WHC-EP-0466-2
UC-721

Facility Effluent Monitoring Plan for 242-A Evaporator Facility

G. M. Crummel
R. D. Gustavson

RECEIVED
MAR 2 7 1995
OSTI

Date Published
February 1995

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

Westinghouse Hanford Company
P.O Box 1970
Richland, Washington

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

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

Document Title: Facility Effluent Monitoring Plan for the 242-A Evaporator Facility

Prepared by: 2/16/95
G. M. Crummel, Senior Engineer
Date

Approved by: R. D. Gustavson 2/20/95
R. D. Gustavson, Manager
Tank Farms Environmental Engineering
Date

Approved by: 2/27/95
W. E. Ross, Manager
Evaporator/LERF/241-AW Operations
Date

Approved by: 2-27-95
L. P. Diediker, Manager
Effluent and Emission Monitoring
Date

Approved by: For 2-28-95
D. D. Volkman, Manager
Environmental and Engineering
Quality Assurance
Date

RELEASE AUTHORIZATION

Document Number:	WHC-EP-0466-2
Document Title:	242-A Evaporator Facility Effluent Monitoring Plan
Release Date:	3/6/95

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 M. Broz

Kara M. Broz

March 6, 1995

A-6001-400 (07/94) WEF256

FACILITY EFFLUENT MONITORING PLAN FOR THE 242-A EVAPORATOR FACILITY

G. M. Crummel

ABSTRACT

A facility effluent monitoring plan is required by the U.S. Department of Energy in DOE Order 5400.1 for any operations that involve hazardous materials and radioactive substances that could affect employee or public safety or the environment. A facility effluent monitoring plan determination was performed during Calendar Year 1991 and the evaluation showed the need for a facility effluent monitoring plan. This document is prepared using the specific guidelines identified in* A Guide for Preparing Hanford Site Facility Effluent Monitoring Plans, *WHC-EP-0438-1**. This facility effluent monitoring plan assesses effluent monitoring systems and evaluates whether they are adequate to ensure the public health and safety as specified in applicable federal, state, and local requirements.*

This facility effluent monitoring plan shall ensure long-range integrity of the effluent monitoring systems by requiring an update whenever a new process or operation introduces new hazardous materials or significant radioactive materials. This document must be reviewed annually even if there are no operational changes, and it must be updated, as a minimum, every three years.

**General Environmental Protection Program*, DOE Order 5400.1, U.S. Department of Energy, Washington, D.C., 1988.

***A Guide for Preparing Hanford Site Facility Effluent Monitoring Plans*, WHC-EP-0438-1, Westinghouse Hanford Company, Richland, Washington, 1992.

This facility effluent monitoring plan has been revised to include U.S. Department of Energy/Westinghouse Hanford Company Regulatory Analysis comments, procedure changes (revisions), and improved U.S. Environmental Protection Agency "National Emission Standards for Hazardous Air Pollutants" point-by-point evaluation.*

---

*"National Emission Standards for Hazardous Air Pollutants" (NESHAP), Title 40, *Code of Federal Regulations*, Part 61, as amended, U.S. Environmental Protection Agency, Washington, D.C., 1987.

CONTENTS

CONTENTS (continued)

CONTENTS (continued)

LIST OF FIGURES

LIST OF TABLES

LIST OF TERMS

ACV	Administrative Control Value
ALARA	as low as reasonably achievable
ALI	Annual limit on intake
AMU	aqueous makeup
ANSI	American National Standards Institute
ASF	ammonia scrubber feed
ASP	alarm set point
ASTM	American Society for Testing and Materials
BAT	best available technology
CAM	continuous air monitor
CASS	Computer Automated Surveillance System
CBRS	Component-Based Recall System
CERCLA	*Comprehensive Environmental Response Compensation, and Liability Act of 1989*
CFR	Code of Federal Regulations
cpm	counts per minute
CRW	cladding removal waste
DAC	derived air concentrations
DCG	derived concentration guide
DDSSF	dilute double-shell slurry feed
DOE	U.S. Department of Energy
DP	differential pressure
DSI	Don't Say It -- Write It
DSSF	double-shell slurry feed
DST	double-shell tank
DW	dangerous waste
E/C	Evaporator/Crystallizer
EDE	effective dose equivalent
EDP	electronic data processing
EDTA	ethylenediamine tetraacetic acid
EHW	extremely hazardous waste
EMP	Environmental Monitoring Plan
EMS	effluent monitoring system
EP	Environmental Protection group
EPA	U.S. Environmental Protection Agency
ETF	effluent treatment facility
FEMP	Facility Effluent Monitoring Plan
HEDTA	hydroxy ethylenediaminetetraacetic acid
HEHF	Hanford Environmental Health Foundation
HEPA	high-efficiency particulate air (filter)
HP	Health Physics
HPT	Health Physics Technician
HVAC	heating, ventilating, and air conditioning
ICRP	International Commission on Radiation Protection
LCCS	laboratory customer computer system
LERF	Liquid Effluent Retention Facility
M&TE	measuring and test equipment
MCS	monitor and control system
MEI	maximally exposed individual
MOV	motor-operated valve

