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ENGINEERING CHANGE NOTICE

Page 1 of 4

1. ECN 613528

Proj. ECN

2. ECN Category (mark one) Supplemental [] Direct Revision [x] Change ECN ~~[x]~~ JKE 9/29/94 Temporary [] Standby [] Supersedure [] Cancel/Void []	3. Originator's Name, Organization, MSIN, and Telephone No. C.H. Mulkey, 7C420, R1-51, 373-5609	4. Date 09/30/94
	5. Project Title/No./Work Order No. 242-A Evaporator Waste Analysis Plan	6. Bldg./Sys./Fac. No. N/A
		7. Impact Level EQ
	8. Document Numbers Changed by this ECN (includes sheet no. and rev.) WHC-SD-WM-EV-060, REV. 3	9. Related ECN No(s). 613527,08/02/94
		10. Related PO No. N/A

11a. Modification Work	11b. Work Package No.	11c. Modification Work Complete	11d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 11b) [X] No (NA Blks. 11b, 11c, 11d)	N/A	N/A Cog. Engineer Signature & Date	N/A Cog. Engineer Signature & Date

12. Description of Change

The entire document, WHC-SD-WM-EV-060, REV. 3, is being replaced with WHC-SD-WM-EV-060, Rev. 4, ECN# 613528.

13a. Justification (mark one)			
Criteria Change [X]	Design Improvement []	Environmental []	
As-Found []	Facilitate Const. []	Const. Error/Omission []	Design Error/Omission []

13b. Justification Details

14. Distribution (include name, MSIN, and no. of copies)

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A-7900-013-2 (06/92) GEF095

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15. Design Verification Required	16. Cost Impact		17. Schedule Impact (days)
	ENGINEERING	CONSTRUCTION	
[] Yes	Additional [] $	Additional [] $	Improvement [] N/A
[X] No	Savings [] $	Savings [] $	Delay []

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]		[]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision

20. Approvals

	Signature	Date		Signature	Date
OPERATIONS AND ENGINEERING			ARCHITECT-ENGINEER		
Cog Engineer	* C. H. Mulkey	9/27/94	PE		
	T. S. Basra	9/27/94			
Cog. Mgr.	* R.D. Gustavson	9/27/94	QA		
QA	*Yogi Ananda	9/27/94	Safety		
Safety			Design		
Security			Environ.		
Environ.		9/27/94	Other		
Projects/Programs					
Tank Waste Remediation System					
Facilities Operations			DEPARTMENT OF ENERGY		
Restoration & Remediation			Signature or Letter No.		
Operations & Support Services		9/27/94			
IRM			ADDITIONAL		
Other	R.C. Brunner	9/28/94			
Waste Treatment System Engineering	* Brian Von Bargen	9/27/94			
Sampling Data and Laboratory Administration					

APPENDIX B

Unreviewed Safety Question Forms

Figure B-1. Unreviewed Safety Question - Changes Screening Form. (1 Sheet)

REFERENCE ITEM # ECN 613528
TITLE 242-A Evaporator Waste Analysis Plan, WHC-SD-WM-EV-060, Rev. 4

Does the referenced item:

A. Make PROPOSED CHANGES to the facility or procedures which differ from conditions described in the AUTHORIZATION BASIS documentation?

N/A____ NO_x_ Yes/Maybe____

Basis: ECN 613528 does not make proposed changes to the facility or procedures which differ from conditions described in WHC-SD-WM-SAR-023, "242-A Evaporator/Crystallizer Safety Analysis Report", Rev. 1-B, or WHC-SD-W105-SAR-001, Final Safety Analysis Report 242-A Evaporator Liquid Effluent Retention Facility", Rev. 0-C. The ECN implements the Waste Analysis Plan (part of the Part B Permit Application) which provides guidance necessary to meet environmental compliance objectives only. Implementation of this document has no effect on the accidents described in Table 9-1, "Summary of Radiological Consequences".

B. Make PROPOSED CHANGES that represent conditions that have not been analyzed in the AUTHORIZATION BASIS?

N/A____ NO_x_ Yes/Maybe____

Basis: ECN 613528 does not make proposed changes that represent conditions that have not been analyzed in WHC-SD-WM-SAR-023, "242-A Evaporator/Crystallizer Safety Analysis Report", Rev. 1-B, Chapter 9 or WHC-SD-W105-SAR-001, Final Safety Analysis Report 242-A Evaporator Liquid Effluent Retention Facility", Rev. 0-C. The ECN implements the Waste Analysis Plan (part of the Part B Permit Application) which provides guidance necessary to meet environmental compliance objectives only. Implementation of this document has no effect on the accidents described in Table 9-1, "Summary of Radiological Consequences".

C. Describe tests or experiments which differ from those described in the AUTHORIZATION BASIS documentation?

N/A____ NO_x_ Yes/Maybe____

Basis: ECN 613528 does not describe any tests of experiments at all. The ECN implements the Waste Analysis Plan (part of the Part B Permit Application) which provides guidance necessary to meet environmental compliance objectives only. Implementation of this document has no effect on the accidents described in Table 9-1, "Summary of Radiological Consequences".

D. Is a change in a TSR, OSR, or compliance plan to OSR involved?

N/A____ NO_x__ Yes/Maybe____

Basis: ECN 613528 does not change any TSR, OSR, or compliance plan to OSR as described in WHC-SD-WM-SAR-023, "242-A Evaporator/Crystallizer Safety Analysis Report", Rev. 1-B, Chapter 9 or WHC-SD-W105-SAR-001, Final Safety Analysis Report 242-A Evaporator Liquid Effluent Retention Facility", Rev. 0-C. The ECN implements the Waste Analysis Plan (part of the Part B Permit Application) which provides guidance necessary to meet environmental compliance objectives only. Implementation of this document has no effect on the accidents described in Table 9-1, "Summary of Radiological Consequences".

USQE #1 Brian Von Bargen
Print Name

[signature] 9/12/94
Signature Date

USQE #2 Elvis Le
Print Name

[signature] 9/12/94
Signature Date

RELEASE AUTHORIZATION

Document Number:	WHC-SD-WM-EV-060, REV.4
Document Title:	242-A Evaporator Waste Analysis Plan
Release Date:	September 29, 1994

* * * * * * * * * * * * * *

This document was reviewed following the procedures described in WHC-CM-3-4 and is:

APPROVED FOR PUBLIC RELEASE

* * * * * * * * * * * * * *

WHC Information Release Administration Specialist:

Kara Broz
(Signature)

September 29, 1994
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A-6001-400 (07/94) WEF256

SUPPORTING DOCUMENT

1. Total Pages	35
2. Title: 242-A Evaporator Waste Analysis Plan	3. Number: WHC-SD-WM-EV-060
4. Rev No.	Rev. 4

5. Key Words

Waste characterization of candidate feed tank(s) and process condensate at the evaporator.

