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WHC-EP-0342
Addendum 19

UO_3 Plant Process Condensate Stream-Specific Report

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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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UO_3 Plant Process Condensate Stream-Specific Report

W. E. Toebe
D. C. Hedengren
J. H. E. Rasmussen

Date Published
August 1990

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

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UO_3 PLANT PROCESS CONDENSATE

W. E. Toebe
D. C. Hedengren
J. H. E. Rasmussen

ABSTRACT

The proposed wastestream designation for the UO_3 Plant Process Condensate wastestream is that this stream is not a dangerous waste, pursuant to the Washington (State) Administration Code (WAC) 173-303, Dangerous Waste Regulations.* *A combination of process knowledge and sampling data was used to make this determination.*

---

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

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EXECUTIVE SUMMARY

The proposed wastestream designation for the UO_3 Plant Process Condensate (located in the 200 West Area) is that this stream is not a dangerous waste, pursuant to the Washington (State) Administrative Code (WAC) 173-303, *Dangerous Waste Regulations*.* A combination of process knowledge and sampling data was used to determine if the effluent contains a listed dangerous waste (WAC 173-303-080). Sampling data alone are used to assess the stream in accordance with the dangerous waste criteria (WAC 173-303-100) and dangerous waste characteristics (WAC 173-303-090).

In July 1989, discharges to the 216-U-17 crib were temporarily suspended by Westinghouse Hanford Company. This conservative action was taken following a review of the process condensate stream characterization data which revealed the presence of part-per-billion concentrations of organic species, including butanol, acetone, and 2-butanone. Given the sensitivity of the listed waste issue, it was felt that the prudent approach would be to store the condensate at the UO_3 Plant on an interim basis until such time as the investigation of the source of contaminants could be completed and a determination made regarding the regulatory status of this wastestream. A separate study (WHC 1990b) documents the source of these contaminants as trace processing impurities sent with uranyl nitrate hexahydrate from the Plutonium-Uranium Extraction (PUREX) Plant. Information from this study was used for assessment of this stream.

---

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

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LIST OF TERMS

90%CI	90 percent confidence interval
BAT	best available technology
DB	dibasic
DCG	derived concentration guidelines
DOE	U.S. Department of Energy
DWS	drinking water standards
EC	equivalent concentration
EC%	percent equivalent concentration
Ecology	Washington State Department of Ecology
EP	extraction procedure
EPA	U.S. Environmental Protection Agency
HEPA	high-efficiency particulate air (filter)
HH	halogenated hydrocarbons
HVAC	heating, ventilation, and air conditioning
IC	ion chromatography
ISE	ion-specific electrode
MB	monobasic
MCL	maximum contaminant levels
MSDS	Material Safety Data Sheets
MTU	metric tons of uranium
NPH	normal paraffin hydrocarbon
PAH	polycyclic aromatic hydrocarbons
PUREX	Plutonium-Uranium Extraction
RCRA	*Resource, Conservation, and Recovery Act*
REDOX	reduction oxidation
SARA	*Superfund Amendments and Reauthorization Act*
SC	specific carcinogen
TB	tribasic
TBP	tributyl phosphate
TC	total carcinogen
UNH	uranyl nitrate hexahydrate
WAC	Washington (State) Administrative Code
Westinghouse Hanford	Westinghouse Hanford Company

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CONTENTS

1.0 INTRODUCTION 1-1
1.1 BACKGROUND 1-1
1.2 APPROACH 1-1
1.3 SCOPE 1-4

2.0 PROCESS KNOWLEDGE 2-1
2.1 PHYSICAL LAYOUT 2-1
2.1.1 UO_3 Plant Process Facilities 2-1
2.1.2 Process Condensate Handling Facilities 2-5
2.2 CONTRIBUTORS 2-5
2.2.1 Contributions From Process Off-gas Condensates . . . 2-9
2.2.2 Contribution From Sanitary Water 2-10
2.2.3 Phosphoric Acid and Potassium Hydroxide Addition to Process Condensate 2-10
2.3 PROCESS ACTIVITIES 2-11
2.3.1 Present Activities 2-11
2.3.2 Past Activities 2-11
2.3.3 Future Activities 2-18
2.4 PROCESS DATA 2-18
2.4.1 Overall Stream Data 2-18
2.4.2 Feed Uranyl Nitrate Hexahydrate Concentrator Off-gas 2-19
2.4.3 Calciner Off-gas 2-20
2.4.4 Recycle Uranyl Nitrate Hexahydrate Concentrator Off-gas 2-24
2.4.5 Steam From 284-W Powerhouse 2-27
2.4.6 Fumes From Miscellaneous Process Vessel Vents 2-27
2.4.7 Sanitary Water 2-27
2.4.8 Phosphoric Acid 2-27
2.4.9 Potassium Hydroxide 2-28
2.5 ADMINISTRATIVE CONTROLS 2-30
2.5.1 General UO_3 Plant Process Condensate Management . . . 2-30
2.5.2 General Requirements 2-30
2.5.3 Specific Requirements 2-30
2.5.4 Diligent Search 2-31

3.0 SAMPLE DATA 3-1
3.1 DATA SOURCE 3-1
3.1.1 Wastestream Sampling Data 3-1
3.1.2 Background Data 3-2
3.2 DATA PRESENTATION 3-2

4.0 DATA OVERVIEW 4-1
4.1 DATA COMPARISON 4-1
4.2 STREAM DEPOSITION RATES 4-1

5.0 DESIGNATION 5-1
5.1 DANGEROUS WASTE LISTS 5-1
5.1.1 Discarded Chemical Product 5-1
5.1.2 Dangerous Waste Sources 5-3

CONTENTS (continued)

5.2 LISTED WASTE DATA CONSIDERATIONS 5-3
5.2.1 Process Evaluation 5-3
5.2.2 Sampling Data 5-4
5.3 PROPOSED LISTED WASTE DESIGNATION 5-5
5.3.1 Discarded Chemical Products 5-5
5.3.2 Dangerous Waste Sources 5-14
5.4 DANGEROUS WASTE CRITERIA 5-15
5.4.1 Toxic Dangerous Wastes 5-15
5.4.2 Persistent Dangerous Wastes 5-21
5.4.3 Carcinogenic Dangerous Wastes 5-21
5.5 DANGEROUS WASTE CHARACTERISTICS 5-22
5.5.1 Ignitability 5-22
5.5.2 Corrosivity 5-23
5.5.3 Reactivity 5-23
5.5.4 Extraction Procedure Toxicity 5-23
5.6 PROPOSED DESIGNATION 5-24

6.0 ACTION PLAN 6-1
6.1 FUTURE SAMPLING 6-1
6.2 TECHNICAL ISSUES 6-2

7.0 REFERENCES 7-1

APPENDIXES:

A A-1
B B-1

LIST OF FIGURES

1-1 Characterization Strategy 1-3

1-2 UO_3 Plant Site Map 1-5

2-1 UO_3 Plant and Ancillary Facilities 2-2

2-2 224-U Building 2-3

2-3 224-UA Building 2-4

2-4 Crib 216-U-17 2-6

2-5 Contributors to UO_3 Plant Process Condensate 2-8

2-6 UO_3 Process Flow Diagram 12-2

2-7 UO_3 Plant Process Condensate Neutralization System 12-6

2-8 Potassium Nitrate Concentration Trends During Calcination 2-29

5-1 Designation Strategy 5-2

LIST OF TABLES

1-1 Stream-Specific Characterization Reports 1-2

2-1 Contributors to UO_3 Plant Process Condensate 2-7

2-2 Process Condensate Generation Rates 2-19

2-3 Specification for Shipping Uranyl Nitrate Hexahydrate From PUREX to UO_3 Plant 2-21

2-4 Summary of 200 West Area Raw Water and Sanitary Water Data 2-22

2-5 Specification for UO_3 Plant Recovered Nitric Acid 2-24

3-1 Procedures for UO_3 Plant Process Condensate Calcination Samples 3-3

3-2 Statistics for UO_3 Plant Process Condensate 3-5

4-1 Evaluation of UO_3 Plant Process Condensate 4-2

LIST OF TABLES (continued)

4-2 Deposition Rate for UO_3 Plant Process Condensate 4-3

5-1 Inorganic Constituents from Ion Analytes 5-6

5-2 Dangerous Waste Data Designation Report for UO_3 Plant Process Condensate 5-16

UO_3 PLANT PROCESS CONDENSATE STREAM SPECIFIC REPORT

1.0 INTRODUCTION

1.1 BACKGROUND

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

This assessment is described in the *Liquid Effluent Study Project Plan* (WHC 1990a), a portion of which characterizes 33 liquid effluent streams. This characterization consists of integrating the following elements, pursuant to the Washington (State) Administrative Code (WAC), 173-303 (Ecology 1989): process data, sampling data, and dangerous waste regulations.

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

1.2 APPROACH

This report characterizes the UO_3 Plant Process Condensate wastestream in sufficient detail so a wastestream designation, in accordance with WAC 173-303, can be supported and so an assessment of the relative effluent priorities can be made with regard to the need for treatment and/or alternative disposal practices.

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

1. Provide both process and sampling data (Sections 2.0 and 3.0, respectively).

2. Evaluate the data (Section 4.0).

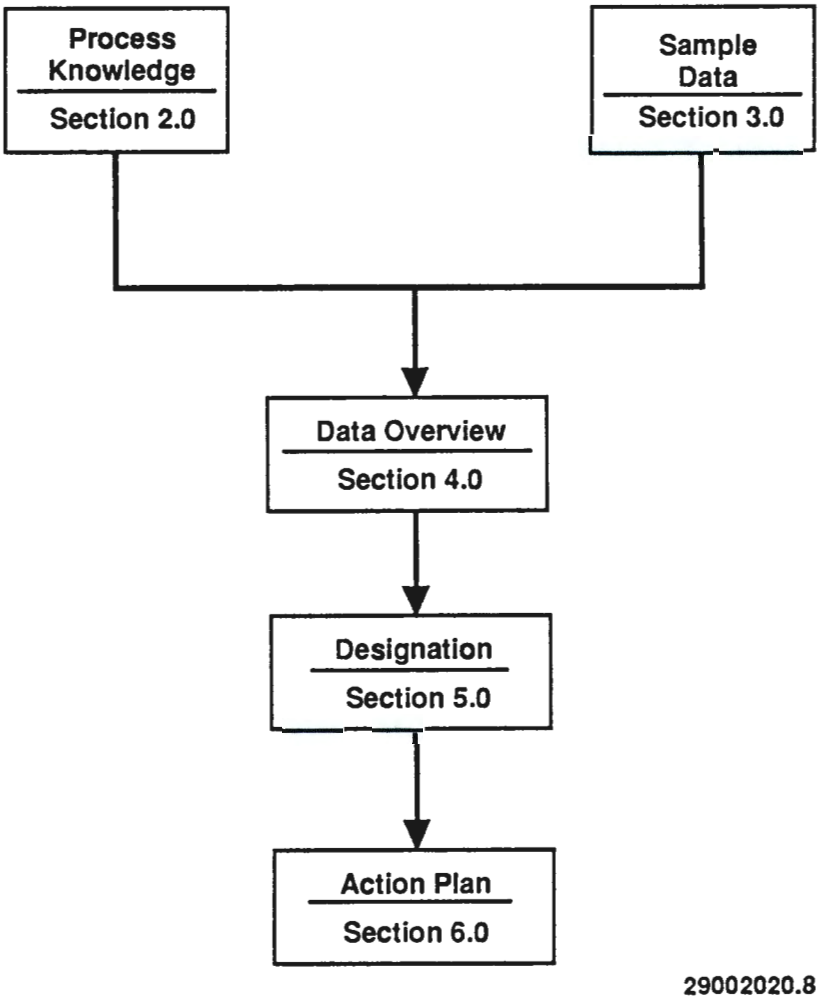
3. Propose a designation (Section 5.0).

4. Develop an action plan, if necessary, to obtain additional characterization data (Section 6.0).

Table 1-1. Stream-Specific Characterization Reports.

WHC-EP-0342	Addendum 1	300 Area Process Wastewater
WHC-EP-0342	Addendum 2	PUREX Plant Chemical Sewer
WHC-EP-0342	Addendum 3	N Reactor Effluent
WHC-EP-0342	Addendum 4	163N Demineralization Plant Wastewater
WHC-EP-0342	Addendum 5	PUREX Plant Steam Condensate
WHC-EP-0342	Addendum 6	B Plant Chemical Sewer
WHC-EP-0342	Addendum 7	UO_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-AY/AZ Tank Farms Steam Condensate
WHC-EP-0342	Addendum 31	209-E Laboratory Reflector Water
WHC-EP-0342	Addendum 32	T Plant Laboratory Wastewater
WHC-EP-0342	Addendum 33	183-D Filter Backwash Wastewater

Figure 1-1. Characterization Strategy.

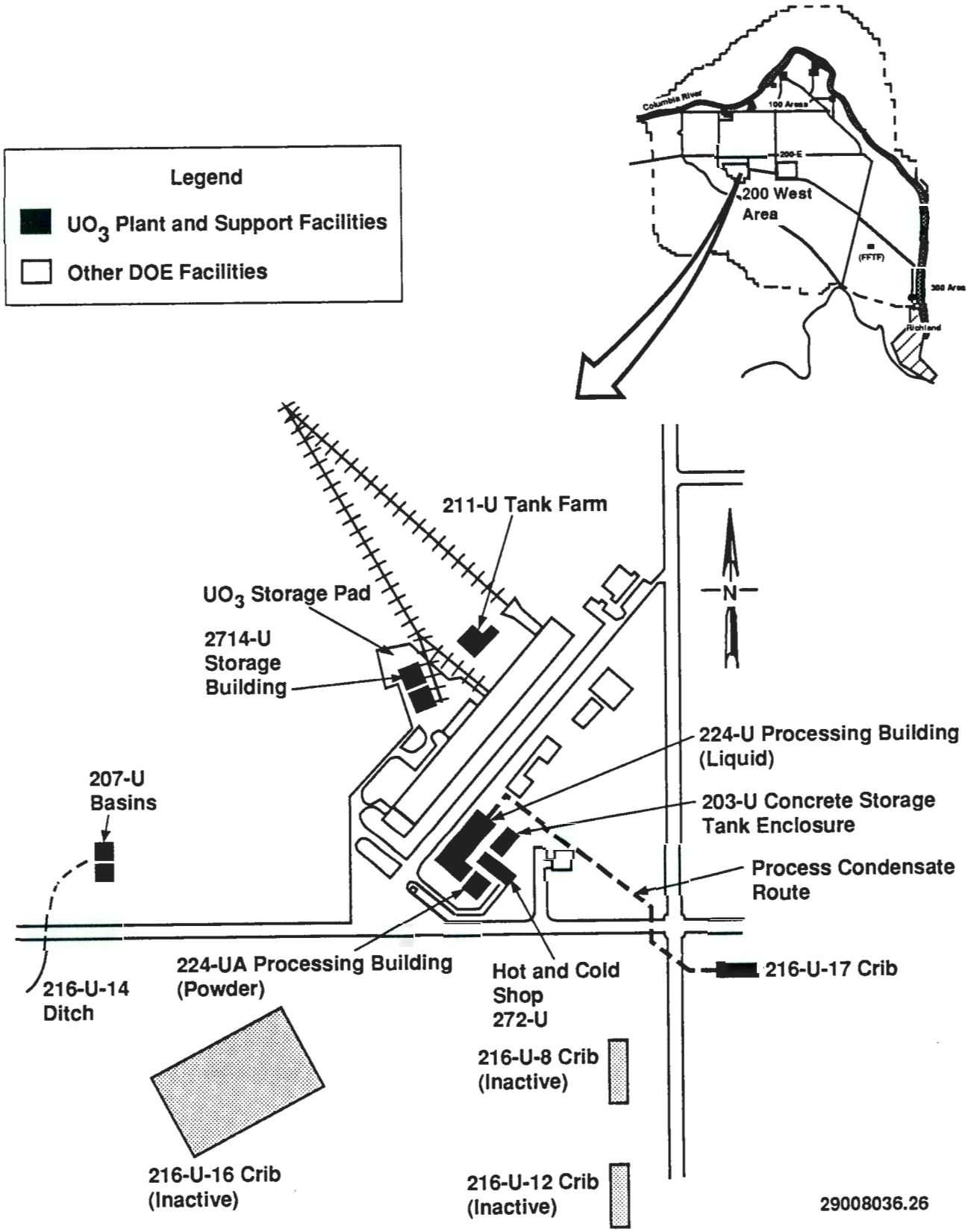


1.3 SCOPE

This document characterizes the UO_3 Plant Process Condensate. Under the current configuration this stream is routinely discharged to the 216-U-17 Crib (see Figure 1-2). Prior to January 31, 1988, the effluent was discharged to the 216-U-12 Crib. Data used for designation of this stream are old data. Old Data refer to data from samples collected prior to October 1989. Since no new data exist for the UO_3 Plant Process Condensate, old data are used for proposing the wastestream designation, calculating loadings, maximum contaminant level (MCL) comparisons, etc. Although the proposed designation is based on sample data taken only since installation of a neutralization system (in January 1988), a supporting document (WHC 1990b) uses pre-1988 data, when discharges were sent to the 216-U-12 crib. Pre-1988 data are important because they are useful for documenting a trend exhibited by organic contaminants found in the process condensate stream. Analysis of these data taken prior to the change in process configuration is beyond the scope of this report; however, information from the above referenced document constitutes process knowledge which is used in the assessment. Upon initial management request for information concerning organic constituents during the summer of 1989, the source of these contaminants was unknown. As a conservative measure, a decision was made at that time by Westinghouse Hanford Company management to temporarily suspend discharges to the 216-U-17 Crib, pending resolution. Consequently, the UO_3 Plant Process Condensate has been routed to storage tanks at the UO_3 Plant since July 1989.

Historical changes, process campaign changes, and sampling data are considered only if relevant to the characterization of the UO_3 Plant Process Condensate. Future configurational/process modifications are addressed if they will significantly alter the effluent contents.

Figure 1-2. UO_3 Plant Site Map.



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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 UO_3 Plant Process Condensate. The UO_3 Plant Process Condensate originates from a number of sources throughout the UO_3 Plant. After describing the location and physical layout of the UO_3 Plant, streams contributing to the process condensate will be identified. An overview of the processing activities performed at the facility will lead into a discussion of constituents of each contributor.

2.1 PHYSICAL LAYOUT

The UO_3 Plant is located in the south-central portion of the 200 West Area of the Hanford Site. The plant consists of two primary processing facilities, Buildings 224-U and 224-UA, and several ancillary facilities as shown in Figure 2-1.

2.1.1 UO_3 Plant Process Facilities

Building 224-U is a roofed concrete-walled building constructed in 1944. The building is 44 m long and 28 m wide. Its principal roof is 12 m above grade. The primary purposes of this building are receiving uranyl nitrate hexahydrate (UNH) solution from the Plutonium-Uranium Extraction (PUREX) Plant and concentrating it for processing in Building 224-UA. In addition, a nitric acid recirculation loop from Building 224-U scrubs the calciner off-gas system in Building 224-UA to dissolve entrained UO_3 fines. Details of the building are shown schematically in Figure 2-2.

Building 224-UA is a steel walled and framed building constructed in 1957. The building is 29 m long and 16 m wide. Its principal roof is 8.5 m above grade, although a processing tower extends to 15.5 m above grade. The primary purposes of this building are to convert UNH from Building 224-U to uranium trioxide (UO_3) powder and to package it for off-site shipment. Calciner off-gas is routed to the nitric acid recovery system in Building 224-U. Figure 2-3 shows details of the building.

The 203-U enclosure is a roofless concrete-diked process chemical tank storage 24 m long and 13.7 m wide. The 203-U enclosure stores feed UNH from PUREX, recycle UNH for return to the PUREX Plant, and process condensate and potassium hydroxide. Any solutions collected in the 203-U enclosure sump are transferred to Building 224-U for further processing.

The Backpad area between 224-U, 203-UX, 224-UA, and 203-U contains additional tankage and piping connecting the main process buildings. The concrete-diked 203-UX enclosures in the Backpad area adjacent to the 224-U Building contain tanks which store concentrated UNH from the 224-U Building in preparation for processing in 224-UA. Any rainfall or uranium-bearing solutions collected in sumps in the potentially contaminated Backpad area are routed to Building 224-U for further processing.

Figure 2-1. UO_3 Plant and Ancillary Facilities.

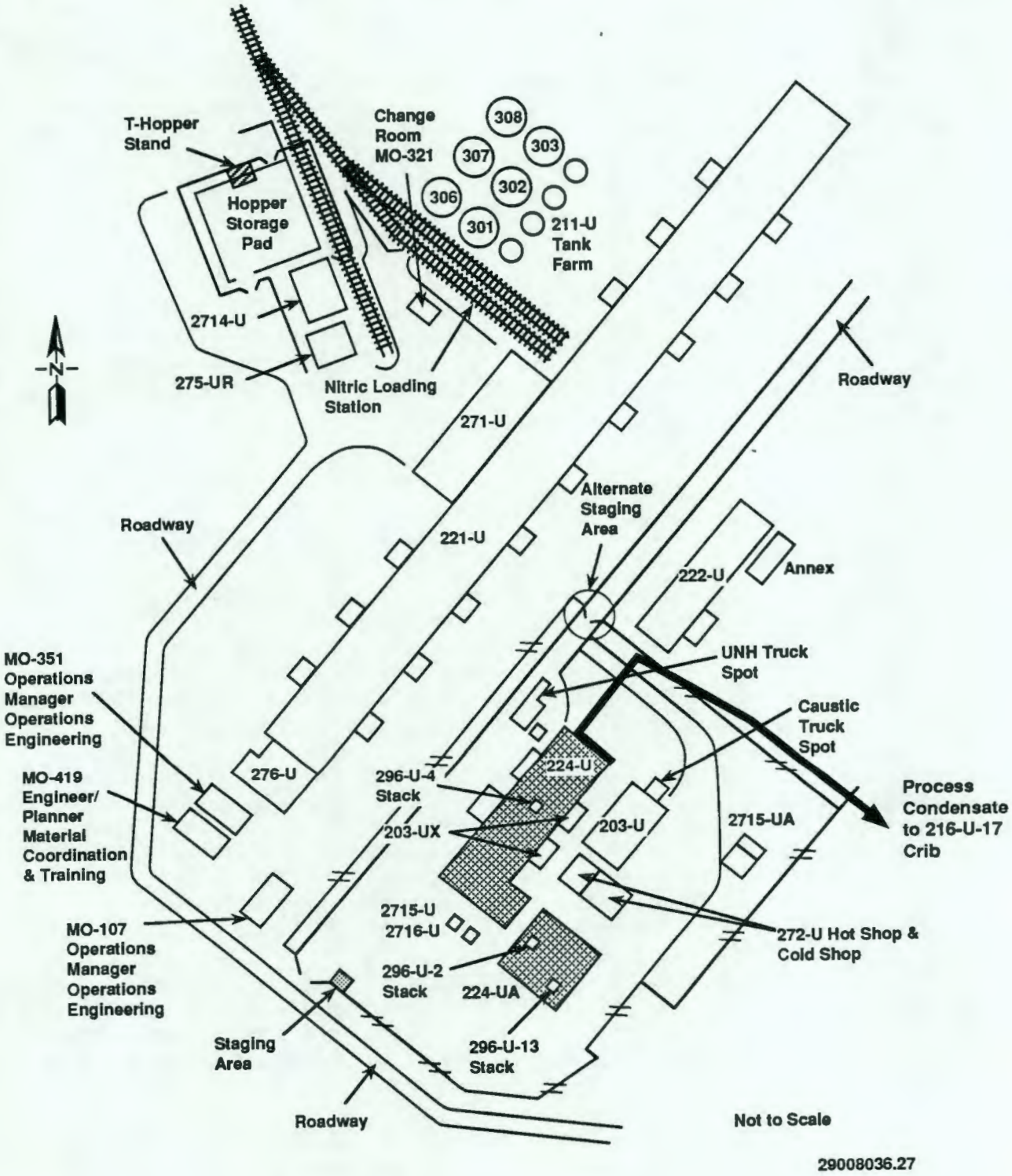
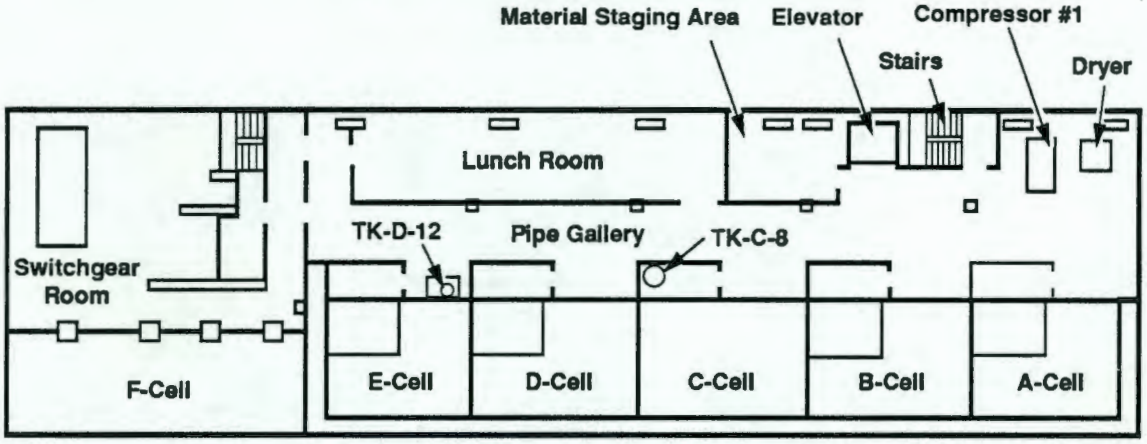
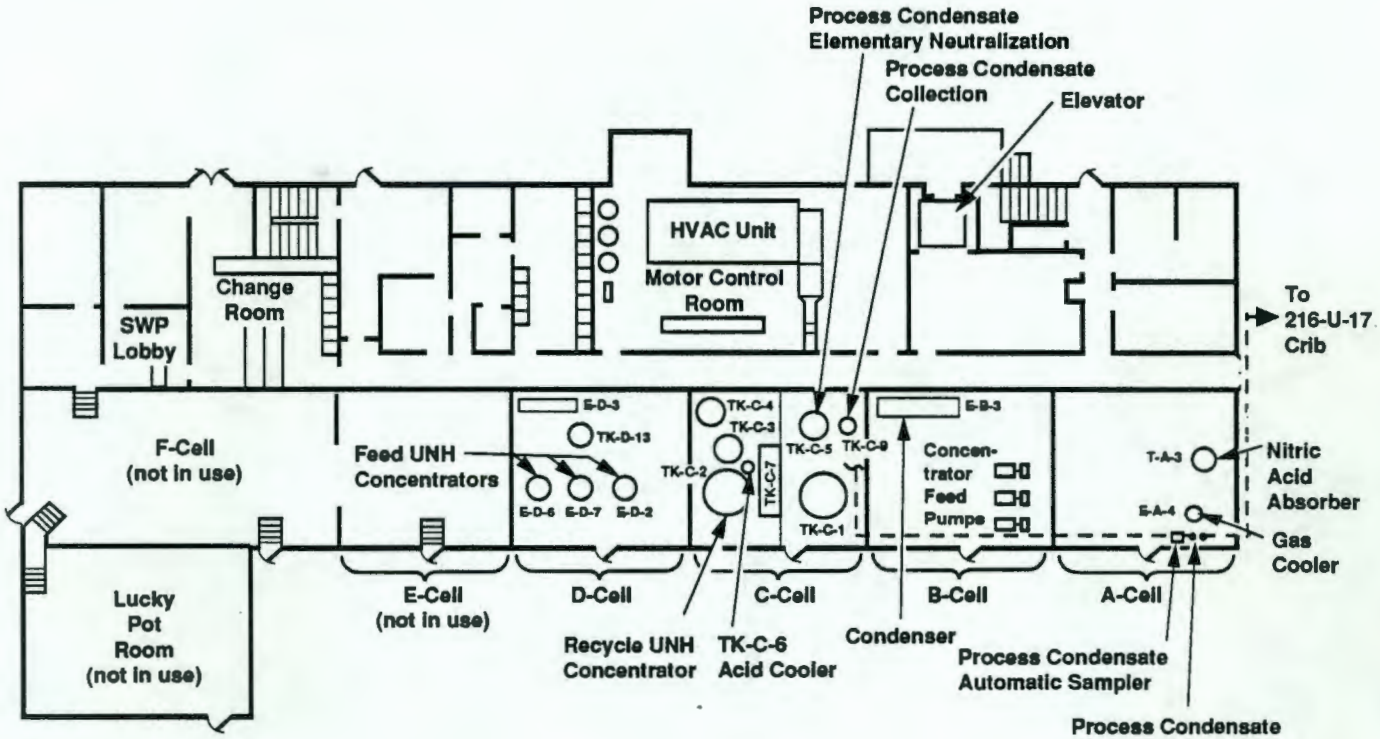


Figure 2-2. 224-U Building.



