Accession #: **D3287099**

Document #: **HNF-14755**

Title/Desc:

DOCUMENTED SAFETY ANALYSIS FOR THE 242A EVAPORATOR [SEC 1 OF 2] [TEXT THRU APPENDIX 2A PAGE 2A-12]

Pages: **230**

This document was too large to scan as a single document. It has been divided into smaller sections.

Section 1 of 2

Document Information			
Document #	**HNF-14755**	**Revision**	**0**
Title	DOCUMENTED SAFETY ANALYSIS FOR THE 242A EVAPORATOR [TEXT THRU SEC 2A-12]		
Date	**11/14/2003**		
Originator	**CAMPBELL TA**	**Originator Co.**	**CH2M**
Recipient		**Recipient Co.**	
References			
Keywords			
Projects			
Other Information			

Sta 4. (2)

NOV 14 2003 **ENGINEERING DATA TRANSMITTAL**

1. EDT 820278
1A. Page 1 of 1

2. To: (Receiving Organization) Distribution	3. From: (Originating Organization) CH2M HILL Hanford Group, Inc., Nuclear Safety & Licensing	4. Related EDT No.: N/A 7. Purchase Order No.: N/A
5. Proj./Prog./Dept./Div.: RPP	6. Design Authority/Resp. Engr./Design Agent: TA CAMPBELL	9. Equip./Component No.: N/A 10. System/Bldg./Facility: RPP/242-A Evaporator
8. Originator Remarks: HNF ~~RPP~~ 11-14-03 THIS DOCUMENT (~~RPP~~-14755) IS EFFECTIVE ON NOVEMBER 17, 2003, AND IMPLEMENTED ON THAT DATE AS THE DOCUMENTED SAFETY ANALYSIS FOR THE 242-A EVAPORATOR		12. Major Assembly Dwg. No.: N/A 13. Permit/Permit Application No.: N/A
11. Receiver Remarks: NONE	11A. Design Basis Document? ☐ Yes ☒ No	14. Required Response Date: N/A

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Desig-nator	(G) Reason for Trans-mittal	(H) Origi-nator Dispo-sition	(I) Receiv-er Dispo-sition
1	HNF-14755	--	0	Documented Safety Analysis for the 242-A Evaporator	D,N	1	1	3

16. KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
See TFC-ESHQ-Q-INSP-C-05	1. Approval 2. Review 3. Post-Review	1. Approved 2. Approved w/comment 3. Reviewed no comment 4. Reviewed w/comment 5. Disapproved

17. SIGNATURE/DISTRIBUTION

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN
		Design Auth.									
1	1	Resp. Engr. TA Campbell	[signature]	11/14/03	S5-08						
1	1	Resp. Mgr. RJ Stevens	R.J. Stevens	11/14/03	R2-58						
		QA									
		Safety									
		Env.									
		Design Agent									
1	1	NS&L Review SD Kozlowski	[signature]	11/14/03	S4-44						

18.	19.	20.
Charlotte Williams 11/14/03 Signature of EDT Originator — Date	DOE APPROVAL (if required) Ctrl. No. 03-AMTF-022/03-AMTF-029	R.J. Stevens 11/14/03 Design Auth./Resp. Engr./Resp. Mgr. — Date

BD-7400-172.2 (08/03)

DISTRIBUTION SHEET

To	From	Page 1 of 1
DISTRIBUTION	Nuclear Safety & Licensing	Date 11/14/03
Project Title/Work Order		EDT No. 820278
HNF- 14755, Rev. 0, "Documented Safety Analysis for the 242-A Evaporator"		ECN No. N/A

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
TA CAMPBELL	S5-08	H			
SD KOZLOWSKI	S4-44	H			
RJ STEVENS	R2-58	H			
NS&L LICENSING FILES	R2-12	H			
CENTRAL FILES (ORIGINAL +2)	A3-83	H			
DOE PUBLIC READING ROOM	H2-53	H			
HANFORD TECHNICAL LIBRARY	P8-55	H			

A-6000-135 (10/97)

Documented Safety Analysis for the 242-A Evaporator

Teresa A. Campbell
CH2M HILL Hanford Group, Inc.
Richland, WA 99352
U.S. Department of Energy Contract DE-AC27-99RL14047

EDT/ECN: 820278 UC: N/A
Cost Center: 7G510 Charge Code: 501661
B&R Code: N/A Total Pages: 457

Key Words: 242-A Evaporator, Documented Safety Analysis, DSA, Technical Safety Requirements, TSR, Safety Basis

Abstract: The 242-A Evaporator Documented Safety Analysis documents and supports the conclusion that operation of the 242-A Evaporator complies with the U.S. Department of Energy and other agency rules, regulations, and orders.

11/14/03
Release Approval Date

DATE: HANFORD RELEASE
STA: 4 ID: 2
NOV 14 2003
Release Stamp

Approved For Public Release

DOCUMENTED SAFETY ANALYSIS FOR THE 242-A EVAPORATOR

This page intentionally left blank.

CONTENTS

This page intentionally left blank.

EXECUTIVE SUMMARY

This page intentionally left blank.

CONTENTS

LIST OF TABLES

This page intentionally left blank.

EXECUTIVE SUMMARY

ES.1 FACILITY BACKGROUND AND MISSION

This chapter summarizes the 242-A Evaporator Documented Safety Analysis. A second document, RPP-13033, *Tank Farms Documented Safety Analysis*, provides the Hanford Site characteristics and summarizes the safety management programs used by the Tank Farm Contractor. Section ES.7 describes the documented safety analysis and RPP-13033 and their relationships more fully.

The 242-A Evaporator is located in the 200 East Area of the Hanford Site. Construction started in 1974, and operation began in 1977. Chapter 2.0, Section 2.1, discusses the 242-A Evaporator and upgrades and modifications to the facility. Through the late 1980s, the 242- Evaporator missions included support for defense-related production of nuclear weapons material, protecting the environment by concentrating and transferring liquid waste from single-shell tanks to double-shell tanks, and managing double-shell tank waste by reducing the volume and the number of double-shell tanks required to store liquid wastes.

The current and future mission of the 242-A Evaporator is to support environmental restoration and remediation of the Hanford Site by optimizing the 200 Area double-shell tank waste volumes in support of the Tank Farm Contractor and Waste Treatment Plant Contractor. Waste volume projections performed in fiscal year 2000 indicate the 242-A Evaporator will be required through the year 2018. Therefore, no change in the facility mission is expected until that time.

ES.2 FACILITY OVERVIEW

The facility structures most important to safety are the 242-A Building, which is the main process building, and the adjoining but independent 242-AB Building, which houses a computer-based monitoring and control system. The principal process components of the 242-A Evaporator system are the reboiler, evaporator vessel, recirculation pump, recirculation pipe loop, slurry product pump, condensers, jet vacuum system, and the condensate collection tank.

A principal interface is with the tank farms. 242-A Evaporator feed is staged in the evaporator feed tank TK-241-AW-102, a 1-million gallon double-shell tank, and is pumped from there to the 242-A Evaporator through an underground encased pipeline. Miscellaneous solutions are returned to the feed tank via three underground drain lines. Backup power is supplied automatically by a diesel generator within one minute of loss of normal power. Steam is supplied to the 242-A Evaporator from the 242A-BA Building boiler annex. Three water services are required: raw water (from the Columbia River), filtered raw water, and sanitary water. The 222-S Laboratory and the Waste Sample Characterization Facility also support 242-A Evaporator operations.

