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WHC-EP-0342
Addendum 14

PUREX Plant Ammonia Scrubber 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

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PUREX/UO₃ Operations

Date Published
August 1990

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Office of Environmental Restoration
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PUREX PLANT ASD
STREAM SPECIFIC REPORT

PUREX/UO₃ Operations

ABSTRACT

The proposed wastestream designation for the Plutonium-Uranium Extraction (PUREX) Plant Ammonia Scrubber Condensate wastestream is that this stream was 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. Process modifications are being made which are intended to produce a future ASD stream that will not be a dangerous waste.*

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

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EXECUTIVE SUMMARY

The proposed dangerous waste designation for the Plutonium-Uranium Extraction (PUREX) Plant ASD (sometimes called the Ammonia Scrubber Condensate), located in the 200 East Area of the Hanford Site, is that the stream was a dangerous waste (WT02) pursuant to the *Dangerous Waste Regulations** contained in the Washington (State) Administrative Code (WAC) 173-303-070. A combination of process knowledge and sampling data was used to determine if the effluent contained a listed dangerous waste (WAC 173-303-080). Sampling data alone are used to compare to the dangerous waste criteria (WAC 173-303-100) and dangerous waste characteristics (WAC 173-303-090). Samples were collected downstream of all process contributors between August 1985 and July 1987.

There is currently no ASD wastestream. Until 1987, this stream flowed into the 216-A-36-B Crib for disposal. In 1987, it was determined that the ammonia in the stream periodically exceeded the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*** reportable quantity and the WAC 173-303-101 Toxic dangerous waste limit of 0.001 percent equivalent concentration. Discharge to the 216-A-36-B Crib was discontinued, and rerouted to underground storage tanks pending construction of the ammonia destruction process and an effluent treatment facility.

An ammonia destruction process is being installed which is intended to produce an ASD stream which is not a dangerous waste.

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

**CERCLA, 1989, *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*, as amended, Public Law 96-510, 96 Stat. 2767, 42 USC 9601 et seq.

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LIST OF TERMS

AFAN	ammonium fluoride and ammonium nitrate
AMU	aqueous makeup
BAT	best available technology
BDL	below detection limits
CERCLA	<i>Comprehensive Environmental Response, Conservation, and Liability Act of 1980</i>
CI	confidence interval
DCG	Derived Concentration Guide
DOE	U.S. Department of Energy
DWS	Drinking Water Standard
EC%	percent equivalent concentration
Ecology	Washington State Department of Ecology
EP	extraction procedure
EPA	U.S. Environmental Protection Agency
HH	halogenated hydrocarbons
ICRP	International Commission of Radiological Protection
LERF	Liquid Effluent Retention Facility
MSDS	Material Safety Data Sheet
NA	not applicable
NPH	normal paraffin hydrocarbon
P&O	Pipe and Operations (Gallery)
PAH	polycyclic aromatic hydrocarbons
PNL	Pacific Northwest Laboratory
ppb	parts per billion
PUREX	Plutonium-Uranium Extraction
RMW	radioactive mixed waste
SC	specific carcinogen
TBP	tributyl phosphate
TC	total carcinogen
TOC	total organic carbon
Tri-Party Agreement	<i>Hanford Federal Facility Agreement and Consent Order</i>
UGS	underground storage (in tanks)
WAC	Washington (State) Administrative Code

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1.0 INTRODUCTION

1.1 BACKGROUND

In response to the *Hanford Federal Facility Agreement and Consent Order* (hereinafter referred to as the Tri-Party Agreement) (Ecology et al. 1989), comments were received from the public 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 both the waste disposal and 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 this study consists of characterizing 33 liquid effluent streams. The characterization consists of comparing process data and sampling data with the dangerous waste regulations pursuant to the Washington (State) Administrative Code (WAC) 173-303 (Ecology 1989). The comparison and any followup investigations will provide a designation of the stream per WAC 173-303 and may provide priorities for further cleanup of some streams.

The results of the characterization study are documented in 33 separate reports (one report 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 ASD (also known as the Ammonia Scrubber Condensate wastestream) in sufficient detail so that a dangerous waste designation, in accordance with WAC 173-303, can be proposed.

This characterization effort is implemented according to the strategy outlined in Figure 1-1, and consists of the following four steps.

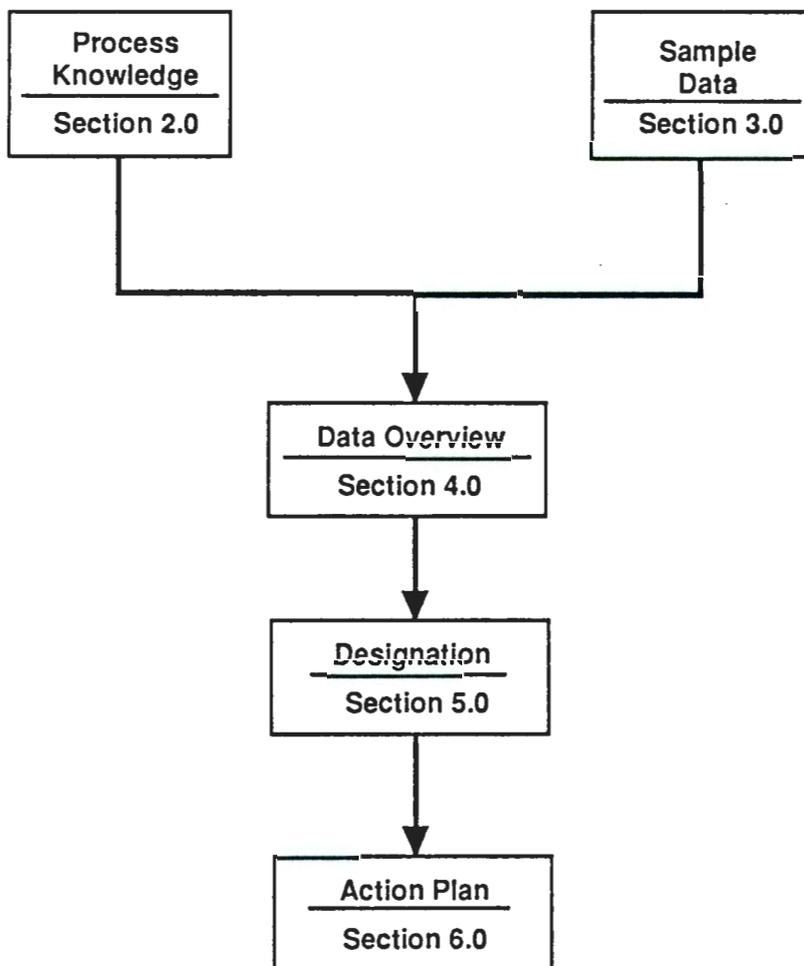
- Describe both process and sampling data (Sections 2.0 and 3.0).
- Integrate the data (Section 4.0).
- Propose a designation (Section 5.0).
- Design an action plan to obtain additional characterization data (Section 6.0), if needed.

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 ₃ /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 ₃ 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-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

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Figure 1-1. Characterization Strategy.

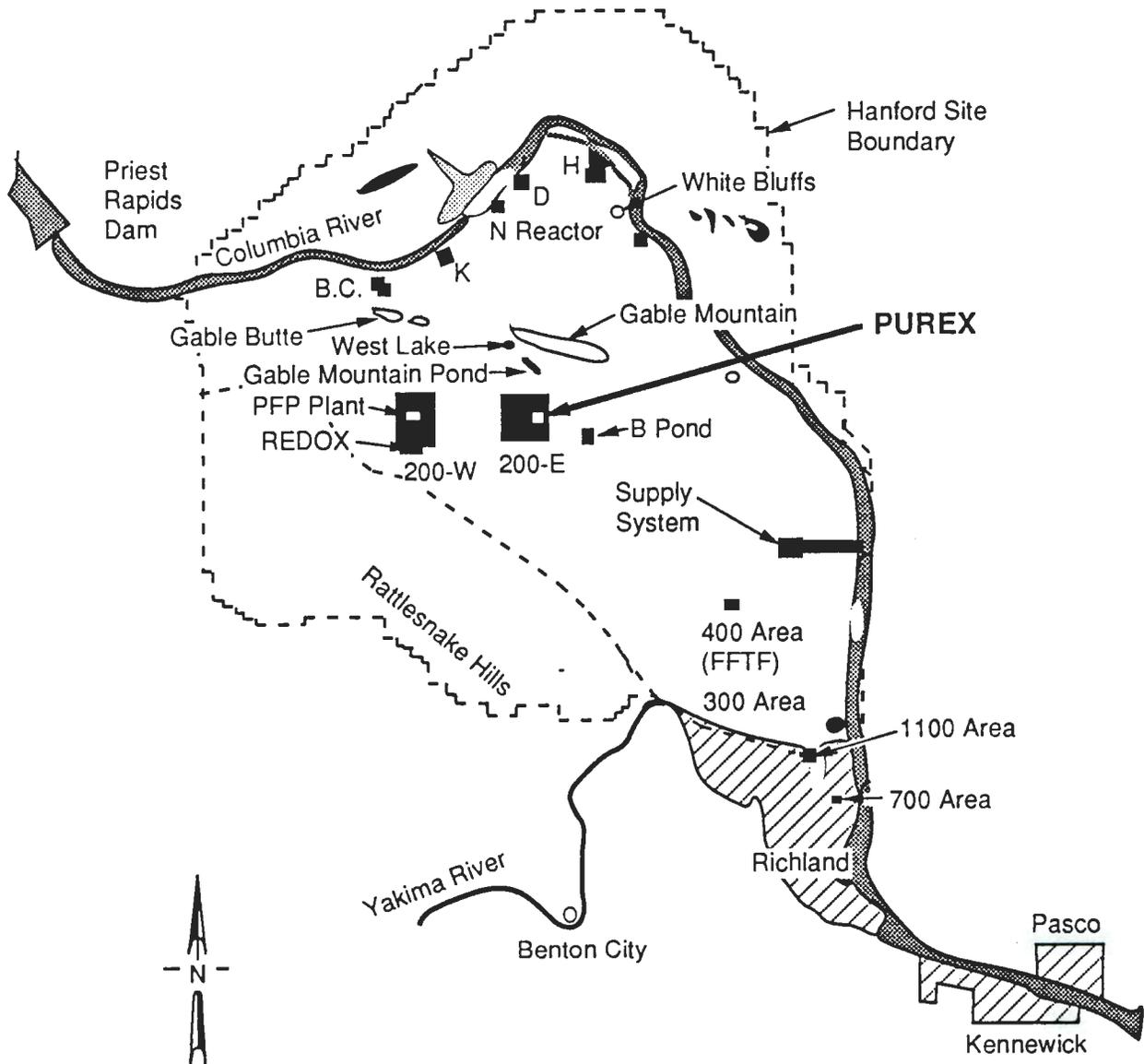


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1.3 SCOPE

The scope of this document is the chemical and radiological characterization of the ASD wastestream, which originates in the PUREX Plant located on the Hanford Site (Figure 1-2). This document does not address any other wastestream leaving the PUREX Plant (e.g., solid, gaseous, or sanitary waste). This report focuses on the recent past and near future. However, relevant data outside of this timeframe are included where appropriate.

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



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2.0 PROCESS KNOWLEDGE

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

- Location and physical layout of the process facility
- General description of the present, past, and future activities of the process
- Identity of the wastestream contributors
- Identity and concentration of the constituents of each contributor.

2.1 PHYSICAL LAYOUT

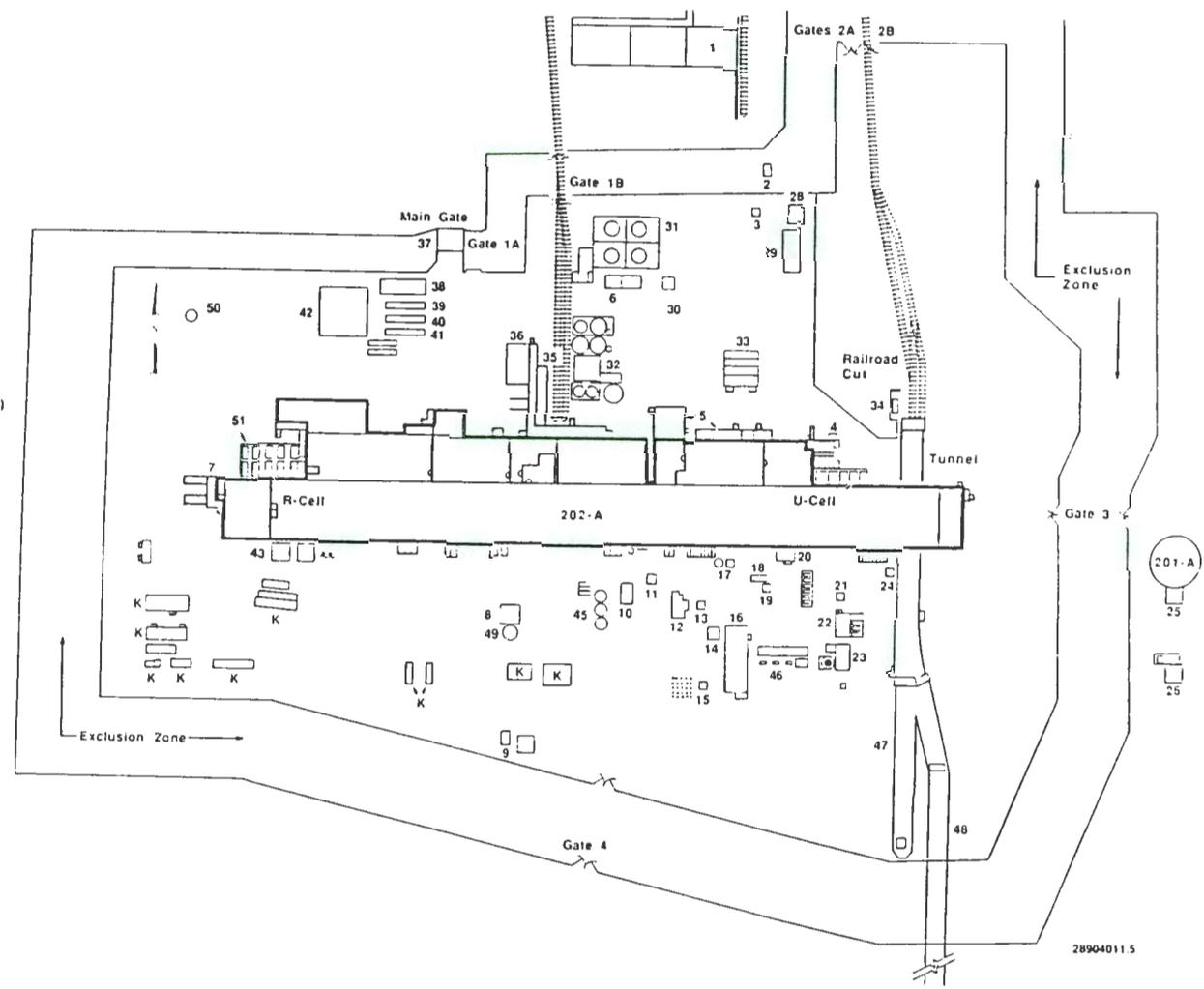
The PUREX Plant is a collection of buildings and facilities located in the 200 East Area of the Hanford Site (Figure 2-1). The main building, 202-A, is a heavily shielded, reinforced concrete structure known as a canyon building. Other facilities include the 203-A Pumphouse and Uranium Product Storage Facility, 211-A Pumphouse and Chemical Storage Facility, 2714-A Chemical Storage Warehouse, 206-A Acid Fractionator Building, 213-A Building, 212-A Building, 294-A Building, 293-AA Facility, 293-A Building, 291-A Facility, effluent monitoring buildings, and 218-E-14 and 218-E-15 contaminated equipment storage tunnels. Figure 2-1 is a plot plan for the PUREX Plant.

2.1.1 The 202-A Building

The 202-A Building is a reinforced concrete structure 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, hot pipe trench, and ventilation air tunnel.

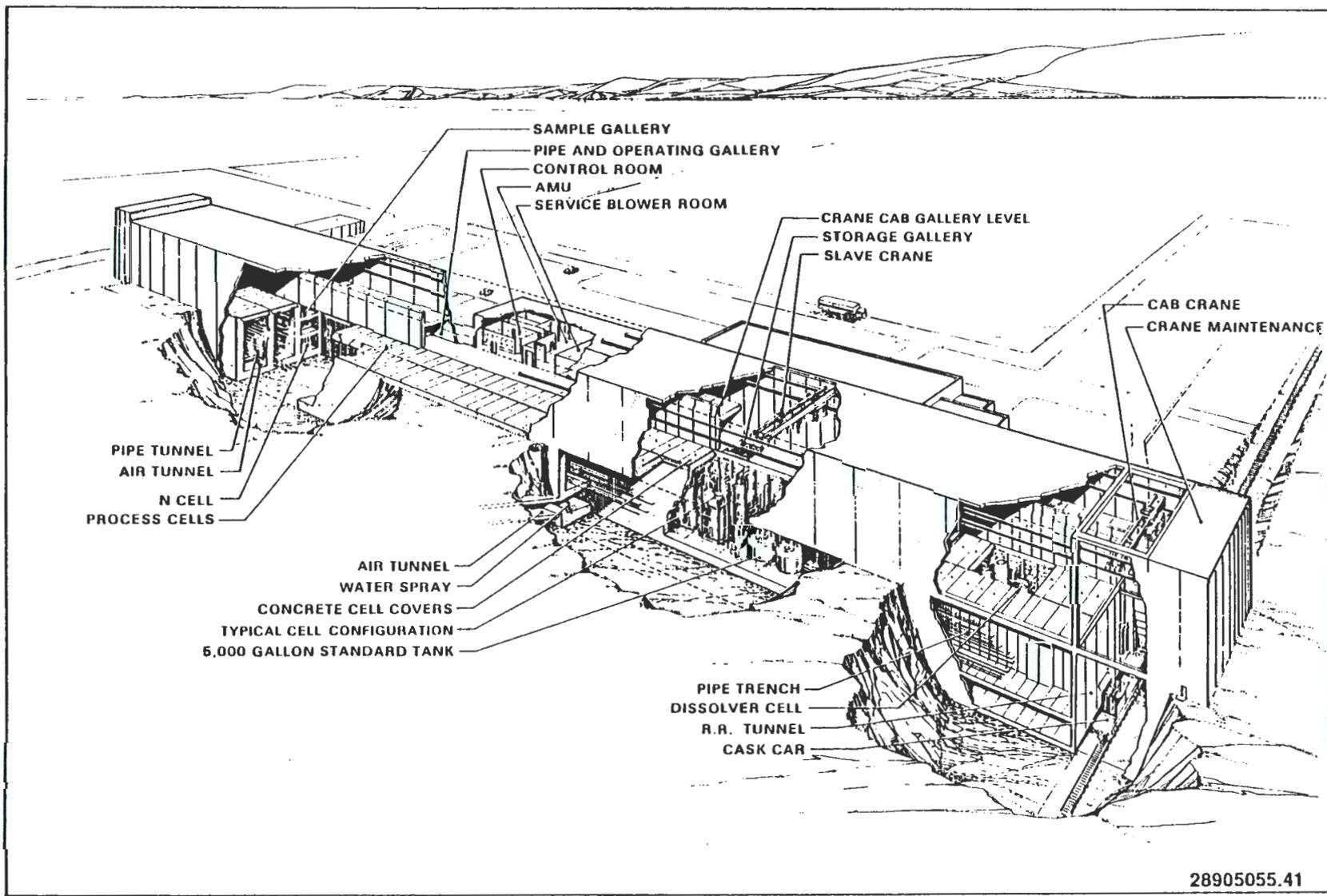
The canyon proper is a large, long room that contains three bridge cranes used for canyon maintenance and for charging irradiated fuel into the process. On either end of the canyon proper is a crane maintenance platform. Near the east end of the canyon proper, just west of the crane maintenance platform, are a fuel storage basin and horizontal door to the railroad tunnel, which is used for moving fuel and equipment into and out of the canyon.

Figure 2-1. The PUREX Plant Plot Plan.



1. 275-EA Warehouse
 2. CSL PIT
 3. 295-AC CSL (Chem. Sewer Line)
 4. 206-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 Off Gas Filter Bldg.
 19. 291-AH Ammonia Off Gas Sampler Bldg.
 20. 212-A Load Out
 21. 294-A Instr. Shack
 22. 293-A Dissolver Off 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. BT2 Exhauster Area
 28. 252-A
 29. 281-A Emergency Generators
 30. MO-332
 31. 203-A Storage Area
 32. 211-A Demineralizer Bldg.
 33. MO-409 Laboratory Trailer
 34. Railroad Storage Shed
 35. 214 A, B, C, D
 36. 2714-A
 37. 2701-A Badge House
 38. MO-035 Training Trailer
 39. MO-707
 40. 64-15323
 41. 202A-T-1
 42. MO-023 Engineering Trailer
 43. 2711-A-1
 44. 2712-A
 45. Hydrogen Peroxide Tanks
 46. 291-A Exhaust Fans
 47. 218-E-14 Storage Tunnel
 48. 218-E-15 Storage Tunnel
 49. 216-A-5
 50. 2901-A Water Tank
 51. 276-A R Cell
- K = Kaiser Related Facilities

Figure 2-2. The 202-A Building.



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The crane cab gallery runs the length of the north side of the canyon proper. It consists of a floor and a parapet wall that provides shielding to the cabs of the two main canyon cranes. Three more galleries that extend nearly the length of the building are located below the crane cab gallery. These are the Pipe and Operations (P&O) Gallery, which contains cold side piping to the process; the sample gallery, which contains sampling equipment used for taking process control samples from the equipment located in the process cells; and the storage gallery.

The process cells contain most of the process equipment and are shielded with massive concrete (6-ft thick on the north side) that is designed to reduce the radiation field on the outside of the canyon to 0.01 mSv/h (1 mrem/h). The floor of the canyon cells is a layer of reinforced concrete 5-ft, 10-in. thick. The process cells are covered by cover blocks, which are removable blocks of reinforced concrete designed to reduce the radiation field at the upper surface to 1 mSv/h (100 mrem/h).

The hot pipe trench, located to the south of the process cells, and above the ventilation air tunnel, contains pipes that connect pieces of process equipment. The hot pipe trench is covered by cover blocks that, together with the cover blocks over the process cells, compose the canyon deck (the floor of the main part of the canyon proper).