Second Floor Level



Ground Floor Level

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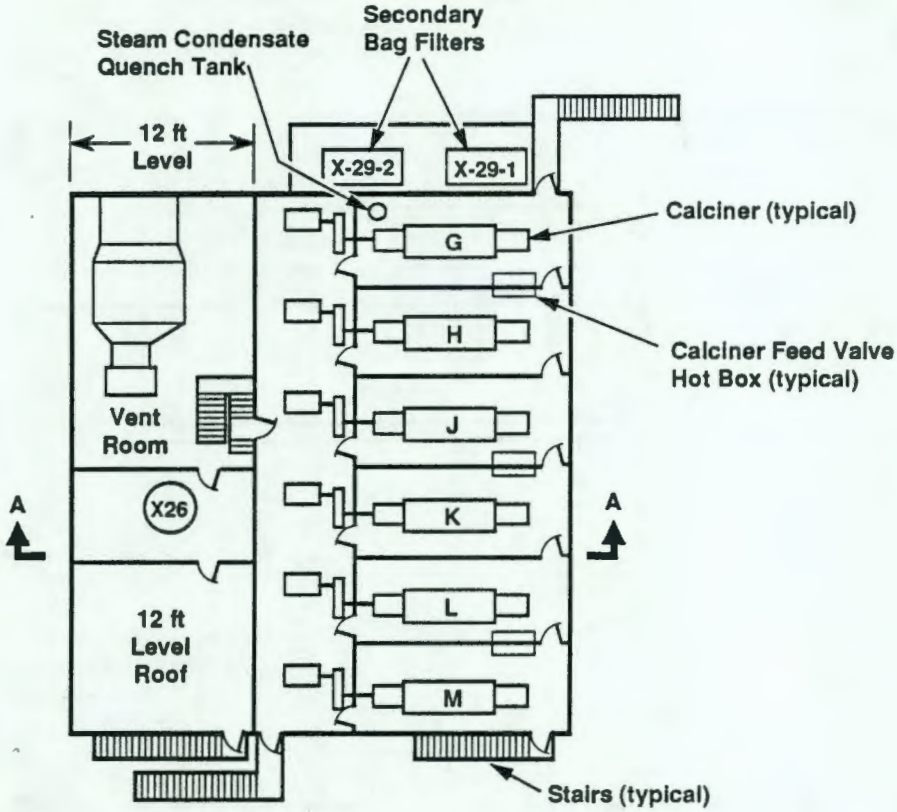
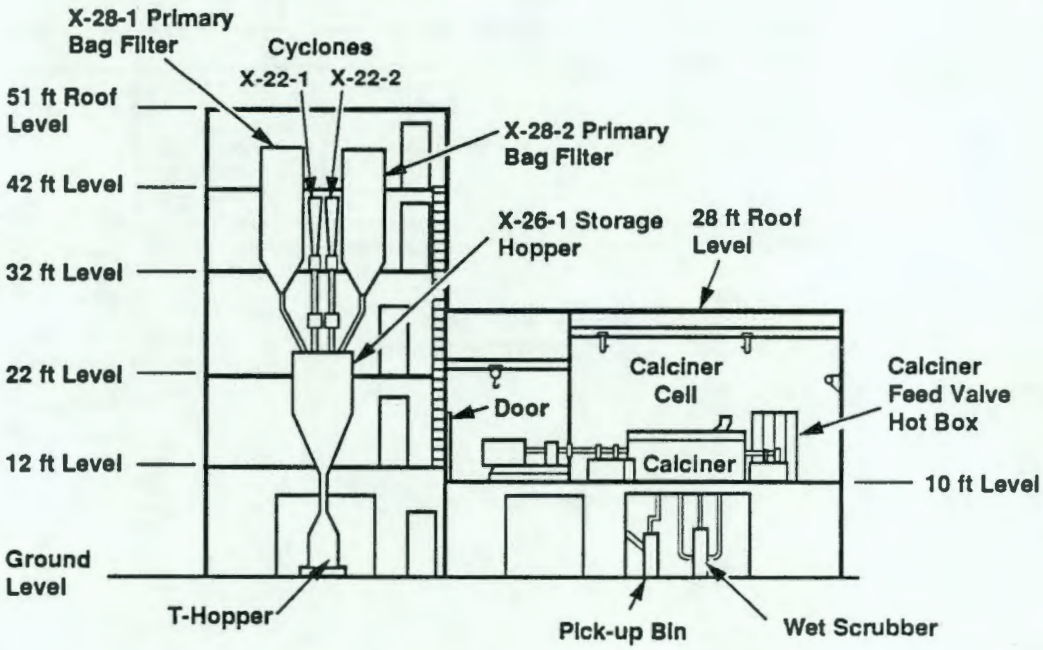
Figure 2-3. 224-UA Building.



Second Floor Level



Section A-A

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The 211-U Tank Farm contains four storage tanks (of which one is maintained as a spare) where nitric acid recovered at the UO_3 Plant is staged for rail shipment to PUREX. Sumps in the 211-U area drain to the UO_3 Plant wastewater stream. There is no connection from this facility to the UO_3 Plant Process Condensate stream.

Former process and laboratory buildings 221-U, 271-U, 222-U, and other tanks at 211-U formerly associated with 221-U, are no longer in operation. While these retired facilities are not directly associated with the UO_3 Plant, rainwater run-off and HVAC condensates from these buildings still drain to the UO_3 Plant wastewater system. There is no connection from these facilities to the UO_3 Plant Process Condensate stream, however.

2.1.2 Process Condensate Handling Facilities

The UO_3 Plant Process Condensate stream originates in off-gas condensers in Building 224-U, which process contributor streams from throughout the plant. From the condensers, the process condensate drains to a surge tank (TK-X-37) in 203-U. The process condensate is neutralized in Building 224-U and is pumped to the 216-U-17 Crib for disposal. Redundant pH probes, transmitters, alarm switches, and stripchart recorders monitor the pH of the process condensate at a location just prior to exiting the 224-U Building.

The 216-U-17 Crib became the disposal site for the UO_3 Plant Process Condensate on January 31, 1988, upon the completion of Project B-545, 216-U-12 Crib Replacement. The 216-U-17 Crib is approximately 200 ft south of 16th Street, and 200 ft west of Beloit Avenue in the 200 West Area. A dedicated pipeline about 1,200 ft long transports the UO_3 Plant Process Condensate from 224-U to 216-U-17 as shown on Figure 1-2. The crib consists of about 150 ft of 6-in. perforated fiberglass reinforced pipe, laid in a gravel bed, and covered with a polyethylene barrier, backfilled, and stabilized, as shown in Figure 2-4. The crib is sized to dispose, by percolation, of up to 15,000 gal/d of process condensate. No corrosive solutions have ever been discharged to 216-U-17.

2.2 CONTRIBUTORS

Direct contributors to the UO_3 Plant Process Condensate are listed in Table 2-1. The process activities which generate these contributors are described in Section 2.3. Figure 2-5 shows the pathways of contributors to the process condensate as they flow to TK C-9. Condensate is pumped for use as reflux to the TA-3 Acid Absorber Tower from this tank; the excess becomes waste at this stage and is routed from TK C-9 to TK X-37 for temporary accumulation prior to neutralization. All contributors to the process condensate are active during calcination mode (see Section 2.3.2.1). Contributors which are also in operation during standby mode (see Section 2.3.2.2) are noted in Table 2-1. Process data and other information pertaining to the contributor compositions and flowrates are presented in Section 2.4.

Figure 2-4. Crib 216-U-17.

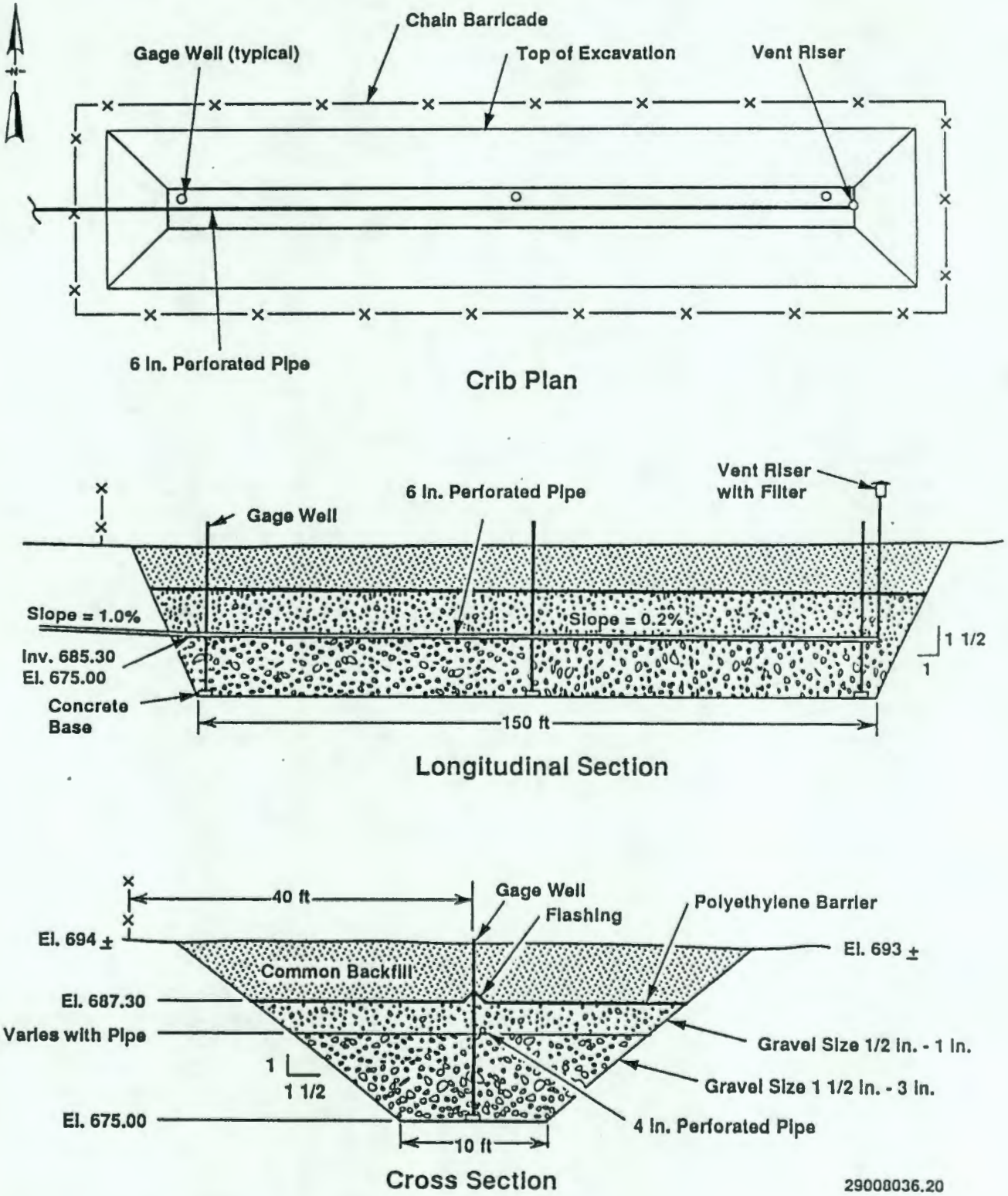
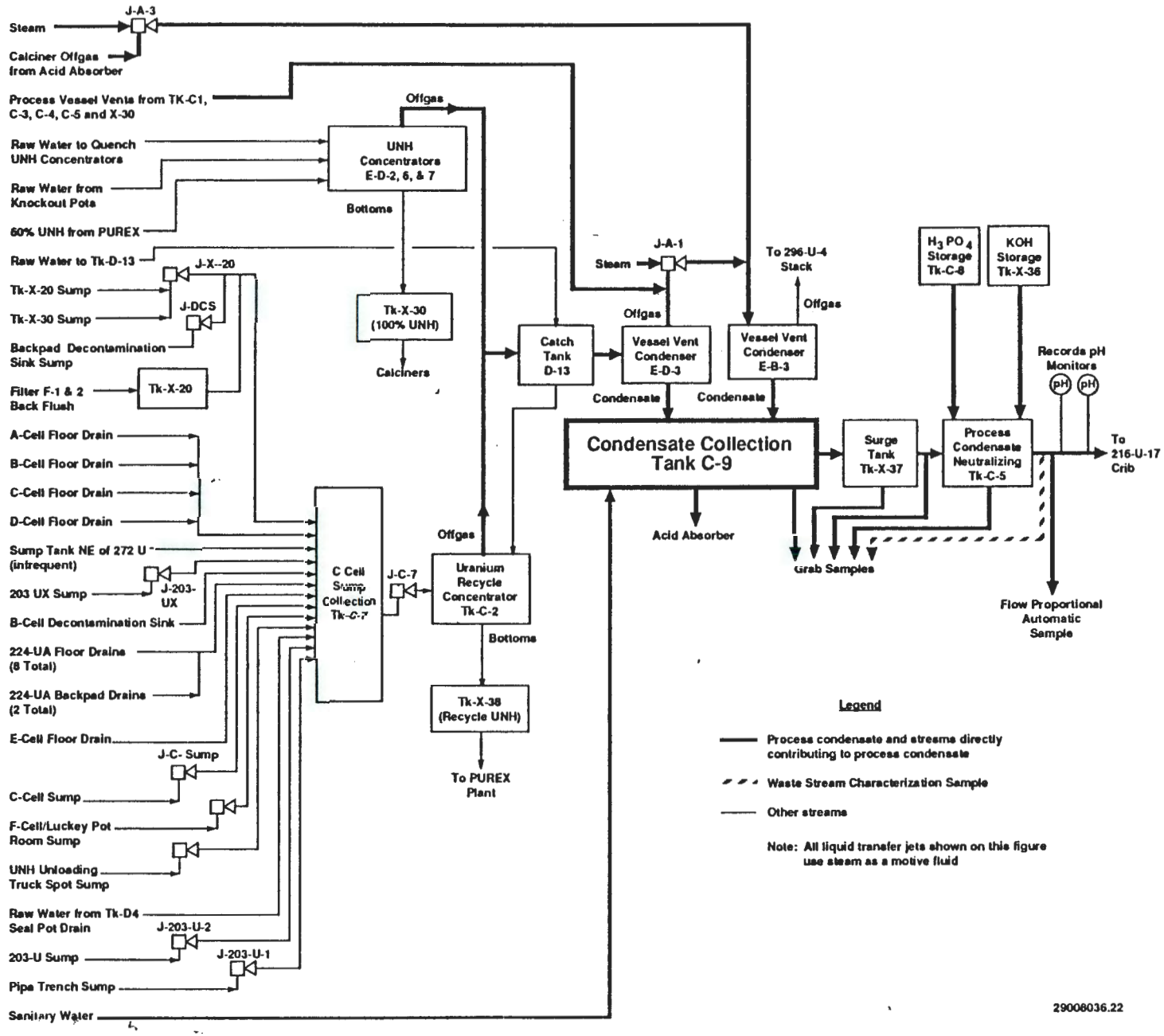


Table 2-1. Contributors to UO_3 Plant Process Condensate.

Contributor Stream	Pathway into Condensate	Operating Modes
Feed UNH concentrator off-gas	Evaporation in concentrators E-D-6, E-D-7, and/or E-D-2, and condensation in E-D-3 and E-B-3.	Calcination only.
Calciner off-gas	Sprayed with nitric acid in 224-UA wet scrubbers, condensed in E-A-4 (condensate routed to recovered nitric acid tank), passes through T-A-3 nitric acid scrubber, condensed in E-B-3.	Calcination only.
Recycle UNH concentrator off-gas	Evaporation in TK-C-2, and condensation in E-D-3 and E-B-3.	Calcination and standby.
Steam from 284-W Powerhouse	Motive fluid in J-A-1 and J-A-3 off-gas jets; condensed in E-D-3 and E-B-3.	Calcination and standby.
Fumes from miscellaneous process vessel vents	Swept from tank vapor space by vessel ventilation system and condensed in E-B-3.	Calcination and standby.
Sanitary water	Added to TK-C-9, to provide scrub water for nitric acid absorber when concentrators not in operation.	Calcination only.
Phosphoric acid	Pumped from C-8 tank into neutralization tank C-5 to immobilize uranium and for pH buffering.	Calcination and standby.
Potassium hydroxide	Pumped from X-36 tank into neutralization tank C-5 for elementary neutralization.	Calcination and standby.

Figure 2-5. Contributors to UO_3 Plant Process Condensate.



Most of the contributors to the process condensate are acidic. The UO_3 Plant Process Condensate neutralization system is used to control the process condensate pH prior to discharge to the 216-U-17 crib, as described in Section 2.3.2.3.

2.2.1 Contributions From Process Off-gas Condensates

With the exception of sanitary water, phosphoric acid, and potassium hydroxide, the contributors to the process condensate are condensates formed when the corresponding process off-gas stream passes through the E-D-3 and/or E-B-3 condensers. Figure 2-5 shows the routes of process off-gases to the E-B-3 and E-D-3 condensers. Figure 2-6 is a flowsheet of the process. Condensates from the condensers drain to TK-C-9, via submerged inlet lines, which provide a water seal between E-D-3 and E-B-3. From TK-C-9 some of the condensate is pumped to nitric acid absorber tower T-A-3, and the remainder overflows to surge tank X-37. From TK-X-37, the condensate is pumped batchwise to TK-C-5, neutralized, and is discharged to the 216-U-17 crib.

2.2.1.1 Feed Uranyl Nitrate Hexahydrate Concentrator Off-gas Condensate. A 60% UNH feedstock from PUREX is thermally boiled in the steam-heated E-D-2, E-D-6, and E-D-7 concentrators to produce 100% UNH. The concentrated 100% UNH bottoms overflow continuously to TK-X-30 for further processing in 224-UA. The J-A-1 off-gas jet draws water vapor and other volatiles evolved by the concentrators through the concentrator off-gas header and the TK-D-13 catch tank to the E-D-3 condenser. Water vapor and any other condensibles present in the concentrator off-gas drop out in the E-D-3 condenser and drain into TK-C-9. The J-A-1 jet discharges the off-gas from the E-D-3 condenser to the E-B-3 condenser, where the steam used by the jet is condensed along with any remaining condensibles.

2.2.1.2 Calciner Off-gas Condensate. The electrically heated UO_3 Plant calciners convert 100% UNH to UO_3 powder, liberating off-gases containing mostly water vapor and oxides of nitrogen. The calciner off-gas is scrubbed with recovered nitric acid in the 224-UA wet scrubbers to dissolve any entrained UNH fines. The calciner off-gas then passes through the E-A-4 condenser, which removes most of the water vapor from the stream. The condensate from E-A-4 drains to the C-4 recovered nitric acid pump/surge tank. The remaining calciner off-gas is drawn through the 20 bubble cap trays of the T-A-3 nitric acid absorber by the J-A-3 off-gas jet. Process condensate from TK-C-9 scrubs the calciner off-gas in T-A-3, and removes virtually all of the uranium-bearing mists and most of the NO_x from the calciner offgas. The remaining calciner off-gas exits T-A-3, is mixed with steam from J-A-3 and J-A-1, and passes through the E-B-3 condenser. Condensibles drain from E-B-3 to TK-C-9.

2.2.1.3 Recycle Uranyl Nitrate Hexahydrate Concentrator Off-gas Condensate. Potentially uranium-bearing flush solutions, decontamination solutions, and rainwater from sumps throughout 203-U, 224-UA, the Backpad area, and the 224-U process cells are boiled off in the steam-heated TK-C-2 recycle UNH concentrator. The purpose of this operation is twofold: (1) the potential for contamination spread and discharge of uranium to the soil column is minimized, and (2) uranium is put back into the fuel cycle through

reprocessing at PUREX. The nonvolatile bottoms accumulate in TK-C-2 until the UNH concentration is high enough to warrant filtration and recycle to PUREX via TK-X-38. The J-A-1 off-gas jet draws water vapor and other volatiles evolved from the recycle concentrator through the concentrator off-gas header and the D-13 surge tank to the E-D-3 condenser. Water vapor and other condensibles present in the recycle concentrator off-gas drop out in E-D-3 and drain to TK-C-9. The J-A-1 jet discharges the off-gas from the E-D-3 condenser to the E-B-3 condenser, where the steam used by the jet is condensed along with any remaining condensibles. Condensate from E-B-3 also drains to TK-C-9.

2.2.1.4 284-W Powerhouse Steam Condensate. Steam from the 284-W powerhouse provides the motive fluid for process off-gas jets J-A-1 and J-A-3. Steam used by the jets passes through the E-B-3 condenser, from which condensate drains to TK-C-9.

2.2.1.5 Miscellaneous Process Vessel Vent Condensate. Many of the process vessels in 224-U are vented by the process vessel vent system. These vessels include UNH storage tanks, nitric acid storage tanks, and the process condensate neutralization tank. Vapors are drawn from these vessels by the J-A-1 jet and discharged to the E-B-3 condenser, from which condensate drains to TK-C-9. Alternatively, the process vessel vent system can be routed to the E-B-3 condenser via the E-A-4 calciner off-gas condenser, T-A-3 nitric acid absorber, and J-A-3 to the E-B-3 condenser.

2.2.2 Contribution From Sanitary Water

During calcination, a portion of the process condensate in TK-C-9 is re-used as reflux scrubbing water in the T-A-3 nitric acid absorber. When condensate generation rates are too low to operate the nitric acid absorber, sanitary water is added to TK-C-9 to ensure an uninterrupted supply of scrub water. This occurs mainly when, in preparation for a weekend shutdown, the feed UNH concentrators are shut down, and the calciners continue to work off the 100% UNH inventory in TK-X-30.

2.2.3 Phosphoric Acid and Potassium Hydroxide Addition to Process Condensate

From TK-C-9, the process condensate overflows to a 14,000-gal surge tank, X-37. Any excess sanitary water added to TK-C-9 to support acid absorber operation also overflows to TK-X-37 as well. From TK-X-37, condensate is pumped batchwise to TK-C-5, buffered with phosphoric acid, neutralized with potassium hydroxide, and discharged to the 216-U-17 Crib. The amounts of these contributors added to the process condensate are controlled by the process condensate neutralization system, as discussed in Section 2.3.2.3.

2.3 PROCESS ACTIVITIES

The UO_3 Plant has two principal operating modes. Currently, the plant is in standby, awaiting receipt of UNH feedstock from PUREX. When sufficient feedstock is on hand, the UO_3 Plant enters a UNH calcination mode to produce UO_3 powder. Process condensate neutralization is performed as needed to eliminate the corrosive aspect of acidic waste generated during both operating modes. These processing activities are described in the following sections.

2.3.1 Present Activities

Presently, the UO_3 Plant is in standby. In addition, the uranium recycle concentrator is out of service, awaiting repair. Precipitation and other contributors to the recycle concentrator have been diverted to storage tanks in 203-U, 203-UX, and 224-U. Standby mode activities (see Section 2.3.2.2) have been curtailed to the maximum extent possible in order to minimize the generation of contributors to the recycle concentrator. A small supply of unneutralized process condensate is being held in TK-X-37 for any required flushing activities. Therefore, no process condensate effluent is being generated. The stream is currently inactive. No sampling or monitoring has been performed since July 1989.

2.3.2 Past Activities

Since restart in 1984, the UO_3 Plant has alternated between calcination and standby operating modes, as needed to process UNH from PUREX. These modes will be described in more detail below.

2.3.2.1 Calcination Mode Process Activities. In calcination mode, virtually all process systems at UO_3 Plant are in continuous operation, to convert UNH from PUREX into UO_3 powder. Other operations performed at UO_3 Plant in support of this mission include:

- Scrubbing of UNH calcination off-gas with nitric acid to dissolve entrained UO_3 and second-stage acid absorption treatment with process condensates to recover nitric acid for reuse at PUREX
- Collecting and concentrating various uranium-bearing rinse, flush, and decontamination solutions for shipment to PUREX and subsequent uranium recovery at that facility
- Handling and disposing gaseous and liquid wastes.

These operations are shown schematically in Figure 2-6.