LIST OF TERMS (continued)

NBS	National Bureau of Standards
NCRW	neutralized cladding removal waste
NESHAPS	National Emissions Standards for Hazardous Air Pollutants
NO/NC	normally opened/normally closed
NPDES	National Pollutant Discharge Elimination System
NWPA	*Nuclear Waste Policy Act of 1982*
OHP	operational health physics
OSR	operational safety requirements
PC	process condensate
PF	protection factor
PFP	Plutonium Finishing Plant
PISCES	Plant Instrumentation Surveillance Calibration and Evaluation System
PNL	Pacific Northwest Laboratory
POP	plant operating procedure
POTW	Publicly Owned Treatment Works
PUREX	Plutonium/Uranium Extraction (Plant)
QA	Quality Assurance
QAPP	Quality Assurance Program Plan
QAPjP	Quality Assurance Project Plan
RCRA	*Resource Conservation and Recovery Act of 1976*
RCG	Radioactivity Concentration Guides
RCT	Radiation control technician
REDOX	Reduction Oxidation (Plant) Operations
RL	U.S. Department of Energy Operations Office, Richland
RQ	reportable quantities
SC	steam condensate
SWP	Special Work Permit
TLD	thermoluminescent dosimeter
TRU	transuranic (waste)
TSD	treatment, storage, and disposal
UBC	Uniform Building Code
URW	used raw water
WAC	Washington Administrative Code
WHC	Westinghouse Hanford Company

METRIC CONVERSION CHART

INTO METRIC		
If you know	Multiply by	To get
Length		
inches	2.54	centimeters
feet	30.48	centimeters
Volume		
gallons	3.786	liters
cubic feet	0.02832	cubic meters
Temperature		
Fahrenheit	Subtract 32 then multiply by 5/9ths	Celsius
Pressure		
inches water	1.87	mm Hg
inches water	249	Pascal (Pa)
OUT OF METRIC		
Length		
centimeters	0.3937	inches
meters	3.28	feet
Volume		
milliliters	1.247×10^{-3}	cubic feet
liters	0.264	gallons
cubic meters	35.31	cubic feet
Temperature		
Celsius	Multiply by 9/5ths, then add 32	Fahrenheit
Pressure		
mm Hg	0.5353	inches water
Pascal (Pa)	4.02×10^{-3}	inches water

1.0 FACILITY EFFLUENT MONITORING PLAN

1.1 INTRODUCTION

This section provides information on the policy, purpose, and scope of a facility effluent monitoring plan (FEMP).

1.1.1 Policy

It is the policy of the U. S. Department of Energy (DOE) and its contractor, Westinghouse Hanford Company (WHC), to conduct facility effluent monitoring (sampling and monitoring) that is adequate in determining whether the public and the environment are sufficiently protected during DOE operations; and to determine whether operations are in compliance with DOE and other applicable federal, state, and local emission standards and requirements. It is also DOE and WHC policy that effluent monitoring programs meet high standards of quality and credibility and that their operations are in compliance with federal, state, and local emission standards and requirements.

1.1.2 Purpose

This plan fulfills the DOE requirement (DOE 5400.1) (DOE 1988) for a FEMP to exist for each site, facility, or process that uses, generates, releases, or manages significant pollutants of radioactive or hazardous materials that could affect public and employee safety and the environment. This document is specifically intended to meet this requirement for the 242-A Evaporator/Crystallizer (E/C) facility on the Hanford Site.