The ventilation air tunnel conducts air from the process cells to the main ventilation exhaust system, which filters particulate matter from the air before releasing it to the atmosphere. The ventilation exhaust system ensures air flow from areas of lower potential contamination to areas of higher potential contamination, thereby helping to prevent the spread of radioactive contamination. The process cells, hot pipe trench, and ventilation air tunnel are all located below grade.

The service annexes located north of the galleries contain control rooms, offices, rest rooms, changerooms, lunchrooms, the PUREX Plant laboratory, the aqueous makeup unit (AMU), and maintenance shops. The service annexes are made primarily of steel and transite.

2.1.2 Effluent Monitoring Buildings

Several small buildings and other enclosures contain equipment for monitoring and sampling various liquid and gaseous effluent streams. The 295-A Building houses the equipment that was used to monitor and sample the ASD when it flowed to the 216-A-36-B Disposal Site.

2.2 CONTRIBUTORS

The ASD has only one contributor--the condensate from the E-F11 Concentrator. The E-F11 Concentrator is fed by the four ammonia scrubber catch tanks, Tk-A3-4, Tk-B3-4, Tk-C3-4, and Tk-E3-2. In addition

to water from the dissolver ammonia scrubbers, the first three catch tanks also collect ammonia-rich condensate from the A, B, and C dissolver condensers.

The liquid collected by the four catch tanks consists of raw water, condensate, radionuclides, and up to slightly over 2.5 weight percent ammonium hydroxide. (The actual composition varies during the process.) In the past, processing through the E-F11 Concentrator removed most of the dissolved solids found in raw (river) water, and the radionuclides (except tritium) from the ASD.

2.3 PROCESS DESCRIPTIONS

The process description consists of three parts: present activities, past activities, and future activities. Because there is currently no ASD, the present activities portion covers those activities that are common to past and future operations. Past activities cover operations before the discontinuance of ASD production in late 1987. Future activities cover operations after processing is resumed at the PUREX Plant.

2.3.1 Present Activities

Because of concerns with disposing ammonia to the soil, there is currently no ASD. Consequently, the three-part discussion of present activities describes those portions of the ASD process that are common to past and future operations. The first is an overview of the PUREX Plant process with emphasis on the liquid effluents. The second is a discussion of the generation of the ASF, which has been and will be the feed stream for the ASD process. The third is a discussion of 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 byproducts of the various driving forces. These liquid effluent streams are the PDD, CWL, SCD, CSL, and ASD.

The concentration changes are provided by dilution with water and by removal of 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 water, which requires disposal. This water is the source of the PDD, also known as Process Condensate. Addendum 12 addresses 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 the PUREX Plant, namely, the CWL (also known as Cooling Water), SCD (also known as Steam Condensate), and most of the CSL (also known as 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 overheads, the ammonia-bearing condensate stream, were released as the ASD, also known as 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 will be combined with the PDD, or recycled to the ammonia scrubbers.

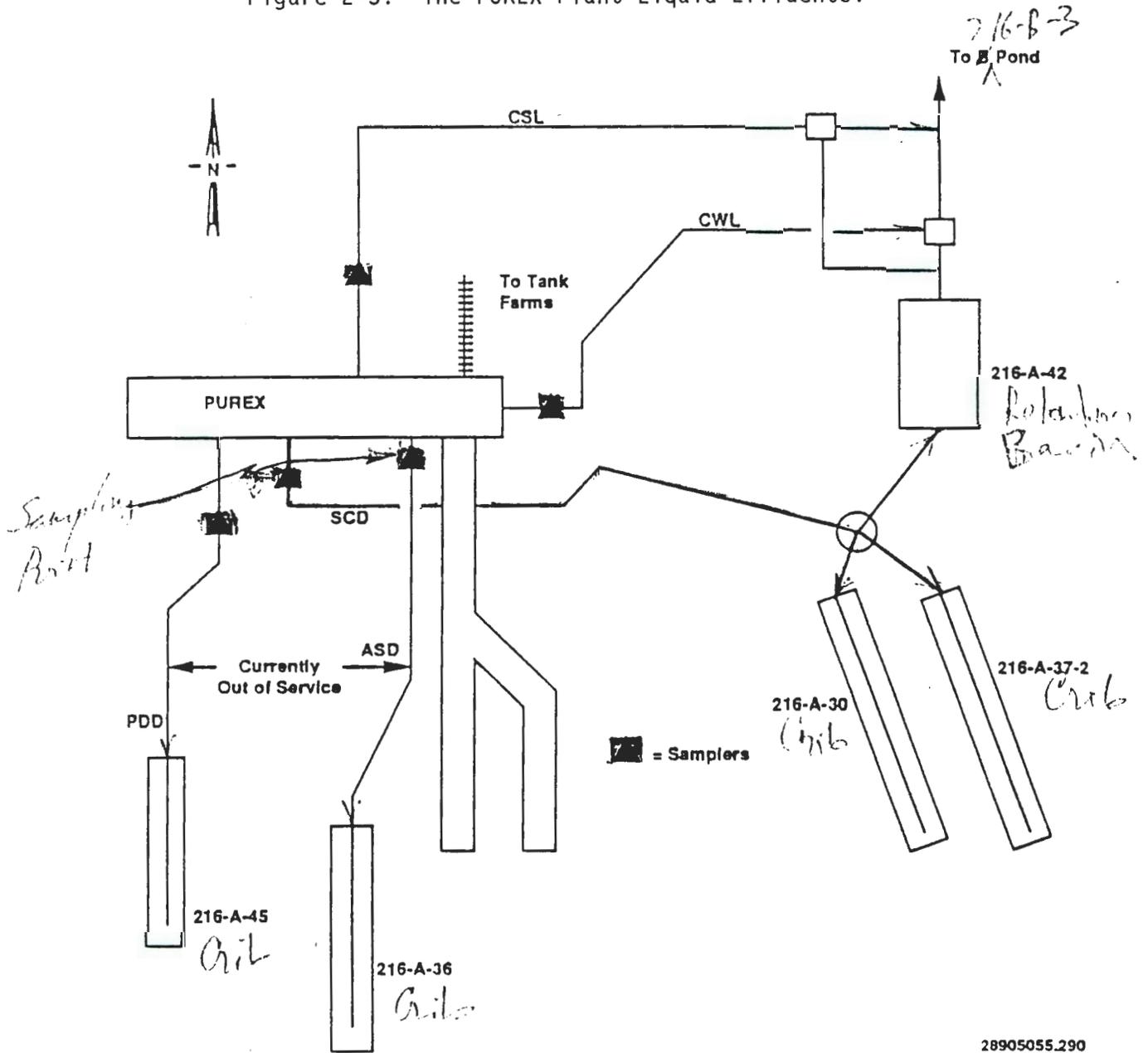
Figure 2-3 diagrams the disposition of the ASD, CSL, CWL, PDD, and SCD.

2.3.1.2 ASD Process Description. When N Reactor began operation in the early 1960's, it was the first production reactor at the Hanford Site to use zirconium-clad fuel rods. The zirconium cladding required a new dissolution process--the zirflex process--in the PUREX Plant head end to remove the cladding. The zirflex process uses ammonium fluoride and ammonium nitrate (AFAN) and produces large quantities of gaseous ammonia during both the decladding and pH adjustment that is required before the decladding waste is sent to UGS tanks. This ammonia is scrubbed from the offgas with water to minimize the release of ammonia to the air and to alleviate the explosion hazard that the ammonia would otherwise cause. The resulting ammonia solution, the ASF, was transferred to UGS tanks during the present period (between October 1989 and April 1990). During the present period, there was no ASD.

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 has incorporated administrative controls as an aid to prevent the release of hazardous material to the liquid effluent streams.

Figure 2-3. The PUREX Plant Liquid Effluents.



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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 followup inspections. These are conducted on a regular basis and are supplemented with random surveillances.

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

Specific activity control is maintained by the use of detailed, written procedures. These outline proper handling of materials as an aid to assure 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.

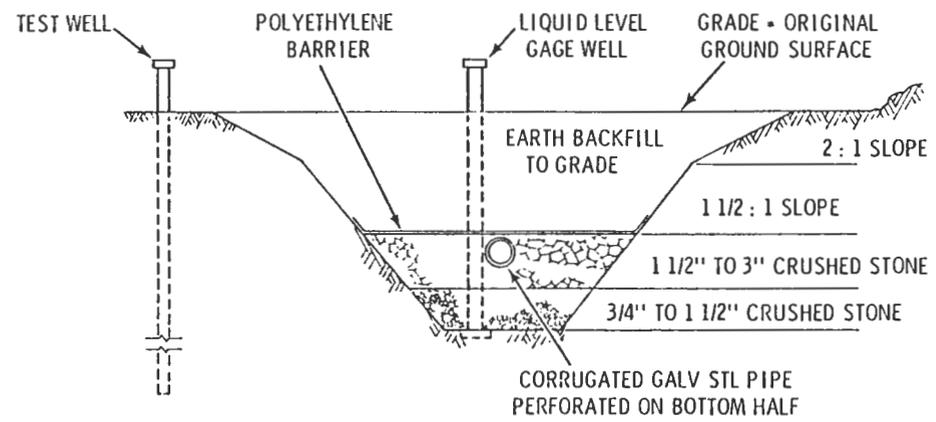
There are also several requirements for the acquisition, storage, use and disposal of materials. They are to be physically controlled so that the risks of them entering the PUREX liquid effluent systems are minimized. This is achieved by placing them, wherever possible, at distances removed from entry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

2.3.2 Past Activities

From the time the PUREX Plant was restarted in 1984 until late 1987, the E-F11 Concentrator boiled the ASW to separate the bulk of the water and ammonia (which condensed to form the ASD and flowed to the 216-A-36-B Crib) from the bulk of the radionuclides (which remained in the ASW, the solution in the reboiler section of the concentrator). Radionuclide concentrations in the ASD were determined when the ASW was transferred to UGS tanks. The transfer required cooling the concentrator and adjusting the pH and nitrite concentration of the ASW. Figure 2-4 shows a typical crib. Figure 2-5 shows the historical ASD process.

The PUREX Plant has not produced any ASD since late 1987 when it was determined that the ammonium hydroxide concentration in the ASD sometimes exceeded 1%, making it a dangerous waste per WAC 173-303-101 (Ecology 1989)

TYPICAL CRIB CROSS SECTION



TYPICAL CRIB LONG. SECTION

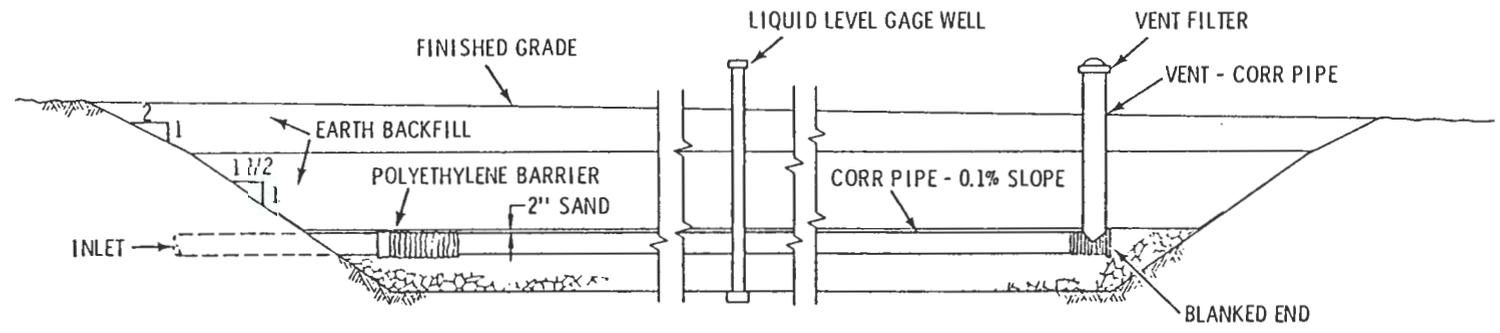
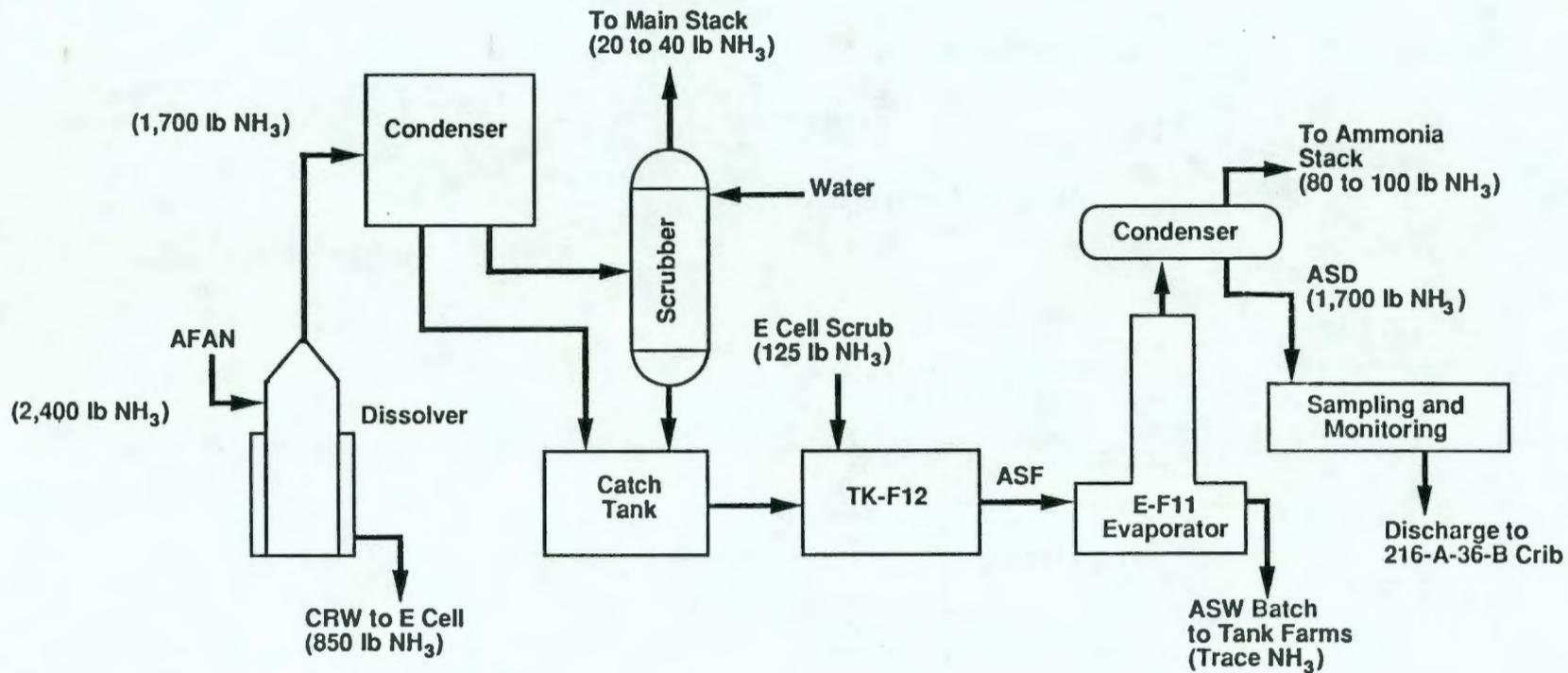


Figure 2-4. A Typical Crib.

28905055.56

2-10



BASIS: 10.2 MTU Charge/29-Hour Cycle

28902005.1M

Figure 2-5. The Historical ASD Process.

and exceeding the *Comprehensive Environmental Response, Conservation, and Liability Act of 1980* (CERCLA) reportable quantity. Instead, the ASF has been transferred to UGS tanks.

The existing sampling point was used because it was the first accessible point downstream of the single contributor. This sample point was identified at the initiation of the study (WHC 1989). Historic average stream flows ($1.26 \text{ E}+06 \text{ L/mo}$) were used for calculating deposition rates.

There are no current data for the ASD. Table 2-1 presents flow data for the ASD for the months in which characterization grab samples were taken.

Table 2-1. ASD Flow Data.

Month/ Year	Flow (liters)
August 1985	$8.68 \text{ E}+06$
May 1987	$2.40 \text{ E}+06$
June 1987	$1.28 \text{ E}+06$
July 1987	$8.38 \text{ E}+06$

2.3.3 Future Activities

Future activities will include the resumption of ammonia scrubber effluent processing at the PUREX Plant; therefore, future plans for ammonia scrubber effluent processing will include reduction of the ammonia concentration via the ammonia destruction process. Similarly, because the 216-A-36-B Crib has been closed, a new disposal method or site will be needed for the aqueous effluent produced by ammonia scrubber effluent processing. Processing of the old ASF currently in UGS tanks will eventually be needed.

2.3.3.1 Ammonia Destruction. Ammonia destruction is considered as the best available technology (BAT) treatment for the ASD. Of the several possible processes, the nitrite addition method is the best method for destroying the ammonia. Design and development on this method have reached the point where a full scale plant test will be conducted in order to refine the actual process. The ammonia destruction process consists of five steps:

1. Neutralization of ammonia scrubber effluent
2. Concentration of effluent
3. Destruction of ammonia with sodium nitrite
4. Adjustment of pH and nitrite, and
5. Transfer to UGS tanks.

Figure 2-6 is a schematic of this process.

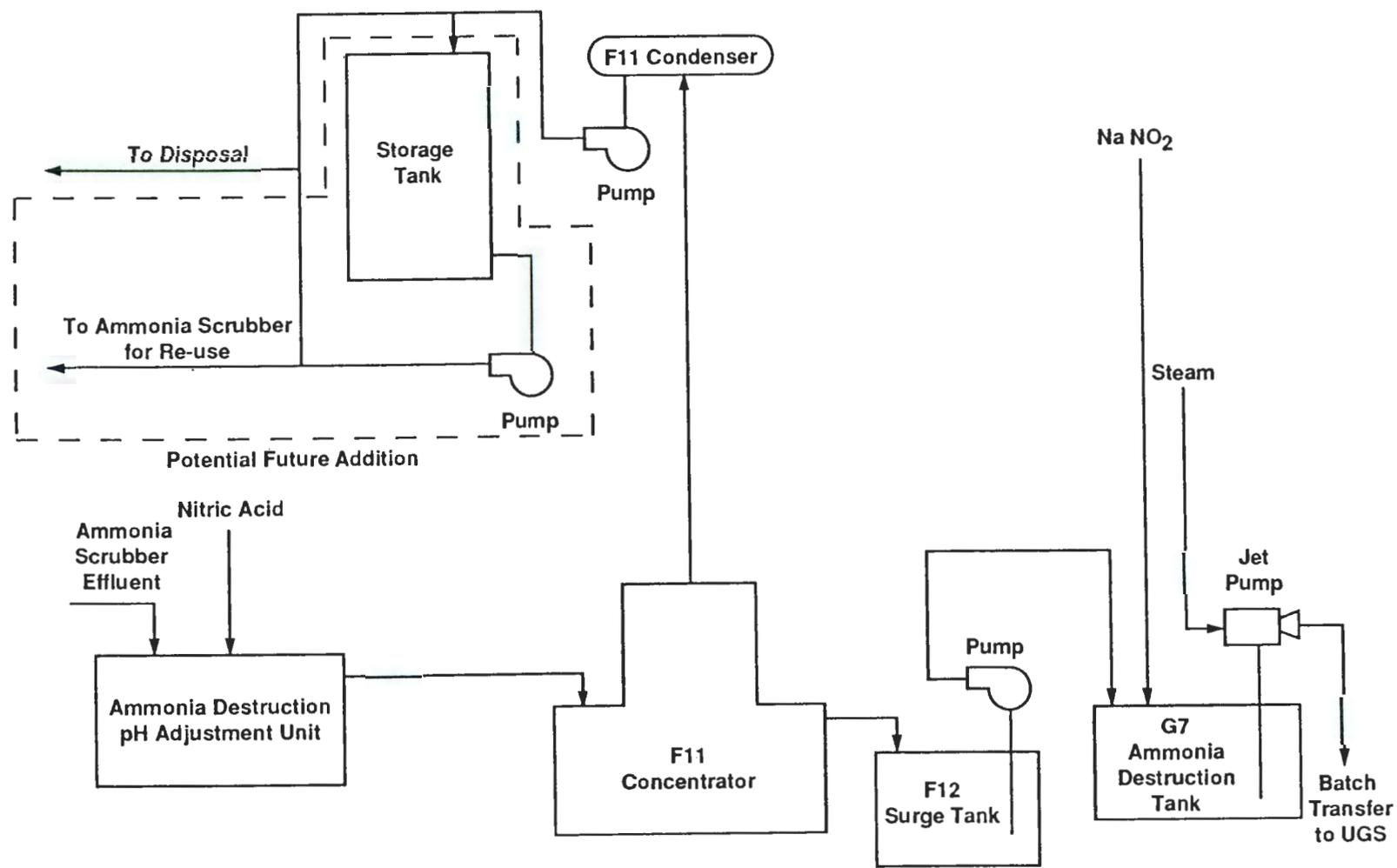


Figure 2-6. Proposed Ammonia Destruction Process.

29004070.2

The first step, neutralization of the effluent from the ammonia scrubbers, will be accomplished by a new neutralization system installed in the PUREX Plant Sample Gallery. The system is a three-chambered gravity overflow tank with three pH probes and three nitric acid addition systems.

The second step, concentration of the neutralized effluent produced by the first step, will occur in the E-F11 Concentrator. This step produces the ASD, which is shown going "To Disposal" (i.e., Liquid Effluent Retention Facility [LERF]) in Figure 2-5. Because of the low vapor pressure of ammonia over ammonium nitrate solutions, this process is expected to produce a lower concentration of ammonium hydroxide in the ASD (less than 0.005 M) and only trace amounts of ammonium nitrate.

The third step, the actual ammonia destruction by the addition of sodium nitrite occurs in Tk-G7. The nitrite ions present in the sodium nitrite, added at elevated temperature (80 - 90°C), will react with the ammonium ions in the concentrated neutralized effluent to produce water and nitrogen gas. The sodium and nitrate ions remain in solution, accounting for most of the dissolved solids content of the resulting radioactive liquid waste.

The fourth step, pH and nitrite adjustment, occurs in Tk-G7. Sodium hydroxide will be added to raise the pH of the liquid 12.5, and additional sodium nitrite will be added to protect the carbon steel equipment associated with UGS tanks.

The fifth step, transfer to UGS tanks, would be from Tk-G7.