The process depicted in this figure begins with the transport of UNH from PUREX. Uranium product, as 60% UNH (2.1 Molar), is transported to the UO_3 Plant on a batch basis contained in a 2,800 gal tank trailer via the Hanford Site highway system. The UNH solution is pumped from the tank trailer at the truck spot to Tank C-1 in C-Cell. The solution is sampled for

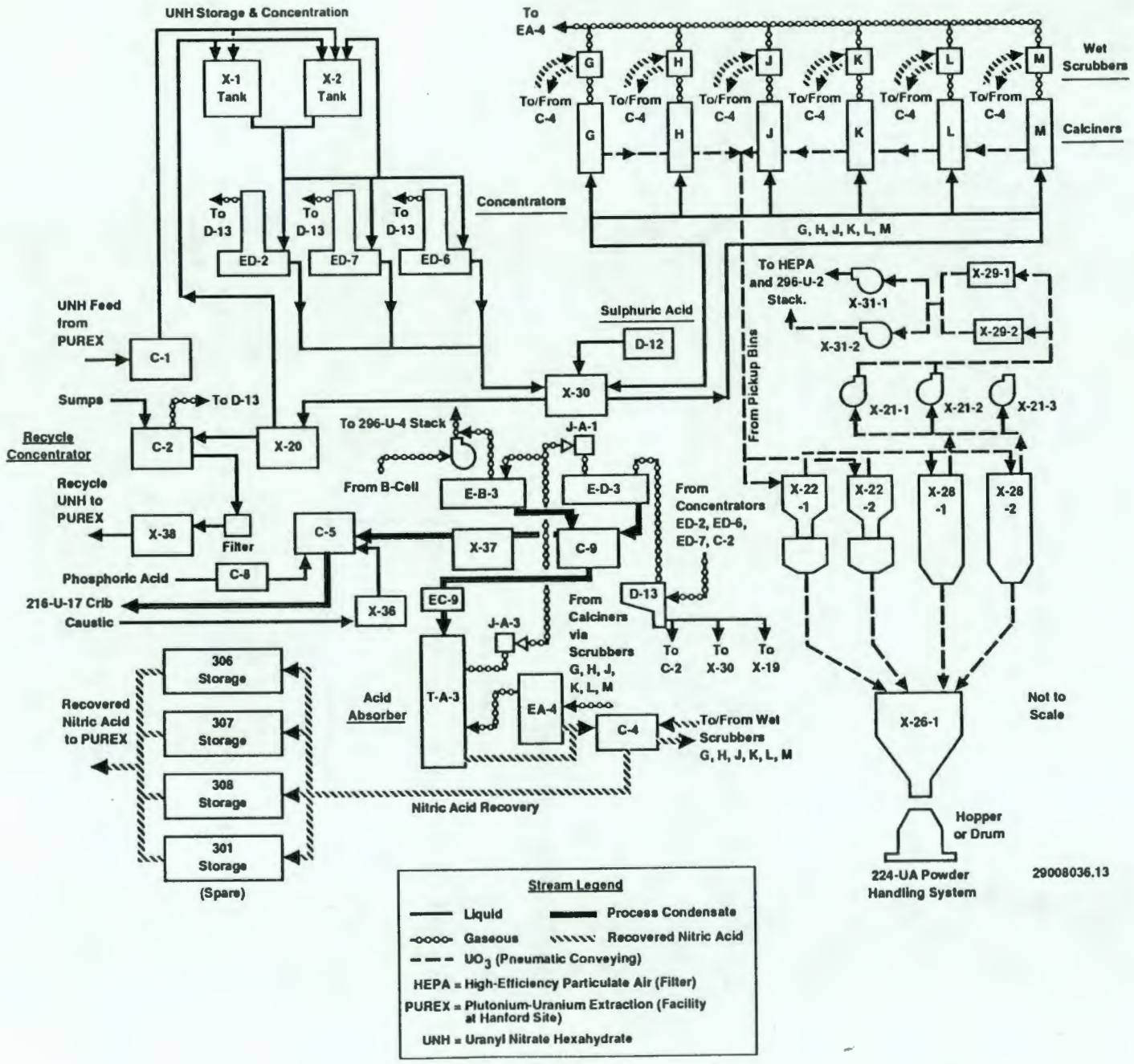


Figure 2-6. UO_3 Process Flow Diagram.

accountability and observed for the presence of a visible organic layer. In the unlikely event an organic layer is observed, the UNH solution is returned to PUREX for rework. The UNH accepted for processing is pumped to, and stored in, two 100,000-gal storage tanks (X-1 and X-2) located in the 203-U area.

After sufficient UNH inventory has been accumulated in the storage facilities at the PUREX and UO_3 Plants, concentration of the UNH is started. The UNH solution is pumped from the 203-U area to concentrators in D-cell. The solution is concentrated from a uranium content of 2.1 Molar (60 percent UNH) to 5.5 Molar (100 percent UNH) by thermal boiling in the concentrators. The concentrated UNH, routed to the 203-UX area, is stored in a steam-heated tank (X-30) to prevent freezing of the concentrated solution.

Off-gas from each concentrator overheads knockout pot is routed through a catch tank to the E-D-3 condenser. Water and a small amount of nitric acid vapors evolved during concentration are condensed and comprise, on a volume basis, the largest contributor to the process condensate. A portion of the process condensate is used as reflux water in the acid absorber tower; the balance is neutralized and discarded to the 216-U-17 crib as waste.

Small quantities of 17 Molar (93 percent) sulfuric acid are injected into the concentrated UNH stored in the 203-UX area. Sulfuric acid is added because sulfur in the powder product aids further processing of the uranium at the Feed Materials Production Center in Fernald, Ohio.

Concentrated UNH is filtered and pumped to the 224-UA Building where the calcination process is conducted. Conversion of UNH to UO_3 powder occurs by thermal decomposition in six electrically heated, continuously agitated trough calciners. The UNH feed is supplied to the calciners from a pressurized, electrically heat-traced recirculation loop.

Before operation, the calciners are filled with UO_3 bed powder and the electric furnaces are turned on. The furnaces are operated over a 30-h period to bring the calciner shell temperature to 400 °C. This time period is necessary to minimize warpage of the calciner shell. As the temperature reaches 400 °C, UNH is introduced into the calciners through four feed points. This initial feed introduction reduces the calciner temperature. The UNH feed to the calciner is temperature controlled such that the calciner bed operates at 270 °C, while the shell temperature is incrementally increased to about 500 °C for optimal processing efficiency.

When UNH contacts the heated bed powder, the conversion to UO_3 is almost instantaneous. This UO_3 coats the bed powder to form larger spherical particles. The resulting accumulation overflows a weir at one end of the calciner.

The rapid decomposition of UNH in the calciners liberates quantities of water vapor, oxygen, and oxides of nitrogen. This off-gas is scrubbed with nitric acid to dissolve UO_3 fines and then is routed through a gas cooler and on to an acid absorber tower. Suction vacuum for this system is provided by steam jets on the 224-U roof. As the off-gas bubbles rise through bubble

cap trays in the tower, nitric acid is formed. This acid is approximately 10.4 Molar (50 percent). The remaining gas is passed through the E-B-3 condenser prior to discharge to the environment in accordance with PSD-X80-14 via the 80 ft 296-U-4 stack. Calciner off-gas condensate from the E-B-3 condenser contributes the bulk of the acidity found in the pre-neutralized process condensate.

The UO_3 powder from the calciner falls into a pickup bin. This product is conveyed pneumatically to the powder handling tower where the powder and air are separated by a cyclone separator. The exhaust air from this operation is routed through primary and secondary bag filters, a prefilter, and high-efficiency particulate air (HEPA) filter before discharge to the environment via the 296-U-2 stack. Powder from the cyclone and primary bag filter is collected in the powder hopper. Powder from the secondary bag filter is collected in 30-gal drums. There are two parallel trains of cyclones and bag filters; when one is in operation, the other is in standby.

The UO_3 in the powder hopper discharges into shipping containers in the powder loadout room. Filled containers called T-hoppers contain about 4.6 metric tons of uranium (MTU) each as UO_3 and are stored on a concrete pad in a fenced area north of the 2714-U Building. Powder is shipped offsite from this area via specially equipped railcars. Small amounts of powder from the secondary bag filters are collected in 30-gal drums and put back into the powder handling system.

Room air from the loadout enclosure in the loadout room is passed through a prefilter and HEPA filter, then sampled for radioactive particulates and monitored before discharge to the environment via the 296-U-13 stack.

The TK-C-2 recycle concentrator operates as needed to concentrate flush solutions, rainwater, and other solutions in the 203-U, 224-UA, Backpad, and 224-U cell drain system sumps that potentially contain uranium. Before entering calcination mode, the batch accumulation recycle concentrator is emptied as needed to ensure that it will not need to be emptied while in calcination mode.

Process condensate resulting from these activities is neutralized and discharged to the 216-U-17 Crib on a batch-continuous basis. The condensate in surge tank X-37 is sampled regularly to ensure no entrainment of uranium or technetium has occurred in violation of environmental release limits. Samples are also analyzed for nitrate content to ensure that the nitrate concentration will be below the administrative control limit of 5 weight percent upon discharge. Process condensate neutralization, sampling, and monitoring are discussed further in Sections 2.3.2.3 and 2.3.2.4.

2.3.2.2 Standby Mode Process Activities. During standby, activities are focused on preparing the UO_3 Plant for the next calcination mode operation. Equipment is flushed, decontaminated, and repaired. The TK-C-2 recycle concentrator operates as needed to concentrate flush solutions, rainwater, and other solutions in the 203-U, 224-UA, Backpad, and 224-U cell drain system sumps which potentially contain uranium. The contents of the recycle concentrator are filtered and stored in TK-X-38 for shipment to PUREX during

standby when necessary to assure adequate concentrator capacity during calcination mode. Recovered nitric acid is shipped to PUREX when needed at that facility. The UNH feed solution is shipped from PUREX to UO_3 Plant as available in preparation for the next calcination mode operating period.

Process condensate resulting from standby mode activities is accumulated in the X-37 surge tank, and neutralized and discharged to the 216-U-17 Crib after sampling. Process condensate generation rates during standby mode are low enough that the accumulated pre-neutralized solution can be quarantined in the X-37 tank for sampling before neutralization and discharge to the crib. Samples are analyzed for uranium, technetium, and nitrate, to ensure that any entrainment from the recycle concentrator is within environmental release limits. The following two sections address neutralization, sampling, and monitoring of process condensate.

2.3.2.3 Process Condensate Neutralization. The present UO_3 Plant Process Condensate neutralization system, shown in Figure 2-7, has successfully neutralized all process condensates ever discharged to the 216-U-17 Crib. The few process condensate neutralization system upsets to date have resulted in locking up the system, in accordance with built-in fail-safe features, to prevent discharge to the crib. The 14,000-gal X-37 surge tank allows for neutralization system maintenance and calibration outages.

The process condensate neutralization system is an automatic batch elementary neutralization process. Level interlocks automatically control the transfer pump from surge tank X-37 to neutralization tank C-5. A predetermined dose of phosphoric acid is pumped from TK-C-8 to TK-C-5 every time condensate is pumped from TK-X-37 to TK-C-5. TK-C-5 is equipped with a pumped recirculation loop and a mechanical agitator. Potassium hydroxide from TK-X-36 is added to the pumped recirculation loop under pH feedback control. When two independent pH sensors agree that TK-C-5 has stabilized within the target pH 6.5 to 8.5 range, the pumped recirculation loop is diverted to the 216-U-17 crib; any deviation of the pH outside of normal range during transfer will result in stoppage of transfer. Additionally, an administrative control is provided that will trigger a neutralization incomplete alarm if the neutralization process takes longer than a predetermined length of time that is established by the capacity of the metering pumps and the expected maximum initial acidity. Significantly higher incoming condensate acidity would take much longer to neutralize, triggering this alarm and a subsequent investigation as to the cause.

Many redundant and fail-safe features have been provided to prevent discharges from TK-C-5 to 216-U-17 outside the target pH range. For example, the pumped recirculation loop is isolated from the crib by double-block-and-bleed valving. Caustic addition and batch discharge are only permitted when the agitator and pumped recirculation loop are operating to ensure uniform mixing and representative pH readings. The pumped recirculation loop shuts down and the valves revert to their fail-safe double-block-and bleed positions upon loss of electrical power. The configuration of the discharge line to 216-U-17 does not permit gravity drainage from TK-C-5 to the crib in the event the pumps fail.

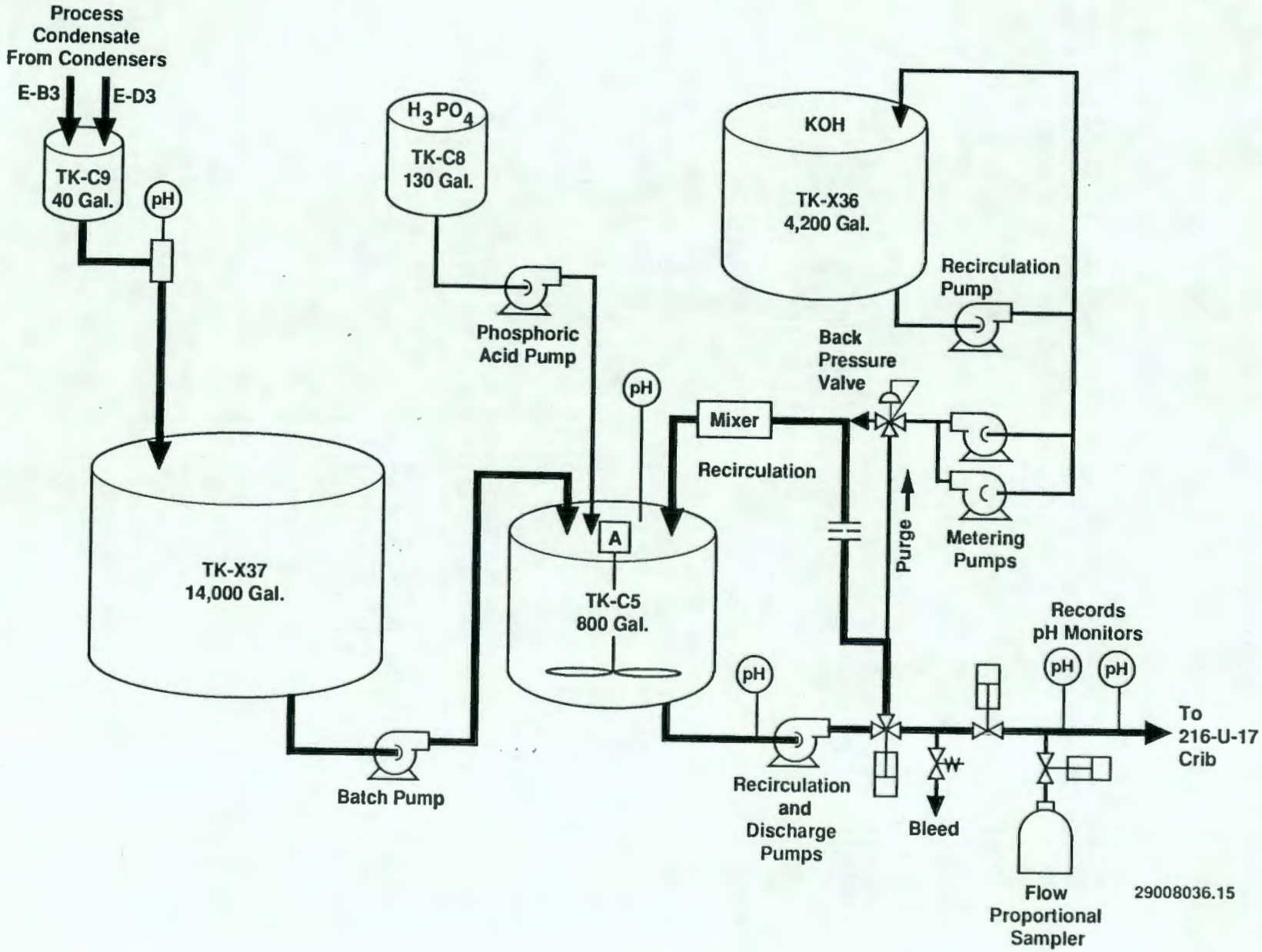


Figure 2-7. UO_3 Plant Process Condensate Neutralization System.

2.3.2.4 Process Condensate Sampling and Monitoring. An automatic batch proportional composite sampler and redundant pH probes have been installed downstream of the neutralization system in A-cell to monitor the effluent to 216-U-17 immediately prior to exiting 224-U. The A-cell location was chosen for two reasons. First, A-cell is downstream of any contributors to the process condensate line to 216-U-17 to ensure that samples are representative of what is actually sent to the disposal site. Secondly, A-cell is a convenient, readily accessible indoor location protected from adverse weather conditions.

Each of the two A-cell pH probes is connected to a separate transmitter, alarm switch, and stripchart recorder to assure redundancy in case of single-component equipment failure. An alarm sounds in the 224-U control room if either of the A-cell pH monitors is outside the expected 6.5-9 pH range (allowing for calibration tolerances between the in-tank control pH system and the A-cell monitoring system). The A-cell pH monitors perform no control functions.

The A-Cell pH instruments are calibrated monthly with pH 2, 4, 7, 10, and 12 buffer solutions to span the pH range of interest. The recorders are capable of displaying pH over the entire 0-14 pH range.

The Isolok* Model SAB automatic sampler is controlled by the TK-C5 discharge interlocks. The automatic sampler is located in A-cell just upstream of the record pH probes. Samples are obtained whenever condensate is being transferred to the 216-U-17 crib. The resulting composite batch sample is flow proportional. Each TK-C-5 batch is well mixed, the TK-C-5 batch discharge volumes are consistent, and the sampler obtains the same sample volume from each batch.

Flow monitoring for the UO_3 Plant process condensate consists of a digital batch counter. The batch volume is multiplied by the batch counter reading to determine the total discharge volume. Each batch discharge is also documented on TK-C-5 and TK-X-37 level charts.

Grab samples can be obtained from the following locations as shown in Figure 2-5:

- TK-C-9
- TK-X-37
- The transfer line from TK-X-37 to TK-C-5
- TK-C-5
- The transfer line from TK-C-5 to the 216-U-17 crib. This sample point is upstream of the effluent pH monitors.

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*Isolok is a registered trademark of Bristol Engineering Company, Yorkville, Illinois.

2.3.3 Future Activities

In the future, the UO_3 Plant will continue to alternate between calcination mode (Section 2.3.2.1) and standby mode (Section 2.3.2.2) according to the availability of UNH feedstock from the PUREX Plant. Process condensate neutralization will be performed as needed. Continuous pH monitoring will resume when the recycle concentrator returns to service. Effluents will be sampled when discharge of the stream resumes.

A fiber mist eliminator will be installed in the concentrator off-gas line downstream of the three feed UNH concentrators and the recycle concentrator to capture any UNH droplets entrained from these concentrators. The collected UNH will coalesce in the fiber mist eliminator elements, and will drain to the C-7 sump collection tank for rework through the recycle concentrator. Once this fiber mist eliminator is installed per project C-089, it is anticipated that the concentration of uranium and other nonvolatiles carried over from the concentrators into the process condensate will be reduced by a factor of 100.

2.4 PROCESS DATA

The constituents of each contributor to the UO_3 Plant process condensate will be discussed below. It should be noted that the only contributors which directly enter the process condensate are steam from the 284-W powerhouse, sanitary water, and neutralization chemicals (H_3PO_4 and KOH). All other contributors are either evaporated in one of the concentrators or pass through the nitric acid recovery system before condensing and joining the process condensate stream. Most of the contributors to the process condensate are acidic. The process condensate neutralization system automatically performs elementary neutralization to prevent corrosive discharges to the 216-U-17 crib. Sampling and monitoring is performed downstream of any contributors to the stream to confirm that the discharge is not corrosive.

2.4.1 Overall Stream Data

The volume of condensate generated varies greatly according to operating mode. For process condensate discharged to the 216-U-17 Crib, "old data" are used. Since the plant has only operated once during data collection, since changeover to the 216-U-17 Crib, the only calcination mode data set available is from the February 6, 1989 sampling. 2.14 E05 liters of process condensate were produced in 5 d of calcination mode operation. The monthly calcination mode process condensate generation rate may then be estimated to be 9.18 E05 L/mo, based on 5 calcination days per week, and a 30-d month. Table 2-2 summarizes the process condensate generation rate data for both calcination and standby mode.

Table 2-2. Process Condensate Generation Rates.

	Standby Operating Mode			Calcination Operating Mode	
Month-	3/88	Liters:	4.32 E04	2/1-6/88 Liters: 2.14 E05 (only 5 calcination mode days during that period)	
	5/88		5.63 E04		
	6/88		6.21 E04		
	8/88		3.95 E04		
Average monthly volume, L:			5.03 E04	9.18 E05	(Extrapolated for 30-d month, calcining 5 d per week)

2.4.2 Feed Uranyl Nitrate Hexahydrate Concentrator Off-gas

Process condensate produced from the feed UNH concentrator off-gas contains mostly condensed water vapor, acidified to a pH of 1.5 to 2.5 with associated NO_x fumes, and contaminated with minute quantities of uranium-bearing mists entrained from the liquid phase in the concentrator.

In the E-D-2, E-D-6, and E-D-7 feed UNH concentrators, 60 wt% UNH from PUREX is thermally boiled to produce 100 wt% UNH for further processing in 224-UA. Small amounts of raw water are used to flush the concentrators and rinse the knockout pot mesh sprays. The off-gas contains mostly water vapor, with some NO_x and any entrained UNH. Comparison of the mass flowrate of uranium through the concentrator with combined rates of uranium exiting through the process condensate and 296-U-4 stack indicates that the concentrator knockout pots and the D-13 surge tank allow only 0.000075% of the liquid in the concentrators to become entrained in the concentrator off-gas.

Table 2-3 shows the specification for UNH shipped from PUREX to UO_3, but only lists those constituents important for process control purposes. Other trace impurities may be present, for which analytical data are not available. Attempts to analyze the feed UNH for trace organic constituents proved unsuccessful due to interference from the large amounts of uranium present.

In order to prevent formation of a potentially explosive red oil phase in the feed UNH concentrators, considerable effort is expended to exclude from the UO_3 Plant TBP-NPH used in PUREX solvent extraction. The feed is steam-stripped and decanted at PUREX prior to shipment to the UO_3 Plant. The feed is inspected for a visible layer at UO_3 Plant and returned to PUREX in the event that a visible organic layer is present. The feed is allowed to settle in TK-C-1, and is decanted (pumped from the bottom) to storage tanks X-1 and X-2. The feed is allowed to settle again in tanks X-1 and X-2, and is decanted once more when transferred to the feed UNH concentrators.

Despite these precautions, traces of normal paraffin hydrocarbon (NPH) and tributyl phosphate (TBP) from PUREX inevitably contaminate the feed processed in the UO_3 Plant concentrators. As discussed in reference (WHC 1990b), TBP and NPH have not been found in the process condensate during concentration, indicating that these compounds are not volatilized in the concentrators. Any NPH and TBP present in the feed that has not had the opportunity to undergo degradation will pass through to the concentrated feed pump tank X-30.

Table 2-4 shows the constituents typically found in 200 West Area raw water. Over an entire calcination campaign, raw water accounts for <0.1% of the material processed through the feed UNH concentrators.

The feed UNH concentrator off-gas is the largest volume contributor to the UO_3 Plant process condensate during calcination mode. The rate of condensate production from this contributor varies from 0 to 40 L/min during a calcination period, depending on the inventory of 100% UNH in TK-X-30. No 100% UNH is stored at UO_3 Plant during standby, because of its tendency to solidify and plug piping systems and equipment. At the beginning of a calcination period, two to three UNH feed concentrators are operated to build up the inventory of 100% UNH in TK-X-30. While the plant is at steady-state, often only 1-2 concentrators operate, contributing about 15 to 30 L/min. In preparation for weekend shutdowns or standby mode, the concentrators are shut down 1-2 shifts before the calciners, so that the calciners can consume the 100% UNH inventory in TK-X-30.

2.4.3 Calciner Off-gas

Mixed with steam from the J-A-3 and J-A-1 off-gas jets, the calciner off-gas stream exiting the nitric acid recovery system condenses in E-B-3 to produce distilled water acidified by the NO_x absorbed. This highly acidic process condensate contributor accounts for the majority of the acidity in the entire process condensate stream. After passing through the nitric acid recovery system, the calciner off-gas contains mostly air, NO_x, and small amounts of water vapor. While the nitric acid recovery system removes essentially all of the uranium originally present in the calciner off-gas, traces of uranium are entrained from the scrub water recycled to the top tray of T-A-3.

Calciner off-gas, containing mostly water vapor, oxides of nitrogen, and entrained UO_3 powder, passes through several purification steps before reaching the process condensate via condensation in the E-B-3 condenser. The calciner off-gas is scrubbed with recovered nitric acid (Table 2-5) to de-superheat the stream and dissolve any entrained UO_3 powder fines. Most of the water vapor drops out in E-A-4 to produce a concentrated nitric acid stream which drains to the recovered nitric acid tank C-4. Air from the A-cell atmosphere is added to the calciner offgas to promote oxidation of NO to NO_2 in the T-A-3 nitric acid tower. The 20-bubblecap tray T-A-3 nitric acid absorber removes most of the remaining NO_x and virtually all of the entrained uranium.

Table 2-3. Specification for Shipping Uranyl Nitrate Hexahydrate From PUREX to UO_3 Plant.