ES.3 FACILITY HAZARD CATEGORIZATION

As required by Title 10, *Code of Federal Regulations*, Part 830, "Nuclear Safety Management" (10 CFR 830), Subpart B, "Safety Basis Requirements," the methodology of DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, was employed for the 242-A Evaporator hazard categorization. Because neither segmentation nor airborne release fraction adjustments were made, the results of the preliminary hazard categorization will be the sole basis for the 242-A Evaporator facility hazard categorization and serve as the final hazard categorization (DOE-STD-1027-92, Section 2.1).

Based on the information provided in Chapter 3.0, Section 3.3.2.1, the maximum radioactive material inventory for the 242-A Evaporator can be up to 1.5 E+5 Ci of ^{137}Cs (9.9 E+4 L x 1.5 Ci/L ^{137}Cs). The Hazard Category 2-threshold value for ^{137}Cs is 8.9 E+4 Ci that is provided by the attachment to DOE-STD-1027-92. Because the total quantity of ^{137}Cs is 1.5 E+5 Ci, it is apparent that the 242-A Evaporator is a Hazard Category 2 nuclear facility.

ES.4 SAFETY ANALYSIS OVERVIEW

ES.4.1 Hazards Analyzed

The methodology used for the hazard analysis is based on HNF-8739, *Safety Analysis and Risk Assessment Handbook (SARAH)*. The hazard analysis identifies, organizes, and evaluates the hazards associated with 242-A Evaporator operation. DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, recommends identifying a limited set of bounding accidents, termed design basis accidents, for analysis and evaluation.

The hazard analysis used a checklist adapted from HNF-8737, Table 1-1, Hazard Identification Checklist and Energy Designators. The completed checklist is provided in HNF-13117, *Hazard Analysis for the 242-A Evaporator*, Table 1. The following five categories of hazards are identified:

- Radioactive materials, including penetrating radiation
- Chemicals and hazardous materials
- Thermal, including flammable liquids, gases, and miscellaneous combustibles
- Mechanical–kinetic, including moving vehicles and equipment
- Electrical.

The hazard analysis identifies and evaluates a comprehensive set of potential hazardous conditions for the 242-A Evaporator. The hazard analysis was performed on unmitigated events that can potentially contribute to the uncontrolled release of radioactive or hazardous materials.

The bounding accident scenarios are comprised of two fire events, four spill events, four natural phenomena events, and eight external events. Two representative and bounding accidents were selected for further analysis. The accidents were analyzed using HNF-8739 methods and the RADIDOSE software. RADIDOSE is a computer spreadsheet that uses analysis methods recommended in HNF-8739 to perform dose calculations for postulated nonreactor nuclear facility accidents. It provides a standardized methodology for evaluating accident consequences.

The risk of hazardous conditions was estimated for the following four potential receptors: (1) the maximally-exposed offsite individual at the Hanford Site boundary; (2) a co-located worker defined to be 100 meters from the point of the accident; (3) the immediate worker; and (for information only) a member of the onsite public assumed to be on Highway 240. The quantitative doses for each accident analysis are compared with the evaluation guidelines to consider if safety-class or safety-significant structures, systems, or components are required.

Chapter 3.0, Section 3.3, discusses the hazard analysis and Section 3.4 discusses the accident analysis. A summary of each is presented below.

ES.4.2 Evaluation Basis Accidents

A bounding spill postulates a seismic event that initiates collapse of the 242-A Evaporator building structure, damaging the cell cover block and causing it to fall on the vessel releasing all of its contents. A second bounding release is postulated due to an unidentified initiator that ignites the combustibles in the 242-A evaporator room causing gaskets to fail and slurry to spray onto the fire. This causes the slurry to boil and disperse as contaminated steam. The two scenarios are summarized in Table E-1.

ES.4.3 Significant Preventive and Mitigative Features

As shown in the table, of these two bounding accidents, only the fire scenario challenges the evaluation guidelines for the co-located worker or maximally-exposed offsite individual. Therefore, only one design feature, the 242-A Evaporator Building is a safety-significant structure. No safety-class structures, systems, or components are required.

The risk to the immediate worker for the spill scenario is due to direct shine based on the slurry's ^{137}Cs content. This is a conservative risk ranking because personnel are restricted from entering the 242-A Evaporator room when the 242-A Evaporator is operating. The spill scenario bounds a postulated misrouting of tank farm waste to the 242-A Evaporator pump room. However, the misrouting scenario requires a unique control. A defense-in-depth control is required for 242-A Evaporator personnel when working in the pump room to install a lockout tag-out system with key control on the transfer lines feeding the 242-A Evaporator. Because of the conservatism in the analysis (spill of entire vessel contents), R III is acceptable.

The combined effect of an ignition control program and the emergency response program, and the credited design feature of the 242-A Evaporator Building lowers the fire risk to the immediate worker from R I to R III. Because of the conservatism in the analysis, R III is acceptable. Additional technical safety requirement controls are provided based on the spill and fire scenarios. Table E-2 summarizes the technical safety requirement controls by type.

ES.5 ORGANIZATIONS

The 242-A Evaporator is owned by the U. S. Department of Energy and is operated and maintained by CH2M HILL Hanford Group, Inc., (CH2M HILL). The Waste Feed Operations manages the 242-A Evaporator. The top-level organization structure of CH2M HILL, including the Waste Feed Operations, is provided in RPP-13033, Chapter 17.0. The Waste Feed Operations organizations with significant-safety functions are described in Chapter 17.0.

ES.6 SAFETY ANALYSIS CONCLUSIONS

The safety analysis supports the conclusion that operation of the 242-A Evaporator complies with U.S. Department of Energy and other agency rules, regulations, and orders, and can be performed with acceptable risks to the public and onsite personnel. The types of accidents analyzed are listed in Section ES.4. No credible criticality accidents were identified. The unmitigated consequences of the two bounding postulated accidents do not necessitate any safety-class structures, systems, or components, but do necessitate one safety-significant structure, the 242-A Evaporator Building structure, which is designated as a design feature. Technical safety requirements, administrative controls, and safety management program features have been implemented to prevent or reduce the frequency of the accidents and/or mitigate their consequences. The selected controls ensure that all identified hazards associated with the 242-A Evaporator are adequately controlled.

ES.7 DOCUMENTED SAFETY ANALYSIS ORGANIZATION

This 242-A Evaporator Documented Safety Analysis is based on the format and content guidance of DOE-STD-3009-94, and the requirements of DOE O 5480.23, *Nuclear Safety Analysis Reports*. It refers to and makes use of RPP-13033, which includes summaries of the safety management programs used by the Tank Farm Contractor. When supplemented by the appropriate sections of RPP-13033, this documented safety analysis, meets the requirements of the standard. RPP-13033 provides summary descriptions of the Hanford Site characteristics in Chapter 1.0 and summary descriptions of safety management programs in chapters 6.0 through 17.0. The facility-specific and activity-specific information required for chapters 1.0 through 17.0 are provided by this documented safety analysis.

ES.8 REFERENCES

10 CFR 830, "Nuclear Safety Management," *Code of Federal Regulations*.

DOE O 5480.23, *Nuclear Safety Analysis Reports*, U.S. Department of Energy, Washington, D.C.

DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, U.S. Department of Energy, Washington, D.C.

DOE-STD-3009-94, 2002, *Preparation Guide for U. S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, Change Notice 2, U.S. Department of Energy, Washington, D.C.