2.3.3.2 Old Ammonia Scrubber Feed Processing. Since the 216-A-36-B Crib was closed in 1987, all subsequent ammonia scrubber effluent has been transferred to UGS tanks. This liquid is accumulating, pending some method of disposal. Processing the liquid at the PUREX Plant is complicated by the sodium hydroxide that was added to the liquid to raise the pH above 12.5. (This addition was necessary to protect the carbon steel UGS equipment.) The ammonia in this material may be destroyed using the PUREX Plant equipment, which would require additional operation of the PUREX Plant. Alternatively, the process might be carried out using a new or existing equipment at the Hanford Site.

2.3.3.3 ASD Recycling. Studies are ongoing to diminish the volume of the ASD by recycling it to the spray nozzles of the ammonia scrubber towers. Funding for the ASD recycle equipment has not yet been resolved.

2.3.3.4 PDD and ASD Interim Storage and Treatment, Projects W-105 and C-018. Project C-018 will provide treatment for the PDD and ASD in accordance with Tri-Party Agreement Milestone M-17-02 (1995). This treatment is currently envisioned to include ion removal (including all radionuclides except tritium) and organic chemical destruction.

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

Project W-105 is currently under construction. Project C-018 is a line item that has not yet been funded by the U.S. Congress. (A line item must be specifically authorized in the Congressional budget.)

2.4 PROCESS DATA

Depending on the processing performed (and in the case of organic chlorides, on the time of year), the concentrations of the solutes in the ASD can vary from somewhat above the limit listed in Table 2-2 to essentially zero. Consequently, the best way to assess variability is to analyze samples.

Adequate information is not currently available on the new ASD process to permit predictions about the variability of the new ASD stream. However, recycling of the ASD would be expected to diminish the variability of the stream composition.

Table 2-2 lists bounding estimates of the concentrations of the expected constituents in the historical ASD. Each constituent is discussed in the text that follows.

Table 2-2. Historical Constituents in the ASD.
(parts per billion)

Component	Maximum
Water	1.0 E+09
Ammonium	2.0 E+07
Chloride	?
Fluoride	?
Nitrate	?
Uranium	1.0 E+01
Organic Chlorides (TOX)	7.7 E+02
Dearborn Filmeen 14 ^a	1.3 E+03
Fission Products	(Controlled by Procedure)

^aFilmeen is a trademark of Grace Dearborn, Hackettstown, New Jersey.

TOX = total organic halogen.

2.4.1 Water

Water normally constitutes more than 99% of the ASD. In the past, most of the added water was raw water used to scrub ammonia from certain offgas streams. With the implementation of ammonia destruction and ASD recycle, most of the water will be derived from condensed steam, makeup water used in preparing the decladding solution, and demineralized water added during decladding to maintain the volume of the decladding solution.

2.4.2 Ammonium

The decladding process generates large quantities of ammonia, which is removed by the downdraft condensers and ammonia scrubbers connected to the offgas systems on the three dissolvers. Processing of the spent decladding solution liberates even more ammonia into the vapor space of the processing vessels. This additional ammonia is removed by the E-3 Ammonia Scrubber. The ammonia-bearing solutions from the four ammonia scrubbers and three downdraft condensers collect in four ammonia scrubber catch tanks. Steam jets transfer the solutions to the ammonia waste handling system.

In the past, the ammonia-bearing solutions collected in the four ammonia scrubber catch tanks were boiled in the E-F11 Concentrator to separate the ammonia and water from the bulk of the entrained fission products. After passing through the E-F11 Condenser, the distilled ammonia and water became the ASD stream. The bulk of the fission products in the ASD were transferred to UGS tanks. Production and disposal of the ASD were discontinued when it was determined that the concentration of ammonia (ammonium hydroxide) in the ASD could exceed the CERCLA reportable quantity and WAC 173-303 (Ecology 1989) toxic dangerous waste limit of 1 weight percent.

In the future, with ammonia destruction, the quantities of ammonia in the new ASD are not anticipated to exceed regulatory limits. The primary specification of the ammonia destruction process is to produce a stream that will not be regulated because of ammonia.

2.4.3 Chloride

Chloride is known to be present in the raw water used in generating the ASF. Additional chloride is expected as an impurity in the AFAN used in decladding. Because the ASF is basic, the chloride should be nonvolatile and should not be present in the ASD in concentrations that would be of regulatory concern. Chloride concentrations will be determined by sampling.

2.4.4 Fluoride

The decladding solution, AFAN, contains fluoride in a concentration that should not exceed a molarity of 10, which corresponds to 190M ppb. However, this fluoride should be quite nonvolatile, and may or may not be detectable in the ASD. The concentration of fluoride in the ASD is not expected to be of regulatory concern.

2.4.5 Nitrate

The AFAN contains nitrate in a concentration that should not exceed a molarity of 1, which corresponds to 52M ppb. However, this nitrate should be quite nonvolatile. The concentration of nitrate in the ASD should be considerably less than the concentration of ammonium.

In future processing, the nitrate concentrations in the E-F11 Concentrator will be higher than they have been in the past, but levels of nitrate in the future ASD are expected to remain within acceptable limits.

2.4.6 Uranium

Uranium enters the ASD by way of the irradiated fuel, which is the feed to the PUREX Plant process. Traces of dissolved fuel are present in the dissolver at the beginning of the decladding process. As decladding progresses, the decladding solution breaches the cladding of the fuel rods and begins to dissolve small quantities of fuel, releasing uranium into the decladding solution. Although the uranium is not volatile, some is entrained in the offgas from the decladding process. The entrained uranium is then scrubbed from the offgas (and combined with traces of uranium that occur naturally in the raw water used in the scrubbers) to become a constituent of the ASF.

In the past, the E-F11 Concentrator boiled the ASF to separate the ammonia and water (which became the ASD) from the bulk of the radionuclides (uranium and fission products). The radionuclide content of the ASD was monitored to determine when to transfer the concentrated radionuclide-bearing solution to UGS tanks.

In the future, this concentrator will probably boil an ammonium nitrate solution to separate most of the water from the ammonium nitrate and the bulk of the radionuclides. The solubility of ammonium nitrate will limit the extent of concentration to a much lower level than in the past, resulting in lower radionuclide emissions in the new ASD.

2.4.7 Organic Chlorides

Steam jets transfer the collected solution out of the ammonia scrubber catch tanks. This steam originates in the 200 East Powerhouse as dechlorinated sanitary water. In the production of this sanitary water, chlorine is added to destroy bacteria and other organic debris in the raw water pumped from the Columbia River. (Raw water is the feed to the process which makes sanitary water.) Some of the chlorine reacts with organic materials in the water to produce organic chlorides. The dechlorination process removes ionic chlorides, but not organic chlorides. Although organic chlorides are expected, their concentrations should not exceed those found in sanitary water.

2.4.8 Dearborn Filmeen 14

Steam jets transfer the collected solution out of the ammonia scrubber catch tanks. This steam originates in the 200 East Powerhouse. A corrosion inhibitor, Filmeen* 14, is continuously added to the steam at the 200 East

*Filmeen is a trademark of Grace Dearborn, Hackettstown, New Jersey.

Powerhouse to protect the steam piping from corrosion by the steam. The Filmeen 14 is an amine, with a molecular weight of approximately 270. The concentration of Filmeen 14 in the steam is approximately 13,000 ppb. Assuming a jet dilution of 10%, the concentration of Filmeen 14 in the ASF and ASD would be approximately 1,300 ppb.

2.4.9 Fission Products

Fission products enter the ASD by way of the irradiated fuel that is the feed to the PUREX process. Traces of dissolved fuel are present in the dissolver at the beginning of the decladding process. As decladding progresses, the AFAN breaches the cladding of the fuel rods and begins to dissolve small quantities of fuel, releasing fission products into the AFAN. Because most of the fission products are not volatile, they remain in the decladding solution. Some fission products (including an unidentified ruthenium-containing species) evaporate from the decladding solution. Traces of other fission products are entrained in the offgas from the decladding process. The evaporated and entrained fission products are scrubbed from the offgas and become constituents of the ASF.

In the past, the E-F11 Concentrator boiled the ASF to separate the ammonia and water (which became the ASD) from the bulk of the radionuclides (uranium and fission products). The radionuclide content of the ASD was monitored to determine when to transfer the concentrated radionuclide-bearing solution to UGS tanks.

As discussed in Section 2.5.6, the E-F11 Concentrator will probably boil an ammonium nitrate solution to separate most of the water from the ammonium nitrate and the bulk of the radionuclides. The solubility of ammonium nitrate will limit the extent of concentration resulting in lower radionuclide emissions in the new ASD.

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3.0 SAMPLE DATA

This section provides an evaluation of the sampling data pertaining to the PUREX Plant ASD. 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 samples (Section 3.1) and addresses data presentation (Section 3.2).

3.1 DATA SOURCE

Two sources of sampling data were used in this analysis: wastestream data for routine operation and background data for the raw water. Old data were used for the ASD since the ASD was inactive during the new data sampling period.

Sampling and analytical protocols followed are discussed in the "parent" document of WHC-EP-0342.

3.1.1 Wastestream Data

Volume 2 of the *Waste Stream Characterization Report* (WHC 1989) documents the results of a program to sample Hanford Site liquid effluents and to analyze them for chemical contaminants. Appendix A.4 of Volume 2 of the report summarizes the sampling results for the PUREX Plant ASD, and Appendix B contains the complete results. The chemical data set comprises the analysis results for four samples that were taken over a 23-mo interval.

The sampling scheme took representative samples of raw water and the ASD by following sampling and analytical protocol in EPA (1986). 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 details of the sampling, analytical, quality control, and quality assurance procedures are contained in Volume 4 of the *Waste Stream Characterization Report*.

The PUREX Plant ASD was randomly sampled four times over a time frame of 23 mo during routine operation. The sampling dates were August 23, 1985; May 8, 1987; June 23, 1987; and July 30, 1987. The number of chemical analytes detected was 12, although not every chemical analyte was detected at each sampling time.

Table 3-1 shows the analyses performed, analytical methods, and sample identification numbers. Table 3-2 summarizes the analytical results reported in the *Waste Stream Characterization Report* (WHC 1989) for samples of the ASD taken during routine operation. Table 3-3 summarizes the radionuclide concentrations in picoCuries per liter for the ASD streams from 1982 through 1987. Appendix B contains the complete ASD sample data.

The ASD radiological data have been generated as a part of the environmental protection program in the 200 East Area of the Hanford Site (Appendix B). The data covering the period from 1966 through September 1987 (when the ASD was discontinued) were obtained from analyses of 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.

3.1.2 Background Data

The background data comprise data sets for the 200 East Area raw water and 200 East Area sanitary water. The data for the raw water were collected as a part of the same effort as the ASD data. The data for the sanitary water were collected to assure that the water was suitable for drinking.

3.2 DATA PRESENTATION

Table 3-2 summarizes the analytical results for the ASD samples. The complete results for all analytes detected are in Appendix B.

Table 3-3 contains averages of the detected levels of radionuclides in the ASD. That is, all nondetection results were eliminated and the remainder averaged. Table 3-3 values do not agree with Table 3-2 values. As explained in the radiological history section of Appendix B, the data presented in Table 3-3 derive ultimately from composite samples that reflected the average composition of the ASD as discharged to the 216-A-36-B Crib. As noted in Table 3-3, the historical data set was censored to remove all analytical results that were below detection. As a result, the reported "averages" are not based on a representative population and are overstated. These overstated results were enhanced by high radiation background in the laboratory where these data originated; a high radiation background can lead to apparent "detections" of concentrations that are orders of magnitude higher than the actual concentrations in the samples.

Table 3-4 summarizes analytical results for the 200 East Area raw water and the 200 East Area sanitary water. Volatile components of the 200 East Area raw water would be expected to enter the ASD.

Table 3-5 summarizes organic analytical results for the 200 East Area sanitary water. These volatile organic compounds are expected in the steam used in the PUREX Plant. Because the ASF is estimated to contain about 10% condensed steam, these compounds are also expected in the ASD.

Table 3-1. Procedures for PUREX Ammonia Scrubber Condensate Samples.

LEAD# CofC#	50006 50006	50297 50297	50317 50317	50330 50330
Alpha counting	X	X	X	X
Ammonia	X	X	X	X
Atomic emission spectroscopy	X	X	X	X
Beta counting	X	X	X	X
Conductivity-field	X	X	X	X
Cyanide	X	X	X	X
Direct aqueous injection (GC/MS)	X	X	X	X
Fluoride (LDL)				X
Hydrazine	X	X	X	X
Ion chromatography	X	X	X	X
Lead		X	X	X
Mercury	X	X	X	X
pH-field	X	X	X	X
Semivolatile organics (GC/MS)	X	X	X	X
Sulfide		X	X	X
Temperature-field	X	X	X	X
Total organic carbon	X	X	X	X
Total organic halides	X			
Total organic halides (LDL)		X	X	X
Uranium	X	X	X	X
Volatile organics (GC/MS)	X	X	X	X
LEAD# CofC#		50297B 50298	50317B 50318	50330B 50331
Volatile organics (GC/MS)		X	X	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. CofC# is the chain-of-custody number.

Abbreviations:

GC = gas chromatography.

LDL = low-detection limit.

MS = mass spectrometry.

Table 3-2. Statistics for PUREX Ammonia Scrubber Condensate.

Constituent	N	MDA	Method	Mean	StdErr	90%CILim	Maximum
Calcium	4	2	DL	6.80E+01	1.15E+01	8.68E+01	9.80E+01
Chloride	4	2	DL	1.17E+03	6.83E+02	2.29E+03	3.22E+03
Chromium	4	3	DL	1.06E+01	6.50E-01	1.17E+01	1.26E+01
Magnesium	1	0	n/a	2.10E+01	n/a	n/a	2.10E+01
Nickel	4	3	DL	1.02E+01	2.50E-01	1.07E+01	1.10E+01
Nitrate	4	3	DL	5.50E+02	5.00E+01	6.32E+02	7.00E+02
Sodium	4	2	DL	2.79E+02	1.08E+02	4.56E+02	5.33E+02
Uranium	4	0	n/a	3.91E-01	2.22E-01	7.55E-01	1.03E+00
Zinc	4	2	DL	3.50E+01	1.80E+01	6.45E+01	7.70E+01
Ammonia	4	0	n/a	3.66E+05	3.31E+05	9.09E+05	1.36E+06
1-Butanol	1	0	n/a	1.20E+01	n/a	n/a	1.20E+01
Alpha Activity (pCi/L)	4	0	n/a	3.01E+01	1.71E+01	5.81E+01	7.78E+01
Beta Activity (pCi/L)	4	0	n/a	3.99E+04	3.18E+04	9.20E+04	1.35E+05
Conductivity (μ S)	4	0	n/a	1.79E+02	7.39E+01	3.00E+02	3.95E+02
pH (dimensionless)	4	0	n/a	9.35E+00	1.87E-01	9.66E+00	9.74E+00
Temperature ($^{\circ}$ C)	4	0	n/a	3.24E+01	3.62E+00	3.83E+01	4.28E+01
TOC	4	3	DL	2.16E+03	1.62E+03	4.82E+03	7.02E+03

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.

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.

Table 3-3. Detected Radionuclides in PUREX Plant ASD
 from 1982 through 1987.

Analyte	N	Average concentration (pCi/L)	90%CI upper limit (pCi/L)
Alpha	12	1.1 E+03	2.0 E+03
Beta	45	4.1 E+05	4.9 E+05
⁹⁰ Sr	45	9.5 E+03	1.9 E+04
¹⁰⁶ Ru	38	2.4 E+05	2.8 E+05
¹⁰³ Ru	20	4.8 E+04	6.3 E+04
¹³⁷ Cs	46	8.0 E+03	1.1 E+04
¹⁴⁷ Pm	32	2.8 E+04	3.7 E+04
U(Gross)	2	3.9 E+01	1.6 E+02
³ H	41	3.1 E+06	4.3 E+06
²⁴¹ Am	3	7.5 E+02	2.1 E+03
¹²⁹ I	2	5.3 E+01	1.4 E+02
²⁴¹ Pu	36	3.3 E+03	5.6 E+03
²³⁹ Pu	37	5.0 E+02	9.3 E+02
¹¹³ Sn	17	2.8 E+04	3.4 E+04

N is the number of samples in which the analytes was detected. The average concentration does not reflect less-than values, and it is the sum of the detected values divided by N.

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

Constituent/Parameter [all ppb, exceptions noted]	Raw Water ^a (1986-1987)			Sanitary Water ^b (1985-1988)		
	N ^c	AVG	STD DEV	N	AVG	STD DEV
Arsenic				4	<5.00E+00	1.45E-08
Barium	5	2.80E+01	3.04E+00	4	<1.05E+02	1.00E+01
Cadmium	5	2.40E+00	8.00E-01	4	<5.00E-01	0.00E+00
Calcium	5	1.84E+04	1.32E+03			
Chromium				4	<6.25E+00	2.50E+00
Chloride	5	8.71E+02	2.12E+02			
Conductivity-field (μS)	5	9.32E+01	4.12E+01			
Copper	5	1.06E+01	1.20E+00	4	<5.50E+01	1.00E+01
Color (units)				4	<5.00E+03	0.00E+00
Iron	5	6.36E+01	2.30E+01	4	<8.25E+01	5.19E+01
Fluoride				4	<1.13E+02	2.50E+01
Lead				4	<5.00E+00	1.45E-08
Magnesium	5	4.19E+03	4.32E+02			
Manganese	5	9.80E+00	3.12E+00	4	<1.00E+01	2.90E-08
Mercury				4	<5.00E-01	0.00E+00
Nickel	5	1.04E+01	8.00E-01			
Nitrate	5	9.96E+02	7.86E+02	4	<3.72E+02	5.44E+02
pH (dimensionless)	5	7.41E+00	1.06E+00			
Potassium	5	7.95E+02	5.58E+01			
Selenium				4	<4.25E+00	1.50E+00
Silver				4	<6.25E+00	2.50E+00
Sodium	5	2.26E+03	2.16E+02	4	2.28E+03	1.26E+02
Sulfate	5	1.06E+04	8.92E+02	4	1.68E+04	3.37E+03
Temperature-field (C)	5	1.64E+01	5.22E+00			
TOC (μg/g)	5	1.36E+03	2.26E+02			
TDS (mg/L)				4	8.10E+04	1.69E+04
Trichloromethane	5	1.18E+01	3.60E+00			
Uranium	4	7.26E-01	1.92E-01			
Zinc	5	2.00E+01	1.90E+01	4	<6.25E+01	2.50E+01
Radionuclides (pCi/L)						
Alpha Activity	4	8.85E-01	4.59E-01			
Beta Activity	4	4.47E+00	1.53E+00			

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

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

^bCompiled from HEHF 1986, Hanford Sanitary Water Quality Surveillance, for CY 1985, 1986, 1987, and 1988 (Somers 1986, 1987, 1988, 1989).

^cN 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.

pCi/L = picoCuries/liter.

TOC = total organic carbon.

TOX = total organic halides.

TDS = Total Dissolved Solids.

μS = microsiemen.

μg = microgram.

91110951412

Table 3-5. 200 East Sanitary Water--Organic Data (1987-1988)^a.

Constituent/Parameter [all ppb, exceptions noted]	200 East ^b		
	N ^c	AVG	STD DEV
1,1,1-Trichloroethane	1	<DL ^c	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

^aThe 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).

^bN 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."

^cSee companion table for organic detection limits as compiled from HEHF data.

DL = detection limit
ppb = parts per billion.

3.3 SAMPLE OF AUGUST 23, 1985

The sample of August 23, 1985, is unique. Seven of the eight unexpected analytes were reported to be present in this sample. Four of the eight unexpected analytes (butyl alcohol, chromium, magnesium, and nickel) were never reported as having been detected in any other ASD sample. Of the remaining four unexpected analytes, three (calcium, sodium, and zinc) were reported as detected in this sample and only one other ASD sample.

Table 3-6 shows that samples of other effluent streams at the PUREX Plant taken on August 22 and August 23, 1985, also exhibit this difference with later samples of the same streams. Table 3-7 shows which analytes were reported in the August 1985 samples only.

The high incidence of unique reports of detections in the August 1985 samples suggest that there was either some systematic error in the sampling-analysis process (e.g., the samples were contaminated), or that these were unique samples resulting from unique conditions in the process or the water supply. Reviews of the PUREX Process Engineering Logbook and the PUREX operations logbook did not identify any unique conditions or events that would cause contamination of the various streams affected, nor could any scenario be hypothesized that would introduce the contaminants concurrently into streams that are primarily raw water and streams that are condensates of process solutions. A search of the sample results (in Appendix B of the *Waste Stream Characterization Report*) failed to discover any blank data relating to these five samples.

Taken together, these observations strongly suggest that the samples taken in August 1985 differed significantly from the other samples and that it is justifiable to ignore the August 1985 samples. Nevertheless, these samples were included in the preparation of the Dangerous Waste Designation Reports (Table 5-2).

Table 3-6. Evaluation of August 1985 Samples.

	ASD	CSL ^a	CWL	PDD	SCD
Number of samples	4	5	5	8	5
Number of unique results	6	8	7	15	6
Number of unique results in August 1985	6	4	4	10	3
Page numbers in <i>Waste Stream Characterization Report</i> (WHC 1989a)	A.6-4 A.6-9	A.4-6 A.4-16	A.8-4 A.8-9	A.5-4 A.5-10	A.7-4 A.7-13

^aNon-regen.

Table 3-7. Analytes Uniquely Reported in August 1985.

Analyte	ASD	CSL	CWL	PDD	SCD
Beryllium			X		
Butyl alcohol	X				
Cadmium		X	X	X	X
Chromium	X	X			
Copper				X	
Cyanide					X
Di-n-Butyl phthalate		X	X		
Isophorone				X	
Magnesium	X				
Methyl Ethyl Ketone				X	
Nickel	X	X	X	X	X
Nitrate	X				
Nitromethane				X	
TOC	X				
Unknown				X	
Unknown				X	
Unknown				X	
Unknown				X	

TOC = total organic carbon.

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4.0 DATA OVERVIEW

This section compares 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 PUREX Plant ASD wastestream.

4.1 DATA COMPARISON

4.1.1 Radionuclides

Table 4-1 gives a comparison of radionuclide data with Derived Concentration Limits and with EPA drinking water limits. The Derived Concentration Guides (DCG) are those concentrations of radionuclides in water that would result in a maximum effective, committed dose equivalent to 100 mrem/year using International Commission on Radiological Protection (ICRP) 30 dose methodology (WHC 1988b). Table 4-1 presents the ratios of the average-measured concentrations of the radionuclides to the DCGs and Drinking Water Standards (DWS). As expected, this stream exceeds these criteria because of carryover of a small fraction of the radionuclides present in the E-F11 Concentrator. Note, Table 4-1 is based on data from Table 3-3 which contains overstated radionuclide values as discussed in Section 3.2.