Variable	Criteria
Uranium	3.9 TO 4.4 lbs/gal
Nitric Acid	<0.10 lb/gal
Actinides	
1. ^{235}Uranium	<1.0 wt% in uranium
2. Plutonium	<10 ppb uranium
3. Thorium	<750 ppmp uranium
Fission products	
1. ^{95}Zr Nb	<10 µCi/lb uranium
2. ^{103}Ru and ^{106}RuRh	<20 µCi/lb uranium
3. All others excluding ^{99}Tc	<2 µCi/lb uranium
	<0.5 µCi/lb uranium average for each 480 tons
Metal Impurities	
1. Iron	<10 ppmp uranium
2. Nickel	<12 ppmp uranium
3. Chromium	<16 ppmp uranium
4. Sodium	<20 ppmp uranium
Organic (e.g., normal paraffin hydrocarbon, tributyl phosphate from PUREX in the UNH)	No visible organic phase

Table 2-4. Summary of 200 Area Raw Water and Sanitary Water Data (1985-1989). (sheet 1 of 2)

Constituent/Parameter [all ppb, exceptions noted]	Raw Water[a] (1986-1987) N[d]	AVG	STD DEV	Sanitary Water[b] (1985-1988) N	AVG	STD DEV	2724-W Laundry Sanitary Water[c] (1989) N	AVG	STD DEV
Alkalinity (Method B)				4	5.45E+04	5.78E+02			
Aluminum	5	1.78E+02	6.31E+01						
Arsenic				4	<5.00E+00	NA			
Arsenic (EP Toxic)							4	<5.00E+02	NA
Barium	5	2.94E+01	1.52E+00	4	*1.15E+02	1.91E+01	4	2.90E+01	1.41E+00
Barium (EP Toxic)							4	<1.00E+03	NA
Boron							4	1.77E+01	1.00E+01
Cadmium				4	<5.00E-01	NA			
Cadmium (EP Toxic)							4	<1.00E+02	NA
Calcium	5	1.76E+04	2.71E+03				4	1.87E+04	2.94E+02
Chromium				4	<1.00E+01	NA			
Chromium (EP Toxic)							4	<5.00E+02	NA
Chloride	5	8.25E+02	1.99E+02	4	2.35E+03	8.66E+02	4	2.92E+03	1.71E+02
Conductivity-field (μS)	5	9.40E+01	4.65E+01				4	1.45E+02	1.60E+01
Copper	5	1.52E+01	7.96E+00	4	<5.00E+01	NA			
Color (units)				4	*6.25E+00	2.50E+00			
Ignitability (deg F)							4	2.11E+02	2.00E+00
Iron	5	1.14E+02	1.44E+02	4	*2.50E+02	2.68E+02	4	3.27E+01	3.40E+00
Fluoride	1	9.30E+01	NA	4	*1.08E+02	1.50E+01	4	1.28E+02	8.68E+00
Lead	3	8.13E+00	5.42E+00	4	<5.00E+00	NA			
Lead (EP Toxic)							4	<5.00E+02	NA
Magnesium	5	4.12E+03	5.41E+02				4	4.35E+03	1.59E+02
Manganese	5	1.68E+01	1.99E+01	4	<1.00E+01	NA			
Mercury				4	<5.00E-01	NA			
Mercury (EP Toxic)							4	<2.00E+01	NA
Nitrate (as N)				4	*8.50E+01	4.12E+01	4	5.00E+02	0.00E+00
pH (dimensionless)	5	6.52E+00	1.04E+00				4	7.10E+00	3.40E-01
Potassium	5	7.88E+02	4.25E+01				4	7.28E+02	5.44E+01
Reactivity Cyanide (mg/kg)							4	<1.00E+02	NA
Reactivity Sulfide (mg/kg)							4	<1.00E+02	NA
Selenium				4	<5.00E+00	NA			
Selenium (EP Toxic)							4	<5.00E+02	NA
Silicon							4	2.14E+03	1.02E+01
Silver				4	<1.00E+01	NA	4	1.00E+01	0.00E+00
Silver (EP Toxic)							4	<5.00E+02	NA

Table 2-4. Summary of 200 Area Raw Water and Sanitary Water Data (1985-1989). (sheet 2 of 2)

Constituent/Parameter [all ppb, exceptions noted]	Raw Water[a] (1986-1987) N[d]	AVG	STD DEV	Sanitary Water[b] (1985-1988) N	AVG	STD DEV	2724-W Laundry Sanitary Water[c] (1989) N	AVG	STD DEV
Sodium	5	2.23E+03	9.28E+01	4	2.20E+03	1.15E+02	4	2.05E+03	1.28E+02
Strontium							4	9.47E+01	3.00E+00
Sulfate	5	9.83E+03	1.40E+03	4	1.47E+04	1.16E+03	4	1.40E+04	4.44E+02
Sulfide	5	1.00E+03	8.63E-05						
Temperature-field (C)	5	1.48E+01	6.80E+00				4	1.31E+01	7.40E+00
Total Carbon (μg/g)							4	1.51E+04	1.71E+02
TOC (μg/g)	5	1.61E+03	4.76E+02						
TOX (μg (Cl)/L)	4	1.44E+01	8.30E+00				4	1.42E+02	1.30E+01
TDS (mg/L)				4	7.95E+01	1.28E+01	4	5.37E+04	3.06E+04
Trichloromethane							4	2.82E+01	7.94E+00
Uranium	5	5.21E-01	1.80E-01				3	2.54E-01	9.46E-02
Zinc	5	7.60E+00	8.94E-01	4	*1.03E+02	4.50E+01	4	5.85E+01	3.12E+01
Alpha Activity	5	2.34E+00	3.49E+00						
Beta Activity	5	1.05E+01	1.47E+01				3	4.33E+00	3.86E+00

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

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

[a]Compiled from "Substance Toxicity Evaluation of Waste Data Base" provided by F. M. Jungfleisch (this data is an update of the data presented in WHC 1988, *Preliminary Evaluation of Hanford Liquid Discharges*), Westinghouse Hanford Company, Richland, Washington.

[b]Compiled from HEHF, 1986, *Hanford Sanitary Water Quality Surveillance, CY 1985*, HEHF-55, Hanford Environmental Health Foundation, Environmental Health Sciences, Richland, Washington; HEHF-59; HEHF-71; and HEHF-74 (corresponding reports for CY 1986, 1987, and 1988).

[c]Data are from sampling campaign conducted October 1, 1989, to March 30, 1990, in support of Stream Specific Reports. The sanitary water supplied to the 2724-W Laundry originates from the same source as the sanitary water used at the UO_3 Plant.

[d]N is defined as the number of test results available for a particular analyte; N may reflect both single and multiple data sets.

ppb = parts per billion.
TOC = total organic carbon.
TOX = total organic halides.
μS = microsiemen.
μg = microgram.

Table 2-5. Specification for UO_3 Plant Recovered Nitric Acid.

Constituent	Concentration value	Units
HNO_3	4.9 to 6.0	lb/gal
H_2O	remainder of solution	--
U	<0.15	lb/gal
^{235}U	<1.0	%wt U
Cl^-	<50	ppm

*Shipping specification for recovered nitric acid.

After mixing with steam from the JA-1 and JA-3 off-gas jets, the remaining volatiles in the calciner off-gas condense in E-B-3 to contribute most of the acidity found in the process condensate. The TK-C-9 outlet pH indicator shows that the calciner offgas condensate accounts for much of the acidity in the process condensate stream. When only the feed UNH concentrators are operating, the process condensate pH exiting TK-C-9 is typically near 1.5, as measured by the in-line pH instruments. As calciners are brought on-line, the TK-C-9 exit pH monitor reading progressively decreases to 0.5 to 0.6. When the feed UNH concentrators are shut down while the calciners are operating, the TK-C-9 pH indication decreases further, to 0.4 to 0.5. While the TK-C-9 outlet pH indicator is not calibrated with any standard buffer solutions below a pH of 2, the trend is clear.

As discussed in Section 2.4.2, trace undegraded TBP and NPH contaminants present in the 60% UNH feed from PUREX are expected to pass through the feed UNH concentrators and exit with the 100% UNH concentrator bottoms. When the 100% UNH passes through the calciners, hydrocarbon-cracking and volatilization are expected due to the high calciner powder bed temperatures. Data in reference WHC (1990b) indicates the possibility of oxidation of NPH degradation products in the calciner off-gas stream. Any TBP and NPH remaining in the calciner off-gas is expected to be collected by the nitric acid scrubbers, E-A-4 condenser, and nitric acid absorber, and is expected to exit the plant in the recovered nitric acid. TBP and NPH are not expected to pass through the nitric acid absorber to the E-B-3 condenser.

Process condensate is regularly analyzed for nitrate to ensure that the resulting potassium nitrate concentration (which is normally about 3%) in the neutralized process condensate will not exceed 5 weight percent, as discussed in Section 2.4.9.

2.4.4 Recycle Uranyl Nitrate Hexahydrate Concentrator Off-gas

Process condensate produced from the recycle UNH concentrator off-gas consists of condensed water vapor, acidified to a pH of 1.5 to 2.5 with associated NO_x fumes, and contaminated with minute quantities uranium-bearing of mists entrained from the liquid phase in the concentrator. Any other volatiles boiled off in the recycle concentrator may also be condensed in the E-D-3 and E-D-3 condensers.

In the TK-C-2 recycle UNH concentrator, potentially uranium-bearing aqueous solutions from throughout the 224-U process cells, 224-U building, 203-U enclosure, and the Backpad area are accumulated and thermally boiled until sufficiently concentrated for re-processing at PUREX. The residence time of the recycle concentrator depends on the rate of uranium accumulation, which depends, in turn, upon the UO_3 Plant processing schedule and equipment flushing and decontamination activities needed at the time. The acidity of the recycle concentrator keeps the uranium in solution.

The UO_3 Plant recycle concentrator provides an operating environment unique to the Hanford Site, as increasingly concentrated solutions of UNH and nitric acid are boiled for long periods of time. The high temperatures (100 to 110 °C), presence of nitric acid, and long residence times (several months to several years) provide an oxidizing environment capable of breaking down many classes of organic compounds. Except for entrainment, the only pathway for nonvolatile compounds such as TBP and NPH to escape from the recycle concentrator is by being broken down into more volatile compounds which are then stripped from the recycle concentrator by the water vapor bubbles rising from the steam heating coil surfaces (WHC 1990b).

Constituents added to the recycle concentrator include:

- Feedstock UNH From PUREX: Some of this material finds its way into the recycle concentrator via tank and equipment flushes, leaks, sample returns, etc. The principal process-related constituents in the feedstock UNH are listed in Table 2-3. Other trace impurities have not been analyzed.

  As discussed in Section 2.4.2, traces of TBP and NPH are present in the UNH. Data in WHC (1990b) show an interesting trend. While no detectable quantities of TBP and NPH are evolved from the recycle concentrator, detectable concentrations of butanol are seen during processing, and acetone, butanone, and other volatile degradation products are detected upon the completion of a calcination campaign. The concentrations of degradation products decay away over several months following the calcination campaign.

  This trend suggests that the recycle concentrator digests trace quantities of TBP and NPH over a period of time, and drives off the volatile degradation products.

- Concentrated (100%) UNH, diluted with steam condensate (no sample data available), raw water (Table 2-4), and/or sanitary water (Table 2-4): The concentrated UNH is similar in composition to the 60% UNH with three exceptions; 1) The concentrated UNH contains less nitric acid and 2) less water than the 60% UNH from PUREX (Table 2-3), and 3) Approximately 400-600 parts sulfur per million parts uranium (ppmpU) are added in the form of 92 wt% sulfuric acid to the 100% UNH for optimal processing of the UO_3 product at the Feed Materials Production Center in Fernald, Ohio. The 100% UNH reaches the recycle concentrator when steam cleaning the 100% UNH recirculation header, back-flushing the F-1 and F-2 100% UNH filters, and similar activities are performed.

TBP and NPH impurities present in the 60% UNH from PUREX are believed to pass through the feed UNH concentrators, and contaminate the 100% UNH, as discussed in previous sections.

- Recovered nitric acid (Table 2-5): used for dissolving UNH and UO_3 powder adhering to or blocking process vessels or piping. The portions of the calciner off-gas lines immediately exiting the calciners are cleaned with recovered nitric acid following every calcination period to remove accumulated uranium solids. Other vessels and equipment are cleaned as needed.

  As discussed in the previous section, the recovered nitric acid is believed to contain NPH and TBP driven off from the 100% UNH in the calciners. The consistent post-calcination pattern of degradation product detection in the process condensate (WHC 1990b) may result from the increased use of recovered nitric acid for equipment cleaning following a campaign. Recovered nitric acid used for uranium dissolution is routed to the recycle concentrator: it is not returned to the recovered nitric acid system.

- Uranium oxide powder: dissolved in recovered nitric acid (Table 2-5) during equipment cleaning and decontamination.

- Raw water: used for cleaning and flushing equipment, and for testing the concentrator quench system.

- Sanitary water: used for cleaning and flushing equipment, and in eyewashes and safety showers, which are tested on a regular basis.

- Steam condensate: from steam tracing lines. Steam is also used to clean out piping and process vessels. Condensate from steam jets dilutes most solutions transferred to the recycle concentrator, to the extent that steam condensate comprises 10 to 20% of the liquid transferred to the recycle concentrator.

- Phosphoric acid leakage from the process condensate neutralization system and associated piping: The double-block-and-bleed valves on the outlet of TK-C-5 drain to the C-cell sump, which is eventually transferred to the recycle concentrator.

- Potassium hydroxide leakage from the process condensate neutralization system and associated piping: The double-block-and-bleed valves on the outlet of TK-C-5 drain to the C-cell sump, which is eventually transferred to the recycle concentrator.

- Rainwater and snowmelt from potentially contaminated roof drains, the 203-U enclosure, and the Backpad area: Approximately 20,000 gal of process condensate result from each inch of precipitation.

- Chemicals: including detergent, WEDAC*, and calcium chloride de-icer.

- Corrosion products associated with any of the streams listed above: Most of the process piping at 224-U is 300 series stainless steel. Carbon steel, brass, copper, cast iron, and malleable iron are used for water, steam, and compressed air supply lines.

2.4.5 Steam From 284-W Powerhouse

Steam from the 284-W powerhouse combines with process off-gases in the J-A-1 and J-A-3 off-gas jets, and condenses in the E-B-3 condenser. No sample results are available for steam condensate from the branch distribution line immediately upstream of UO_3 Plant.

2.4.6 Fumes From Miscellaneous Process Vessel Vents

The process vessel ventilation system is connected to 224-U Building process tanks containing UNH, recovered nitric acid, and process condensate. In addition, the process vessel ventilation system services the 100% UNH storage tank. Vapors from these tanks contain many of the same constituents discussed elsewhere in this section, but in far more modest quantities.

2.4.7 Sanitary Water

Sanitary water is added directly to TK-C-9 when condensate generation rates are expected to be too low for continued nitric acid absorber operation during calcination. Excess sanitary water then overflows to TK-X-37. An analysis of 200-West area sanitary water is presented in Table 2-4.

2.4.8 Phosphoric Acid

Approximately 500 ml of 70 wt% commercial-grade phosphoric acid are added to each 1,860-L batch of process condensate neutralized in TK-C-5. This phosphoric acid serves two complementary purposes. First, the presence of low concentrations of phosphate in the process condensate greatly reduces the mobility of any uranium in the stream to the 216-U-17 Crib. Also, the phosphate buffers the process condensate neutralization tank, allowing pH control in a tight pH range which further minimizes mobility of uranium in 216-U-17. The phosphoric acid is sampled for phosphoric acid content only; no sample data are available to document impurities in the phosphoric acid.

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*WEDAC is a registered trademark of West Chemical Products Incorporated, Long Island City, New York.

2.4.9 Potassium Hydroxide

Potassium hydroxide is added to the process condensate to neutralize the acidity present. The amount added is determined by a feedback pH control algorithm according to the amount of acidity to be neutralized. For a pre-neutralized pH of 0.5, approximately 64 L of 40 weight percent potassium hydroxide are required to neutralize a resulting 1,860-L batch of process condensate. The amount of potassium hydroxide added during standby is much less than during calcination, because of the lower initial acidity encountered. The potassium hydroxide is sampled at Hanford Laboratories for caustic potash, chloride, sodium, calcium, and strontium.

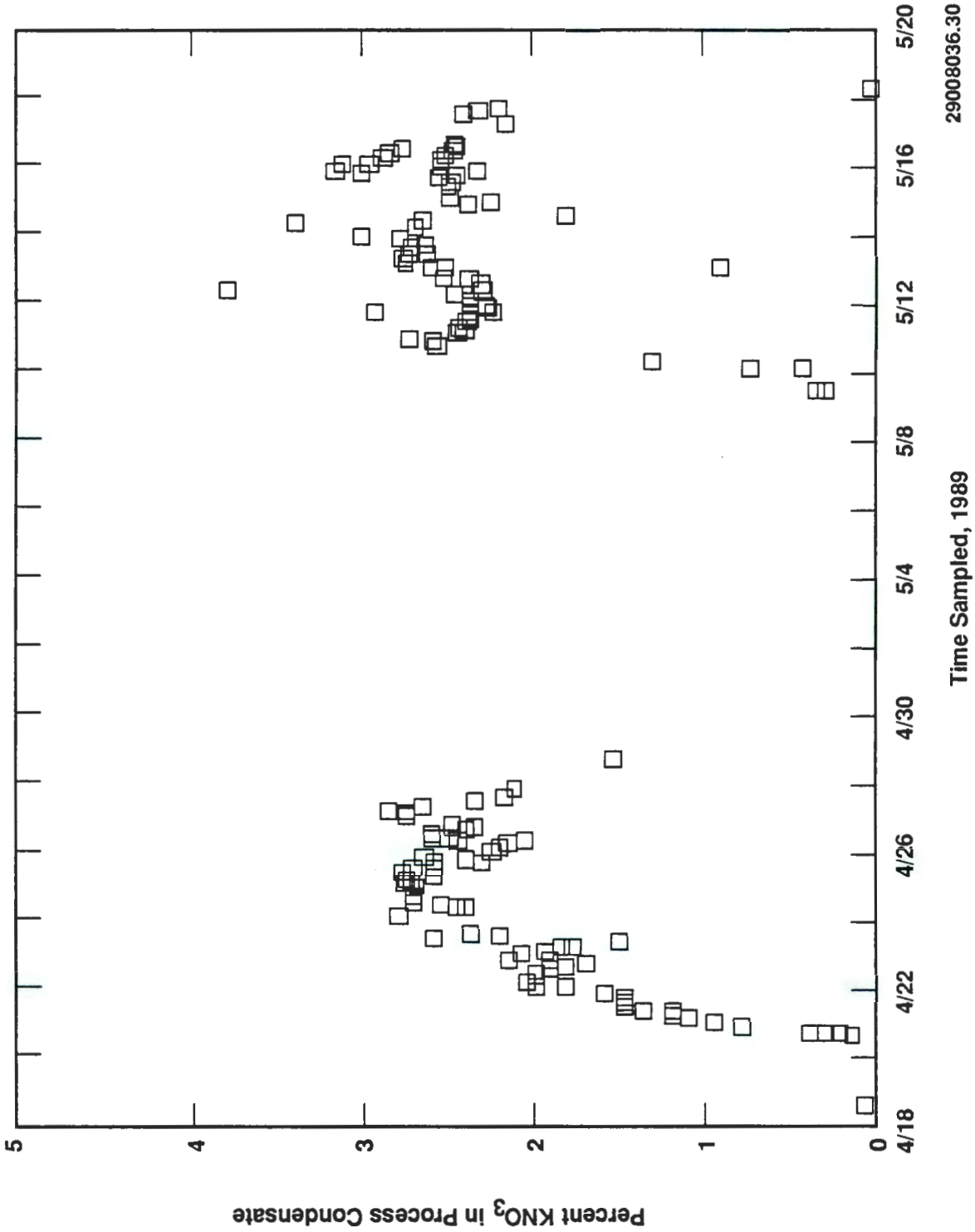
When the process condensate is neutralized, the potassium hydroxide reacts with nitric acid and phosphoric acid buffer to form potassium nitrate, dibasic potassium phosphate, and monobasic potassium phosphate. As discussed in Section 5.4.1, the potassium nitrate contributor accounts for over 95% of the equivalent toxic concentration found during process condensate characterization sampling. In order to ensure that the neutralized process condensate is not a dangerous waste, the process condensate is regularly sampled for nitrate prior to neutralization. The potassium nitrate concentration in the neutralized condensate is limited by the amount of nitrate available in the unneutralized waste. Barring a catastrophic process upset, the process condensate will never be a toxic dangerous waste per WAC 173-303-9906 as long as the nitrate concentration is kept below the administrative control limit of 5 wt%.

Process control samples have shown that the potassium nitrate concentration is always less than 1 weight percent in the standby mode. During calcination, the potassium nitrate concentration reaches a maximum value of slightly over 3 weight percent when, in preparation for shutdown, the calciners continue to process the inventory of 100% UNH after the feed UNH concentrators are shut down. The 296-U-4 stack NO_x monitor and the TK-C-9 pH monitor provide real-time assurance that insufficient nitrate is available to violate this administrative limit.

Potassium nitrate data for the most recent calcination mode operation are shown in Figure 2-8. Standby mode samples are included at the beginning and end of the calcination activity. TK-X-37 was agitated continuously, and the preneutralized condensate was sampled and analyzed at regular intervals for nitrate by the Westinghouse Hanford laboratories. Potassium nitrate concentrations were calculated assuming that all of the available nitrate exited the neutralization tank as potassium nitrate. At no time did the potassium nitrate exceed the 5 weight percent administrative control limit.

The processing campaign illustrated in Figure 2-8 achieved the highest UO_3 production of any campaign since 1984 and represents the highest nitrate concentrations expected to be encountered during future operations. The potassium nitrate concentrations clearly reflect the process activities occurring at the time. For example, it is readily apparent in Figure 2-8 that the plant briefly reverted to standby mode from April 28, 1990, to May 8, 1990, to complete planned maintenance activities.

Figure 2-8. Potassium Nitrate Concentration Trends During Calcination (Calculated from X-37 Sample Data).



2.5 ADMINISTRATIVE CONTROLS

Administrative controls have been imposed to meet the requirements, intent, and spirit of all applicable federal, state, and local environmental laws, regulations, and standards. A program of regulatory compliance has been developed based on environmental laws and input from regulatory agencies.

2.5.1 General UO_3 Plant Process Condensate Management

Since current technology does not exist for on-line (real-time) monitoring for all regulated materials, the UO_3 Plant management has incorporated administrative controls to regulate generation and discharge of the UO_3 Plant Process Condensate. Some of these controls are addressed in Sections 2.3.2.1 through 2.3.2.4; others are addressed below.

2.5.2 General Requirements

The administrative controls are based on general requirements that apply to all activities associated with regulated materials.

Training is fundamental to the implementation of administrative controls. General training courses are given to all employees, and specific training is given to employees who work with regulated materials or in areas where they may come in contact with them. This training program includes annual refresher training. A tickler system is used at UO_3 Plant to minimize the potential for employees to become delinquent in training requirements.

An additional general requirement that provides an important control consists of frequent surveillances and inspections. These are conducted on a regular basis and are supplemented with random surveillances.

2.5.3 Specific Requirements

Administrative controls are in place for assuring that no materials regulated by Ecology, the EPA, and the DOE are released into Hanford soil columns. In the case of the UO_3 Plant Process Condensate, a two-pronged approach is taken:

- Disposal of dangerous waste is controlled to prevent improper disposal of wastes to any sumps, sinks, or drains which are routed to the uranium recycle concentrator. This is accomplished by mandating that all wastes of a chemical nature are dispositioned through the chemical waste disposal system. This methodology is incorporated to ensure that all chemical waste designations are performed by Solid Waste Engineering (SWE) and all designated wastes are properly staged, packaged, and transported from the facility in accordance with applicable laws. Company manuals are available at the facility to provide guidance on waste management.

- Operation of the process condensate neutralization system is strictly controlled to ensure that the pH, radionuclide, and potassium nitrate concentrations are within the respective discharge limits. Specific controls for the neutralization system are addressed below.

Administrative controls surrounding the UO_3 Plant Process Condensate neutralization system include:

- **Regular sampling of the preneutralized condensate for uranium, technetium, and nitrate.** In standby mode, TK-X-37 is isolated and quarantined after sampling, and condensate is not discharged until sample results have been reviewed. In calcination mode, frequent samples provide a running check on the process.

- **Monitoring of process indicators that warn of potential problems with the condensate system.** In calcination mode, real-time indicators such as 296-U-4 stack NO_x concentration and TK-C-9 pH are monitored to ensure insufficient nitrate is available to make the condensate a toxic waste. The operation of the concentrators is monitored to guard against burps or other process upsets which could result in entrainment of radionuclides.

- **Direct monitoring for operation of the process condensate neutralization system.** Four independent pH readings (two process pH meters controlling the neutralization system and two record pH meters in the discharge line downstream of the neutralization system) are recorded for each batch discharged. The neutralization incomplete alarm activates if a condensate batch cannot be neutralized within a predetermined time interval. Condensate with sufficient acidity to exceed the 5 weight percent potassium nitrate administrative limit would take much longer to neutralize and would trigger this alarm.

- **Administrative reinforcement of physical control.** The fail-safe neutralization system interlocks are reinforced by a management philosophy which prohibits bypassing or otherwise operating the neutralization system during times of key equipment failures. The discharge is shut down, and the X-37 surge tank accumulates condensate while repairs are made without impacting operations.

2.5.4 Diligent Search

As a check for effectiveness of administrative controls, a diligent search was performed. This consisted on an inspection of the UO_3 Plant for materials or activities that have a direct bearing on the environmental compliance of the facility. The facility search encompassed review of documentation and inspection of selected operating activities for product and waste handling. This was done to assure that an accurate proposed designation of the UO_3 Plant Process Condensate could be presented in this report.

Documentation reviewed included Material Safety Data Sheets (MSDS), *Superfund Amendment and Reauthorization Act of 1986* (SARA) 312 inventory reports, dangerous waste shipping reports (manifests), spill reports, and facility procedures. The inspection included discussions with facility staff on chemical waste disposal practices.

Diligent search with respect to the potential for improper disposal to the UO_3 Plant Process Condensate is incorporated in the Section 5.3 discussion.

3.0 SAMPLE DATA

This section reports and summarizes the sample results for the UO_3 Plant process condensate stream. There are two data sets provided: wastestream sampling data and background data.

3.1 DATA SOURCE

The wastestream sampling data, which identify both chemical and radiological constituents during both calcination and standby mode, consist of five samples taken during the period from February 1988 through August 1988. These data are reported in Appendix A. Since discharges to the 216-U-17 crib have been administratively suspended since July 1989, new data are not available for this wastestream. Additionally, all data taken in support of WHC (1989) are provided in Appendix B.

The background data consist of samples taken of the raw water supply from the Columbia River and samples taken of 200 West sanitary water. This information is provided in Table 2-4.

3.1.1 Wastestream Sampling Data

The wastestream sampling data consists of two separate sets: a) the chemical data set, and b) the radiological data set, both of which are reported in Appendix A.

3.1.1.1 Chemical. The chemical data consists of 5 samples collected over a 7-mo period of time; these samples were obtained from the process condensate discharge line sample location immediately downstream of tank C-5, the process condensate neutralization tank, as noted in Figure 2-5. This location was chosen because it is downstream of the point of generation (tank C-9), and it is also downstream of neutralization chemical contributors. The dates that samples were taken, and the corresponding plant status, are as follows:

Sample Date	Plant Status
February 6, 1988	Uranium calcination*
March 1, 1988	Standby
May 13, 1988	Standby
June 21, 1988	Standby
August 9, 1988	Standby

*Samples taken prior to February 1988, during discharge to the 216-U-12 crib are not used in the designation process, except as information that has helped in the evolution of process knowledge.

The sampling procedure called for representative sampling in accordance with SW-846 (EPA 1982) sampling and analytical protocol. This protocol requires that a sufficient number of samples be collected in a random manner over a sufficient period of time to characterize variability or uniformity of the stream. This was done by taking grab samples on a partitioned time random basis. The sampling was randomized by splitting each workday of the month to be sampled into two 4-h time periods and selecting one of these time periods by using a random number generator. All samples were taken to the Contract Laboratory in Richland, Washington for analysis. The specific details of the sampling and analytical procedures used are contained in Volume 4 of WHC (1989). The error introduced by chemical analysis is not specifically addressed in this report.

3.1.1.2 Radiological. The radiological data set consists of samples taken at the same location on the same dates as mentioned in Section 3.1.1.1.

3.1.2 Background Data

Information on the impurity content of incoming water supplies to UO_3 Plant was used in conjunction with other data in an effort to identify background constituents existing in the stream prior to use at the facility. This data was not used in calculations of corrected concentrations for waste designation purposes. However, in situations where process knowledge reveals no identifiable source, this information, in conjunction with sample blank data may prove useful in determining the most plausible source of a contaminant. See Table 2-4.

3.2 DATA PRESENTATION

The following three-step approach has been taken in determining which constituents are present in the UO_3 Plant Process Condensate: 1) identify constituents of concern, 2) specify which of these constituents have been detected, and 3) present the data in a statistical summary format.