HNF-8739, 2003, *Hanford Safety Analysis and Risk Assessment Handbook (SARAH)*, Rev. 0, Fluor Hanford, Richland, Washington.

HNF-13117, 2002, *Hazard Analysis for the 242-A Evaporator*, Fluor Hanford, Richland, Washington.

RPP-13033, *Tank Farms Documented Safety Analysis*, as amended, CH2M HILL Hanford Group, Inc., Richland, Washington.

Table ES-1. Accidents, Risks, and Control Types Summary.

Accident type	Section number	Scenario description	Uncontrolled risk uncontrolled dose, rem controlled risk			Control types
			IW	CW	MOI	
Spill	3.4.2.1	Seismic event causes evaporator support structure failure with subsequent failure of vessel and spill	I II	III 3.6 III	III 0.003 III	Technical Safety Requirements-Administrative Controls
Fire	3.4.2.2	Fire causes evaporator gaskets to fail causing spray release of slurry and dispersal of slurry-contaminated steam	I III	I 79 III 7.9	III 0.5 III 0.05	Technical Safety Requirements-Administrative Controls safety-significant design feature

Notes:
CW = co-located worker.
IW = immediate worker.
MOI = maximally exposed offsite individual.

Table ES-2. Controls Requiring Technical Safety Requirement Coverage.

Control and type	Accident type (fire, spill, NPH, external event)
Design features	
242-A Evaporator Building structure	Fire
Administrative controls	
Restrictions on 242-A Evaporator and Pump Room Access	All
Evaporator Feed Verification	Fire
Sample Cubicle Leak Detection System	Spill
Source Strength Control	All
Fire Protection (combustible and ignition controls)	Fires
Criticality Safety Program (CSE feed concentration control)	Criticality
Emergency Response (Building Emergency Plan)	All

Notes:
CSE = criticality safety evaluation.
NPH = natural phenomena hazard.

This page intentionally left blank.

CHAPTER 1.0

SITE CHARACTERISTICS

This page intentionally left blank.

CONTENTS

This page intentionally left blank.

1.0 SITE CHARACTERISTICS

This chapter, combined with RPP-13033, *Tank Farms Documented Safety Analysis,* meets the requirements of DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, Chapter 1.0, by providing the facility-specific safety-related details and site characteristics for the 242-A Evaporator.

A description of the entire Hanford Site is provided in the RPP-13033. This chapter provides additional facility-specific information so that, in combination, this chapter and RPP-13033 meet the requirements of DOE-STD-3009-94.

1.1 REQUIREMENTS

The requirements for this chapter are described in RPP-13033, Chapter 1.0.

1.2 SITE DESCRIPTION

RPP-13033, Section 1.3, provides a general description of the Hanford Site geography. The paragraphs below provide additional data that are important for the safety analyses presented in Chapter 3.0.

1.2.1 Geography

The location of the 200 East Area is shown in RPP-13033, Chapter 1.0, Figure 1.3.1.2-1, and the location of the 242-A Evaporator within 200 East Area is shown in RPP-13033, Figure 1.3.1.2.1-2. The 242-A Evaporator is closer to Highway 240 than to the Columbia River. Among the data required for safety analyses are the distances to potential receptors near the point of origination of postulated accidents described and analyzed in Section 3.4.2. The values are 8.0 km (5.0 mi) to Highway 240 for the offsite public individual and 10.7 km (6.2 mi) to the Hanford Site boundary for the maximally-exposed offsite individual. The co-located worker is assumed to be at a distance of 100 m. These distances are combined with the Hanford Site meteorology described in RPP-13033, Section 1.4.1, to evaluate exposures to the receptors.

1.2.2 Demography

Demography is described in RPP-13033.

1.3 ENVIRONMENTAL DESCRIPTION

The Hanford Site environment is described in RPP-13033.

1.4 NATURAL EVENT ACCIDENT INITIATORS

RPP-13033, Section 1.5, describes the natural phenomena threats at the Hanford Site, which includes severe weather, floods, earthquakes, snow, rain, volcanic activity, and range fires. Severe weather includes dust storms, high winds, thunderstorms, lightning strikes, and tornadoes.

The 242-A Evaporator (Project B-100) was designed and constructed in 1977 in accordance with Hanford Plant Standard Design Criteria (SDC) 4.1, Rev. 6, *Design Loads for Facilities* (DOE-RL 1975), which established the design loads and acceptance criteria for all permanent Hanford Site facilities constructed at that time. The standard was revised in September 1989 (SDC-4.1, Rev. 11; DOE-RL 1989). A comparison of the 242-A Evaporator design to criteria defined in SDC-4.1, Rev. 11, is provided in Chapter 2.0, Section 2.4.2.1. Also included in that section is a detailed discussion of the other design criteria that were applicable at the time such as DOE O 6430.1A, *General Design Criteria.*

The 242-A Evaporator was designed to withstand a 0.25g earthquake (safe shutdown earthquake). The reinforced-concrete structures comprising the 242-A Building will survive a safe shutdown earthquake and are expected to provide containment and confinement of radioactivity. An earthquake is the worst-case design basis accident that could affect habitability of the control room. The control room was designed to the 1988 Uniform Building Code. Therefore, a design basis accident could make the control room uninhabitable and unusable. Interlocks are designed to automatically shut down the 242-A Evaporator, dump the 242-A Evaporator vessel contents to the feed tank, and place the facility in a safe shutdown condition as facility personnel monitor the building as the highly radioactive process solution drains back to the feed tank.

An analysis provided in Scott (1987), "242-A Evaporator Building - Category I Analysis Review," shows that the structural shell in radioactive material processing areas meets design requirements for a tornado with a total horizontal wind velocity of 190 km/h (120 mi/h) and associated tornado-generated missile loadings. It is noted that the exterior doors in that portion of the structure are inadequate to resist missile loadings. The criteria exceed those required by the SDC-4.1, Rev. 11, for moderate hazard facilities and for Hazard Category 2 facilities.

Among the natural phenomena hazard events considered in Section 3.3.2.3.5, "Bounding, Representative, and Unique Accidents at 242-A Evaporator," are the following:

- Seismic
- Wind/tornado
- Volcanic ash/snow fall
- Lightning
- Range fire.

1.5 MAN-MADE EXTERNAL EVENT ACCIDENT INITIATORS

Man-made external event accident initiators are described in RPP-13033, Section 1.6, with the following additional information.

Among the events listed in Section 3.3.2.3.5 are the following:

- Collision of an external vehicle with the 242-A Evaporator building.
- Site loss of power
- Aircraft crash into the 242-A Evaporator.

An aircraft crash is considered as a postulated scenario in Section 3.3.2.3.5. Aircraft crash impact frequencies for the 242-A Evaporator are determined using the "four-factor" formula from DOE-STD-3014-96, *Accident Analysis for Aircraft Crash into Hazardous Facilities*. The frequency analysis is provided in Appendix 3A. The potential aircraft impact frequency for the 242-A Evaporator is due mainly to non-airport activities and the helicopter overflight. By only considering either the non-airport or helicopter contribution, the overall impact frequency of 5.40E-7/yr is well below the requirement limit of 1E-6/yr. Therefore, the aircraft crash accident scenario is not included among the accidents analyzed in Section 3.4.2.

1.6 NEARBY FACILITIES

Nearby facilities are described in RPP-13033, Section 1.7, with the following additional information.