6. Author

Name: Tejpal S. Basra
C. M. Mulkey

C M Mulkey Tejpal S. Basra
Signature

1D1E4C / 7C420
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7. Abstract

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9. Impact Level

10. **RELEASE STAMP**

RECORD OF REVISION	(1) Document Number WHC-SD-WM-EV-060

(2) Title
242-A Evaporator Waste Analysis Plan

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change – Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Proj. Engr	(6) Cog. Proj. Mgr	Date
1 RS	(7) WHC-SD-WM-EV-060, REV. 0 EDT 125688 Revise per ECN 153251	[signature]	[signature]	4/5/91
2 RS	WHC-SD-WM-EV-060, REV. 1 ECN 153251 Revise per ECN 192267 CML 4/20/93	C M Koll	C M Koll for RD Gustavson	4/13/93
3 RS	WHC-SD-WM-EV-060, REV. 2 ECN 192267 Revise per ECN 161468	C M Koll	R.D. Gustavson	11/18/93
4 RS	WHC-SD-WM-EV-060, REV. 3 ECN 161468 Revise per ECN 613528	C H Miller	R.D. Gustavson	9/27/94

A-7320-005 (3 89)

242-A EVAPORATOR WASTE ANALYSIS PLAN

By

Tejpal S. Basra
Charles H. Mulkey

September 23, 1994

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ABBREVIATIONS & ACRONYMS

ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
CFR	CODE OF FEDERAL REGULATIONS
DOE	U.S. DEPARTMENT OF ENERGY
DQO	DATA QUALITY OBJECTIVE
DSC	DIFFERENTIAL SCANNING CALORIMETER
DST	DOUBLE SHELL TANKS
Ecology	WASHINGTON STATE DEPARTMENT OF ECOLOGY
EPA	U.S. ENVIRONMENTAL PROTECTION AGENCY
ETF	EFFLUENT TREATMENT FACILITY
Evaporator	242-A EVAPORATOR
HDPE	HIGH DENSITY POLYPROPYLENE
LDR	LAND DISPOSAL RESTRICTION
LERF	LIQUID EFFLUENT RETENTION FACILITY
PC	PROCESS CONDENSATE
QA	QUALITY ASSURANCE
QAPjP	QUALITY ASSURANCE PROJECT PLAN
QAPP	QUALITY ASSURANCE PROGRAM PLAN
QC	QUALITY CONTROL
RSD	RELATIVE STANDARD DEVIATION
SD	SUPPORTING DOCUMENT
TC	TOTAL CARBON
TCLP	*TOXICITY CHARACTERISTIC LEACHING PROCEDURE*
TIC	TOTAL INORGANIC CARBON
TSD	TREATMENT, STORAGE, DISPOSAL
WAC	WASHINGTON ADMINISTRATIVE CODE
WAP	WASTE ANALYSIS PLAN
WHC	WESTINGHOUSE HANFORD COMPANY
WM	WASTE MANAGEMENT (WHC)

1.0 INTRODUCTION

1.1 PURPOSE

This Waste Analysis Plan (WAP) provides the plan for obtaining information needed for proper waste handling and processing in the 242-A Evaporator (Evaporator) located on the Hanford Site. In particular it addresses analysis necessary to manage the waste according to *Washington Administrative Code* (WAC) 173-303 and Parts 264 and 265 of the *Code of Federal Regulations* (CFR). Regulatory and safety issues are addressed by establishing boundary conditions for waste received and treated at the 242-A Evaporator. The boundary conditions are set by establishing limits for items such as potential exothermic reactions, waste compatibility, and control of vessel vent organic emissions. Boundary conditions are also set for operational considerations and to ensure waste acceptance at receiving facilities.

1.2 SCOPE

The issues that are addressed in this plan include prevention of exotherms in the waste, waste compatibility, vessel vent emissions, and compatibility with the liner in the Liquid Effluent Retention Facility (LERF). Samples from the other streams associated with the Evaporator are taken as required by Process Control Plans but are excluded from this plan because either the streams do not contain dangerous waste or the analyses are not required by WAC 173-303-300.

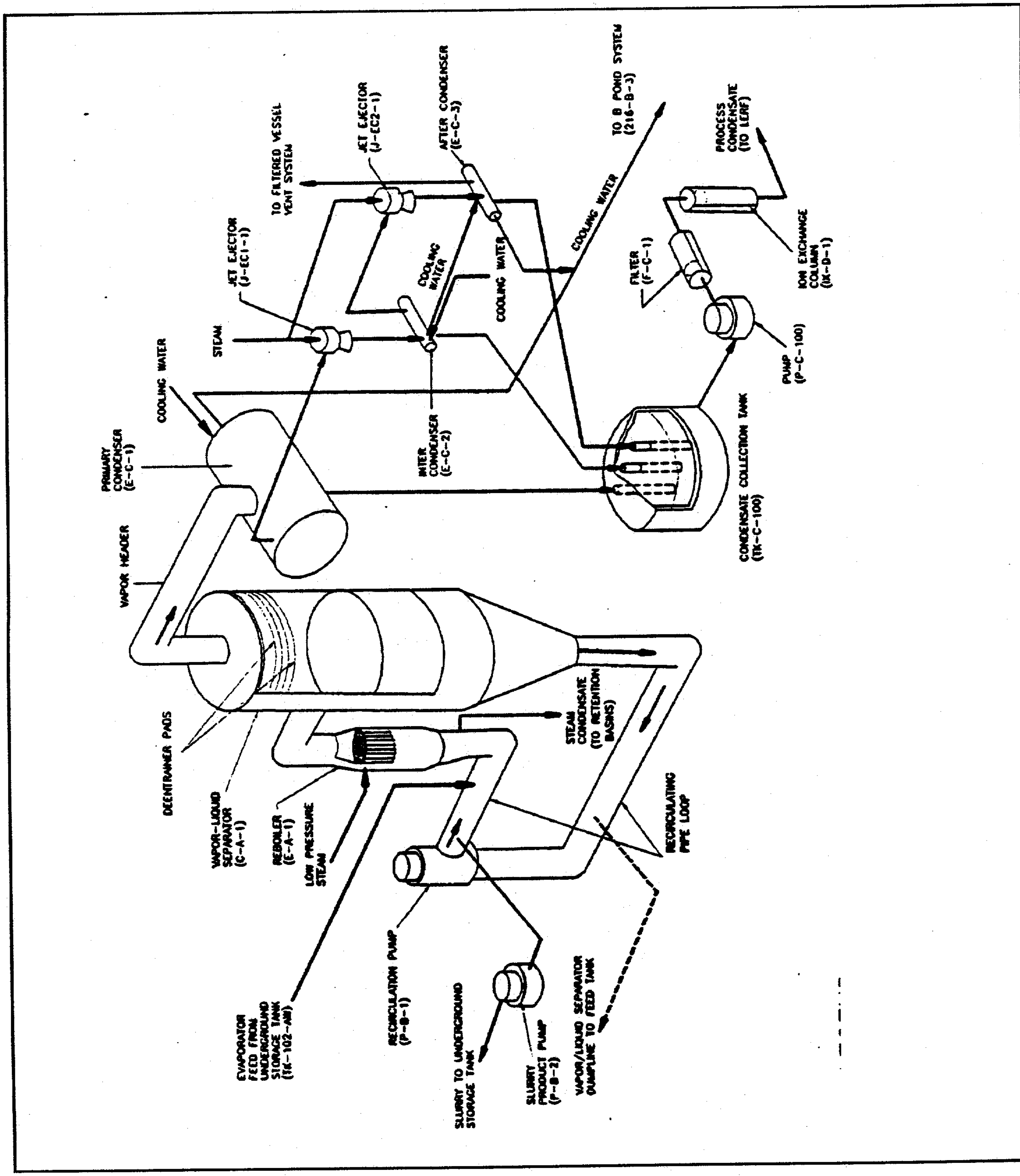
2.0 FACILITY AND PROCESS DESCRIPTION

The 242-A Evaporator is located in the 200 East Area of the Hanford Site. This Evaporator separates the waste into three components as described in the following paragraph. Also associated with this Evaporator are utility waste streams such as cooling water and steam condensate. The types of wastes processed by the Evaporator are described in Section 3.0.