Procedural Liquid Effluent Analytical Data and Chain of Custody reference numbers associated with the UO_3 Plant process condensate samples are identified in Table 3-1. Twenty-three and thirty-one unique chemical constituents were identified in the stream as being at or above the Contract Laboratory contract detection limits during calcination and standby modes, respectively. These data can be found in Table 3-2 in a statistical summary format.

Table 3-1. Procedures for UO_3 Plant Process Condensate Samples. (sheet 1 of 2)

Calcination Samples				
LEAD #	50380			
C of C #	50380			
Alpha counting	X			
Ammonia	X			
Atomic emission spectroscopy	X			
Beta counting	X			
Cyanide	X			
Direct aqueous injection (GC/MS)	X			
Fluoride (LDL)	X			
Hydrazine	X			
Ion chromatography	X			
Lead	X			
Mercury	X			
pH-field	X			
Semivolatile organics (GC/MS)	X			
Sulfide	X			
Temperature-field	X			
Total organic carbon	X			
Total organic halides (LDL)	X			
Uranium	X			
Volatile organics (GC/MS)	X			
LEAD #	50380B			
C of C #	50381			
Volatile organics (GC/MS)	X			
Standby Samples				
LEAD #	50386	50420	50432	50444
C of C #	50386	50420	50432	50444
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	X	X	X
Hydrazine	X	X	X	X
Ion chromatography	X	X	X	X
Lead	X	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	X

Table 3-1. Procedures for UO_3 Plant Process Condensate Standby Samples. (sheet 2 of 2)

	Standby Samples			
LEAD #	50386	50420	50432	50444
C of C #	50386	50420	50432	50444
Temperature-field	X	X	X	X
Total organic carbon	X	X	X	X
Total organic halides (LDL)	X	X	X	X
Uranium	X	X	X	X
Volatile organics (GC/MS)	X	X	X	X
LEAD #	50386B	50420B	50432B	50444B
C of C #	50387	50421	50433	50445
Volatile organics (GC/MS)	X	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. C of C # is the chain-of-custody number.

Abbreviations:

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

Table 3-2. Statistics for UO_3 Plant Process Condensate.
(sheet 1 of 2)

Constituent	N	MDA	Method	Mean	StdErr	90%CILim	Maximum
Calcination Statistics							
Barium	1	0	n/a	8.00E+00	n/a	n/a	8.00E+00
Cadmium	1	0	n/a	2.00E+00	n/a	n/a	2.00E+00
Chromium	1	0	n/a	1.08E+02	n/a	n/a	1.08E+02
Fluoride	1	0	n/a	2.47E+04	n/a	n/a	2.47E+04
Manganese	1	0	n/a	9.00E+00	n/a	n/a	9.00E+00
Mercury	1	0	n/a	3.68E+00	n/a	n/a	3.68E+00
Nickel	1	0	n/a	5.50E+01	n/a	n/a	5.50E+01
Nitrate	1	0	n/a	1.52E+07	n/a	n/a	1.52E+07
Phosphate	1	0	n/a	2.66E+05	n/a	n/a	2.66E+05
Potassium	1	0	n/a	1.22E+07	n/a	n/a	1.22E+07
Sodium	1	0	n/a	2.24E+04	n/a	n/a	2.24E+04
Uranium	1	0	n/a	4.19E+02	n/a	n/a	4.19E+02
Zinc	1	0	n/a	1.10E+01	n/a	n/a	1.10E+01
Acetone	1	0	n/a	2.30E+01	n/a	n/a	2.30E+01
Benzoic acid	1	0	n/a	1.40E+01	n/a	n/a	1.40E+01
1-Butanol	1	0	n/a	5.00E+00	n/a	n/a	5.00E+00
2-Butanone	1	0	n/a	1.20E+01	n/a	n/a	1.20E+01
2-Butoxyethanol	1	0	n/a	5.80E+01	n/a	n/a	5.80E+01
Butyl nitrate	1	0	n/a	4.40E+01	n/a	n/a	4.40E+01
Trans-4-chloro-cyclohexanol	1	0	n/a	7.80E+01	n/a	n/a	7.80E+01
Methyl nitrate	1	0	n/a	6.60E+01	n/a	n/a	6.60E+01
2-Methyl-5-propylnonane	1	0	n/a	5.00E+01	n/a	n/a	5.00E+01
Nitroethane	1	0	n/a	4.30E+01	n/a	n/a	4.30E+01
N-Nitrosodimethylamine	1	0	n/a	4.00E+01	n/a	n/a	4.00E+01
Unknown	1	0	n/a	7.00E+00	n/a	n/a	7.00E+00
Unknown aliphatic HC	1	0	n/a	9.80E+01	n/a	n/a	9.80E+01
Alpha Activity (pCi/L)	1	0	n/a	4.47E+02	n/a	n/a	4.47E+02
Beta Activity (pCi/L)	1	0	n/a	7.07E+03	n/a	n/a	7.07E+03
pH (dimensionless)	1	0	n/a	7.13E+00	n/a	n/a	7.13E+00
Temperature (°C)	1	0	n/a	2.62E+01	n/a	n/a	2.62E+01
TOC	1	0	n/a	6.39E+03	n/a	n/a	6.39E+03
TOX (as Cl)	1	0	n/a	2.18E+01	n/a	n/a	2.18E+01

Table 3-2. Statistics for UO_3 Plant Process Condensate.
(sheet 2 of 2)

Constituent	N	MDA	Method	Mean	StdErr	90%CILim	Maximum
Standby Statistics							
Chloride	4	0	n/a	7.31E+02	6.73E+01	8.41E+02	8.78E+02
Chromium	4	0	n/a	2.57E+01	5.36E+00	3.45E+01	3.60E+01
Cyanide	4	0	n/a	1.67E+02	2.80E+01	2.13E+02	2.46E+02
Fluoride	4	0	n/a	5.53E+02	2.98E+02	1.04E+03	1.42E+03
Iron	4	3	DL	4.50E+01	1.50E+01	6.96E+01	9.00E+01
Mercury	4	2	DL	1.25E-01	1.89E-02	1.56E-01	1.80E-01
Nickel	4	0	n/a	2.15E+01	2.06E+00	2.49E+01	2.60E+01
Nitrate	4	0	n/a	2.98E+05	1.46E+05	5.37E+05	7.35E+05
Phosphate	4	1	DL	1.41E+05	5.16E+04	2.25E+05	2.25E+05
Potassium	4	0	n/a	3.64E+05	1.11E+05	5.47E+05	6.92E+05
Sodium	4	0	n/a	7.10E+02	1.40E+02	9.40E+02	1.13E+03
Sulfate	4	2	DL	6.83E+04	6.66E+04	1.77E+05	2.68E+05
Uranium	4	0	n/a	4.10E+01	1.50E+01	6.55E+01	7.24E+01
Zinc	4	3	DL	5.25E+00	2.50E-01	5.66E+00	6.00E+00
Acetone	2	0	n/a	1.50E+02	4.00E+01	2.73E+02	1.90E+02
Ammonia	4	2	DL	7.37E+01	1.37E+01	9.62E+01	9.90E+01
9,10-Anthracenedione	1	0	n/a	1.80E+01	n/a	n/a	1.80E+01
2-Butanone	4	3	DL	1.67E+01	6.75E+00	2.78E+01	3.70E+01
Phenanthrene	2	0	n/a	2.15E+01	1.45E+01	6.61E+01	3.60E+01
Unknown aliphatic HC	1	0	n/a	1.10E+01	n/a	n/a	1.10E+01
Alpha Activity (pCi/L)	4	0	n/a	2.62E+01	8.92E+00	4.09E+01	4.19E+01
Beta Activity (pCi/L)	4	0	n/a	5.40E+02	1.68E+02	8.16E+02	1.02E+03
Conductivity (μS)	4	0	n/a	1.10E+03	3.63E+02	1.69E+03	2.17E+03
pH (dimensionless)	4	0	n/a	7.34E+00	1.05E-01	7.51E+00	7.64E+00
Temperature (°C)	4	0	n/a	2.66E+01	2.13E+00	3.01E+01	2.99E+01
TOC	4	3	DL	8.94E+02	1.77E+02	1.18E+03	1.40E+03
TOX (as Cl)	4	0	n/a	6.98E+01	8.12E+00	8.31E+01	9.20E+01

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 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.

4.0 DATA OVERVIEW

This section is provided to present a comparison of stream characterization data that has been obtained through both process knowledge (see Section 2.0) and sampling data (see Section 3.0).

4.1 DATA COMPARISON

Table 4-1 provides a comparison of average stream constituent concentrations to drinking water standards (DWS) for chemical constituents (including total alpha activity) and to derived concentration guidelines (DCG) for both alpha and beta activity. The DWS values are based on MCL as stated in Table 4-1. The DCG values do not constitute compliance criteria, but rather are used as screening values for making downstream dose estimates and for best available technology (BAT) assessments. These criteria are not intended to be used here for compliance purposes.

Process knowledge reveals no applications at the UO_3 Facility for any of the hypothetical compounds identified from the analysis of the data. Although a contained quantity of hydrogen fluoride was found in the facility in 1987, personnel knew of no application for it in the facility's current configuration; consequently the material was staged as a dangerous waste and transported from the facility by manifest. Disposal of unwanted and spent chemicals through the chemical waste disposal process is a routine practice for UO_3 personnel. It is not possible for the hypothetical compounds postulated by the identification of fluoride, mercury, and cyanide in this stream to exist as sole active ingredients in chemical products used at the UO_3 Plant and go unnoticed by personnel. There is no connection between the hypothetical compounds postulated by the sampling data and the information available through process knowledge, other than the discovery of the 0.45 kg hydrogen fluoride (discussed in Section 5.3) which was properly manifested from the facility.

4.2 STREAM DEPOSITION RATES

Table 4-2 has been included to provide deposition rates using the average data from Table 3-2 adjusted according to flow data from Section 2.0.

Table 4-1. Evaluation of UO_3 Plant Process Condensate.

Evaluation of UO3 Plant Process Condensate-Calcination

Constituent	Result[a]	SV1[b]	SV2[c]
Barium	8.0E-03	5.0E+00 g	
Cadmium	2.0E-03	5.0E-03 e	
Chromium	1.1E-01	1.0E-01 e *	
Fluoride	2.5E+01	2.0E+00 g *	
Manganese	9.0E-03	5.0E-02 h	
Mercury	3.7E-03	2.0E-03 g *	
Nickel	5.5E-02	1.0E-01 e	
Nitrate	1.5E+04	4.5E+01 e *	
Zinc	1.1E-02	5.0E+00 h	
Alpha Activity (pCi/L)[n]	4.5E+02	1.5E+01 g *	3.0E+01 *
Beta Activity (pCi/L)	7.1E+03		1.0E+03 *

Evaluation of UO3 Plant Process Condensate-Standby

Constituent	Result[a]	SV1[b]	SV2[c]
Chloride	7.3E-01	2.5E+02 h	
Chromium	2.6E-02	1.0E-01 e	
Cyanide	1.7E-01	2.0E-01 e	
Fluoride[d]	5.5E-01	2.0E+00 g	
Iron	4.5E-02	3.0E-01 h	
Mercury	1.3E-04	2.0E-03 g	
Nickel	2.2E-02	1.0E-01 e	
Nitrate	3.0E+02	4.5E+01 e *	
Sulfate	6.8E+01	2.5E+02 h	
Zinc	5.3E-03	5.0E+00 h	
Alpha Activity (pCi/L)[n]	2.6E+01	1.5E+01 g *	3.0E+01
Beta Activity (pCi/L)	5.4E+02		1.0E+03

NOTES:

[a]Units of results are mg/L unless indicated other. The results are the mean values reported in the Statistics table of Section 3.0.

[b]Screening Value 1 (SV1) lists the value first, basis second and an asterisk (*) third if the result exceeds the regulatory value. The basis is the proposed primary MCL (e), the proposed secondary MCL (f), the primary MCL (g), or the secondary MCL (h). The value is the smaller of two MCLs: the proposed primary MCL (or the primary MCL as a default) or the proposed secondary MCL (or the secondary MCL as a default). See WHC-EP-0342, "Hanford Site Stream-Specific Reports", August 1990.

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

[d]Constituents are identified (d) if any detected result is less than any detection limit.

[n]The SV1 and SV2 values for Gross Alpha are used to evaluate Alpha Activity.

Table 4-2. Deposition Rate for UO_3 Plant Process Condensate. (sheet 1 of 2)

Flow Rate: 9.18E+05 L/mo--Calcination mode

Constituent	Kg/L*	Kg/mo*
Barium	8.00E-09	7.34E-03
Cadmium	2.00E-09	1.84E-03
Chromium	1.08E-07	9.91E-02
Fluoride	2.47E-05	2.27E+01
Manganese	9.00E-09	8.26E-03
Mercury	3.68E-09	3.38E-03
Nickel	5.50E-08	5.05E-02
Nitrate	1.52E-02	1.40E+04
Phosphate	2.66E-04	2.44E+02
Potassium	1.22E-02	1.12E+04
Sodium	2.24E-05	2.06E+01
Uranium	4.19E-07	3.85E-01
Zinc	1.10E-08	1.01E-02
Acetone	2.30E-08	2.11E-02
Benzoic acid	1.40E-08	1.29E-02
1-Butanol	5.00E-09	4.59E-03
2-Butanone	1.20E-08	1.10E-02
2-Butoxyethanol	5.80E-08	5.32E-02
Butyl nitrate	4.40E-08	4.04E-02
Trans-4-chlorocyclohexanol	7.80E-08	7.16E-02
Methyl nitrate	6.60E-08	6.06E-02
2-Methyl-5-propylnonane	5.00E-08	4.59E-02
Nitroethane	4.30E-08	3.95E-02
N-Nitrosodimethylamine	4.00E-08	3.67E-02
Unknown	7.00E-09	6.43E-03
Unknown aliphatic HC	9.80E-08	9.00E-02
Alpha Activity *	4.47E-10	4.10E-04
Beta Activity *	7.07E-09	6.49E-03
TOC	6.39E-06	5.87E+00
TOX (as Cl)	2.18E-08	2.00E-02

Table 4-2. Deposition Rate for UO_3 Plant Process Condensate. (sheet 2 of 2)

Flow Rate: 5.03E+04 L/mo--Standby mode

Constituent	Kg/L*	Kg/mo*
Chloride	7.31E-07	3.68E-02
Chromium	2.57E-08	1.29E-03
Cyanide	1.67E-07	8.40E-03
Fluoride	5.53E-07	2.78E-02
Iron	4.50E-08	2.26E-03
Mercury	1.25E-10	6.29E-06
Nickel	2.15E-08	1.08E-03
Nitrate	2.98E-04	1.50E+01
Phosphate	1.41E-04	7.09E+00
Potassium	3.64E-04	1.83E+01
Sodium	7.10E-07	3.57E-02
Sulfate	6.83E-05	3.44E+00
Uranium	4.10E-08	2.06E-03
Zinc	5.25E-09	2.64E-04
Acetone	1.50E-07	7.54E-03
Ammonia	7.37E-08	3.71E-03
9,10-Anthracenedione	1.80E-08	9.05E-04
2-Butanone	1.67E-08	8.40E-04
Phenanthrene	2.15E-08	1.08E-03
Unknown aliphatic HC	1.10E-08	5.53E-04
Alpha Activity *	2.62E-11	1.32E-06
Beta Activity *	5.40E-10	2.72E-05
TOC	8.94E-07	4.50E-02
TOX (as Cl)	6.98E-08	3.51E-03

NOTES:

Data collected during March 1988, May 1988, June 1988 and August 1988.

Flow rate is the average of rates from Section 2.0.

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.

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

5.0 DESIGNATION

This section proposes that the UO_3 Plant Process Condensate Wastestream not be designated a dangerous waste. This proposed designation 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.

The procedure for determining whether a waste is a dangerous or extremely hazardous waste is contained in the Washington State Dangerous Waste Regulations (WAC 173-303-070). This procedure is illustrated in Figure 5-1 and includes the following:

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

5.1 DANGEROUS WASTE LISTS

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

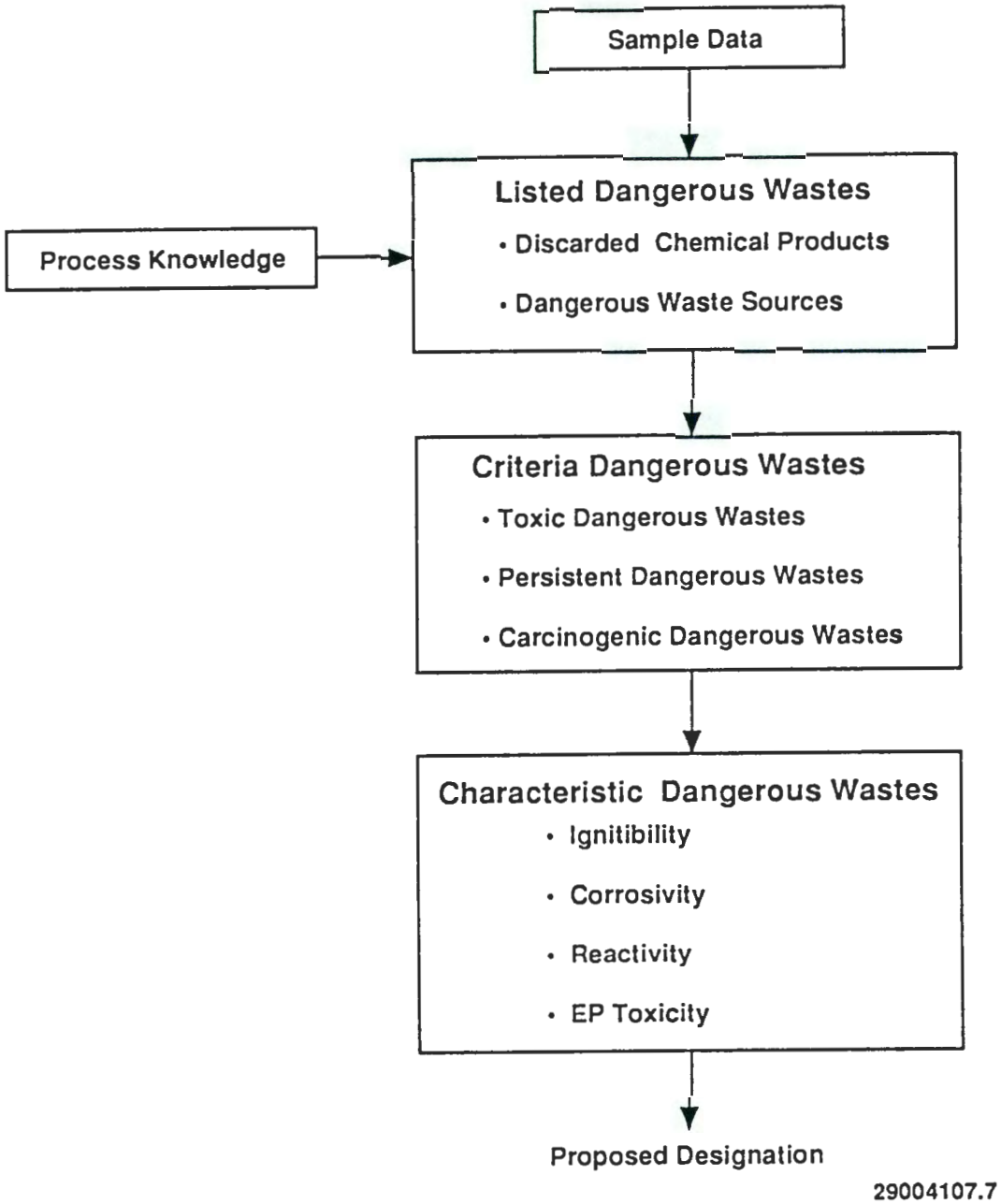
5.1.1 Discarded Chemical Product

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 all of the following descriptions.

- The constituent is the sole active ingredient in a commercial chemical product which had been discarded. Commercial chemical products which, as purchased, contained two or more active ingredients were not designated as discarded chemical products. Products which 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. This should not cause the wastestream to be permanently designated unless a review of past spill events indicates that the spills are predictable, systematic events that are ongoing or are reasonably anticipated to occur in the future. In this report, the evaluation of this criterion is based on a review of spill data reported in accordance with the *Comprehensive Environmental Response, Compensation, and Liability Act*.)

Figure 5-1. Designation Strategy.



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

5.1.2 Dangerous Waste Sources

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

5.2 LISTED WASTE DATA CONSIDERATIONS

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

5.2.1 Process Evaluation

At the UO_3 Facility, waste disposal guidance is always available to personnel who work there. An Environmental Engineer advises employees about Federal, State, and Company requirements with respect to the handling of dangerous wastes. Employees have been instructed never to dispose of wastes of a chemical nature without going through the chemical waste disposal process. Employees have also been alerted to the potential consequences of disregarding environmental laws. Satellite stations are available for temporary staging of dangerous wastes; briefings are periodically held to assure that the importance of environmental compliance is given high priority in daily activities. Although employees are well aware of the importance associated with proper waste dispositioning, part of the process evaluation included asking employees if they had ever disposed of or knew of anyone else disposing of chemicals to a drain or vessel.

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 sources list. This process evaluation was necessary because the stream could be designated as waste from a listed source if a listed waste is known to have been added

at any upstream location, even if a listed constituent could not be detected at the sample point. This process evaluation included a review of the following information sources:

- Material Safety Data Sheets (MSDS)
- Superfund Amendments and Reauthorization Act (SARA) Title III Inventory reports
- Operating procedures
- Process chemical inventories
- Physical inspections, where possible.

Interviews with appropriate facility personnel were conducted to determine if any activities had taken place that may have resulted in generation of wastes from listed sources which may not have been evident during other facets of the process evaluation. These interviews, as well as a review of guidance addressing the dispositioning of chemical products that become dangerous wastes, provided no evidence that any chemical meeting the above criteria had been disposed of to this stream. If a commercial product containing a chemical addressed in the lists was identified, the specific use of the chemical was evaluated to determine if such use resulted in the generation of a waste identified in the discarded chemical product list. Furthermore, if a waste was determined to be generated, waste manifests were reviewed to ensure that proper dispositioning had occurred.

5.2.2 Sampling Data

Sampling data were used as screening tools to enhance and support the results of the process evaluation. This step consisted of comparing the results of the sampling data to the WAC 173-303-9903 and -9904 lists. If a constituent was cited on one or both of these lists, an engineering evaluation was performed to determine if the constituent had either 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 screen inorganic analytical data because inorganic data are reported as ions rather than as chemical substances. For example, an analysis may show that a wastestream contains the cations sodium and calcium along with the anions chloride and nitrate. The possible combinations of substances include: sodium chloride, sodium nitrate, calcium chloride, and calcium nitrate. In a situation with many cation and anions, the list of possible combinations is extensive.

A procedure was developed by Westinghouse Hanford for combining the inorganic constituents to produce hypothetical chemical compounds. A detailed discussion of this procedure can be found in WHC (1990c). Table 5-1 documents the ion analyte pairing which results in neutral compounds. This method is intended to be used as a tool in the evaluation of a wastestream. The identification of the inorganic substances developed by this screening procedure is not intended to be an indication that the substance was discharged to the wastestream, only that the necessary cations and anions are present and an investigation should be conducted to determine how they entered the wastestream.

5.3 PROPOSED LISTED WASTE DESIGNATIONS

A process evaluation, along with a review of sampling data, indicates that the UO_3 Plant Process Condensate has not contained waste from either the discarded chemical products list or the dangerous waste sources list. The following sections discuss the evaluation that was conducted to substantiate this conclusion.

5.3.1 Discarded Chemical Products

As discussed in Section 5.2, a process evaluation of the contributors to the UO_3 Plant Process Condensate wastestream was conducted. This evaluation included a review of MSDSs at the plant and chemical inventories compiled for compliance with the SARA Title III requirements for possible listed waste contributors.

There were six and ten potential discarded chemical products identified from sampling data (using the screening procedure described in Section 5.2) for calcination and standby modes, respectively. The six compounds identified during the one calcination mode sampling were:

hydrogen fluoride (U134),
mercury (U151),
acetone (U002),
1-butanol (U031),
2-butanone (U159),
n-nitrosodimethylamine (P082).

Table 5-1. Inorganic Constituents from Ion Analytes.
(sheet 1 of 3)

Calcination

Constituent	ppb	Ion	Eq/g	Normalized
Charge Normalization:				
*Barium	8.00E+00	Ba+2	1.16E-10	
*Cadmium	2.00E+00	Cd+2	3.56E-11	
*Chromium	1.08E+02	CrO4-2	4.15E-09	5.19E-09
*Fluoride	2.47E+04	F-1	1.30E-06	1.62E-06
*Manganese	9.00E+00	Mn+2	3.28E-10	
*Mercury	3.68E+00	Hg+2	3.67E-11	
*Nickel	5.50E+01	Ni+2	1.87E-09	
*Nitrate	1.52E+07	NO3-1	2.45E-04	3.06E-04
*Phosphate	2.66E+05	HPO4-2	4.22E-06	5.27E-06
*Potassium	1.22E+07	K+1	3.12E-04	
*Sodium	2.24E+04	Na+1	9.74E-07	
*Uranium	4.19E+02	UO2+2	3.52E-09	
*Zinc	1.10E+01	Zn+2	3.36E-10	
*Hydrogen Ion (from pH 7.1)		H+	(7.41E-11)	
*Hydroxide Ion (from pH)		OH-	(1.35E-10)	
Cation total			3.13E-04	
Anion total			2.51E-04	
Anion normalization factor:	1.249			

Substance formation:

Substance	%	Cation Out	Anion Out
*Nickel(II) hydroxide	8.69E-06	0.00E+00	
*Sodium chromate(VI)	4.20E-05	9.69E-07	0.00E+00
*Mercury(II) nitrate	5.95E-07	0.00E+00	3.06E-04
*Uranyl nitrate	6.94E-05	0.00E+00	3.06E-04
*Potassium fluoride	9.42E-03	3.10E-04	0.00E+00
*Zinc nitrate	3.19E-06	0.00E+00	3.06E-04
*Barium nitrate	1.52E-06	0.00E+00	3.06E-04
*Cadmium nitrate	4.21E-07	0.00E+00	3.06E-04
*Potassium nitrate	3.09E+00	4.30E-06	0.00E+00
*Sodium phosphate, DB	6.88E-03	0.00E+00	4.31E-06
*Manganese(II) phosphate, DB	2.47E-06	0.00E+00	4.30E-06
*Potassium phosphate, DB	3.75E-02	0.00E+00	1.78E-09

Table 5-1. Inorganic Constituents from Ion Analytes.
(sheet 2 of 3)

Standby				
Constituent	ppb	Ion	Eq/g	Normalized
Charge Normalization:				
Chloride	8.41E+02	Cl-1	2.37E-08	
Chromium	3.45E+01	CrO4-2	1.33E-09	
Cyanide	2.13E+02	CN-1	8.17E-09	
Fluoride	1.04E+03	F-1	5.48E-08	
Iron	6.96E+01	Fe+3	3.74E-09	4.27E-09
Mercury	1.56E-01	Hg+2	1.56E-12	1.78E-12
Nickel	2.49E+01	Ni+2	8.48E-10	9.68E-10
Nitrate	5.37E+05	NO3-1	8.66E-06	
Phosphate	2.25E+05	HPO4-2	3.58E-06	
Potassium	5.47E+05	K+1	1.40E-05	1.60E-05
Sodium	9.40E+02	Na+1	4.09E-08	4.67E-08
Sulfate	1.77E+05	SO4-2	3.69E-06	
Uranium	6.55E+01	UO2+2	5.51E-10	6.29E-10
Zinc	5.66E+00	Zn+2	1.73E-10	1.98E-10
Hydrogen Ion (from pH 7.5)		H+	(3.09E-11)	
Hydroxide Ion (from pH)		OH-	(3.24E-10)	
Cation total			1.40E-05	
Anion total			1.60E-05	
Cation normalization factor:	1.142			

Substance Formation: Substance	%	Cation Out	Anion Out
Nickel(II) cyanide	5.36E-06	0.00E+00	7.20E-09
Sodium chromate(VI)	1.08E-05	4.53E-08	0.00E+00
Hydrogen cyanide	1.95E-05		0.00E+00
Mercury(II) chloride	2.41E-08	0.00E+00	2.37E-08
Uranyl nitrate	1.24E-05	0.00E+00	8.66E-06
Iron(III) fluoride	1.60E-05	0.00E+00	5.06E-08
Potassium fluoride	2.94E-04	1.59E-05	0.00E+00
Zinc nitrate	1.87E-06	0.00E+00	8.65E-06
Potassium chloride	1.77E-04	1.59E-05	0.00E+00
Potassium nitrate	8.75E-02	7.23E-06	0.00E+00
Sodium phosphate, DB	3.22E-04	0.00E+00	3.53E-06
Potassium phosphate, DB	3.08E-02	3.70E-06	0.00E+00
Potassium sulfate	3.22E-02	7.49E-09	0.00E+00

Table 5-1. Inorganic Constituents from Ion Analytes. (sheet 3 of 3)

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 (Eq/g)**2 divided by the hydrogen ion value (in Eq/g).