4.1.2 Nonradionuclides

Table 4-2 compares the measured composition of the ASD (from Table 3-2) with that of the 200 East Area raw water previously given in Table 3-4. Table 4-3 compares the inorganic constituents of the ASD with drinking water limits (SV1). The table also compares total alpha and beta activity with derived concentration limits (SV2) given in Appendix A of WHC-CM-7-5 (WHC 1988b).

Tables 4-1 and 4-3 provide a comparison of average constituent concentrations to various screening criteria. These criteria are not used here for compliance purposes.

Table 4-1. Comparison of Radiological Sample Data to Various Criteria (pCi/L; ratios are dimensionless).

Analyte	Sample Average	Drinking Water Standard	Ratio ^a	DCG ^b	DCG ratio
Alpha activity	1,100	15	73	NA	NA
Beta activity	410,000	50	8,200	NA	NA
⁹⁰ Sr	9,500	50	190	1,000	9.5
¹³⁷ Cs	8,000	100	80	3,000	2.7
¹⁴⁷ Pm	28,000	NA	NA	1.0 E+05	0.28
U(Gross)	39	NA	NA	500	0.078
³ H	3,100,000	90,000	34	2.0 E+06	1.5
²³⁹ Pu	500	40	12	30	17

^aRatio is sample average/drinking water standard.

^bDCG is the Derived Concentration Guide used for relating concentrations of radionuclides in the environment to a human dose. The DCG is only applicable for specific radionuclides.

NA = not applicable.

Table 4-2. Comparison of ASD Data to Raw Water Background (ppb unless otherwise stated).

Analyte	Sample average	Background average
Alpha activity (pCi/L)	30	0.9
Beta Activity (pCi/L)	40,000	4.5
Ammonium	370,000	BDL
Butyl alcohol	12	BDL
Calcium	68	18,000
Chloride	1,900	870
Chromium	13	BDL
Conductivity ^a (μS)	180	93
Magnesium	21	4,200
Nickel	11	10
Nitrate	700	1,000
pH**	9.4	7.4
Sodium	280	2,300
Temperature ^a (°C)	32	16
TOC	2,200	1,400,000
Uranium	0.39	0.73
Zinc	35	20

BDL = below detection limits.

NA = not applicable/not available.

TOC = total organic carbon.

^aMeasurements taken under field conditions.

Table 4-3. Evaluation of PUREX Ammonia Scrubber Condensate.

Constituent	Result ^a	SV1 ^b	SV2 ^c
Chloride	1.2E+00	2.5E+02 h	
Chromium	1.1E-02	1.0E-01 e	
Nickel	1.0E-02	1.0E-01 e	
Nitrate	5.5E-01	4.5E+01 e	
Zinc	3.5E-02	5.0E+00 h	
Alpha Activity (pCi/L) ⁿ	3.0E+01	1.5E+01 g *	3.0E+01 *
Beta Activity (pCi/L)	4.0E+04		1.0E+03 *

NOTES:

^aUnits of results are mg/L unless indicated otherwise. The results are the mean values reported in the Statistics table of Section 3.0.

^bScreening 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). See WHC-EP-0342, "Hanford Site Stream-Specific Reports", August 1990.

^cScreening 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.

ⁿThe SV1 and SV2 values for Gross Alpha are used to evaluate Alpha Activity.

^oThe SV2 for Gross Beta is used to evaluate Beta Activity.

4.2 INTERPRETATION

4.2.1 Radionuclides

Because the source of ammonia scrubber solution involves the dissolver, offgas, elevated radionuclide levels are expected. Scrubber solution activity will be reduced by the distillation process in the F-11 Concentrator.

4.2.2 Nonradionuclides

Inorganic constituents in the ASF will correspond to the raw water values with small contributions from equipment corrosion. The distillation process in the E-F11 Concentrator will reduce these values depending on entrainment in the concentrator tower and the volatility of the constituent.

The primary inorganic constituent is ammonia; its concentration can vary by as much as two orders of magnitude. Releases of other chemical species are not believed to vary as ammonia does; therefore, the sampling data are adequate for designating the stream with respect to all constituents except ammonia.

4.3 DEPOSITION RATES

Table 4-4 gives the deposition rate in kilograms of constituent per month based on knowledge of stream flow and concentration data. Table 4-4 has been included to provide deposition rates using average data from Table 3-2 and flow data from Section 2.3.

Table 4-4. Deposition Rate for PUREX Ammonia Scrubber Condensate
 Flow Rate: 1.26E+06 L/mo.

Constituent	Kg/L*	Kg/mo*
Calcium	6.80E-08	8.57E-02
Chloride	1.17E-06	1.47E+00
Chromium	1.06E-08	1.34E-02
Magnesium	2.10E-08	2.65E-02
Nickel	1.02E-08	1.29E-02
Nitrate	5.50E-07	6.93E-01
Sodium	2.79E-07	3.52E-01
Uranium	3.91E-10	4.93E-04
Zinc	3.50E-08	4.41E-02
Ammonia	3.66E-04	4.61E+02
1-Butanol	1.20E-08	1.51E-02
Alpha Activity *	3.01E-11	3.79E-05
Beta Activity *	3.99E-08	5.03E-02
TOC	2.16E-06	2.72E+00

NOTES:

Data collected during August 1985, May 1987, June 1987, and July 1987.

Flow rate is the average of rates from Section 2.0.

Non-steady-state, batch process sampled at less than maximal constituent concentrations.

Constituent concentrations are average values from the Statistics Report in Section 3.0.

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

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

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5.0 DESIGNATION

In 1987, it was determined that the ASD periodically contained enough ammonia to be a dangerous waste, with a dangerous waste number of WT02. At that time, both the production and discharge of the ASD was discontinued. It is currently expected that the proposed ammonia destruction process will allow the production of a new ASD stream that will not be a dangerous waste.

The ammonia destruction process has not yet been implemented. Consequently, there are no samples of the future ASD available for analysis. It is therefore not possible to designate the future ASD at this time. It is possible, however, to examine the old data to determine if there are any other dangerous waste issues concerning the ASD that need to be resolved. The designation procedure provides a vehicle to identify any additional such issues.

This section proposes that the PUREX Plant ASD not be designated a dangerous waste from any standpoint other than ammonia concentration. Because of process samples, it is known that the ASD periodically contained enough ammonia to be a toxic dangerous waste with a dangerous waste number WT02. The designation procedure uses data from both the effluent source description and sample data (Sections 2.0 through 4.0) and complies with the designation requirements of WAC 173-303-070 (Ecology 1989).

The procedure for determining whether or not a waste is a dangerous or extremely hazardous waste is contained in the WAC 173-303-070. This procedure is illustrated in Figure 5-1.

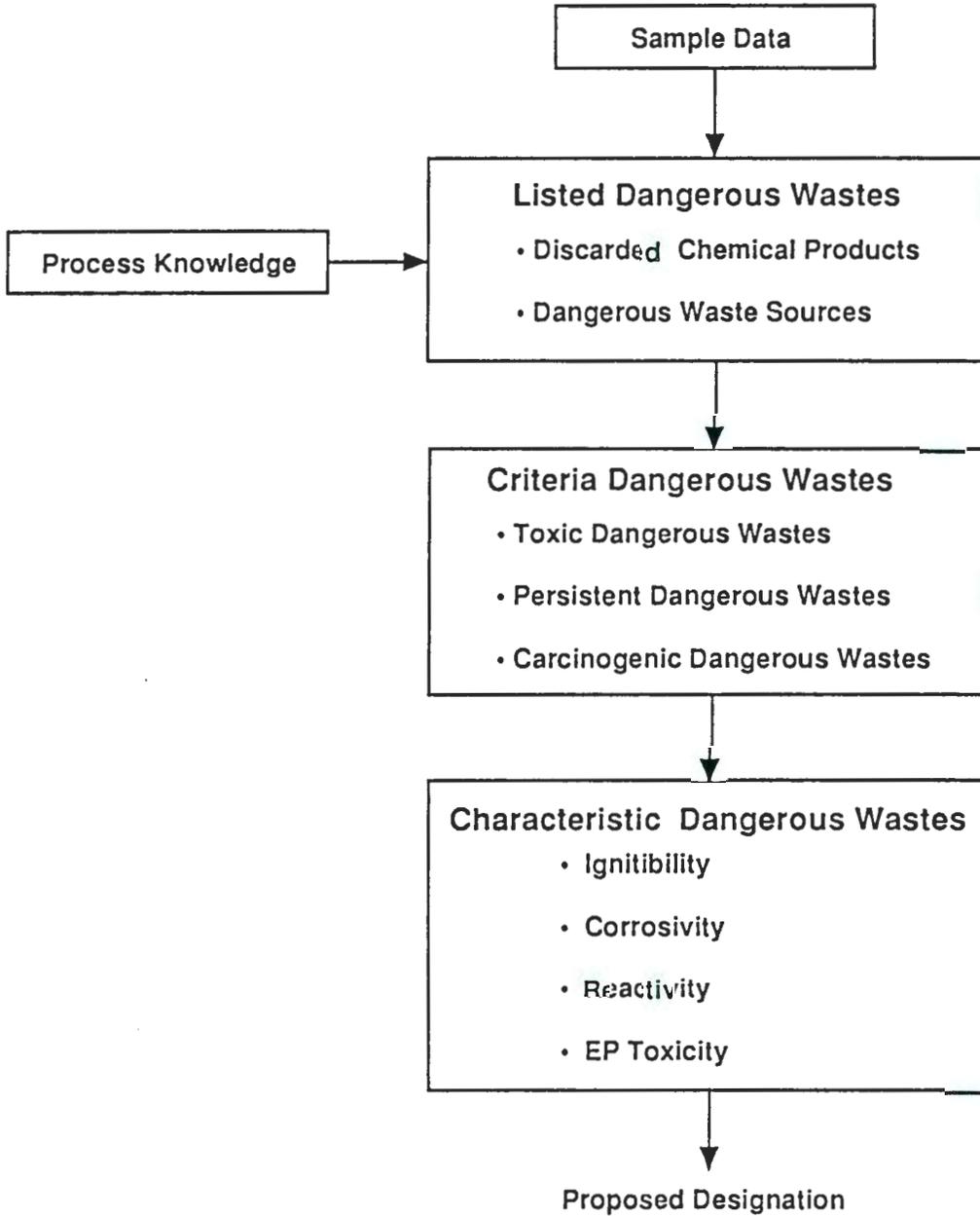
The designation process involves two types of methods. Process knowledge such as the sources of the stream, all additions to the stream, and pathway are reviewed. Sample data are also incorporated to check for potential or existing listed dangerous waste components covered in WAC 173-303-080 through WAC 173-303-083.

A separate procedure is used for "criteria" dangerous wastes in WAC 173-303-100 and "characteristic" wastes in WAC 173-303-090. Broad spectrum chemical analyses are compiled and compared with the limiting conditions given in these WACs. If the effluent discharge rates and/or concentrations are below the posted limits then the stream is not a designated dangerous waste or an extremely hazardous waste.

5.1 DANGEROUS WASTES LISTS

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

Figure 5-1. Designation Strategy.



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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.

- The listed constituent is the sole active ingredient in a commercial chemical product that has 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 commercial chemical products. (A spill of a discarded chemical product would cause a wastestream to be designated during the time that the discharge is occurring. The current wastestream would not be designated unless a review of past spill events indicates that the spills are predictable, systematic events that are ongoing and reasonably anticipated to occur in the future. The evaluation of this criteria, in this report, is based on a review of spill data reported in accordance with the CERCLA.
- The constituent is discarded in the form of a residue resulting from cleanup of a spill of an unused chemical contained on the discarded products list. (A chemical product that is used in a process and then released to the wastestream 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. This list is divided into three parts. The first is the specific sources list, primarily aimed at certain industries (e.g., pesticide production, inorganic pigment production, organic chemical production). The second is the nonspecific sources list, which includes wastestreams generated by a wide variety of industries. The third is state sources which are limited to polychlorinated biphenyl-contaminated transformers and capacitors resulting from salvaging, rebuilding, or discarding activities.

5.2 LISTED WASTE DATA CONSIDERATIONS

The proposed designation of the wastestream described in this report is based on an evaluation of process information and sampling data. The following sections describe the types of information utilized 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 discarded chemical products list and the dangerous waste source list. 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 cannot be detected at the sample point. The process evaluation includes a review of process diagrams and operating procedures. The PUREX Plant ASD stream had only one contributor, the condensate from the F-11 Concentrator. Potential contributors to the F-11 Concentrator were limited, as discussed in Section 5.3.2.

If a listed chemical is identified, the specific use of the chemical must be evaluated to determine if such use results in the generation of a listed waste.

5.2.2 Sampling Data

Sampling data is used as a screening tool to enhance and support the results of the previously discussed process evaluation. In this step, the results of the sampling data are compared to the WAC 173-303-9903 and -9904 lists. If a constituent is contained on one or both of these lists, an engineering evaluation is performed to determine if it has entered the wastestream as a discarded chemical product or from a dangerous waste source.

Screening organic constituents is a relatively simple procedure because analytical data for 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. This is because inorganic data is reported as ions and elements rather than 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 real example, with many cations and anions, the list of possible combinations is extensive.

A procedure was developed by Westinghouse Hanford for combining the inorganic constituents into substances. The potential substances are then compared to the WAC 173-303-9903 and -9904 list. This screening procedure is described in the *Wastestream Designation of Liquid Effluent Analytical Data* (WHC 1990b).

Table 5-1 shows the formation procedure and results for the ASD stream.

The screening procedure is described in the *Wastestream Designation of Liquid Effluent Analytical Data* (WHC 1990b). 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 cation and anion are present and an investigation should be conducted to determine how they entered the wastestream.

Table 5-1. Inorganic Chemistry for PUREX Ammonia Scrubber Condensate.
(sheet 1 of 2)

Constituent	ppb	Ion	Eq/g	Normalized
Charge Normalization:				
Calcium	8.68E+01	Ca+2	4.33E-09	1.85E-08
Chloride	2.29E+03	Cl-1	6.47E-08	
Chromium	1.17E+01	CrO4-2	4.51E-10	
*Magnesium	2.10E+01	Mg+2	1.73E-09	7.39E-09
Nickel	1.07E+01	Ni+2	3.63E-10	1.55E-09
Nitrate	6.32E+02	NO3-1	1.02E-08	
Sodium	4.56E+02	Na+1	1.98E-08	8.48E-08
Uranium	7.55E-01	UO2+2	6.34E-12	2.71E-11
Zinc	6.45E+01	Zn+2	1.97E-09	8.43E-09
Hydrogen Ion (from pH 9.7)		H+	(2.20E-13)	
Hydroxide Ion (from pH)		OH-	(4.54E-08)	
Cation total			2.82E-08	
Anion total			1.21E-07	
Cation normalization factor: 4.275				

Substance Formation: Substance	%	Cation out	Anion out
Calcium chromate(VI)	3.52E-06	1.81E-08	0.00E+00
Nickel(II) hydroxide	7.20E-06	0.00E+00	
Uranyl nitrate	5.34E-07	0.00E+00	1.02E-08
Zinc nitrate	7.99E-05	0.00E+00	1.73E-09
*Magnesium chloride	3.52E-05	0.00E+00	5.73E-08
Calcium nitrate	1.42E-05	1.63E-08	0.00E+00
Sodium chloride	3.35E-04	2.75E-08	0.00E+00

NOTES:

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.

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Table 5-1. Inorganic Chemistry for PUREX Ammonia Scrubber Condensate.
(sheet 2 of 2)

Substance names may include MB (monobasic), DB (dibasic), 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 (gms/100gms). 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.

5.3 PROPOSED LISTED WASTE DESIGNATION

A process evaluation along with a review of sampling data indicated that the PUREX Plant ASD stream did not contain a discarded chemical product or a listed waste source. The following sections discuss the evaluation that was conducted to substantiate this conclusion.

5.3.1 Discarded Chemical Products

Based on the following considerations, it is concluded that the ASD did not contain any discarded chemical products.

As discussed in Section 5.2, a process evaluation of the contributors to the PUREX Plant ASD stream was conducted. As discussed in Section 2.2, the ASD stream had only one contributor, the condensate from the E-F11 Concentrator, which received ammonia-rich raw water via steam jets from the ammonia scrubber catch tanks. The process configuration did not provide a path for the discarding of chemicals via the PUREX Plant ASD stream.

A CERCLA spill review was not conducted for the ASD because there are no floor drains connected to the ASD. However, it was determined in 1987 that the ammonia in the ASD periodically exceeded the CERCLA reportable quantity and the WAC 173-303-101 toxic dangerous waste limit of 0.001% equivalent concentration (EC%). Discharge to the 216-A-36-B Crib was discontinued and the ASF was rerouted to underground storage tanks.

5.3.1.1 1-Butanol. 1-butanol was used in the PUREX laboratory, and recycled into the PUREX process for recovery of product materials, but this practice has been discontinued. 1-Butanol is not disposed into the PUREX process or the ASD stream as a discarded chemical product.

1-butanol appeared in only one sample at a concentration of 12 ppb. The threshold value for 1-butanol is 33 ppb based on analyses of current data blanks taken site-wide as presented in Section 5.2 of the "parent" document of WHC-EP-0342. As the concentration of this sample is less than the threshold value this datum will not be considered in the designation of the wastewater stream. Furthermore this single sample was the sample of August 23, 1985, discussed above (Section 3.3), and therefore it is likely that the 1-butanol was present due to sample contamination.

5.3.1.2 Calcium Chromate. Calcium chromate is not used as a pure chemical at the PUREX Plant; rather, it is a compound postulated to be present based upon ionic pairings of wastestream analytes. Chromium is a corrosion product of stainless steel and could be expected at the low concentrations seen. It should be noted that chromium was only reported in the suspect sample of August 23, 1985, and as such was probably due to sample contamination.

5.3.2 Dangerous Waste Sources

The process evaluation (Section 5.2) 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 WAC 173-303-9904.

As discussed previously, the sampling data were used to enhance the process evaluation. Table 5.2 lists 1-butanol as the only potential waste from a listed source identified by sampling data. The 1-butanol would be listed if it were discarded as a spent solvent. As previously discussed in Section 5.3.1.1, no evidence was found that this chemical was present in the ASD as the result of the disposal of waste chemicals from the PUREX facility. It is also noted that the level of 1-butanol, found in only a single sample, is consistent with possible sample contamination based on the results of blank analyses. Therefore, it is concluded that the ASD does not contain 1-butanol as a result of the discard of a spent solvent.

5.4 DANGEROUS WASTE CRITERIA

A waste is a criteria dangerous waste if the waste meets one or more of the following criteria categories (WAC 173-303-100): toxic dangerous waste, persistent dangerous waste, or carcinogenic dangerous waste. A description of the methods used to test the sampling data against the criteria requirements is contained in the *Wastestream Designation of Liquid Effluent Analytical Data* (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 of the wastestream.
- Calculate the upper limit of the one-sided 90%CI for each analyte in the wastestream (WHC 1990b).
- Formulate substances from the analytical data. NOTE: This step is 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 the *Wastestream Designation of Liquid Effluent Analytical Data* (WHC 1990b) and is based on an evaluation of the most toxic compounds that can exist in an aqueous environment at ambient temperatures and pressures.
- Assign toxic categories to the substances in the wastestream.
- Calculate the contribution of each substance to the percent EC%.

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

Dangerous Waste Data Designation Report for PUREX Ammonia Scrubber Condensate
Finding. Undesignated

Discarded Chemical Products - WAC 173-303-081

Substance	Review Number	Status	DW Number
Calcium chromate(VI)	U032(EHW)	Not Discarded	Undesignated
*1-Butanol	U031(DW)	Not Discarded	Undesignated

Dangerous Waste Sources - WAC 173-303-082

Substance	Review Number	Status	DW Number
*1-Butanol	F003	Unlisted Source	Undesignated

Infectious Dangerous Waste - WAC 173-303-083

No regulatory guidance

Dangerous Waste Mixtures - WAC 173-303-084

Substance	Toxic	Persistent		Carcinogenic
	EC%	HH%	PAH%	Total%
Calcium chromate(VI)	3.52E-09	0.00E+00	0.00E+00	3.52E-06
Calcium nitrate	1.42E-09	0.00E+00	0.00E+00	0.00E+00
*Magnesium chloride	3.52E-09	0.00E+00	0.00E+00	0.00E+00
Nickel(II) hydroxide	7.20E-09	0.00E+00	0.00E+00	7.20E-06
Sodium chloride	3.35E-08	0.00E+00	0.00E+00	0.00E+00
Uranyl nitrate	5.34E-09	0.00E+00	0.00E+00	0.00E+00
Zinc nitrate	7.99E-08	0.00E+00	0.00E+00	0.00E+00
Ammonia	9.09E-04	0.00E+00	0.00E+00	0.00E+00
*1-Butanol	1.20E-10	0.00E+00	0.00E+00	0.00E+00
Total	9.09E-04	0.00E+00	0.00E+00	1.07E-05
DW Number	Undesignated	Undesignated	Undesignated	Undesignated

Dangerous Waste Characteristics - WAC 173-303-090

Characteristic	Value	DW Number
Ignitables % (Calc.)	1.20E-06	Undesignated
Corrosivity-pH	9.66	Undesignated
Total Cyanide (mg/kg)	0.00E+00	Undesignated
Total Sulfide (mg/kg)	0.00E+00	Undesignated
Total Chromium (mg/L)	1.17E-02	Undesignated

Dangerous Waste Criteria - WAC 173-303-100

Substance	Toxic	Persistent		Carcinogenic	
	EC%	HH%	PAH%	Total%	DW Number-Positive
Calcium chromate(VI)	3.52E-09	0.00E+00	0.00E+00	3.52E-06	Undesignated
Calcium nitrate	1.42E-09	0.00E+00	0.00E+00	0.00E+00	
*Magnesium chloride	3.52E-09	0.00E+00	0.00E+00	0.00E+00	
Nickel(II) hydroxide	7.20E-09	0.00E+00	0.00E+00	7.20E-06	Undesignated
Sodium chloride	3.35E-08	0.00E+00	0.00E+00	0.00E+00	
Uranyl nitrate	5.34E-09	0.00E+00	0.00E+00	0.00E+00	
Zinc nitrate	7.99E-08	0.00E+00	0.00E+00	0.00E+00	
Ammonia	9.09E-04	0.00E+00	0.00E+00	0.00E+00	
*1-Butanol	1.20E-10	0.00E+00	0.00E+00	0.00E+00	
Total	9.09E-04	0.00E+00	0.00E+00	1.07E-05	
DW Number	Undesignated	Undesignated	Undesignated	Undesignated	

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

Dangerous Waste Data Designation Report for PUREX Ammonia Scrubber Condensate

Dangerous Waste Constituents - WAC 173-303-9905

Substance
Calcium chromate(VI)
Chromium and compounds,NOS
Nickel 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.