The 242-A Evaporator process uses a conventional forced circulation and vacuum evaporation system to concentrate mixed waste solutions. The 242-A Evaporator feed stream is separated into two liquid streams: a concentrated slurry stream and a process condensate. A gaseous exhaust stream is also produced. The slurry contains the majority of the radionuclides and inorganic constituents. This stream is pumped back to the double shell tanks (DSTs) and stored for further treatment after being concentrated to target levels. The process condensate (PC) is primarily water that contains trace amounts of organic material and a greatly reduced concentration of radionuclides. The process condensate is presently stored in the Liquid Effluent Retention Facility (LERF) until it can be further processed in the Effluent Treatment Facility

(ETF) once it is operational. The process exhaust or vessel vent stream is filtered for fine particulates and discharged through an exhaust stack. Figure 2-1 shows a simplified schematic of the Evaporator. A more detailed description of the Evaporator is contained in the *242-A Evaporator Part B Dangerous Waste Permit Application* (DOE-RL 1991a).

Figure 2-1 The 242-A Evaporator Simplified Schematic



3.0 WASTE STREAM IDENTIFICATION

All of the waste accepted by the Evaporator comes from double-shell tanks (DSTs). The waste in the DSTs is received from onsite generators, which characterize the waste before transfer to the DSTs. Waste characterization is based on actual analytical knowledge and/or process knowledge. Based on this and other available information, certain DSTs are selected as "candidates" for being processed in the Evaporator. The contents of these candidate feed tanks are subjected to closer scrutiny and evaluated against processing criteria before the final tank selection is made. In order to meet processing criteria, the contents of several tanks may be blended together in the Evaporator Feed Tank (DST 241-AW-102) prior to actually being processed in the Evaporator.

3.1 IDENTIFICATION OF WASTE

The waste processed in the evaporator is classified as a mixed waste because it contains both radioactive and hazardous chemical components. Historical analytical data for the three dangerous waste streams (feed, slurry product, and process condensate) are presented in Chapter 3.0 of the *242-A Evaporator Part B Dangerous Waste Permit Application* (DOE-RL 1991a). The candidate feed stream and the feed and slurry are classified as extremely hazardous waste as specified in WAC 173-303-100 (5). Most of the radionuclides and dangerous waste constituents remain in the slurry after being processed in the Evaporator. Because some radionuclides and dangerous waste constituents may carry over into the process condensate, the PC remains classified as a dangerous waste per WAC 173-303-100. Table 3-1 lists the waste codes which are applied to the waste at the 242-A Evaporator.

Analysis of utility streams including cooling water and steam condensate are conducted. These analyses are not discussed in this plan because these streams are not considered dangerous wastes under WAC 173-303.

3.2 GENERAL CONSTITUENT DESCRIPTION

The waste sent to the Evaporator contains water as a major constituent of the waste. The pH of the waste can be 12.5 or higher due to the quantity of hydroxide used as corrosion protection for the DSTs. Qualitatively, the other major constituents of the mixed waste are sodium salts of nitrate, nitrite, fluoride, phosphate, carbonate, and sulfate. Additionally other salts including calcium, aluminum, and potassium salts may be present. Detectable levels of halogenated and non-halogenated organic compounds may also be present. The mixed waste in some tanks has detectable levels of heavy metals such as lead, chromium, and cadmium. The radionuclide content includes fission products such as the isotopes ^{90}Sr and ^{137}Cs, and actinide series elements such as uranium and plutonium.

3.3 WASTE CHARACTERISTICS

Due to the blending which occurs in the Evaporator Feed Tank, the composition of waste actually sent to the Evaporator is more homogenized than the waste in the candidate feed tanks. Generally, this waste is a stable aqueous liquid with a low organic content. The waste has been designated as characteristically ignitable, corrosive, reactive, and TCLP toxic per WAC 173-303-90. It has also been designated as an extremely hazardous waste because it meets the toxic, carcinogenic, and persistent criteria described in WAC 173-303-100. The waste has also been assigned the nonspecific waste codes F001 to F005 due to the presence of spent halogenated and nonhalogenated solvents. The Evaporator may also process waste from leachate systems that has been assigned the nonspecific waste code F039.

The Evaporator separates the waste into two streams (slurry and the process condensate) that are sent to other treatment, storage, or disposal (TSD) units. Process knowledge and historical data indicate that the slurry stream exhibits the same dangerous waste properties as the waste feed, so the same dangerous waste codes are applicable to the slurry. The process condensate exhibits different dangerous waste characteristics because most of the nonvolatile toxic compounds have remained in the slurry. The process condensate has still been assigned the nonspecific source codes F001 to F005 and F039 because it has been derived from the treatment of a listed waste. The process condensate is also designated state characteristically toxic (WT02) due to the ammonia concentration.

Table 3-1 contains a list of the dangerous waste codes assigned to the feed and slurry streams of the *242-A Evaporator in the Hanford Facility Dangerous Waste Part A Permit Application* (DOE/RL-88-21). Table 3-2 contains a listing of the dangerous waste codes which have been assigned to the process condensate in the LERF portion of the *Hanford Facility Dangerous Waste Part A Permit Application* (DOE/RL-88-21). A detailed description of waste designation is contained in Chapter 3.0 of the Evaporator Part B permit application (DOE-RL 1991a).

The DST waste was designated ignitable due to the presence of nitrates and nitrites, which are classified as oxidizers in 49 CFR 173. However the concentrations of these nitrogen compounds in the waste are normally so dilute that ignitability is not an issue. DSTs which contain concentrated quantities of these materials, such as tank 101-SY, will not be processed in the Evaporator without an evaluation of the potential ignitability problem.

To confirm that a waste will not produce an exothermic or spontaneous reaction that would result in a violent change, a differential scanning calorimetry (DSC) check is performed on samples from the candidate feed tanks. This is used to indicate that the waste is not reactive.

A detailed discussion of the assertion that the DST waste processed in the Evaporator is not physically ignitable or reactive is given in Chapter 3.0 of the Evaporator Part B permit application (DOE-RL 1991a).

