

# PUREX Plant Process Condensate Stream- Specific Report



Prepared for the U.S. Department of Energy  
Office of Environmental Restoration  
and Waste Management



**Westinghouse**  
**Hanford Company** Richland, Washington

Hanford Operations and Engineering Contractor for the  
U.S. Department of Energy under Contract DE-AC06-87RL10930

Approved for Public Release

#### **DISCLAIMER**

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

This report has been reproduced from the best available copy. Available in paper copy and microfiche.  
The U.S. Department of Energy and its contractors can obtain copies of this report from:  
Office of Scientific and Technical Information  
P.O. Box 62  
Oak Ridge, TN 37831  
(615) 576-8401  
This report is publicly available from:  
National Technical Information Service  
5285 Port Royal Road  
Springfield, VA 22161  
(703) 487-4650

Printed in the United States of America

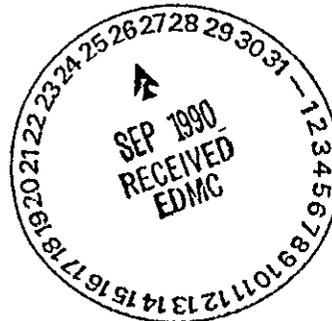
DISCLM-1.CHP (7-90)

# START

0010815  
10b

WHC-EP-0342  
Addendum 12

## PUREX Plant Process Condensate Stream- Specific Report



Prepared for the U.S. Department of Energy  
Office of Environmental Restoration  
and Waste Management



**Westinghouse**  
**Hanford Company** Richland, Washington

Hanford Operations and Engineering Contractor for the  
U.S. Department of Energy under Contract DE-AC06-87RL10930

Approved for Public Release

9111195113

**THIS PAGE INTENTIONALLY  
LEFT BLANK**

# PUREX Plant Process Condensate Stream-Specific Report

PUREX/UO<sub>3</sub> Operations

Date Published  
August 1990

Prepared for the U.S. Department of Energy  
Office of Environmental Restoration  
and Waste Management



**Westinghouse**  
**Hanford Company**

P.O. Box 1970  
Richland, Washington 99352

Hanford Operations and Engineering Contractor for the  
U.S. Department of Energy under Contract DE-AC06-87RL10930

Approved for Public Release

91111151114

**THIS PAGE INTENTIONALLY  
LEFT BLANK**

PUREX PLANT PDD  
STREAM-SPECIFIC REPORT

PUREX/UO<sub>3</sub> OPERATIONS

ABSTRACT

*The proposed wastestream designation for the PUREX Plant PDD wastestream is that this stream is not a dangerous waste, pursuant to the Washington (State) Administration Code (WAC) 173-303, Dangerous Waste Regulations.\* A combination of process knowledge and sampling data was used to make this determination.*

---

\*Ecology, 1989, *Dangerous Waste Regulations*, Washington (State) Administrative Code (WAC) 173-303, Washington State Department of Ecology, Olympia, Washington.



### EXECUTIVE SUMMARY

The proposed dangerous waste designation for the PUREX PDD (sometimes called the Process Condensate wastewater stream), located in the 200 East Area of the Hanford Site, is that the stream is not a dangerous waste pursuant to the Washington Administrative Code (WAC) 173-303, *Dangerous Waste Regulations*.<sup>\*</sup> A combination of process knowledge and present sampling data was used to determine if the effluent contains a listed dangerous waste (WAC 173-303-080). Sampling data alone are compared to the dangerous waste criteria (WAC 173-303-100) and dangerous waste characteristics (WAC 173-303-090). Sampling data were based on results of analyses of eight samples taken at random sampling times between January 1990 and March 1990. Five of these samples were analyzed for the full suite of analytes; the remaining three samples were analyzed for volatile organics.

Before the opening of the 216-A-45 Crib in 1987, the PDD was sometimes corrosive, and consequently designated as dangerous waste, with a dangerous waste number of D002. The designation change resulted from process changes that coincided with the opening of the 216-A-45 Crib, and not from the opening itself.

---

<sup>\*</sup>Ecology, 1989, *Dangerous Waste Regulations*, Washington (State) Administrative Code, WAC 173-303, Washington State Department of Ecology, Olympia, Washington.



LIST OF TERMS

AFAN	ammonium fluoride-ammonium nitrate
ALARA	as low as reasonably achievable
AMU	aqueous makeup
BAT	best available technology
DCG	Derived Concentration Guide
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
HEHF	Hanford Environmental Health Foundation
HH	halogenated hydrocarbon
LERF	Liquid Effluent Retention Facility
MEK	methyl ethyl ketone (2-butanone)
N.O.S	not otherwise specified
NPH	normal paraffin hydrocarbon
P&O Gallery	Pipe and Operations Gallery
PAH	polycyclic, aromatic hydrocarbon
PUREX	Plutonium-Uranium Extraction
SNM	special nuclear material
TBP	tributyl phosphate
TOC	total organic carbon
TOX	total organic halogen
Tri-Party Agreement	<i>Hanford Federal Facility Agreement and Consent Order</i>
UGS	underground storage (tanks)
VOA	volatile organic compounds
WAC	Washington (State) Administrative Code
90%CI	90 percent confidence interval



CONTENTS

1.0	INTRODUCTION . . . . .	1-1
1.1	BACKGROUND . . . . .	1-1
1.2	APPROACH . . . . .	1-1
1.3	SCOPE . . . . .	1-4
2.0	PROCESS KNOWLEDGE . . . . .	2-1
2.1	PHYSICAL LAYOUT . . . . .	2-1
2.1.1	The 202-A Building . . . . .	2-1
2.1.2	206-A Acid Fractionator Building . . . . .	2-4
2.1.3	The 293-A Building . . . . .	2-4
2.1.4	Effluent-Monitoring Buildings . . . . .	2-4
2.1.5	Tank 216-A-5 Calcium Carbonate Neutralization Tank . . . . .	2-4
2.2	CONTRIBUTORS . . . . .	2-4
2.3	PROCESS DESCRIPTIONS . . . . .	2-8
2.3.1	Present Activities . . . . .	2-8
2.3.2	Past Activities . . . . .	2-11
2.3.3	Future Activities . . . . .	2-15
2.4	PROCESS DATA . . . . .	2-16
3.0	SAMPLE DATA . . . . .	3-1
3.1	DATA SOURCE . . . . .	3-1
3.1.1	Wastestream Data . . . . .	3-1
3.1.2	Background Data . . . . .	3-1
3.2	DATA PRESENTATION . . . . .	3-4
3.2.1	Primary Organic and Inorganic Constituents . . . . .	3-4
3.2.2	Radionuclide Data . . . . .	3-4
3.2.3	Background Chemical Data . . . . .	3-4
4.0	DATA OVERVIEW . . . . .	4-1
4.1	DATA COMPARISON . . . . .	4-1
4.1.1	Cyanide . . . . .	4-1
4.1.2	Fluoride . . . . .	4-1
4.1.3	Mercury . . . . .	4-4
4.1.4	Nitrate and Nitrite . . . . .	4-4
4.2	STREAM DEPOSITION RATES . . . . .	4-4
5.0	DESIGNATIONS . . . . .	5-1
5.1	DANGEROUS WASTE LISTS . . . . .	5-1
5.1.1	Discarded Chemical Products . . . . .	5-1
5.1.2	Dangerous Waste Sources . . . . .	5-3
5.2	LISTED WASTE DATA CONSIDERATIONS . . . . .	5-3
5.2.1	Process Evaluation . . . . .	5-3
5.2.2	Sampling Data . . . . .	5-4
5.3	PROPOSED LISTED WASTE DESIGNATIONS . . . . .	5-4
5.3.1	Discarded Chemical Products . . . . .	5-4
5.3.2	Dangerous Waste Sources . . . . .	5-11

CONTENTS (continued)

5.4	DANGEROUS WASTE CRITERIA . . . . .	5-13
5.4.1	Toxic Dangerous Waste . . . . .	5-13
5.4.2	Persistent Dangerous Waste . . . . .	5-14
5.4.3	Carcinogenic Dangerous Waste . . . . .	5-14
5.5	DANGEROUS WASTE CHARACTERISTICS . . . . .	5-15
5.5.1	Ignitability . . . . .	5-15
5.5.2	Corrosivity . . . . .	5-15
5.5.3	Reactivity . . . . .	5-16
5.5.4	Extraction Procedure Toxicity . . . . .	5-16
5.6	PROPOSED DESIGNATIONS . . . . .	5-16
6.0	ACTION PLAN . . . . .	6-1
6.1	FUTURE SAMPLING . . . . .	6-1
6.2	TECHNICAL ISSUES . . . . .	6-1
7.0	REFERENCES . . . . .	7-1
APPENDICES		
A	PDD PRESENT CHEMICAL DATA . . . . .	A-1
B	PDD HISTORICAL RADIOLOGICAL AND CHEMICAL DATA . . . . .	B-1

**LIST OF FIGURES**

1-1	Characterization Strategy . . . . .	1-3
1-2	Location of the PUREX Plant Within the Hanford Site . . . . .	1-5
2-1	The PUREX Plant Plot Plan . . . . .	2-2
2-2	The 202-A Building . . . . .	2-3
2-3	PDD System Within the PUREX Plant . . . . .	2-6
2-4	The "Current" PDD Process . . . . .	2-7
2-5	The "Historical" PDD Process . . . . .	2-13
2-6	The PUREX Plant Liquid Effluents . . . . .	2-14
5-1	Designation Strategy . . . . .	5-2

**LIST OF TABLES**

1-1	Stream-Specific Characterization Reports . . . . .	1-2
2-1	"Current" PDD Flows . . . . .	2-10
3-1	Procedures for PUREX PDD Samples . . . . .	3-2
3-2	Statistics for PUREX PDD . . . . .	3-5
3-3	Average Radionuclide Content of the PUREX PDD . . . . .	3-7
3-4	Summary of 200 East Area Raw Water Data . . . . .	3-8
3-5	200 East Sanitary Water--Organic Data . . . . .	3-10
3-6	Summary of 2724-W Laundry Steam Condensate Data . . . . .	3-11
4-1	Evaluation of PUREX PDD . . . . .	4-2
4-2	Historic Radionuclide Comparison to Guideline Ratios . . . . .	4-3
4-3	Deposition Rate for PUREX PDD . . . . .	4-5
5-1	Inorganic Chemistry for PUREX PDD . . . . .	5-5
5-2	Dangerous Waste Designation Report for the PDD . . . . .	5-8



**PUREX PLANT PDD  
STREAM-SPECIFIC REPORT**

**1.0 INTRODUCTION**

**1.1 BACKGROUND**

In response to the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989), comments from the public were received regarding reduction of the discharge of liquid effluents into the soil column. As a result, the U.S. Department of Energy (DOE), with concurrence of the Washington State Department of Ecology (Ecology) and the U.S. Environmental Protection Agency (EPA), committed to assess the contaminant migration potential of liquid discharges at the Hanford Site (Lawrence 1989).

This assessment is described in the *Liquid Effluent Study Project Plan* (WHC 1990a), a portion of which characterizes 33 liquid effluent streams. The characterization consists of comparing process data and sampling data with dangerous waste regulations pursuant to the Washington (State) Administrative Code (WAC) 173-303 (Ecology 1989). The comparison and follow-up investigations will provide a designation of the stream per WAC 173-303 and may provide priorities for further treatment of some streams.

The results of the characterization study are documented in 33 separate reports, one for each wastestream. The complete list of stream-specific reports appears in Table 1-1. This document is one of the 33 reports.

**1.2 APPROACH**

This report characterizes the Plutonium-Uranium Extraction (PUREX) Plant PDD (sometimes called the Process Condensate wastestream), located in the 200 East Area of the Hanford Site, in sufficient detail so that a dangerous waste designation, in accordance with WAC 173-303, can be proposed.

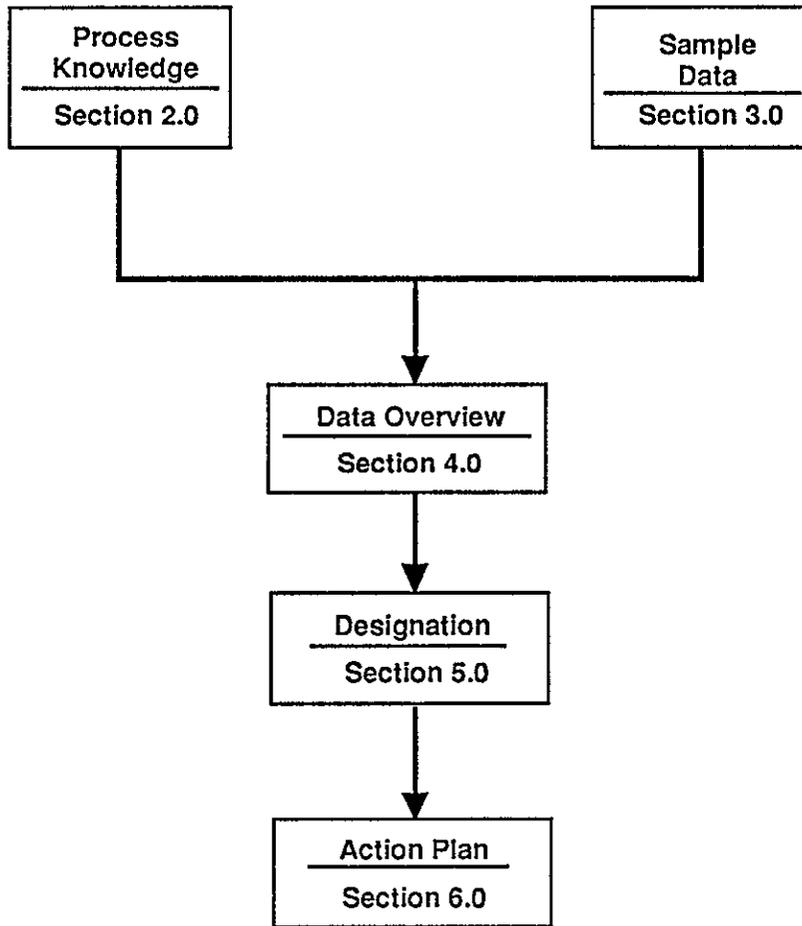
This characterization strategy (shown in Figure 1-1) is implemented by means of the following steps.

1. Describe both process and sampling data (Sections 2.0 and 3.0).
2. Integrate the data (Section 4.0).
3. Propose a designation (Section 5.0).
4. Design an action plan, if needed, to obtain additional characterization data (Section 6.0).

Table 1-1. Stream-Specific Characterization Reports.

WHC-EP-0342	Addendum 1	300 Area Process Wastewater
WHC-EP-0342	Addendum 2	PUREX Plant Chemical Sewer
WHC-EP-0342	Addendum 3	N Reactor Effluent
WHC-EP-0342	Addendum 4	163N Demineralization Plant Wastewater
WHC-EP-0342	Addendum 5	PUREX Plant Steam Condensate
WHC-EP-0342	Addendum 6	B Plant Chemical Sewer
WHC-EP-0342	Addendum 7	UO <sub>3</sub> /U Plant Wastewater
WHC-EP-0342	Addendum 8	Plutonium Finishing Plant Wastewater
WHC-EP-0342	Addendum 9	S Plant Wastewater
WHC-EP-0342	Addendum 10	T Plant Wastewater
WHC-EP-0342	Addendum 11	2724-W Laundry Wastewater
WHC-EP-0342	Addendum 12	PUREX Plant Process Condensate
WHC-EP-0342	Addendum 13	222-S Laboratory Wastewater
WHC-EP-0342	Addendum 14	PUREX Plant Ammonia Scrubber Condensate
WHC-EP-0342	Addendum 15	242-A Evaporator Process Condensate
WHC-EP-0342	Addendum 16	B Plant Steam Condensate
WHC-EP-0342	Addendum 17	B Plant Process Condensate
WHC-EP-0342	Addendum 18	2101-M Laboratory Wastewater
WHC-EP-0342	Addendum 19	UO <sub>3</sub> Plant Process Condensate
WHC-EP-0342	Addendum 20	PUREX Plant Cooling Water
WHC-EP-0342	Addendum 21	242-A Evaporator Cooling Water
WHC-EP-0342	Addendum 22	B Plant Cooling Water
WHC-EP-0342	Addendum 23	241-A Tank Farm Cooling Water
WHC-EP-0342	Addendum 24	284-E Powerplant Wastewater
WHC-EP-0342	Addendum 25	244-AR Vault Cooling Water
WHC-EP-0342	Addendum 26	242-A Evaporator Steam Condensate
WHC-EP-0342	Addendum 27	284-W Powerplant Wastewater
WHC-EP-0342	Addendum 28	400 Area Secondary Cooling Water
WHC-EP-0342	Addendum 29	242-S Evaporator Steam Condensate
WHC-EP-0342	Addendum 30	241-AY/AZ Tank Farms Steam Condensate
WHC-EP-0342	Addendum 31	209-E Laboratory Reflector Water
WHC-EP-0342	Addendum 32	T Plant Laboratory Wastewater
WHC-EP-0342	Addendum 33	183-D Filter Backwash Wastewater

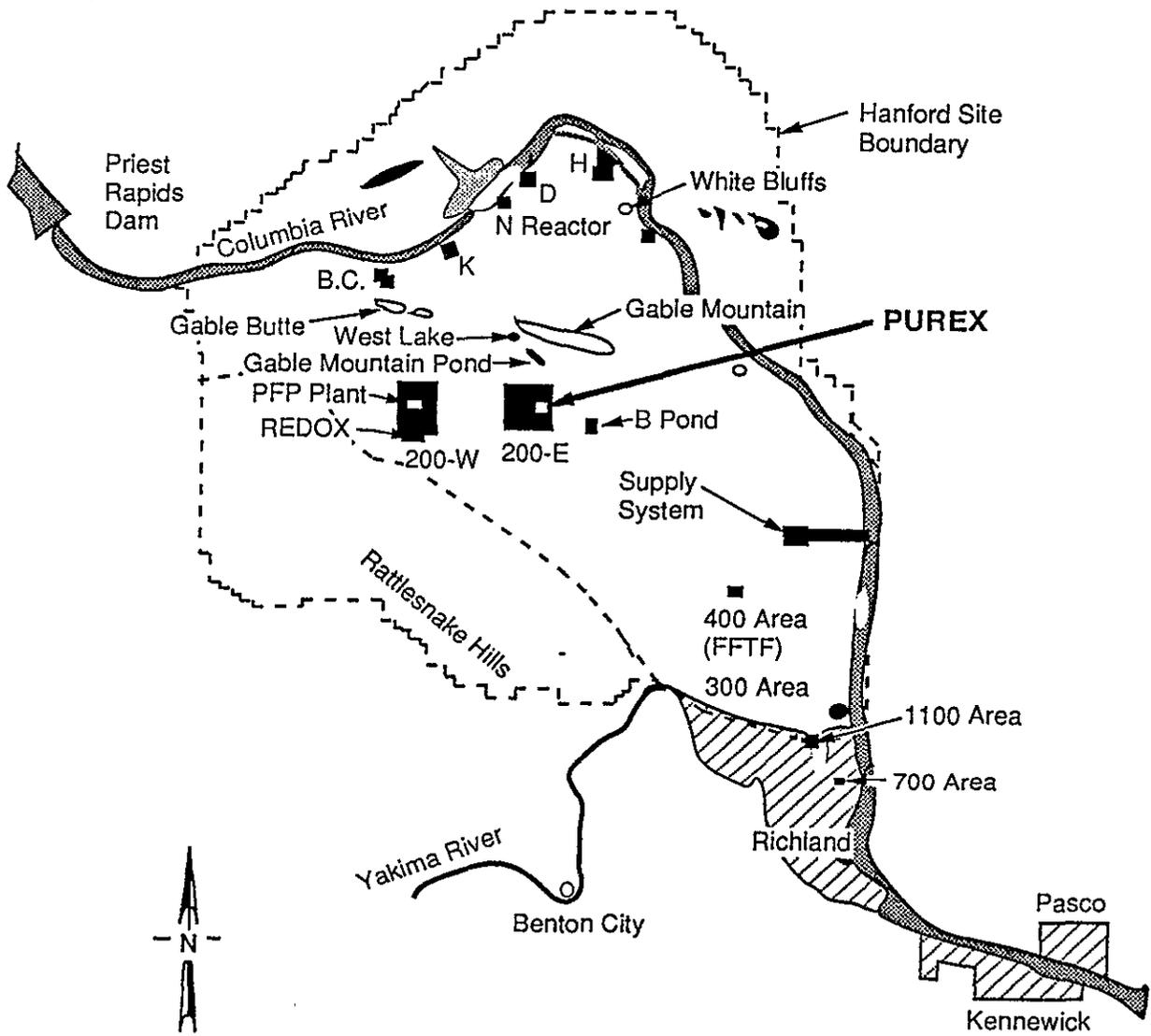
Figure 1-1. Characterization Strategy.



29002020.8



Figure 1-2. Location of the PUREX Plant Within the Hanford Site.



28905055.72M

This page intentionally left blank.

0  
1  
1  
5  
6  
1  
1  
1  
1  
6

## 2.0 PROCESS KNOWLEDGE

This section presents a qualitative and quantitative process-knowledge-based characterization of the chemical and radiological constituents of the PDD wastestream. These process data are discussed in terms of the following factors:

1. Location and physical layout of the process facility
2. A general description of the present, past, and future activities of the process
3. The identity of the wastestream contributors
4. The identity and concentration of the constituents of each contributor.

The PUREX process generates various condensates from liquid concentrators. These condensates are recycled through the PUREX process and are discharged as low-level aqueous effluents. This section discusses the process data for one of these condensates, the PDD.

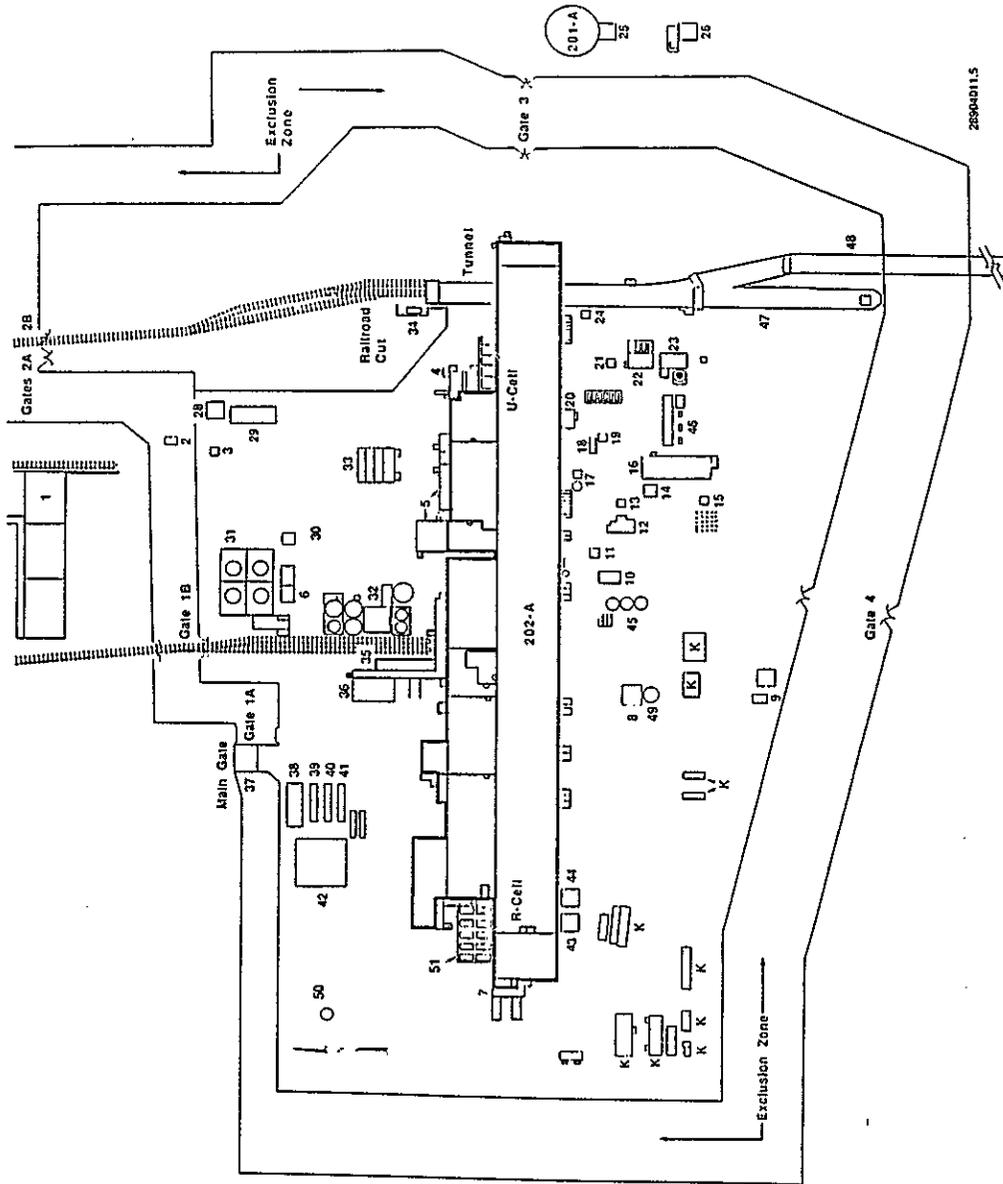
### 2.1 PHYSICAL LAYOUT

The PUREX Plant comprises several buildings and facilities located in the 200 East Area of the Hanford Site. The main building, 202-A, is a heavily shielded reinforced-concrete structure known as a canyon building. There are many peripheral structures as well; however, most have no immediate effect on the PDD effluent. The 206-A Acid Fractionator Building, the 293-A Building, Tank 216-A-5 Calcium Carbonate Neutralizer (or "Carbonate Bed"), and the 295-AB Effluent-Monitoring Building are external facilities that have close connections with processes feeding the PDD concentrators or with the stream itself after it exits the 202-A Building. Figure 2-1 is a plot plan for the PUREX Plant complex.

#### 2.1.1 The 202-A Building

The 202-A Building is 1,005 ft long, 119 ft wide at its widest point, and 100 ft high, with 40 ft of this height below grade (Figure 2-2). The canyon itself extends nearly the length of the 202-A Building. The canyon contains and shields the process equipment used for processing irradiated nuclear fuel. The canyon consists of the canyon proper, crane cab gallery, process cells, the hot pipe trench, and the ventilation air tunnel.

Figure 2-1. The PUREX Plant Plot Plan.