The FEMP assesses and documents this information to determine if the monitoring, sampling, and controls are sufficient to protect the public and the environment and to assess whether these systems are in compliance with all federal, state, and local requirements and regulations.

1.1.3 Scope

This document includes program plans for monitoring and characterizing radioactive and nonradioactive hazardous materials discharged in 242-A E/C facility effluents. This plan includes complete documentation for both gaseous and liquid effluent monitoring systems (EMS) for both radioactive and nonradioactive hazardous pollutants that could be discharged under routine and/or upset conditions.

The FEMPs are written to provide sufficient information on the effluent characteristics and the EMS of facilities so that a compliance assessment against the applicable requirements may be easily accomplished. Adequate details are supplied so that radioactive and hazardous material source terms related to specific effluent streams and, in turn, to specific discharge points can be finally compared to the EMS capability.

1.1.4 Discussion

The FEMPs are required for facilities if the total projected effective dose equivalent* (EDE) to any member of the public from radionuclide airborne emissions at the facility exceeds 0.1 mrem/yr from any one discharge point or if any one regulated material discharged over a 24-hour period from a facility exceeds 100% of the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) Reportable Quantity (RQ) as listed in Title 40 Code of Federal Regulations (CFR) Part 302.4, "Designation of Hazardous Substances" (EPA 1991c). A FEMP is required for a facility if the liquid effluent stream contains measurable radionuclide concentrations and the concentrations exceed the drinking water standards. The FEMPs are self-supporting in-depth documents that detail the effluents, the effluent discharge points, the monitoring systems, the sampling protocol, and the controls at the facility.

This document was prepared under the guidance given in WHC-EP-0438-1, *A Guide For Preparing Hanford Facility Effluent Monitoring Plans* (WHC 1991a).

---

*An EDE is defined to be the summation of the products of the dose equivalent received by specific tissues of the body and a tissue-specific weighing factor. The sum is a risk-equivalent value that can be used to estimate the health-effects risk of exposed individuals. The tissue-specific weighing factor represents the fraction of the total health risk resulting from uniform whole-body radiation that would be contributed by that particular tissue. The EDE includes the committed EDE from internal deposition of radionuclides, and the EDE caused by penetrating radiation from sources external to the body. The EDE is expressed in units of rem (or sievert).

2.0 FACILITY DESCRIPTION

This chapter is provided to briefly describe, and thus introduce, the 242-A Evaporator facility.

2.1 FACILITY PHYSICAL DESCRIPTION

The 242-A Evaporator complex is located in the 200 East Area of the Hanford Site, which is located in the south-central region of Washington State. The 242-A Building is located south of the 241-A and 241-AX Tank Farms and north of the 241-AW Tank Farm. The facility location and layout are shown in Figures 2-1 and 2-2. The 242-A Evaporator complex covers approximately 1,394 m^2 (15,000 ft^2).

The 242-A Building contains the evaporator vessel and supporting process equipment. The building ventilation exhaust fans and high-efficiency particulate air (HEPA) filter housings are located on the north side of the building. An emergency diesel generator is located on the southeast side of the building. Raw water, steam, and electrical power are provided to the 242-A Building from existing service facilities in the 200 East Area.

In general, the 242-A Evaporator facility can be divided into three areas: process, service, and operating. The process area includes the evaporator room, pump room, condenser room, and ion exchange enclosure. The service area includes the aqueous makeup unit (AMU) room, loadout and hot equipment storage room, loading room, and heating, ventilating, and air conditioning (HVAC) room. The operating areas include the control room, men's and women's change rooms, lunchroom, office, and storage rooms.

The principal process components of the E/C system are located in the process building (242-A), which includes supporting service and operating areas. The 242-A Evaporator is a multistory, structural steel, reinforced-concrete building and comprises two adjoining, but structurally independent buildings, herein designated A and B. The control room building (242-AB) is adjoined to, but structurally independent of, Building 242-A. An additional building, 242-A-81, is located directly south of Building 242-A, adjacent to the employee parking lot.