Table 3-1 Waste Designation For 242-A Evaporator Feed And Slurry

EPA/State Waste Code	Characteristic	Basis for designation
D001	Ignitable	Presence of constituents but not at conditions which cause ignition
D002	Corrosive	pH > 12.5
D003	Reactive	Presence of constituents but not at conditions which cause reactivity
D004	TCLP toxic	Arsenic
D005	TCLP toxic	Barium
D006	TCLP toxic	Cadmium
D007	TCLP toxic	Chromium
D008	TCLP toxic	Lead
D009	TCLP toxic	Mercury
D010	TCLP toxic	Selenium
D011	TCLP toxic	Silver

EPA/State Waste Code	Characteristic	Basis for designation
D018	TCLP toxic	Benzene
D019	TCLP toxic	Carbon Tetrachloride
D022	TCLP toxic	Chloroform
D028	TCLP toxic	1,2-Dichloroethane
D029	TCLP toxic	1,1-Dichloroethylene
D030	TCLP toxic	2,4-Dinitrotoluene
D033	TCLP toxic	Hexachloro-1,3-butadiene
D034	TCLP toxic	Hexachloroethane
D035	TCLP toxic	Methyl ethyl ketone
D036	TCLP toxic	Nitrobenzene
D038	TCLP toxic	Pyridine
D039	TCLP toxic	Tetrachloroethylene

EPA/State Waste Code	Characteristic	Basis for designation
D040	TCLP toxic	Trichloroethylene
D041	TCLP toxic	2,4,5-Trichlorophenol
D043	TCLP toxic	Vinyl chloride
WT01/WT02	Toxicity	Sodium hydroxide, Sodium nitrite, Sodium nitrate, Sodium fluoride, Ammonium hydroxide, Tributyl phosphate
WC01/ WC02	Carcinogenic	Not determined
WP01/WP02	Persistent	Not determined
F001	Spent halogenated solvents	Carbon Tetrachloride and others
F002	Spent halogenated solvents	Methylene chloride, 1,1,1 Trichloroethane, and others
F003	Spent nonhalogenated solvents	Acetone,Methyl Isobutyl ketone, and others
F004	Spent nonhalogenated solvents	Cresylic acid, and others

EPA/State Waste Code	Characteristic	Basis for designation
F005	Spent nonhalogenated solvents	Methyl ethyl ketone, and others
F039	Leachate from hazardous waste disposal operations	Receipt of waste with the F039 code

Table 3-2 Waste Designation For 242-A Evaporator **Process Condensate/LERF Waste**

EPA/State Waste Code	Characteristic	Basis for designation
F001	Spent halogenated solvents	Derived from F001 waste
F002	Spent halogenated solvents	Derived from F002 waste
F003	Spent nonhalogenated solvents	Acetone, Methyl Isobutyl ketone and others Derived from F003 waste
F004	Spent nonhalogenated solvents	Derived from F004 waste
F005	Spent nonhalogenated solvents	Methyl ethyl ketone
F039	Leachate from hazardous waste disposal operations	Derived from and/ or contains F039 designated waste
WT02	Toxicity	Ammonia

4.0 EVAPORATOR PROCESSING CRITERIA

Processing criteria have been established from regulatory requirements, operating experience, process knowledge, analyses, and calculations. Processing criteria are maximum and/or minimum values of a waste analyte that, if exceeded alert the operator that the waste requires further attention before proceeding. When any criteria are exceeded, the situation is evaluated and options are developed. The criteria selection process is discussed in detail in the 242-A Evaporator/LERF DQO Document (Von Bargen 1994). The reason for selecting a given analyte for inclusion in this WAP as required by WAC 173-303, is indicated in Sections 4.1 and 4.2 of this plan.

Analyses of the feed and slurry streams are also conducted for the purpose of monitoring the evaporation process and ensuring that the resulting slurry will meet the DST waste acceptance criteria. This type of sampling is considered outside the scope of this plan and is addressed by the latest editions of the 242-A Evaporator Process Control Plan (the plan for each campaign has a unique number beginning with WHC-SD-WM-PCP-) and the DST WAP (Halgren 1991).

4.1 EVAPORATOR FEED WASTE ACCEPTANCE AND PROCESS CRITERIA

Sections 4.1.1 through 4.1.4 discuss waste acceptance analysis issues and the assurances that processing criteria will not be exceeded when waste from the candidate feed tanks is processed in the Evaporator.

4.1.1 Exothermic Reactions

To evaluate the probability of an uncontrolled reaction, a differential scanning calorimeter (DSC) test is performed on all waste to be processed in the Evaporator. Waste exhibiting exotherms below 335°F, or with an absolute value of the exotherm-to-endotherm ratio greater than one, will not be processed in the Evaporator without further technical evaluation.

4.1.2 Compatibility

A compatibility evaluation is performed on wastes from the candidate feed tanks in order to verify that there will be no adverse affects due to mixing the contents of different waste tanks in the 242-A Evaporator feed tank. The evaluation uses information gained from a mixing and compatibility study. As part of the mixing and compatibility study, samples of waste from the candidate feed tanks are taken to the laboratory where they are combined, mixed, and then observed for any unusual changes in color, temperature, clarity, solids formation, or other visual characteristic. If any changes are observed, further compatibility evaluations will be conducted or the wastes will not be processed.

4.1.3 Organic Constituents

The levels of volatile organics in the candidate feed tanks must be limited to prevent organic vessel vent emissions from exceeding 3 lbs/hr and 3.1 tons/yr during processing (40 CFR 265). To ensure that these limits are not exceeded, equilibrium calculations were performed in the *242-A Evaporator Part B Dangerous Waste Permit Application* (DOE/RL 1991a) to determine limits for individual organic constituents. These limits, shown in Table 4.1, include a modifier "R-1/R", which adjusts the limits based on the campaign's planned boil-off rate (R is the ratio of feed flow rate to slurry flow rate).

The organic limits in the permit application were based on twelve months of continuous operation each year. These limits were adjusted to six months continuous operation each year for this plan. The six months operating is a realistic limit because the Evaporator must shut down during the year for maintenance outages, candidate feed tank analysis, and establishing transfer routes for staging the waste into the feed tank. Since the limits are based on a calendar year and they depend on operating time, the limits in Table 4.1 may need to be adjusted to reflect actual operation. The total carbon (TC) minus total inorganic carbon (TIC) is used as a screening tool to account for all organic species. If the TC - TIC limit is exceeded, a more detailed estimate of organic emissions out the vessel vent must be conducted. This limit is based on acetone due to its relatively low percent carbon.

In addition to the organics with limits shown in Table 4.1, analyses for 2-hexanone, 2-pentanone, methyl isobutyl ketone, and tetrahydrofuran will be conducted to ensure they are not routinely present in the waste. In the future, characterizations of candidate feed tank waste (if these compounds are regularly seen) feed limits will be added for these organics as well.

The level of volatile organics in the feed must be limited to ensure process condensate is compatible with the LERF liner. The HDPE liner used at the LERF is exposed to process condensate that may contain trace quantities of chemicals, which in turn may cause degradation of the liner material. Based on the liner manufacturer's data, the concentration limits in Table 4.2 are imposed on those classes of constituents that could potentially degrade the liner. The basis for these limits is presented in the 242-A Evaporator/LERF DQO document (Von Bargen 1994). To ensure that these limits are not exceeded in the process condensate, the concentration limits are applied to the candidate feed tanks as well and modified by "R-1/R," as appropriate.