Among the events listed in Section 3.3.2.3.5 are the following:

- Steam explosion at the nearby package boiler installation
- Tank farm accident
- Accident on the nearby Hanford Rail System.

1.7 VALIDITY OF EXISTING ENVIRONMENTAL ANALYSES

Validity of existing environmental analyses is described in RPP-13033, Section 1.8.

1.8 REFERENCES

DOE O 6430.1A, 1989, *General Design Criteria*, U.S. Department of Energy, Washington, D.C.

DOE-RL, 1975, *Hanford Plant Standard Design Criteria (SDC) 4.1*, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1989, *Hanford Plant Standard Design Criteria: Design Loads for Facilities (SDC) 4.1*, Rev. 11, U.S. Department of Energy, Richland, Operations Office, Richland, Washington.

DOE-STD-3009-94, 2002, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, Change Notice 2, U.S. Department of Energy, Washington, D.C.

DOE-STD-3014-96, 1996, *Accident Analysis for Aircraft Crash into Hazardous Facilities*, U.S. Department of Energy, Washington, D.C.

RPP-13033, *Tank Farms Documented Safety Analysis*, as amended, CH2M HILL Hanford Group, Inc., Richland, Washington.

Scott, M.A., 1987, "242-A Evaporator Building - Category I Analysis Review," (Internal Letter 65620-MS-87-160 to R. M. Marusich, Rockwell Hanford Operations, Richland, Washington); see WHC-SD-WM-TI-490.

WHC-SD-WM-TI-490, 1991, *Compilation of Basic Letters and Communications Referenced in the 241-A Evaporator-Crystallizer Final Safety Analysis Report, Revision 1*, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

CHAPTER 2.0

FACILITY DESCRIPTION

This page intentionally left blank.

CONTENTS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

LIST OF TERMS

ALARA	as low as reasonably achievable
AMU	Aqueous Make Up
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
DOE	U.S. Department of Energy
DSA	documented safety analysis
DSS	double-shell slurry
DSSF	double-shell slurry feed
DST	double-shell tank
Ecology	State of Washington Department of Ecology
ETF	Effluent Treatment Facility
FRW	filtered raw water
FY	fiscal year
HEPA	high-efficiency particulate air
HVAC	heating, ventilation, and air conditioning
ICD	interface control document
ID	inside diameter
LERF	Liquid Effluent Retention Facility
MCS	monitoring and control system
MPFL	Maximum Permissible Fire Loss
NFPA	National Fire Protection Association
OD	outside diameter
PPE	personnel protective equipment
PRC	process condensate recycle
PRV	pressure relief valve
QA	quality assurance
RCRA	*Resource Conservation and Recovery Act of 1976*
RCT	radiological control technician
RL	Richland Operations Office
RTD	resistance temperature detector
SDC	standard design criteria
SSC	structures, systems, or components
SSE	safe shutdown earthquake
SST	single-shell tank
TDI	temperature differential indicator
TEDF	Treated Effluent Disposal Facility
TOC	total organic carbon
UBC	Uniform Building Code
UPS	uninterruptible power supply
WF	weight factor
WSCF	Waste Sample Characterization Facility
WVR	waste volume reduction
WVRF	waste volume reduction factor

2.0 FACILITY DESCRIPTION

2.1 INTRODUCTION

This chapter describes the 242-A Evaporator (Figure 2-1) facility and operations to support the hazards and accident analyses in Chapter 3.0. Structures, systems, and components (SSC) are necessary to the 242-A Evaporator mission and provide the means to manage processing of tank farm waste. The SSCs applicable to the 242-A Evaporator are based on the facility boundaries depicted in Figure 2-2. The design, siting, and operation of these SSCs, in conjunction with the institutional and safety management programs discussed in chapters 6.0 through 17.0, are the physical barriers and administrative controls that prevent or mitigate releases of radioactive or hazardous materials to the environment. Those systems that are relied on to protect the facility worker, onsite worker, or offsite individuals are identified as defense in depth, safety class, or safety significant, are discussed in chapters 3.0 and 4.0.

The 242-A Evaporator is located in the 200 East Area of the Hanford Site. Construction extended from 1974 to 1977. Process piping was terminated at the building wall by the original project and continued later to the 241-A and 241-AW tank farms under projects B-102 and B-120.

The 242-A Evaporator began operations in 1977. Between 1977 and the late 1980s, the 242-A Evaporator missions included:

- Supporting defense-related production of nuclear weapons material

- Protecting the environment by concentrating and transferring liquid waste from approximately 150 single-shell tanks (SST) into 20 double-shell tanks (DST)

- Managing DST waste by reducing the volume and the number of DSTs required to store liquid waste.

Portions of the 242-A Evaporator were expanded and upgraded in 1983. These modifications added ~ 140 m^2 (1,500 ft^2) to the 242-A Evaporator building and included:

- Expanding the control room, relocating instrumentation, and adding a new annunciator panel

- Expanding the men's change room and adding a women's change room

- Adding a pre-engineered lean-to building to house clean and soiled laundry (displaced by other expansions) and a storage area.

Floor plans and elevation sketches for the 242-A Evaporator facility are shown in figures 2-3 through 2-6. Sections 2.4 through 2.9 contain detailed discussions of SSCs and processes. A process flowsheet is shown in Figure 2-7.

The design life of the 242-A Evaporator as originally constructed was 10 years. In a study based on 1987 waste volume projections, Westinghouse Hanford Company determined that the 242-A Evaporator would be required through the year 2000. Engineering studies and design efforts were initiated in fiscal year (FY) 1987 to upgrade the facility to extend the operating life by 10 years. A major construction outage to incorporate the design changes (Table 2-1) was scheduled for FY 1990.

The 242-A Evaporator was placed in temporary shutdown in April 1989, pending determination if process condensate is a mixed waste due to mixed waste being introduced into the DSTs and, consequently, into the 242-A Evaporator. Mixed waste contains both radioactive and hazardous constituents that are classified as dangerous waste by the State of Washington Department of Ecology (Ecology). Subsequent meetings with Ecology concluded that the process condensate stream is a mixed waste stream regulated by Ecology, and further discharges to the 216-A-37-1 Crib were eliminated. The determination led to a 5-year shutdown of the 242-A Evaporator until the Liquid Effluent Retention Facility (LERF) basins were constructed for storing process condensate.

242-A Evaporator operation, and treating and disposing of the process condensate are key activities in supporting the goals and milestones defined in Ecology et al. (1990), *Hanford Federal Facility Agreement and Consent Order*. The LERF basins store process condensate prior to treatment in support of 242-A Evaporator operation. Treatment facilities were constructed to reduce the concentrations of ammonia, residual organics, and dissolved radionuclides in the process condensate to levels that permit direct disposal of the treated liquid effluent to the Hanford Site soil column.

242-A Evaporator upgrades were initiated during the shutdown pending resolution of the dangerous waste issue. The 242-AB Building was constructed to house the upgraded evaporator control room (Room 18) and an electrical room (Room 19). The upgrades were completed in FY 1993, and operations restarted in April 1994.

Other facility changes include rerouting evaporator steam condensate from the 207-A Retention Basins to the Treated Effluent Disposal Facility (TEDF) in 1997, rerouting the condenser cooling water from B-Pond to TEDF in 1997, and installing a new package boiler system in 1998.

The current and future mission of the 242-A Evaporator is to support environmental restoration and remediation of the Hanford Site by optimizing the 200 East and West areas DST waste volumes in support of the tank farm and vitrification contractors.