1. 275-EA Warehouse
  2. CSL PIT
  3. 295-AC CSL (Chem. Sewer Line)
  4. 205-A Fractionator
  5. Laboratory Sample Receiving Dock
  6. 203-A UNH Pump House/Control Room
  7. PR-Dock
  8. 295-AB PDD (Process Distillate Discharge)
  9. A-4 PIT/PDD PIT
  10. 213-A Reg Maint. Workshop
  11. 291-AB Sample Shack
  12. Shielded Valve PIT
  13. 291-AC Instr. Shack
  14. 291-AG Instr. Shack
  15. 291-AJ Instr. Shack
  16. 291-AE #4 Filter Bldg.
  17. 295-AA SCD (Steam Condensate Discharge)
  18. 291-AH Ammonia Oil Gas Filter Bldg.
  19. 291-AI Ammonia Oil Gas Sampler Bldg.
  20. 212-A Load Out
  21. 293-A Instr. Shack
  22. 295-A Dissolver Oil Gas Bldg.
  23. 292-AB Main Stack Bldg.
  24. 295-A ASD (Ammonia Scrubber Discharge)
  25. 201-A Pump PIT
  26. 295-AD CWL (Cooling Water Line)
  27. B12 Exhauster Area
  28. 292-A Emergency Generators
  29. 201-5
  30. 203-A Storage Area
  31. 211-Demonstrator Bldg.
  32. 440-603 Laboratory Trailer
  33. 211-Demonstrator Storage Shed
  34. 211-A, B, C, D
  35. 211-A Badge House
  36. 211-A Training Trailer
  37. 211-A Training Trailer
  38. MO-202
  39. 64-15323
  40. 202A-T1
  41. MO-023 Engineering Trailer
  42. 2711-A-1
  43. 2712-A
  44. Hydrogen Peroxide Tanks
  45. 291-A Exhaust Fans
  46. 218-E-14 Storage Tunnel
  47. 218-E-15 Storage Tunnel
  48. 216-A-5
  49. 2901-A Water Tank
  50. 276-A R Cell
  51. Kaiser Related Facilities
- K = Kaiser Related Facilities

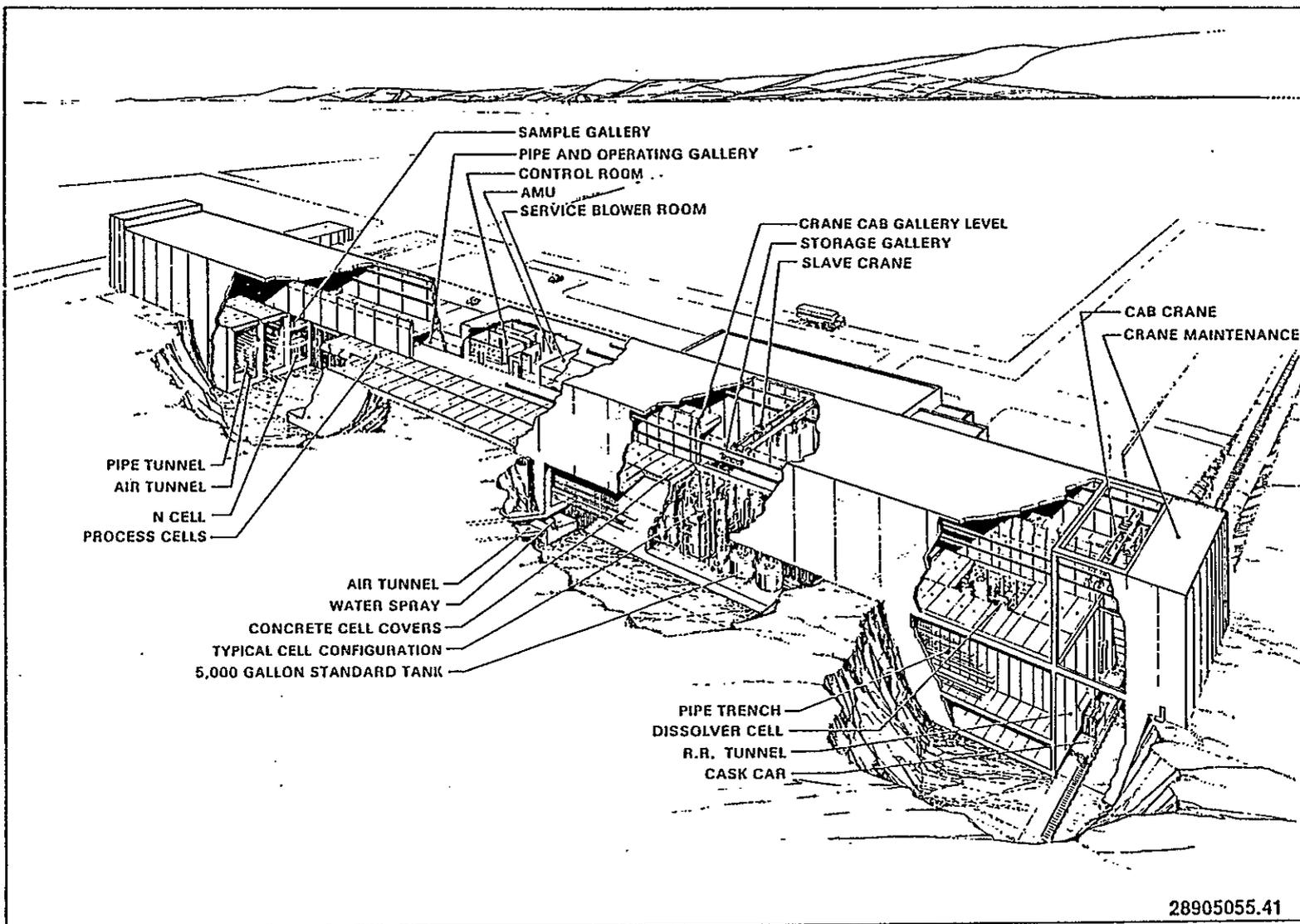


Figure 2-2. The 202-A Building.

WHC-EP-0342 Addendum 12 08/31/90  
PUREX Plant PDD

### 2.1.2 206-A Acid Fractionator Building

The 206-A Building is a reinforced concrete structure located adjacent to the 202-A Building. It houses the vacuum fractionator (which concentrates recovered nitric acid) and associated equipment. Condensate from the 206-A Building flows to the E-H4 concentrator, which in turn feeds other concentrators that contribute to the PDD wastestream.

### 2.1.3 The 293-A Building

The 293-A Building houses the backup facility, which removes nitrogen oxides from the dissolver off-gas stream, converting them to nitric acid that is recycled into the PUREX process via the 206-A Building.

### 2.1.4 Effluent-Monitoring Buildings

Several small buildings and other enclosures contain equipment for monitoring various liquid and gaseous effluent streams. The 295-AB Building houses sampling and monitoring equipment for the PDD.

### 2.1.5 Tank 216-A-5 Calcium Carbonate Neutralization Tank

This tank contains calcium carbonate (crushed limestone), which provides assurance that the PDD will not exceed the 2.0 pH limit if upstream neutralization systems do not perform as expected.

## 2.2 CONTRIBUTORS

The two primary direct contributors to the PDD are the condensed overheads (vapors) from the J8 and K4 concentrators.

Sources of chemicals in the PDD fall into three classifications: irradiated fuel from N Reactor, essential materials (process and laboratory chemicals), and utilities (air, water, and steam). Demineralizer water is used to prepare process solutions and for dilution during certain steps in the process. Steam from the powerhouse is used by the steam jets for transferring solutions between vessels.

The irradiated fuel processed at the PUREX Plant contains both fission products and transuranic elements, including traces of most of the known elements. The contribution to the PDD of most of these species is limited to the effects of the emitted radiation on the chemicals in the process because most of the species formed by the dissolution of the fuel are nonvolatile.

The most prevalent radionuclides, from a volatility standpoint, are tritium (an isotope of hydrogen which is largely converted to water) and the radioisotopes of ruthenium. At least one volatile ruthenium species, ruthenium tetroxide, is known. However, ruthenium volatility is found in the PUREX process even under conditions that are hostile to the production and existence of the tetroxide. Therefore, at least one unknown species is produced. Because of the small quantities of ruthenium actually present, it is not practical to isolate and identify the unknown ruthenium species.

The bulk of the process chemicals are nonvolatile and do not contribute significant contamination to the PDD. The most notable exception is the organic extractant used in the process, a solution of tributyl phosphate (TBP) and a mixture of normal paraffin hydrocarbons (NPH). Other possibly volatile chemical species include fluoride (which is a part of the ammonium fluoride-ammonium nitrate [AFAN] solution used for decladding fuel), chloride (which can enter the process as impurities in the AFAN and in the sulfamate chemicals), and sulfate (which is a breakdown product of the sulfamate chemicals).

The feedstreams to the concentrators are aqueous solutions from the PUREX process (Figure 2-3). These streams contain small amounts of TBP and NPH because the aqueous and organic solution are in intimate contact with each other in the process. However, one of the primary desirable properties of the PUREX process organic solvents is that they are nearly insoluble in water. Therefore, very little organic contamination gets into the concentrators, and from there into the PDD stream.

Additional organic constituents in the PDD result from the recycle of analyzed process samples (containing recoverable actinides) which contain various laboratory reagents used in the analyses. Potentially listed organic solvents are not returned to the process but are packaged for disposal as mixed waste.

Many of the chemicals used in the PUREX process are first diluted with demineralized water. Because the ion exchange process used to produce the demineralized water does not remove organic chlorides, this dilution water serves as an avenue for volatile organic chlorides to enter the PUREX process and contaminate the PDD. (Volatile organic chlorides exist in the sanitary water, which is the feed to the ion exchange process used to produce the demineralized water. Chlorination, a step in the production of sanitary water from raw water, converts some of the organic materials in the raw water into organic chlorides. The raw water is pumped from the Columbia River.)

The specific contributors for past, present, and future operations are discussed in Section 2.3. The immediate potential contributors to the PDD are as follows (Figure 2-4):

- J8 Concentrator Condenser
- J8 Sample Pot

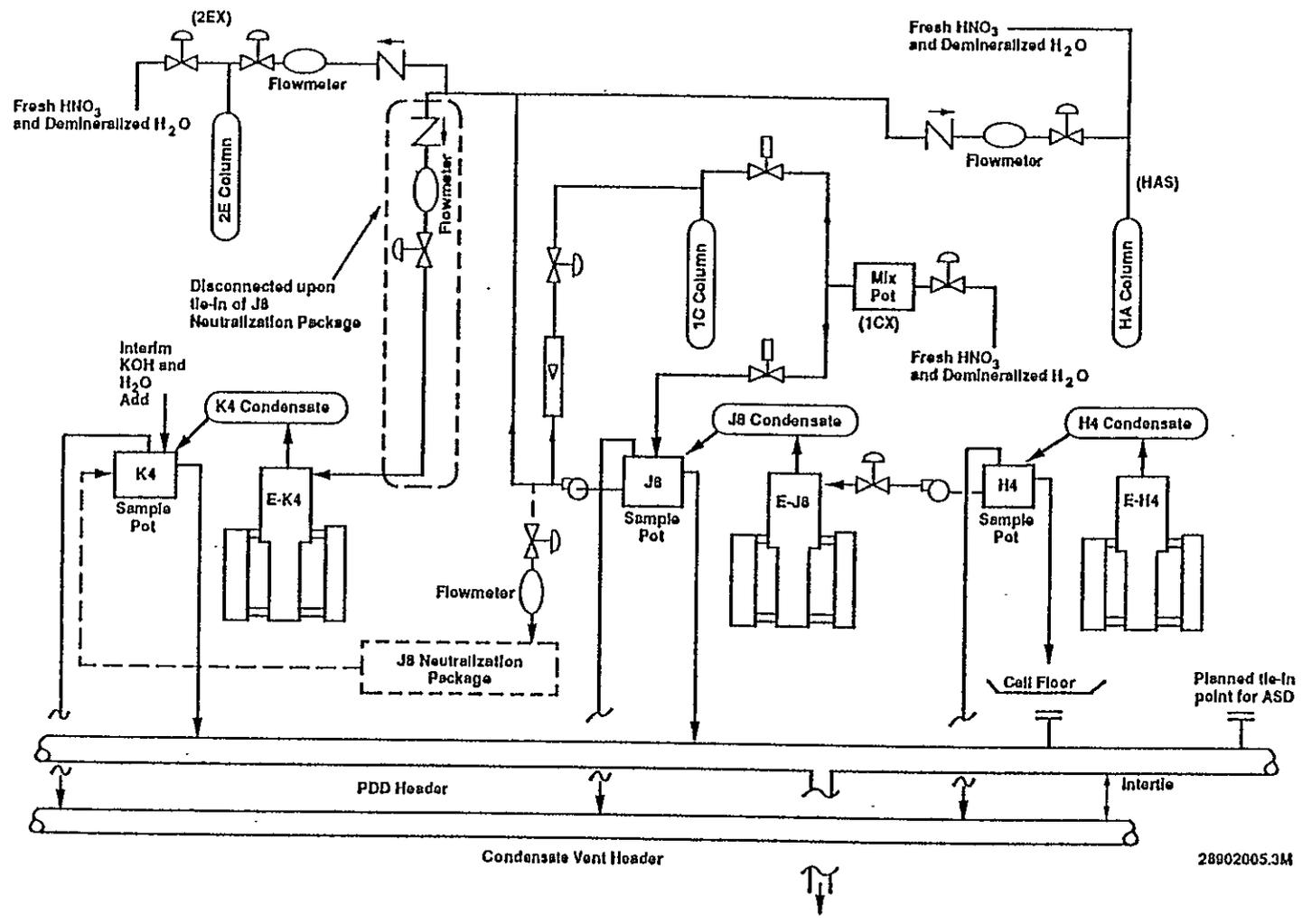


Figure 2-3. PDD System Within the PUREX Plant.

28902005.3M

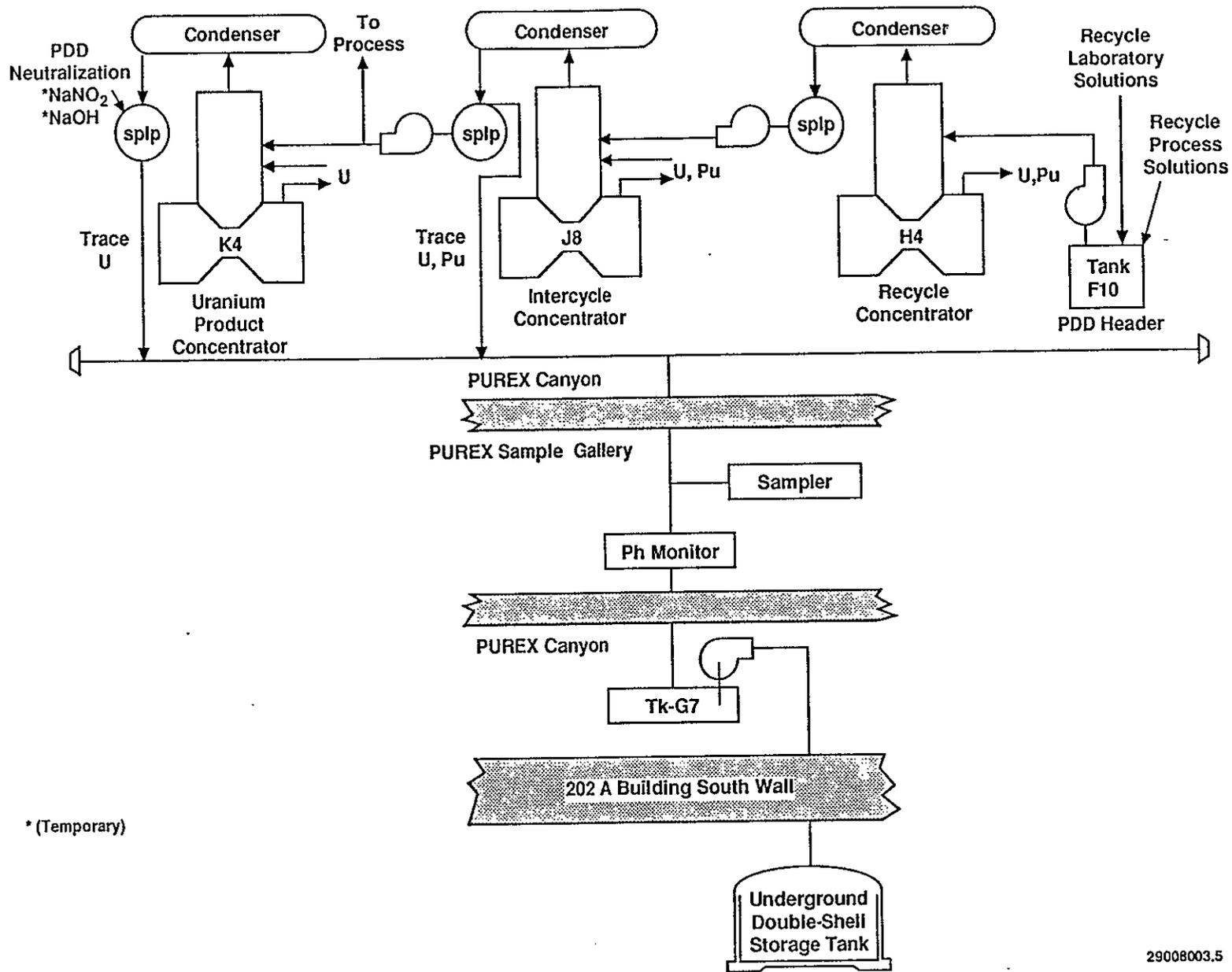


Figure 2-4. The "Current" PDD Process.

2-7

\*(Temporary)

- K4 Concentrator Condenser
- K4 Sample Pot Carrier Water
- K4 Sample Pot Potassium Hydroxide
- Calcium Carbonate pH Polishing Tank.

## 2.3 PROCESS DESCRIPTIONS

The PDD process description proceeds in three parts: present activities, past activities, and future activities. For purposes of this document, present (or current) activities are defined as those occurring from October 1989 to March 1990. Designation is based on present activities. Past (or historical) activities are defined as those preceding October 1989. Future activities are defined as those occurring after March 1990.

It should be emphasized that the PDD is a discontinuous stream, which is normally produced only when the solvent extraction process is operating. Thus, there was no PDD produced from October 1989 through December 1989.

### 2.3.1 Present Activities

The discussion of present activities comprises three parts. The first provides an overview of the entire PUREX Plant, with emphasis on the liquid effluent streams which traditionally have been disposed to the ground. The second focuses on the operation of the PDD itself. The third discusses administrative controls.

**2.3.1.1 PUREX Process Overview.** The PUREX Plant, located in the 200 East Area of the DOE's Hanford Site in southeast Washington, separates usable actinides from fission products in irradiated nuclear fuel. Briefly, the process consists of dissolving the fuel and then separating the actinides using liquid-liquid solvent extraction. The driving forces for the separations consist of concentration changes, temperature changes, and chemical additions. The PUREX Plant is the source of five liquid effluent streams, which are mostly by-products of the various driving forces. These liquid effluent streams are the PDD, CWL, SCD, CSL, and ASD.

The concentration levels are changed by diluting with water and by removing water (and sometimes nitric acid) by boiling. Cold chemical additions to the process add water that must be removed in the concentration stages. Although most of the water that is boiled out of solutions is re-used in dilution stages, there is some excess which requires disposal. This water is the source of the PDD.

Boiling process solutions and condensing the resulting vapors requires the use of steam and cooling water, and produces steam condensate and warm water as effluents. Changing the temperatures of process solutions to drive

the separations produces more steam condensate and warm water. This steam condensate and warm water constitute most of the liquid effluents from PUREX, namely, the CWL (sometimes called Cooling Water), SCD (sometimes called Steam Condensate), and most of the CSL (sometimes called Chemical Sewer). Addenda 20, 5, and 2 address the CWL, SCD, and CSL, respectively.

Ventilation, heating, and water services, together with room drainage (mostly shower rooms, water coolers, housekeeping water, and steam and water leaks, together with occasional chemical leaks) contribute the remainder of the CSL.

Removing the protective cladding from the fuel, the first step in fuel dissolution, produces large quantities of gaseous ammonia. This ammonia is scrubbed from the offgas with water to prevent releasing the ammonia to the air, and to alleviate the explosion hazard which the ammonia would otherwise present. The resulting ammonia solution, contaminated with radionuclides from the fuel, is then boiled to remove the radionuclides. Before 1987, the resulting ammonia-bearing condensate stream was released as the ASD, sometimes called Ammonia Scrubber Condensate. In the future, with the implementation of the Ammonia Destruction process, this stream will consist of water with only traces of ammonia. The new ASD might be combined with the PDD, or it might be recycled to the ammonia scrubbers. Addendum 14 addresses the ASD.

Figure 2-6 diagrams the disposition of the PUREX Plant liquid effluents.

**2.3.1.2 The PDD Process.** The PDD can receive condensate from the intercycle (or first cycle uranium) concentrator (E-J8) and/or the final uranium concentrator (E-K4) depending upon the degree of condensate recycle being employed or the operational phase (e.g., startup, shutdown,) at any given time. During routine, full recycle operation, the only source of PDD is from E-K4. (Approximately 90% of the water entering the E-K4 Concentrator is distilled out to form the PDD.) Overflow into the PDD header from the J8 sample pot is still possible but is not a normal occurrence. Most of the condensate from E-J8 is recycled to the 2E, 1C, and HA columns.

The condensate in the PDD is distilled water with a nitric acid content that can exceed 0.01M (pH 2). Additionally, the stream contains various quantities of radionuclides, mostly uranium.

Because of concerns that the PDD might be held to have been a dangerous waste, the PDD was disposed to UGS during the "current" period (November 1989 through April 1990). This disposition was accomplished by routing the effluent from the K4 Sample Pot to Tk-G7 and then transferring the contents of Tk-G7 to UGS. Sodium hydroxide and sodium nitrite were added to the PDD on a continuous basis to protect the carbon steel UGS equipment. (As a result of these additions, the pH of the PDD was maintained greater than 12 in Tk-G7.) See Figure 2-4 for a flow diagram of the "current" PDD process.

Because this routing to UGS was only temporary, the pH adjustment of the PDD was discontinued before collection of each characterization sample. Consequently, the characterization samples do not reflect the chemical composition of the waste sent to UGS, but do reflect the composition of the effluent generated by the PUREX operation before any treatment.

Table 2-1 presents the flows of PDD to UGS during the "current" period.

Table 2-1. "Current" PDD Flows.

Month/yr	Flow (L)
January 1990	1.16 E+06
February 1990	2.86 E+06
March 1990	6.47 E+05

During the present period, the flow was not measured directly by a flowmeter. Instead, the PDD was routed into a tank of known diameter, and the level of the liquid in the tank was measured. This is how the data in Table 2-1 was developed. Because the PDD was not being released to the environment, no on-line radioactive monitoring was performed. The sole monitoring was for pH, to ensure that the pH was maintained above 12.5.

**2.3.1.3 Administrative Controls.** Administrative controls have been enacted to implement the overall policy of conducting operations to meet the requirements, intent, and spirit of all applicable federal, state, and local environmental laws, regulations, and standards. A program of regulatory compliance based on the requirements of applicable environmental laws and input from appropriate regulatory agencies has been developed.

Since current technology does not exist for on-line (real-time) monitoring for all regulated materials, PUREX Plant has incorporated administrative controls as an aid to prevent the release of hazardous material to the liquid effluent streams.

The administrative controls have general requirements that apply to all activities associated with regulated materials.

Training is a very important function of the administrative controls. General training courses are given to all employees, and specific training is given to employees working with regulated materials or in areas where they may come into contact with them. This training program includes annual refresher training.

A general requirement that acts as an important control is the system of frequent surveillances and inspections with the associated action findings and follow-up inspections. These are conducted on a regular basis and are supplemented with random surveillances.

9111151170

Administrative controls for materials regulated by Ecology, EPA, and DOE have the clear goal of assuring that no regulated dangerous (hazardous) material is released into PUREX liquid effluent systems.

Specific activity control is maintained by the use of detailed, written procedures. These procedures outline proper handling of materials as an aid to ensure regulatory compliance. They are updated as needed when new regulatory requirements are mandated.

In terms of the management of sinks and drains, there are several stipulations. The most important one is that no dangerous (hazardous) waste shall be disposed of in drains.

There are also several requirements for the acquisition, storage, use and disposal of materials. They are to be physically controlled so that the risks of them entering the PUREX liquid effluent systems are minimized. This is achieved by placing them, wherever possible, at distances removed from entry points to the systems. Also, physical barriers such as closed doors and dams are used wherever possible.

### 2.3.2 Past Activities

Past activities include six changes in plant operation that affect the PDD: laboratory practice, sampling history H4 condensate, pH neutralization, ventilation changes, and sampling and monitoring.

**2.3.2.1 Laboratory Practice.** Process sample analysis provides needed input for controlling the PUREX process. Analysis usually involves the addition of various reagents to the samples, and can also involve extraction of actinides with organic solvents. In the past, organic solvents returned to F10-Tanks included acetone, butanol, toluene, and xylene. The small quantities of acetone and butanol added to F10-Tanks by this route readily evaporated in the H4 concentrator and flowed into the J8 concentrator with the H4 condensate. These organic solvents could enter the condensate system and leave the PUREX process via the PDD.

The use of acetone and butanol in the PUREX Plant laboratory has been discontinued, and the use of toluene and xylene has been reduced. Toluene and xylene solutions are no longer returned to the PUREX process. Instead, these solvents are sent to underground storage tanks.

**2.3.2.2 Sampling History.** Existing sampling points were used because they were the first accessible points downstream of all contributors. Additional upstream sampling points would have required extensive engineering design, development, and installation to overcome safety considerations of high radiation exposure and high temperatures. These sample points were identified at the initiation of the study (WHC 1989a). Current average steam flows were used for calculating deposition rates.

2.3.2.3 H4 Condensate. The condensate from the H4 concentrator originally went directly to the PDD header. For a period, the H4 concentrator condensate was pumped to the J8 concentrator for better acid and radionuclide recovery, but the H4 concentrator condensate overflowed from the H4 sample pot to the PDD if the pump failed or was not started. This overflow has been disconnected so that any overflow from the H4 sample pot now goes to the cell sump and is handled as miscellaneous waste. Miscellaneous waste is ultimately transferred to UGS, and is outside the scope of this report.

2.3.2.4 pH Neutralization. Before 1986 (except for a brief interval during early Plant operations [1956 through 1961]), there was no attempt to neutralize the traces of nitric acid which distilled over with the PDD before discharging that stream to a crib. (The soil at the Hanford Site is naturally quite alkaline, which neutralized the acid in the PDD before it reached the water table.) After 1986, however, a neutralization system was instituted. This system included a controlled addition of potassium hydroxide to the PDD via the K4 sample pot, a pH polishing tank containing calcium carbonate (crushed limestone), and pH monitoring instrumentation.

2.3.2.5 Ventilation Changes. In 1986, an observed correlation between the measured alpha-emitting contamination in the PDD and operation of certain equipment in the final plutonium purification stage at the PUREX Plant led to speculation that plutonium was becoming airborne and travelling through the ventilation system to contaminate the PDD. The vessel ventilation air flow from the final plutonium purification stage was rerouted to avoid such contamination of the PDD. The plutonium content of the PDD subsequently decreased by a factor of between 10 and 100.

2.3.2.6 Sampling and Monitoring. Before the "current" period, the PDD was sampled and monitored after the stream left the 202-A Building. Record sampling (for radionuclides), gamma monitoring, and flow monitoring were accomplished before the PDD reached the pH polishing tank. Additional pH monitors provided records of the PDD pH both before the stream entered the pH polishing tank and after the stream exited the pH polishing tank. (The second of these, which measured the pH of the stream actually released to the 216-A-45 Crib, was designated the record pH monitor.)

The pH monitors were used (1987 through 1989) to control the pH of the PDD and to ensure that the PDD, as released, was not a corrosive stream. Record sampling and flow measurement provided a record of the quantities of radionuclides actually released to the crib, and also provided monitoring for radionuclides with lower detection limits than available from any real-time monitor. The monitoring for radionuclides pointed out when there was an opportunity to diminish the radionuclide content of the PDD (e.g., see Section 2.3.2.4, Ventilation Changes). See Figure 2-5 for a flow diagram of the historical PDD process.