- Calculate the EC% by summing the contributions of each substance.
- Designate the wastestream as a toxic dangerous waste if the EC% is >0.001%, per WAC 173-303-9906.

Nine substances potentially present in the ASD were determined to have toxic categories associated with them. These substances are listed in Table 5-2 along with the individual and sum equivalent concentration values. The EC% based on the random samples is 9.09 E-04. However, in 1987 it was determined from process samples and calculations that the concentration of ammonia has exceeded 0.001% occasionally and, therefore, the wastestream was designated a toxic dangerous waste, with a dangerous waste number of WT02.

The future ASD, after the ammonia destruction process is initiated, is expected to have less than 10% of the toxic limit for ammonia in it, and therefore will not be a toxic dangerous waste. The ASD is currently not active.

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 one-sided 90%CI for the substances of interest (WHC 1990b).
- Calculate the weight percent of each HH and PAH, separately.
- Sum the resulting weight percent contributions to the HH% and PAH%, separately.
- Designate the wastestream as persistent if the HH% concentration is greater than 0.01% or if the PAH% concentration is greater than 1.0%, per WAC 173-303-9907.

No substance present in the PUREX Plant ASD stream were determined to be HH or PAH (see Table 5-2); therefore, the wastestream 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 limit of the one-sided 90%CI for the analytes 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 evaluations based on the concentrations of cations and anions. This methodology is described in the *Wastestream Designation of Liquid Effluent Analytical Data* (WHC 1990b) and is based on an evaluation of the carcinogenic compounds that can exist in an aqueous environment under ambient 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 weight percent concentration for each carcinogen.
- Sum the resulting weight percent.
- Designate the wastestream as carcinogenic if any of the positive carcinogens is above 0.01% or if the total concentration of positive and suspected carcinogens is above 1.0%.

Two chemical compounds potentially present in the PUREX Plant ASD stream were determined to be carcinogenic chemical compounds. The individual and sum percent carcinogens for these chemicals are listed in Table 5-2. Since none of the positive carcinogens exceed 1.00 E-02% (i.e., 0.01%) and the sum is less than 1.0%, the PUREX Plant ASD wastestream is not a carcinogenic dangerous waste. The two postulated contributors to the percent carcinogens are nickel(II) hydroxide and calcium chromate.

5.5 DANGEROUS WASTE CHARACTERISTICS

A waste is a characteristic dangerous waste if it is ignitable, corrosive, reactive, and/or extraction procedure (EP) toxic (WAC 173-303-090). A description of the methods used to manipulate the analytical data is contained in the *Wastestream Designation of Liquid Effluent Analytical Data* (WHC 1990b). Summaries of the methods along with the results are contained in the following subsections.

5.5.1 Ignitability

Because of the dilute aqueous nature of these wastes, flashpoint testing was not performed on initial samples collected from the wastestream; instead, an ignitability index was calculated for the samples and was based on the sum of the percent contributions of all ignitable contributions in the waste. Pure substances with a flashpoint <140 °F were considered ignitable. Using best professional judgment, samples with an ignitability index below 1% were not considered ignitable.

The value of the ignitability index presented in Table 5-2 is $1.20 \text{ E-}06\%$. Therefore, the PUREX Plant ASD stream is not considered to be an ignitable waste.

5.5.2 Corrosivity

A waste is a corrosive dangerous waste if it has a pH of ≤ 2.0 or ≥ 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 .

Because the mean value of the pH measurements for the ASD was above 7.25, the upper confidence interval limit, 9.66, was used. The wastestream is not a corrosive dangerous waste (WAC 173-303-090[6]).

5.5.3 Reactivity

An aqueous waste is reactive if the waste contains an amount of cyanide or sulfide under conditions which could be 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 EPA 1986 provides a more quantitative indicator level for cyanide and sulfide. It states that levels of (equivalent) HCN below 250 ppm or of (equivalent) H_2S below 500 ppm, would not be considered reactive.

For the ASD samples, total cyanide and total sulfide results were used for comparison.

No sulfide or CN^- were found in the sample data as shown in Table 5-2. Therefore this wastestream 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 testing results, total analyte concentrations are used. One analyte with a concentration above detection limits that is on the EP toxic list was found in the PUREX Plant ASD stream (see Table 5-2). The concentration of this analyte, chromium, was $1.17 \text{ E-}02 \text{ mg/L}$ and therefore does not exceed the limit of 5 mg/L. Therefore, the PUREX Plant ASD stream is not an EP toxic dangerous waste.

5.6 PROPOSED DESIGNATIONS

The wastestream has been designated a toxic dangerous waste (WT02) in the past, pursuant to WAC 173-303-070, due to high concentrations of ammonia. The designation process has not uncovered any additional reasons for the ASD to be a dangerous waste. Process modifications are planned including ammonia destruction which is anticipated to result in a future ASD stream that will not be a dangerous waste.

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6.0 ACTION PLAN

This chapter addresses recommendations for future waste characterization tasks for the ASD that are within the scope of the Liquid Effluent Study. The final extent of and schedule for any recommended tasks are subject to negotiation between Ecology, the EPA, and DOE. An implementation schedule for the completion of these tasks will give consideration to other compliance actions already under way 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*, issued November 9, 1988).

6.1 FUTURE SAMPLING

The random sampling conducted during the August 1985 to July 1987 period covered the historical process configuration. The future configuration (following the implementation of the ammonia destruction process) was not sampled. The ammonia destruction process is expected to produce an effluent which will not be a dangerous waste. The future configuration will be sampled upon restart of the ASD stream to verify that the effluent is not a dangerous waste. When the ASD is restarted, it will not be discharged to the environment, but to the Liquid Effluent Retention Facility (LERF), project W-105, discussed in Section 2.3.3.

6.2 TECHNICAL ISSUES

As described in Section 2.0, the effluent was sampled at the 295-A Building. This sample point was chosen because it is a common, accessible location downstream of all the contributing wastestream. With the implementation of the ammonia destruction process and the re-routing of the ASD to the LERF, the 295-A Building will no longer be available for sampling. Consequently, a new sample point will be needed for the characterization of the future ASD.

Much of the water sent to the ammonia destruction system will be derived from condensed steam. Therefore, it is recommended that analyses be performed on steam condensate samples roughly concurrent with the sampling of the future ASD.

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7.0 REFERENCES

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APPENDIX A

FILMEEN MATERIAL SAFETY DATA SHEET

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Figure A-1. Material Safety Data Sheet. (sheet 1 of 2)

Material Safety Data Sheet Emergency Phone
312-438-8241

MSDS # 12387

Section 1 Product Identification

TRADE NAME SUPER FILMEEN 14	PRODUCT TYPE Return line treatment	CODE IDENT 12-174
DOT SHIPPING NAME Compound Boiler Cleansing, Preserving, Scale Removing Liquid		

Section 2 Hazardous Ingredients

Does not contain hazardous constituents under 29 CFR 1910.1200, d(3) & (4).

CAS NUMBER % EXPOSURE CRITERIA

HMS 2-0-0
Section 3 Physical Data

BOILING POINT, 760 mm Hg	ND	MELTING POINT	NA
FREEZING POINT	32 F	VAPOR PRESSURE	ND
SPECIFIC GRAVITY (H ₂ O = 1)	0.98	SOLUBILITY IN H ₂ O	Emulsion
VAPOR DENSITY (AIR = 1)	ND	EVAPORATION RATE, (Bu Ac = 1)	C 1
% VOLATILES BY VOLUME	ND	pH	8-9

APPEARANCE & ODOR

White emulsion/characteristic odor

Section 4 Fire & Explosion Hazard Data

FLASH POINT (METHOD USED)	FLAMMABLE LIMITS IN AIR % BY VOLUME		AUTO IGNITION TEMPERATURE
NA, water-based product	LOWER NA	UPPER NA	NA

EXTINGUISHING MEDIA: **FOAM CO2 DRY CHEMICAL**

SPECIAL FIRE FIGHTING PROCEDURES:

Firefighters should wear full protective gear.

UNUSUAL FIRE AND EXPLOSION HAZARD:

None known

Section 5 Reactivity Data

STABILITY (NORMAL CONDITIONS) Stable	CONDITIONS TO AVOID Extreme heat
--	--

INCOMPATIBILITY (MATERIALS TO AVOID)

Strong oxidizing agents

HAZARDOUS DECOMPOSITION PRODUCTS

CO, CO₂, nitrogen oxides

HAZARDOUS POLYMERIZATION
Will not occur

CONDITIONS TO AVOID
NA

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Figure A-1. Material Safety Data Sheet. (sheet 2 of 2)

Material Safety Data Sheet (continued)

SUPER FULFLEN 14 CONTINUED

Section 6: Health Hazard Information

TOXICITY INFORMATION:

No TLV established for product.

MSDS # 12387

EFFECTS OF OVEREXPOSURE:

- INHALATION: Inhalation of vapors or mist may irritate nasal passages.
- INGESTION: Harmful if swallowed.
- SKIN OR EYE CONTACT: Prolonged or frequent skin contact may cause irritation.

EMERGENCY AND FIRST AID PROCEDURES

- INHALATION: Remove affected persons to fresh air and treat symptoms.
- INGESTION: If conscious, induce vomiting and feed citrus juice. Contact physician.
- SKIN CONTACT: Wash with soap and water. Remove and wash contaminated clothing.
- EYE CONTACT: Flush eyes with water and seek medical attention.

Section 7: Special Protection Information

VENTILATION REQUIREMENTS

Use adequate mechanical ventilation.

RESPIRATORY PROTECTION (SPECIFY TYPE)

None special

EYE PROTECTION

Safety glasses or goggles

GLOVES

Recommended

OTHER PROTECTIVE CLOTHING AND EQUIPMENT

Long sleeve work shirt and pants

Section 8: Spill/Leak Procedures

STEPS TO TAKE IF MATERIAL IS RELEASED OR SPILLED

Collect using absorbent, place in container for proper disposal. Flush area of spill with water.

WASTE DISPOSAL METHOD

Dispose using authorized scavenger service in authorized landfill. For additional disposal instruction, contact your state water pollution control agency. This product is NOT an EPA Hazardous Waste.

Section 9: Special Precautions

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

Keep container closed to prevent contamination or loss of water from emulsion by evaporation. Keep from freezing.

OTHER PRECAUTIONS

For industrial use only. Keep out of reach of children.

PREPARED BY:

S. MORSS

DATE:

6/20/88

The data included herein are presented according to W. R. Grace & Co.'s practices current at the time of preparation hereof, are made available solely for the consideration, investigation and verification of the original recipient hereof and do not constitute a representation or warranty for which Grace assumes legal responsibility. It is the responsibility of a recipient of this data to remain currently informed on chemical hazard information to design and operate its own safety program and to comply with all national, federal, state and local laws and regulations applicable to safety, occupational health, right to know and environmental protection.

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APPENDIX B

DATA FOR PUREX AMMONIA SCRUBBER CONDENSATE

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Table B-1. Data for PUREX Ammonia Scrubber Condensate.
 (sheet 1 of 4)

Constituent	Sample #	Date	Method	Result
Calcium	50006	8/23/85	ICP	7.40E+01
Calcium	50297	5/08/87	ICP	9.80E+01
Calcium	50317	6/23/87	ICP	<5.00E+01
Calcium	50330	7/30/87	ICP	<5.00E+01
Chloride	50006	8/23/85	IC	<3.90E+02
Chloride	50297	5/08/87	IC	5.82E+02
Chloride	50317	6/23/87	IC	<5.00E+02
Chloride	50330	7/30/87	IC	3.22E+03
Chromium	50006	8/23/85	ICP	1.26E+01
Chromium	50297	5/08/87	ICP	<1.00E+01
Chromium	50317	6/23/87	ICP	<1.00E+01
Chromium	50330	7/30/87	ICP	<1.00E+01
Magnesium	50006	8/23/85	ICP	2.10E+01
Magnesium	50297	5/08/87	ICP	<5.00E+01
Magnesium	50317	6/23/87	ICP	<5.00E+01
Magnesium	50330	7/30/87	ICP	<5.00E+01
Nickel	50006	8/23/85	ICP	1.10E+01
Nickel	50297	5/08/87	ICP	<1.00E+01
Nickel	50317	6/23/87	ICP	<1.00E+01
Nickel	50330	7/30/87	ICP	<1.00E+01
Nitrate	50006	8/23/85	IC	7.00E+02
Nitrate	50297	5/08/87	IC	<5.00E+02
Nitrate	50317	6/23/87	IC	<5.00E+02
Nitrate	50330	7/30/87	IC	<5.00E+02
Sodium	50006	8/23/85	ICP	5.33E+02
Sodium	50297	5/08/87	ICP	<1.00E+02
Sodium	50317	6/23/87	ICP	<1.00E+02
Sodium	50330	7/30/87	ICP	3.84E+02
Uranium	50006	8/23/85	FLUOR	2.71E-01
Uranium	50297	5/08/87	FLUOR	2.17E-03
Uranium	50317	6/23/87	FLUOR	2.62E-01
Uranium	50330	7/30/87	FLUOR	1.03E+00
Zinc	50006	8/23/85	ICP	5.30E+01
Zinc	50297	5/08/87	ICP	7.70E+01
Zinc	50317	6/23/87	ICP	<5.00E+00
Zinc	50330	7/30/87	ICP	<5.00E+00
Ammonia	50006	8/23/85	ISE	1.25E+04
Ammonia	50297	5/08/87	ISE	3.75E+04
Ammonia	50317	6/23/87	ISE	5.60E+04
Ammonia	50330	7/30/87	ISE	1.36E+06
1-Butanol	50006	8/23/85	VOA	1.20E+01
Dichloromethane	50006	8/23/85	VOA	<1.00E+01
Dichloromethane	50297	5/08/87	VOA	<1.00E+01
Dichloromethane	50297B	5/08/87	VOA	3.30E+01
Dichloromethane	50317	6/23/87	VOA	<1.00E+01
Dichloromethane	50317B	6/23/87	VOA	1.70E+01

Table B-1. Data for PUREX Ammonia Scrubber Condensate.
(sheet 2 of 4)

Constituent	Sample #	Date	Method	Result
Dichloromethane	50330	7/30/87	VOA	<1.00E+01
Dichloromethane	50330B	7/30/87	VOA	1.30E+01
Alpha Activity (pCi/L)	50006	8/23/85	Alpha	1.26E+00
Alpha Activity (pCi/L)	50297	5/08/87	Alpha	3.11E+01
Alpha Activity (pCi/L)	50317	6/23/87	Alpha	7.78E+01
Alpha Activity (pCi/L)	50330	7/30/87	Alpha	1.01E+01
Beta Activity (pCi/L)	50006	8/23/85	Beta	1.35E+05
Beta Activity (pCi/L)	50297	5/08/87	Beta	1.42E+04
Beta Activity (pCi/L)	50317	6/23/87	Beta	3.53E+03
Beta Activity (pCi/L)	50330	7/30/87	Beta	6.94E+03
Conductivity (μ S)	50006	8/23/85	COND-F1d	1.41E+02
Conductivity (μ S)	50297	5/08/87	COND-F1d	1.18E+02
Conductivity (μ S)	50317	6/23/87	COND-F1d	6.20E+01
Conductivity (μ S)	50330	7/30/87	COND-F1d	3.95E+02
pH (dimensionless)	50006	8/23/85	PH-F1d	9.74E+00
pH (dimensionless)	50297	5/08/87	PH-F1d	8.90E+00
pH (dimensionless)	50317	6/23/87	PH-F1d	9.20E+00
pH (dimensionless)	50330	7/30/87	PH-F1d	9.56E+00
Temperature ($^{\circ}$ C)	50006	8/23/85	TEMP-F1d	3.10E+01
Temperature ($^{\circ}$ C)	50297	5/08/87	TEMP-F1d	2.96E+01
Temperature ($^{\circ}$ C)	50317	6/23/87	TEMP-F1d	2.61E+01
Temperature ($^{\circ}$ C)	50330	7/30/87	TEMP-F1d	4.28E+01
TOC	50006	8/23/85	TOC	7.02E+03
TOC	50297	5/08/87	TOC	<5.50E+02
TOC	50317	6/23/87	TOC	<4.65E+02
TOC	50330	7/30/87	TOC	<6.16E+02

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.

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

Code	Analytical Method	Reference
ABN	Semivolatle Organics (GC/MS)	USEPA-8270
AEA	²⁴¹ 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	⁹⁰ Sr	UST-20Sr02
COLIF	Coliform Bacteria	USEPA-9131

Table B-1. Data for PUREX Ammonia Scrubber Condensate.
(sheet 3 of 4)

Code	Analytical Method	Reference
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-D3549-85
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
LIEPD	¹²⁹ I	UST-20I02
LSC	¹⁴ 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
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.

Table B-1. Data for PUREX Ammonia Scrubber Condensate.
(sheet 4 of 4)

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.

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 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.

In order 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. Since 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 the time.)

Since 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 also 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 Surveillance Results

The following tables present available radiological data on ASD discharges from 1966 through September 1987. The data were obtained from monthly composite samples of the effluent actually released to the environment. The samples were obtained by a flow proportional sampler, and composited monthly using data from the ASD flow instrumentation. The data have been published on a yearly or quarterly basis, and made available to the public. The data have also been published in Volume II of WHC (1989).

At the end of 1984, a change was made in the reporting of plutonium in liquid effluents released to the environment. Prior to that time, plutonium releases were reported in grams per liter. Subsequent to that time, they were reported in microCuries per liter (mCi/L). In producing the following table, the reported concentrations were multiplied by 1,000,000 to yield picoCuries per liter (pCi/L) after 1984, and micrograms per liter (mg/L) prior to 1985. The pre-1985 plutonium results can be converted to pCi/L by multiplying by the specific activity of ^{239}Pu , which is 61,400 pCi/mg.

The graphs which follow the tables present the same data 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 ^{129}I (page B-24) shows only two instances in which ^{129}I was actually detected in the ASD (September 1985 and May 1987). The rest of the line on the ^{129}I graph is merely an upper bound for the actual emissions of ^{129}I through the ASD. In the graphical presentation, the plutonium data are all in pCi/L.

Crib Waste Management System
Wastestream Activity Detail
Units in pCi/L except Volume in L

Stream Code: PH		PUREX Ammonia Scrubber					
Date	H-3	AM-241	I-129	PU-241	PU-239	SN-113	
8211		3.70E+00			9.45E-04		
8305		2.20E+03			1.95E-01		
8307	<2.00E+02						
8308	5.00E+02						
8310	<2.00E+02						
8311	5.00E+05						
8312	1.50E+06						
8401	1.30E+06	<2.00E+02		<5.80E+02	<8.16E-04		
8402	2.60E+06	5.00E+01		5.92E+03	8.32E-03		
8403	2.40E+06	<3.04E+03		3.21E+03	4.52E-03		
8404	1.90E+06	<4.00E+02		3.13E+03	4.40E-03		
8405	1.50E+06	<4.00E+02		4.87E+03	6.85E-03		
8406	1.90E+06	<6.00E+02		9.86E+02	1.39E-03		
8407	2.20E+06	<9.30E+02		7.88E+03	1.11E-02		
8408	1.90E+06	<9.00E+02		4.87E+02	5.85E-04		
8409	4.00E+07	<3.00E+03		8.70E+03	1.22E-02		
8411	1.60E+06	<1.20E+03		1.29E+03	1.81E-03		
8412	1.76E+06	<7.00E+02		1.24E+03	1.75E-03		
8501	3.40E+06	<5.00E+02		4.56E+02	2.85E+01	1.40E+04	
8502	1.60E+06	<1.30E+03		8.32E+02	5.20E+01	1.50E+04	
8503	1.60E+06	<6.00E+02		5.60E+02	3.50E+01	9.40E+03	
8504	2.20E+06	<6.00E+02		1.07E+03	9.90E+01	5.00E+04	
8505	1.70E+06	<1.30E+03	<7.30E+01	5.62E+02	5.20E+01	1.52E+04	
8506	7.80E+05	<1.50E+03	<3.50E+02	4.54E+02	4.20E+01	2.10E+04	
8507	2.10E+06	<4.00E+02	<1.40E+02	4.25E+02	2.62E+01	2.50E+04	
8508	1.60E+06	<6.00E+02	<2.40E+02	6.61E+02	6.30E+01	3.40E+04	
8509	1.80E+06	<1.50E+03	2.66E+01	5.71E+02	6.52E+01	6.80E+04	
8510	9.00E+06	<1.60E+03		7.94E+02	3.10E+01	<1.00E+02	
8511	6.10E+06	<1.80E+03		2.18E+03	8.20E+01	<8.00E+01	
8512	4.70E+06	<1.30E+03		6.23E+04	1.96E+03	<2.20E+02	
8601	1.70E+06	<1.30E+03	<2.00E+01	1.08E+03	1.02E+02	3.30E+04	
8602	2.50E+06	<1.03E+03	<2.00E+01	6.61E+02	6.50E+01	5.90E+04	
8603	2.65E+06	<8.00E+02	<1.00E+01	3.73E+02	3.19E+01	4.30E+04	
8604	2.90E+06	<1.20E+03	<6.00E+01	4.79E+02	4.13E+01	1.30E+04	
8605	3.40E+06	<3.50E+02	<2.00E+01	1.14E+02	1.05E+01	7.10E+02	
8606	1.60E+06	<1.00E+03	<1.00E+02	4.85E+02	4.90E+01	3.00E+04	
8607	2.30E+06	<1.50E+03	<4.00E+01	2.26E+02	2.30E+01	2.20E+04	
8608	2.10E+06	<1.40E+03	<3.00E+01	1.63E+02	1.68E+01	2.30E+04	
8703	5.40E+05	<3.70E+03		1.23E+03	1.27E+02		
8704	1.70E+06	<7.00E+02	<1.01E+02	2.61E+03	1.48E+02		
8705	5.80E+05	<2.00E+02	8.03E+01	1.34E+03	7.11E+01		
8706	1.41E+06	<1.10E+03	<6.36E+01	6.28E+02	<3.30E+01		
8707	1.42E+06	<8.97E+02	<2.36E+01	<5.46E+02	<2.88E+01		
8708	2.27E+06	<5.50E+01	<3.05E+01	1.15E+03	6.35E+01		
8709	9.02E+05	<9.00E+01	<2.24E+01	3.43E+02	1.89E+01		

