allowed.
Can connections to the ventilation system be made?	Yes.



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

**Solid/Liquid Disposal**

	Disposal System 1
Location. Service area.	Access difficult from airlock, however arrangements can be made.
What are acceptable as feeds and what are the limits?	Feeds can include: 2-10M NaOH containing <400g Pu, NO <sub>3</sub> , NO <sub>2</sub> , and iron solids.

10. Miscellaneous:

-What else should we know about your facility?

[No response was 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 was provided.]

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

[No response was provided.]

-Who else should we talk to?

[No response was provided.]

Survey # 95-3-14-1

Hanford Site - T Plant

No response was received.

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 reported that they didn't think they could make a meaningful contribution to the survey.*

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 planned to do their own decommissioning.*

Survey # 95-2-21-9

Lawrence Livermore National Laboratory - Building 251

No response was received.

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 did not have a significant plutonium solution inventory. However, they suggested that we look at DOE/EH 0415 Plutonium Vulnerability Assessment [DOE] for a fairly comprehensive inventory of plutonium solutions.*

Survey # 95-3-9-1

Oak Ridge National Laboratory - Chemical Technology Division

No response was received.

Survey # 95-3-7-2

Rocky Flats Plant - Building 779

The respondent completed a survey on the decontamination of equipment [CONNER]. However, the equipment outlined in the survey is contaminated primarily with plutonium, and solutions used to decontaminate this equipment will require treatment.



**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.

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

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' of 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 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?

	Criticality safe / criticality 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 criticality safe.	Criticality prevented by using pencil tanks.	N/A
Process/ System 2	System is criticality safe.	Criticality prevented by limiting volume and Pu concentration.	N/A
Process/ System 3	System is criticality safe.	Criticality prevented by limiting volume and Pu concentration.	N/A

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

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 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	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

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

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. NO <sub>x</sub> , H <sub>2</sub> O)?	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.

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

### 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 # 95-2-20-5

Sandia National Laboratories

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

*The respondent reported that they were not currently doing any decommissioning and didn't really have a big need for decontamination and decommissioning activities.*

Survey # 95-2-22-2

Savannah River Site - F & H Canyons

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

**Site: Savannah River Site**

**Date: 3/6/95**

**Facility: F and H Separations**

### Questions:

1. Do you have any processes/systems that have plutonium-bearing solutions/heels? If so in which processes/systems are they present? Please provide a brief description of each process/system containing the solutions/heels.

	Name
Process/ System 1	PUREX Process - F Canyon
Process/ System 2	HM Process - H Canyon

2. How much solution/heel is present and what is the composition of the solutions/heels?

	How much?	What composition?
Process/ System 1	Approximately 80,000 gallons of plutonium solutions in F Canyon.	
Process/ System 2	Approximately 8700 gallons of plutonium solutions in H Canyon.	

3. Is there a current treatment method for these solutions/heels? If so what is it?

The current planned treatment is to process remaining solutions into a stable metal or oxide using existing process equipment. Systems will then be flushed and solution processed until there is no change realized in composition. At this point, the remaining residual solutions will be sent to the tank farm/DWPF.

4. Can the solutions/heels be removed? If so, are there any problems removing the solutions/heels (e.g., safety concerns, permitting requirements)?

There may be residuals in some systems that will require further decontamination.



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

5. Would a portable treatment system be useful/needed? What concerns are there with operating portable treatment system (e.g., safety concerns, permitting requirements)?

After flushing and deactivation, the systems will require final decontamination. A portable treatment system may be useful then, especially for the last tankage being decommissioned. The portable system will be best suited for systems outside the canyon since access to the canyon will be difficult.

If a portable system is used, the waste products should be compatible with the existing waste streams at SRS in order to send waste to waste tanks and DWPF.

The canyons are under special consideration and are not currently permitted under RCRA or other waste water treatment scenarios.

6. What would be a good product to produce (e.g., PuO<sub>2</sub>, cement) from a treatment system? What would be a good container for storing the product (e.g., crimp can, sch. 80 pipe)?

PuO<sub>2</sub> would be good since current plans are to produce PuO<sub>2</sub> in the H Canyon for solution disposition.

Will portable unit have resin beds requiring disposal? If wet beds, there could be problems with transporting.

7. What concerns are there with interfacing to a portable treatment system?

	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 and 2	<p>Canyon - Access will be difficult. The systems outside the canyon will be much easier to access.</p> <p><u>Concerns:</u>                      -release outside of canyon operations.                      -overpressure of systems.                      -transportation of liquid waste.                      -interface with canyon tankage.                      -waste compatibility with SRS waste streams.</p>	Hanford connections and flanges.

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

8. Are there any pressing constraints to the system?

	Low floor loading limits?	Minimal passageway or door widths	Others?
Process/ System 1 and 2			-Radiologically controlled areas.  -Some tanks/systems are underground.  -Canyon systems/tankage will be difficult to access.