Ion concentrations in equivalents per gram (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.

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.

The 10 compounds identified during four standby mode samplings were:

hydrogen cyanide (P063)
hydrogen fluoride (U134)
mercury (U151)
nickel (II) cyanide ((P074)
potassium cyanide (P098)
sodium cyanide ((P106)
zinc cyanide (P121)
acetone (U002)
2-butanone (U159)
cyanides, soluble salts not elsewhere specified (P030).

Of these compounds, only one was identified as being present in the facility during the process evaluation. The potential discarded chemical product identified in both the process evaluation and in the screening of the sampling data is acetone. Based on the considerations and data presented in the following sections, it is concluded that the wastestream does not contain any discarded chemical products.

5.3.1.1 Hydrogen Fluoride. Fluoride has been detected in all five samples taken on this stream during both calcination and standby modes. The concentrations reported differed considerably, depending on which method of analysis was used - ion chromatography (IC) or ion-specific electrode (ISE). The reported values are as follows:

Sample Date	IC (ppb)	ISE (ppb)
2/06/88	49,300	46
3/01/88	2,830	20
5/13/88	626	69
6/21/88	---	73
8/09/88	686	48

Due to the extent of disparity in the data, it is presumed that some of the data are suspect. Consequently, there is an element of uncertainty as to which of the two fluoride concentrations in the stream is actually representative. Hydrogen fluoride, a compound hypothetically existing in the stream, has been identified by computer cation-anion match with available hydrogen.

A physical inspection of the facility was conducted to ensure proper identification of all chemicals in stock. The MSDS information was also reviewed to reinforce knowledge of chemical products in current plant inventories containing this substance as an active ingredient. Review of past spill reports revealed no evidence of any past incident involving a spill of hydrogen fluoride at the facility. The only identification of hydrogen fluoride at the facility came from a review of historical manifests. A past manifest indicates that a plastic container with 0.45 kg of

48.5% hydrogen fluoride was found in a processing cell (apparently from past thorium processing activities) and transferred from the facility as dangerous waste on January 28, 1987.

If results of the ion chromatography analyses are assumed valid for the sake of argument, the occurrence of fluoride in this stream since the inception of the process condensate neutralization system is recognized as following a trend. Process knowledge acquired from pre-neutralization system samplings indicates that this trend was not apparent. One potential contributor that was not present prior to 1988 is the potassium hydroxide that is used in the neutralization system. During calcination mode (sample taken February 6, 1988), the reported level is 49,300 ppb. Since condensate generated during calcination is generally much more acidic than condensate generated during standby, greater quantities of potassium hydroxide must be used for neutralization. During the first standby sample taken nearly a month later (March 1, 1988), the concentration of fluoride is significantly lower at 2,830 ppb. During this time, plant activities include product recovery from processing equipment by dissolving uranium in nitric acid. Acidic process condensate is generated by this process, but the quantity of acid requiring neutralization will be significantly less than during calcination. Samples taken on May 13, 1988, and August 9, 1988, indicate fluoride levels of 626 and 686 ppb, respectively. Potassium hydroxide usage in the neutralization process is much lower as time passes since completion of post-processing activities. Given the trending evidence and the fact that fluoride has been identified in only 1 of 7 pre-1988 samples (at 513 ppb), potassium hydroxide used at the facility constitutes a plausible contributor to the fluoride in the stream. Efforts to establish fluoride impurity levels in potassium hydroxide from manufacturers have revealed a source for fluoride. One manufacturer (Van, Waters & Rogers) indicated that fluoride had not been looked for in their product. The other manufacturer (Great Western) indicated that they check for fluoride content twice a year. They state that it is generally below 500 ppb, but has been identified at up to 1,000 ppb in their potassium hydroxide product. This impurity concentration does not represent introduction of enough fluoride to explain the concentrations reported by ion chromatography analyses. For example, the sample taken on February 6, 1988, yielded a potassium concentration of 1.22 E07 ppb. At the manufacturer's reported fluoride impurity level, this potassium should contribute approximately 6 to 12 ppb fluoride.

Fluoride is likely contained in the UNH product received from PUREX. Since large quantities of fluoride are used at PUREX in the decladding process, fluoride salts are potentially formed during subsequent processing and transferred with the UNH product sent to the UO_3 Facility. No evidence of past UNH sampling for fluoride content has been found; however, the vast difference in fluoride content during calcination and standby cannot be explained by the KOH content alone; this suggests the UNH as a fluoride contributor. Additional potential contributors of fluoride to the UO_3 Plant process condensate include: (1) phosphoric acid, added to the process condensate for buffering prior to neutralization (fluoride impurity content of this source is not yet available); (2) both sanitary and raw water supplies (data in Table 2-4).

Since hydrogen fluoride is not present as an active ingredient in any chemical used at UO_3 Plant, its hypothetical presence in UO_3 Plant process condensate is not the result of discarded chemical products.

5.3.1.2 Mercury. Mercury has been detected in this stream during both calcination (1 of 1 sample) and standby activities (2 of 4 samples). The concentration was highest during calcination (3.68 ppb on February 6, 1988), then tailed off during standby mode (0.18 ppb on March 1, 1988, and 0.12 ppb on May 13, 1988). There was no evidence of mercury in the stream by June 21, 1988. Mercury is used in the dissolution process at PUREX in a temperature sensing application and is speculated to enter the process in trace amounts. Given this process knowledge, coupled with the trend exhibited by the sampling evidence, it is probable that mercury is received in the UNH from PUREX and is gradually eliminated from UO_3 Plant through operation. Review of MSDS information and physical inspection indicate that there are no chemical products in the plant inventories containing this substance.

Based on this analysis, it is concluded that the presence of mercury in the UO_3 Plant process condensate is not the result of discarded chemical products.

5.3.1.3 Acetone. Acetone has been detected in this stream during both calcination (1 of 1 sample) and standby activities (2 of 4 samples). The first sample taken on February 6, 1988, yielded a concentration of 23 ppb. Almost one month later (March 1, 1988) the concentration increased to 190 ppb, then dropped to 110 ppb by May 13, 1988. Acetone is used in the UO_3 Plant for cleaning dirty acetylene tetrabromide from glass manometer tubes, a maintenance activity that is not dependent on mode of operation. Interviews with personnel - including a senior instrument technician who has been handling the acetone for many years - and reviews of the procedures in place for the use of acetone and the disposal of hazardous and mixed wastes provided no evidence that acetone had been discarded into the UO_3 Plant process condensate. Waste acetone generated by the maintenance activity is always staged as dangerous waste and transported from the facility by manifest.

Degradation of processing materials has been determined to be the most plausible source of organic contaminants, including acetone, in the UO_3 Plant process condensate stream. Evidence supporting this source is presented in detail in WHC (1990b) and from the evidence, the following conclusions are drawn:

- Operating practices and plant configuration make the likelihood of spent solvent disposal at the UO_3 Facility extremely remote

- Sampling data fail to link acetone detection to operation of UNH concentrators, indicating that it is not probable that acetone is sent to UO_3 Plant in UNH; if acetone were received in the feed in detectible concentrations, it would be boiled off in the UNH concentrators and detected during their operation

- Detection of paraffin-cracking products and nitroparaffins, coupled with the fact that TBP and NPH are known to enter the facility but are not accounted for in exit streams, further supports the theory that reactions have taken place to produce acetone.

Based on the extensive process knowledge acquired concerning the formation of acetone under conditions similar to those found at the UO_3 Plant, the knowledge concerning disposal practices for acetone at the facility, and the evidence presented by sampling data, it is concluded that the existence of trace amounts of acetone in the UO_3 Plant process condensate is not due to disposal of chemical products.

5.3.1.4 1-Butanol. Butanol has been detected in this stream only in the one sample taken during calcination mode (February 6, 1988). The concentration was only 5 ppb.

A physical inspection of the facility was conducted to ensure proper identification of all chemicals in stock. The MSDS information was also reviewed to reinforce knowledge of chemical constituents in products. This search indicated that butanol is contained in one chemical routinely used at the facility, although it is not the sole active ingredient. The chemical product identified at the facility that contains butanol is an aerosol product called Lectra-Clean*. Butanol accounts for about 1.5% by weight of Lectra Clean. Administrative controls are in place that provide for the proper dispositioning of chemicals that are no longer needed or usable. Conversations with employees reveal no evidence of improper disposal of this substance. Review of past spill reports revealed no evidence of any past incident involving a spill of butanol-containing products.

The sample taken on February 6, 1988, also revealed the presence of butyl nitrate at a concentration of 44 ppb, which is likely formed from butanol. Detection of butanol and butyl nitrate in the stream is not surprising. Butanol is a well-documented degradation product of tributyl phosphate, a substance that is known to enter the facility in trace amounts, yet has not been identified in the process condensate stream leaving the plant. Butanol will be readily formed from tributyl phosphate in nitric acid. Additionally, there is ample supply of nitrate available (February 6, 1988, sampling, 1.52 E+07 ppb) for the nitration of butanol. In fact, butanol in the presence of >2 M nitric acid will almost exclusively be converted to butyl nitrate. The most plausible source for butanol in the UO_3 Plant process condensate is formation from tributyl phosphate.

Based on information gathered concerning chemical products in use at the facility and process knowledge, it is concluded that the presence of butanol in the UO_3 Plant process condensate is not due to chemical product disposal.

5.3.1.5 2-Butanone. 2-Butanone has been detected in this stream during both calcination mode (1 of 1 sample) and standby mode (1 of 4 samples).

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*CRC Lectra-Clean is a registered trademark of CRC Chemicals Inc., Jenkintown, Pennsylvania.

A physical inspection of the facility was conducted to ensure proper identification of all chemicals in stock. The MSDS information was also reviewed to reinforce knowledge of chemical constituents in products. This search indicated that 2-butanone is contained in two chemicals routinely used at the facility, although it is not the sole active ingredient in either of them. The chemical products identified at the facility that contain 2-butanone are: Blue Toolmaker's Ink (51-70%) and Weld-On P-70 Primer for PVC Plastic Pipe (minor%). Administrative controls are in place that provide for proper dispositioning of chemicals that are no longer needed or usable. Facility inspections and personnel interviews indicate that disposal of these substances, when necessary, has been proper; there is no indication of any improper disposal of these substances. Review of past spill reports revealed no indication of any spills involving these substances.

Detection of 2-butanone practically mirrors the detection of acetone; this fact supports the theory presented in WHC (1990b) that these substances are oxidation products formed from the degradation of trace TBP-NPH unavoidably received in UNH from PUREX. Given the operating conditions at UO_3 Plant, 2-butanone is likely formed at the facility by the oxidation of butanol, by oxygenation of hydrocarbon cracking products, as a by-product in the formation of nitroparaffin material, or by a combination of these paths. Since TBP undergoes hydrolysis to form butanol in the 60% UNH with a half-life of about 8 h, it is not surprising to see an oxidation product of butanol such as 2-butanone shortly after completion of processing.

It is concluded, based on process knowledge and sampling data, that the presence of 2-butanone in the UO_3 Plant process condensate is not the result of chemical product disposal.

5.3.1.6 N-nitrosodimethylamine. N-nitrosodimethylamine has only been detected in this stream on one occasion. This sample was taken during the calcination mode on February 6, 1988, and yielded a concentration of 40 ppb. A search of available MSDS information and plant inventories revealed no products containing this substance at the UO_3 Plant. According to *The Merck Index*, (Windholz 1989) this substance has been identified in tobacco smoke condensates, bacon, and smoked fish. It is a potent carcinogen. No other potential sources were identified. It is possible that this substance formed as a trace by-product from reactions involving trace hydrocarbon impurities received in UNH from PUREX and nitrates or oxides of nitrogen at the facility.

Due to the absence of potential for this chemical to be contained as an active ingredient in any UO_3 Plant chemical product, it is concluded that its presence in the stream on the one occasion is not the result of a discarded chemical product.

5.3.1.7 Cyanide. Cyanide has been detected in this stream in 4 of 4 samples taken during standby mode, but has not been detected during calcination. Detection of cyanide (in ppb) during standby is as follows:

Date	Concentration
3/1/88	154
5/13/88	153
6/21/88	246
8/9/88	114

A physical inspection of the facility was conducted to ensure proper identification of all chemicals in stock. The MSDS information was also reviewed to reinforce knowledge of chemical constituents in products. This search indicated that there are no chemical products in current plant inventories containing any cyanide compound as an active ingredient. Discussions with plant employees revealed no knowledge that cyanide-containing products had ever been used at the facility. Review of past spill reports revealed no evidence of any past incident involving a spill of cyanide at the facility.

Assuming that cyanide is not sent to the facility as an impurity in neutralization chemicals, the only plausible source for cyanide is the UNH received from PUREX. If cyanide is received in UNH as some stable complex, resistant enough to acid attack to significantly retard formation of volatile (b.p. 78.1 °F) hydrogen cyanide, then quantities of these cyanide salts would likely be received in TK C-2. Hydrogen cyanide may then be gradually formed in TK C-2 and condensed in EB-3, then passed to TK X-37 for staging and subsequent transfer to TK C-5, where neutralization takes place. Although there is admittedly little evidence to support the above speculated source, the following factors support and effectively eliminate other possibilities.

- Cyanide is known to be in process streams that are used for processing UNH destined for UO_3 Plant, salts that may not readily decompose to form hydrogen cyanide could be transferred with UNH.

- Assuming no cyanide impurities in chemicals added to the process condensate as part of the neutralization process, there is no known other way for cyanide to get to TK C-5 except to leave TK C-2 as vapor, either as evolution of hydrogen cyanide or through entrainment.

Since no chemical products are in use at the UO_3 Facility that contain cyanide as an active ingredient, the presence of cyanide in the UO_3 Plant process condensate cannot be the result of chemical product disposal.

5.3.2 Dangerous Waste Sources

The process evaluation (see 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 the Dangerous Waste Source List WAC 173-303-9904. Sampling data were utilized to enhance the process

evaluation. Three potential listed solvents were identified for calcination by the sampling data; these are acetone, 1-butanol, and 2-butanone. Three potential listed solvents were identified for standby. These are acetone, 2-butanone, and cyanides (soluble salts). Acetone is the only one of these chemicals that appear on the plant chemical inventories for solvent purposes. As stated in the previous section, acetone is used for cleaning of manometers. The used acetone is accumulated, stored, and disposed of as a dangerous waste. Based on the knowledge and sampling data as discussed in Section 5.3.1, it is concluded that spent acetone has not been discarded to the UO_3 Plant process condensate.

5.4 DANGEROUS WASTE CRITERIA

A waste is considered a dangerous waste if it meets any of the following criteria categories (WAC 173-303-100): toxic dangerous waste, persistent dangerous waste, or carcinogenic dangerous waste. A description of the methods used to test the sampling data against the criteria is contained in WHC (1990c). Summaries of the methods, along with the results, are contained in the following sections.

5.4.1 Toxic Dangerous Wastes

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

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

Table 5-2. Dangerous Waste Data Designation Report for UO_3 Plant Process Condensate. (sheet 1 of 5)

Dangerous Waste Data Designation Report for UO3 Plant Process Condensate-Uranium Calcination

Finding: Undesignated

Discarded Chemical Products - WAC 173-303-081

Substance	Review Number	Status	DW Number
*Hydrogen fluoride	U134(DW)	Not Discarded	Undesignated
*Mercury	U151(EHW)	Not Discarded	Undesignated
*Acetone	U002(DW)	Not Discarded	Undesignated
*1-Butanol	U031(DW)	Not Discarded	Undesignated
*2-Butanone	U159(DW)	Not Discarded	Undesignated
*N-Nitrosodimethylamine	P082(EHW)	Not Discarded	Undesignated

Dangerous Waste Sources - WAC 173-303-082

Substance	Review Number	Status	DW Number
*Acetone	F003	Unlisted Source	Undesignated
*1-Butanol	F003	Unlisted Source	Undesignated
*2-Butanone	F005	Unlisted Source	Undesignated

Infectious Dangerous Waste - WAC 173-303-083

No regulatory guidance

Dangerous Waste Mixtures - WAC 173-303-084

Substance	Toxic EC%	Persistant HH%	Persistant PAH%	Carcinogenic Total%
*Barium nitrate	1.52E-09	0.00E+00	0.00E+00	0.00E+00
*Cadmium nitrate	4.21E-10	0.00E+00	0.00E+00	0.00E+00
*Mercury(II) nitrate	5.95E-08	0.00E+00	0.00E+00	0.00E+00
*Nickel(II) hydroxide	8.69E-09	0.00E+00	0.00E+00	8.69E-06
*Potassium fluoride	9.42E-06	0.00E+00	0.00E+00	0.00E+00
*Potassium nitrate	3.09E-04	0.00E+00	0.00E+00	0.00E+00
*Sodium chromate(VI)	4.20E-08	0.00E+00	0.00E+00	4.20E-05
*Sodium phosphate, DB	6.88E-07	0.00E+00	0.00E+00	0.00E+00
*Uranyl nitrate	6.94E-07	0.00E+00	0.00E+00	0.00E+00
*Zinc nitrate	3.19E-09	0.00E+00	0.00E+00	0.00E+00
*Acetone	2.30E-10	0.00E+00	0.00E+00	0.00E+00
*Benzoic acid	1.40E-10	0.00E+00	0.00E+00	0.00E+00
*1-Butanol	5.00E-11	0.00E+00	0.00E+00	0.00E+00
*2-Butanone	1.20E-10	0.00E+00	0.00E+00	0.00E+00
*2-Butoxyethanol	5.80E-09	0.00E+00	0.00E+00	0.00E+00
*Methyl nitrate	6.60E-09	0.00E+00	0.00E+00	0.00E+00
*Nitroethane	4.30E-09	0.00E+00	0.00E+00	0.00E+00
*N-Nitrosodimethylamine	4.00E-08	0.00E+00	0.00E+00	4.00E-06
Total	3.20E-04	0.00E+00	0.00E+00	5.47E-05
DW Number	Undesignated	Undesignated	Undesignated	Undesignated

Dangerous Waste Characteristics - WAC 173-303-090

Characteristic	Value	DW Number
Ignitables % (Calc.)	1.41E-05	Undesignated
*Corrosivity-pH	7.13	Undesignated
Total Cyanide (mg/kg)	0.00E+00	Undesignated
Total Sulfide (mg/kg)	0.00E+00	Undesignated
*Total Barium (mg/L)	8.00E-03	Undesignated
*Total Cadmium (mg/L)	2.00E-03	Undesignated
*Total Chromium (mg/L)	1.08E-01	Undesignated
*Total Mercury (mg/L)	3.68E-03	Undesignated

Table 5-2. Dangerous Waste Data Designation Report for UO_3 Plant Process Condensate. (Sheet 2 of 5)

Dangerous Waste Data Designation Report for UO3 Plant Process Condensate-Uranium Calcination

Dangerous Waste Criteria - WAC 173-303-100

Substance	Toxic EC%	Persistant HH%	Persistant PAH%	Carcinogenic Total%	DW Number-Positive
*Barium nitrate	1.52E-09	0.00E+00	0.00E+00	0.00E+00	
*Cadmium nitrate	4.21E-10	0.00E+00	0.00E+00	0.00E+00	
*Mercury(II) nitrate	5.95E-08	0.00E+00	0.00E+00	0.00E+00	
*Nickel(II) hydroxide	8.69E-09	0.00E+00	0.00E+00	8.69E-06	Undesignated
*Potassium fluoride	9.42E-06	0.00E+00	0.00E+00	0.00E+00	
*Potassium nitrate	3.09E-04	0.00E+00	0.00E+00	0.00E+00	
*Sodium chromate(VI)	4.20E-08	0.00E+00	0.00E+00	4.20E-05	Undesignated
*Sodium phosphate, DB	6.88E-07	0.00E+00	0.00E+00	0.00E+00	
*Uranyl nitrate	6.94E-07	0.00E+00	0.00E+00	0.00E+00	
*Zinc nitrate	3.19E-09	0.00E+00	0.00E+00	0.00E+00	
*Acetone	2.30E-10	0.00E+00	0.00E+00	0.00E+00	
*Benzoic acid	1.40E-10	0.00E+00	0.00E+00	0.00E+00	
*1-Butanol	5.00E-11	0.00E+00	0.00E+00	0.00E+00	
*2-Butanone	1.20E-10	0.00E+00	0.00E+00	0.00E+00	
*2-Butoxyethanol	5.80E-09	0.00E+00	0.00E+00	0.00E+00	
*Methyl nitrate	6.60E-09	0.00E+00	0.00E+00	0.00E+00	
*Nitroethane	4.30E-09	0.00E+00	0.00E+00	0.00E+00	
*N-Nitrosodimethylamine	4.00E-08	0.00E+00	0.00E+00	4.00E-06	Undesignated
Total	3.20E-04	0.00E+00	0.00E+00	5.47E-05	
DW Number	Undesignated	Undesignated	Undesignated	Undesignated	

Dangerous Waste Constituents - WAC 173-303-9905

Substance
*Hydrogen fluoride
*Acetone
*N-Nitrosodimethylamine
*Barium and compounds,NOS
*Cadmium and compounds,NOS
*Chromium and compounds,NOS
*Mercury 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 nutralized 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 fomulated and their possible concentrations calculated for designation purposes only. The actual existance in the waste of these substances is not implied and should not be infered.

Table 5-2. Dangerous Waste Data Designation Report for UO_3 Plant Process Condensate. (sheet 3 of 5)

Dangerous Waste Data Designation Report for UO3 Plant Process Condensate-Standby

Finding: Undesignated

Discarded Chemical Products - WAC 173-303-081

Substance	Review Number	Status	DW Number
Hydrogen cyanide	P063(EHW)	Not Discarded	Undesignated
Hydrogen fluoride	U134(DW)	Not Discarded	Undesignated
Mercury	U151(EHW)	Not Discarded	Undesignated
Nickel(II) cyanide	P074(EHW)	Not Discarded	Undesignated
Potassium cyanide	P098(EHW)	Not Discarded	Undesignated
Sodium cyanide	P106(EHW)	Not Discarded	Undesignated
Zinc cyanide	P121(EHW)	Not Discarded	Undesignated
Acetone	U002(DW)	Not Discarded	Undesignated
2-Butanone	U159(DW)	Not Discarded	Undesignated
Cyanides(soluble salts),NOS	P030(EHW)	Not Discarded	Undesignated

Dangerous Waste Sources - WAC 173-303-082

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

Infectous Dangerous Waste - WAC 173-303-083

No regulatory guidance

Dangerous Waste Mixtures - WAC 173-303-084

Substance	Toxic EC%	Persistant HH%	Persistant PAH%	Carcinogenic Total%
Hydrogen cyanide	1.95E-06	0.00E+00	0.00E+00	0.00E+00
Iron(III) fluoride	1.60E-07	0.00E+00	0.00E+00	0.00E+00
Mercury(II) chloride	2.41E-09	0.00E+00	0.00E+00	0.00E+00
Nickel(II) cyanide	5.36E-06	0.00E+00	0.00E+00	0.00E+00
Potassium chloride	1.77E-08	0.00E+00	0.00E+00	0.00E+00
Potassium fluoride	2.94E-07	0.00E+00	0.00E+00	0.00E+00
Potassium nitrate	8.75E-06	0.00E+00	0.00E+00	0.00E+00
Sodium chromate(VI)	1.08E-08	0.00E+00	0.00E+00	1.08E-05
Sodium phosphate, DB	3.22E-08	0.00E+00	0.00E+00	0.00E+00
Uranyl nitrate	1.24E-07	0.00E+00	0.00E+00	0.00E+00
Zinc nitrate	1.87E-09	0.00E+00	0.00E+00	0.00E+00
Acetone	2.73E-09	0.00E+00	0.00E+00	0.00E+00
Ammonia	9.62E-08	0.00E+00	0.00E+00	0.00E+00
2-Butanone	2.78E-10	0.00E+00	0.00E+00	0.00E+00
Phenanthrene	6.61E-10	0.00E+00	0.00E+00	0.00E+00
Total	1.68E-05	0.00E+00	0.00E+00	1.08E-05
DW Number	Undesignated	Undesignated	Undesignated	Undesignated

Dangerous Waste Characteristics - WAC 173-303-090

Characteristic	Value	DW Number
Igritables % (Calc.)	4.96E-05	Undesignated
Corrosivity-pH	7.51	Undesignated
Total Cyanide (mg/kg)	2.21E-01	Undesignated
Total Sulfide (mg/kg)	0.00E+00	Undesignated
Total Chromium (mg/L)	3.45E-02	Undesignated
Total Mercury (mg/L)	1.56E-04	Undesignated

Table 5-2. Dangerous Waste Data Designation Report for UO_3 Plant Process Condensate. (sheet 4 of 5)

Dangerous Waste Data Designation Report for UO3 Plant Process Condensate-Standby

Dangerous Waste Criteria - WAC 173-303-100

Substance	Toxic EC%	Persistant HH%	Persistant PAH%	Carcinogenic Total%	DW Number-Positive
Hydrogen cyanide	1.95E-06	0.00E+00	0.00E+00	0.00E+00	
Iron(III) fluoride	1.60E-07	0.00E+00	0.00E+00	0.00E+00	
Mercury(II) chloride	2.41E-09	0.00E+00	0.00E+00	0.00E+00	
Nickel(II) cyanide	5.36E-06	0.00E+00	0.00E+00	0.00E+00	
Potassium chloride	1.77E-08	0.00E+00	0.00E+00	0.00E+00	
Potassium fluoride	2.94E-07	0.00E+00	0.00E+00	0.00E+00	
Potassium nitrate	8.75E-06	0.00E+00	0.00E+00	0.00E+00	
Sodium chromate(VI)	1.08E-08	0.00E+00	0.00E+00	1.08E-05	Undesignated
Sodium phosphate, DB	3.22E-08	0.00E+00	0.00E+00	0.00E+00	
Uranyl nitrate	1.24E-07	0.00E+00	0.00E+00	0.00E+00	
Zinc nitrate	1.87E-09	0.00E+00	0.00E+00	0.00E+00	
Acetone	2.73E-09	0.00E+00	0.00E+00	0.00E+00	
Ammonia	9.62E-08	0.00E+00	0.00E+00	0.00E+00	
2-Butanone	2.78E-10	0.00E+00	0.00E+00	0.00E+00	
Phenanthrene	6.61E-10	0.00E+00	0.00E+00	0.00E+00	
Total	1.68E-05	0.00E+00	0.00E+00	1.08E-05	
DW Number	Undesignated	Undesignated	Undesignated	Undesignated	

Dangerous Waste Constituents - WAC 173-303-9905

Substance
Hydrogen cyanide
Hydrogen fluoride
Nickel(II) cyanide
Potassium cyanide
Sodium cyanide
Zinc cyanide
Acetone
Chromium and compounds,NOS
Cyanides(soluble salts),NOS
Mercury and compounds,NOS
Nickel and compounds,NOS

Table 5-2. Dangerous Waste Data Designation Report for UO_3 Plant Process Condensate. (sheet 5 of 5)

Dangerous Waste Data Designation Report for UO3 Plant Process Condensate-Standby

Substance names may include MB (monobasic), DB (dibasic), or TB (tribasic) to identify the equivalence of hydrogen ion that have been nutralized 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 fomulated and their possible concentrations calculated for designation purposes only. The actual existance in the waste of these substances is not implied and should not be infered.