Table B-2. PUREX Plant ASD Radiological Release History.
(sheet 1 of 4)

Crib Waste Management System
Wastestream Activity Detail
Units in pCi/L except Volume in L

Stream Code: PH		PUREX Ammonia Scrubber								
Date	VOLUME	ALPHA	BETA	SR-90	RU-106	RU-103	CS-137	PM-147	CO-60	U(GROSS)
6612	4.19E+06	4.30E+06	4.20E+09	6.00E+07	2.00E+08		5.00E+07		5.00E+06	1.66E+04
6712	4.94E+06	8.53E+05	5.80E+09	2.50E+07	7.00E+07		1.50E+07		7.00E+06	3.43E+03
6812	1.26E+07	1.19E+06	9.28E+08	1.40E+07	1.61E+07		1.48E+07		8.00E+05	3.43E+03
6912	1.78E+07	4.42E+05	1.79E+09	9.91E+07	4.54E+08		1.10E+08		6.60E+06	2.33E+03
7012	9.88E+06	2.15E+05	1.13E+10	2.29E+08	1.67E+09		1.31E+08		6.30E+06	8.72E+03
7112	2.27E+07	<9.15E+05	7.01E+09	<2.11E+07	3.20E+09		<7.01E+07		<7.10E+06	6.96E+02
7212	2.26E+07	2.95E+06	3.28E+09	9.84E+07	7.73E+08		1.65E+08		<1.86E+07	6.49E+02
8211	1.58E+06	1.87E+02	3.90E+04	3.50E+03			2.70E+04			
8212	7.84E+05	1.30E+01	1.20E+04	9.10E+02			7.60E+03			
8305	1.67E+06	8.12E+03	2.16E+03	2.60E+02			9.20E+02			
8307	1.60E+05	2.33E+02	3.80E+03	5.10E+02			4.84E+03			
8308	1.06E+06	7.40E+01	1.20E+05	1.11E+04			5.01E+04			
8310	1.62E+06	4.18E+02	6.33E+03	9.90E+02			1.24E+03			<1.00E+00
8311	2.61E+06	<4.30E+02	5.40E+03	1.10E+03			1.50E+03			<1.00E+00
8312	2.88E+06	2.20E+02	1.12E+04	2.10E+03			1.60E+03			7.70E+01
8401	5.38E+06	7.40E+01	1.54E+04	2.20E+03	2.90E+03		3.10E+03			1.60E+00
8402	2.31E+06	<1.87E+02	3.10E+05	1.80E+02	8.00E+03		1.60E+01			<2.00E+00
8403	5.30E+06	<3.75E+01	1.40E+05	2.19E+02	6.38E+04		3.01E+03	3.20E+02		<2.00E+00
8404	4.72E+06	<9.62E+01	<2.80E+04	2.57E+02	4.18E+03		1.60E+03	7.10E+03		<2.00E+00
8405	4.66E+06	3.60E+02	2.44E+05	1.21E+03	4.12E+04		6.84E+04	3.98E+03		<2.00E+00
8406	3.43E+06	<3.40E+01	4.53E+05	5.03E+02	2.15E+05		9.48E+02	3.29E+04		<2.00E+00
8407	4.86E+06	<6.29E+01	6.87E+05	6.42E+02	2.58E+05		9.55E+02	8.30E+03		<6.10E+01
8408	6.52E+06	<1.81E+01	3.37E+05	6.84E+02	2.43E+05		1.11E+03	2.00E+03		<2.00E+00
8409	3.67E+06	<1.89E+01	3.66E+05	<4.10E+02	2.20E+05		1.20E+03	<4.00E+03		<2.00E+00
8411	2.40E+06	<2.80E+01	4.74E+05	4.70E+02	2.62E+05		2.72E+03	1.40E+04		<2.30E+00
8412	4.56E+06	6.75E+01	6.71E+05	6.70E+02	3.48E+05		4.32E+03	1.90E+04		<2.00E+00
8501	7.18E+06	<8.60E+01	9.42E+05	4.70E+02	5.12E+05	7.47E+03	3.51E+03	2.10E+05		
8502	4.99E+06	<1.81E+02	8.05E+05	4.50E+02	4.20E+05	9.95E+03	1.72E+03	2.50E+04		
8503	5.41E+06	<5.03E+02	8.93E+05	7.09E+02	3.71E+05	3.31E+04	1.41E+03	4.64E+04		
8504	5.65E+06	<5.26E+02	9.62E+05	6.30E+02	6.24E+05	1.56E+05	2.42E+03	<4.00E+02		
8505	4.17E+06	<7.37E+01	3.73E+05	2.31E+03	2.83E+05	4.84E+04	7.76E+03	<4.00E+02		
8506	3.59E+06	<8.60E+01	4.27E+05	2.62E+03	2.82E+05	3.91E+04	4.21E+03	3.80E+03		
8507	1.02E+07	<1.17E+01	4.74E+05	1.10E+03	4.52E+05	7.15E+04	4.80E+03	5.00E+04		
8508	8.67E+06	<1.14E+02	6.01E+05	1.82E+03	3.82E+05	8.95E+04	3.61E+03	3.50E+04		
8509	4.78E+06	<5.50E+01	6.80E+05	1.70E+03	3.74E+05	1.33E+05	1.50E+03	3.10E+04		
8510	5.16E+06	<8.80E+01	8.71E+04	1.53E+03	6.63E+04	6.92E+03	9.31E+03	1.60E+04		
8511	8.76E+06	<1.31E+02	5.42E+04	9.20E+02	3.32E+04	1.65E+03	7.60E+03	<1.00E+02		
8512	6.83E+06	2.90E+03	1.24E+06	3.41E+05	2.30E+05	8.13E+02	6.50E+04	1.10E+05		
8601	3.77E+06	<4.31E+02	8.40E+05	1.32E+04	3.53E+05	7.08E+04	9.74E+02	3.00E+03		
8602	6.17E+06	<8.00E+02	1.25E+06	3.53E+03	6.19E+05	1.34E+05	1.51E+03	4.40E+04		
8603	8.43E+06	<7.45E+02	1.17E+06	4.57E+03	5.26E+05	6.57E+04	4.61E+03	1.90E+04		
8604	8.77E+06	<7.99E+01	7.16E+05	4.02E+03	3.09E+05	2.04E+04	7.60E+03	2.00E+04		
8605	5.25E+06	<8.20E+01	5.35E+05	4.22E+03	2.91E+05	2.03E+03	1.60E+04	4.80E+04		
8606	6.51E+06	<7.16E+02	8.89E+05	3.32E+03	4.59E+05	5.00E+04	9.11E+03	2.00E+04		
8607	1.01E+07	<1.82E+02	7.20E+05	1.45E+03	3.50E+05	1.11E+04	5.02E+03	8.40E+04		

Table B-2. PUREX Plant ASD Radiological Release History.
(sheet 2 of 4)

Table B-2. PUREX Plant ASD Radiological Release History.
 (sheet 3 of 4)

Crib Waste Management System
 Wastestream Activity Detail
 Units in pCi/L except Volume in L

Stream Code: PH		PUREX Ammonia Scrubber								
Date	VOLUME	ALPHA	BETA	SR-90	RU-106	RU-103	CS-137	PM-147	CO-60	U(GROSS)
8608	7.53E+06	<6.97E+01	6.43E+05	9.20E+02	3.08E+05	1.38E+04	4.61E+03	2.00E+04		
8703	1.95E+06	6.81E+01	7.69E+04	4.24E+03	4.79E+04	<6.00E+01	3.72E+03	3.80E+03		
8704	2.33E+06	<1.24E+02	8.25E+04	8.33E+02	7.51E+04	<5.70E+01	4.31E+03	3.80E+03		
8705	2.40E+06	<4.99E+01	3.80E+04	2.02E+03	1.59E+04	<4.20E+01	5.20E+03	7.00E+02		
8706	1.28E+06	<3.80E+01	4.14E+04	7.65E+02	1.83E+04	<4.47E+01	3.20E+03	4.70E+03		
8707	8.38E+06	<1.34E+02	2.19E+04	4.21E+02	8.18E+03	<3.77E+01	3.23E+03	1.05E+03		
8708	6.42E+06	<5.10E+01	1.07E+04	4.70E+02	3.00E+03	<3.62E+01	2.68E+03	1.50E+03		
8709	5.38E+06	<6.91E+01	8.87E+03	4.22E+02	2.17E+03	<3.47E+01	2.79E+03	4.45E+02		

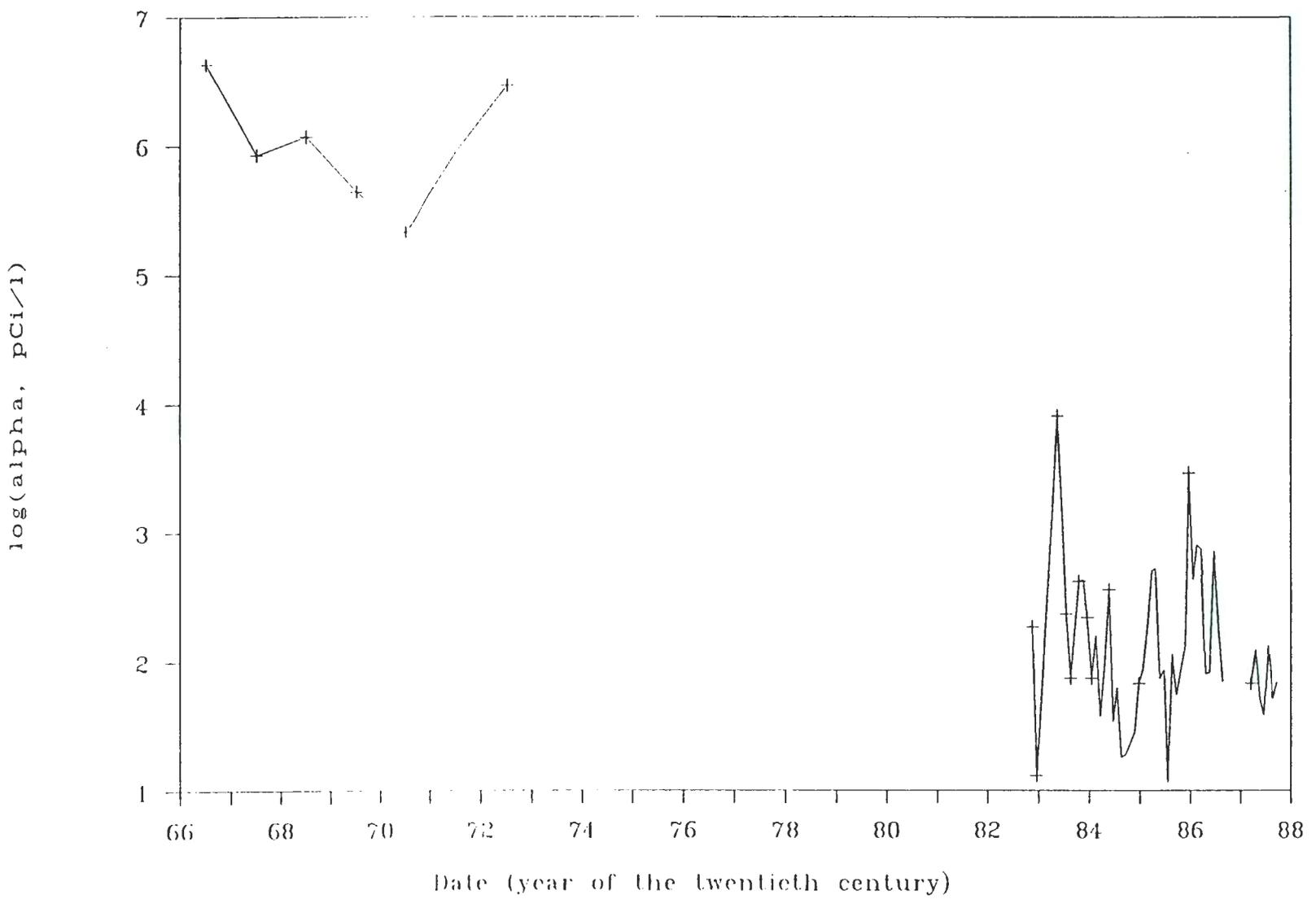
Table B-2. PUREX Plant ASD Radiological Release History.
(sheet 4 of 4)

Crib Waste Management System
Wastestream Activity Detail
Units in pCi/L except Volume in L

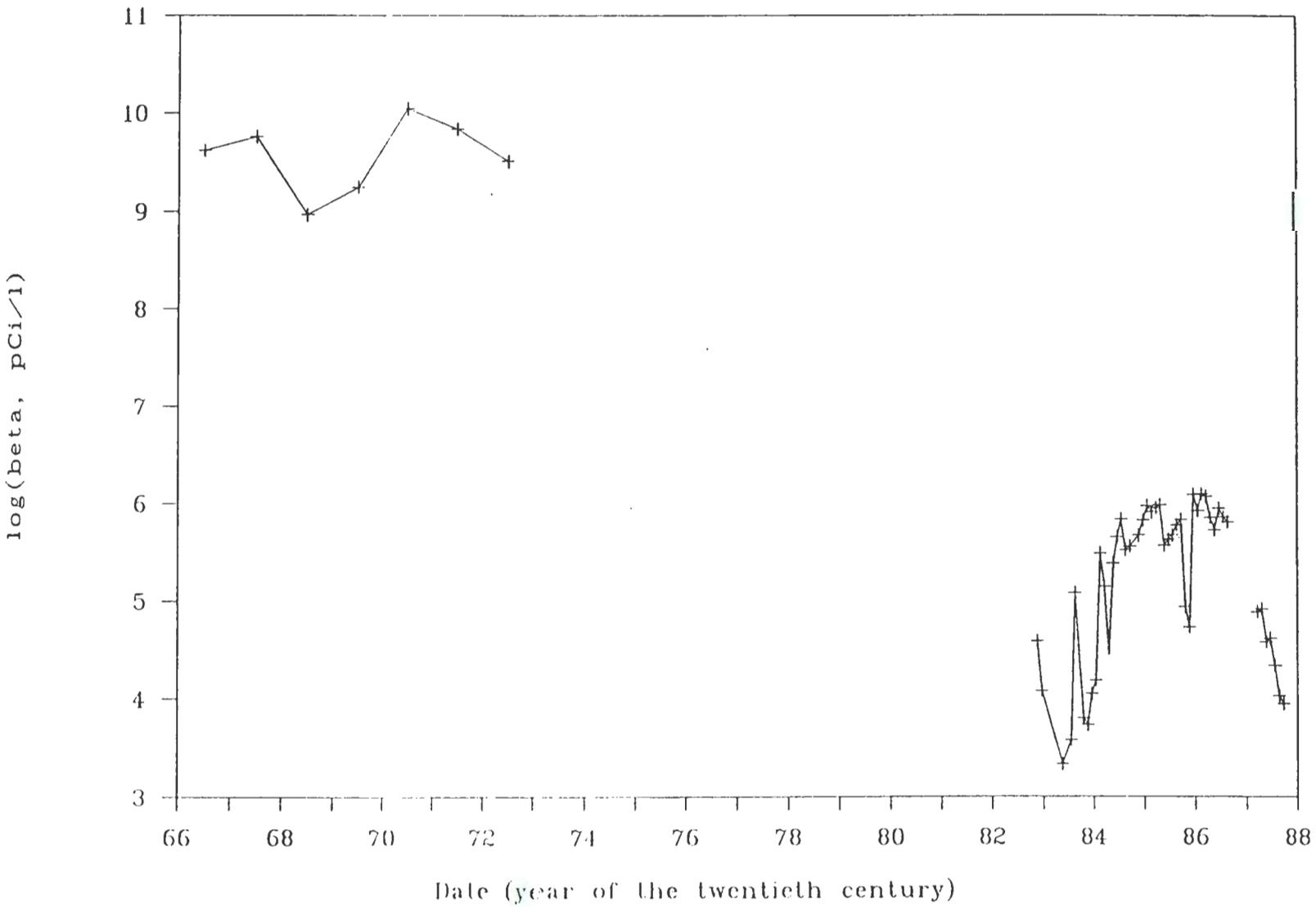
Stream Code: PH	PUREX Ammonia Scrubber					
Date	H-3	AM-241	I-129	PU-241	PU-239	SN-113
Total volume:	3.15E+08					

0 1 1 1 1 5 1 1 0 3

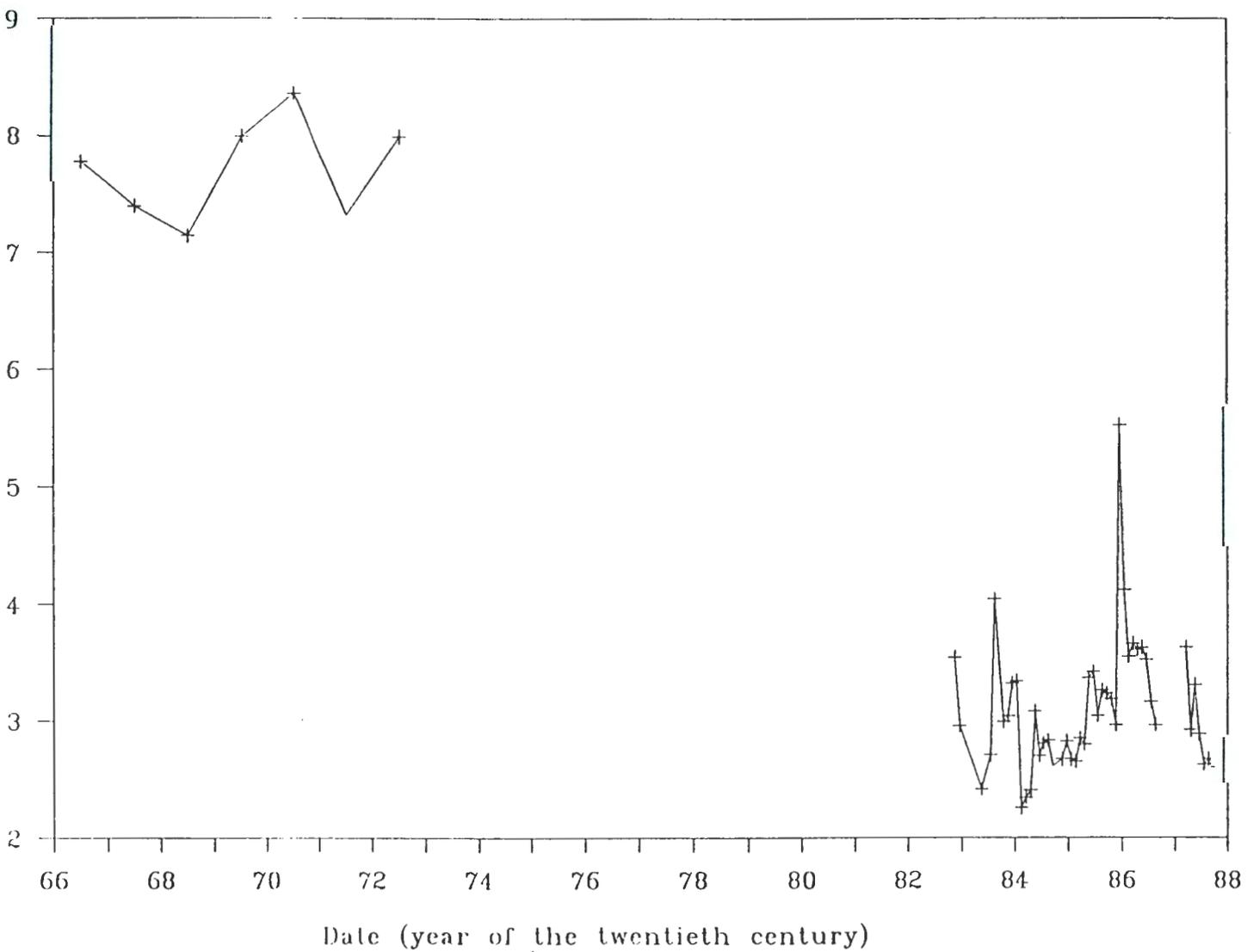
PUREX Plant ASD Radiological Release History
Alpha Emitting Nuclides.



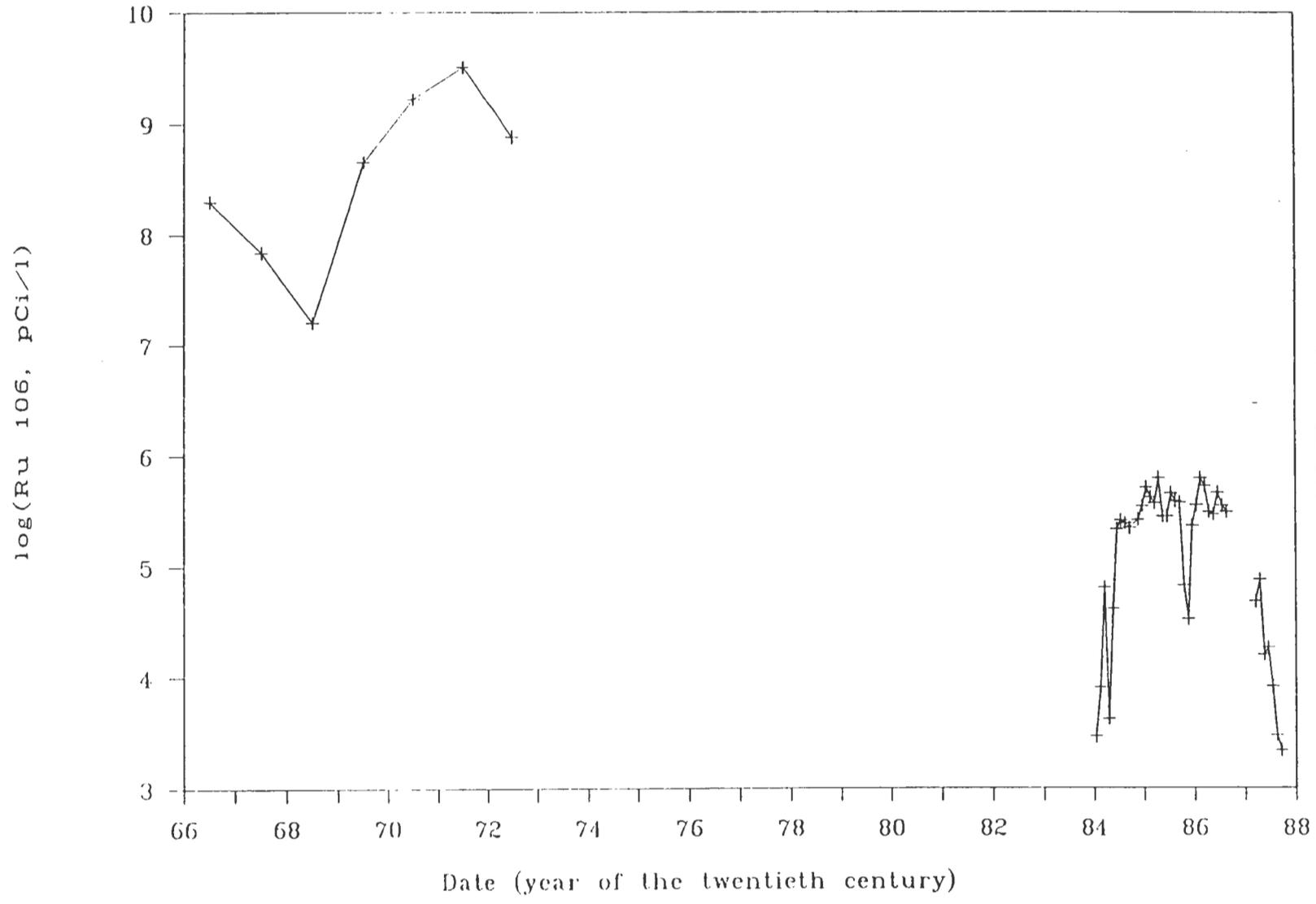
PUREX Plant ASD Radiological Release History
Beta Emitting Nuclides.