4.1.4 Ammonia

The candidate feed tanks must be sampled for ammonia so that processing can be adjusted to ensure the process condensate does not exceed 1 wt%, which is the limit for Washington State extremely hazardous waste as indicated in WAC 173-303-100. The 1 wt% limit equates to a concentration of 0.58M ammonia in the process condensate. This assumes a typical 50% waste volume reduction per pass (R equals 2) through the Evaporator and conservatively assumes all the ammonia transfers with the process condensate, candidate feed tank blending is performed to ensure the ammonia concentration in the feed stream remains below 0.29M (5,000 mg/L).

4.2 PROCESS CONDENSATE PROCESS CRITERIA

The process condensate is analyzed for ammonia and pH to verify the waste designation. The ammonia concentration should be less than 1 wt% (10,000 ppm or 0.59M) to ensure that the process condensate is not a Washington State extremely hazardous waste according to WAC 173-303-100. The pH should be more than 2.0 and less than 12.5 to prevent the process condensate from being classified as a characteristically corrosive waste (WAC 173-303-090).

The process condensate must also be sampled to ensure that the waste is compatible with the LERF liner. The limits shown in Table 4.3 apply to the process condensate. Based on analytes historically found in the process condensate, analyses will measure ammonia, pH, acetone, 1-butanol, 1-butoxyethanol, 1-butanone, tri-butyl phosphate, 2-hexanone, 2-pentanone, methyl isobutyl ketone, and tetrahydrafuran. Refer to Section 6.0 of this plan for more information on concerns relating to PC.

Table 4-1 Candidate Waste Tank Limits for Vessel Vent Organic Discharge[a]

Feed Constituent	Limit (mg/L)[b,c]
Acetone	174.4 x (R-1)/R
1-Butanol	452 x (R-1)/R
2-Butoxyethanol	190.4 x (R-1)/R
2-Butanone	116 x (R-1)/R
Tri-Butyl Phosphate	2.030 E+4 x (R-1)/R
2-Hexanone	N/A (see discussion)
2-Pentanone	N/A (see discussion)
Methyl Isobutyl Ketone	N/A (see discussion)
Tetrahydrofuran	N/A (see discussion)
TC	(TC - TIC) < 174.4 x (R-1)/R (as acetone)
TIC	

[a]Limits in this table are based on a maximum continuous operating time equivalent to six months per year. If total operating time is expected to exceed six months per year, the limits must be evaluated.

[b]The limits are applied using the sum of the fraction technique:

$$\sum_{n=1}^{i} \left(\frac{Conc_n}{LIMIT_n}\right) \leq 1$$

where i is the number of organic constituents detected in analysis of the waste feed tank. TC- TIC is not part of this summation.

[c]R is the ratio of feed flowrate to slurry flowrate (typically R = 2).

Table 4-2 Candidate Feed Tank Limits for LERF Liner Compatibility

Chemical Family/Parameter	Current Target Compounds	Limit (mg/L)[a,b,c,d]
Alcohol/Glycol	2-butanol	500,000 x (R-1)/R
Alkanone[e]	Sum of acetone, 2-butanone, 2-hexanone, methyl isobutyl ketone	200,000 x (R-1)/R
Alkenone[f]	none targeted	2000 x (R-1)/R
Aromatic/Cyclic Hydrocarbon	tetrahydrofuran	2000 x (R-1)/R
Halogenated Hydrocarbon	none targeted	2000 x (R-1)/R
Aliphatic Hydrocarbon	none targeted	500,000 x (R-1)/R
Ether	Butoxyethanol	2000 x (R-1)/R
Other Hydrocarbons	Tri-butyl Phosphate	2000 x (R-1)/R
Oxidizing Acid, Salt, Inorganic	none targeted	1000 x (R-1)/R
Non-oxidizing Acid, Base, Salt (including Ammonia)	Ammonia	500,000 x (R-1)/R
TC	N/A	(TC - TIC) < 1240 x (R-1)/R
TIC	N/A	

[a]R is the ratio of feed flow rate to boil off rate (typically R = 2).
[b]The limits are applied using the sum of the fraction technique:

$$\sum_{n=1}^{i} \left(\frac{Conc_n}{LIMIT_n} \right) \leq 1$$

where i is the number of organic constituents detected in analysis of the waste feed tank. TC - TIC and pH are not part of this summation.
[c]Where vendor's literature specifies different limits for chemicals in the same family, the most restrictive limit is listed.
[d]If a chemical fits in more than one chemical family, the more restrictive limit applies.
[e]Ketone containing saturated alkyl group(s)
[f]Ketone containing unsaturated alkyl group(s)

Table 4-3 Process Condensate Limits for LERF Liner Compatibility

Chemical Family/Parameter	Current Target Compounds	Limit (mg/L)[a,b,c]
Alcohol/Glycol	2-butanol	500,000
Alkanone[d]	Sum of acetone, 2-butanone, 2-hexanone, methyl isobutyl ketone	200,000
Alkenone[e]	none targeted	2000
Aromatic/Cyclic Hydrocarbon	tetrahydrofuran	2000
Halogenated Hydrocarbon	none targeted	2000
Aliphatic Hydrocarbon	none targeted	500,000
Ether	Butoxyethanol	2000
Other Hydrocarbons	Tri-butyl Phosphate	2000
Oxidizing Acid, Salt, Inorganic	none targeted	1000
Non-oxidizing Acid, Base, Salt (including Ammonia)	Ammonia	500,000
pH	N/A	$2.0 < pH < 12.5$[f]
TC	N/A	(TC - TIC) < 1240
TIC	N/A	

[a]The limits are applied using the sum of the fraction technique:

$$\sum_{n=1}^{i} \left(\frac{Conc_n}{LIMIT_n} \right) \leq 1$$

where i is the number of organic constituents detected in analysis of the waste feed tank. TC - TIC and pH are not part of this summation.

[b]Where vendor's literature specifies different limits for chemicals in the same family, the most restrictive limit is listed.
[c]If a chemical fits in more than one chemical family, the more restrictive limit applies.
[d]Ketone containing saturated alkyl group(s)
[e]Ketone containing unsaturated alkyl group(s)
[f]Based on the definition of noncharacteristically corrosive waste per WAC 173-303-090. Liner compatibility in the vendor's literature allows a pH range of 0.5 to 13.0.

5.0 CANDIDATE FEED TANK SAMPLING AND ANALYSIS

This section discusses parameters associated with candidate feed tanks. The parameters include tank selection, sampling frequency, and selection of analytes . Due to the highly radioactive nature of the samples, it is anticipated that all analyses will be conducted at one of the laboratories on the Hanford Site because they are equipped to handle such samples. Laboratory selection will be dependent on the analyses needed and the availability and capability of the laboratories at the time of sampling.

5.1 SELECTION OF CANDIDATE FEED TANKS

The Evaporator feed stream originates from the DSTs. For each campaign of the 242-A Evaporator, DSTs will be selected based on process knowledge of waste characteristics (components) with respect to waste acceptability criteria provided in Section 4.0 of this plan. If the waste is suitable for evaporation it will be transferred to the evaporator feed tank, 241-AW-102.