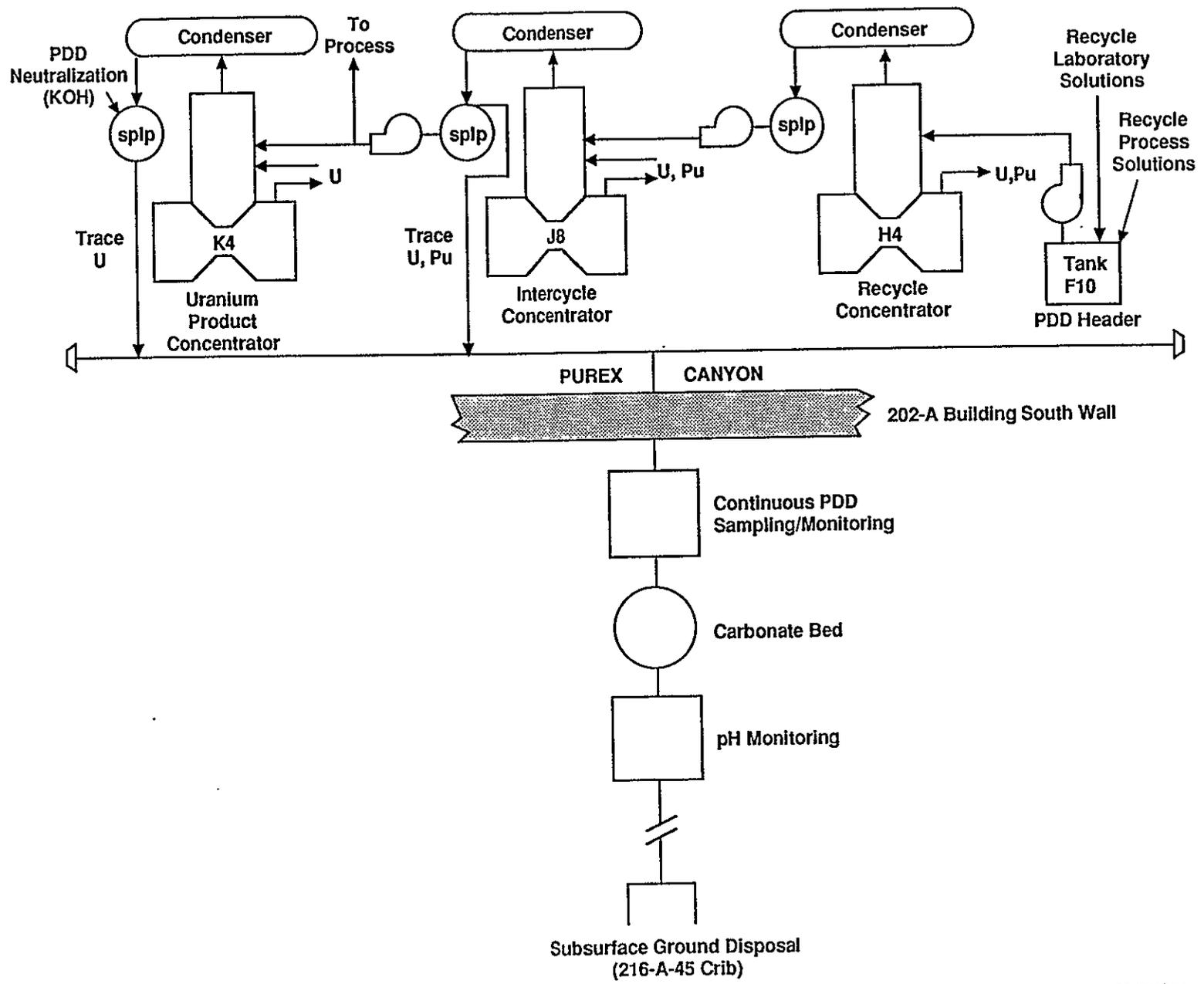
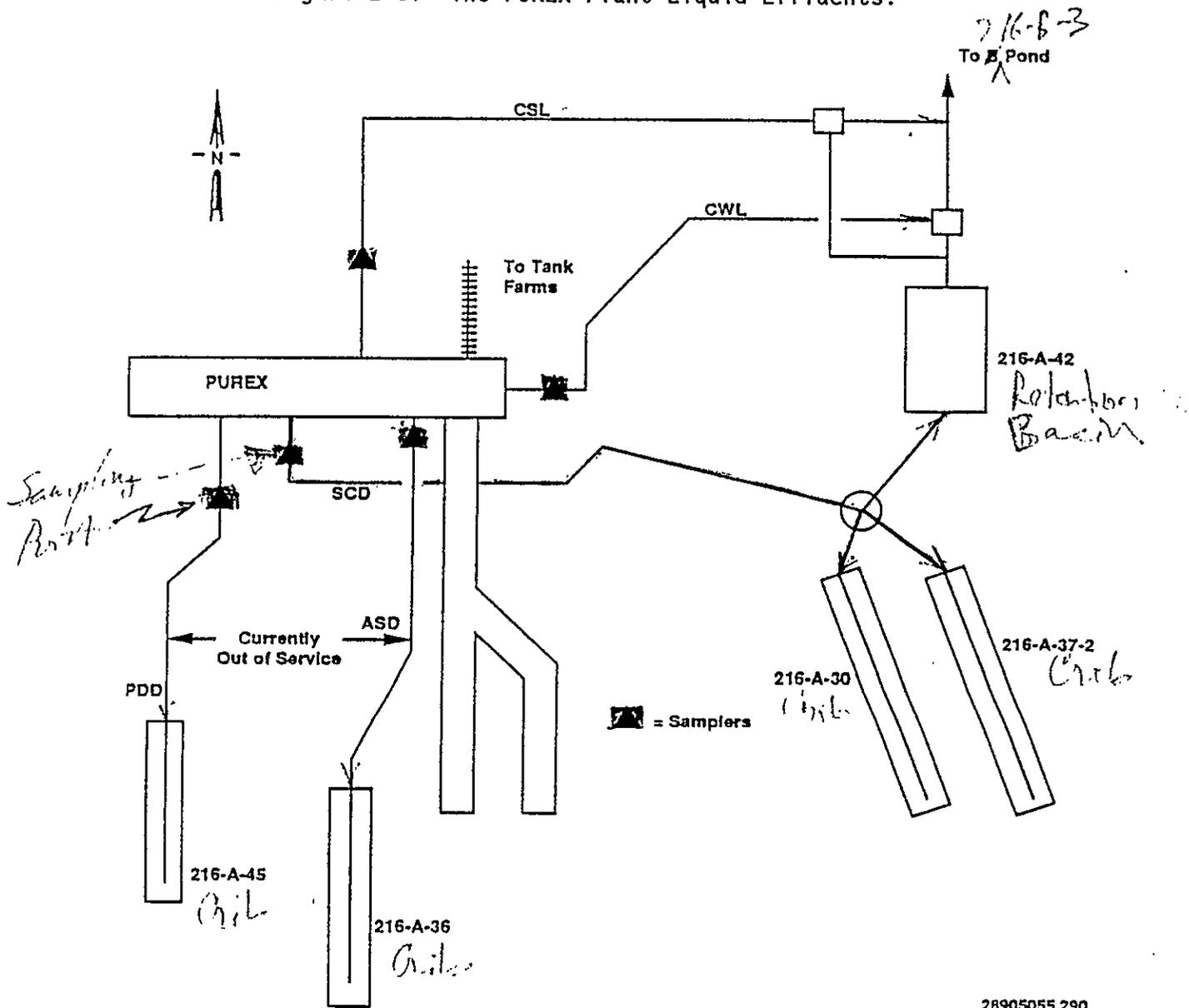


Figure 2-5. The "Historical" PDD Process.

Figure 2-6. The PUREX Plant Liquid Effluents.



28905055.290

### 2.3.3 Future Activities

Planned future activities include several changes in plant operation that will affect the PDD: changes in laboratory practices, operation of an improved continuous pH neutralization system, PDD volume minimization, and interim storage and treatment for the PDD and ASD.

**2.3.3.1 Laboratory Sample Recovery.** Process sample analysis provides needed input for controlling the PUREX process. Analysis usually involves the addition of various reagents to the samples and can also involve extraction of actinides with organic solvents. Cyanide-containing compounds that have been used in the laboratory are fed to the H4 concentrator, which can produce volatile cyanide compounds that eventually carry over into the PDD. Alternate analytical methods are being evaluated by the laboratory organization.

**2.3.3.2 J8 Neutralization Package.** Disposal of the PDD to the 216-A-10 Crib was discontinued in 1987, both because this soil column was approaching its capacity to remove radionuclides and because this wastestream had occasionally had a pH of less than 2. In order to prevent the release of corrosive waste to the new crib (216-A-45), equipment was installed to add potassium hydroxide to this stream. Because the installed equipment was difficult to control and the K4 concentrator was not a credible source of low pH material, a neutralization package for the J8 condensate was designed and installed (see Figure 2-3).

The J8 neutralization package is a continuous neutralization system consisting of three chambers arranged in a series, each with its own agitator, pH probe, and controller. The controllers for the first two chambers control three potassium hydroxide addition pumps each; the controller for the third chamber controls two such pumps. The controllers are designed to respond exponentially to the measured pH. The package is expected to keep the pH of the PDD well above 2 without closely approaching 12.5.

As of this writing, the J8 neutralization package has not yet been connected into the process and tested.

**2.3.3.3 PDD Volume Minimization.** Studies are ongoing to further diminish the volume of the PDD.

**2.3.3.4 PDD and ASD Interim Storage and Treatment, Projects W-105 and C-018.** Project C-018 (Tri-Party Agreement Milestone M-17-02) will provide treatment for the PDD and ASD. This treatment is currently envisioned to include ion removal (including all radionuclides except tritium) and organic chemical destruction.

Project W-105, the Liquid Effluent Retention Facility (LERF), will provide interim storage for the PDD and ASD generated by the PUREX Plant before the treatment plant comes online.

It is currently planned that, when the temporary rerouting to UGS is discontinued, process control pH monitors will continue to be used to control the pH of the PDD between 2.5 and 12. In accordance with the "as low as reasonably achievable" (ALARA) concept, tighter internal controls will likely be implemented as the control technology improves.

Project W-105 is currently under construction. Project C-018 is a line item which has not yet been funded by the U.S. Congress.

## 2.4 PROCESS DATA

The composition of the PDD can vary depending on several factors. The primary interest in the context of this report is the possibility of a wide variety of trace organic constituents. The primary constituent is water (condensed overheads from the K4 evaporator) that has been in intimate contact with process organic. The process organics are TBP and NPH (kerosene). Because these chemicals are technical grade, they contain a variety of trace impurities: butanol, butyraldehyde (butanol), acetone, methyl ethyl ketone (2-butanone) and others. Additionally, in the presence of the high radiation and strong chemical fields, which exist in the PUREX process, the major and minor constituents degrade and recombine. Thus, there is a potential for, and analyses show, a very wide variety of trace (ppb) organics in the PDD stream.

Also of interest, variations in the process affect the flow and composition of inorganics, such as nitrate and hydroxide.

### 3.0 SAMPLE DATA

This section provides an evaluation of the sampling data pertaining to the PDD wastestream. These data are divided into two categories--wastestream data and background data--each of which is further subdivided into chemical data and radiological data. The discussion identifies the source of the samplings (Section 3.1) and data presentation (Section 3.2).

#### 3.1 DATA SOURCE

Two sources of sampling data were used in this analysis: wastestream data and background data.

##### 3.1.1 Wastestream Data

The sampling scheme used for the PDD and raw water followed sampling and analytical protocol discussed in Section 3.0 of the "parent" document of WHC-EP-0342. This protocol requires that a sufficient number of samples be taken in a random manner over a time period sufficient to characterize variability or uniformity of the stream. This requirement was accomplished by taking grab samples on a partitioned time random basis. The sampling was randomized by splitting the workdays of the month into two 4-h time periods and using a random-number generator to choose one of these time periods. All samples were taken to the contract laboratory for analysis.

The PDD data presented in this report are derived from eight samples taken between January and March 1990, during normal operation. Five samples were analyzed for all constituents of interest and three additional samples were analyzed for selected organics only. Table 3-1 shows analyses, analytical methods, and sample identification for the PDD samples.

##### 3.1.2 Background Data

The water in the PDD ultimately derives from the 200 East Area raw water. The water enters the process either as steam or demineralized water. Ideally, then, background data would include analytical results for 200 East Area raw water, steam condensate (sampled at the PUREX Plant), and demineralized water from the PUREX Plant. Since analytical results are not available for the last two of these streams, certain substitutions have been made; steam condensate collected at the laundry in the 200 West Area has been substituted for steam condensate collected at the PUREX Plant, and 200 East Area sanitary water organic data have been substituted for demineralized water data.

Table 3-1: Procedures for PUREX PDD Samples. (sheet 1 of 2)

LEAD#	50895	50935	50988	51020
CofC#	50895	50935	50988	51020
Alpha counting	X			X
Ammonia	X	X	X	X
Arsenic	X	X	X	X
Atomic emission spectroscopy	X	X	X	X
Beta counting	X			X
Conductivity-field	X	X	X	X
Cyanide	X	X	X	X
Direct aqueous injection (GC)		X	X	X
Gamma energy analysis	X			X
Ion chromatography	X	X	X	X
Lead	X	X	X	X
Mercury	X	X	X	X
pH-field	X	X	X	X
Selenium	X	X	X	X
Semivolatile organics (GC/MS)	X	X	X	X
Sulfide	X	X	X	X
Temperature-field	X		X	X
Total organic carbon	X	X	X	X
Total organic halides (LDL)	X	X	X	X
Volatile organics (GC/MS)	X		X	X
LEAD#	50895B	50935B	50988B	51020B
CofC#	50896	50936	50989	51021
Volatile organics (GC/MS)	X	X	X	X
LEAD#	50895T	50935T	50988T	51020T
CofC#	50897	50937	50990	51022
Volatile organics (GC/MS)	X	X	X	X
LEAD#	50895E	50935E	50988E	51020E
CofC#	50898	50938	50991	51023
Ignitability	X	X	X	X
LEAD#	50951			
CofC#	50951			
Alpha counting				
Ammonia	X			
Arsenic	X			
Atomic emission spectroscopy	X			
Plutonium isotopes				

Table 3-1. Procedures for PUREX PDD Samples. (sheet 2 of 2)

Beta counting	
Conductivity-field	
Cyanide	X
Direct aqueous injection (GC)	X
Gamma energy analysis	
Ion chromatography	X
Lead	X
Mercury	X
pH-field	
Selenium	X
Semivolatile organics (GC/MS)	X
Sulfide	X
Temperature-field	
Total organic carbon	X
Total organic halides (LDL)	X
Volatile organics (GC/MS)	X
LEAD#	50951B
CofC#	50952
Volatile organics (GC/MS)	X
LEAD#	50951T
CofC#	50953
Volatile organics (GC/MS)	X
LEAD#	50951E
CofC#	50954
Ignitability	X

NOTES: Procedures that were performed for a given sample are identified by an "X". Procedure references appear with the data. LEAD # is the Liquid Effluent Analytical Data number that appears in the data reports. C of C# is the chain-of-custody number.

Abbreviations:

GC = gas chromatography.  
 LDL = low-detection limit.  
 MS = mass spectrometry.

The 200 East Area raw water is representative of natural water occurring in the vicinity of the Hanford Site, and is therefore useful for a baseline against which to compare chemical concentrations.

The steam condensate and 200 East Area sanitary water are representative of the water that actually enters the PUREX process, and are therefore useful for determining what is added to the PDD by the PUREX process itself. Since the 200 East Area sanitary water enters the PUREX process after being de-ionized, ionic data are not relevant, but organic data are relevant (organics are not expected to be removed by the de-ionizers).

The 200 East Area raw water data were generated from characterization samples of the 200 East Area raw water. Similarly, the steam condensate data were generated from characterization samples of the steam condensate. The sanitary water data were generated from samples of the 200 East Area sanitary water which were analyzed to ensure that the water was fit for drinking. Consequently, the 200 East Area sanitary water samples were subjected to a different battery of tests from the characterization data, and have different detection levels.

## 3.2 DATA PRESENTATION

### 3.2.1 Primary Organic and Inorganic Constituents

Analytical results and statistics are given in Table 3-2. Accompanying footnotes explain the column headings. Data in this group are derived from January to March 1990 samples and include total alpha and beta activity measurements.

### 3.2.2 Radionuclide Data

Historical radionuclide data from 1981 to 1988 (previously published in WHC 1989a) are included in Table 3-3. Since all results below the detection limit were ignored in preparing the averages in Table 3-3, the table is not as informative as it might be. Similarly, since the PDD is known to originate in the process, the radioactivity does not provide otherwise unavailable information about the potential presence of material from the process. The radiological data are included for the purpose of completeness.

### 3.2.3 Background Chemical Data

The 200 East Area raw water data are included as Table 3-4. Although raw water is sometimes used as a carrier for potassium hydroxide being added to the PDD stream, it was not so used during the present period.

Table 3-2. Statistics for PUREX PDD. (sheet 1 of 2)

Constituent	N	MDA	Method	Mean	StdErr	90%CILim	Maximum
Boron	5	3	DL	1.64E+01	3.93E+00	2.24E+01	2.70E+01
Calcium	5	4	DL	5.02E+01	2.00E-01	5.05E+01	5.10E+01
Cyanide	5	0	n/a	3.57E+01	5.59E+00	4.43E+01	4.65E+01
Fluoride	5	3	DL	8.60E+02	2.29E+02	1.21E+03	1.60E+03
Mercury	5	1	LM	9.66E-01	2.75E-01	1.39E+00	1.90E+00
Nitrate	5	0	n/a	5.56E+04	4.12E+04	1.19E+05	2.17E+05
#Nitrite	5	1	DL	4.93E+04	3.05E+04	9.61E+04	1.65E+05
Potassium	5	2	DL	5.08E+02	3.17E+02	9.94E+02	1.74E+03
Silicon	5	3	DL	2.19E+02	1.55E+01	2.43E+02	2.80E+02
Sodium	5	0	n/a	1.29E+04	4.74E+03	2.02E+04	2.94E+04
Acetone	4	1	DL	5.75E+01	1.60E+01	8.37E+01	7.90E+01
Ammonia	5	4	DL	5.32E+01	3.20E+00	5.81E+01	6.60E+01
1-Butanol	3	0	n/a	1.90E+01	7.55E+00	3.32E+01	3.40E+01
2-Butanone	4	0	n/a	2.85E+01	1.45E+01	5.23E+01	7.20E+01
Butylated hydroxy toluene	1	0	n/a	1.00E+02	n/a	n/a	1.00E+02
Dibutylphosphate	4	1	DL	1.74E+04	4.03E+03	2.40E+04	2.81E+04
Dodecane	7	0	n/a	9.14E+03	4.91E+03	1.62E+04	3.50E+04
Tetradecane	8	0	n/a	2.10E+04	1.02E+04	3.55E+04	7.70E+04
Tetrahydrofuran	4	0	n/a	7.45E+01	1.45E+01	9.83E+01	1.03E+02
Tributylphosphate	8	0	n/a	7.78E+04	2.03E+04	1.07E+05	1.98E+05
Tridecane	8	0	n/a	3.28E+04	1.59E+04	5.53E+04	1.20E+05
Undecane	1	0	n/a	1.20E+02	n/a	n/a	1.20E+02
Unknown	4	0	n/a	3.78E+03	3.74E+03	9.90E+03	1.50E+04
Unknown aliphatic HC	2	0	n/a	1.19E+03	5.05E+02	2.75E+03	1.70E+03
Unknown ester	4	0	n/a	5.24E+02	3.93E+02	1.17E+03	1.70E+03
Unknown ester	3	0	n/a	3.07E+01	6.36E+00	4.27E+01	4.20E+01
Unknown hydrocarbon	2	0	n/a	1.55E+04	1.55E+04	6.32E+04	3.10E+04
Alpha Activity (pCi/L)	5	0	n/a	2.25E+01	9.74E+00	3.74E+01	4.65E+01
Beta Activity (pCi/L)	5	0	n/a	7.89E+00	1.84E+00	1.07E+01	1.45E+01
Conductivity (μS)	4	0	n/a	5.08E+02	3.40E+02	1.06E+03	1.50E+03
Ignitability (°F)	5	0	n/a	2.08E+02	1.67E+00	2.05E+02	2.04E+02
pH (dimensionless)	4	0	n/a	3.04E+00	4.67E-01	2.28E+00	2.30E+00
Temperature (°C)	3	0	n/a	4.66E+01	1.68E+01	7.82E+01	7.90E+01
TOC	5	0	n/a	1.06E+05	1.55E+04	1.30E+05	1.42E+05
TOX (as Cl)	5	0	n/a	4.80E+01	6.35E+00	5.77E+01	6.40E+01
<sup>137</sup> Cs (pCi/L)	2	1	DL	1.41E+00	9.68E-01	4.39E+00	2.38E+00

NOTES:

Mean values, standard errors, confidence interval limits and maxima are in ppb (parts per billion) unless indicated otherwise.

The column headed MDA (Minimum Detectable Amount) is the number of results in each data set below the detection limit.

Table 3-2. Statistics for PUREX PDD. (sheet 2 of 2)

---

The column headed Method shows the MDA replacement method used: replacement by the detection limit (DL), replacement of single-valued MDAs by the log-normal plotting position method (LM), or replacement of multiple valued MDAs by the normal plotting position method (MR).

The column headed "90%CILim" (90% Confidence Interval Limit) is the lower limit of the one-tailed 90% confidence interval for all ignitability data sets and pH data sets with mean values below 7.25. For all other data sets it is the upper limit of the one-tailed 90% confidence interval.

The column headed "Maximum" is the minimum value in the data set for ignitability, the value furthest from 7.25 for pH, and the maximum value for all other analytes.

# Denotes an ill-conditioned data set, i.e., one in which at least one reported measurement is less than at least one reported detection limit.

Table 3-3. Average Radionuclide Content of the PUREX PDD.

Radionuclide	N	Average concentration (pCi/L)	U90%CI (pCi/L)
Alpha	65	1.0 E+05	2.2 E+05
Beta	68	2.6 E+05	4.9 E+05
<sup>90</sup> Sr	27	5.0 E+02	8.5 E+02
<sup>106</sup> Ru	30	3.4 E+04	5.5 E+04
<sup>103</sup> Ru	19	1.9 E+03	2.7 E+03
<sup>134</sup> Cs	1	8.8 E-03	NA
<sup>137</sup> Cs	30	4.5 E+04	8.8 E+04
<sup>147</sup> Pm	44	3.2 E+03	4.2 E+03
Uranium (gross)	51	5.1 E+01	6.4 E+01
<sup>3</sup> H	59	6.0 E+07	6.8 E+07
<sup>241</sup> Am	8	6.5 E+03	1.2 E+04
<sup>129</sup> I	22	5.6 E+02	7.8 E+02
<sup>238</sup> Pu	33	1.2 E+03	2.2 E+03
<sup>241</sup> Pu	54	1.2 E+05	1.9 E+05
<sup>239</sup> Pu	59	1.2 E+04	1.9 E+04

Data covers period from 1981 to 1988.

All less than data values have been omitted.

N = number of measurements above detection limit.

U90%CI = upper limit of 90% confidence interval.

Recent radiological data are presently unavailable.

Table 3-4. Summary of 200 East Area Raw Water Data (1985-1988).

Constituent/Parameter [all ppb, exceptions noted]	Raw Water <sup>a</sup> (1986-1987)			Sanitary Water <sup>b</sup> (1985-1988)		
	N <sup>c</sup>	AVG	STD DEV	N	AVG	STD DEV
Arsenic				4	<5.00E+00	NA
Barium	5	2.80E+01	3.40E+00	4	*1.05E+02	1.00E+01
Cadmium	5	2.40E+00	8.94E-01	4	<5.00E-01	NA
Calcium	5	1.84E+04	1.47E+03			
Chromium				4	<1.00E+01	NA
Chloride	5	8.71E+02	2.37E+02	4	3.05E+03	6.76E+02
Conductivity-field ( $\mu$ S)	5	9.32E+01	4.61E+01			
Copper	5	1.06E+01	1.34E+00	4	*2.50E+01	1.00E+01
Color (units)				4	<5.00E+00	NA
Iron	5	6.36E+01	2.57E+01	4	*8.25E+01	5.19E+01
Fluoride				4	*1.13E+02	2.50E+01
Lead				4	<5.00E+00	NA
Magnesium	5	4.19E+03	4.83E+02			
Manganese	5	9.80E+00	3.49E+00	4	<1.00E+01	NA
Mercury				4	<5.00E-01	NA
Nickel	5	1.04E+01	8.94E-01			
Nitrate (as N)	5	9.96E+02	8.79E+02	4	*3.72E+02	5.44E+02
pH (dimensionless)	5	7.41E+00	1.18E+00			
Potassium	5	7.95E+02	6.24E+01			
Selenium				4	<5.00E+00	NA
Silver				4	<1.00E+01	NA
Sodium	5	2.26E+03	2.42E+02	4	2.28E+03	1.26E+02
Sulfate	5	1.06E+04	9.97E+02	4	1.68E+04	3.37E+03
Temperature-field (C)	5	1.64E+01	5.84E+00			
TOC ( $\mu$ g/g)	5	1.36E+03	2.53E+02			
TDS (mg/L)				4	8.10E+01	1.69E+01
Trichloromethane	5	1.18E+01	4.02E+00			
Uranium	4	7.26E-01	2.22E-01			
Zinc	5	2.00E+01	2.12E+01	4	<1.00E+02	NA
Radionuclides (pCi/L)						
Alpha Activity	4	8.85E-01	5.30E-01			
Beta Activity	4	4.47E+00	1.76E+00			

NOTES: Averages denoted by an asterisk include a mix of above- and below-detection limit in computations when the actual values are below the detection limit.

See companion table for inorganic detection limits as compiled from Hanford Environmental Health Foundation.

<sup>a</sup>Compiled from "Substance Toxicity Evaluation of Waste Data Base," provided by F. M. Jungfleisch (this data is an update of the data presented in the Preliminary Evaluation of Hanford Liquid Discharges to Ground (Jungfleisch 1988).

<sup>b</sup>Compiled from the Hanford Sanitary Water Quality Surveillance, CY 1985, 1986, 1987, and 1988 (Somers 1986, 1987, 1988, and 1989).

<sup>c</sup>N is defined as the number of test results available for a particular analyte. N may reflect both single and multiple data sets.

ppb = parts per billion. TOX = total organic halides.  $\mu$ S = microsiemen.  
pCi/L = picoCuries/liter. TDS = Total Dissolved Solids.  $\mu$ g = microgram.  
TOC = total organic carbon.



Table 3-5. 200 East Sanitary Water--Organic Data (1987-1988)<sup>a</sup>.

Constituent/Parameter [all ppb, exceptions noted]	200 East <sup>b</sup>		
	N <sup>c</sup>	AVG	STD DEV
1,1,1-Trichloroethane	1	<DL <sup>c</sup>	NA
1,1 Dichloroethylene	1	<DL	NA
1,2,-Dichloroethane	1	<DL	NA
1,3,5-Trimethylbenzene	1	<DL	NA
Benzene	1	<DL	NA
Bromodichloromethane	5	1.76E+00	6.68E-01
Bromoform	5	<DL	NA
Carbon Tetrachloride	1	<DL	NA
Chlorodibromomethane	5	<DL	NA
Chloroform	5	2.65E+01	1.27E+01
Difluorodichloromethane	2	<DL	NA
Ethylbenzene	1	<DL	NA
o-Xylene	1	<DL	NA
p-Chlorotoluene	1	<DL	NA
p-Dichlorobenzene	1	<DL	NA
Tetrachloroethylene	1	<DL	NA
Toluene	1	<DL	NA
Trichloroethylene	1	<DL	NA
Vinyl Chloride	1	<DL	NA

<sup>a</sup>The data given in this table were compiled by Hanford Environmental Health Foundation (HEHF). Data sets included first quarter 1987 and quarterly 1988 data. The total trihalomethane concentration for the 200 and 300 Areas appear in the *Hanford Sanitary Water Quality Surveillance Report for CY 1988* (Somers 1989), and the *Hanford Sanitary Water Quality Surveillance Report for CY 1989* (Thurman 1990).

<sup>b</sup>N is defined as the number of test results available for a particular analyte; N may reflect both single and multiple data sets. For N = 1 the sole available data entry is listed as "avg."

<sup>c</sup>See companion table for organic detection limits as compiled from HEHF data.

DL = detection limit  
ppb = parts per billion.