PUREX Plant ASD Radiological Release History
Strontium 90.

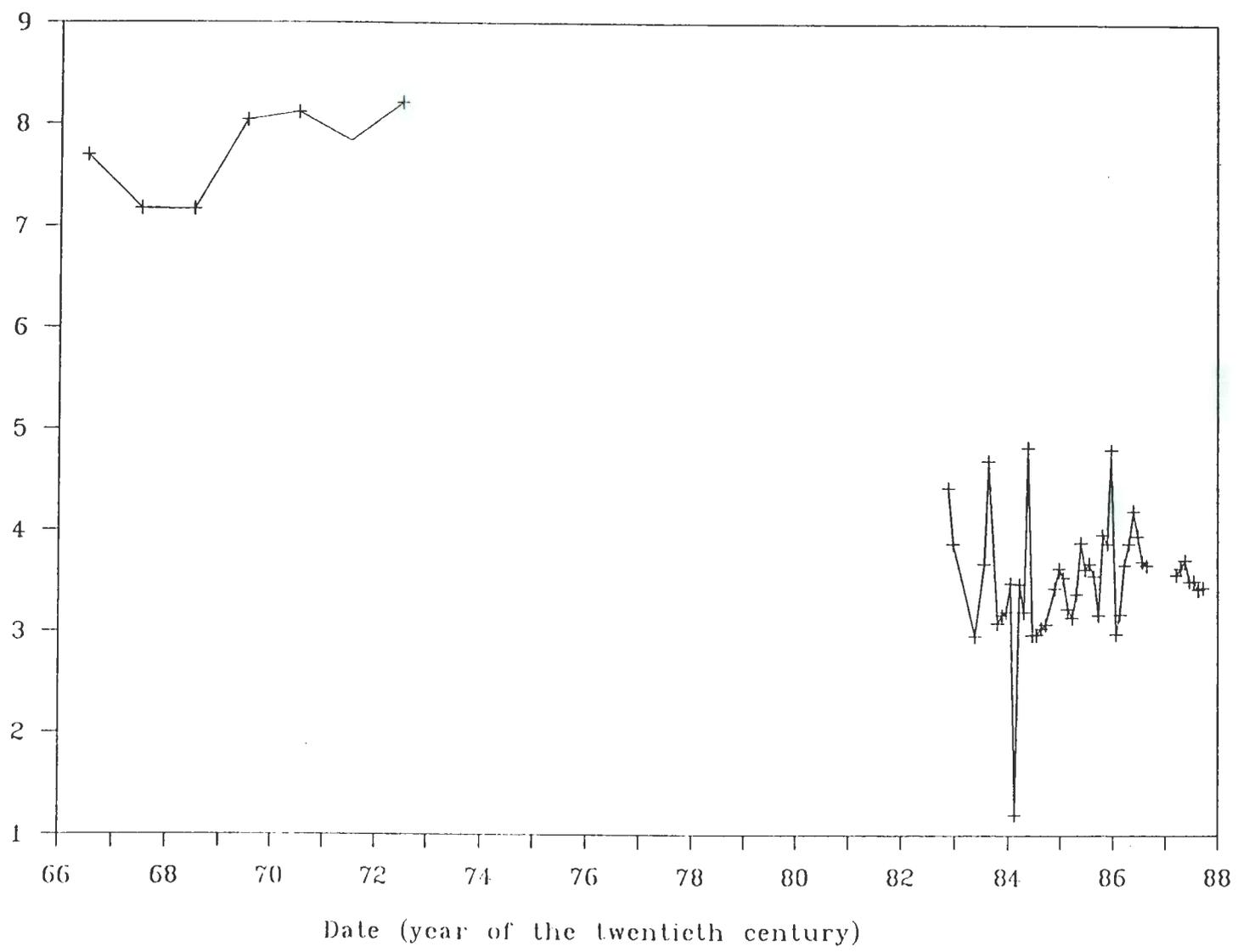


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Ruthenium 106.



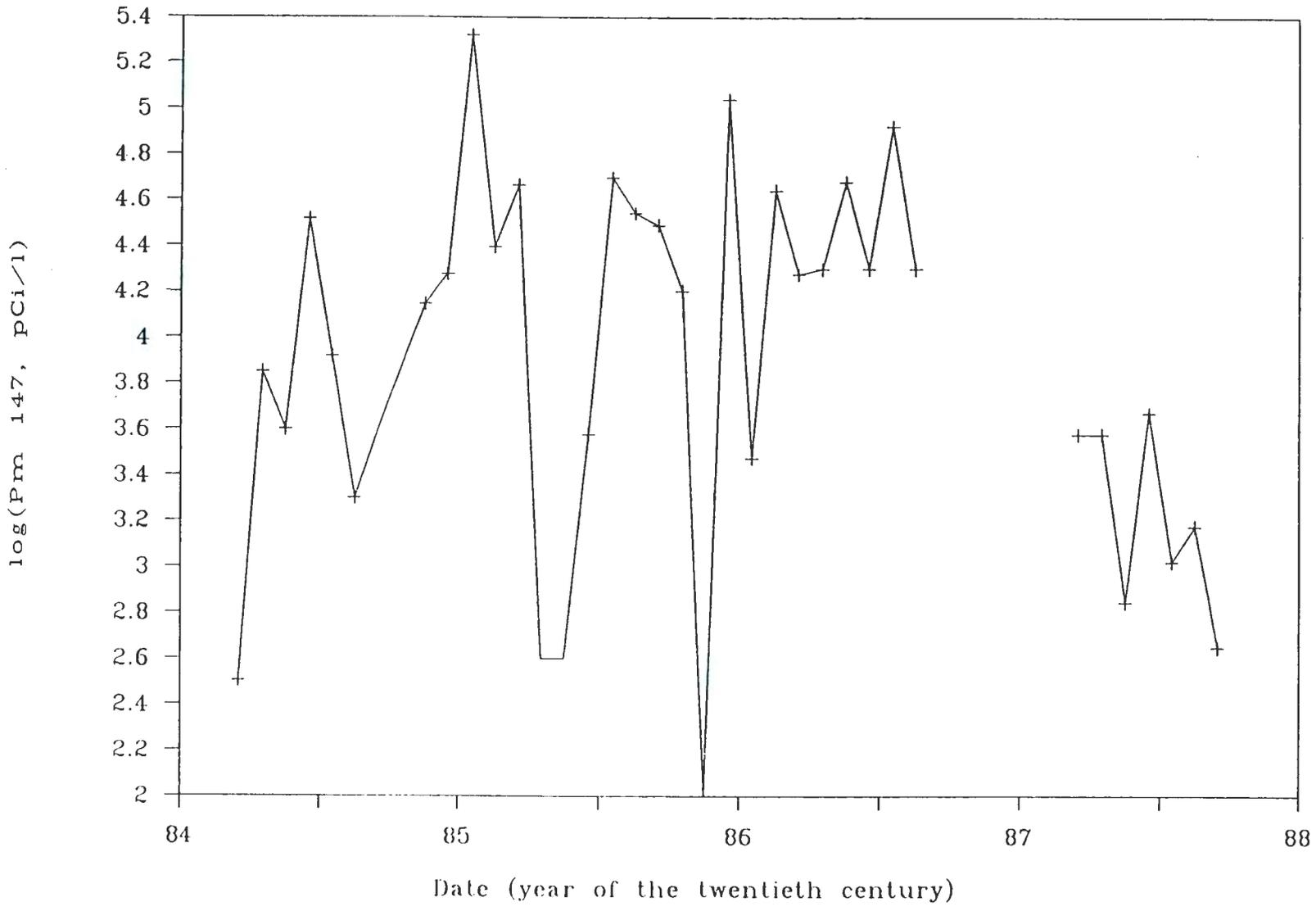
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PUREX Plant ASD Radiological Release History
Cesium 137.



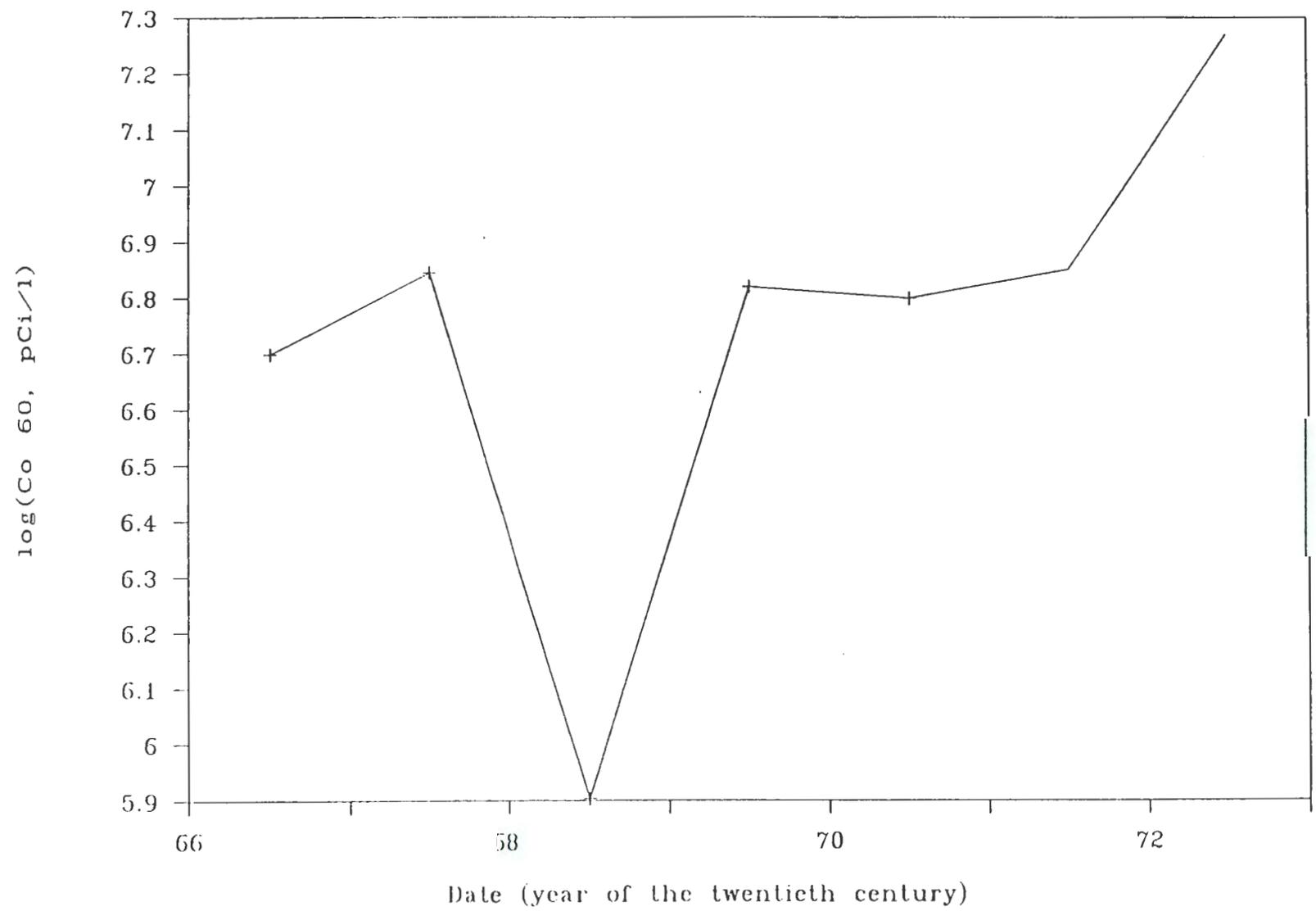
(l/r/r)Cs 137, pCi/l

B-19

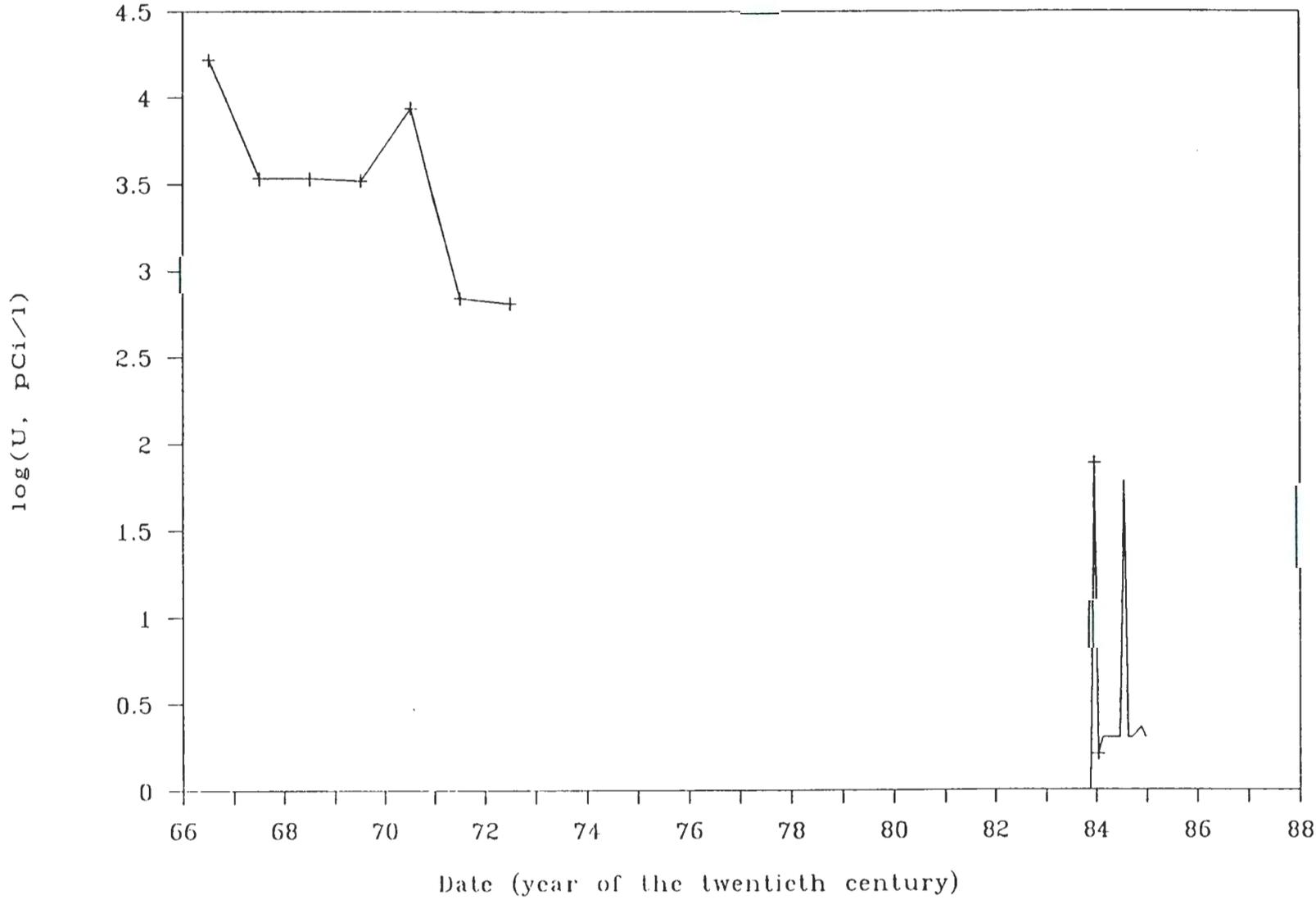


PUREX Plant ASD Radiological Release History
Promethium 147.

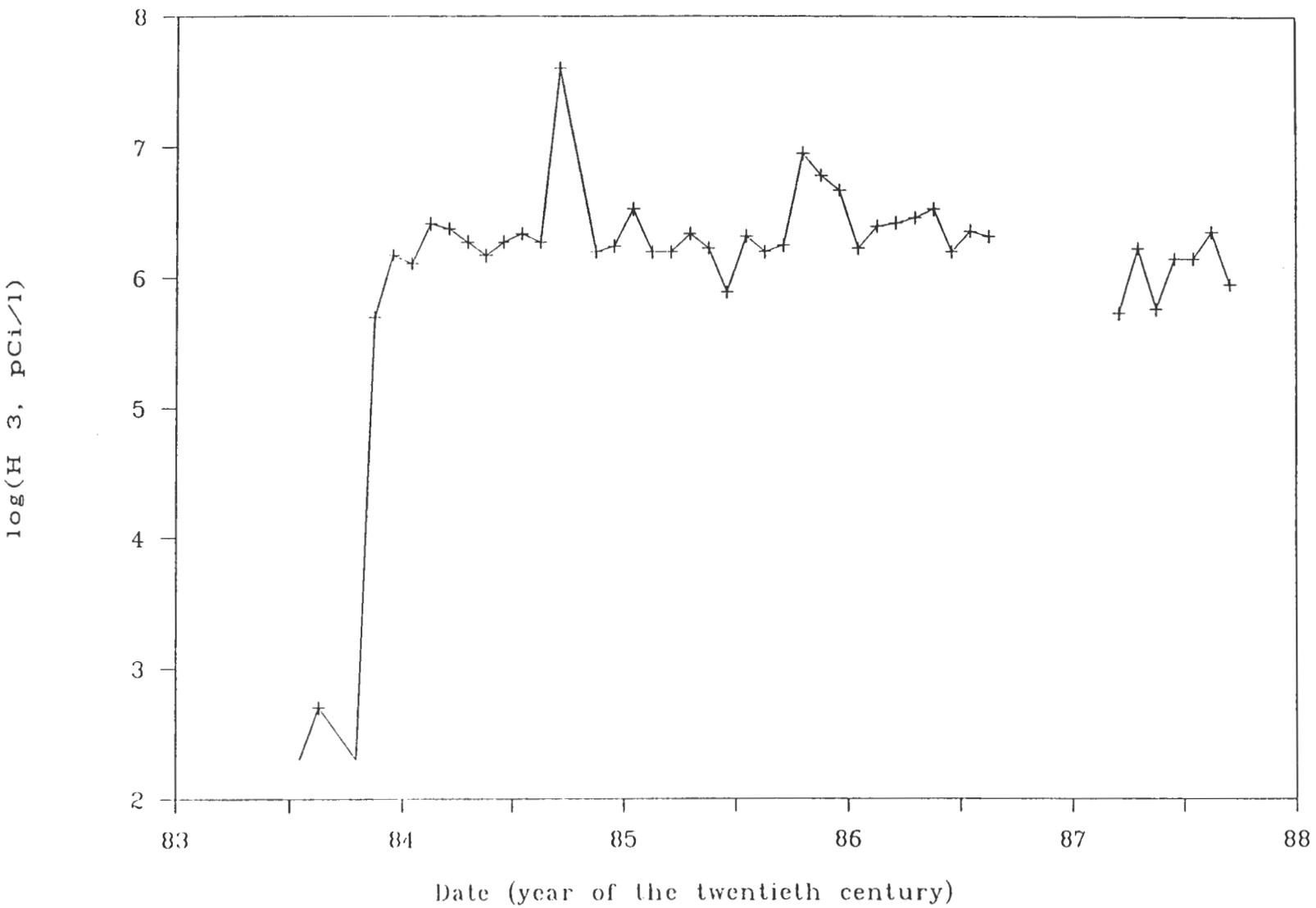
PUREX Plant ASD Radiological Release History
Cobalt 60.