Building 242-A has plan dimensions of approximately 23.8 m (75 ft) by 32.9 m (108 ft) and is 18.9 m (62 ft) above finished grade at its highest point. A portion of the building extends 3.05 m (10 ft) below grade. Floor plans and building elevations are shown in Figures 2-3, 2-4, and 2-5.

Structure A, which houses processing and service areas (e.g., evaporator room, HVAC room), is a reinforced concrete shear wall and slab structure with concrete mat footing in below-grade regions and spread footing elsewhere. It has plan dimensions of 15.2 m (50 ft) by 22.9 m (75 ft). The evaporator room section of structure A is set 3.05 m (10 ft) below grade and is sized to contain the entire liquid volume of the evaporator vessel should it somehow be accidentally released to the room. For shielding and contamination containment, the walls are constructed of 0.56-m- (1.83-ft-) thick reinforced concrete.

Figure 2-1. The Hanford Site Map.

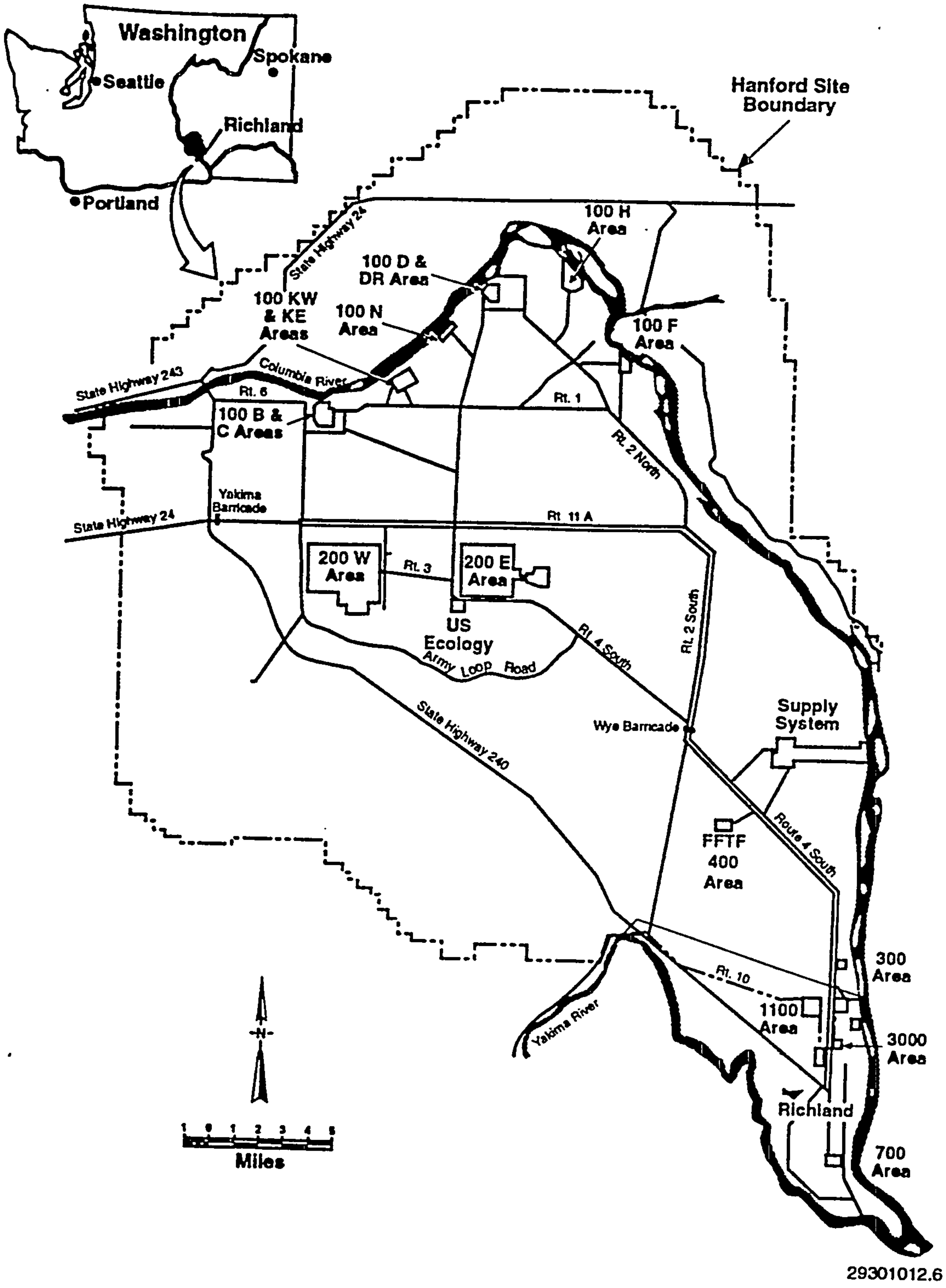


Figure 2-2. The 242-A Evaporator Site Plan.