Waste volume projections performed in FY 2000 indicate the 242-A Evaporator will be required through the year 2018. Engineering studies were performed in 2001, and design efforts were initiated to extend the operating life.

2.2 REQUIREMENTS

The design codes, standards, regulations, and U.S. Department of Energy (DOE) orders relevant to this chapter and required for establishing the safety basis for the 242-A Evaporator are as follows:

- 10 CFR 830, "Nuclear Safety Management"
- 10 CFR 835, "Occupational Radiation Protection"
- DOE O 435.1, *Radioactive Waste Management*
- DOE O 5400.5, *Radiation Protection of the Public and the Environment*
- DOE O 5480.7A, *Fire Protection*[1]
- DOE O 5480.11, *Radiation Protection for Occupational Workers*
- DOE O 5480.28, *Natural Phenomena Hazards Mitigation*
- DOE O 6430.1A, *General Design Criteria*
- DOE O 414.1A, *Quality Assurance*
- DOE O 420.1, *Facility Safety*
- DOE-STD-1020-94, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*
- DOE-STD-1021-93, *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components*
- DOE-STD-1022-94, *Natural Phenomena Hazards Characterization Criteria*
- DOE-STD-1023-95, *Natural Phenomena Hazards Assessment Criteria.*

242-A Evaporator SSCs were designed and constructed in accordance with the functional and safety requirements documented in project functional design criteria, specifications, and drawings (see WHC-SD-TWR-RPT-002, *Structural Integrity and Potential Failure Modes of the Hanford High-Level Waste Tanks*) before current design requirements were issued.

2.3 FACILITY OVERVIEW

This section provides a brief overview of 242-A Evaporator configuration and the evaporation process.

[1] Although this order has been rescinded, the contractor is obligated by the existing requirements document to meet the order's requirements.

2.3.1 Facility Configuration

The 242-A Evaporator is located in the 200 East Area. The following four principal structures make up the 242-A Evaporator:

- 242-A Building, main process building
- 242-AB Building, adjacent control room building
- 242-A-81 Building, water services building
- 207-A Retention Basins (including the 207-A Building).

The principal process components of the 242-A Evaporator system are illustrated in figures 2-8 through 2-10. These components include the reboiler, evaporator vessel C-A-1, recirculation pump and recirculation pipe loop, slurry product pump, condensers, jet vacuum system, and the condensate collection tank. This equipment is located in the 242-A Building, which consists of two adjoining but independent structures. One structure houses the processing and service areas, rooms A through G, and is designed and constructed to withstand a 0.25 g seismic event (Section 2.4.2.1.5). The other structure contains rooms 1 through 17 and houses operating and personnel support areas such as change rooms and supply room, etc. Under Project B-534, a new building, 242-AB, was constructed to house the upgraded evaporator control room and an electrical room, rooms 18 and 19, respectively.

A computer-based monitoring and control system (MCS) is located in the 242-AB Building control room. The MCS is used to operate and monitor the 242-A Evaporator and various tank farm facilities as described in sections 2.4 and 2.5. Utilities and services supplied to the 242-A Evaporator include electrical power, water, and steam. Figure 2-2 shows utility, and water service locations. Electrical power is provided by the electrical substation and a backup diesel generator. The backup diesel generator electrical cabinet contains a transfer switch that transfers power from the backup generator if normal power is lost. Water is provided from the 200 East Area Power House to the 242-A-81 Water Services Building. Steam used in the 242-A Evaporator process and for building heat is provided by package boilers, located in the 242A-BA Building, which are operated by an independent contractor. A brief discussion of the package boiler system is provided in Section 2.9.4.

The 207-A Retention Basins and 207-A Building are 242-A Evaporator systems that have been physically isolated from the 242-A Evaporator and are no longer used. They were support facilities used for temporary storage of 242-A Evaporator process condensate and steam condensate prior to disposal. 242-A Evaporator process condensate is sent to the LERF, where it is stored temporarily prior to treatment at the 200 Area Effluent Treatment Facility (ETF). The steam condensate is discharged directly to the TEDF. The basins contain low levels of fixed residual radioactive contamination.

242-A Evaporator feed is staged in the evaporator feed tank, TK-241-AW-102 (102-AW), a 3.8 million L (1 million gal) DST, and is pumped from feed tank 102-AW to the 242-A Evaporator through an underground-encased pipeline. Miscellaneous solutions are returned to feed tank 102-AW via three underground drain lines (two of which are encased) that run from the 242-A Building to the tank drain pit. 242-A Evaporator slurry is pumped to a tank farm valve pit via underground-encased piping. The slurry can be directed to a specific DST by tank farm personnel from the valve pit using the tank farm transfer system. The tank farm transfer system is physically connected to the 242-A Evaporator in-facility process piping at the exterior walls of the 242-A Evaporator and consists of single and encased piping, pumps, valve pits, diversion boxes, clean-out boxes, and support systems such as leak detectors and cathodic protection. The waste storage and transfer systems are addressed in RPP-13033, *Tank Farms Documented Safety Analysis*. Figure 2-2 shows the general location of the piping runs.

242-A Evaporator process condensate, steam condensate, and cooling water (called used raw water) streams are transferred to other waste handling facilities. Process condensate is transferred to LERF via an underground-encased transfer line. Steam condensate and cooling water are transferred via separate underground transfer lines to an underground 36-in. transfer line connected to TEDF Pump Station 3. The TEDF and the LERF transfer systems are discussed in HNF-SD-W049H-ICD-001, *200 Area Treated Effluent Disposal Facility Interface Control Document*, and HNF-SD-LEF-ASA-002, *242AL Liquid Effluent Retention Facility Auditable Safety Analysis*, respectively.

This documented safety analysis (DSA) is limited in scope to systems and components located within the exterior walls of the 242-A Evaporator, ventilation systems, 242-A-81 water supply, backup electrical system, and the 207-A Building and 207-A Retention Basins. Discussion of facilities and utilities that support the 242-A Evaporator are included in this DSA to clarify the interface or relationship between the 242-A Evaporator and tank farms, LERF, TEDF, and the package boiler system.

2.3.2 Process Overview

The 242-A Evaporator is designed to reduce waste volume and the number of DSTs required to store liquid waste generated at the Hanford Site. The process uses a conventional, forced-circulation, vacuum evaporation system operating at low pressure (approximately 60 torr) and low temperature (approximately 50 °C [122 °F]) to concentrate radioactive waste solutions.

The waste feed is pumped from feed tank 102-AW through an underground-encased feed line to the 242-A Evaporator and subsequently into vessel C-A-1 for processing. The waste feed is concentrated in vessel C-A-1 to a specified concentration creating product slurry and water vapor. The slurry is transferred from the 242-A Evaporator through underground-encased piping to 241-AW-A or AW-B valve pits in the 241-AW Tank Farm. The slurry is generally routed from the valve pits to tank TK-241-AW-106, but can be routed to other DSTs in the 200 East Area. Process offgases and water vapor are passed through one primary and two secondary condensers, creating the process condensate and a gaseous effluent. Gaseous effluents are filtered and released to the environment from the vessel ventilation exhaust system. Process condensate is collected in condensate collection tank TK-C-100 and pumped directly to LERF or used in the process condensate recycle system. In the past, if the process condensate required additional cesium and strontium removal it was processed through ion exchange columns before discharge to the LERF. However, the ion exchange columns have been removed because treatment is provided by the ETF. Cooling water from the process vapor condensers and the steam condensate stream is discharged to TEDF Pump Station 3.