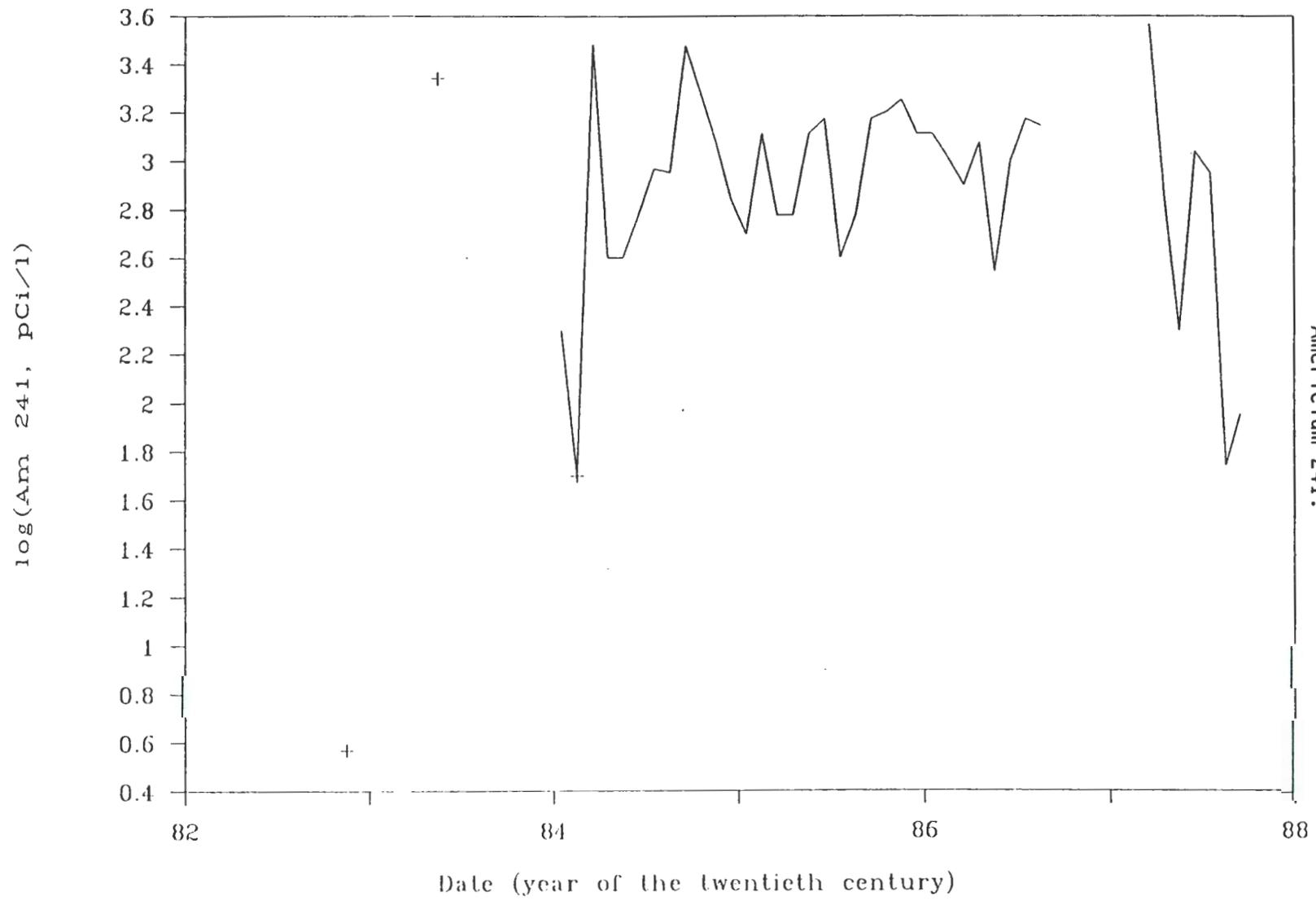
PUREX Plant ASD Radiological Release History
Gross Uranium.



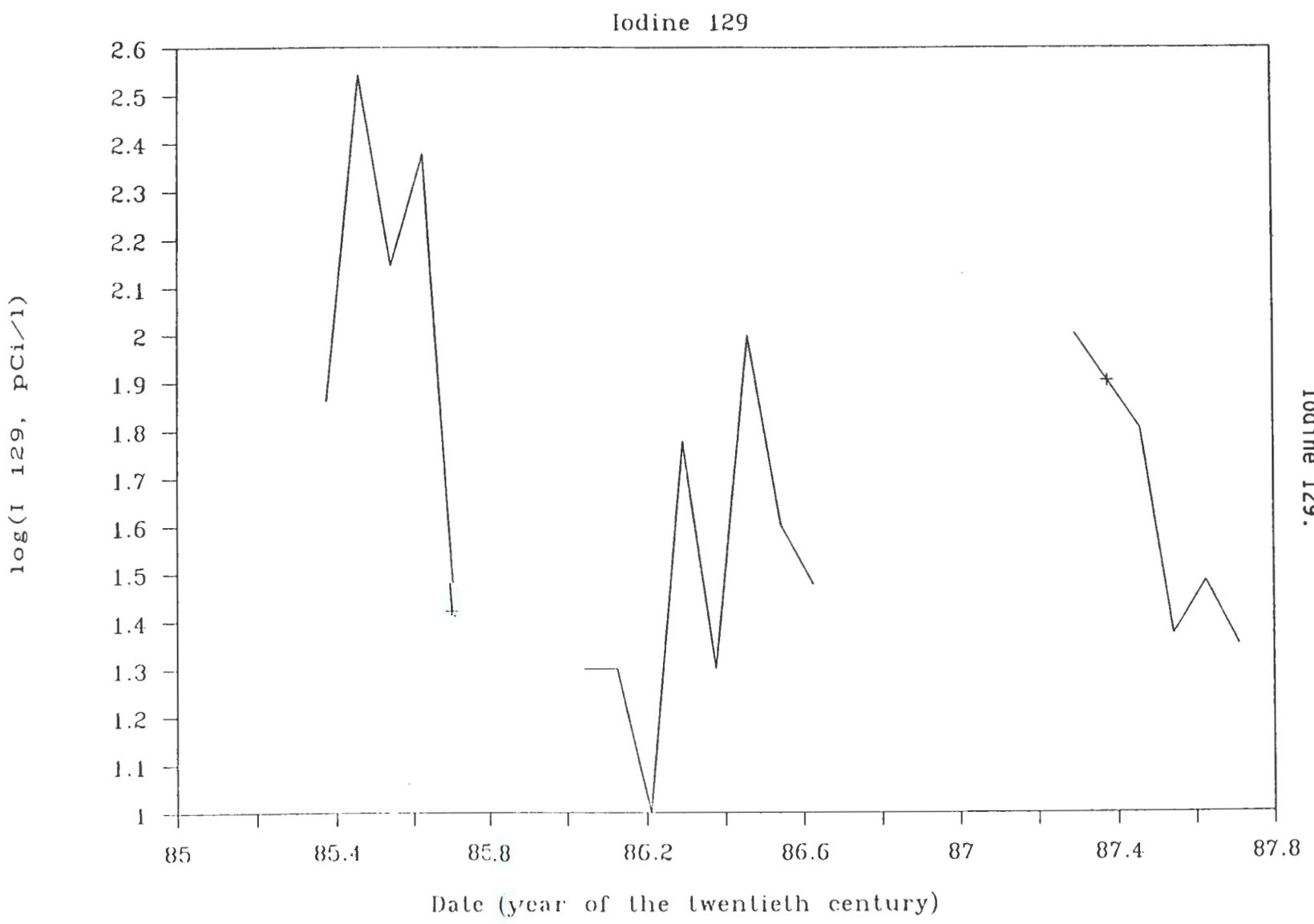
PUREX Plant ASD Radiological Release History
Tritium.



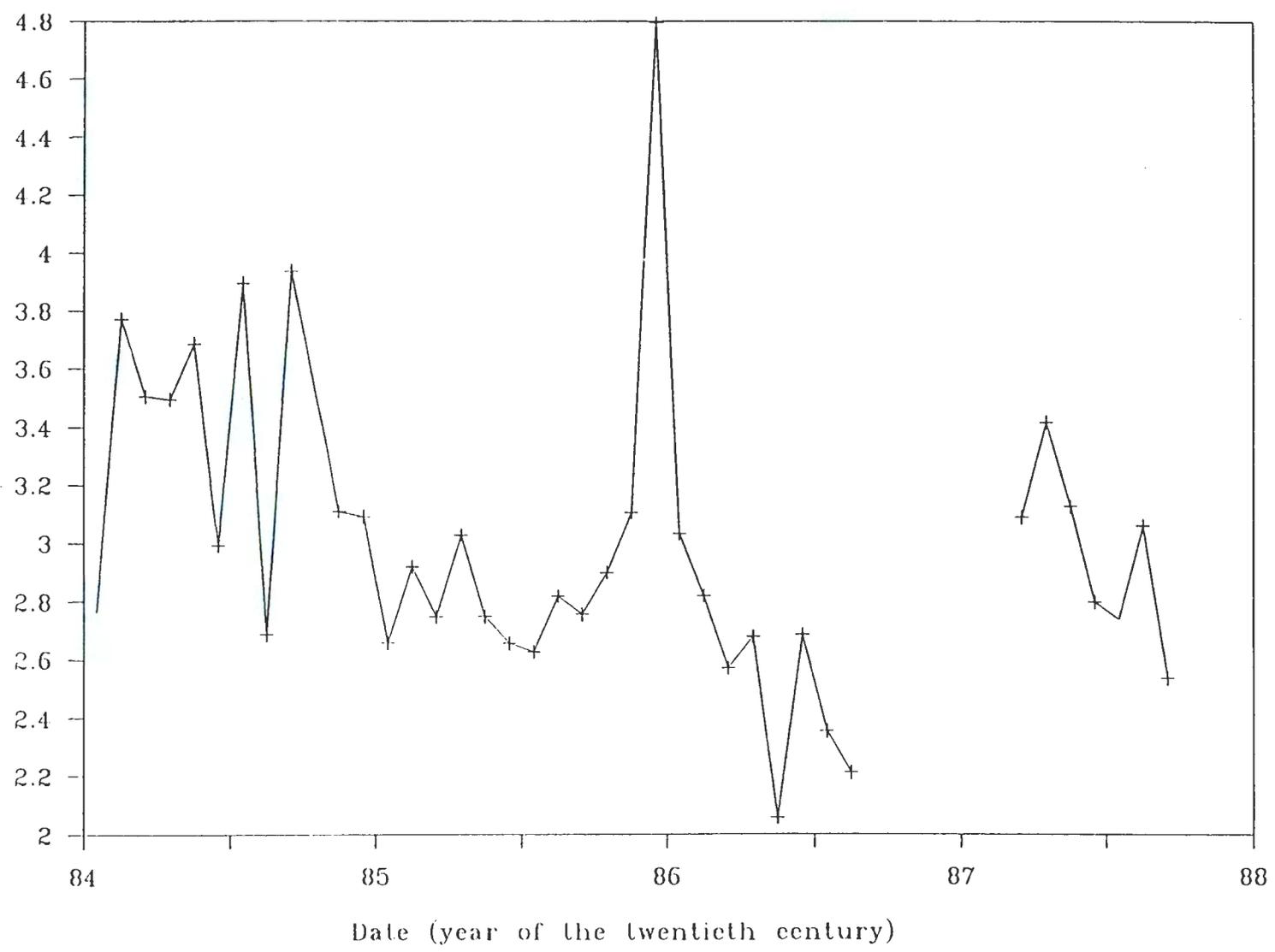
PUREX Plant ASD Radiological Release History
Americium 241.



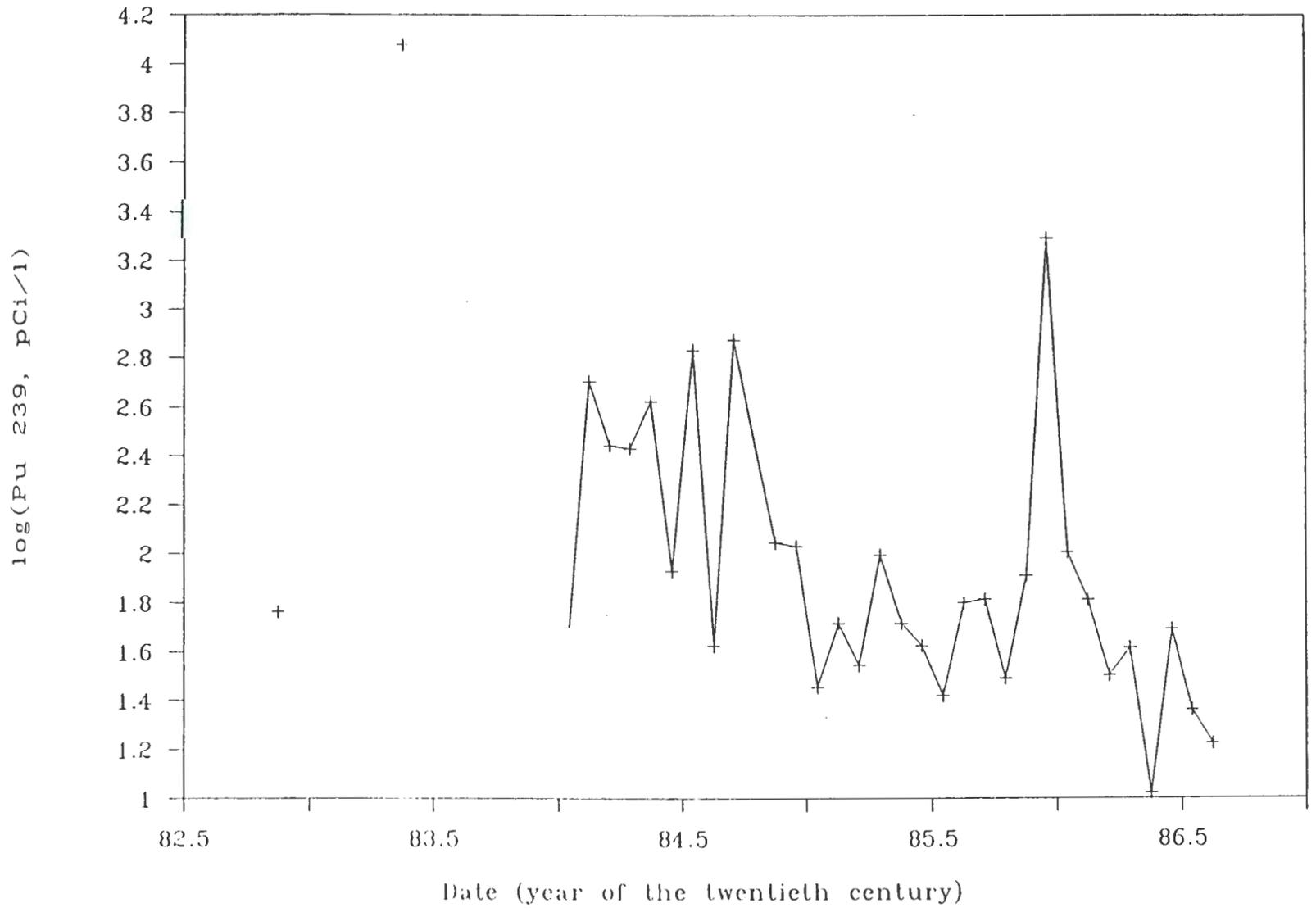
PUREX Plant ASD Radiological Release History
Iodine 129.



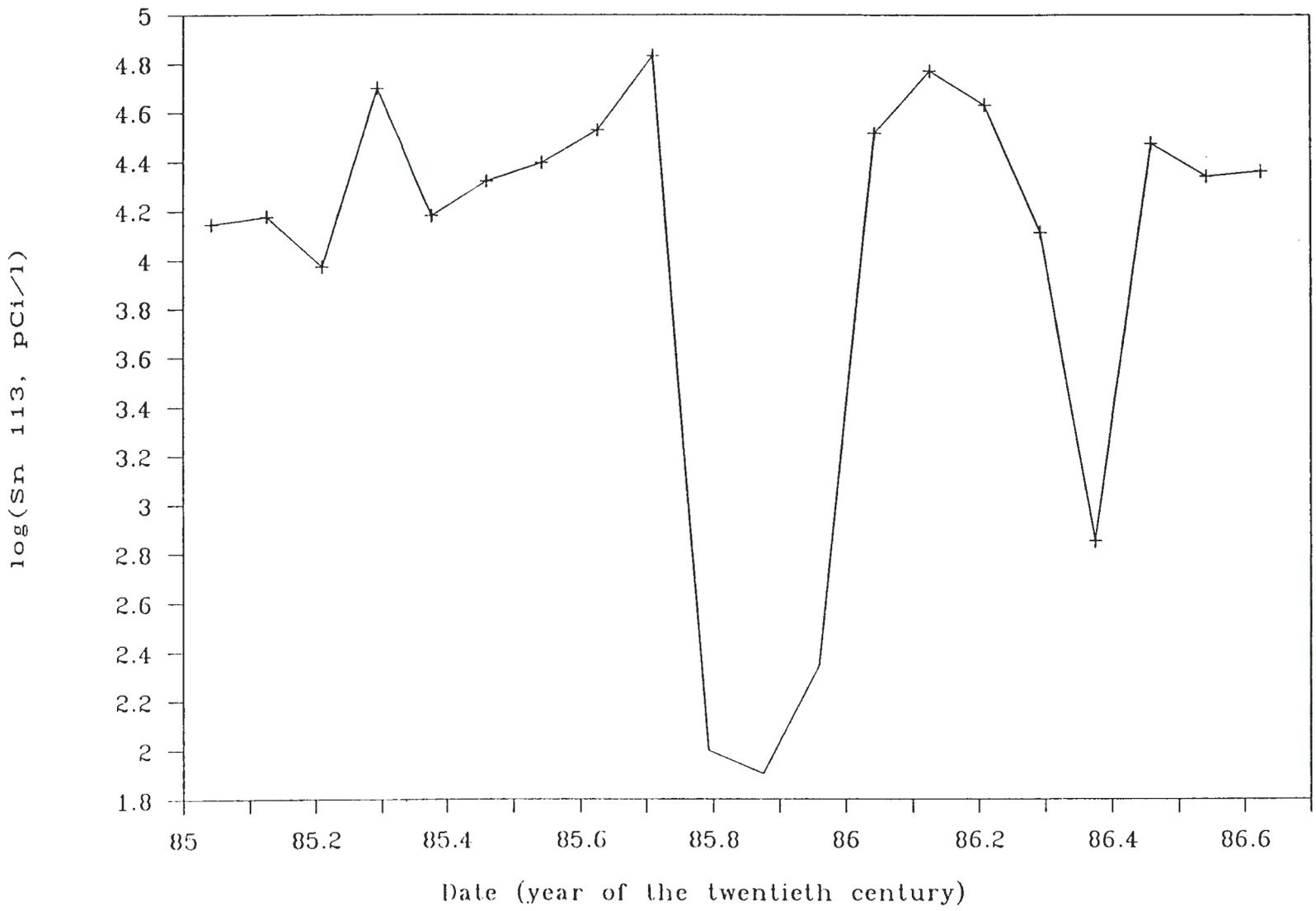
PUREX Plant ASD Radiological Release History
Plutonium 241.



PUREX Plant ASD Radiological Release History
Plutonium 239.



PUREX Plant ASD Radiological Release History
Tin 113.



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Table C-1. 200 East Area Raw Water. (sheet 1 of 2)

Sample	1st	2nd	3rd	4th
Sampling date	4/24/86	9/04/86	10/10/86	3/27/87
US Testing Number	50033	50127	50151	50269
Stream Fraction	1.0000	1.0000	1.0000	1.0000
Aluminum	<1.5 E+02	<1.5 E+02	<1.5 E+02	<1.5 E+02
Ammonium	NIC	<5.0 E+01	<5.0 E+01	<5.0 E+01
Antimony	<1.0 E+02	<1.0 E+02	<1.0 E+02	<1.0 E+02
Barium	3.2 E+01	2.7 E+01	2.4 E+01	2.6 E+01
Beryllium	<5.0 E+00	<5.0 E+00	<5.0 E+00	<5.0 E+00
Cadmium	<2.0 E+00	<2.0 E+00	<2.0 E+00	<2.0 E+00
Calcium	2.0 E+04	1.8 E+04	NIC	2.0 E+04
Chromium	<1.0 E+01	<1.0 E+01	<1.0 E+01	<1.0 E+01
Copper	<1.0 E+01	1.3 E+01	1.0 E+01	<1.0 E+01
Iron	NIC	<5.0 E+01	1.1 E+02	<5.0 E+01
Lead	NR	NR	<5.0 E+00	<5.0 E+00
Magnesium	4.8 E+03	4.0 E+03	3.7 E+03	4.7 E+03
Manganese	6.0 E+00	8.0 E+00	1.4 E+01	8.0 E+00
Mercury	<1.0 E-01	HTE	<1.0 E-01	<1.0 E-01
Nickel	<1.0 E+01	<1.0 E+01	<1.0 E+01	<1.0 E+01
Potassium	8.9 E+02	8.1 E+02	7.5 E+02	8.1 E+02
Silver	<1.0 E+01	<1.0 E+01	<1.0 E+01	<1.0 E+01
Sodium	NIC	2.4 E+03	1.9 E+03	2.1 E+03
Strontium	<3.0 E+02	<3.0 E+02	<3.0 E+02	<3.0 E+02
Uranium	7.6 E-01	6.6 E-01	1.0 E+00	4.8 E-01
Vanadium	<5.0 E+00	<5.0 E+00	<5.0 E+00	<5.0 E+00
Zinc	5.7 E+01	7.0 E+00	6.0 E+00	1.2 E+01
Chloride	7.1 E+02	7.3 E+02	6.7 E+02	1.2 E+03
Cyanide	<1.0 E+01	<1.0 E+01	<1.0 E+01	<1.0 E+01
Fluoride	<5.0 E+02	<5.0 E+02	<5.0 E+02	<5.0 E+02
Nitrate	2.5 E+03	<5.0 E+02	<5.0 E+02	<5.0 E+02
Phosphate	<1.0 E+03	<1.0 E+03	<1.0 E+03	<1.0 E+03
Sulfide	HTE	<1.0 E+03	HTE	<1.0 E+03
Sulfate	1.2 E+04	9.6 E+03	9.5 E+03	1.1 E+04
Amount (L/month)	2.1 E+09	2.1 E+09	2.1 E+09	2.1 E+09
pH (dimensionless)	7.98	7.00	8.05	5.54
Temperature (°C)	11.1	22.4	19.4	9.2
Alpha activity (pCi/L)	1.1 E+00	4.2 E-01	1.6 E+00	<5.2 E-01

Table C-1. 200 East Area Raw Water. (sheet 2 of 2)

Sample	1st	2nd	3rd	4th
Sampling date	4/24/86	9/04/86	10/10/86	3/27/87
US Testing Number	50033	50127	50151	50269
Stream Fraction	1.0000	1.0000	1.0000	1.0000
Beta (pCi/L)	4.2 E+00	4.6 E+00	6.7 E+00	<2.4 E+00
Conductivity (μ S/cm)	1.3 E+01	1.1 E+02	1.2 E+01	1.0 E+02
TOC (ppb)	1.7 E+03	1.6 E+03	1.1 E+03	1.3 E+03
TOX (ppb)	1.1 E+01	<6.0 E+00	<1.0 E+02	<2.0 E+01

NOTES: Analyte concentrations are in ppb. Result notations include data that were not recorded (NR), measurements that were not in control (NIC) at the time of measurement, and measurements made after holding times were exceeded (HTE).

Table C-2. Columbia River Water Radiological
 Background Data Summary of Radiological
 Background Analytes (units are pCi/L).

Analyte	N	Mean	U90%CI
Alpha activity	12	3.1 E-01	4.5 E-01
Beta activity	12	9.6 E-01	1.3 E+00
⁹⁰ Sr	12	1.0 E-01	1.2 E-01
¹³⁷ Cs	20	4.0 E-03	4.9 E-03
⁶⁰ Co	20	1.5 E-03	4.9 E-03
Uranium (total)	12	3.7 E-01	4.0 E-01
Tritium	12	7.0 E+01	7.5 E+01
²³⁹ Pu	12	6.0 E-05	1.0 E-04

N = number of samples.
 U90%CI = upper 90% confidence level.

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