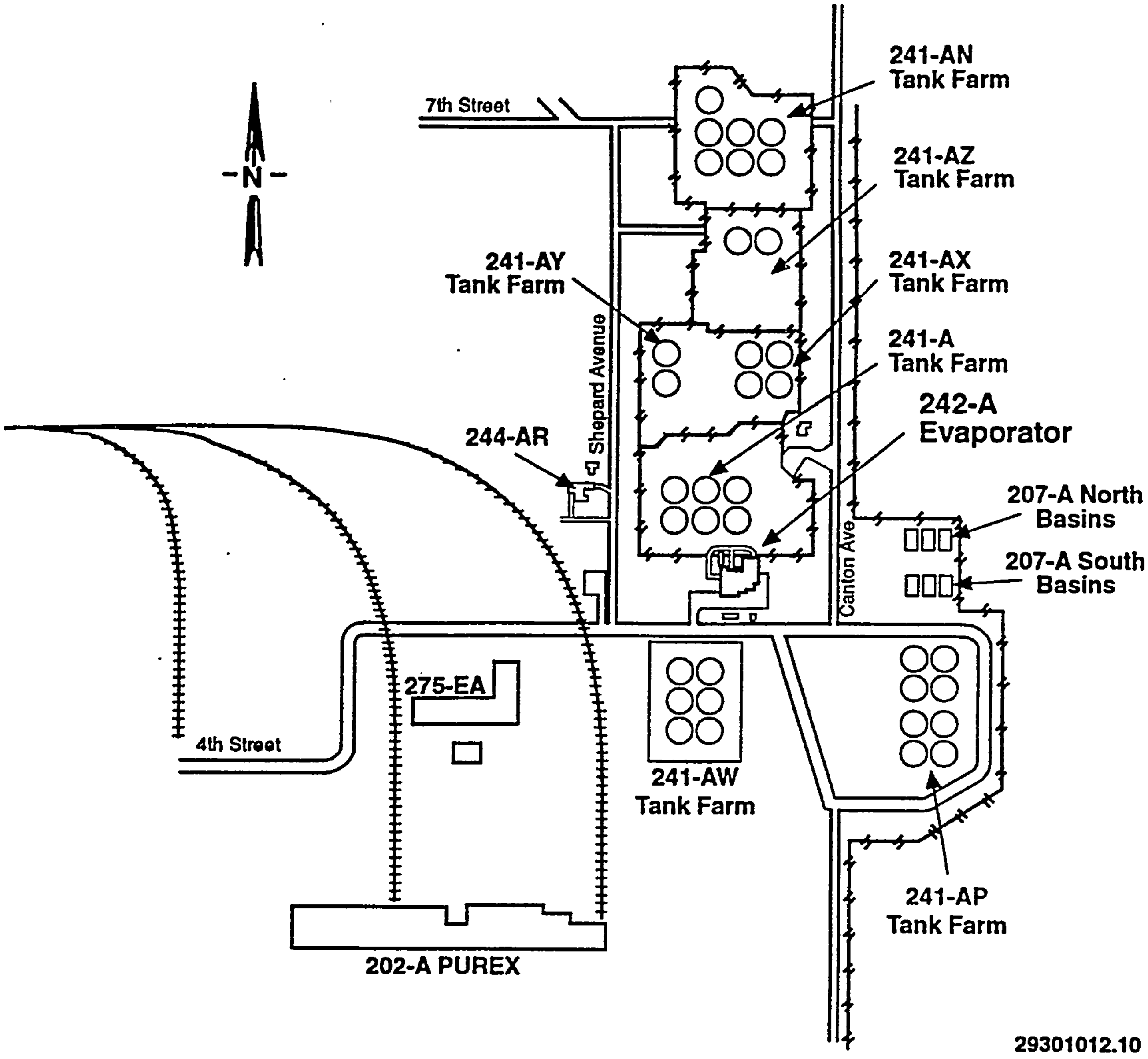