9. What are your current utility/disposal capabilities?

### Utility connections

	What utilities are typically available (e.g., 110V 1 $\phi$ power, 220V 3 $\phi$ power, compressed air, water, steam)?
Process/ System 1 and 2	Utilities may be limited when deactivation takes place. Presently have all of the above.  Disposal capabilities - Currently have internal canyon decontamination. Waste from decontamination and system flushing can be processed and transferred to existing tank farms with ultimate disposition at DWPF.

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

### HEPA filter exhaust

	HEPA System 1
Location. Service area.	<p>Canyons and buildings have sand filters primarily. Some systems may be HEPA filtered.</p> <p>Outside facilities may not have access to HEPAs.</p> <p>Underground tanks are HEPA filtered.</p>
Maximum flow rate.	
Condition.	Operational.
What can be discharged to the system (e.g. NO <sub>x</sub> , H <sub>2</sub> O)?	Anything compatible with HEPA filters and sand filters.
Can connections to the ventilation system be made?	Yes.

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

### Solid/Liquid Disposal

Disposal System 1	
Location. Service area.	<p>HLW - goes to tank farm and DWPF.</p> <p>LLW - goes to E-Area Vault.</p> <p>TRU - goes to pad storage for eventual WIPP disposal.</p>
What are acceptable as feeds and what are the limits?	<p>Not to exceed (HLW) criteria:</p> <p>0.5% (by vol.) organics; no arsenic, cadmium, selenium or silver;</p> <p>2.0% (by wt.) solids;</p> <p>pH 10-12.</p>

10. Miscellaneous:

-What else should we know about your facility?

Other areas of SRS may have systems with residual solutions and heels. There are numerous holding tanks that could have residuals and could be cleaned with a portable treatment system.

High activity waste trailers may be potential candidates for a portable treatment system.

-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?

SRS Integrated Stabilization Management Plan (Draft, March 1995)

F Canyon Pu Solutions EIS of 12/94 (Final)

Interim Management of Nuclear Materials of 2/95 (Draft, unapproved)

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

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

A certified, acceptable method for mobile processing of liquid Low Level (<100 Ci/g)/High Activity (>1000 d/m/mL) Waste.

-Who else should we talk to?

[Removed in the interest of anonymity.]



APPENDIX B.

PLUTONIUM-BEARING SOLUTIONS TREATMENT 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 Portable Treatment System for Plutonium Solutions**

Many DOE facilities that have handled large quantities of liquid plutonium solutions are being deactivated. Some of these facilities have residual solution and heels remaining in them. Draining and flushing the equipment (e.g. piping, tankage, glove boxes, ventilation ducts) in these facilities are expected to generate substantial quantities of liquids containing accountable quantities of plutonium. In addition, these solutions are expected to have a variety of components including: acids, bases, and suspended solids. A modular, portable treatment system is being developed to treat these solutions. The system must be able to interface with existing utilities and safety systems, maneuver in process areas, and meet criticality-safety constraints.

An initial survey is being completed to determine the composition and quantities of solutions and heels present, what methods have been used to treat these solutions and heels in the past, and what potential problems are there with removing and treating these solutions and heels. Information from this survey will be used to develop system design criteria and locate sites for prototype testing.

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. Do you have any processes/systems that have plutonium-bearing solutions/heels? If so in which processes/systems are they present? Please provide a brief description of each process/system containing the solutions/heels.

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

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

2. How much solution/heel is present and what is the composition of the solutions/heels?

	How much?	What composition?
Process/ System 1		
Process/ System 2		
Process/ System 3		

3. Is there a current treatment method for these solutions/heels? If so what is it?

4. Can the solutions/heels be removed? If so, are there any problems removing the solutions/heels (e.g. safety concerns, permitting requirements)?

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

5. Would a portable treatment system be useful/needed? What concerns are there with operating portable treatment system (e.g. safety concerns, permitting requirements)?
6. What would be a good product to produce (e.g. PuO<sub>2</sub>, cement) from a treatment system? What would be a good container for storing the product (e.g. crimp can, sch. 80 pipe)?
7. What concerns are there with interfacing to a portable treatment system?

	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		

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

8. Are there any pressing constraints to the system?

	Low floor loading limits?	Minimal passageway or door widths	Others?
Process/ System 1			
Process/ System 2			
Process/ System 3			

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

9. What are your current utility/disposal capabilities?

### Utility connections

	What utilities are typically available (e.g. 110V 1 $\phi$ power, 220V 3 $\phi$ power, compressed air, water, steam)?
Process/ System 1	
Process/ System 2	
Process/ System 3	

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

### 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 <sub>x</sub> , H <sub>2</sub> O)?			
Can connections to the ventilation system be made?			

### Solid/Liquid Disposal

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

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

10. 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 a portable treatment technology? Do you have any sites that might be suitable for potential demonstrations?

Who else should we talk to?

Distribution for ANL-95/31

Internal:

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