Table 3-6. Summary of 2724-W Laundry Steam Condensate Data.  
(sheet 1 of 2)

Constituent/Parameter [All ppb, exceptions noted]	2724-W Laundry Steam Condensate <sup>a</sup> (1989)		
	N <sup>b</sup>	AVG	STD DEV
Acetone	4	1.10E+01	1.73E+00
Alkalinity (Method B)	4	2.95E+04	1.01E+04
Aluminum	4	5.63E+02	6.86E+02
Ammonia	4	6.92E+01	1.19E+01
Arsenic (EP Toxic)	4	<5.00E+02	0.00E+00
Barium	4	1.80E+01	8.92E+00
Barium (EP Toxic)	4	<1.00E+03	0.00E+00
Boron	4	2.30E+01	8.52E+00
1-Butanol	1	3.90E+01	
Cadmium	4	<2.00E+00	0.00E+00
Cadmium (EP Toxic)	4	<1.00E+02	0.00E+00
Calcium	4	7.65E+03	6.43E+03
Chromium (EP Toxic)	4	<5.00E+02	0.00E+00
Chloride	4	1.35E+03	8.61E+02
Conductivity-field ( $\mu$ S)	4	6.32E+01	5.39E+01
Copper	4	8.17E+02	6.11E+02
Ignitability ( $^{\circ}$ F)	4	2.06E+02	4.76E+00
Iron	4	2.06E+03	2.48E+03
Fluoride	4	7.50E+01	
Lead	4	1.55E+01	7.72E+00
Lead (EP Toxic)	4	<5.00E+02	0.00E+00
Magnesium	4	1.82E+03	1.39E+01
Manganese	4	1.57E+01	1.59E+01
Mercury (EP Toxic)	4	<2.00E+01	0.00E+00
pH (dimensionless)	4	6.98E+00	8.42E-01
Potassium	4	3.27E+02	1.94E+02
Reactivity Cyanide (mg/kg)	4	<1.00E+02	0.00E+00
Reactivity Sulfide (mg/kg)	4	<1.00E+02	0.00E+00
Selenium (EP Toxic)	4	<5.00E+02	0.00E+00
Silicon	4	1.75E+03	8.49E+02
Silver (EP Toxic)	4	<5.00E+02	0.00E+00
Sodium	4	8.85E+02	6.15E+02
Strontium	4	3.92E+01	3.15E+01
Sulfate	4	5.50E+03	4.88E+03
Suspended Solids (mg/L)	4	2.02E+04	1.61E+03
Temperature-field (C)	4	6.63E+01	8.66E+00
Titanium	4	8.75E+01	4.76E+01
Total Carbon ( $\mu$ g/g)	4	4.53E+03	2.77E+03
TOX ( $\mu$ g (Cl)/L)	4	2.52E+01	2.79E+01
TDS (mg/L)	4	2.70E+04	2.25E+04
Trichloromethane	4	1.17E+01	1.17E+01
Uranium	3	3.45E-01	1.43E-01
Zinc	4	3.02E+01	2.44E+01

Table 3-6. Summary of 2724-W Laundry Steam Condensate Data.  
 (sheet 2 of 2)

Constituent/Parameter [All ppb, exceptions noted]	2724-W Laundry Steam Condensate <sup>a</sup> (1989)		
	N <sup>b</sup>	AVG	STD DEV
Radionuclides (pCi/L)			
<sup>241</sup> Am	2	5.77E-03	1.66E-03
<sup>60</sup> Co	3	7.13E-01	3.14E-01
<sup>137</sup> Cs	3	1.80E+00	1.21E+00
<sup>129</sup> I	3	1.19E-01	6.94E-02
<sup>238</sup> Pu	2	1.57E-03	1.27E-03
<sup>239</sup> Pu	4	7.82E-03	6.27E-03
<sup>90</sup> Sr	4	1.80E-01	1.60E-01
<sup>234</sup> U	4	8.90E-02	6.65E-02
<sup>235</sup> U	3	1.43E-02	7.13E-03
<sup>238</sup> U	3	9.39E-02	2.16E-02

<sup>a</sup>Data from sampling campaign conducted October 1, 1989 to March 30, 1990 in support of WHC-EP-0342.

<sup>b</sup>N is defined as the number of test results available for a particular analyte. N may reflect both single and multiple data sets.

ABBREVIATIONS:

- ppb = parts per billion
- μS = microSiemens
- μg = micrograms
- TOC = Total Organic Carbon
- TOX = Total Organic Halides
- TDS = Total Dissolved Solids
- pCi/L = picocuries/liter.

## 4.0 DATA OVERVIEW

This section presents a comparison of the process data set (Section 2.0) with the sampling data set (Section 3.0) to determine the identity and concentration levels of the chemical analytes present in the PDD wastestream.

### 4.1 DATA COMPARISON

Table 4-1 compares inorganic constituents with EPA drinking water standard limits (SV1). The table also includes a comparison between total alpha and beta activity in pCi/L versus derived concentration limits (SV2) given in WHC-CM-7-5 (WHC 1988).

Table 4-2 shows a comparison of historical radionuclide data and derived concentration guideline data. These PDD data are those shown in Table 3-3 and are derived from record samples taken from 1981 to 1988, because recent radionuclide data are unavailable.

Inorganic constituents data in Table 4-1 indicate that stream concentrations meet drinking water standards for all chemical constituents except nitrate and nitrite. The radionuclide data in Table 4-1 indicate that the stream contains alpha activity less than the drinking water limit of 15 pCi/L assuming  $^{239}\text{Pu}$  is the dominant isotope. This is the case as shown in Table 4-2 radionuclide data. It appears that the drinking water limit for beta emitters may not be exceeded by the PDD; however, specific radionuclide data should be used to determine the cumulative dose value.

The following paragraphs discuss the presence of constituents in Table 4-1.

#### 4.1.1 Cyanide

Cyanide compounds have been used in the analysis of process control samples. After analysis, some of the cyanide-containing analyzed samples were recycled to the PUREX process to recover actinides. Cyanide is quite volatile under the acidic conditions that prevail in the PUREX process, and consequently accumulates in the condensate recycle system. From the condensate recycle system, the cyanide enters the PDD, either directly or via the K4 concentrator condenser. Alternate analytical methods are being evaluated by the laboratory organization.

#### 4.1.2 Fluoride

Fluoride is a major component of the solution used to remove the cladding from the irradiated fuel that is the feed for the PUREX process. Some of this fluoride gets into the solvent extraction system and enters the condensate recycle system. (Fluoride is volatile and will appear in the concentrator overheads in acidic media.) From the condensate recycle system, the fluoride enters the PDD, either directly or via the K4 concentrator condenser.

Table 4-1. Evaluation of PUREX PDD.

Constituent	Result <sup>a</sup>	SV1 <sup>b</sup>	SV2 <sup>c</sup>
Cyanide	3.6E-02	2.0E-01 e	
Fluoride	8.6E-01	2.0E+00 g	
Mercury	9.7E-04	2.0E-03 g	
Nitrate	5.6E+01	4.5E+01 e*	
Nitrite <sup>d</sup>	4.9E+01	4.0E+00 e*	
Alpha Activity (pCi/L) <sup>e</sup>	2.3E+01	1.5E+01 g*	3.0E+01
Beta Activity (pCi/L) <sup>f</sup>	7.9E+00		1.0E+03
<sup>137</sup> Cs (pCi/L)	1.4E+00	1.0E+02 e	3.0E+03

NOTES:

<sup>a</sup>Units of results are mg/L unless indicated otherwise. The results are the mean values reported in Table 3-2.

<sup>b</sup>Screening Value 1 (SV1) lists the value first, basis second, and an asterisk (\*) third if the result exceeds the regulatory value. The basis is the proposed primary MCL (e), the proposed secondary MCL (f), the primary MCL (g), or the secondary MCL (h). The value is the smaller of two MCLs: the proposed primary MCL (or the primary MCL as a default) or the proposed secondary MCL (or the secondary MCL as a default).

<sup>c</sup>Screening Value 2 (SV2) lists the value first and an asterisk (\*) second if the result exceeds the SV2. These values are derived concentration guides obtained from Appendix A of WHC-CM-7-5, "Environmental Compliance Manual", Revision 1, January 1990 (WHC 1988).

<sup>d</sup>Constituents are identified (d) if any detected result is less than any detection limit.

<sup>e</sup>The SV1 and SV2 values for Gross Alpha are used to evaluate Alpha Activity.

<sup>f</sup>The SV2 for Gross Beta is used to evaluate Beta Activity.

Table 4-2. Historic Radionuclide Comparison to Guideline Ratios.

Radio-nuclide	N	Concentration average (pCi/L)	DCG (pCi/L)	DCG ratio
<sup>90</sup> Sr	27	5.0 E+02	1.0 E+03	5.0 E-01
<sup>106</sup> Ru	30	3.4 E+04	6.0 E+03	5.7 E+00*
<sup>103</sup> Ru	19	1.9 E+03	5.0 E+04	3.8 E-02
<sup>134</sup> Cs	1	8.8 E-03	2.0 E+03	4.4 E-06
<sup>137</sup> Cs	30	4.5 E+04	3.0 E+03	1.5 E+01*
<sup>147</sup> Pm	44	3.2 E+03	1.0 E+05	3.2 E-02
Uranium (gross)	51	5.1 E+01	5.0 E+02	1.0 E-01
<sup>3</sup> H	59	6.0 E+07	2.0 E+06	3.0 E+01*
<sup>241</sup> Am	8	6.5 E+03	3.0 E+01	2.2 E+02*
<sup>129</sup> I	22	5.6 E+02	5.0 E+02	1.1 E+00*
<sup>238</sup> Pu	33	1.2 E+03	4.0 E+01	3.0 E+01*
<sup>241</sup> Pu	54	1.2 E+05	2.0 E+03	6.0 E+01*
<sup>239</sup> Pu	59	1.2 E+04	3.0 E+01	4.1 E+02*
Sum of ratios				7.7 E+02*

NOTES:

Radionuclide data is from WHC-EP-0287 (WHC 1989a).  
DCGs (Derived Concentration Guides) are from WHC-CM-7-5.  
Note that many process changes have been instituted during the period represented by this data (1981 through 1988), which significantly reduced radionuclide release levels.

N = Number of measurements above detection limit.

\* = Exceeds DCG.

Recent radiological data are presently unavailable.

#### 4.1.3 Mercury

Although mercury was reported in all of the sample results for the PDD, the concentration was very low, 0.97 ppb, which is less than the Drinking Water Standard of 2.0 ppb.

There are two likely sources of mercury in the PDD stream. First, mercury is used in open thermo-wells in the dissolvers. The vapor pressure of mercury at dissolver operating temperatures is 0.000384 to 0.000635 atm. This provides a mechanism for mercury to evaporate and ultimately enter the PDD stream. Second, mercury is present, as a minor contaminant, in the technical-grade sodium hydroxide used in the PUREX process. It is possible that minute traces of mercury could migrate from the points of use to the PDD stream.

#### 4.1.4 Nitrate and Nitrite

Nitrate and nitrite ions exist at many places in the PUREX process. They may be found in concentrator overheads due to the volatility of nitric and nitrous acids and NO<sub>x</sub> compounds. Volatility is suppressed only if the concentrator bottoms chemistry is alkaline or neutral and if no entrainment is occurring in the concentrator tower.

#### 4.2 STREAM DEPOSITION RATES

Table 4-3 provides an estimate of deposition of PDD constituents in terms of kilograms per month. These data are derived from sample analyses of the present stream, and the average stream flowrate over the time interval January through March 1990. Because the PDD did not flow to a crib during this period, the deposition rates do not reflect actual deposition to the environment. Similarly, because the PDD will be treated to remove contaminants before it is next released, these deposition rates do not reflect potential future deposition to the environment.

Table 4-3. Deposition Rate for PUREX PDD.  
Flowrate: 1.56E+06 L/mo

Constituent	Kg/L*	Kg/mo*
Boron	1.64E-08	2.55E-02
Calcium	5.02E-08	7.81E-02
Cyanide	3.57E-08	5.55E-02
Fluoride	8.60E-07	1.34E+00
Mercury	9.66E-10	1.50E-03
Nitrate	5.56E-05	8.65E+01
Nitrite #	4.93E-05	7.67E+01
Potassium	5.08E-07	7.90E-01
Silicon	2.19E-07	3.41E-01
Sodium	1.29E-05	2.01E+01
Acetone	5.75E-08	8.95E-02
Ammonia	5.32E-08	8.28E-02
1-Butanol	1.90E-08	2.96E-02
2-Butanone	2.85E-08	4.43E-02
Butylated hydroxy toluene	1.00E-07	1.56E-01
Dibutylphosphate	1.74E-05	2.71E+01
Dodecane	9.14E-06	1.42E+01
Tetradecane	2.10E-05	3.27E+01
Tetrahydrofuran	7.45E-08	1.16E-01
Tributylphosphate	7.78E-05	1.21E+02
Tridecane	3.28E-05	5.10E+01
Undecane	1.20E-07	1.87E-01
Unknown	3.78E-06	5.88E+00
Unknown aliphatic HC	1.19E-06	1.85E+00
Unknown ester	5.24E-07	8.15E-01
Unknown ester	3.07E-08	4.78E-02
Unknown hydrocarbon	1.55E-05	2.41E+01
Alpha Activity *	2.25E-11	3.51E-05
Beta Activity *	7.89E-12	1.23E-05
TOC	1.06E-04	1.65E+02
TOX (as Cl)	4.80E-08	7.47E-02
<sup>137</sup> Cs	1.41E-12	2.20E-06

NOTES:

Data collected from October 1989 through March 1990.

Flow rate is the average of rates from Section 2.0.

Constituent concentrations are average values from Table 3-2.

Concentration units of flagged (\*) constituents are reported as curies per liter.

Deposition rate units of flagged (\*) constituents are reported as curies per month.

Constituents are flagged (#) if any detected result is less than any detection limit.

9111151103

This page intentionally left blank.

91111051124

## 5.0 DESIGNATIONS

This section proposes that the current PDD not be designated a dangerous waste. (Before the opening of the 216-A-45 Crib in 1987, the PDD was sometimes corrosive, and consequently designated as dangerous waste, with a dangerous waste number of D002 [see Section 2.3.2.3, pH neutralization].) This proposed designation uses data from both the effluent source description and sample data (see Sections 2.0 through 4.0) and complies with the designation requirements of WAC 173-303-070.

The WAC (WAC 173-303-070) contains the procedure for determining if a waste is dangerous. This procedure is illustrated in Figure 5-1 and includes the following steps.

- Dangerous Waste Lists (WAC 173-303-080)
- Dangerous Waste Criteria (WAC 173-303-100)
- Dangerous Waste Characteristics (WAC 173-303-090).

### 5.1 DANGEROUS WASTE LISTS

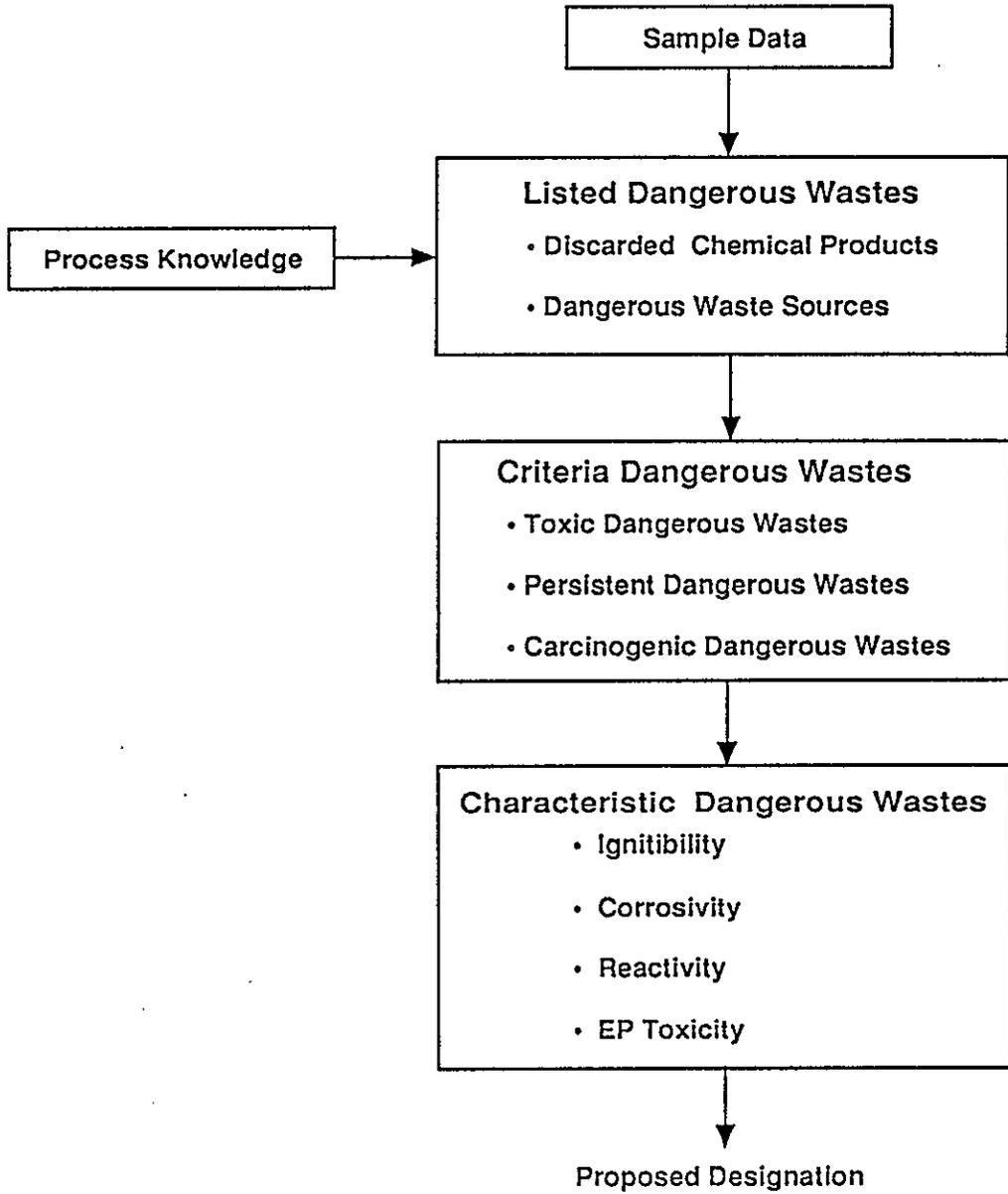
A waste is considered a listed dangerous waste if it either contains a discarded chemical product (per WAC 173-303-081) or originates from a dangerous waste source (per WAC 173-303-082). The proposed designation was based on a combination of process knowledge and sampling data.

#### 5.1.1 Discarded Chemical Products

A wastestream constituent is a discarded chemical product (WAC 173-303-081) if it is listed in WAC 173-303-9903 and is characterized by one or more of the following descriptions.

- A commercial chemical product that had been discarded. Commercial chemical products which, as purchased, contained two or more active ingredients were not designated as discarded chemical products. Products that contained nonactive components such as water, however, were designated if the sole active ingredient in the mixture was listed in WAC 173-303-9903.
- The constituent results from a spill of unused chemicals. (A spill of a discarded chemical product would cause a wastestream to be designated during the time that the discharge is occurring. The approach taken is that the current wastestream would not be designated unless a review of past spill events indicates that the spills are predictable, systematic events which are ongoing and are reasonably anticipated to occur in the future. In this report,

Figure 5-1. Designation Strategy.



29004107.7

the evaluation of this criterion is based on a review of spill data reported in accordance with the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA 1980).

- The constituent is discarded in the form of a residue resulting from cleanup of a spill of an unused commercial chemical product contained on the discarded chemical products list. (A wastestream constituent that is used in a process and then released to the wastestream when not disposed of in accordance with the regulations is not a discarded chemical product. Off-specification unused chemicals and chemicals that have exceeded a shelf life but have not been used are considered discarded chemical products.)

### 5.1.2 Dangerous Waste Sources

A list of dangerous waste sources is contained in WAC 173-303-9904, pursuant to WAC 173-303-082. There are three major categories of sources in WAC 173-303-9904. The first is nonspecific sources from routine operations occurring at many industries. The second is specific sources (e.g., wastes from ink formulation). The third is state sources, which are limited to PCB contaminated transformers and capacitors resulting from salvaging, rebuilding, or discarding activities.

## 5.2 LISTED WASTE DATA CONSIDERATIONS

The proposed designation of the wastestream contained in this report is based on an evaluation of process information and on sampling data. The following sections describe the types of information used in this designation.

### 5.2.1 Process Evaluation

The process evaluation began with a thorough review of the processes contributing to the wastestream. Processes were reviewed and compared with the dangerous waste source list (no chemicals are discarded into the stream). This process evaluation is necessary because the stream could be a listed waste if a listed waste was known to have been added at any upstream location, even if a listed constituent was not detected at the sample point. The process evaluation included a review of process diagrams and operating procedures.

Additionally, waste handling practices at the PUREX Plant were reviewed. The PUREX Plant has a very aggressive program of proper waste handling including: training, certification, oversight, and technical support that ensures that hazardous wastes are disposed of properly. Administrative controls are discussed in Section 2.3.1.3.

If a potentially listed source was identified, the process was evaluated to determine if the process resulted in the generation of a listed waste.

## 5.2.2 Sampling Data

Sampling data were used as a screening tool to enhance and support the results of the previously discussed process evaluation. This screening compared the results of the sampling data with the WAC 173-303-9903 and -9904 lists. If a constituent was cited on one or both of these lists, an engineering evaluation was performed to determine if it had entered the wastestream as a discarded chemical product or came from a dangerous waste source.

Screening organic constituents is a relatively simple procedure because organic constituents are reported as substances and are easily compared to the WAC 173-303-9903 and -9904 lists. It is not as simple to perform this screening on inorganic analytical data because inorganic data are reported as ions rather than as substances. For example, an analysis may show a wastestream contains the cations sodium and calcium, along with the anions chloride and nitrate. The possible combinations of substances include sodium chloride, sodium nitrate, calcium chloride, and calcium nitrate. In a situation with many cations and anions, however, the list of possible combinations is extensive.

A procedure was developed by Westinghouse Hanford for combining the inorganic constituents into substances. This screening procedure is described in WHC-EP-0275 (WHC 1990a) and is intended to be a tool in the evaluation of a wastestream. The listing of the inorganic substances developed by this screening procedure is not intended to be an indication that the substance was discharged to the wastestream, only that the necessary cations and anions are present and an investigation should be conducted to determine how they entered the wastestream.

Results from the inorganic constituent combining procedure are given in Table 5-1. Assumptions and additional notes are provided in the attached footnotes.

## 5.3 PROPOSED LISTED WASTE DESIGNATIONS

A process evaluation, along with a review of sampling data, indicated that the PDD does not contain a discarded chemical product or waste from a listed waste source. The following sections will present a discussion of the evaluation that was conducted to substantiate this conclusion.

### 5.3.1 Discarded Chemical Products

Section 2.0 contains a process evaluation of the contributors to the PDD. The process evaluation did not identify any discarded chemical products in the PDD. A review of CERCLA spill records for the current period identified a single spill which involved chemicals of interest. Mixed solvents, including methylene chloride, were spilled to grade level soil. The spill did not reach any effluent streams.

Table 5-1. Inorganic Chemistry for PUREX PDD. (sheet 1 of 2)

Constituent	ppb	Ion	Eq/g	Normalized
Charge Normalization:				
Boron	2.24E+01	B407-2	1.04E-09	1.56E-09
Calcium	5.05E+01	Ca+2	2.52E-09	
Cyanide	4.43E+01	CN-1	1.70E-09	2.56E-09
Fluoride	1.21E+03	F-1	6.38E-08	9.60E-08
Mercury	1.39E+00	Hg+2	1.38E-11	
Nitrate	1.19E+05	NO3-1	1.91E-06	2.88E-06
Nitrite	9.61E+04	NO2-1	2.09E-06	3.14E-06
Potassium	9.94E+02	K+1	2.54E-08	
Silicon	2.43E+02	SiO3-2	1.73E-08	2.61E-08
Sodium	2.02E+04	Na+1	8.77E-07	
Hydrogen Ion (from pH 2.3)		H+	(5.25E-06)	
Hydroxide Ion (from pH)		OH-	(1.91E-15)	
Cation total			6.15E-06	
Anion total			4.09E-06	
Anion normalization factor:		1.505		

Substance Formation: Substance	%	Cation Out	Anion Out
Hydrogen cyanide	6.92E-06		0.00E+00
Mercury(II) nitrate	2.24E-07	0.00E+00	2.88E-06
Sodium nitrite	6.05E-03	0.00E+00	2.27E-06
Potassium fluoride	1.48E-04	0.00E+00	7.05E-08
Calcium tetraborate	1.52E-05	9.59E-10	0.00E+00
Calcium fluoride	3.74E-06	0.00E+00	6.96E-08

Statistics based on a single datum are noted by an asterisk (\*). With the exception of hydrogen ion and hydroxide, others report the upper limit of the one-tailed 90% confidence interval. Hydrogen ion is based on the lower limit of the one-tailed 90% confidence interval for pH sets with mean values below 7.25 and on the upper limit of the one-tailed 90% confidence interval for pH data sets with mean values of 7.25 or higher. The hydroxide magnitude is equal to 1.00E-20 equivalents per gram (Eq/g)\*\*2 divided by the hydrogen Ion value (in Eq/g).

Ion concentrations in Eq/g are based on the statistic. Conversions include scale (ppb to g/g), molecular weight (constituent form to ionic form), and equivalents (charges per Ion). The column headed "Normalized" shows normalized concentrations (also in Eq/g) calculated by increasing concentrations of cations, excluding hydrogen ion, or anions, excluding hydroxide, by the normalization factor. The normalization factor is the larger of the cation total, including hydrogen ion, or anion total, including hydroxide, divided by the smaller total.

Table 5-1. Inorganic Chemistry for PUREX PDD. (sheet 2 of 2)

---

Substance names may include MB (monobasic), DB (dibasic), or TB (tribasic) to identify the equivalents of hydrogen ion that have been neutralized from polycrotic weak acids to form their conjugate bases.

Substances are formulated in the order listed. The column headed "%" is the percent of the substance in the waste (g/100g). Substances formulated with oxygen are based on the residual concentration of the counterion. Other substance concentrations are based on the limiting residual concentration of the cation or anion. The columns headed "Cation Out" and "Anion Out" indicate the residual concentrations (in Eq/g) of each ion after a substance concentration has been calculated.

0  
1  
2  
3  
4  
5  
6  
7  
8  
9

Table 5-2 contains a listing of the 11 potential chemical products identified from sampling data using the screening procedure described in Section 5.2.

Based on the considerations and data presented in the following sections it is concluded that the wastestream does not contain any discarded chemical products.

**5.3.1.1 Cyanide Compounds.** Cyanide compounds are used in the PUREX Plant laboratory operations as a complexant for photometric analyses. Interviews with laboratory personnel provided no evidence that listed cyanide compounds had been disposed of as the sole active ingredient in an unused or out-of-specification chemical product.

Cyanide-containing compounds have been used in the PUREX Plant laboratory as reagents for process control sample analyses. Following analysis, the solutions containing recoverable product and laboratory reagent have been recycled to the PUREX process. In the acidic conditions prevailing in the PUREX process, the cyanide readily volatilizes as hydrogen cyanide, and migrates into the condensate recycle system, eventually exiting the plant in the PDD.

The postulated cyanide-containing substances are not discarded chemical products.

**5.3.1.2 Hydrogen Fluoride.** Hydrogen fluoride is used in the PUREX Plant laboratory operations as a complexant for photometric analyses. Interviews with laboratory personnel provided no evidence that unused hydrogen fluoride had been disposed to the PDD stream.

Fluoride is used in the fuel decladding process at the PUREX Plant. Fluoride can also be used to help dissolve out-of-specification plutonium product for re-work in the PUREX process. Although aluminum is added to the PUREX process as a scavenger for the fluoride, some fluoride does volatilize from the nitric acid recovery system and contaminate the condensate recycle system. Some of this fluoride eventually exits the PUREX process in the PDD.

Hydrogen fluoride is not a discarded chemical product in the PDD.

**5.3.1.3 Acetone.** Previously, acetone was used in the PUREX Plant in the following areas: the analytical laboratories (as a cleaning solvent for analytical instrumentation) and maintenance shops (as a degreasing solvent for dye penetrant testing). Interviews with personnel in these areas indicated that acetone is no longer used at the PUREX Plant.