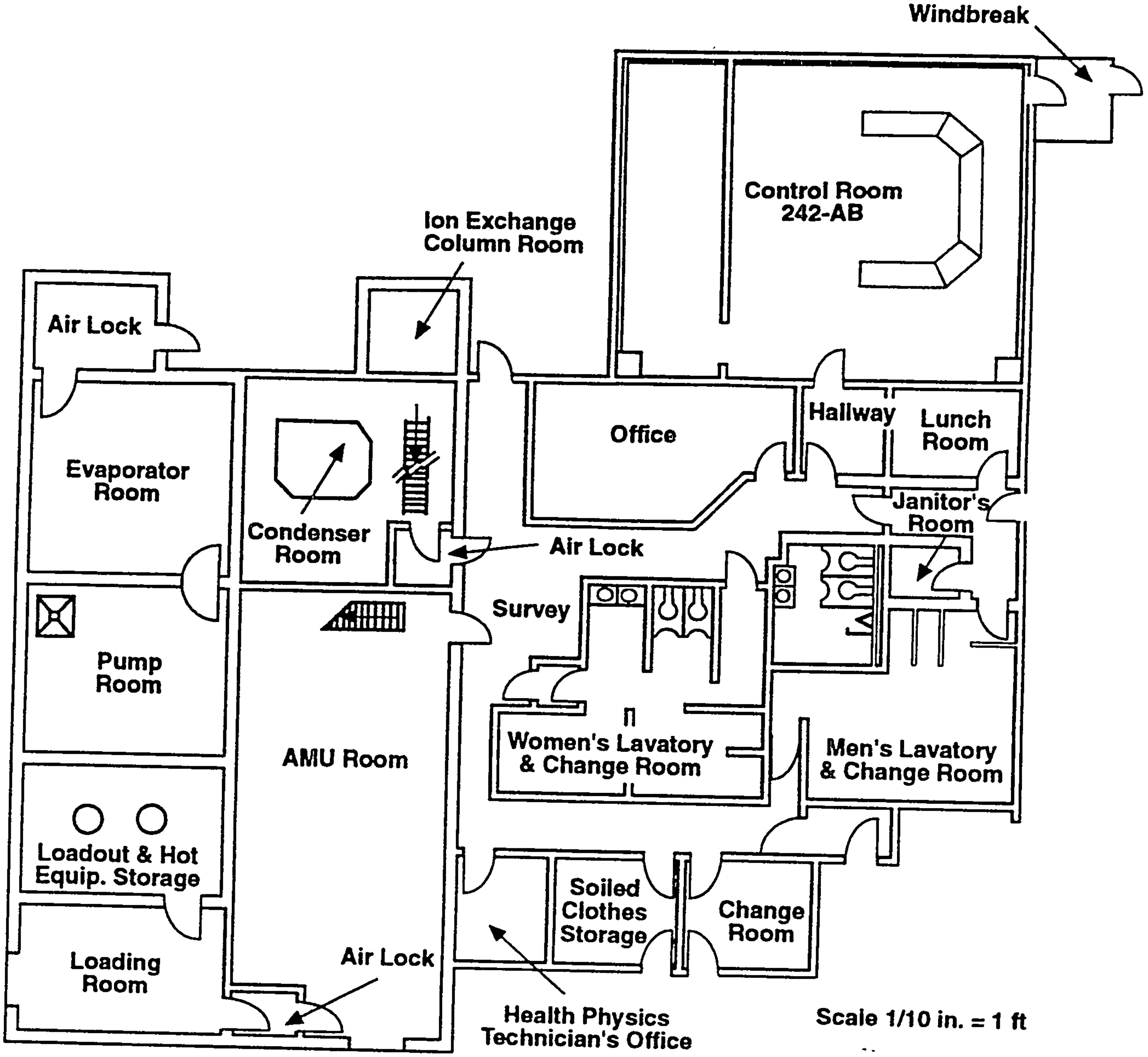