5.2 SAMPLE COLLECTION

The number of lateral sampling locations in candidate feed tanks is limited by the availability of tank risers providing access into the tank. Generally, only a few risers in each tank are actually available for sampling because some of the risers are dedicated to instrumentation or other uses. Sampling within a vertical column is generally limited only by the depth of waste in the tank. The number of available sample locations, information on the proximity of expected tank analyte concentration to a decision point or target threshold, and information from previous Evaporator runs will be used to statistically determine the number of samples necessary to verify the composition of the tank. The statistical analysis includes the generation of power curves as indicated in the 242-A Evaporator/LERF DQO Document (Von Bargen 1994). If a critical analyte concentration is expected to have less than a 20% chance of exceeding its target threshold, then analysis of only a few samples will be necessary. Conversely, if an analyte is expected to be close to, but still below, its Target Threshold, then a larger number of samples may be necessary to minimize sampling anomalies and verify levels below target thresholds. Figure 5-1 illustrates the decision logic path which can be used to determine the number of samples needed for a given tank. Generally two to five samples will be taken from each candidate feed tank.

Samples will be obtained by using a grab sampling (e.g. "bottle on a string method") method approved for use on the Hanford Site. Normally only one set of samples will be needed for each feed tank. Additional samples may be taken if needed to confirm that processing criteria will be met. Table 5.1 should be used when determining the specific sampling locations:

Table 5-1 Sample Point Selection

Number of Samples	Location of Sample Points
Two Samples	One sample taken from the upper half of the waste from one riser and the other sample taken from the lower half of the waste from another riser.
Three Samples	Two Samples taken from one riser (one from the top half and the other from the bottom half of the waste) and one sample from another riser (determined by random number generator).
Four Samples	Two samples taken from each of two separate risers. One sample is to be taken from the top half of the waste and one from the bottom half of the waste from each of the selected risers.
Five Samples	Same as for four samples except one sample from either the top or bottom half of the tank will be taken from a third riser

Riser selection will be made by numbering the available risers which are at least 15 feet from each other and using a random number generator to select which risers will be used. Sample depth will be determined by dividing the tank level into one foot increments and then by using a random number generator to determine a depth which meets the criteria given in Table 5-1. One additional grab sample will be obtained from the waste surface of each tank for visual and total organic carbon analysis to determine the presence of a separable organic layer.

The requirements contained in the latest editions of the 242-A Evaporator/LERF DQO (WHC-SD-WM-DQO-014) and the 242-A Evaporator Quality Assurance Project Plan (WHC-SD-WM-QAPP-009) regarding QA/QC requirements, sample size, and holding times must be met. A chain of custody must also be completed for all samples required to be taken by this plan. The chain of custody must include a discreet sample number, date and time sample was taken, shipment number, and signature.

5.3 ANALYTE SELECTION AND RATIONALE

The 242-A Evaporator/LERF DQO Document (Von Bargen 1994) examined the data needs for sampling the candidate feed tanks and determined that the analyses in Table 5-2 should be conducted in order to satisfy WAC 173-303-300 (b) requirements. The 242-A Evaporator/LERF DQO Document (Von Bargen 1994) contains additional information on how and why these analytes were selected.

5.4 ANALYTICAL METHODS AND QA/ QC

Performance based specifications rather than procedure based specifications were used for determining appropriate analytical methods due to problems associated with analysis of waste with high radioactivity and the sample matrix. This allows adjustments for Hanford site-specific issues while ensuring acceptable data quality. The test methods which must be followed are included in Table 5-2. The analyses will in some cases deviate from SW-846 specifications for holding times, sample preservation, and other specific analytical procedures. These deviations are discussed in *Analytical Methods for Mixed Waste Analysis at the Hanford Site* (DOE/RL 1994). All analytical and sampling methods conducted as part of this plan must meet the related data quality requirements for dangerous waste compliance samples contained in the latest editions of the 242-A Evaporator/LERF DQO (WHC-SD-WM-DQO-014) and the 242-A Evaporator Quality Assurance Project Plan (WHC-SD-WM-QAPP-009). The current editions of these documents (Von Bargen 1994 and Basra 1994) are listed in the reference section of this document.

Figure 5-1 Process for Assessing the Number of Candidate Feed Tank Samples (page 1)

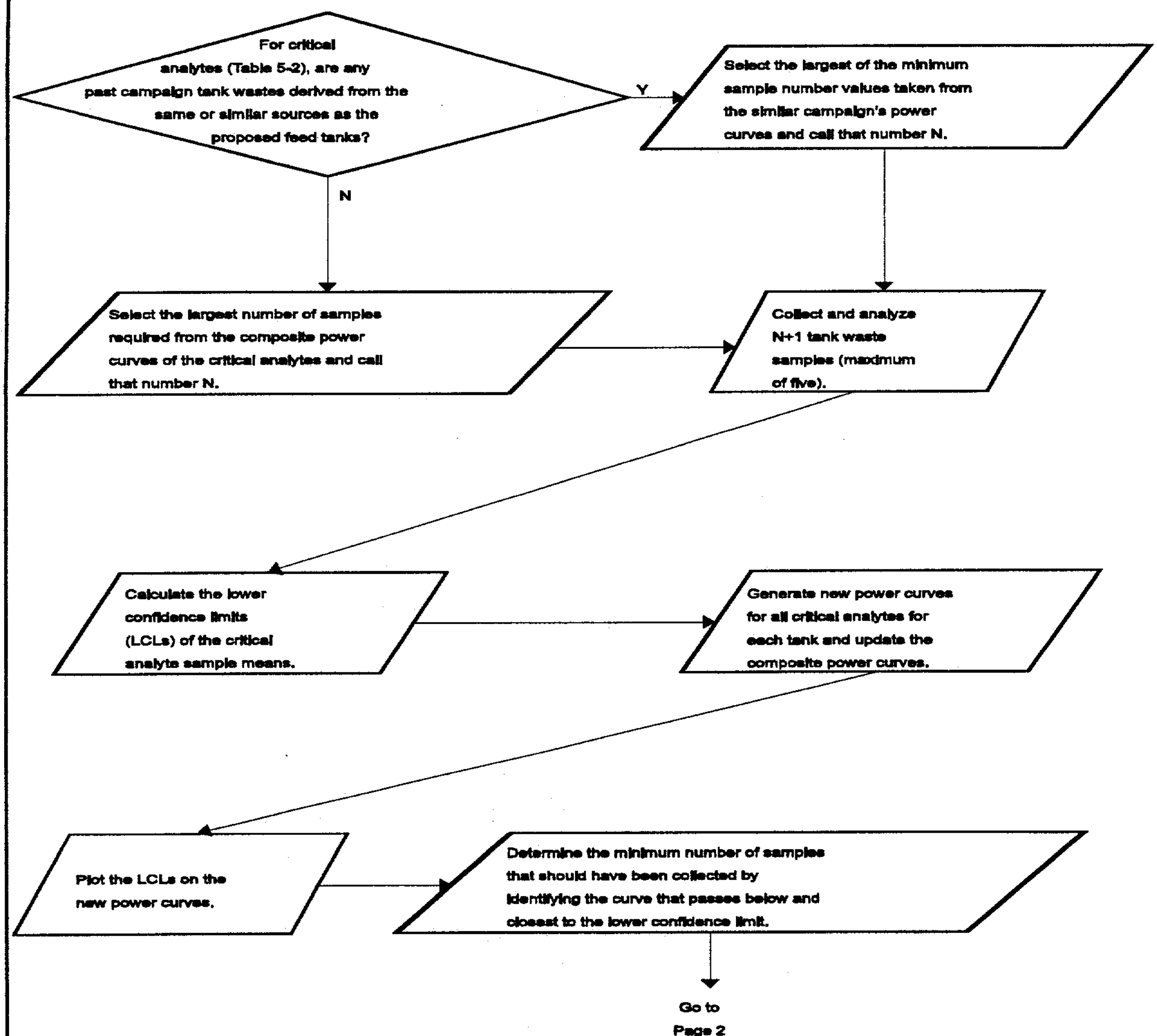


Figure 5-1 Process for Assessing the Number of Candidate Feed Tank Samples (page 2)