Eighteen and twenty-three substances potentially present in the UO_3 Plant Process Condensate during calcination and standby, respectively, were determined to have toxic categories associated with them. These substances are listed in Table 5-2. The individual and sum EC% values for these substances are listed in Table 5-2. Since the EC% sums are 3.2 E-04 and 1.68 E-05, respectively, which are less than the cutoff of 1.0 E-03 (i.e., 0.001%), the wastestream is not a toxic dangerous waste. A review of the Table 5-2 toxic EC% for calcination mode data shows that potassium nitrate accounts for an EC% of 3.09 E-04, or approximately 96.5% of the contribution. This contribution is administratively controlled, as discussed in Section 2.4.9.

5.4.2 Persistent Dangerous Wastes

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

Two substances potentially present in the UO_3 Plant Process Condensate (during standby) were determined to be HH and no substances were determined to be PAH. The HH% values for these substance are listed in Table 5-2. Since the HH% sum is 0.00, which is less than the 1.00 E-02% (i.e., 0.01%), the UO_3 Plant Process Condensate is not a persistent dangerous waste.

5.4.3 Carcinogenic Dangerous Wastes

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 90%CI for the substances of interest.

- Formulate substances from the analytical data. NOTE: This step is only required for inorganic analytes since it is not possible to complete the evaluation based on the concentration of cations and anions. This methodology is described in WHC (1990c) and is based on an evaluation of the most toxic substances that can exist in an aqueous environment under normal temperatures and pressures.

- Determine which substances in the wastestream are carcinogenic 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 (human or animal) carcinogens is above 0.01% or if the total concentration of positive and suspected (human or animal) carcinogens is above 1.0%.

Three substances potentially present in the UO_3 Plant Process Condensate during calcination and one during standby were determined to be carcinogenic substances. These substances are listed in Table 5-2. The individual and sum percent carcinogens for these chemicals are listed in Table 5-2. Since none of the specific carcinogen exceed 1.00 E-02% (i.e., 0.01%) and the sum is less than 1.0%, the UO_3 Plant Process Condensate is not a carcinogenic dangerous waste.

5.5 DANGEROUS WASTE CHARACTERISTICS

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

5.5.1 Ignitability

Because of the dilute aqueous nature of these wastes, flashpoint testing was not performed during the initial samples collected from the wastestream; instead, an ignitability index was calculated for the samples and was based on the sum of the concentrations of all ignitable contributors in the waste. Pure substances with a flashpoint <140 °F (60 °C) were considered ignitable. Using best professional judgment, samples that exhibited an ignitability index below 1% were not considered ignitable.

The value of the ignitability index calculated for UO_3 Plant Process Condensate is 1.41 E-05 (calcination) and 4.96 E-05 (standby). These values are less than 1%. Therefore, the UO_3 Plant Process Condensate is not an ignitable waste.

5.5.2 Corrosivity

A waste is a corrosive dangerous waste if it has a pH of $\leq$2.0 or $\geq$12.5. The comparison to this characteristic was based on the lower limit of the 90%CI for a stream with a mean value of pH <7.25 and the upper limit of the 90%CI for a stream with a mean value of pH $\geq$7.25. Because the mean value of the pH measurements for both calcination and standby for the UO_3 Plant Process Condensate wastestream is below 7.25, the lower confidence interval limit, 7.13, is used. The wastestream is not a corrosive dangerous waste according to 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 near corrosivity sufficient to threaten human health or the environment (WAC 173-303-090[7]). A recent revision to the SW-846 procedure provides more quantitative indicator levels for cyanide and sulfide. These indicator levels for hydrogen cyanide and hydrogen sulfide are 250 mg/kg and 500 mg/kg, respectively. If the upper 90%CI for the compounds in the effluent streams was below these levels, the streams were considered not regulated based on reactivity.

Before July 1989, total cyanide and total sulfide were used for comparison. After July 1989, the revised SW-846 procedure was utilized in comparing the data.

The concentrations of total cyanide and total sulfide were used to estimate HCN and H_2S reactivity concentrations. The estimated concentrations of HCN are 0 and 2.21 E-01 mg/kg for calcination and standby respectively. The estimated concentrations of H_2S are 0 ppm for both calcination and standby. Therefore this aqueous waste is not reactive.

5.5.4 Extraction Procedure Toxicity

An effluent stream was considered regulated under the EP toxicity criteria (WAC 173-303-090[8]) if the upper 90%CI for the specific compounds in the wastestream exceeded the EP toxicity concentration limits. The SW-846 procedure provides specific guidance for obtaining data results for comparison against the EPA toxicity limits. Until July 1989, total compounds concentrations were compared against the limits, resulting in a more conservative designation. Since that time, the sampling data has been collected and analyzed according to the EP toxicity method specified in SW-846. Four and two analytes with concentrations above detection limits that are on the EP toxic list were found in the UO_3 Plant Process Condensate wastestream during calcination and standby respectively. The concentrations of these analytes are listed in Table 5-2. Because their concentrations are all below their respective limits, the UO_3 Plant Process Condensate wastestream is not an EP toxic dangerous waste.

5.6 PROPOSED DESIGNATION

Based upon the analyses of samples taken from February to August 1988, and an evaluation of the process, it is believed that the UO_3 Plant Process Condensate does not contain any dangerous waste as defined in WAC 173-303. It is proposed that the wastestream not be designated a dangerous waste.

6.0 ACTION PLAN

This chapter addresses recommendations for future waste characterization tasks for the liquid effluents that are within the scope of WHC (1990a). 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 (1988).

6.1 FUTURE SAMPLING

During the random sampling conducted during the 1989 to March 1990 period, no UO_3 Plant Process Condensate samples were taken in either the calcination or standby modes because the condensate was being accumulated in plant tanks pending internal resolution of sources of trace contaminants of which sources were previously unknown. Consequently "old data" were used to assess the stream. Pre-1988 data were not used for the designation process since, prior to 1988, discharges were corrosive and were sent to a different location (216-U-12 Crib). However, data taken on the UO_3 Plant Process Condensate stream prior to 1988 do provide useful information that has enhanced process knowledge. These data are addressed in WHC (1990b). Because of the trend identified in this document, it is recommended that coordinated samples be collected and an effort be made to confirm the validity of the conclusions; this could be accomplished by sampling for targeted compounds on a regular basis during calcination and for several months following completion of calcination. Additionally, attempts should be made to acquire data on fluoride, cyanide, and organic impurity contents of UNH sent to the UO_3 Plant from PUREX.

It is recommended that additional random sampling be performed on the UO_3 Plant Process Condensate stream during calcination for the purpose of reinforcing confidence in the EC% for toxicity. Since the fluoride concentrations have differed by such a great amount depending on which method of analysis was used, special attention should be given to potential interference factors that may adversely affect the accuracy of quantitative results.

It is recommended that potassium hydroxide, phosphoric acid, and sulfuric acid be sampled for both cyanide and fluoride to complete the diligent search with respect to those contaminants. These samples should be used to either confirm or dispute fluoride impurities as reported by the potassium hydroxide manufacturer.

It is recommended that recovered nitric acid be sampled for targeted compounds to determine potential contaminants that are returned to the PUREX process.

A fiber mist eliminator will be installed at the facility as mentioned in Section 2.0; after installation, additional sampling will be necessary to characterize the quality of the UO_3 Plant Process Condensate in this modified configuration.

6.2 TECHNICAL ISSUES

As described in Section 2.0, the effluent was sampled at tank C-5. This sample point was chosen because it is a common, accessible location downstream of all the contributing wastestreams.

The samples collected at this location are considered to be representative of the types of constituents present in the contributing wastestreams. As a result, the characterization data presented in this report are considered to be representative of the effluent stream.

7.0 REFERENCES

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APPENDIX A

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Data for UO_3 Plant Process Condensate--Uranium Calcination				
Constituent	Sample #	Date	Method	Result
Barium	50380	2/06/88	ICP	8.00E+00
Cadmium	50380	2/06/88	ICP	2.00E+00
Chromium	50380	2/06/88	ICP	1.08E+02
Fluoride	50380	2/06/88	IC	4.93E+04
Fluoride	50380	2/06/88	ISE	4.60E+01
Manganese	50380	2/06/88	ICP	9.00E+00
Mercury	50380	2/06/88	CVAA	3.68E+00
Nickel	50380	2/06/88	ICP	5.50E+01
Nitrate	50380	2/06/88	IC	1.52E+07
Phosphate	50380	2/06/88	IC	2.66E+05
Potassium	50380	2/06/88	ICP	1.22E+07
Sodium	50380	2/06/88	ICP	2.24E+04
Uranium	50380	2/06/88	FLUOR	4.19E+02
Zinc	50380	2/06/88	ICP	1.10E+01
Acetone	50380	2/06/88	VOA	2.30E+01
Benzoic acid	50380	2/06/88	ABN	1.40E+01
1-Butanol	50380	2/06/88	VOA	5.00E+00
2-Butanone	50380	2/06/88	VOA	1.20E+01
2-Butanone	50380B	2/06/88	VOA	<1.00E+01
2-Butoxyethanol	50380	2/06/88	ABN	5.80E+01
Butyl nitrate	50380	2/06/88	ABN	4.40E+01
Trans-4-chlorocyclohexanol	50380	2/06/88	ABN	7.80E+01
Methyl nitrate	50380	2/06/88	VOA	6.60E+01
2-Methyl-5-propylnonane	50380	2/06/88	ABN	5.00E+01
Nitroethane	50380	2/06/88	VOA	4.30E+01
N-Nitrosodimethylamine	50380	2/06/88	ABN	4.00E+01
Trichloromethane	50380	2/06/88	VOA	<5.00E+00
Trichloromethane	50380B	2/06/88	VOA	1.40E+01
Unknown	50380	2/06/88	VOA	7.00E+00
Unknown aliphatic HC	50380	2/06/88	ABN	9.80E+01
Alpha Activity (pCi/L)	50380	2/06/88	Alpha	4.47E+02
Beta Activity (pCi/L)	50380	2/06/88	Beta	7.07E+03
pH (dimensionless)	50380	2/06/88	PH-Fld	7.13E+00
Temperature (°C)	50380	2/06/88	TEMP-Fld	2.62E+01
TOC	50380	2/06/88	TOC	6.39E+03
TOX (as Cl)	50380	2/06/88	LTOX	2.18E+01
Data for UO_3 Plant Process Condensate--Standby				
Chloride	50386	3/01/88	IC	5.52E+02
Chloride	50420	5/13/88	IC	7.56E+02
Chloride	50432	6/21/88	IC	8.78E+02
Chloride	50444	8/09/88	IC	7.38E+02
Chromium	50386	3/01/88	ICP	3.60E+01
Chromium	50420	5/13/88	ICP	3.40E+01
Chromium	50432	6/21/88	ICP	1.60E+01
Chromium	50444	8/09/88	ICP	1.70E+01

Data for UO_3 Plant Process Condensate--Standby

Constituent	Sample #	Date	Method	Result
Cyanide	50386	3/01/88	SPEC	1.54E+02
Cyanide	50420	5/13/88	SPEC	1.53E+02
Cyanide	50432	6/21/88	SPEC	2.46E+02
Cyanide	50444	8/09/88	SPEC	1.14E+02
Fluoride	50386	3/01/88	IC	2.83E+03
Fluoride	50386	3/01/88	ISE	2.00E+01
Fluoride	50420	5/13/88	IC	6.26E+02
Fluoride	50420	5/13/88	ISE	6.90E+01
Fluoride	50432	6/21/88	IC	<5.00E+02
Fluoride	50432	6/21/88	ISE	7.30E+01
Fluoride	50444	8/09/88	IC	6.86E+02
Fluoride	50444	8/09/88	ISE	4.80E+01
Iron	50386	3/01/88	ICP	<3.00E+01
Iron	50420	5/13/88	ICP	9.00E+01
Iron	50432	6/21/88	ICP	<3.00E+01
Iron	50444	8/09/88	ICP	<3.00E+01
Mercury	50386	3/01/88	CVAA	1.80E-01
Mercury	50420	5/13/88	CVAA	1.20E-01
Mercury	50432	6/21/88	CVAA	<1.00E-01
Mercury	50444	8/09/88	CVAA	<1.00E-01
Nickel	50386	3/01/88	ICP	2.60E+01
Nickel	50420	5/13/88	ICP	2.40E+01
Nickel	50432	6/21/88	ICP	1.80E+01
Nickel	50444	8/09/88	ICP	1.80E+01
Nitrate	50386	3/01/88	IC	7.35E+05
Nitrate	50420	5/13/88	IC	1.52E+05
Nitrate	50432	6/21/88	IC	1.60E+05
Nitrate	50444	8/09/88	IC	1.45E+05
Phosphate	50386	3/01/88	IC	2.12E+05
Phosphate	50420	5/13/88	IC	2.25E+05
Phosphate	50432	6/21/88	IC	1.25E+05
Phosphate	50444	8/09/88	IC	<1.00E+03
Potassium	50386	3/01/88	ICP	6.92E+05
Potassium	50420	5/13/88	ICP	2.76E+05
Potassium	50432	6/21/88	ICP	1.94E+05
Potassium	50444	8/09/88	ICP	2.94E+05
Sodium	50386	3/01/88	ICP	1.13E+03
Sodium	50420	5/13/88	ICP	5.52E+02
Sodium	50432	6/21/88	ICP	5.92E+02
Sodium	50444	8/09/88	ICP	5.67E+02
Sulfate	50386	3/01/88	IC	4.11E+03
Sulfate	50420	5/13/88	IC	<5.00E+02
Sulfate	50432	6/21/88	IC	<5.00E+02
Sulfate	50444	8/09/88	IC	2.68E+05
Uranium	50386	3/01/88	FLUOR	7.24E+01
Uranium	50420	5/13/88	FLUOR	6.08E+01
Uranium	50432	6/21/88	FLUOR	1.46E+01

Data for UO_3 Plant Process Condensate--Standby

Constituent	Sample #	Date	Method	Result
Uranium	50444	8/09/88	FLUOR	1.62E+01
Zinc	50386	3/01/88	ICP	6.00E+00
Zinc	50420	5/13/88	ICP	<5.00E+00
Zinc	50432	6/21/88	ICP	<5.00E+00
Zinc	50444	8/09/88	ICP	<5.00E+00
Acetone	50386	3/01/88	VOA	1.90E+02
Acetone	50420	5/13/88	VOA	1.10E+02
Ammonia	50386	3/01/88	ISE	<5.00E+01
Ammonia	50420	5/13/88	ISE	<5.00E+01
Ammonia	50432	6/21/88	ISE	9.60E+01
Ammonia	50444	8/09/88	ISE	9.90E+01
9,10-Anthracenedione	50386	3/01/88	ABN	1.80E+01
2-Butanone	50386	3/01/88	VOA	3.70E+01
2-Butanone	50386B	3/01/88	VOA	<1.00E+01
2-Butanone	50420	5/13/88	VOA	<1.00E+01
2-Butanone	50420B	5/13/88	VOA	<1.00E+01
2-Butanone	50432	6/21/88	VOA	<1.00E+01
2-Butanone	50432B	6/21/88	VOA	<1.00E+01
2-Butanone	50444	8/09/88	VOA	<1.00E+01
2-Butanone	50444B	8/09/88	VOA	<1.00E+01
Phenanthrene	50386	3/01/88	ABN	3.60E+01
Phenanthrene	50420	5/13/88	ABN	7.00E+00
Trichloromethane	50386	3/01/88	VOA	<5.00E+00
Trichloromethane	50386B	3/01/88	VOA	1.20E+01
Trichloromethane	50420	5/13/88	VOA	<5.00E+00
Trichloromethane	50420B	5/13/88	VOA	5.00E+00
Trichloromethane	50432	6/21/88	VOA	<5.00E+00
Trichloromethane	50432B	6/21/88	VOA	<5.00E+00
Trichloromethane	50444	8/09/88	VOA	<5.00E+00
Trichloromethane	50444B	8/09/88	VOA	<5.00E+00
Unknown aliphatic HC	50386	3/01/88	ABN	1.10E+01
Alpha Activity (pCi/L)	50386	3/01/88	Alpha	4.19E+01
Alpha Activity (pCi/L)	50420	5/13/88	Alpha	4.05E+01
Alpha Activity (pCi/L)	50432	6/21/88	Alpha	1.68E+01
Alpha Activity (pCi/L)	50444	8/09/88	Alpha	5.80E+00
Beta Activity (pCi/L)	50386	3/01/88	Beta	1.02E+03
Beta Activity (pCi/L)	50420	5/13/88	Beta	3.57E+02
Beta Activity (pCi/L)	50432	6/21/88	Beta	2.66E+02
Beta Activity (pCi/L)	50444	8/09/88	Beta	5.18E+02
Conductivity (μS)	50386	3/01/88	COND-Fld	2.17E+03
Conductivity (μS)	50420	5/13/88	COND-Fld	8.20E+02
Conductivity (μS)	50432	6/21/88	COND-Fld	5.63E+02
Conductivity (μS)	50444	8/09/88	COND-Fld	8.38E+02
pH (dimensionless)	50386	3/01/88	PH-Fld	7.15E+00
pH (dimensionless)	50420	5/13/88	PH-Fld	7.64E+00
pH (dimensionless)	50432	6/21/88	PH-Fld	7.27E+00
pH (dimensionless)	50444	8/09/88	PH-Fld	7.29E+00

Data for UO_3 Plant Process Condensate--Standby

Constituent	Sample #	Date	Method	Result
Temperature (°C)	50386	3/01/88	TEMP-Fld	2.08E+01
Temperature (°C)	50420	5/13/88	TEMP-Fld	2.62E+01
Temperature (°C)	50432	6/21/88	TEMP-Fld	2.99E+01
Temperature (°C)	50444	8/09/88	TEMP-Fld	2.97E+01
TOC	50386	3/01/88	TOC	1.40E+03
TOC	50420	5/13/88	TOC	<8.78E+02
TOC	50432	6/21/88	TOC	<6.77E+02
TOC	50444	8/09/88	TOC	<6.21E+02
TOX (as Cl)	50386	3/01/88	LTOX	5.37E+01
TOX (as Cl)	50420	5/13/88	LTOX	9.20E+01
TOX (as Cl)	50432	6/21/88	LTOX	7.01E+01
TOX (as Cl)	50444	8/09/88	LTOX	6.35E+01

NOTES:

Sample# is the number of the sample. See Section 3.0 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	Semivolatile 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
COLIFMF	Coliform Bacteria (Membrane Filter)	USEPA-9132
COND-Fld	Conductivity-Field	ASTM-D1125A
COND-Lab	Conductivity-Laboratory	ASTM-D1125A
CVAA	Mercury	USEPA-7470
CVAA/M	Mercury-Mixed Matrix	USEPA-7470
DIGC	Direct Aqueous Injection (GC)	UST-70DIGC
DIMS	Direct Aqueous Injection (GC/MS)	"USEPA-8240"
DSPEC	Reactive Cyanide (Distillation, Spectroscopy)	USEPA-CHAPTER 7
DTITRA	Reactive Sulfide (Distillation, Titration)	USEPA-CHAPTER 7
FLUOR	Uranium (Fluorometry)	ASTM-D2907-83
GEA	Gamma Energy Analysis Spectroscopy	ASTM-D3649-85

Code	Analytical Method	Reference
GFAA	Arsenic (AA, Furnace Technique)	USEPA-7060
GFAA	Lead (AA, Furnace Technique)	USEPA-7421
GFAA	Selenium (AA, Furnace Technique)	USEPA-7740
GFAA	Thallium (AA, Furnace Technique)	USEPA-7841
IC	Ion Chromatography	EPA-600/4-84-01
ICP	Atomic Emission Spectroscopy (ICP)	USEPA-6010
ICP/M	Atomic Emission Spectroscopy (ICP)-Mixed Matrix	USEPA-6010
IGNIT	Pensky-Martens Closed-Cup Ignitability	USEPA-1010
ISE	Fluoride-Low Detection Limit	ASTM-D1179-80-B
ISE	Ammonium Ion	ASTM-D1426-D
LALPHA	Alpha Activity-Low Detection Limit	EPA-680/4-75/1
LEPD	^{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.

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.

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APPENDIX B

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Data for UO_3 Plant Process Condensate--Uranium Calcination

Constituent	Sample #	Date	Method	Result
Barium	50021	9/18/85	ICP	<6.00E+00
Barium	50032	4/25/86	ICP	<6.00E+00
Barium	50123	8/28/86	ICP	<6.00E+00
Barium	50380	2/06/88	ICP	8.00E+00
Beryllium	50021	9/18/85	ICP	8.00E+00
Beryllium	50032	4/25/86	ICP	<5.00E+00
Beryllium	50123	8/28/86	ICP	<5.00E+00
Beryllium	50380	2/06/88	ICP	<5.00E+00
Cadmium	50021	9/18/85	ICP	<2.00E+00
Cadmium	50032	4/25/86	ICP	<2.00E+00
Cadmium	50123	8/28/86	ICP	<2.00E+00
Cadmium	50380	2/06/88	ICP	2.00E+00
Chromium	50021	9/18/85	ICP	9.30E+01
Chromium	50032	4/25/86	ICP	5.00E+01
Chromium	50123	8/28/86	ICP	5.50E+01
Chromium	50380	2/06/88	ICP	1.08E+02
Fluoride	50021	9/18/85	IC	<5.00E+02
Fluoride	50032	4/25/86	IC	<5.030+05
Fluoride	50123	8/28/86	IC	<2.50E+04
Fluoride	50380	2/06/88	IC	4.93E+04
Fluoride	50380	2/06/88	ISE	4.60E+01
Iron	50021	9/18/85	ICP	3.44E+02
Iron	50032	4/25/86	ICP	9.70E+02
Iron	50123	8/28/86	ICP	2.35E+02
Iron	50380	2/06/88	ICP	<3.00E+01
Magnesium	50021	9/18/85	ICP	1.40E+01
Magnesium	50032	4/25/86	ICP	1.40E+01
Magnesium	50123	8/28/86	ICP	<5.00E+01
Magnesium	50380	2/06/88	ICP	<5.00E+01
Manganese	50021	9/18/85	ICP	6.00E+00
Manganese	50032	4/25/86	ICP	8.00E+00
Manganese	50123	8/28/86	ICP	<5.00E+00
Manganese	50380	2/06/88	ICP	9.00E+00
Mercury	50021	9/18/85	CVAA	1.00E-01
Mercury	50032	4/25/86	CVAA	2.40E+00
Mercury	50123	8/28/86	CVAA	6.40E+00
Mercury	50380	2/06/88	CVAA	3.68E+00
Nickel	50021	9/18/85	ICP	3.50E+01
Nickel	50032	4/25/86	ICP	2.80E+01
Nickel	50123	8/28/86	ICP	3.10E+01
Nickel	50380	2/06/88	ICP	5.50E+01
Nitrate	50021	9/18/85	IC	<5.00E+02
Nitrate	50032	4/25/86	IC	1.43E+07
Nitrate	50123	8/28/86	IC	1.79E+07
Nitrate	50380	2/06/88	IC	1.52E+07
Phosphate	50021	9/18/85	IC	5.31E+05
Phosphate	50032	4/25/86	IC	<1.00E+06
Phosphate	50123	8/28/86	IC	<5.00E+04