The presence of 2-butanone in the PDD indicates that acetone can also be produced in the PUREX process. As discussed below, TBP used in the PUREX process contains some butanol as an impurity. In the presence of high

Dangerous Waste Data Designation Report for PUREX Process Condensate

Finding: Undesignated

Discarded Chemical Products - WAC 173-303-081

Substance	Review Number	Status	DW Number
Calcium cyanide	P021(EHW)	Not Discarded	Undesignated
Hydrogen cyanide	P063(EHW)	Not Discarded	Undesignated
Hydrogen fluoride	U134(DW)	Not Discarded	Undesignated
Mercury	U151(EHW)	Not Discarded	Undesignated
Potassium cyanide	P098(EHW)	Not Discarded	Undesignated
Sodium cyanide	P106(EHW)	Not Discarded	Undesignated
Acetone	U002(DW)	Not Discarded	Undesignated
1-Butanol	U031(DW)	Not Discarded	Undesignated
2-Butanone	U159(DW)	Not Discarded	Undesignated
Tetrahydrofuran	U213(DW)	Not Discarded	Undesignated
Cyanides(soluble salts),NOS	P030(EHW)	Not Discarded	Undesignated

Dangerous Waste Sources - WAC 173-303-082

Substance	Review Number	Status	DW Number
Acetone	F003	Unlisted Source	Undesignated
1-Butanol	F003	Unlisted Source	Undesignated
2-Butanone	F005	Unlisted Source	Undesignated
Cyanides(soluble salts),NOS	F007 thru F012	Unlisted Source	Undesignated

Infectious Dangerous Waste - WAC 173-303-083

No regulatory guidance

Dangerous Waste Mixtures - WAC 173-303-084

Substance	Toxic	Persistant		Carcinogenic
	EC%	HH%	PAH%	Total%
Calcium fluoride	9.84E-10	0.00E+00	0.00E+00	0.00E+00
Hydrogen cyanide	6.92E-07	0.00E+00	0.00E+00	0.00E+00
Mercury(II) nitrate	2.24E-08	0.00E+00	0.00E+00	0.00E+00
Potassium fluoride	1.48E-07	0.00E+00	0.00E+00	0.00E+00
Sodium nitrite	6.05E-05	0.00E+00	0.00E+00	0.00E+00
Acetone	8.37E-10	0.00E+00	0.00E+00	0.00E+00
Ammonia	5.81E-08	0.00E+00	0.00E+00	0.00E+00
1-Butanol	3.32E-10	0.00E+00	0.00E+00	0.00E+00
2-Butanone	5.23E-10	0.00E+00	0.00E+00	0.00E+00
Tetrahydrofuran	9.83E-09	0.00E+00	0.00E+00	0.00E+00
Tributylphosphate	1.07E-06	0.00E+00	0.00E+00	0.00E+00
Total	6.25E-05	0.00E+00	0.00E+00	0.00E+00
DW Number	Undesignated	Undesignated	Undesignated	Undesignated

Dangerous Waste Characteristics - WAC 173-303-090

Characteristic	Value	DW Number
Ignitability (Degrees F)	>205	Undesignated
Corrosivity-pH	2.28	Undesignated
Total Cyanide (mg/kg)	4.61E-02	Undesignated
Total Sulfide (mg/kg)	0.00E+00	Undesignated
Total Mercury (mg/L)	1.39E-03	Undesignated

Table 5-2. Dangerous Waste Designation Report for the PDD. (sheet 1 of 2)

## Dangerous Waste Data Designation Report for PUREX Process Condensate

## Dangerous Waste Criteria - WAC 173-303-100

Substance	Toxic EC%	Persistant		Carcinogenic	
		HH%	PAH%	Total%	DW Number-Positive
Calcium fluoride	9.84E-10	0.00E+00	0.00E+00	0.00E+00	
Hydrogen cyanide	6.92E-07	0.00E+00	0.00E+00	0.00E+00	
Mercury(II) nitrate	2.24E-08	0.00E+00	0.00E+00	0.00E+00	
Potassium fluoride	1.48E-07	0.00E+00	0.00E+00	0.00E+00	
Sodium nitrite	6.05E-05	0.00E+00	0.00E+00	0.00E+00	
Acetone	8.37E-10	0.00E+00	0.00E+00	0.00E+00	
Ammonia	5.81E-08	0.00E+00	0.00E+00	0.00E+00	
1-Butanol	3.32E-10	0.00E+00	0.00E+00	0.00E+00	
2-Butanone	5.23E-10	0.00E+00	0.00E+00	0.00E+00	
Tetrahydrofuran	9.83E-09	0.00E+00	0.00E+00	0.00E+00	
Tributylphosphate	1.07E-06	0.00E+00	0.00E+00	0.00E+00	
Total	6.25E-05	0.00E+00	0.00E+00	0.00E+00	
DW Number		Undesignated	Undesignated	Undesignated	Undesignated

## Dangerous Waste Constituents - WAC 173-303-9905

Substance  
 Calcium cyanide  
 Hydrogen cyanide  
 Hydrogen fluoride  
 Potassium cyanide  
 Sodium cyanide  
 Acetone  
 Cyanides(soluble salts),NOS  
 Mercury and compounds,NOS

Substance names may include MB (monobasic), DB (dibasic), or TB (tribasic) to identify the equivalence of hydrogen ion that have been neutralized from polyprotic weak acids to form their conjugate bases.

Results based on a single datum are noted by an asterisk (\*). Others are based on the lower limit of the one-tailed 90% confidence interval for pH data sets with mean values below 7.25 or by the upper limit of the one-tailed 90% confidence interval for all other data sets.

EP Toxic contaminants, ignitability, and reactivity are reported by standard methods when available. In the absence of EP Toxicity data, total contaminant concentrations are evaluated. In lieu of closed cup ignition results, ignitability is estimated from the sum of the contributions of all substances that are ignitable when pure. A waste is flagged as dangerous if sum of the ignitable substances exceeds one percent. Reactivity is by SW-846: 250 mg of cyanide as hydrogen cyanide per kg of waste or 500 mg of sulfide as hydrogen sulfide per kg of waste. Total cyanide and total sulfide are used in lieu of amenable cyanide and amenable sulfide.

Inorganic substances are formulated and their possible concentrations calculated for designation purposes only. The actual existence in the waste of these substances is not implied and should not be inferred.

Table 5-2. Dangerous Waste Designation Report for the PDD.  
 (sheet 2 of 2)

radiation fields and high concentrations of acid, it is believed that some of the butanol is converted to acetone. The existence of butanone (an intermediate between butanol and acetone) in the PDD is evidence that this reaction takes place (Bergmann 1989).

Acetone is not a discarded chemical product in the PDD.

**5.3.1.4 1-Butanol.** 1-Butanol had been used in the PUREX Plant laboratory, and recycled into the PUREX process for the recovery of product materials, but this practice was discontinued before the latest sampling campaign. 1-Butanol is not disposed into the PUREX process or the PDD as a discarded chemical product.

Tributyl phosphate is used in the PUREX process as an extractant. Tributyl phosphate is manufactured from 1-butanol and phosphoric acid. As a consequence, the commercially procured TBP added to the PUREX process contains some 1-butanol contamination (Bergmann 1989). In the PUREX process, the TBP gradually degrades, producing additional 1-butanol (Lowy et al. 1936). The 1-butanol readily volatilizes into the condensate recycle system, and some exits the PUREX Plant in the PDD.

1-Butanol is not a discarded chemical product in the PDD.

**5.3.1.5 2-Butanone (methyl ethyl ketone).** A review of PUREX plant chemical inventory data did not show 2-butanone to be used at PUREX.

As discussed above, 1-butanol is present in the PUREX Plant process. High energy ionizing radiation and the prevailing oxidizing conditions in the PUREX process can rearrange and oxidize 1-butanol to 2-butanone. (Butanal, a simple oxidation product of 1-butanol, has also been reported in the PDD.)

2-Butanone is not a discarded chemical product in the PDD.

**5.3.1.6 Tetrahydrofuran.** A review of plant chemical inventory data did not show tetrahydrofuran to be used within PUREX.

Tetrahydrofuran can be produced from butanal (butyraldehyde) in the presence of ionizing radiation. 1-Butanol readily oxidizes to butanal, which has been reported twice in the PDD. Tetrahydrofuran was reported in two of the eight PDD samples, at levels as high as 103 ppb.

Tetrahydrofuran is not a discarded chemical product in the PDD.

**5.3.1.7 Mercury.** Mercury is present at the PUREX Plant in a number of applications. Metallic mercury is used in the PUREX Plant in maintenance instruments for calibrating plant equipment. Interviews with maintenance and hazardous waste disposal personnel provided no evidence that metallic mercury had been disposed of improperly as the sole active ingredient in an unused or out-of-specification chemical product. Administrative procedures provide requirements for handling hazardous waste. Mercury was detected in four of the five samples for which mercury analyses were performed, at

concentrations ranging up to somewhat less than six times the detection limit. The maximum concentration reported was 1.9 ppb. The drinking water limit is 2.0 ppb. The PUREX personnel are trained in the proper disposal of hazardous waste.

There are two likely sources of mercury in the PDD stream. First, mercury is used in open thermo-wells in the dissolvers. The vapor pressure of mercury at dissolver operating temperatures is 0.000384 to 0.000635 atm. This provides a mechanism for mercury to evaporate and ultimately enter the PDD stream. Second, mercury is present, as a minor contaminant, in the technical-grade sodium hydroxide used in the PUREX process. It is possible that minute traces of mercury could migrate from the points of use to the PDD stream.

Mercury is not a discarded chemical product in the PDD.

### 5.3.2 Dangerous Waste Sources

The process evaluation contained in Section 2.0 was also used to determine if the wastestream included any specific waste sources (K and W wastes) or any nonspecific waste sources (F Wastes) in the Dangerous Waste Source List (WAC 173-303-9904). The evaluation identified four solvents that had been used in the PUREX Plant laboratory and that would be non-specific waste sources if disposed as spent solvents: xylene, toluene, 1-butanol, and acetone.

As discussed previously, the sampling data were used to enhance the process evaluation. Three potential listed spent solvents were identified by the sampling data. These are acetone, 1-butanol, and 2-butanone. The sampling data also revealed the presence of cyanide compounds, which would be listed if they were derived from metal plating or heat treating operations.

Based on the discussion and data presented in the following sections, it is concluded that the PDD contributors are not listed as a dangerous waste source.

**5.3.2.1 Acetone.** Before June 1989, acetone was commonly used at the PUREX Plant and throughout the Hanford Site as a drying agent for laboratory glassware. Based upon undocumented discussions with the EPA, Westinghouse Hanford interpreted this use of acetone to be outside of the definition of "solvent use" found in the December 31, 1985, Federal Register.

Some acetone used in the PUREX Plant laboratory in this way was routinely sent to TK-F10, and thereby entered the PUREX process. Such acetone contained radionuclides (including recoverable quantities of actinide products) and was transferred to TK-F10 because of the radionuclide content. This acetone then migrated through the condensate recycle system, and some exited the process via the PDD. Use of acetone to dry glassware ceased in February 1988, and all use of acetone in the laboratory ceased in February 1989.

Acetone has been detected in the PDD samples taken during the recently completed stabilization run. The concentrations were approximately an order of magnitude smaller than seen in previous operating runs. It is believed that acetone is produced in the PUREX process by degradation of the NPH and TBP solution. 2-Butanone, a similar chemical, was not used in the laboratory or introduced to the PUREX process by another mechanism, but was also detected in the stabilization run PDD samples. The concentration variations appear to correlate closely, which suggests a common source. Since these chemicals are not used as solvents but appear to be produced in the PUREX process as impurities, their presence in the PDD would not cause it to be designated as a nonspecific dangerous waste source.

**5.3.2.2 1-Butanol.** The PUREX Plant laboratory formerly used small quantities of 1-butanol in sample analyses to extract actinides. After analysis, the actinide-containing solution, containing 1-butanol, was returned to the PUREX process for recovery of the actinides. The use of 1-butanol in the PUREX Plant laboratory was discontinued before the latest sampling campaign.

As discussed above (Section 5.3.1.4), 1-butanol is an impurity in, and a major breakdown product of, TBP. Tributyl phosphate is one of the major chemicals used in the PUREX process.

The 1-butanol currently found in the PDD is not a spent solvent, and is not from a listed dangerous waste source.

**5.3.2.3 2-Butanone.** 2-Butanone is not used in the PUREX Plant, and is consequently not available to be discarded as a spent solvent.

As discussed above, 2-butanone can be produced from the 1-butanol which is known and expected to be present in the PUREX process. Any such 2-butanone would readily migrate to the condensate recycle system and exit the PUREX Plant via the PDD.

The 2-butanone in the PDD is not from a listed dangerous waste source.

**5.3.2.4 Cyanides and Metal Processing.** Cyanide containing compounds are not used in the PUREX Plant for metal plating or metal heat treating.

As discussed above, certain cyanide containing compounds have been used in the PUREX Plant laboratory as reagents for sample analysis. Returning the mixtures of samples and reagents to the PUREX process for product recovery has introduced cyanide into the process. This cyanide has then migrated into the PDD.

The cyanide detected in the PDD is not from a listed dangerous waste source.

#### 5.4 DANGEROUS WASTE CRITERIA

A waste is considered a dangerous waste if it meets any of the following criteria categories (WAC 173-303-100): toxic dangerous waste, persistent dangerous waste, or carcinogenic dangerous waste. Dangerous waste mixtures are included in this section because this list of analytes identified in the PDD is identical to the "Criteria" Dangerous Waste list. A description of the methods used to test the sampling data against the criteria is contained in WHC-EP-0334 (WHC 1990b). Summaries of the methods, along with the results, are contained in the following sections.

##### 5.4.1 Toxic Dangerous Waste

The procedure for determining if a wastestream is a toxic dangerous waste is as follows (WAC 173-303-101):

- Collect and analyze multiple samples from the wastestream.
- Calculate the upper limit of the 90%CI for each analyte in the wastestream (WHC 1990b).
- Formulate substances from the analytical data. NOTE: This step is only required for inorganic analytes since it is not possible to complete the evaluation based on the concentration of cations and anions. This methodology is described in WHC-EP-0334 (WHC 1990b) and is based on an evaluation of the most toxic substances that can exist in an aqueous environment under normal temperatures and pressures.
- Assign toxic categories to the substances formulated for the wastestream.
- Calculate the contribution of each substance to the percent equivalent concentration (EC%).
- Calculate the EC% by summing the contributions of each substance.
- Sum the resulting EC%.
- Designate the wastestream as a toxic dangerous waste if the EC% is greater than 0.001%, per WAC 173-303-9906.

Eleven substances potentially present in the PDD were determined to have toxic categories associated with them. Table 5-2 lists the individual and sum equivalent concentration values for these substances. Since the equivalent concentration sum is 6.25 E-05%, which is less than the cut-off of 0.001%, the wastestream is not a toxic dangerous waste.

21113127

The designation report was prepared according to the procedure of WHC-EP-0334 (WHC 1990b) with one exception; the designation assumes that sodium nitrite is a B category toxic substance rather than an X category toxic substance. WHC-EP-0334 assigned an X category to the substance based on an inhalation rat result from the Registry of Toxic Effects of Chemical Substances (NIOSH 1989). The cited inhalation rat result was based on the lethal concentration of the substance in a volume of air which cannot be directly related to the lethal concentration of the substance in a solution. As a default, the substance is assigned a toxicity category of B based on its aquatic toxicity (EPA 1988).

#### 5.4.2 Persistent Dangerous Waste

The procedure for determining if a wastestream is a persistent dangerous waste is as follows (WAC 173-303-102).

- Collect multiple grab samples of the wastestream.
- Determine which substances in the wastestream are halogenated hydrocarbons (HH) and polycyclic aromatic hydrocarbons (PAH).
- Determine the upper limit of the 90%CI for the substances of interest (WHC 1990b).
- Calculate the weight percent (wt%) contribution of each HH and PAH.
- Sum the resulting wt% contributors, separately.
- Designate the wastestream as persistent if wt% contribution of HH is greater than 0.01% or if the PAH concentration is greater than 1.0%, per WAC 173-303-9907.

No substances potentially present in the PDD were determined to be HH and no substances were determined to be PAH. Consequently, the PDD is not a persistent dangerous waste.

#### 5.4.3 Carcinogenic Dangerous Waste

The procedure for determining if a wastestream is a carcinogenic dangerous waste is as follows (WAC 173-303-103).

- Collect multiple grab samples of the wastestream.
- Determine the upper one-sided 90%CI for the substance of interest (WHC 1990b).

- Formulate substances from the analytical data. NOTE: This step is only required for inorganic analytes since it is not possible to complete the evaluation based on the concentrations of cations and anions. This methodology is described in WHC-EP-0334 (WHC 1990b) and is based on an evaluation of the carcinogenic substances that can exist in an aqueous environment under normal temperatures and pressures.
- Determine which substances in the wastestream are human or animal carcinogens according to the International Agency for Research on Cancer.
- Calculate the wt% concentration for each carcinogen.
- Sum the resulting wt%.
- Designate the wastestream as carcinogenic if any of the carcinogens is above 0.01% or if the total concentration for positive and suspected carcinogens is above 1.0%.

No substances potentially present in the PDD were determined to be carcinogenic substances. Therefore, the wastestream is not a carcinogenic dangerous waste.

## 5.5 DANGEROUS WASTE CHARACTERISTICS

A waste is considered a dangerous waste if it is ignitable, corrosive, reactive, or extraction procedure (EP) toxic (WAC 173-303-090). A description of the methods used to examine the data in terms of these characteristics is contained in WHC-EP-0334 (WHC 1990b). Summaries of the methods along with the results are contained in the following sections.

### 5.5.1 Ignitability

Flashpoint testing was performed on the liquid effluent samples. All samples reached the boiling temperature of water without igniting. These data are included in Table 5-2.

### 5.5.2 Corrosivity

A waste is a corrosive dangerous waste if the stream exhibited a pH of  $\leq 2.0$  or  $\geq 12.5$ . The comparison to this characteristic was based on the lower limit of the one-sided 90%CI for a stream with a mean value of pH  $< 7.25$  and the upper limit of the one-sided 90%CI for a stream with a mean value of pH  $\geq 7.25$ . Because the mean value of the pH measurements for the PDD is below 7.25, the lower confidence interval limit, 2.28, is used. The wastestream is not a corrosive dangerous waste (WAC 173-303-090[6]). Before the change

from the 216-A-10 Crib to the 216-A-45 Crib, the PDD pH was not controlled, and was sometimes a corrosive dangerous waste as defined in WAC 173-303-090(6). The pH has been controlled as discussed in Section 2.3.1 since disposal was changed to the 216-A-45 Crib. (See Section 2.3.2.4, pH neutralization.)

### 5.5.3 Reactivity

An aqueous waste is reactive if the waste contains an amount of cyanide or sulfide under conditions sufficient to threaten human health or the environment at a pH of 2 to 12.5 (WAC 173-303-090(7)). A recent revision to *Test Methods for Evaluating Solid Waste* (EPA 1986) provides more quantitative indicator levels for cyanide and sulfide. It states that levels of (equivalent) hydrogen cyanide below 250 mg/kg or of (equivalent) hydrogen sulfide below 500 mg/kg, would not be considered reactive.

The revised SW-846 procedure was used for the PDD designation samples (EPA 1986).

Total cyanide was 0.0461 mg/kg. Total sulfide was undetected. Consequently, the PDD is not a reactive dangerous waste.

### 5.5.4 Extraction Procedure Toxicity

A waste is an EP toxic dangerous waste if contaminant results from EP toxicity testing exceed limits of WAC 173-303-090(8)(c). In the absence of specific EP toxicity test results, total analyte concentrations are used. One analyte with concentrations above the detection limit that is on the EP toxic list was found in the PDD. The concentration of this analyte is listed in Table 5-2. Because the mercury concentration of 0.00139 mg/L does not exceed the limit of 0.2 mg/L, the PDD is not an EP toxic dangerous waste.

## 5.6 PROPOSED DESIGNATIONS

Because the PDD does not contain any dangerous waste as defined in WAC 173-303-070, it is proposed that the wastestream not be designated a dangerous waste.

Before the opening of the 216-A-45 Crib in 1987, the PDD was sometimes corrosive, and consequently designated as dangerous waste, with a dangerous waste number of D002 (see Section 2.3.2.3, pH neutralization).

## 6.0 ACTION PLAN

This section addresses recommendations for future waste characterization tasks for the PDD that are within the scope of the *Liquid Effluent Study Project Plan* (WHC 1990a). The final extent of and schedule for any recommended tasks are subject to negotiation between the Ecology, EPA, and DOE. An implementation schedule for the completion of these tasks will give consideration to other compliance actions already underway as part of the Tri-Party Agreement (Ecology et al. 1989), and on the availability of funding. All effluent monitoring and sampling will be conducted according to DOE Order 5400.1, *General Environmental Protection Program* (DOE 1988).

### 6.1 FUTURE SAMPLING

The random sampling conducted between October 1989 and March 1990 covered the normal process configurations, with the exception that a significant quantity of rework product decreased the concentration of radionuclides in the PDD. If the J8 sample pot is again used to discharge to the PDD, additional samples may be necessary.

The understanding of the sources of all chemicals in the PDD is hampered by the unavailability of analytical data covering the steam used by the PUREX Plant, and the demineralized water generated by the PUREX Plant. Samples of steam condensate should be collected at the PUREX Plant and analyzed for volatile organic compounds (VOA). Samples of the PUREX Plant demineralized water should also be subjected to the VOA test.

### 6.2 TECHNICAL ISSUES

As described in Section 2.0, the effluent was sampled in the sample gallery of the 202-A Building. This sample point was chosen because it is a common, accessible location downstream of the pertinent contributor. The caustic addition to the sample pot was discontinued before sampling because this addition will not be used in the future. (During the present period, the PDD was routed to UGS, not to a disposal site. The solution was made strongly alkaline to protect the carbon steel equipment of UGS from corrosion.)

During the present period, the volume of the PDD flow was not continuously monitored because the stream was not flowing to the environment. The flows reported in Section 2.0 were obtained by measuring the liquid level in the receiving UGS tanks.

The samples collected at this point are considered to be representative of the types of constituents present in the contributing wastestream. As a result, the characterization data presented in this report are considered to be representative of the PDD.

This page intentionally left blank.

6  
1  
2  
3  
4  
5  
6  
7  
8  
9

## 7.0 REFERENCES

- Allinger, N. L., M. P. Cava, D. C. DeJongh, C. R. Johnson, N. A. Lebel, and C. L. Stevens, 1971, *Organic Chemistry*, Worth Publishers, Inc., New York, New York.
- APHA, 1985, *Standard Methods for the Examination of Water and Wastewater*, Sixteenth Edition, American Public Health Association, American Water Works Association and Water Pollution Control Federal, Washington, D.C.
- ASTM, 1986, *1986 Book of ASTM Standards*, American Society of Testing and Materials, Philadelphia, Pennsylvania.
- Bergmann, David W., 1989, *Sources of n-Butanol and Acetone in the PUREX Process*, WHC-SD-TO-154, pp A-4, B-4, E-2, and F-5, Westinghouse Hanford Company, Richland, Washington.
- CERCLA, 1980, *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*, 42 USC 9601, U.S. Environmental Protection Agency, Washington D. C.
- DOE 1988, *General Environmental Protection Program*, DOE Order 5400.1, U.S. Department of Energy, Washington, D. C.
- DOE-RL, 1987, *Plan and Schedule to Discontinue Disposal of Contaminated Liquids into the Soil Column at the Hanford Site*, U.S. Department of Energy-Richland Operations Office, Richland, Washington.
- Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, Washington State Department of Ecology, U.S. Environmental Protection Agency, Region X, and U.S. Department of Energy, Olympia, Washington.
- Ecology, 1989, *Dangerous Waste Regulations*, Washington (State) Administrative Code (WAC) 173-303, Washington State Department of Ecology, Olympia, Washington.
- EPA, 1988, *List of Hazardous Substances and Reportable Quantities*, Title 40, Code of Federal Regulations, Part 302.4, U.S. Environmental Protection Agency, Washington, D.C.
- EPA, 1986, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, GPA Public SW-846, Second Edition, U.S. Department of Ecology.
- Jungfleisch, F.M., 1988, *Preliminary Evaluation of Hanford Liquid Discharges to Ground*, WHC-EP-0052, p A-38, Westinghouse Hanford Company, Richland, Washington.

- Lawrence, M. J., 1989, "Liquid Effluent Study," (External letter 89021606 to C. Gregoire, Washington State Department of Ecology; and R. Russell, U.S. Environmental Protection Agency, May 13, 1989), U.S. Department of Energy-Richland Operations Office, Richland, Washington.
- Lerch, R.E., *PUREX Process Distillate Discharge Characterization Data* (Letter 8955181 to I.D. Izat, U.S. Department of Energy-Richland Operations Office, Richland, Washington, September 1989) Westinghouse Hanford Company, Richland, Washington.
- Lowy, Alexander, and Harrow, Benjamin, 1936, *An Introduction to Organic Chemistry*, Fourth Edition, John Wiley & Sons, Inc., New York, New York.
- NIOSH, 1989, *Registry of Toxic Effects of Chemical Substances*, U.S. Department of Health and Human Services, Cincinnati, Ohio.
- Somers, S., 1986, *Hanford Sanitary Water Quality Surveillance, CY 1985*, HEHF-55, Hanford Environmental Health Foundation, Richland, Washington.
- Somers, S., 1987, *Hanford Sanitary Water Quality Surveillance, CY 1986*, HEHF-59, Hanford Environmental Health Foundation, Richland, Washington.
- Somers, S., 1988, *Hanford Sanitary Water Quality Surveillance, CY 1987*, HEHF-71, Hanford Environmental Health Foundation, Richland, Washington.
- Somers, S., 1989, *Hanford Sanitary Water Quality Surveillance, CY 1988*, HEHF-74, Hanford Environmental Health Foundation, Richland, Washington.
- Thurman, P.A., 1990, *Hanford Sanitary Water Quality Surveillance, CY 1989*, HEHF-76, Hanford Environmental Health Foundation, Richland, Washington.
- WHC, 1990a, *Liquid Effluent Study Project Plan*, WHC-EP-0275, Revision 2, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1990b, *Wastestream Designation of Liquid Effluent Analytical Data*, WHC-EP-0334, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1990c, *Liquid Effluent Study Characterization Data*, WHC-EP-0355, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1989a, *Waste Stream Characterization Report*, WHC-EP-0287, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1989b, *Westinghouse Hanford Company Effluent Discharges and Solid Waste Management Report for Calendar Year 1988: 200/600 Areas*, WHC-EP-0141-1, Westinghouse Hanford Company, Richland, Washington.
- WHC, 1988, *Environmental Compliance*, WHC-CM-7-5, Revision 0, Westinghouse Hanford Company, Richland, Washington.



This page intentionally left blank.