Fundamental material balances associated with the systems described in this section are given in Table 2-2 and show the characteristics of the systems, inputs to, and outputs from, the 242-A Evaporator that are basic for understanding the processes in the facility.

A detailed discussion of the 242-A Evaporator process is provided in Section 2.5.

2.4 242-A EVAPORATOR STRUCTURES

This section describes the 242-A Evaporator SSCs and includes structural specifications used for design, dimensions, floor plans, equipment layout, construction materials, controlling dimensions, and dimensions significant to the hazard and accident analysis activity.

The principal process components of the 242-A Evaporator system are located in the 242-A Building, which is comprised of two adjoining but independent structures designated as Y and Z is shown in Figure 2-3. Structure Y contains processing and service areas and is a reinforced concrete shear wall and slab structure with concrete mat footing in belowgrade regions and spread footings elsewhere. Structure Z, which is separated from Structure Y by a seismic joint, contains operating and personnel support areas, such as change rooms and a supply room.

The 242-A Building is ~ 23 m (~ 75 ft) wide by 33 m (108 ft) long and 19 m (62 ft) abovegrade at its highest point. A portion of the building extends 3 m (10 ft) belowgrade.

The 242-A Building is compartmentalized by physical barriers and ventilation systems into three areas: process, service, and operations. The process area includes the evaporator room, pump room, condenser room, and ion exchange room. The service area includes the Aqueous MakeUp room (AMU) room, load-out and hot-equipment storage room, loading room, and the heating, ventilation, and air conditioning (HVAC) room. The operations areas located in the 242-A Building and include the change rooms, lunchroom, office, and storage rooms.

The roof of Structure Z consists of metal decking supported by structural steel members spanning to reinforced concrete block walls. The foundation consists of continuous strip footings. This portion of the 242-A Building was designed and constructed in accordance with Uniform Building Code (UBC) specifications in effect at the time.

The 242-AB Building is an addition to Structure Z of the 242-A Building and is of similar design and construction. It shares a common wall with the 242-A Building and is 13.8 by 12.2 m (45 ft 4 in. by 40 ft) by 3.6 m (12 ft) high. The control room and the electrical room are located in the 242-AB Building.

2.4.1 Detailed Structure Descriptions

The following sections describe individual areas in the 242-A Building and 242-AB Building and include essential dimensions, functions, features, and components.

2.4.1.1 Pump Room

The pump room (Figure 2-8) is 6.8 m (22 ft 2 in.) by 5.5 m (18 ft). The ceiling of the room is 3.8 m (12.5 ft) abovegrade and consists of four removable concrete cover blocks that allow crane access from the overhead gallery. A section of the pump room floor 6.8 m (22 ft 2 in.) by 2.7 m (9 ft) is 3 m (10 ft) belowgrade and contains a 1.5 m by 1.5 m by 1.8 (5 ft by 5 ft by 6 ft) deep sump lined with stainless steel. The pump room shares a common wall with the evaporator room through which the 71 cm (28 in.) recirculation line passes. Shielding walls of the pump room are 0.56 m (1 ft-10 in.) thick concrete. A 0.74 m by 0.74 m (2 ft 5 in. by 2 ft 5 in.) oil-filled shielding window is located in the east wall for surveillance and crane operation from the AMU. The floor of the pump room is lined with stainless steel and the walls are painted with a barrier coating to facilitate decontamination.

A series of nozzles is located on the north, west, and south walls to provide services and liquid transfer routes for the cell equipment. Jumpers are installed between the equipment and the wall nozzles.

The pump room is unmanned except for maintenance work. A free-swinging door opens from the -3 m (-10 ft) level of the evaporator room into the pump room for personnel access.

Pump room systems and components introduce evaporator feed, recirculate in-process slurry, withdraw slurry, and transfer the product to a tank farms' valve pit. Feed material for the process is pumped from feed tank 102-AW to the pump room. It is routed through jumpers to a sample cabinet in the load-out and hot-equipment storage room then to the recirculation line where it enters the process. The recirculation pump recirculates the slurry through the reboiler to vessel C-A-1 and back to the reboiler. Slurry is withdrawn from the process and routed via jumpers to the transfer piping and transferred by gravity drainage or the slurry pump through a jumper to a designated tank farm valve pit.

The principal components located in the pump room are the recirculation pump, slurry pump, and process jumpers.

2.4.1.2 Evaporator Room

The evaporator room (Figure 2-9) is 6.8 m (22 ft-2 in.) by 7.7 m (25 ft-4 in.). It is 21.8 m (71 ft-6 in.) from floor (at 3 m [10 ft] belowgrade) to ceiling 18.8 m (61 ft-6 in.) abovegrade with metal grating work platforms at elevations of 9.3 m (30 ft-6 in.) and 12.3 m (40 ft-6 in.). The ceiling/roof consists of removable concrete cover blocks. This type of construction is classified as Type I noncombustible fire-resistive in accordance with National Fire Protection Association (NFPA) 220, *Standards on Types of Building Construction*. The cover blocks are sealed in place and have not been removed since the facility was constructed. The walls are 0.56 m (1 ft-10 in.) thick concrete to provide radiation shielding. Wall penetrations allow the 107 cm (42-in.) vapor line to enter the condenser room and the 71 cm (28-in.) recirculation line to enter the pump room. Two airlocks, one at grade and one at 12.3 m (40 ft-6 in.), allow personnel access to the evaporator room from the building exterior. Ladders extend from the floor to the work platform at elevation 12.3 m (40 ft-6 in.).

Process equipment in the evaporator room evaporates water from process slurry until the required waste volume reduction is achieved.

Evaporator room components include the reboiler and vessel C-A-1.

2.4.1.3 Condenser Room and Ion Exchange Room

The condenser room (Figure 2-10) is 7.3 m (24 ft) by 8.3 m (27 ft). Like the adjacent evaporator room, the condenser room is 21.8 m (71 ft-6 in.) from floor (at 3 m [10 ft] belowgrade) to ceiling (at 18.8 m [61 ft-6 in.] abovegrade). There are metal grating work platforms at elevations 0 m (0.0 in.), 9.3 m (30 ft-6 in.), 12.3 m (40 ft-6 in.), and 15.4 m (50 ft-6 in.), with stairs connecting the platforms. The ceiling/roof consists of removable concrete cover blocks covered with Type A roofing. The cover blocks were removed temporarily in 1990 when the condenser was replaced. The condenser room shares a common wall with the evaporator room through which the 107 cm (42-in.) vapor line passes at the 15.4 m (50 ft-6 in.) level. The wall is 0.56 m (1 ft-10 in.) thick to provide radiation shielding. The other three condenser room walls are 0.3 m (1-ft) thick concrete.

The condenser room is entered from the survey corridor through a personnel airlock at the 0 m elevation. Access from the exterior of the facility is through a set of doors at the 12.3 m (40 ft-6 in.) elevation. A door at the 15.4 m (50 ft-6 in.) elevation provides access to the roof via an exterior wall-mounted ladder. These doors are not used on a routine basis and are not designed as airlocks.

The north wall of the condenser room at the -3 m (-10 ft) level has a small door to the ion exchange room, which is 1.8 m by 2.7 m (6 ft by 9 ft). The enclosure is 5.7 m (18 ft-8 in.) from the floor at -2.1 m (-7.0 ft) to the ceiling at 3.6 m (11 ft-8 in.). The ceiling/roof consists of removable concrete cover blocks covered with roofing. The walls of the enclosure are 0.3 m (1-ft) thick concrete.