Data for UO_3 Plant Process Condensate--Uranium Calcination

Constituent	Sample #	Date	Method	Result
Phosphate	50380	2/06/88	IC	2.66E+05
Potassium	50021	9/18/85	ICP	<1.00E+02
Potassium	50032	4/25/86	ICP	<1.00E+02
Potassium	50123	8/28/86	ICP	<1.00E+02
Potassium	50380	2/06/88	ICP	1.22E+07
Sodium	50021	9/18/88	ICP	4.95E+02
Sodium	50032	4/25/86	ICP	1.50E+02
Sodium	50123	8/28/86	ICP	3.81E+02
Sodium	50380	2/06/88	ICP	2.24E+04
Uranium	50021	9/18/85	FLUOR	6.51E+02
Uranium	50032	4/25/86	FLUOR	5.56E+02
Uranium	50123	8/28/86	FLUOR	4.50E+02
Uranium	50380	2/06/88	FLUOR	4.19E+02
Zinc	50021	9/18/85	ICP	4.80E+01
Zinc	50032	4/25/86	ICP	7.80E+01
Zinc	50123	8/28/86	ICP	<5.00E+00
Zinc	50380	2/06/88	ICP	1.10E+01
Acetone	50380	2/06/88	VOA	2.30E+01
Benzoic acid	50380	2/06/88	ABN	1.40E+01
Butanal	50123	8/28/86	VOA	1.80E+01
1-Butanol	50021	9/18/85	VOA	5.00E+01
1-Butanol	50380	2/06/88	VOA	5.00E+00
2-Butanone	50021	9/18/85	VOA	<1.00E+01
2-Butanone	50032	4/25/86	VOA	<1.00E+01
2-Butanone	50123	8/28/86	VOA	<1.00E+01
2-Butanone	50123B	8/28/86	VOA	<1.00E+01
2-Butanone	50380	2/06/88	VOA	1.20E+01
2-Butanone	50380B	2/06/88	VOA	<1.00E+01
2-Butoxyethanol	50380	2/06/88	ABN	5.80E+01
Butyl nitrate	50032	4/25/88	ABN	4.50E+01
Butyl nitrate	50380	2/06/88	ABN	4.40E+01
Trans-4-chlorocyclohexanol	50380	2/06/88	ABN	7.80E+01
Dichloromethane	50021	9/18/85	VOA	<1.00E+01
Dichloromethane	50032	4/25/86	VOA	<1.00E+01
Dichloromethane	50123	8/28/86	VOA	1.50E+02
Dichloromethane	50380	2/06/88	VOA	<1.00E+01
Dichloromethane	50380B	2/06/88	VOA	<1.00E+01
Dimethoxymethane	50032	4/25/86	ABN	9.00E+02
Dimethoxymethane	50123	8/28/86	ABN	2.60E+02
Dinitro-1,4-butanediol	50032	4/25/86	ABN	3.90E+01
N-Methoxymethanamine	50021	9/18/85	ABN	1.50E+02
N-Methoxymethanamine	50032	4/25/86	ABN	1.90E+02
N-Methoxymethanamine	50123	8/28/86	ABN	1.20E+02
2-Methyldecane	50032	4/25/86	ABN	3.00E+02
Methyl formate	50021	9/18/85	ABN	1.60E+02
Methyl formate	50032	4/25/86	ABN	8.00E+02
Methyl formate	50123	8/28/86	ABN	2.10E+02
Methyl nitrate	50021	9/18/85	VOA	1.40E+02

Data for UO_3 Plant Process Condensate--Uranium Calcination

Constituent	Sample #	Date	Method	Result
Methyl nitrate	50032	4/25/86	VOA	3.30E+01
Methyl nitrate	50123	8/28/86	VOA	2.90E+01
Methyl nitrate	50380	2/06/88	VOA	6.60E+01
2-Methyl-5-propylnonane	50380	2/06/88	ABN	5.00E+01
Nitroethane	50380	2/06/88	VOA	4.30E+01
N-Nitrosodimethylamine	50380	2/06/88	ABN	4.00E+01
Trichloromethane	50021	9/18/85	VOA	<1.00E+00
Trichloromethane	50032	4/25/86	VOA	1.20E+02
Trichloromethane	50123	8/28/86	VOA	<1.00E+01
Trichloromethane	50123B	8/28/86	VOA	<1.00E+01
Trichloromethane	50380	2/06/88	VOA	<5.00E+00
Trichloromethane	50380B	2/06/88	VOA	1.40E+01
Tridecane	50032	4/25/86	ABN	2.10E+02
Unknown	50032	4/25/86	VOA	1.20E+02
Unknown	50380	2/06/88	VOA	7.00E+00
Unknown aliphatic HC	50380	2/06/88	ABN	9.80E+01
Alpha Activity (pCi/L)	50021	9/18/85	Alpha	7.21E+02
Alpha Activity (pCi/L)	50032	4/25/86	Alpha	6.24E+02
Alpha Activity (pCi/L)	50123	8/28/86	Alpha	5.70E+02
Alpha Activity (pCi/L)	50380	2/06/88	Alpha	4.47E+02
Beta Activity (pCi/L)	50021	9/18/85	Beta	8.48E+02
Beta Activity (pCi/L)	50032	4/25/86	Beta	3.91E+02
Beta Activity (pCi/L)	50123	8/28/86	Beta	6.78E+02
Beta Activity (pCi/L)	50380	2/06/88	Beta	7.07E+03
Conductivity (uS)	50021	9/18/85	COND	1.60E+04
Conductivity (uS)	50032	4/25/86	COND	6.31E+03
Conductivity (uS)	50123	8/28/86	COND	1.60E+04
Conductivity (uS)	50380	8/28/86	COND	>1.60E+04
pH (dimensionless)	50021	9/18/85	PH-Fld	9.30E-01
pH (dimensionless)	50032	4/25/86	PH-Fld	1.22E+00
pH (dimensionless)	50123	8/28/86	PH-Fld	6.30E-01
pH (dimensionless)	50380	2/06/88	PH-Fld	7.13E+00
Temperature (degrees C)	50021	9/18/85	TEMP-Fld	3.12E+01
Temperature (degrees C)	50032	4/25/86	TEMP-Fld	2.76E+01
Temperature (degrees C)	50123	8/28/86	TEMP-Fld	4.22E+01
Temperature (degrees C)	50380	2/06/88	TEMP-Fld	2.62E+01
TOC	50021	9/18/85	TOC	5.77E+04
TOC	50032	4/25/86	TOC	1.02E+04
TOC	50123	8/28/86	TOC	2.96E+03
TOC	50380	2/06/88	TOC	6.39E+03
TOX (as Cl)	50380	2/06/88	LTOX	2.18E+01

Data for UO_3 Plant Process Condensate--Standby

Constituent	Sample #	Date	Method	Result
Cadmium	50047	5/20/86	ICP	<2.00E+00
Cadmium	50109	8/14/86	ICP	<2.00E+00
Cadmium	50182	11/13/86	ICP	<2.00E+00
Cadmium	50277	4/10/87	ICP	3.00E+00
Cadmium	50386	3/01/88	ICP	<2.00E+00
Cadmium	50420	5/13/88	ICP	<2.00E+00
Cadmium	50432	6/21/88	ICP	<2.00E+00
Cadmium	50444	8/09/88	ICP	<2.00E+00
Calcium	50047	5/20/86	ICP	<5.00E+01
Calcium	50109	8/14/86	ICP	<5.00E+01
Calcium	50182	11/13/86	ICP	1.15E+03
Calcium	50277	4/10/87	ICP	<5.00E+01
Calcium	50386	3/01/88	ICP	<5.00E+01
Calcium	50420	5/13/88	ICP	<5.00E+01
Calcium	50432	6/21/88	ICP	<5.00E+01
Calcium	50444	8/09/88	ICP	<5.00E+01
Chloride	50047	5/20/86	IC	<2.50E+05
Chloride	50109	8/14/86	IC	<5.00E+02
Chloride	50182	11/13/86	IC	<2.50E+05
Chloride	50109	8/14/86	IC	<5.00E+02
Chloride	50182	11/13/86	IC	<5.00E+03
Chloride	50277	4/10/87	IC	<5.00E+02
Chloride	50386	3/01/88	IC	5.52E+02
Chloride	50420	5/13/88	IC	7.56E+02
Chloride	50432	6/21/88	IC	8.78E+02
Chloride	50444	8/09/88	IC	7.38E+02
Chromium	50047	5/20/86	ICP	1.07E+02
Chromium	50109	8/14/86	ICP	2.30E+01
Chromium	50182	11/13/86	ICP	5.00E+01
Chromium	50277	4/10/87	ICP	2.30E+01
Chromium	50386	3/01/88	ICP	3.60E+01
Chromium	50420	5/13/88	ICP	3.40E+01
Chromium	50432	6/21/88	ICP	1.60E+01
Chromium	50444	8/09/88	ICP	1.70E+01
Cyanide	50047	5/20/86	SPEC	<1.00E+01
Cyanide	50109	8/14/86	SPEC	<1.00E+01
Cyanide	50182	11/13/86	SPEC	<1.00E+01
Cyanide	50277	4/10/87	SPEC	1.33E+01
Cyanide	50386	3/01/88	SPEC	1.54E+02
Cyanide	50420	5/13/88	SPEC	1.53E+02
Cyanide	50432	6/21/88	SPEC	2.46E+02
Cyanide	50444	8/09/88	SPEC	1.14E+02
Fluoride	50047	5/20/86	IC	<2.50E+05
Fluoride	50109	8/14/86	IC	<5.00E+02
Fluoride	50182	11/13/86	IC	<5.00E+03
Fluoride	50277	4/10/87	IC	5.13E+02
Fluoride	50386	3/01/88	IC	2.83E+03

Data for UO_3 Plant Process Condensate--Standby

Constituent	Sample #	Date	Method	Result
Fluoride	50386	3/01/88	ISE	2.00E+01
Fluoride	50420	5/13/88	IC	6.26E+02
Fluoride	50420	5/13/88	ISE	6.90E+01
Fluoride	50432	6/21/88	IC	<5.00E+02
Fluoride	50432	6/21/88	ISE	7.30E+01
Fluoride	50444	8/09/88	IC	6.86E+02
Fluoride	50444	8/09/88	ISE	4.80E+01
Iron	50047	5/20/86	ICP	9.82E+02
Iron	50109	8/14/86	ICP	<5.00E+01
Iron	50182	11/13/86	ICP	2.12E+02
Iron	50277	4/10/87	ICP	1.26E+03
Iron	50386	3/01/88	ICP	<3.00E+01
Iron	50420	5/13/88	ICP	9.00E+01
Iron	50432	6/21/88	ICP	<3.00E+01
Iron	50444	8/09/88	ICP	<3.00E+01
Lead	50182	11/13/86	GFAA	2.29E+01
Lead	50277	4/10/87	GFAA	<5.00E+00
Lead	50386	3/01/88	GFAA	<5.00E+00
Lead	50420	5/13/88	GFAA	<5.00E+00
Lead	50432	6/21/88	GFAA	<5.00E+00
Lead	50444	8/09/88	GFAA	<5.00E+00
Magnesium	50047	5/20/86	ICP	<5.00E+01
Magnesium	50109	8/14/86	ICP	<5.00E+01
Magnesium	50182	11/13/86	ICP	2.88E+02
Magnesium	50277	4/10/87	ICP	<5.00E+01
Magnesium	50386	3/01/88	ICP	<5.00E+01
Magnesium	50420	5/13/88	ICP	<5.00E+01
Magnesium	50432	6/21/88	ICP	<5.00E+01
Magnesium	50444	8/09/88	ICP	<5.00E+01
Manganese	50047	5/20/86	ICP	1.20E+01
Manganese	50109	8/14/86	ICP	7.00E+00
Manganese	50182	11/13/86	ICP	7.00E+00
Manganese	50277	4/10/87	ICP	1.20E+01
Manganese	50386	3/01/88	ICP	<5.00E+00
Manganese	50420	5/13/88	ICP	<5.00E+00
Manganese	50432	6/21/88	ICP	<5.00E+00
Manganese	50444	8/09/88	ICP	<5.00E+00
Mercury	50047	5/20/86	CVAA	1.68E+00
Mercury	50109	8/14/86	CVAA	<1.00E-01
Mercury	50182	11/13/86	CVAA	1.10E-01
Mercury	50277	4/10/87	CVAA	<1.00E-01
Mercury	50386	3/01/88	CVAA	1.80E-01
Mercury	50420	5/13/88	CVAA	1.20E-01
Mercury	50432	6/21/88	CVAA	<1.00E-01
Mercury	50444	8/09/88	CVAA	<1.00E-01
Nickel	50047	5/20/86	ICP	1.28E+02
Nickel	50109	8/14/86	ICP	4.70E+01

Data for UO_3 Plant Process Condensate--Standby

Constituent	Sample #	Date	Method	Result
Nickel	50182	11/13/86	ICP	4.30E+01
Nickel	50277	4/10/87	ICP	1.30E+01
Nickel	50386	3/01/88	ICP	2.60E+01
Nickel	50420	5/13/88	ICP	2.40E+01
Nickel	50432	6/21/88	ICP	1.80E+01
Nickel	50444	8/09/88	ICP	1.80E+01
Nitrate	50047	5/20/86	IC	5.04E+06
Nitrate	50109	8/14/86	IC	7.73E+04
Nitrate	50182	11/13/86	IC	7.08E+05
Nitrate	50277	4/10/87	IC	8.89E+04
Nitrate	50386	3/01/88	IC	7.35E+05
Nitrate	50420	5/13/88	IC	1.52E+05
Nitrate	50432	6/21/88	IC	1.60E+05
Nitrate	50444	8/09/88	IC	1.45E+05
Phosphate	50047	5/20/86	IC	<5.00E+05
Phosphate	50109	8/14/86	IC	<1.00E+03
Phosphate	50182	11/13/86	IC	<1.00E+04
Phosphate	50277	4/10/87	IC	<1.00E+03
Phosphate	50386	3/01/88	IC	2.12E+05
Phosphate	50420	5/13/88	IC	2.25E+05
Phosphate	50432	6/21/88	IC	1.25E+05
Phosphate	50444	8/09/88	IC	<1.00E+03
Potassium	50047	5/20/86	ICP	<1.00E+02
Potassium	50109	8/14/86	ICP	<1.00E+02
Potassium	50182	11/13/86	ICP	<1.00E+02
Potassium	50277	4/10/87	ICP	<1.00E+02
Potassium	50386	3/01/88	ICP	6.92E+05
Potassium	50420	5/13/88	ICP	2.76E+05
Potassium	50432	6/21/88	ICP	1.94E+05
Potassium	50444	8/09/88	ICP	2.94E+05
Sodium	50047	5/20/86	ICP	1.91E+02
Sodium	50109	8/14/86	ICP	1.22E+02
Sodium	50182	11/13/86	ICP	2.04E+02
Sodium	50277	4/10/87	ICP	2.80E+02
Sodium	50386	3/01/88	ICP	1.13E+03
Sodium	50420	5/13/88	ICP	5.52E+02
Sodium	50432	6/21/88	ICP	5.92E+02
Sodium	50444	8/09/88	ICP	5.67E+02
Sulfate	50047	5/20/86	IC	<2.50E+05
Sulfate	50109	8/14/86	IC	<5.00E+02
Sulfate	50182	11/13/86	IC	<5.00E+03
Sulfate	50277	4/10/87	IC	<5.00E+02
Sulfate	50386	3/01/88	IC	4.11E+03
Sulfate	50420	5/13/88	IC	<5.00E+02
Sulfate	50432	6/21/88	IC	<5.00E+02
Sulfate	50444	8/09/88	IC	2.68E+05
Uranium	50047	5/20/86	FLUOR	2.09E+02

Data for UO_3 Plant Process Condensate--Standby

Constituent	Sample #	Date	Method	Result
Uranium	50109	8/14/86	FLUOR	8.05E+02
Uranium	50182	11/13/86	FLUOR	1.40E+01
Uranium	50277	4/10/87	FLUOR	1.66E+00
Uranium	50386	3/01/88	FLUOR	7.24E+01
Uranium	50420	5/13/88	FLUOR	6.08E+01
Uranium	50432	6/21/88	FLUOR	1.46E+01
Uranium	50444	8/09/88	FLUOR	1.62E+01
Zinc	50047	5/20/86	ICP	1.60E+01
Zinc	50109	8/14/86	ICP	<5.00E+00
Zinc	50182	11/13/86	ICP	8.10E+01
Zinc	50277	4/10/87	ICP	<5.00E+00
Zinc	50386	3/01/88	ICP	6.00E+00
Zinc	50420	5/13/88	ICP	<5.00E+00
Zinc	50432	6/21/88	ICP	<5.00E+00
Zinc	50444	8/09/88	ICP	<5.00E+00
Acetone	50047	5/20/86	VOA	6.00E+01
Acetone	50109	8/14/86	VOA	1.00E+02
Acetone	50386	3/01/88	VOA	1.90E+02
Acetone	50420	5/13/88	VOA	1.10E+02
Ammonia	50047	5/20/86	ISE	8.89E+01
Ammonia	50109	8/14/86	ISE	6.60E+01
Ammonia	50182	11/13/86	ISE	8.10E+01
Ammonia	50277	4/10/87	ISE	1.03E+02
Ammonia	50386	3/01/88	ISE	<5.00E+01
Ammonia	50420	5/13/88	ISE	<5.00E+01
Ammonia	50432	6/21/88	ISE	9.60E+01
Ammonia	50444	8/09/88	ISE	9.90E+01
9,10-Anthracenedione	50386	3/01/88	ABN	1.80E+01
Benzaldehyde	50182	11/13/86	ABN	1.40E+01
Benzoic acid	50182	11/13/86	ABN	1.00E+02
2-Butanone	50047	5/20/86	VOA	<1.00E+01
2-Butanone	50047B	5/20/86	VOA	<1.00E+01
2-Butanone	50109	8/14/86	VOA	1.20E+01
2-Butanone	50109B	8/14/86	VOA	<1.00E+01
2-Butanone	50182	11/13/86	VOA	<1.00E+01
2-Butanone	50182B	11/13/86	VOA	<1.00E+01
2-Butanone	50277	4/10/87	VOA	<1.00E+01
2-Butanone	50277B	4/10/87	VOA	<1.00E+01
2-Butanone	50386	3/01/88	VOA	3.70E+01
2-Butanone	50386B	3/01/88	VOA	<1.00E+01
2-Butanone	50420	5/13/88	VOA	<1.00E+01
2-Butanone	50420B	5/13/88	VOA	<1.00E+01
2-Butanone	50432	6/21/88	VOA	<1.00E+01
2-Butanone	50432B	6/21/88	VOA	<1.00E+01
2-Butanone	50444	8/09/88	VOA	<1.00E+01
2-Butanone	50444B	8/09/88	VOA	<1.00E+01

Data for UO_3 Plant Process Condensate--Standby

Constituent	Sample #	Date	Method	Result
Dichloromethane	50047	5/20/86	VOA	7.00E+01
Dichloromethane	50047B	5/20/86	VOA	2.70E+02
Dichloromethane	50109	8/14/86	VOA	<1.00E+01
Dichloromethane	50109B	8/14/86	VOA	1.50E+02
Dichloromethane	50182	11/13/86	VOA	<1.00E+01
Dichloromethane	50182B	11/13/86	VOA	1.02E+02
Dichloromethane	50277	4/10/87	VOA	<1.00E+01
Dichloromethane	50277B	4/10/87	VOA	3.60E+01
Dichloromethane	50386	3/01/88	VOA	<1.00E+01
Dichloromethane	50386B	3/01/88	VOA	<1.00E+01
Dichloromethane	50420	5/13/88	VOA	<1.00E+01
Dichloromethane	50420B	5/13/88	VOA	<1.00E+01
Dichloromethane	50432	6/21/88	VOA	<1.00E+01
Dichloromethane	50432B	6/21/88	VOA	<1.00E+01
Dichloromethane	50444	8/09/88	VOA	<1.00E+01
Dichloromethane	50444B	8/09/88	VOA	<1.00E+01
1-Dodecene	50277	4/10/87	ABN	1.10E+01
N-Methoxymethanamine	50047	5/20/86	VOA	3.00E+01
Methyl nitrate	50047	5/20/86	VOA	2.10E+02
Nonanoic acid	50182	11/13/86	ABN	1.40E+01
Phenanthrene	50386	3/01/88	ABN	3.60E+01
Phenanthrene	50420	5/13/88	ABN	7.00E+00
Trichloromethane	50047	5/20/86	VOA	<1.00E+01
Trichloromethane	50047B	5/20/86	VOA	<1.00E+01
Trichloromethane	50109	8/14/86	VOA	<1.00E+01
Trichloromethane	50109B	8/14/86	VOA	<1.00E+01
Trichloromethane	50182	11/13/86	VOA	<1.00E+01
Trichloromethane	50182	11/13/86	ABN	3.50E+01
Trichloromethane	50182B	11/13/86	VOA	<1.00E+01
Trichloromethane	50277	4/10/87	VOA	<1.00E+01
Trichloromethane	50277B	4/10/87	VOA	<1.00E+01
Trichloromethane	50386	3/01/88	VOA	<5.00E+00
Trichloromethane	50386B	3/01/88	VOA	1.20E+01
Trichloromethane	50420	5/13/88	VOA	<5.00E+00
Trichloromethane	50420B	5/13/88	VOA	5.00E+00
Trichloromethane	50432	6/21/88	VOA	<5.00E+00
Trichloromethane	50432B	6/21/88	VOA	<5.00E+00
Trichloromethane	50444	8/09/88	VOA	<5.00E+00
Trichloromethane	50444B	8/09/88	VOA	<5.00E+00
Unknown	50182	11/13/86	ABN	1.00E+01
Unknown	50277	4/10/87	ABN	1.90E+01
Unknown aliphatic HC	50386	3/01/88	ABN	1.10E+01
Alpha Activity (pCi/L)	50047	5/20/86	Alpha	2.57E+02
Alpha Activity (pCi/L)	50109	8/14/86	Alpha	7.77E+02
Alpha Activity (pCi/L)	50182	11/13/86	Alpha	1.43E+01
Alpha Activity (pCi/L)	50277	4/10/87	Alpha	1.63E+00
Alpha Activity (pCi/L)	50386	3/01/88	Alpha	4.19E+01

Data for UO_3 Plant Process Condensate--Standby

Constituent	Sample #	Date	Method	Result
Alpha Activity (pCi/L)	50420	5/13/88	Alpha	4.05E+01
Alpha Activity (pCi/L)	50432	6/21/88	Alpha	1.68E+01
Alpha Activity (pCi/L)	50444	8/09/88	Alpha	5.80E+00
Beta Activity (pCi/L)	50047	5/20/86	Beta	2.75E+02
Beta Activity (pCi/L)	50109	8/14/86	Beta	1.98E+02
Beta Activity (pCi/L)	50182	11/13/86	Beta	2.34E+01
Beta Activity (pCi/L)	50277	4/10/87	Beta	8.24E+00
Beta Activity (pCi/L)	50386	3/01/88	Beta	1.02E+03
Beta Activity (pCi/L)	50420	5/13/88	Beta	3.57E+02
Beta Activity (pCi/L)	50432	6/21/88	Beta	2.66E+02
Beta Activity (pCi/L)	50444	8/09/88	Beta	5.18E+02
Conductivity (µS)	50047	5/20/86	COND-Fld	2.80E+03
Conductivity (µS)	50109	8/14/86	COND-Fld	4.13E+02
Conductivity (µS)	50182	11/13/86	COND-Fld	5.27E+03
Conductivity (µS)	50277	4/10/87	COND-Fld	4.84E+02
Conductivity (µS)	50386	3/01/88	COND-Fld	2.17E+03
Conductivity (µS)	50420	5/13/88	COND-Fld	8.20E+02
Conductivity (µS)	50432	6/21/88	COND-Fld	5.63E+02
Conductivity (µS)	50444	8/09/88	COND-Fld	8.38E+02
pH (dimensionless)	50047	5/20/86	PH-Fld	1.54E+00
pH (dimensionless)	50109	8/14/86	PH-Fld	3.09E+00
pH (dimensionless)	50182	11/13/86	PH-Fld	2.32E+00
pH (dimensionless)	50277	4/10/87	PH-Fld	3.08E+00
pH (dimensionless)	50386	3/01/88	PH-Fld	7.15E+00
pH (dimensionless)	50420	5/13/88	PH-Fld	7.64E+00
pH (dimensionless)	50432	6/21/88	PH-Fld	7.27E+00
pH (dimensionless)	50444	8/09/88	PH-Fld	7.29E+00
Temperature (°C)	50047	5/20/86	TEMP-Fld	2.80E+01
Temperature (°C)	50109	8/14/86	TEMP-Fld	2.87E+01
Temperature (°C)	50182	11/13/86	TEMP-Fld	1.90E+01
Temperature (°C)	50277	4/10/87	TEMP-Fld	2.07E+01
Temperature (°C)	50386	3/01/88	TEMP-Fld	2.08E+01
Temperature (°C)	50420	5/13/88	TEMP-Fld	2.62E+01
Temperature (°C)	50432	6/21/88	TEMP-Fld	2.99E+01
Temperature (°C)	50444	8/09/88	TEMP-Fld	2.97E+01
TOC	50047	5/20/86	TOC	6.99E+03
TOC	50109	8/14/86	TOC	<9.53E+02
TOC	50182	11/13/86	TOC	1.37E+03
TOC	50277	4/10/87	TOC	<7.02E+02
TOC	50386	3/01/88	TOC	1.40E+03
TOC	50420	5/13/88	TOC	<8.78E+02
TOC	50432	6/21/88	TOC	<6.77E+02
TOC	50444	8/09/88	TOC	<6.21E+02

Data for UO_3 Plant Process Condensate--Standby

Constituent	Sample #	Date	Method	Result
TOX (as Cl)	50047	5/20/86	TOX	6.36E+02
TOX (as Cl)	50109	8/14/86	TOX	<3.00E+01
TOX (as Cl)	50182	11/13/86	TOX	1.92E+02
TOX (as Cl)	50277	4/10/87	LTOX	4.82E+01
TOX (as Cl)	50386	3/01/88	LTOX	5.37E+01
TOX (as Cl)	50420	5/13/88	LTOX	9.20E+01
TOX (as Cl)	50432	6/21/88	LTOX	7.01E+01
TOX (as Cl)	50444	8/09/88	LTOX	6.35E+01

NOTES:

Sample# is the number of the sample. See Section 3.0 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	Semivolatile 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
COLIFMF	Coliform Bacteria (Membrane Filter)	USEPA-9132
COND-Fld	Conductivity-Field	ASTM-D1125A
COND-Lab	Conductivity-Laboratory	ASTM-D1125A
CVAA	Mercury	USEPA-7470
CVAA/M	Mercury-Mixed Matrix	USEPA-7470
DIGC	Direct Aqueous Injection (GC)	UST-70DIGC
DIMS	Direct Aqueous Injection (GC/MS)	"USEPA-8240"
DSPEC	Reactive Cyanide (Distillation, Spectroscopy)	USEPA-CHAPTER 7
DTITRA	Reactive Sulfide (Distillation, Titration)	USEPA-CHAPTER 7
FLUOR	Uranium (Fluorometry)	ASTM-D2907-83
GEA	Gamma Energy Analysis Spectroscopy	ASTM-D3649-85
GFAA	Arsenic (AA, Furnace Technique)	USEPA-7060
GFAA	Lead (AA, Furnace Technique)	USEPA-7421
GFAA	Selenium (AA, Furnace Technique)	USEPA-7740
GFAA	Thallium (AA, Furnace Technique)	USEPA-7841
IC	Ion Chromatography	EPA-600/4-84-01
ICP	Atomic Emission Spectroscopy (ICP)	USEPA-6010

Code	Analytical Method	Reference
ICP/M	Atomic Emission Spectroscopy (ICP)-Mixed Matrix	USEPA-6010
IGNIT	Pensky-Martens Closed-Cup Ignitability	USEPA-1010
ISE	Fluoride-Low Detection Limit	ASTM-D1179-80-B
ISE	Ammonium Ion	ASTM-D1426-D
LALPHA	Alpha Activity-Low Detection Limit	EPA-680/4-75/1
LEPD	^{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.

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.

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