91219711116

Table A-1. Data for PUREX Process Condensate.  
(sheet 1 of 8)

Constituent	Sample #	Date	Method	Result
Boron	50895	1/23/90	ICP	<1.00E+01
Boron	50935	2/13/90	ICP	<1.00E+01
Boron	50951	2/20/90	ICP	<1.00E+01
Boron	50988	2/27/90	ICP	2.70E+01
Boron	51020	3/06/90	ICP	2.50E+01
Calcium	50895	1/23/90	ICP	<5.00E+01
Calcium	50935	2/13/90	ICP	5.10E+01
Calcium	50951	2/20/90	ICP	<5.00E+01
Calcium	50988	2/27/90	ICP	<5.00E+01
Calcium	51020	3/06/90	ICP	<5.00E+01
Cyanide	50895	1/23/90	SPEC	3.74E+01
Cyanide	50935	2/13/90	SPEC	4.65E+01
Cyanide	50951	2/20/90	SPEC	3.30E+01
Cyanide	50988	2/27/90	SPEC	1.58E+01
Cyanide	51020	3/06/90	SPEC	4.58E+01
Fluoride	50895	1/23/90	IC	<5.00E+02
Fluoride	50935	2/13/90	IC	1.20E+03
Fluoride	50951	2/20/90	IC	<5.00E+02
Fluoride	50988	2/27/90	IC	1.60E+03
Fluoride	51020	3/06/90	IC	<5.00E+02
Mercury	50895	1/23/90	CVAA	<3.40E-01
Mercury	50935	2/13/90	CVAA	8.40E-01
Mercury	50951	2/20/90	CVAA	1.20E+00
Mercury	50988	2/27/90	CVAA	5.50E-01
Mercury	51020	3/06/90	CVAA	1.90E+00
Nitrate	50895	1/23/90	IC	4.66E+04
Nitrate	50935	2/13/90	IC	2.17E+05
Nitrate	50951	2/20/90	IC	3.90E+03
Nitrate	50988	2/27/90	IC	4.80E+03
Nitrate	51020	3/06/90	IC	5.50E+03
Nitrite	50895	1/23/90	IC	5.79E+04
Nitrite	50935	2/13/90	IC	1.65E+05
Nitrite	50951	2/20/90	IC	1.01E+04
Nitrite	50988	2/27/90	IC	<9.30E+03
Nitrite	51020	3/06/90	IC	4.30E+03
Potassium	50895	1/23/90	ICP	<1.00E+02
Potassium	50935	2/13/90	ICP	1.04E+02
Potassium	50951	2/20/90	ICP	<1.00E+02
Potassium	50988	2/27/90	ICP	4.95E+02
Potassium	51020	3/06/90	ICP	1.74E+03
Silicon	50895	1/23/90	ICP	<2.00E+02
Silicon	50935	2/13/90	ICP	2.80E+02
Silicon	50951	2/20/90	ICP	<2.00E+02
Silicon	50988	2/27/90	ICP	2.17E+02
Silicon	51020	3/06/90	ICP	<2.00E+02
Sodium	50895	1/23/90	ICP	9.83E+03

9111051217

Table A-1. Data for PUREX Process Condensate.  
 (sheet 2 of 8)

Constituent	Sample #	Date	Method	Result
Sodium	50935	2/13/90	ICP	2.94E+04
Sodium	50951	2/20/90	ICP	1.60E+04
Sodium	50988	2/27/90	ICP	7.81E+03
Sodium	51020	3/06/90	ICP	1.37E+03
Acetone	50895	1/23/90	VOA	6.70E+01
Acetone	50895	1/23/90	ABN	<1.00E+02
Acetone	50895B	1/23/90	VOA	<1.00E+01
Acetone	50895T	1/23/90	VOA	<1.00E+01
Acetone	50935	2/13/90	ABN	<1.00E+03
Acetone	50935B	2/13/90	VOA	<1.00E+01
Acetone	50935T	2/13/90	VOA	<1.00E+01
Acetone	59171	1/17/90	VOA	<5.00E+02
Acetone	59171	1/17/90	ABN	<1.00E+02
Acetone	59171B	1/17/90	VOA	<3.00E+02
Acetone	59171B	1/17/90	ABN	<1.00E+03
Acetone	59171T	1/17/90	VOA	<5.00E+02
Acetone	59176	1/22/90	VOA	<5.00E+02
Acetone	59176	1/22/90	ABN	<1.00E+02
Acetone	59176B	1/22/90	VOA	<5.00E+02
Acetone	59176B	1/22/90	ABN	<1.00E+03
Acetone	59176T	1/22/90	VOA	<5.00E+02
Acetone	59181	1/25/90	VOA	<5.00E+02
Acetone	59181	1/25/90	ABN	<1.00E+02
Acetone	59181B	1/25/90	VOA	<5.00E+02
Acetone	59181T	1/25/90	VOA	<5.00E+02
Acetone	50951	2/20/90	VOA	7.90E+01
Acetone	50951	2/20/90	ABN	<1.11E+02
Acetone	50951B	2/20/90	VOA	<1.00E+01
Acetone	50951T	2/20/90	VOA	<1.00E+01
Acetone	50988	2/27/90	VOA	<1.00E+01
Acetone	50988	2/27/90	ABN	<1.00E+03
Acetone	50988B	2/27/90	VOA	<1.00E+01
Acetone	50988T	2/27/90	VOA	<1.00E+01
Acetone	51020	3/06/90	VOA	7.40E+01
Acetone	51020	3/06/90	ABN	<1.00E+04
Acetone	51020B	3/06/90	VOA	<1.00E+01
Acetone	51020T	3/06/90	VOA	<1.00E+01
Ammonia	50895	1/23/90	ISE	<5.00E+01
Ammonia	50935	2/13/90	ISE	<5.00E+01
Ammonia	50951	2/20/90	ISE	<5.00E+01
Ammonia	50988	2/27/90	ISE	6.60E+01
Ammonia	51020	3/06/90	ISE	<5.00E+01
1-Butanol	50935	2/13/90	DIGC	<1.00E+04
1-Butanol	50951	2/20/90	VOA	1.00E+01
1-Butanol	50951	2/20/90	DIGC	<1.00E+04
1-Butanol	50988	2/27/90	VOA	1.30E+01

Table A-1. Data for PUREX Process Condensate.  
 (sheet 3 of 8)

Constituent	Sample #	Date	Method	Result
1-Butanol	50988	2/27/90	DIGC	<1.00E+04
1-Butanol	50988B	2/27/90	VOA	5.00E+00
1-Butanol	50988T	2/27/90	VOA	7.00E+00
1-Butanol	51020	3/06/90	VOA	3.40E+01
1-Butanol	51020	3/06/90	DIGC	<1.00E+04
1-Butanol	51020T	3/06/90	VOA	3.00E+01
2-Butanone	50895	1/23/90	VOA	1.40E+01
2-Butanone	50895B	1/23/90	VOA	<9.00E+00
2-Butanone	50895T	1/23/90	VOA	<1.00E+01
2-Butanone	50935B	2/13/90	VOA	<7.00E+00
2-Butanone	50935T	2/13/90	VOA	<8.00E+00
2-Butanone	59171	1/17/90	VOA	<5.00E+02
2-Butanone	59171B	1/17/90	VOA	<5.00E+02
2-Butanone	59171T	1/17/90	VOA	<5.00E+02
2-Butanone	59176	1/22/90	VOA	<5.00E+02
2-Butanone	59176B	1/22/90	VOA	<5.00E+02
2-Butanone	59176T	1/22/90	VOA	<5.00E+02
2-Butanone	59181	1/25/90	VOA	<5.00E+02
2-Butanone	59181B	1/25/90	VOA	<5.00E+02
2-Butanone	59181T	1/25/90	VOA	<5.00E+02
2-Butanone	50951	2/20/90	VOA	1.40E+01
2-Butanone	50951B	2/20/90	VOA	1.00E+01
2-Butanone	50951T	2/20/90	VOA	<6.00E+00
2-Butanone	50988	2/27/90	VOA	7.20E+01
2-Butanone	50988B	2/27/90	VOA	<1.00E+01
2-Butanone	50988T	2/27/90	VOA	<1.00E+01
2-Butanone	51020	3/06/90	VOA	1.40E+01
2-Butanone	51020B	3/06/90	VOA	<1.00E+01
2-Butanone	51020T	3/06/90	VOA	<1.00E+01
Butylated hydroxy toluene	59181	1/25/90	ABN	1.00E+02
Dibutylphosphate	50935	2/13/90	DIGC	<1.00E+04
Dibutylphosphate	50951	2/20/90	DIGC	2.81E+04
Dibutylphosphate	50988	2/27/90	DIGC	1.89E+04
Dibutylphosphate	51020	3/06/90	DIGC	1.26E+04
Dodecane	50895	1/23/90	ABN	6.50E+01
Dodecane	50935	2/13/90	ABN	1.60E+03
Dodecane	59171	1/17/90	ABN	1.20E+04
Dodecane	59171B	1/17/90	ABN	1.48E+04
Dodecane	59181	1/25/90	ABN	2.40E+02
Dodecane	50951	2/20/90	ABN	1.50E+04
Dodecane	50988	2/27/90	ABN	5.00E+01
Dodecane	51020	3/06/90	ABN	3.50E+04
Tetradecane	50895	1/23/90	ABN	3.50E+02
Tetradecane	50935	2/13/90	ABN	6.50E+03
Tetradecane	59171	1/17/90	ABN	4.80E+04

911151219



Table A-1. Data for PUREX Process Condensate.  
(sheet 5 of 8)

Constituent	Sample #	Date	Method	Result
Trichloromethane	59171B	1/17/90	VOA	<2.50E+02
Trichloromethane	59171T	1/17/90	VOA	<2.50E+02
Trichloromethane	59176	1/22/90	VOA	<2.50E+02
Trichloromethane	59176B	1/22/90	VOA	<2.50E+02
Trichloromethane	59176T	1/22/90	VOA	<2.50E+02
Trichloromethane	59181	1/25/90	VOA	<2.50E+02
Trichloromethane	59181B	1/25/90	VOA	<2.50E+02
Trichloromethane	59181T	1/25/90	VOA	<2.50E+02
Trichloromethane	50951	2/20/90	VOA	<5.00E+00
Trichloromethane	50951B	2/20/90	VOA	6.00E+00
Trichloromethane	50951T	2/20/90	VOA	<3.00E+00
Trichloromethane	50988	2/27/90	VOA	<5.00E+00
Trichloromethane	50988B	2/27/90	VOA	1.00E+01
Trichloromethane	50988T	2/27/90	VOA	1.00E+01
Trichloromethane	51020	3/06/90	VOA	<5.00E+00
Trichloromethane	51020B	3/06/90	VOA	<5.00E+00
Trichloromethane	51020T	3/06/90	VOA	<5.00E+00
Tridecane	50895	1/23/90	ABN	4.10E+02
Tridecane	50935	2/13/90	ABN	9.70E+03
Tridecane	59171	1/17/90	ABN	7.10E+04
Tridecane	59171B	1/17/90	ABN	8.80E+04
Tridecane	59176	1/22/90	ABN	2.40E+03
Tridecane	59176B	1/22/90	ABN	2.70E+03
Tridecane	59181	1/25/90	ABN	1.50E+03
Tridecane	50951	2/20/90	ABN	5.70E+04
Tridecane	50988	2/27/90	ABN	1.70E+02
Tridecane	51020	3/06/90	ABN	1.20E+05
Undecane	50951	2/20/90	ABN	1.20E+02
Unknown	50895	1/23/90	VOA	7.00E+00
Unknown	50895	1/23/90	ABN	1.20E+02
Unknown	50935	2/13/90	ABN	1.50E+04
Unknown	59176B	1/22/90	ABN	1.30E+03
Unknown	50951	2/20/90	VOA	3.60E+01
Unknown	51020	3/06/90	VOA	5.00E+00
Unknown aliphatic HC	59171	1/17/90	ABN	1.70E+03
Unknown aliphatic HC	59171B	1/17/90	ABN	2.40E+03
Unknown aliphatic HC	50951	2/20/90	ABN	6.90E+02
Unknown ester	50895	1/23/90	ABN	9.60E+01
Unknown ester	59171	1/17/90	ABN	1.70E+03
Unknown ester	59171B	1/17/90	ABN	1.40E+03
Unknown ester	59181	1/25/90	ABN	1.00E+02
Unknown ester	50951	2/20/90	ABN	2.00E+02
Unknown ester	50951	2/20/90	VOA	3.00E+01
Unknown ester	50988	2/27/90	VOA	4.20E+01
Unknown ester	51020	3/06/90	VOA	2.00E+01
Unknown hydrocarbon	50895	1/23/90	ABN	4.50E+01

Table A-1. Data for PUREX Process Condensate.  
 (sheet 6 of 8)

Constituent	Sample #	Date	Method	Result
Unknown hydrocarbon	50935	2/13/90	ABN	3.10E+04
Alpha Activity (pCi/L)	50895	1/23/90	Alpha	1.74E+00
Alpha Activity (pCi/L)	50935	2/13/90	Alpha	5.57E+00
Alpha Activity (pCi/L)	50951	2/20/90	Alpha	4.65E+01
Alpha Activity (pCi/L)	50988	2/27/90	Alpha	4.53E+01
Alpha Activity (pCi/L)	51020	3/06/90	Alpha	1.34E+01
Beta Activity (pCi/L)	50895	1/23/90	Beta	6.07E+00
Beta Activity (pCi/L)	50935	2/13/90	Beta	3.99E+00
Beta Activity (pCi/L)	50951	2/20/90	Beta	9.06E+00
Beta Activity (pCi/L)	50988	2/27/90	Beta	1.45E+01
Beta Activity (pCi/L)	51020	3/06/90	Beta	5.83E+00
Conductivity (μS)	50895	1/23/90	COND-F1d	3.95E+02
Conductivity (μS)	50935	2/13/90	COND-F1d	1.50E+03
Conductivity (μS)	50988	2/27/90	COND-F1d	5.70E+01
Conductivity (μS)	51020	3/06/90	COND-F1d	7.90E+01
Ignitability (°F)	50895E	1/23/90	IGNIT	2.10E+02
Ignitability (°F)	50935E	2/13/90	IGNIT	2.12E+02
Ignitability (°F)	50951E	2/20/90	IGNIT	2.10E+02
Ignitability (°F)	50988E	2/27/90	IGNIT	2.04E+02
Ignitability (°F)	51020E	3/06/90	IGNIT	2.04E+02
pH (dimensionless)	50895	1/23/90	PH-F1d	2.88E+00
pH (dimensionless)	50935	2/13/90	PH-F1d	2.60E+00
pH (dimensionless)	50988	2/27/90	PH-F1d	4.40E+00
pH (dimensionless)	51020	3/06/90	PH-F1d	2.30E+00
Temperature (°C)	50895	1/23/90	TEMP-F1d	2.30E+01
Temperature (°C)	50988	2/27/90	TEMP-F1d	3.78E+01
Temperature (°C)	51020	3/06/90	TEMP-F1d	7.90E+01
TOC	50895	1/23/90	TOC	6.60E+04
TOC	50935	2/13/90	TOC	8.02E+04
TOC	50951	2/20/90	TOC	1.02E+05
TOC	50988	2/27/90	TOC	1.41E+05
TOC	51020	3/06/90	TOC	1.42E+05
TOX (as Cl)	50895	1/23/90	LTOX	6.40E+01
TOX (as Cl)	50935	2/13/90	LTOX	5.60E+01
TOX (as Cl)	50951	2/20/90	LTOX	2.60E+01
TOX (as Cl)	50988	2/27/90	LTOX	4.70E+01
TOX (as Cl)	51020	3/06/90	LTOX	4.70E+01
<sup>137</sup> Cs (pCi/L)	50988	2/27/90	GEA	2.38E+00
<sup>137</sup> Cs (pCi/L)	51020	3/06/90	GEA	<4.43E-01

NOTES:

Sample# is the number of the sample. See chapter three for corresponding chain-of-custody number.

Date is the sampling date.

Results are in ppb (parts per billion) unless otherwise indicated.

911511116

Table A-1. Data for PUREX Process Condensate.  
(sheet 7 of 8)

The following table lists the methods that are coded in the method column.

Code	Analytical Method	Reference
ABN	Semivolatile Organics (GC/MS)	USEPA-8270
AEA	<sup>241</sup> Am	UST-20Am01
AEA	Curium Isotopes	UST-20Am/Cm01
AEA	Plutonium Isotopes	UST-20Pu01
AEA	Uranium Isotopes	UST-20U01
ALPHA	Alpha Counting	EPA-680/4-75/1
ALPHA-Ra	Total Radium Alpha Counting	ASTM-D2460
BETA	Beta Counting	EPA-680/4-75/1
BETA	<sup>90</sup> Sr	UST-20Sr02
COLIF	Coliform Bacteria	USEPA-9131
COLIFMF	Coliform Bacteria (Membrane Filter)	USEPA-9132
COND-Fld	Conductivity-Field	ASTM-D1125A
COND-Lab	Conductivity-Laboratory	ASTM-D1125A
CVAA	Mercury	USEPA-7470
CVAA/M	Mercury-Mixed Matrix	USEPA-7470
DIGC	Direct Aqueous Injection (GC)	UST-70DIGC
DIMS	Direct Aqueous Injection (GC/MS)	"USEPA-8240"
DSPEC	Reactive Cyanide (Distillation, Spectroscopy)	USEPA-CHAPTER 7
DTITRA	Reactive Sulfide (Distillation, Titration)	USEPA-CHAPTER 7
FLUOR	Uranium (Fluorometry)	ASTM-D2907-83
GEA	Gamma Energy Analysis Spectroscopy	ASTM-D3649-85
GFAA	Arsenic (AA, Furnace Technique)	USEPA-7060
GFAA	Lead (AA, Furnace Technique)	USEPA-7421
GFAA	Selenium (AA, Furnace Technique)	USEPA-7740
GFAA	Thallium (AA, Furnace Technique)	USEPA-7841
IC	Ion Chromatography	EPA-600/4-84-01
ICP	Atomic Emission Spectroscopy (ICP)	USEPA-6010
ICP/M	Atomic Emission Spectroscopy (ICP)-Mixed Matrix	USEPA-6010
IGNIT	Pensky-Martens Closed-Cup Ignitability	USEPA-1010
ISE	Fluoride-Low Detection Limit	ASTM-D1179-80-B
ISE	Ammonium Ion	ASTM-D1426-D
LALPHA	Alpha Activity-Low Detection Limit	EPA-680/4-75/1
LEPD	<sup>129</sup> I	UST-20I02
LSC	<sup>14</sup> C	UST-20C01
LSC	Tritium	UST-20H03
LTOX	Total Organic Halides-Low Detection Limit	USEPA-9020
PH-Fld	pH-Field	USEPA-9040
PH-Lab	pH-Laboratory	USEPA-9040
SPEC	Total and Amenable Cyanide (Spectroscopy)	USEPA-9010
SPEC	Hydrazine-Low Detection Limit (Spectroscopy)	ASTM-D1385
SSOLID	Suspended Solids	SM-208D
TC	Total Carbon	USEPA-9060
TDS	Total Dissolved Solids	SM-208B

Table A-1. Data for PUREX Process Condensate.  
(sheet 8 of 8)

TEMP-Fld	Temperature-Field	Local
TITRA	Alkalinity-Method B (Titration)	ASTM-D1067B
TITRA	Sulfides (Titration)	USEPA-9030
TOC	Total Organic Carbon	USEPA-9060
TOX	Total Organic Halides	USEPA-9020
VOA	Volatile Organics (GC/MS)	USEPA-8240

Analytical Method Acronyms:

- AA = atomic absorption spectroscopy.
- GC = gas chromatography.
- MS = mass spectrometry.
- ICP = inductively-coupled plasma spectroscopy.

References:

- ASTM--"1986 Annual Book of ASTM Standards", American Society for Testing and Materials, Philadelphia, Pennsylvania.
- EPA--Various methods of the U.S. Environmental Protection Agency, Washington, D.C.
- UST--Methods of the United States Testing Company, Incorporated, Richland, Washington.
- SM--"Standard Methods for the Examination of Water and Wastewater", 16th ed., American Public Health Association, American Water Works Association and Water Pollution Control Federation, Washington, D.C.
- USEPA--"Test Methods for Evaluating Solid Waste Physical/Chemical Methods", 3rd ed., SW-846, U.S. Environmental Protection Agency, Washington, D.C.

91111151204



This page intentionally left blank.

9  
2  
5  
1  
5  
6  
1  
1  
1  
1  
1  
6

PDD Sample Results.

ANALYTE	08/23/85	05/20/86	07/24/86	04/22/87	05/06/87	06/24/87	06/26/87	08/20/87
Alpha Activity (LDL,pCi/L)	1.04E+02	8.96E+02	1.33E+03	2.76E+01	1.59E+01	8.74E+01	4.27E+01	6.28E+00
Beta Activity (pCi/L)	1.55E+04	6.82E+04	2.06E+04	2.98E+02	3.11E+01	7.89E+01	8.38E+01	7.62E+01
Acetone (VOA)	BDL	3.20E+02	9.50E+02	2.80E+02	BDL	9.00E+02	1.45E+02	1.10E+02
Ammonium	BDL	1.35E+02	BDL	BDL	BDL	9.40E+01	BDL	BDL
Barium	BDL	BDL	BDL	BDL	2.20E+01	1.20E+01	6.00E+00	BDL
Butraldehyde	1.20E+01	BDL	1.80E+01	BDL	BDL	BDL	BDL	BDL
Butyl alcohol	5.00E+01	3.00E+01	2.90E+01	BDL	BDL	1.40E+01	2.60E+01	1.90E+01
Butylnitrate	BDL	2.40E+02	BDL	2.90E+01	BDL	7.50E+01	3.20E+01	2.60E+01
Cadmium	9.00E+00	BDL						
Calcium	7.60E+01	BDL	BDL	5.84E+03	2.14E+04	3.24E+03	1.40E+03	BDL
Chloride	BDL	BDL	1.22E+03	BDL	1.10E+03	BDL	7.83E+03*	6.27E+03
Chromium	BDL	BDL	BDL	BDL	BDL	BDL	1.40E+01	BDL
Conductivity Field (uS)	7.01E+02	9.16E+02	1.55E+03	7.38E+02	1.36E+02	1.16E+02	2.07E+02	4.41+02
Copper	1.30E+01	BDL						
Cyanide	BDL	1.40E+02	5.40E+01	2.22E+01	BDL	BDL	1.95E+01	5.79E+01
Decane	BDL	BDL	BDL	BDL	BDL	BDL	2.30E+02*	BDL
Dodecane	BDL	1.00E+03*	7.10E+02*	4.25E+02*	8.50E+01	7.40E+04*	3.61E+04^	2.60E+04^
Fluoride (IC)	BDL	BDL	BDL	7.50E+02	BDL	BDL	BDL	3.96E+03
Iron	BDL	BDL	BDL	BDL	2.31E+02	2.12E+02	BDL	BDL
Isophorone	1.30E+01	BDL						
Magnesium	1.90E+01	BDL	BDL	7.75E+02	4.62E+03	8.42E+02	3.00E+02	BDL
Manganese	BDL	BDL	BDL	BDL	BDL	1.20E+01	BDL	BDL
Mercury	2.10E-01	6.50E+00	9.00E+00*	3.10E-01*	1.50E-01	4.40E-01	1.70E-01	2.00E-01
N-Methoxymethanamine	BDL	1.25E+02	BDL	BDL	BDL	BDL	BDL	BDL
Methylene chloride	BDL	6.00E+01	BDL	BDL	BDL	BDL	BDL	1.30E+01
Methyl ethyl ketone	BDL	BDL	BDL	2.20E+01	BDL	9.00E+01	5.00E+01	1.40E+01
Methyl vinyl ketone	2.20E+01	BDL						
Methyl nitrate	BDL	2.40E+02	BDL	BDL	BDL	BDL	BDL	BDL
Nickel	1.00E+01	BDL						
Nitrate	1.75E+05	1.69E+06	5.16E+05	1.22E+04	1.99E-03	3.35E+03	4.37E+03	1.02E+04
Nitromethane	8.00E+00	BDL						
Pentadecane	BDL	3.00E+02*	BDL	BDL	BDL	BDL	3.10E+03	2.28E+03*
pH-Field	3.45E+00	2.12E+00	3.32E+00	1.08E+01	5.62E+00	8.32E+00	8.94E+00	1.03E+01
Potassium	BDL	BDL	2.59E+05*	1.23E+05*	2.27E+03	1.41E+04	2.94E+04	7.27E+04*
Sodium	4.41E+02	1.20E+02	1.78E+03	1.42E+03	2.19E+03	5.78E+02	4.33E+02	5.22E+02
Sulfate	BDL	BDL	1.53+03	3.37E+03	1.25E+04	1.72E+03	6.28E+02	BDL
Temperature-Field (celsius)	3.96E+01	4.35E+01	4.85E+01	3.49E+01	1.97E+01	4.03E-01	4.72E+01	4.65E+01
Tetradecane	BDL	4.60E+03*	5.80E+03*	1.67E+03*	4.43E+02*	2.05E+05*	1.03E+05~	6.24E+04^
Tetrahydrofuran	BDL	BDL	BDL	BDL	BDL	1.40E+01	BDL	2.40E+01
TOC	1.86E+04*	4.40E+04*	3.12E+04*	5.21E+04	1.93E+04	1.11E+05	1.01E+05	1.45E+05*
TOC	2.74E+04*	4.59E+04*						
TOX (LDL)	BDL	2.74E+02	BDL	BDL	BDL	2.06E+02	4.84E+01	5.42+01
Tributyl phosphate	3.55E+04	7.20E+04^	7.23E+04^	7.96E+04^	9.49E+03^	1.80E+05*	1.65E+05~	1.83E+05~
Tridecane	BDL	4.70E+03*	5.20E+03	2.07E+03*	4.34E+02*	2.30E+05*	1.26E+05~	6.60E+04^
Undecane	BDL	BDL	BDL	BDL	BDL	BDL	9.50E+02*	5.20E+02*
Uranium	3.21E+01	3.35E+01	5.87E+01	9.88E-01	7.49E+00	3.07E+01	2.37E+01	1.51+00
Zinc	3.20E+01	BDL	BDL	7.00E+00	7.00E+00	BDL	BDL	BDL
Unknown	1.90E+03	BDL						
Unknown	5.50E+02	BDL						
Unknown	8.60E+03	BDL						
Unknown	9.70E+03	BDL						

\* = 1 Dilution. ^ = 2 Dilutions. ~ = 3 Dilutions.

9111351227

### Radioactive Component Analysis Considerations

Understanding the radiological sample results generated routinely at the Hanford Site is complicated by the traditional methods of reporting the results. These methods, although not ideal, are a direct outgrowth of the methods used to detect radionuclides, the physics of radioactive decay, and the ubiquity of ionizing radiation.

Radioactive decay is a random process: each radioactive nucleus has a certain probability of decaying during a certain period of time, and will either decay or not decay. Radioactivity is quantified by counting the number of decays observed during a measured period of time. Consequently, any measurement of the radioactive decay rate includes a considerable amount of random error (experimental uncertainty). Specifically, the standard deviation of a measurement is equal to the square root of the number of decays expected during the counting period. The standard deviation can be approximated as the square root of the number of counts actually observed. Background radiation, which is always present, follows the same statistical rules as the radioactivity being measured.

To avoid reporting background radiation as radioactivity in a sample, each analysis consists of two counting periods of the same length. In the first, the background radiation is counted. In the second, the sample to be analyzed is inserted into the instrument, and the background and sample are counted together. The measured radioactivity of the sample is then the difference between the second and first measurements, divided by the time period. Because the radiation production is a random process, it is possible for an individual measurement of the background to be greater than another measurement of the background plus the radioactivity of a sample, leading to a negative measured radioactivity for the sample. (Indeed, if the sample has negligible radioactivity such negative results will occur about half of the time.)

Because it is physically impossible for a sample to actually contain a negative concentration of radioactive species, negative results have traditionally been reported as "less than" values. Similarly, counting results so low as to make it unclear whether any radioactivity was present in the sample have often been reported as "less than" values. On some occasions, however, small positive results (below the confidence interval reported in "less than" results) have been reported as real numbers. Although the historical data resulting from such reporting methods are not as well suited as they might be for evaluating what has happened in the past, the data did serve their primary function for process control and environmental protection at the time they were generated.

### Radiological Data for the PUREX PDD

The following historical radionuclide data for PDD discharges from 1981 through 1988 have been published in Volume 2, pp. A.5-6 through A.5-9 of WHC 1989b. The data were obtained from monthly composite samples of the effluent actually released to the environment. The data have been published on a yearly or quarterly basis and made available to the public.

The historical radiological data are presented twice: first in tabular form, and then in graphic form. In the graphs, both "less than" results and real results are connected with lines. Each real result is marked with a plus sign ("+"). Thus, the graph for  $^{241}\text{Am}$  (p B-14) shows only eight instances in which  $^{241}\text{Am}$  was reported as detected in the PDD (once in 1982, five times in 1983, once in 1984, and once in 1988). The rest of the line on the  $^{241}\text{Am}$  graph is merely an upper bound for the actual emissions of  $^{241}\text{Am}$  through the PDD.

At the end of 1984, a change was made in the reporting of plutonium in liquid effluents released to the environment. Before that time, plutonium releases were reported in grams per liter. Subsequent to that time, they were reported in microcuries per liter. In producing the table, the reported concentrations were multiplied by 1,000,000 to yield picocuries per liter (pCi/L) after 1984, and micrograms per liter before 1985. The pre-1985 plutonium results can be converted to pCi/L by multiplying by the specific activity of  $^{239}\text{Pu}$ , which is 61,400 pCi/ $\mu\text{g}$ . In the graphical presentation, the plutonium data are all in pCi/L.



PUREX PDD Radiological Release History.  
Units in pCi/L except Volume in L.