Condenser room components include condensers, steam jet eductors, filters, and tanks.

2.4.1.4 Load-Out and Hot-Equipment Storage Room

The load-out and hot-equipment storage room is 6.8 m by 3.7 m by 11 m (22 ft 2 in. by 12 ft by 36 ft-4 in.) high. The floor is at elevation 0 m (0 ft) and contains two sump pits 91 cm (36 in.) in dia and ~ 1.2 m (4 ft) deep lined with stainless steel. One pit, designated the decontamination sump, is equipped with four fixed spray nozzles for cleaning equipment with decontamination solutions. Both pits drain to the pump room sump via 7.6 cm (3-in.) drain lines. The load-out and hot-equipment storage room is open to the crane gallery. The north, east, and west walls are constructed of 0.56 m (1 ft-10 in.) thick concrete. The south wall is 0.3 m (1 ft) thick. A door in the south wall permits entry from the loading room. A ladder on the north wall provides access to the top of the pump room cover blocks. A 10 cm (4-in.) high curb is located at the door to prevent any liquid spills from reaching the loading room.

The load-out and hot-equipment storage room serves as a decontamination and maintenance area in support of pump room operations and contains sampling equipment for sampling the evaporator feed and process slurry.

The sample enclosure is located in the northwest corner of the room. It is constructed of 2.5 cm (1-in.) carbon steel plate and has 5 cm (2-in.) thick lead shielding on the front and side faces and 1.3 cm (0.5-in.) thick lead shielding on top. The enclosure contains two identical sampling devices, one for evaporator feed, and one for process slurry. Instrument air and hot water are supplied to the sample enclosure for operating the samplers and flushing, respectively.

2.4.1.5 Loading Room

The loading room is 7.3 m (23 ft 10 in.) by 3.7 m (12 ft). The floor is at elevation 0 m and contains a 7.6 cm (3-in.) floor drain to the pump room sump. The ceiling is ~ 3.4 m (~ 11 ft) high and consists of a horizontally installed, roll-up, nylon-vinyl, curtain-type door. With the draft curtain rolled back, the loading room is open to the crane gallery. The walls are 0.3 m (1-ft) thick concrete. The loading room is accessed from the AMU through personnel airlocks located at ground level and at the top of the stairs from the AMU mezzanine, or from the building exterior through a ground level 3.7 m by 4.6 m (12 ft by 15 ft) roll-up door.

The loading room serves as a loading dock to support pump room operations and contains no installed equipment.

2.4.1.6 Aqueous Makeup Room

The ground-level AMU room (Figure 2-11) is 7.3 m by 8.2 m (27 ft by 24 ft) and 6.7 m (22 ft) from floor to ceiling. Stairs lead to a metal-grate mezzanine (Figure 2-12) at elevation 3.9 m (12 ft-8 in.) and from there up to the HVAC room entry and to an airlock to the bridge crane service platform. The AMU room shares a common wall with the loading room, load-out and hot-equipment storage room, pump room, and the associated crane gallery. That portion of the wall common with the pump room and load-out and hot-equipment storage room is 0.56 m (1 ft-10 in.) thick concrete. All other walls are 0.3 m (1-ft) thick concrete.

The common wall between the loading room, load-out and hot-equipment storage room, and pump room has four viewing windows for crane operation. The pump room window was discussed in Section 2.4.1.1. The three other windows are located at the mezzanine level. Two windows, one located above the pump room and one above the load-out and hot-equipment storage room, are oil-filled shielding windows identical in design to the pump room window. The third window, located above the loading room, does not require shielding.

There are three doors in the AMU room. A standard door between the AMU room and the survey corridor provides routine access. A 3 m by 3 m (10 ft by 10 ft) sliding door with an integral 0.9 m by 2.1 m (3 ft by 7 ft) access door is located in the south wall. A personnel airlock located in the southwest corner provides controlled access to the loading room.

The function of the AMU room is receipt (or makeup), storage, and transfer of antifoam and decontamination solutions. It also serves as an operating area for the bridge crane.

The systems and components in the AMU include the compressed air system, K2-5-2 exhaust fan, fire protection system components, electrical system components, and three chemical storage tanks.

2.4.1.7 Heating, Ventilation, and Air Conditioning Room

The HVAC room (Figure 2-13) measures 7.3 m by 13.7 m (24 ft by 44 ft 10 in.) and is located above the AMU room at an elevation of 6.7 m (22 ft-0 in.). It shares a common wall with the loading room, load-out and hot-equipment storage room, pump room, and the associated crane gallery. That portion of the wall common with the pump room and load-out and equipment storage room is 0.56 m (1 ft-10 in.) thick concrete. All other walls are 0.3 m (1-ft) thick concrete. The east wall contains a 1.8 m by 2.6 m (6 ft by 8.5 ft) louvered air supply vent. The ceiling/roof of the room is concrete with insulated built-up Type A roofing.

The HVAC room is entered from a staircase leading up from the AMU room mezzanine. A 1.5 m by 2.1 m (5 ft by 7 ft) equipment door in the south wall opens to the building exterior and a personnel door in the east wall opens to the building exterior leading up to the building roof or to the ground by ladder and stairs.

The HVAC room contains equipment to supply conditioned air to the K1 and K2 ventilation systems.

Section 2.6 describes both the K1 and K2 ventilation systems in detail.

2.4.1.8 Miscellaneous Areas

Miscellaneous support areas in the 242-A Building are described below.

2.4.1.8.1 Men's and Women's Change Rooms. The men's and women's change rooms contain sinks, toilets, showers, and lockers for personnel clothing. Note that 'change rooms' is a misnomer; personal protective equipment (PPE) is not allowed in the change room. It is donned near the radiation area entry and removed at control points. Water to the change rooms is supplied from the sanitary water system and drains unmonitored to the sanitary sewer system.

2.4.1.8.2 Personal Protective Equipment Receiving and Shipping Containers. Clean PPE is stored in bulk outside the 242-A Building in steel shipping containers. PPE that is ready for use is staged in appropriate areas. Used PPE is removed at control points, bagged, surveyed for radioactive contamination, and shipped to the laundry facility.

2.4.1.8.3 Survey Corridor. The survey corridor is located at the entry/exit points for the AMU and condenser rooms. This area serves as a base for radiological control technicians (RCT) supporting 242-A Evaporator operations. A whole-body frisker is located in the survey corridor.

2.4.1.8.4 Office and Lunchroom. Office space and a lunchroom are provided for staff.

2.4.1.9 Control Room

The control room is located in the 242-AB Building. The 242-AB Building is 13.8 m by 12.2 m (45 ft 4 in. by 40 ft) and shares a common wall with the 242-A Building. The roof assembly, which has unprotected supporting steel, does not have a fire resistive rating. This type of construction is classified as Type II (000) noncombustible construction in accordance with

NFPA 220. An interior wall divides the building into two areas, a 10.1 by 12.2 m (33 ft 4 in. by 40 ft) control room and a 3.7 m by 12.2 m (12 ft by 40 ft) electrical room. Control room access is through two doors one of which opens to the outside. A third door provides access to the electrical room.

The control room houses the MCS for the 242-A Evaporator and serves as a monitoring point for tank farm equipment not associated with the 242-A Evaporator.