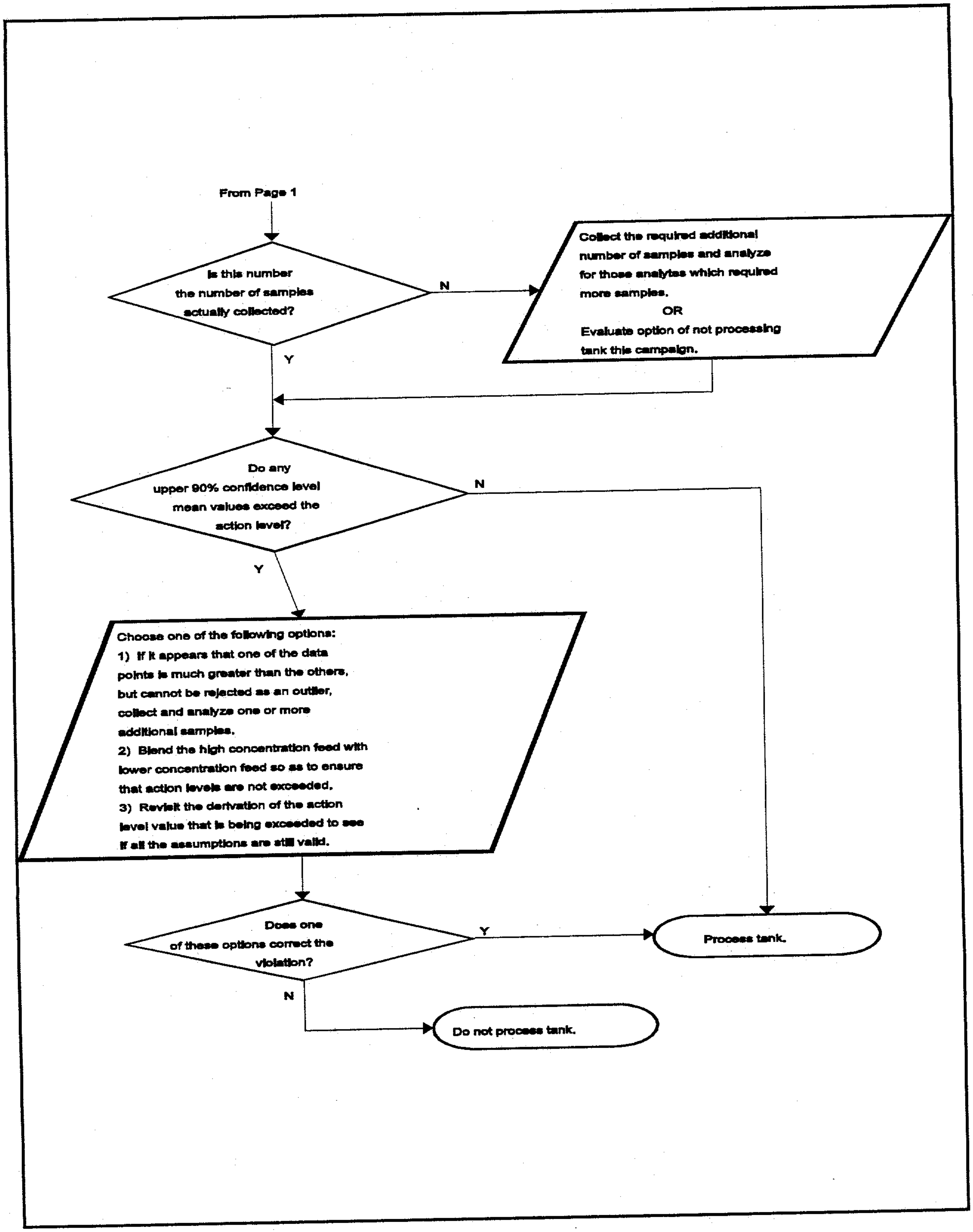


Table 5-2 Analytes for Candidate Feed Tanks

Parameter	Test Method	Analyte	Rationale
Exotherm	Differential Scanning Calorimeter	Temperature and Energy	Verify that the waste will not undergo an exothermic reaction
Compatibility Test	Mixing and compatibility study	Visual physical changes	Verify that the wastes are chemically compatible
Organic Compounds	GC/MS, or GC/FID, or Heated Headspace GC or GC/MS	Acetone, 1-Butanol, 1-Butoxyethanol, 1-Butanone, 2-Hexanone, 2-Pentanone, Tetrahydrofuran, Methyl isobutyl ketone, Tri-butyl phosphate	Used in calculations to verify that Vessel Vent emissions will not exceed regulatory limits and to prevent compatibility problems with the LERF liner.
Ammonia	Kjeldahl Distillation/ Autotitration, or Ion Selective Electrode	Ammonia	Verify that the ammonia content of the process condensate will be below the level which would make it an Extremely Hazardous Waste.

6.0 PROCESS CONDENSATE SAMPLING AND ANALYSIS

Samples taken from the process condensate stream are analyzed to verify that the process condensate being sent to LERF does not damage the LERF liner. In addition, analyses are conducted to verify that the process condensate is not characteristically corrosive or an extremely hazardous waste per WAC 173-303. Samples may be characterized at either the PNL laboratory or the 222-S laboratory on the Hanford Site, or they may be sent to Certified Testing Laboratory off-site for analysis. A more detailed discussion of the parameters of concern can be found in the LERF Part B Permit Application (DOE 1991c) and the 242-A Evaporator/LERF DQO Document (Von Bargen 1994).

6.1 SELECTION OF SAMPLE LOCATION

In order to obtain information on the waste actually entering the LERF basins, samples of PC are taken with a sampler system located in the Condenser room. The sampling system can take either grab or composite samples. Grab samples are taken to meet the requirements of this plan. Samples should not be taken for pH, ammonia or organic analyses using composite sampling because the samples may not be representative of the PC due to the potential change or loss of these components.

6.2 SAMPLE COLLECTION

The number of samples to be collected for characterization will be determined by a statistical evaluation of the available data. The statistical analysis includes the generation of power curves described in further detail in the 242-A Evaporator/LERF DQO document (Von Bargen 1994). If a critical analyte concentration is expected to have less than a 20% chance of exceeding its target threshold, then analysis of only a few samples will be necessary. Conversely, if an analyte is expected to be close to, but still below, its target threshold, then a larger number of samples may be necessary to minimize sampling anomalies and verify that levels are below target thresholds. Figure 6-1 illustrates the decision logic path which can be used to determine the number of samples needed for a given campaign. Generally two to five samples will be taken for each Evaporator campaign.