Stream Code: PP		PUREX Process Condensate									
Date	VOLUME	ALPHA	BETA	SR-90	RU-106	RU-103	CS-134	CS-137	PM-147	U(GROSS)	
8606	7.88E+06	3.32E+04	3.97E+03	9.00E+00	8.00E+02	8.30E+01	<4.80E+01	<4.80E+01	2.30E+02	4.11E+01	
8607	1.35E+07	5.10E+03	3.25E+03	7.70E+01	2.13E+03	<4.00E+01	<4.53E+01	<4.53E+01	<8.00E+01	1.37E+01	
8608	1.11E+07	7.71E+03	4.03E+04	<2.70E+01	4.72E+04	<2.00E+03	<6.20E+01	<6.20E+01	3.50E+03	9.81E+01	
8609	5.79E+06	6.30E+02	2.36E+03	<1.10E+02	1.05E+03	<4.60E+01	<6.80E+01	<6.80E+01	7.20E+01	2.89E+01	
8610	2.18E+06	4.99E+02	9.65E+02	4.49E+01	4.29E+02	<1.89E+01	2.78E+01	2.78E+01	2.94E+01	1.18E+01	
8611	2.40E+05	2.35E+03	5.52E+03	<3.00E+01	1.22E+03	<4.00E+01	1.02E+02	1.02E+02	2.50E+02	5.22E+00	
8612	2.62E+05	6.30E+03	6.70E+03	<5.00E+01	<1.35E+03	<2.50E+01	1.05E+02	1.05E+02	4.00E+02	6.43E+00	
8701	6.47E+06	4.00E+03	6.48E+02	6.70E+01	<2.50E+02	<3.00E+01	<5.60E+01	<5.60E+01	<2.00E+02	8.20E+01	
8703	5.74E+06	5.80E+02	3.17E+02	<1.07E+02	<2.70E+02	<3.20E+01	<4.30E+01	<4.30E+01	1.20E+03	1.51E+00	
8704	8.89E+06	9.70E+02	1.57E+03	<3.00E+01	<1.05E+03	<4.00E+01	5.10E+01	5.10E+01	2.80E+02	6.79E+00	
8705	4.99E+06	3.50E+02	1.97E+02	<4.80E+01	<2.95E+02	<3.50E+01	<4.70E+01	<4.70E+01	8.30E+01	6.74E+00	
8706	7.58E+06	1.38E+03	4.11E+02	<9.80E+01	5.40E+02	<3.24E+01	<5.00E+01	<5.00E+01	2.10E+02	1.29E+01	
8707	8.41E+06	7.78E+01	1.41E+02	<1.76E+02	<3.14E+02	<3.84E+01	<5.31E+01	<5.31E+01	<3.80E+01	6.57E+00	
8708	3.03E+06	7.03E+01	1.51E+02	<5.21E+01	<2.77E+02	<2.89E+01	<4.53E+01	<4.53E+01	5.48E+01	7.05E+00	
8709	4.78E+06	3.40E+01	1.21E+02	<1.60E+02	<2.79E+02	<2.85E+01	<4.80E+01	<4.80E+01	3.36E+02	2.26E+01	
8712	1.41E+06	8.45E+02	<1.15E+02	<1.06E+02	<2.93E+02	<3.07E+01	<4.94E+01	<4.94E+01	<1.80E+02	1.25E+01	
8802	3.45E+06	5.92E+01	1.72E+02	<2.14E+02	<4.04E+02	<3.67E+01	<5.70E+01	<5.70E+01	<1.80E+02	1.69E+01	
8803	5.70E+06	<9.34E+01	1.72E+02	<8.52E+01	<1.20E+02	<1.55E+01	<1.98E+01	<1.98E+01	3.84E+02	7.46E+01	
8805	2.68E+06	7.24E+03	1.03E+03	<9.16E+01	<3.52E+02	<3.75E+01	1.09E+02	1.09E+02	1.68E+03	1.55E+01	
8806	7.94E+06	3.04E+02	1.42E+02	<7.73E+01	<4.11E+02	<4.12E+01	5.26E+02	5.26E+02	1.13E+03	3.66E+01	
8807	3.37E+06	1.07E+02	<1.98E+02	<1.94E+01	<3.00E+02	<3.30E+01	<1.48E+02	<1.48E+02	3.05E+02	4.64E+01	
8808	7.84E+06	2.29E+02	2.81E+02	<1.73E+02	<4.17E+02	<4.14E+01	<9.01E+01	<9.01E+01	9.94E+02	5.98E+00	
8809	5.65E+06	2.84E+02	2.80E+02	<2.83E+01	<3.52E+02	<4.04E+01	<8.26E+01	<8.26E+01	1.16E+03	4.61E+01	
8810	4.14E+06	<8.20E+01	1.89E+02	<2.94E+01	<4.22E+02	<4.57E+01	<5.77E+01	<5.77E+01	7.30E+02	5.68E+01	
8811	3.83E+06	<2.20E+02	3.28E+02	<1.89E+01	<3.22E+02	<3.52E+01	<5.77E+01	<5.77E+01	<9.01E+02	5.85E+01	
8812	4.20E+06	1.74E+02	<1.25E+02	<2.00E+01	<3.22E+02	<3.75E+01	<4.94E+01	<4.94E+01	<9.01E+02	2.05E+01	

WHC-EP-0342 Addendum 12 08/31/90  
PUREX Plant PDD

PUREX PDD Radiological Release History.  
Units in pCi/L except Volume in L.

Stream Code: PP		PUREX Process Condensate				
Date	H-3	AM-241	I-129	PU-238	PU-241	PU-239
8110						4.54E+00
8111						2.11E-02
8210		4.30E+02				3.42E-02
8301	<2.00E+02					
8302	<1.00E+03					
8304	2.60E+02					
8305	4.20E+02	1.60E+03				1.45E-01
8306	4.20E+03	1.30E+04				3.75E-01
8309		4.70E+01				1.32E-02
8310	<2.00E+02					
8311	1.10E+06	2.90E+04				3.75E-01
8312	1.04E+05	3.10E+03				5.05E-02
8401	5.40E+07	4.60E+03			1.17E+05	1.64E-01
8402	4.70E+07	<1.45E+03			3.51E+05	4.94E-01
8403	8.70E+07	<4.00E+02			3.44E+05	4.84E-01
8404	9.20E+07	<4.00E+02			3.48E+05	4.89E-01
8405	4.76E+07	<3.40E+03			9.13E+04	1.23E-01
8406	5.40E+07	<3.20E+03			2.05E+04	2.88E-02
8407	1.01E+08	<3.10E+02			5.37E+03	7.55E-03
8408	9.70E+07	<2.10E+03			1.02E+04	1.43E-02
8409	1.20E+08	<3.80E+02			5.34E+03	7.50E-03
8411	4.40E+07	<4.10E+02			1.58E+03	2.22E-03
8412	2.00E+06	<4.00E+02			9.96E+03	1.40E-02
8501	8.70E+07	<5.00E+02	5.15E+02	4.00E+01	1.14E+04	7.11E+02
8502	1.10E+08	<1.20E+03	2.71E+02	<4.40E+01	8.37E+03	5.23E+02
8503	1.38E+08	<2.20E+03	3.43E+02	1.10E+02	2.45E+04	1.53E+03
8504	1.10E+08	<1.00E+03		1.00E+01	8.91E+03	8.25E+02
8505	1.00E+08	<6.00E+02	3.70E+03	5.80E+02	8.58E+04	7.95E+03
8506	2.04E+07	<3.00E+03		9.00E+02	7.70E+04	7.13E+03
8507	7.74E+07	<6.00E+02	7.78E+02	8.49E+02	3.44E+04	2.67E+03
8508	9.00E+07	<4.10E+03	1.27E+03	2.10E+02	1.01E+04	9.60E+02
8509	6.47E+07	<1.40E+03	1.02E+03	<4.06E+02	1.88E+04	2.15E+03
8510	5.59E+07	<2.40E+03	1.25E+03	2.50E+03	5.91E+05	2.31E+04
8511	1.44E+08	<3.60E+03		2.41E+04	2.93E+06	1.10E+05
8512	1.82E+08	<6.80E+02		1.50E+03	2.47E+05	7.78E+03
8601	9.00E+06	<5.13E+02	2.50E+02	2.64E+03	1.60E+05	1.52E+04
8602	1.07E+08	<5.13E+02	<1.00E+02	1.95E+02	1.14E+04	1.12E+03
8603	1.20E+08	<1.60E+03	1.40E+02	1.64E+02	1.23E+04	1.05E+03
8604	7.53E+07	<2.40E+03	3.80E+02	1.92E+03	2.34E+05	2.02E+04
8605	1.10E+08	<2.02E+03	1.60E+02	<2.00E+02	8.56E+04	7.90E+03
8606	8.01E+07	<9.00E+02	1.00E+02	2.12E+03	2.42E+05	2.45E+04
8607	9.25E+07	<1.20E+03	4.50E+02	4.20E+02	5.30E+04	5.40E+03
8608	1.14E+08	<2.30E+03	3.60E+02	7.76E+02	1.03E+05	1.06E+04
8609	5.70E+06	<7.00E+02	<4.00E+01	3.11E+01	7.29E+03	7.50E+02
8610	3.09E+06	<7.00E+02	<3.00E+01	2.46E+01	5.77E+03	5.94E+02

91111151272

WHC-EP-0342 Addendum 12 08/31/90  
PUREX Plant PDD

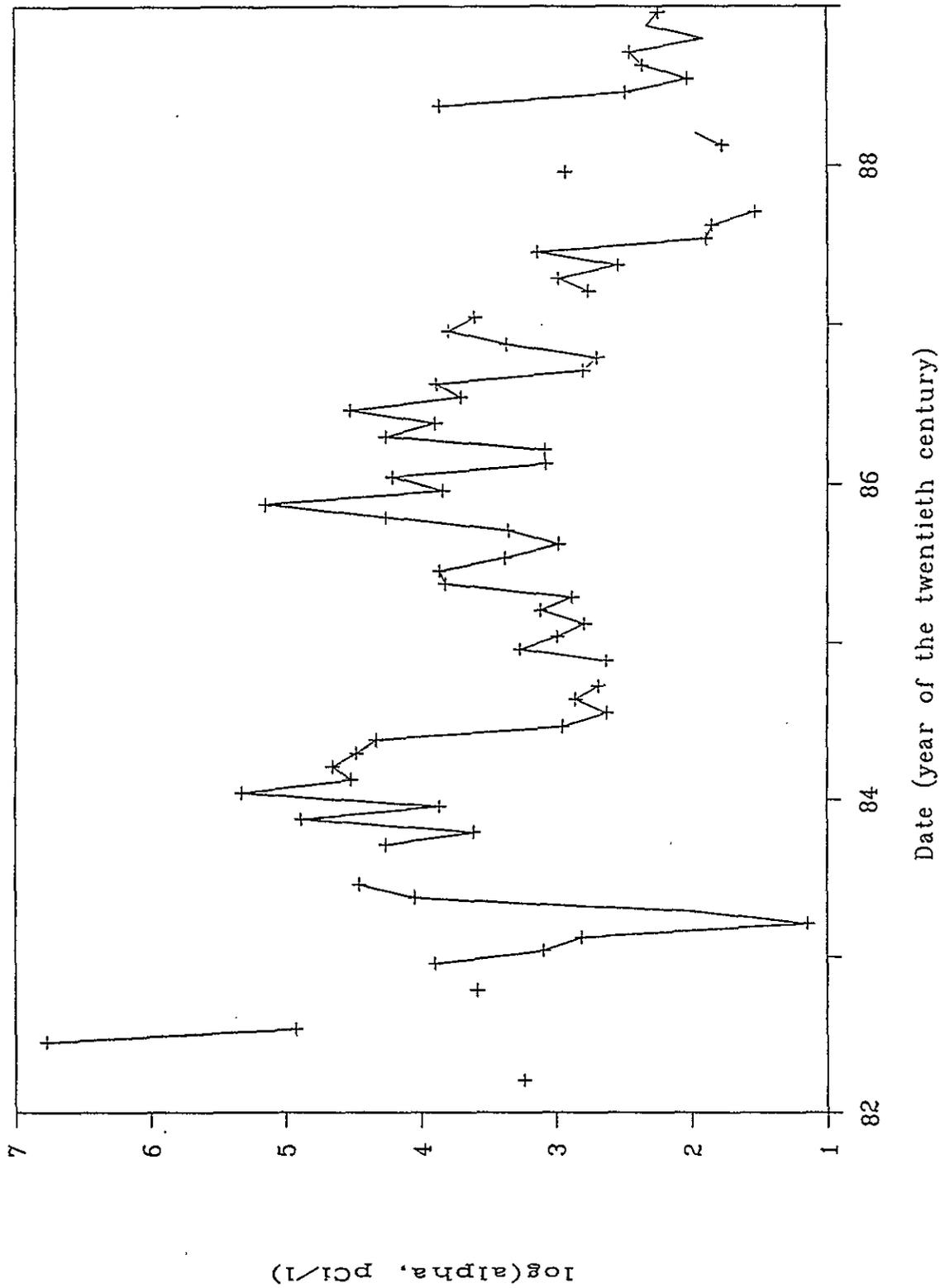
PUREX PDD Radiological Release History.  
Units in pCi/L except Volume in L.

Stream Code: PP		PUREX Process Condensate				
Date	H-3	AM-241	I-129	PU-238	PU-241	PU-239
8611	4.70E+05	<7.05E+03	<2.00E+01	2.51E+02	2.61E+04	2.69E+03
8612	5.90E+04	<7.00E+02	<1.00E+03	5.70E+02	7.19E+04	7.40E+03
8701	4.80E+04	<1.76E+03	<4.00E+01	3.90E+02	3.40E+04	3.50E+03
8703	2.20E+05	<2.10E+03	<2.00E+01	2.60E+01	8.75E+03	9.00E+02
8704	1.90E+06	<2.60E+03	<1.38E+02	7.50E+01	2.39E+04	1.36E+03
8705	2.90E+06	<4.80E+02	<6.29E+01	4.80E+01	6.01E+03	3.20E+02
8706	2.38E+06	<4.41E+03	<8.53E+01	2.18E+02	2.25E+04	1.18E+03
8707	5.44E+07	<3.88E+03	1.10E+02	1.35E+02	2.75E+03	1.45E+02
8708	1.29E+08	<6.00E+01	<1.70E+02	7.64E+01	3.08E+03	1.70E+02
8709	1.29E+08	<8.00E+01	3.36E+02	<1.00E+01	4.82E+02	2.65E+01
8712	7.26E+05	<5.49E+01	<4.70E+01	6.12E+01	2.45E+03	1.35E+02
8802	1.58E+07	<2.50E+02	2.29E+02	<1.00E+01	2.52E+02	<3.35E+01
8803	6.34E+07	<5.61E+01	7.20E+01	1.40E+02	5.43E+02	6.69E+01
8805	1.90E+06	5.68E+02	<9.20E+01	2.60E+01	6.69E+04	7.26E+03
8806	5.12E+07	<5.64E+01	1.47E+02	2.60E+01	2.02E+03	2.31E+02
8807	8.29E+07	<5.33E+01	3.19E+02	<1.00E+01	2.76E+02	<3.20E+01
8808	5.11E+06	<1.56E+02		<4.66E+01	1.38E+03	1.63E+02
8809	8.86E+07	<6.93E+01	<1.18E+02	3.46E+01	1.85E+03	1.91E+02
8810	1.31E+08	<6.54E+01		<1.63E+01	4.57E+02	<4.43E+01
8811	7.65E+07	<7.21E+01	1.85E+02	<1.71E+01	1.04E+03	1.09E+02
8812	5.19E+07	<7.41E+01	<2.21E+01	<2.15E+01	1.33E+03	1.38E+02

Total volume: 4.23E+08

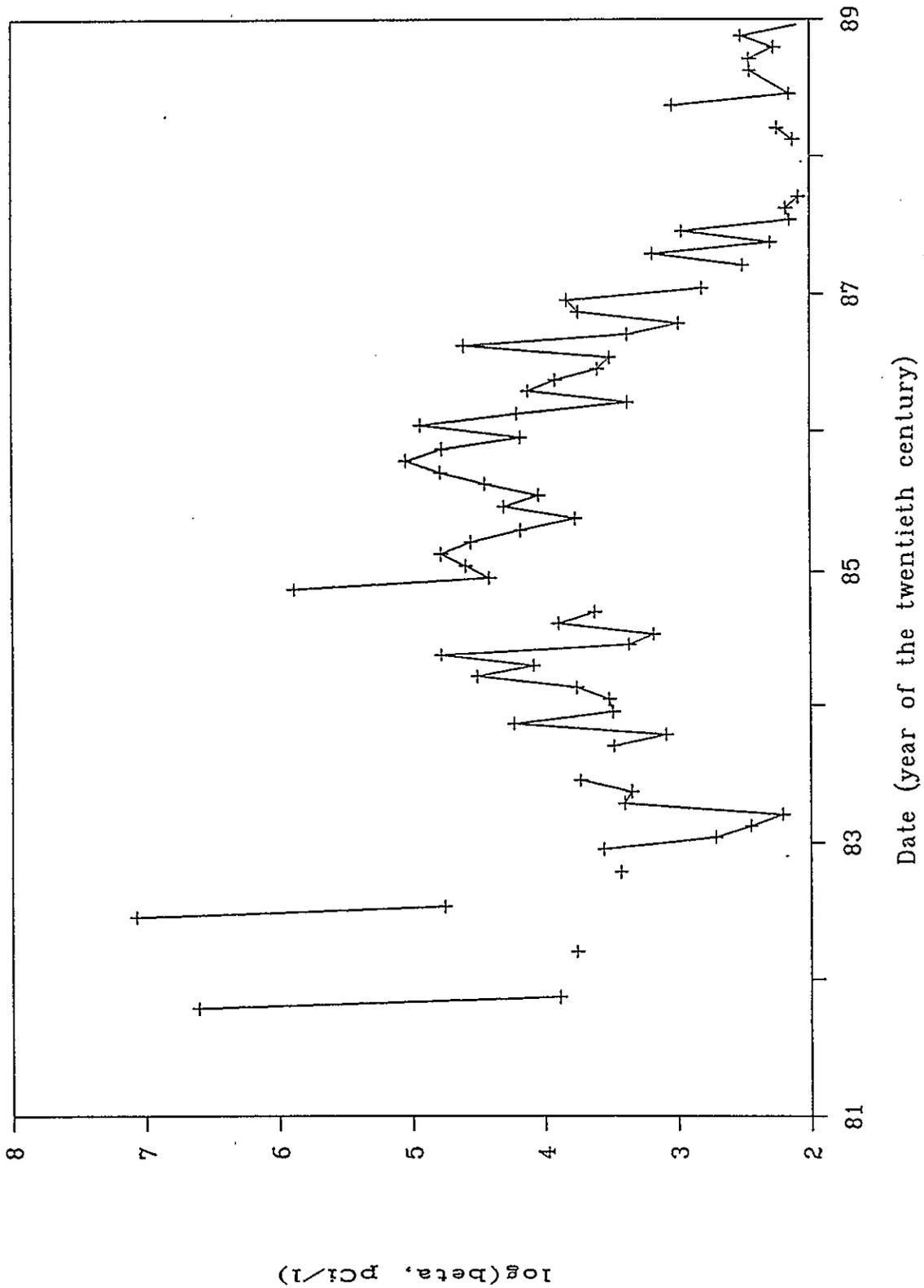
911115123

PDD Radiological Release History.  
Alpha Emitting Nuclides.



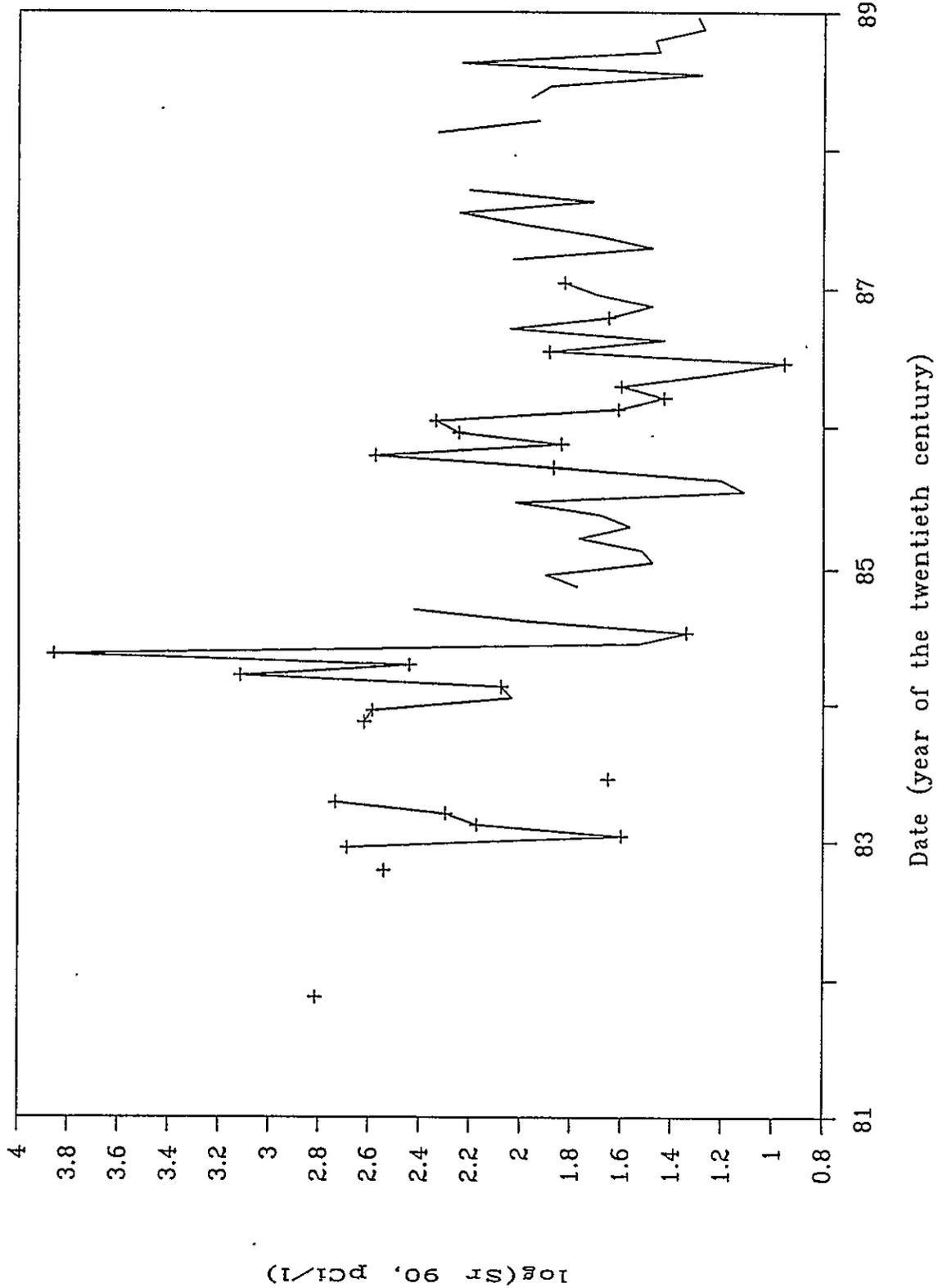
9111151374

PDD Radiological Release History.  
Beta Emitting Nuclides.



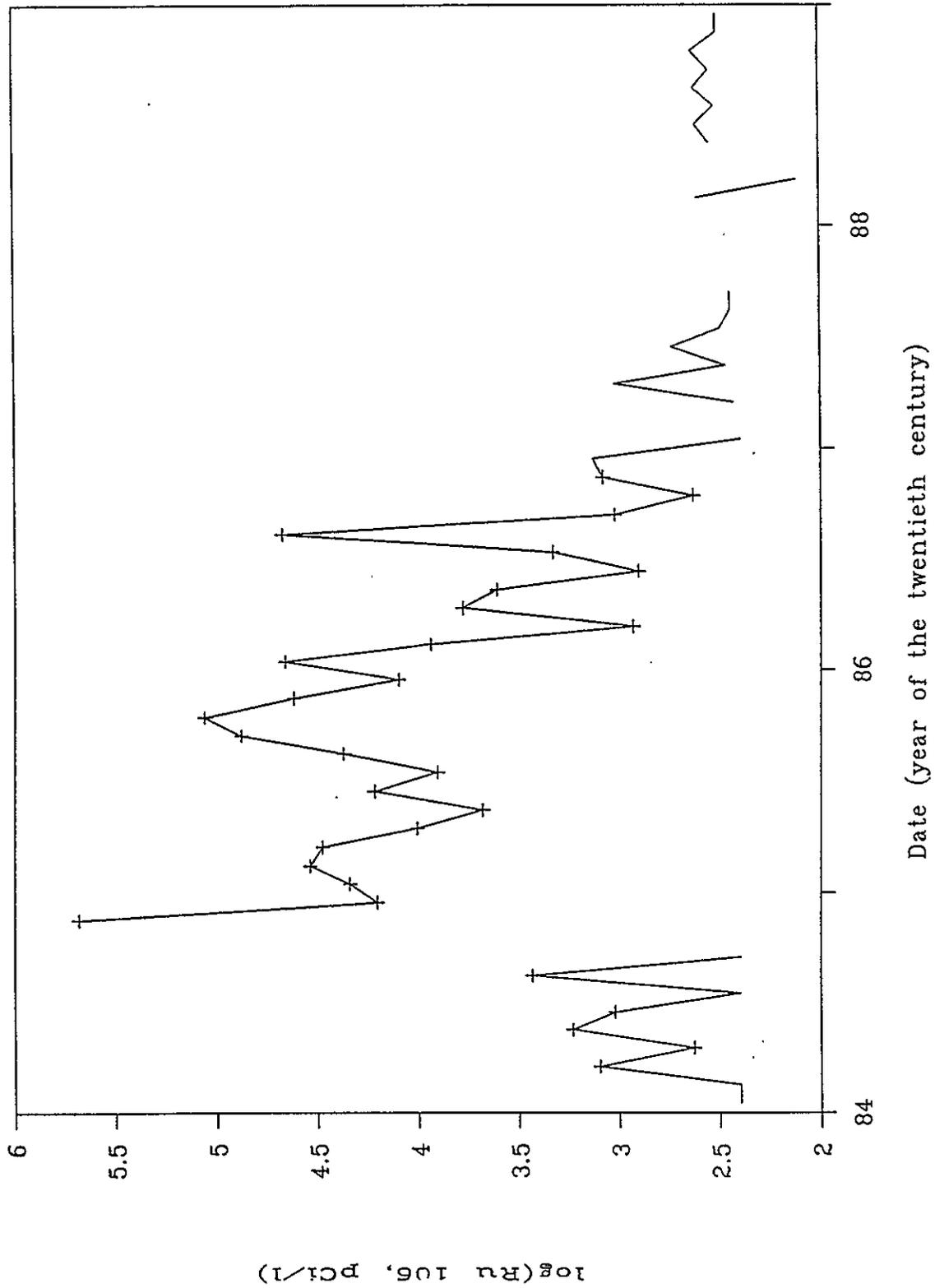
91113751275

PDD Radiological Release History.  
Strontium-90.



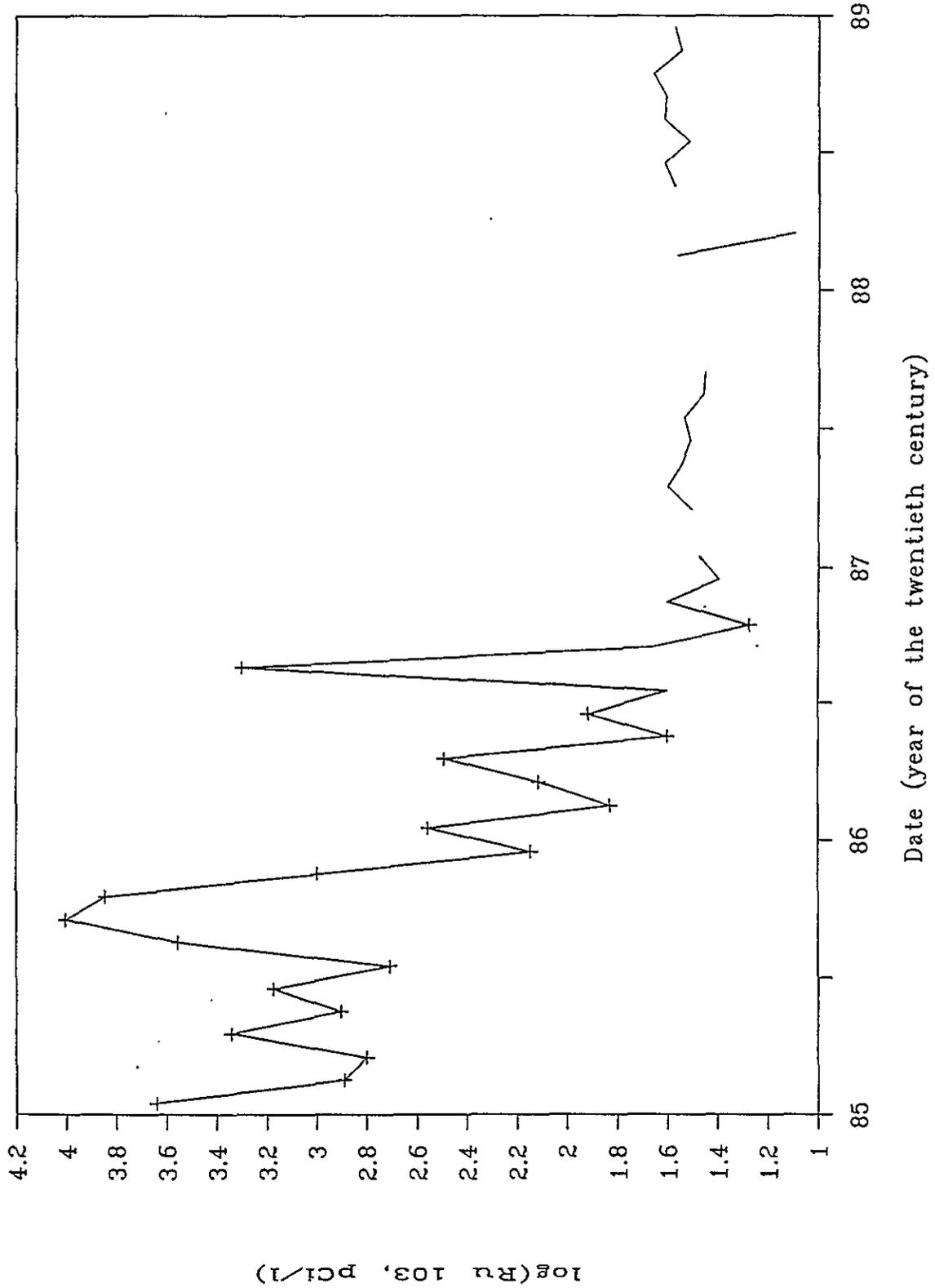
91113751276

PDD Radiological Release History.  
Ruthenium-106.