2.4.1.10 242-A-81 Water Services Building

The 242-A-81 Water Services Building is located south of the 242-A Evaporator. It is a preengineered structure measuring 8.5 m by 6 m by 3 m high (28 ft by 20 ft by 10 ft high). The floor is a 15 cm (6-in.) thick concrete slab sloped to a 0.9 m by 0.9 m by 0.9 m (3 ft by 3 ft by 3 ft) central sump pit. Raw water for the 242-A Building and processes is supplied from the 242-A-81 Water Services Building. Raw water is supplied to the 242-A Evaporator to support operations, for the fire protection sprinkler systems, and for the HVAC.

2.4.1.11 207-A Retention Basins and 207-A Building

The 207-A Building (Figure 2-14) and 207-A Retention Basins were support facilities used for temporary storage of 242-A Evaporator process condensate and steam condensate. 242-A Evaporator process condensate is now sent to the LERF, where it is stored temporarily prior to treatment at the 200 Area ETF. The steam condensate is discharged directly to the TEDF. The 207-A Retention Basins and 207-A Building have been physically isolated from the 242-A Evaporator Building and are no longer used.

2.4.1.11.1 Condensate Retention Basin. Six 260 kL (70,000 gal) retention basins are located east of the 242-A Building. These basins were originally used to retain process condensate and steam condensate until sample analyses verified acceptability for discharge to the 216-A-37-1 Crib and 216-B-3 Pond, respectively. The three south basins, used for the temporary retention of process condensate were taken out of service in 1989. The three north basins used for the temporary retention of steam condensate were taken out of service in 1999. The basins are considered to be a part of the 242-A Evaporator facility until they can be turned over to a separate project and/or contractor for remediation.

The steam and process condensate basins are constructed of 10 cm (4-in.) thick reinforced concrete. They are coated with an elastomeric compound and the north basins are lined with a high-density polyethylene liner to minimize the possibility of leakage. High-density polyethylene covers were installed on each of the north basins in 1991. The floor of each basin is ~ 17 m (~ 55 ft) long and 3.2 m (10.5 ft) wide. The walls slope at a 45° angle, yielding surface dimensions of 24 m (79 ft) by 11 m (36 ft). At the high water elevation the basins have a maximum depth of ~ 1.8 m (~ 6 ft).

2.4.1.11.2 207-A Building. The 207-A Building measures 3.8 m by 4.6 m (12 ft 6 in. by 15 ft). The walls, constructed of 0.3 m (1-ft) thick steel reinforced concrete, are 4.6 m (15 ft) high and extend from 3 m (10 ft) belowgrade to 1.5 m (5 ft) abovegrade. The floor contains a 0.6 m by 0.6 m by 0.6 (2 ft by 2 ft by 2 ft) deep sump. The ceiling/roof of the 207-A Building is metal decking. Access is through an entry hatch. A ladder extends to a 2.4 m by 0.8 m (8 ft by 2 ft

9 in.) metal gratework platform suspended 2.3 m (7.5 ft) above the floor of the building and continues down to floor level.

The 207-A Building contains piping, valves, and pumps that were used to provide the following:

- Route steam and process condensate to a specific basin
- Pump steam condensate from the basins to the 200 Area TEDF Pump Station 3
- Pump process condensate to the 216-A-37-1 Crib
- Pump condensate to the evaporator feed tank 102-AW (recycle condensate).

2.4.1.12 Backup Diesel Generator

The backup diesel generator is described in Section 2.8.1.

2.4.2 Structural Specifications

Structural specifications for the 242-A and 242-AB buildings were defined during design construction using the latest editions of codes and standards in effect at the time of design. Structural specifications are divided into the following categories:

- Earthwork
- Concrete
- Masonry
- Structural steel
- Roofing.

Appendix 2A lists the codes and standards applied in constructing the original 242-A Evaporator and Project B-534 upgrades.

2.4.2.1 Structural and Mechanical Design Criteria

The 242-A Evaporator (Project B-100) was designed and constructed in 1977 in accordance with Hanford Plant Standard Design Criteria (SDC) 4.1, Rev. 6, *Design Loads for Facilities* (DOE-RL 1975), which established the design loads and acceptance criteria for all permanent Hanford Site facilities constructed at that time. The standard was revised in September 1989 (SDC-4.1, Rev. 11; *Standard Architectural - Civil Design Criteria: Design Loads for Facilities* [DOE-RL 1989]). A comparison of the 242-A Evaporator design to criteria defined in SDC-4.1, Rev. 11, is provided in this section. Also included in this section is a detailed discussion of the other applicable design criteria, such as DOE O 6430.1A. The 242-A Evaporator was designed to withstand a 0.25g earthquake (safe shutdown earthquake [SSE]), a 100 mi/h high wind/tornado, and wind-generated missiles. The criteria exceed those required by the SDC-4.1, Rev. 11, for moderate hazard facilities and for Hazard Category 2 facilities. The structure is qualified to PC-3 criteria.

When the 242-A Evaporator was constructed, all process piping was terminated at the building wall. It was subsequently extended to the 241-A and 241-AW tank farms under two separate projects: B-102 and B-120.

A Dangerous Waste Permit Application (Part B) was submitted to the state of Washington in June 1991. A revised Part B was submitted in July 1997 and incorporated into the Hanford Site Permit in January 1998. 242-A Evaporator restart was covered under an Interim Status Permit Application (Part A). An integrity assessment was performed in 1992-93 to confirm integrity of vessels, piping, and secondary containment concrete as part of the dangerous waste permit application. The integrity assessment (WHC-SD-WM-ER-124, *The 242-A Evaporator Crystallized Tank System Integrity Assessment Report*) included ultrasonic testing of vessel wall thickness, and concluded that all tank and containment systems were fit for use. A second integrity assessment (HNF-2905, *242-A Interim Evaporator Tank System Integrity Assessment Report*) reconfirmed that all systems were fit for use.

The original design criteria in DOE O 6430.1A, Section 0111, established facility structural design requirements. It required that structures be protected against dynamic effects that could result from severe natural phenomenon, accidents at nearby facilities, and equipment failures. The specific severe natural phenomenon events to be considered were straight winds, tornados, floods, and earthquakes.

DOE O 6430.1A referenced UCRL-15910, *Design and Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phenomenon Hazards*, as guidance for selecting the magnitude of severe natural phenomenon that could impact a facility. UCRL-15910 suggested four usage categories for designing and evaluating DOE facilities:

1. General Use - facilities that have a nonmission-dependent purpose.

2. Important or Low-Hazard - facilities that have mission-oriented use.

3. Moderate-Hazard - facilities where confinement of contents is necessary for public or employee protection.

4. High-Hazard - facilities where confinement of contents and public and environmental protection are of paramount importance. Facilities in this category represent hazards with potential long-term and widespread effects.

Performance goals were described and a performance goal annual probability of exceedance was established for each category. The magnitude of severe natural phenomenon could then be selected from hazard curves (return period versus magnitude) as a function of the facility-use category. Based on a hazard classification analysis performed for the facility (WHC-SD-WM-PSE-008, *Hazard Classification for the 242-A Evaporator Facility*) and the safety classification of systems and structures in use at the time, the 242-A Evaporator was categorized as a moderate-hazard structure.

The guidance provided in UCRL-15910 was incorporated into DOE-RL (1989). DOE-RL (1989) established the design loads and acceptance criteria for all new facilities and new additions to, or modifications of, existing facilities at the Hanford Site.