The requirements contained in the latest editions of the 242-A Evaporator/LERF DQO (WHC-SD-WM-DQO-014) and the 242-A Evaporator Quality Assurance Project Plan (WHC-SD-WM-QAPP-009) regarding QA/QC requirements, sample size, and holding times must be met. A chain of custody must also be completed for all samples required to be taken by this plan. The chain of custody must include a discreet sample number, date and time sample was taken, shipment number, and signature.

6.3 ANALYTE SELECTION AND RATIONALE

Von Bargen (1994) examined the data needs for sampling the process condensate and determined that the analyses in Table 6-1 should be conducted in order to satisfy WAC 173-303-300 (b) requirements. Von Bargen 1994 also contains additional information on how and why these analytes were selected.

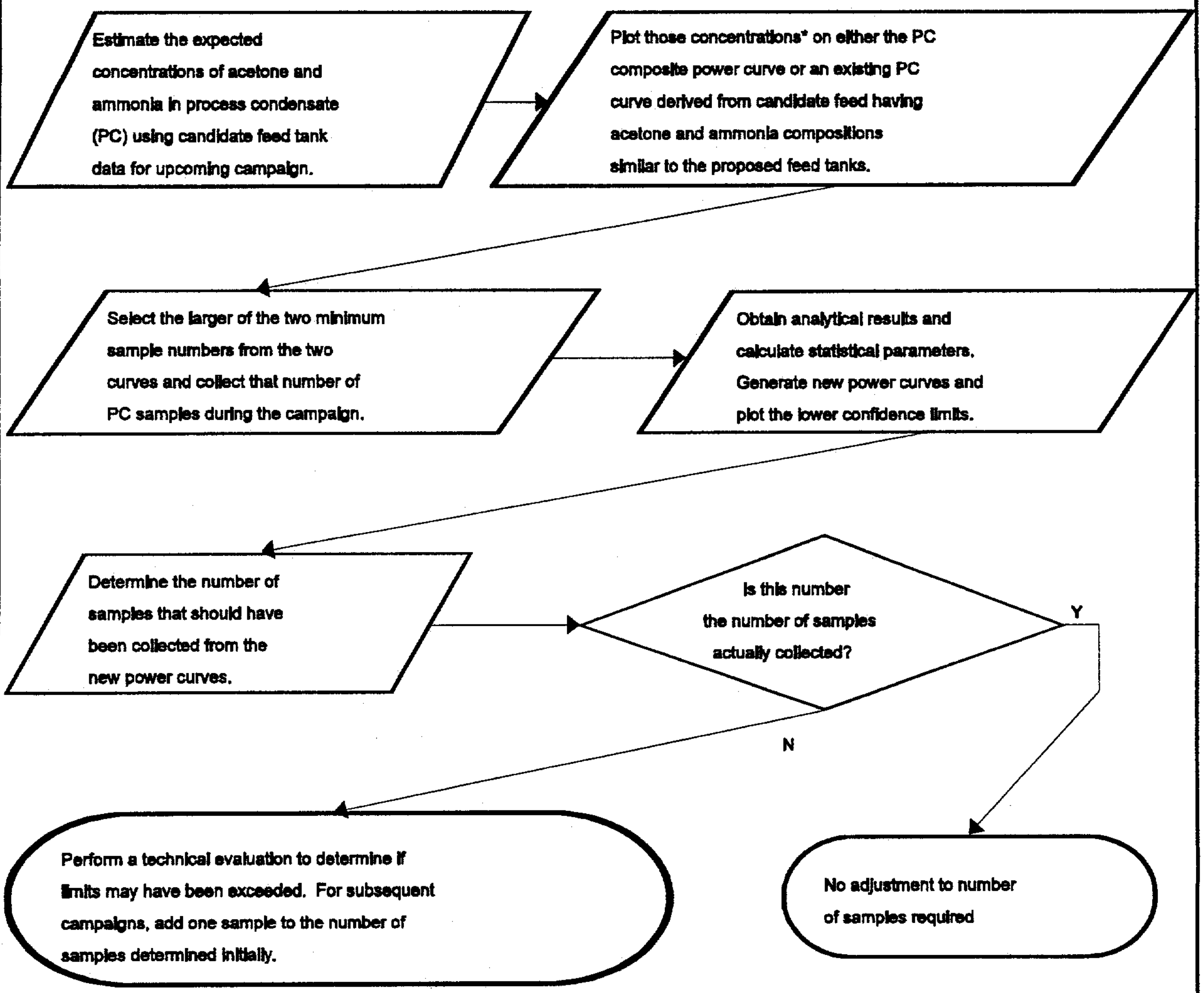
6.4 ANALYTICAL METHODS AND QA/QC

Performance based specifications rather than procedure based specifications were used for determining appropriate analytical methods due to problems associated with analysis of waste with high radioactivity and the sample matrix. This allows adjustments for Hanford Site-specific issues while ensuring acceptable data quality. The test methods which must be followed are included in Table 6-1. The analyses will in some cases deviate from SW-846 specifications for holding times, sample preservation, and other specific analytical procedures. These deviations are discussed in *Analytical Methods for Mixed Waste Analysis at the Hanford Site* (DOE/RL 1994). Due to the relatively benign nature of the process condensate matrix, low solids content, and the low radioactivity, material deviations from SW-846 should be minimal. All analytical and sampling methods conducted as part of this plan must meet the related data quality requirements for dangerous waste compliance samples contained in the latest editions of the 242-A Evaporator/LERF DQO (WHC-SD-WM-DQO-014) and the 242-A Evaporator Quality Assurance Project Plan (WHC-SD-WM-QAPP-009). The current editions of these documents (Von Bargen 1994 and Basra 1994) are listed in the reference section of this document.

Table 6-1 Analytes for Process Condensate

Parameter	Test Method	Analyte	Rationale
Corrosivity	Glass probe	pH	Verify that the waste is not corrosive
Organic Compounds	GC/MS, or GC/FID, or Heated Headspace GC or GC/MS	Acetone, 1-Butanol, 1-Butoxyethanol, 1-Butanone, 2-Hexanone, 2-Pentanone, Tetrahydrofuran, Methyl isobutyl ketone, Tri-butyl phosphate	Prevent compatibility problems with the LERF liner.
Ammonia	Kjeldahl Distillation/ Autotitration, or Ion Selective Electrode	Ammonia	Verify that the ammonia content of the process condensate will be below the level which would make it an Extremely Hazardous Waste.

Figure 6-1 Process for Assessing the Number of Process Condensate Samples



In order to gain a better understanding of the number of PC samples required and ensure that the number collected is always greater than the minimum dictated by power curve analysis, correlate and compare the following:

1) The number of samples required by candidate feed/process condensate power curve pairs for various campaigns since the DQO document was implemented.

2) How far the estimated results are from actual results and how the difference impacts the selection of sample number from the power curves.

* Normally the lower confidence limit is plotted on the curves to determine the minimum number of samples required. Since there is no lower confidence limit associated the estimated results, the expected mean value is conservatively plotted. Although conservative, the analyte concentrations are anticipated to be far from liner compatibility limits, so the minimum number of samples should not change.

7.0 REFERENCES

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