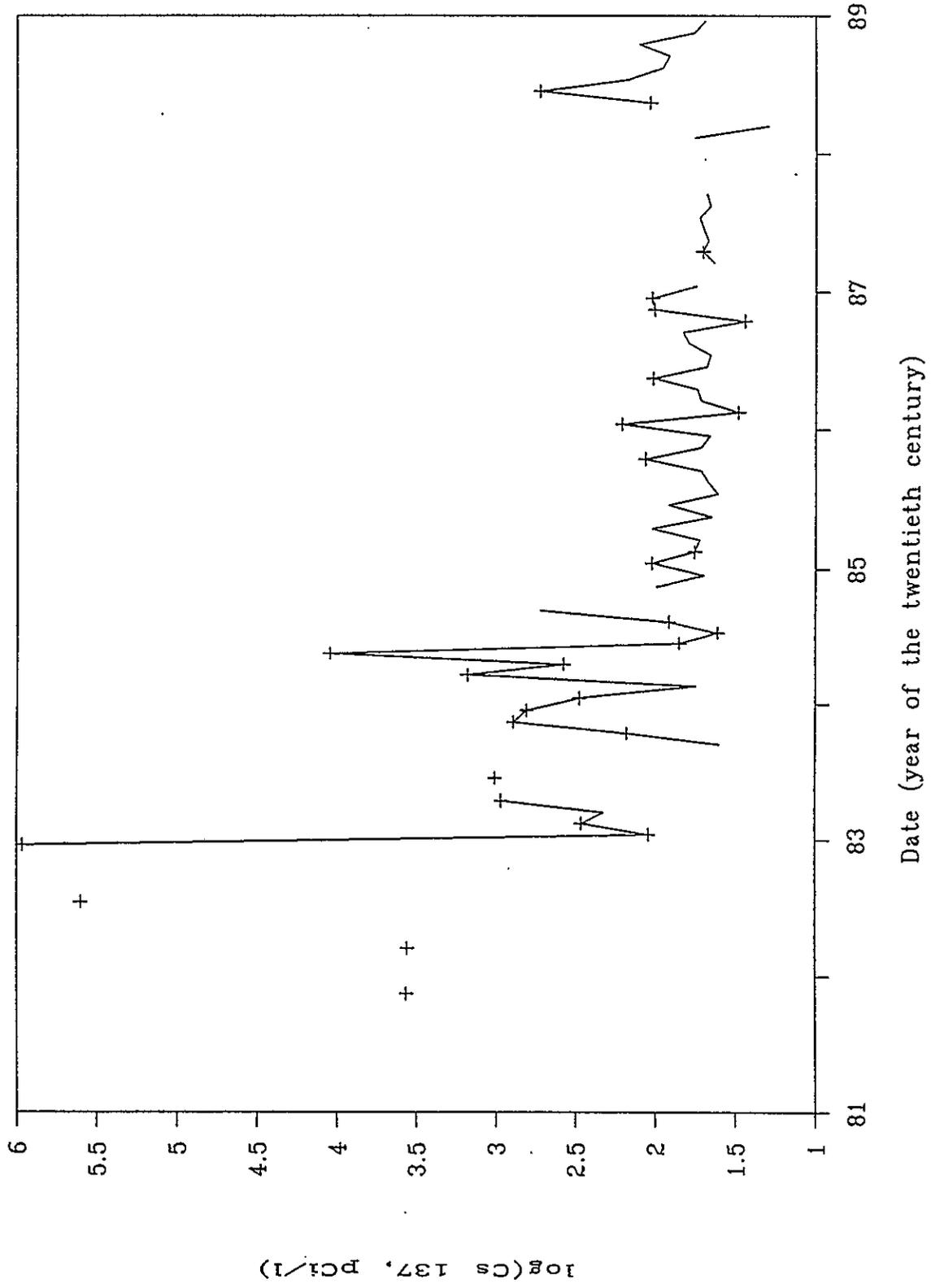
91113051277

PDD Radiological Release History.  
Ruthenium-103.



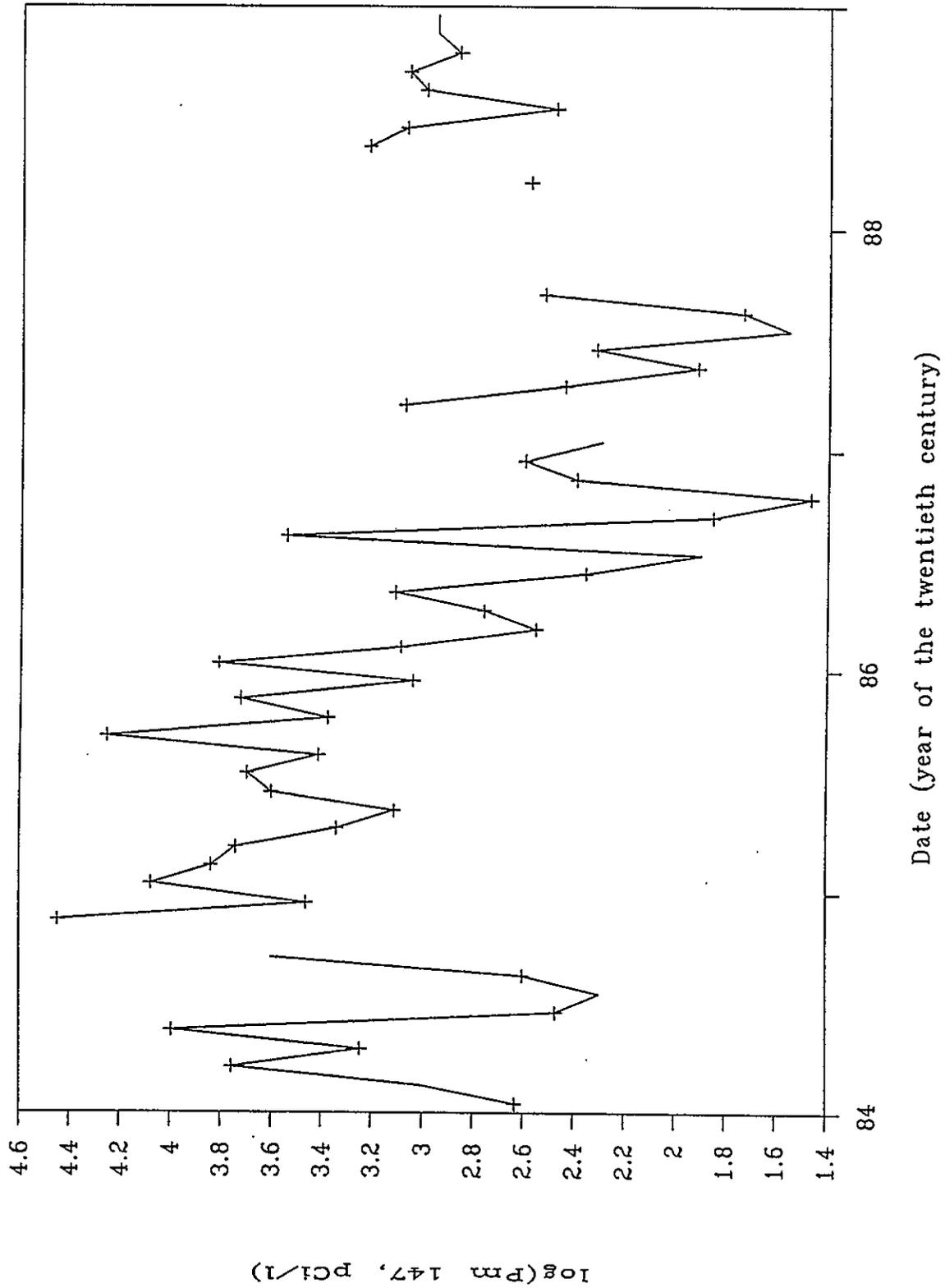
91118251230

PDD Radiological Release History.  
Cesium-137.



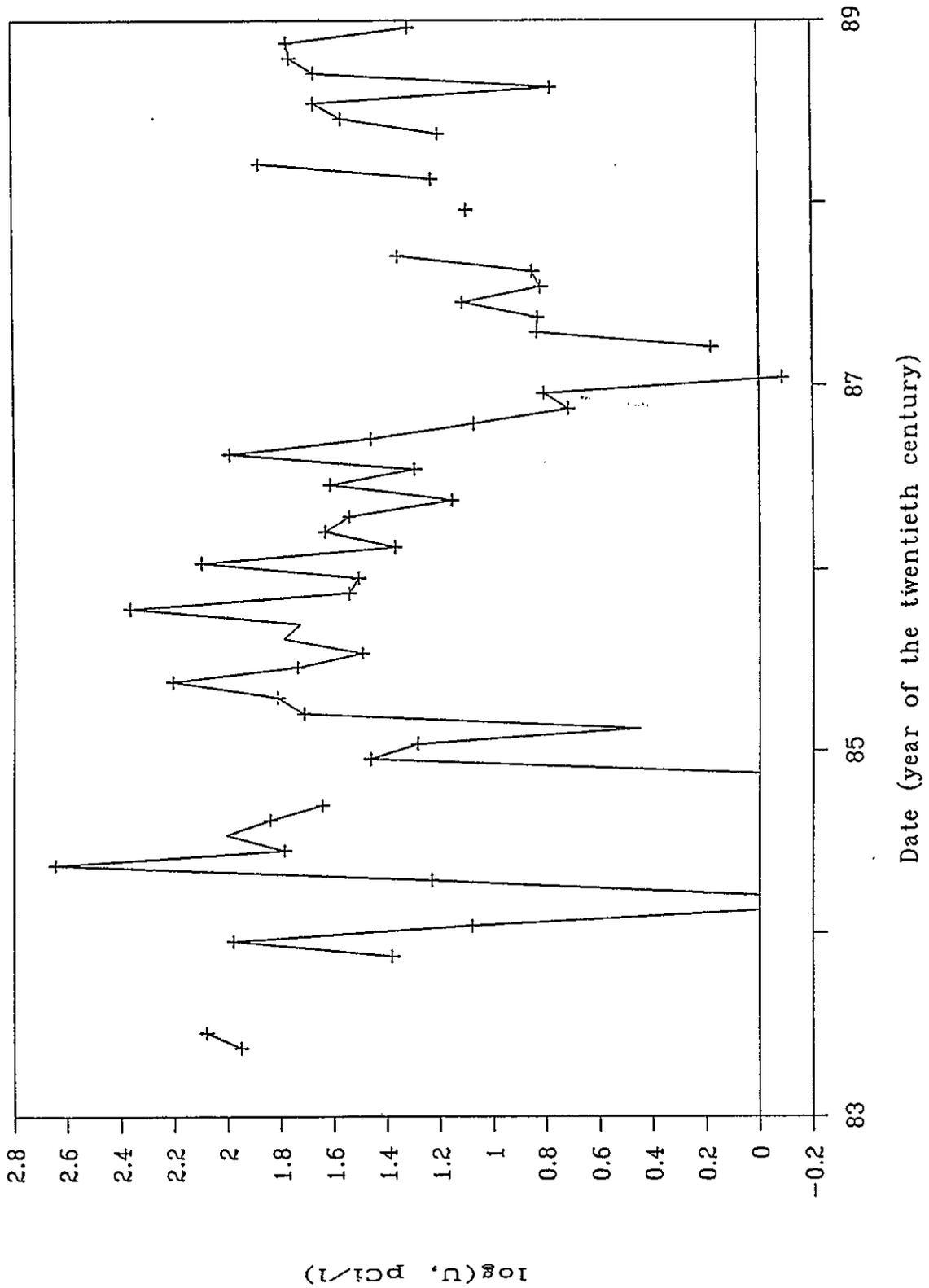
91111951239

PDD Radiological Release History.  
Promethium-147.



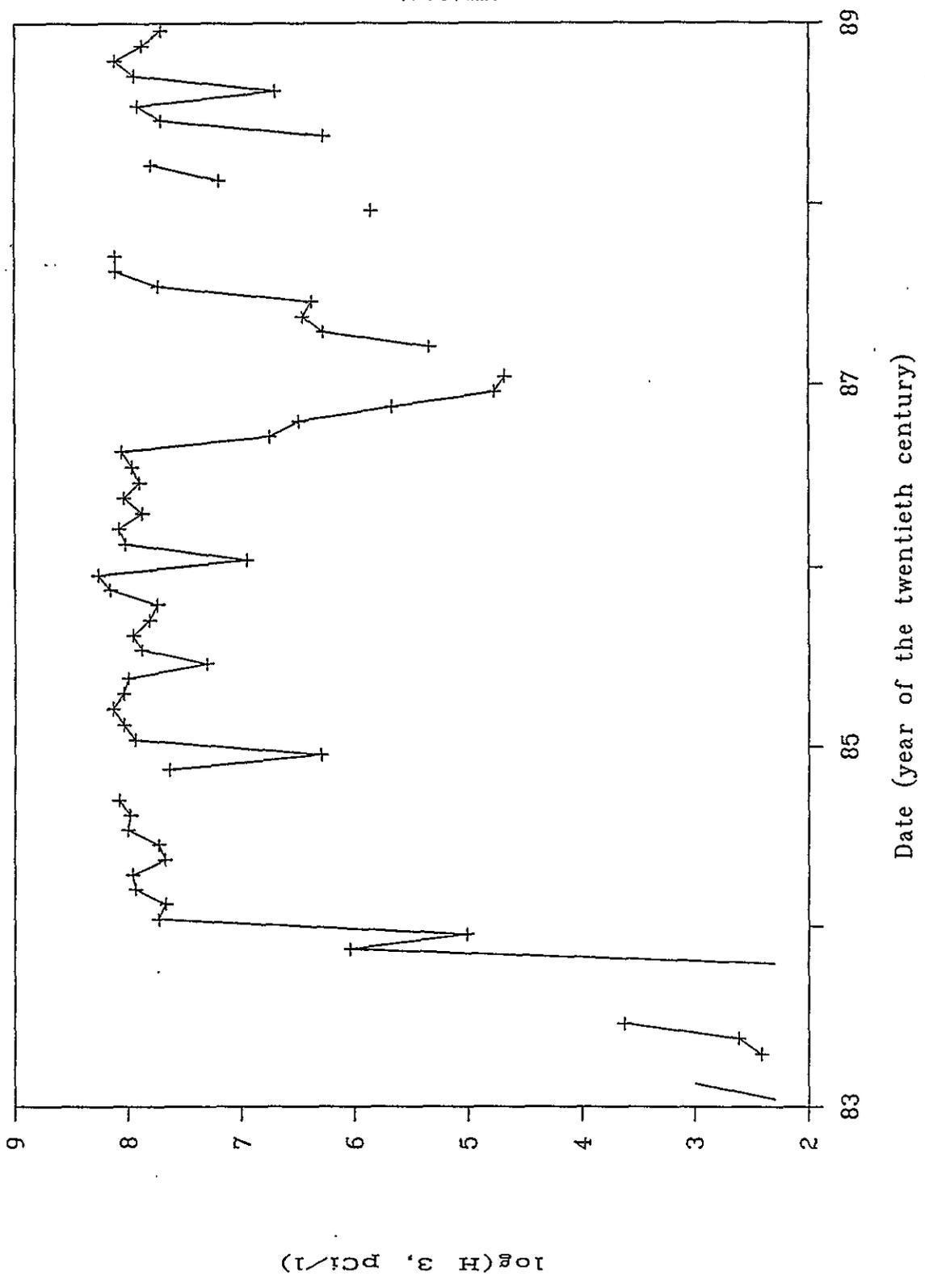
91113751210

PDD Radiological Release History.  
Gross Uranium.



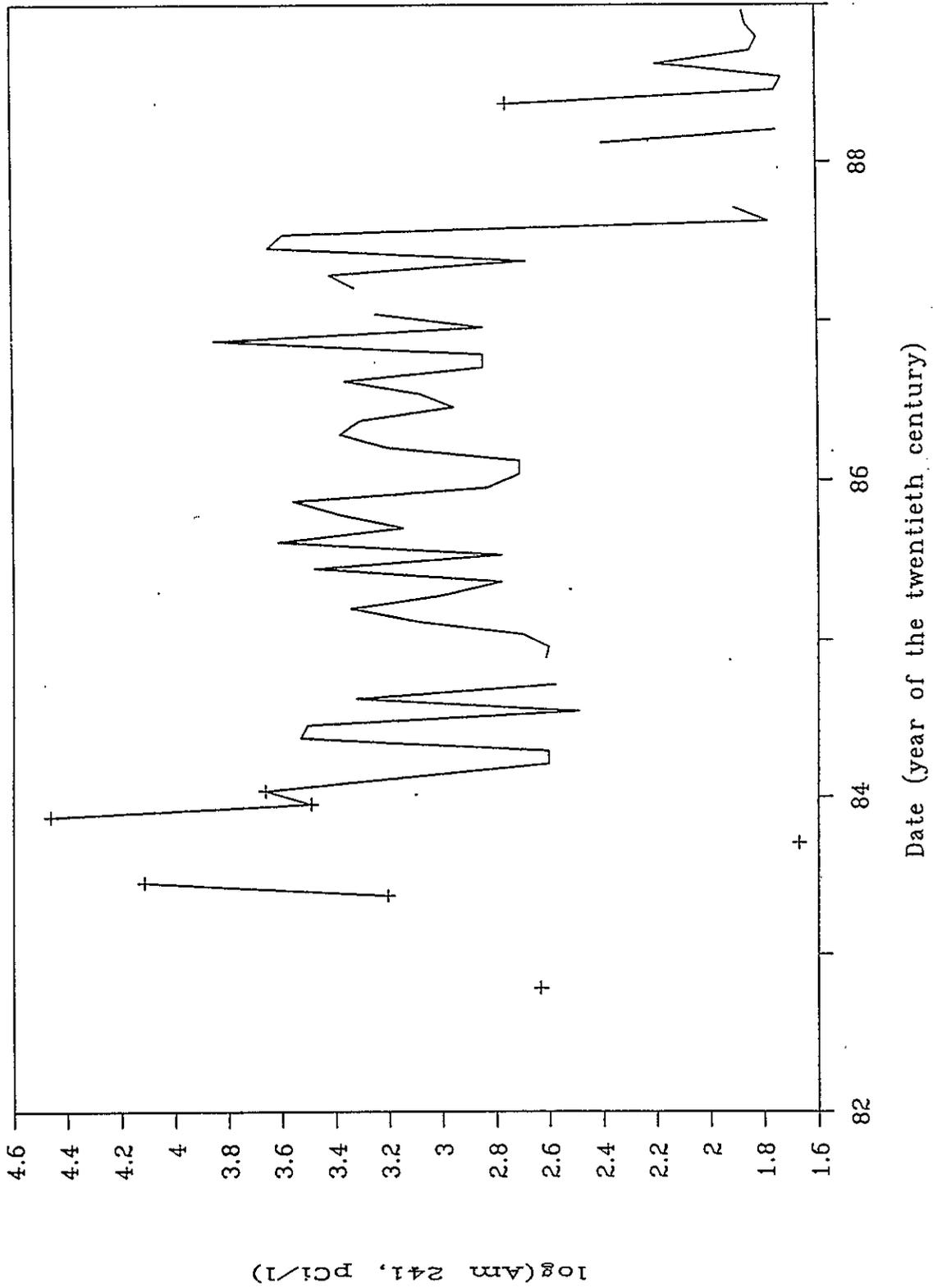
91111751211

PDD Radiological Release History.  
Tritium.



91113751212

PDD Radiological Release History.  
Americium-241.

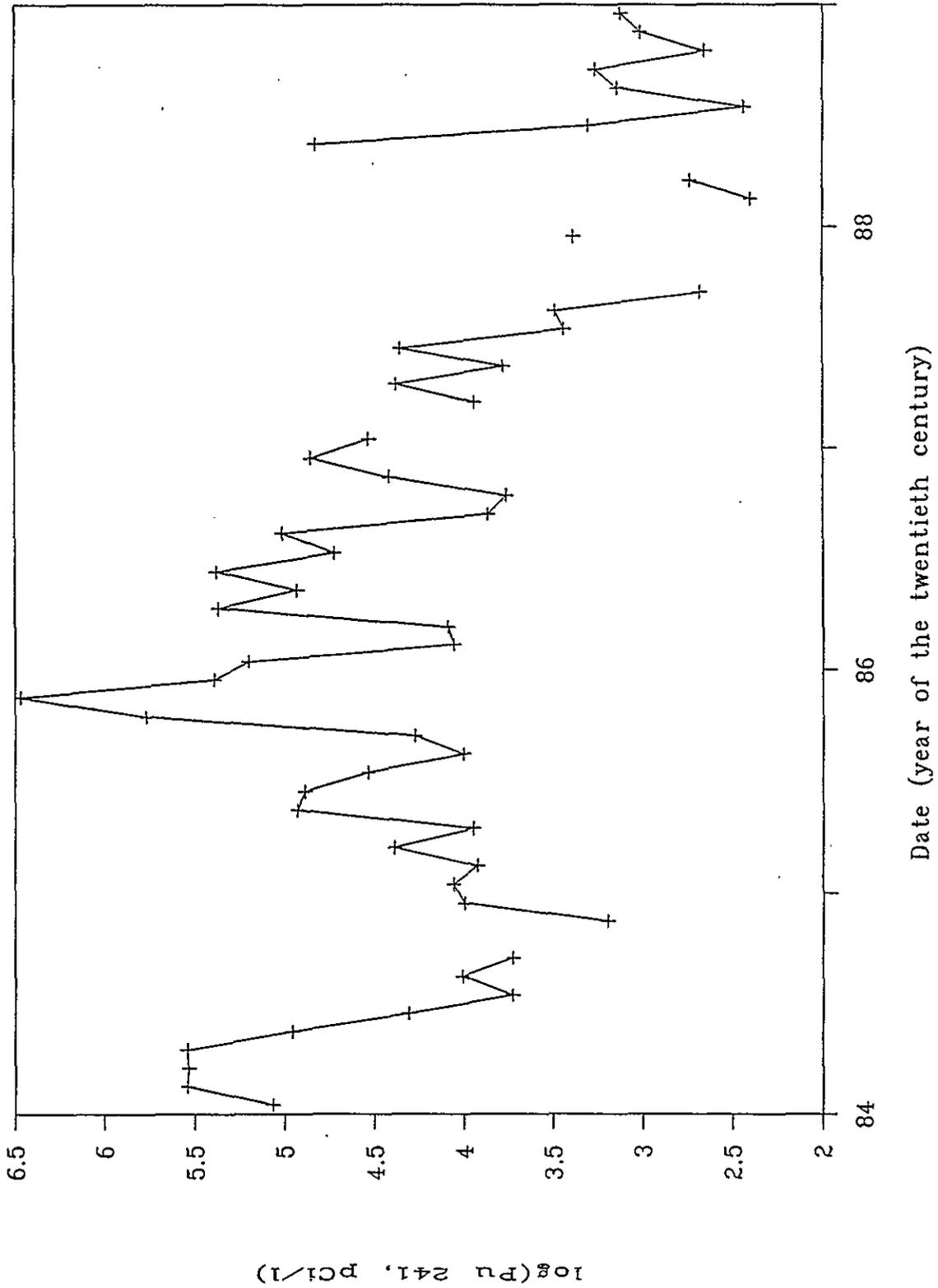


91113751213



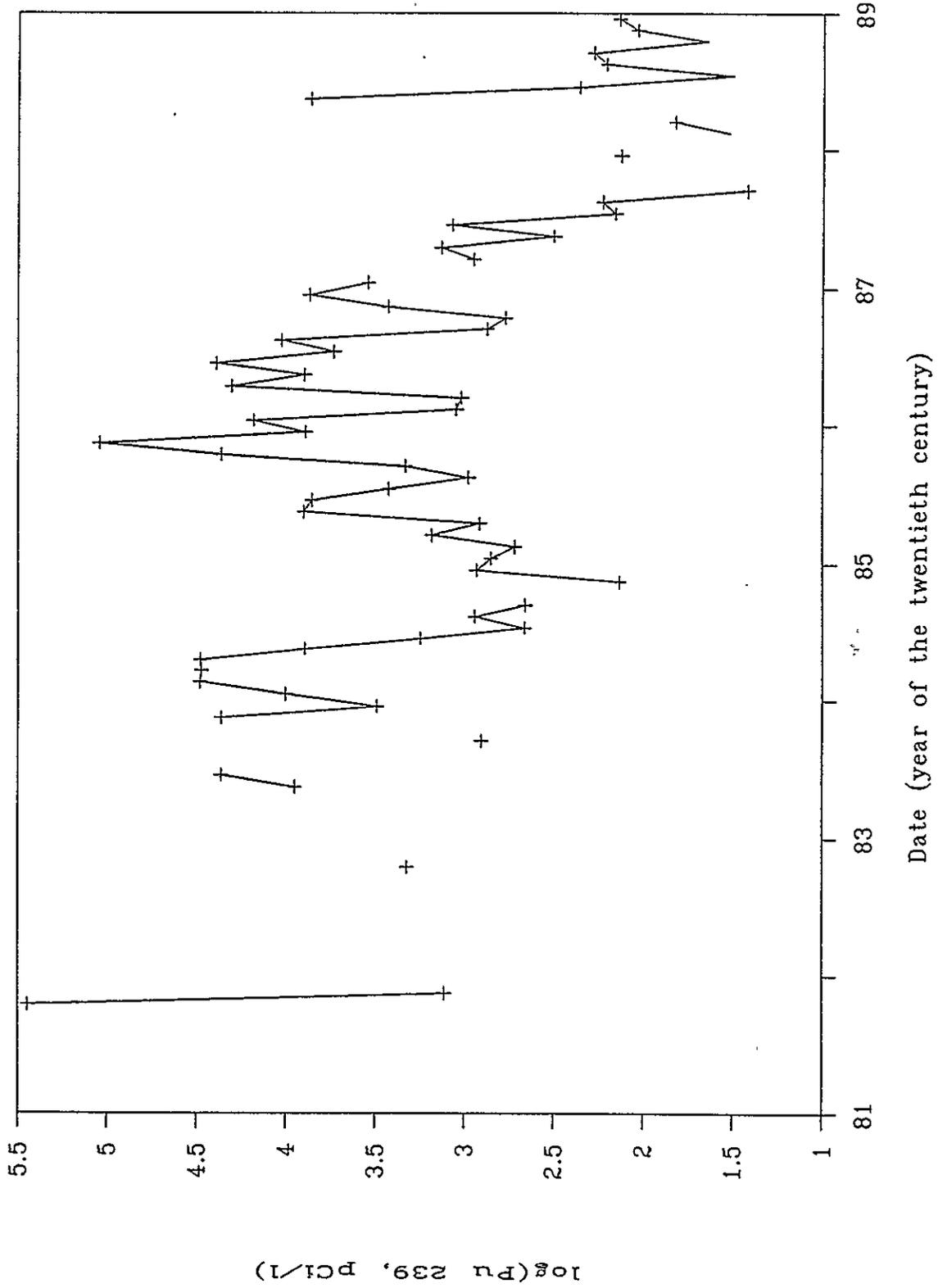


PDD Radiological Release History.  
Plutonium-241.



91111251216

PDD Radiological Release History.  
Plutonium-239.



91111751217

This page intentionally left blank.

911113251210