Figure 2-3. The 242-A Evaporator First Floor Plan.



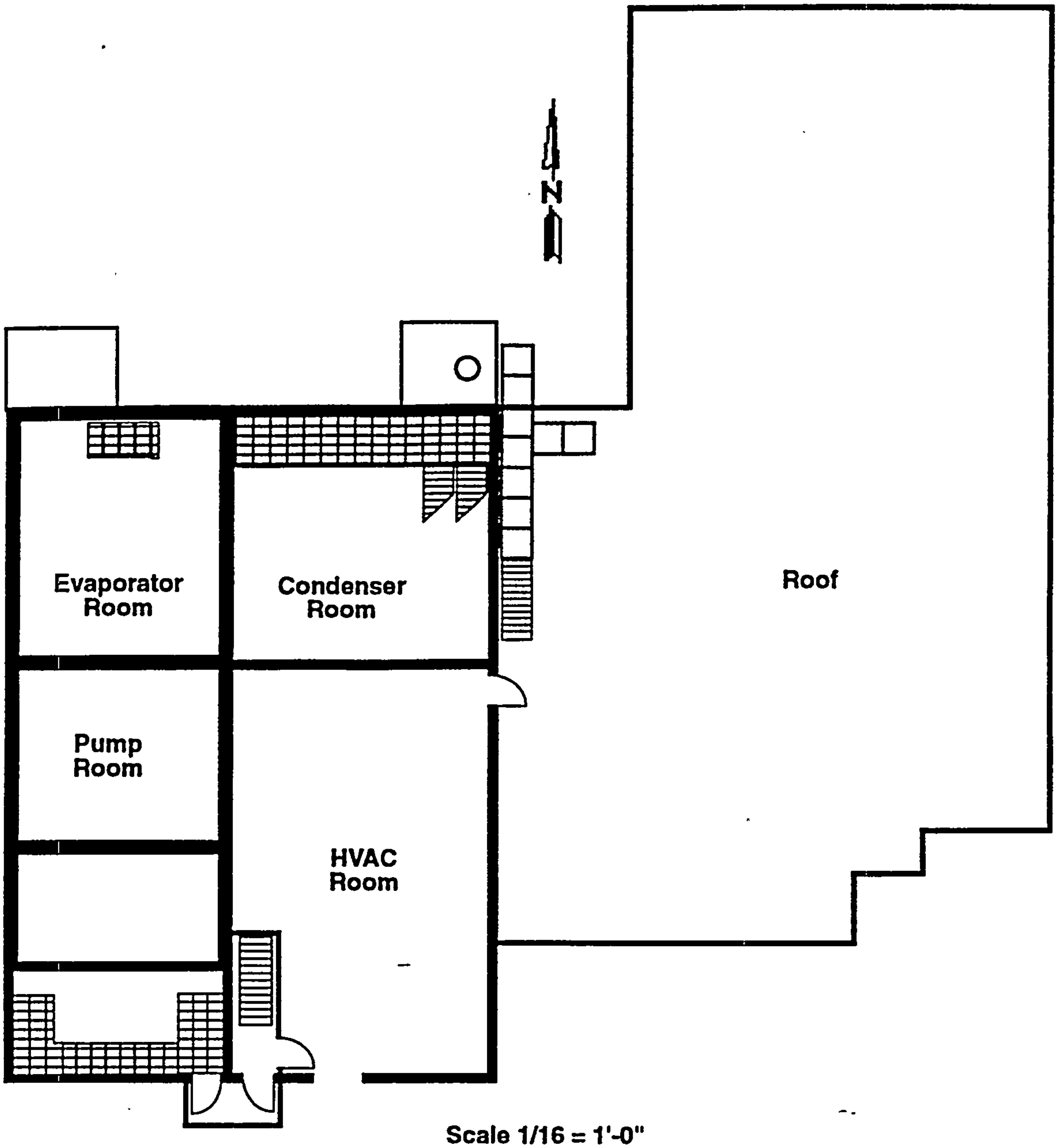
Scale 1/10 in. = 1 ft

Note:

AMU = Aqueous Makeup
The new control room is identified as 242-AB Building.
Other rooms are part of the 242-A Building.

29301012.12

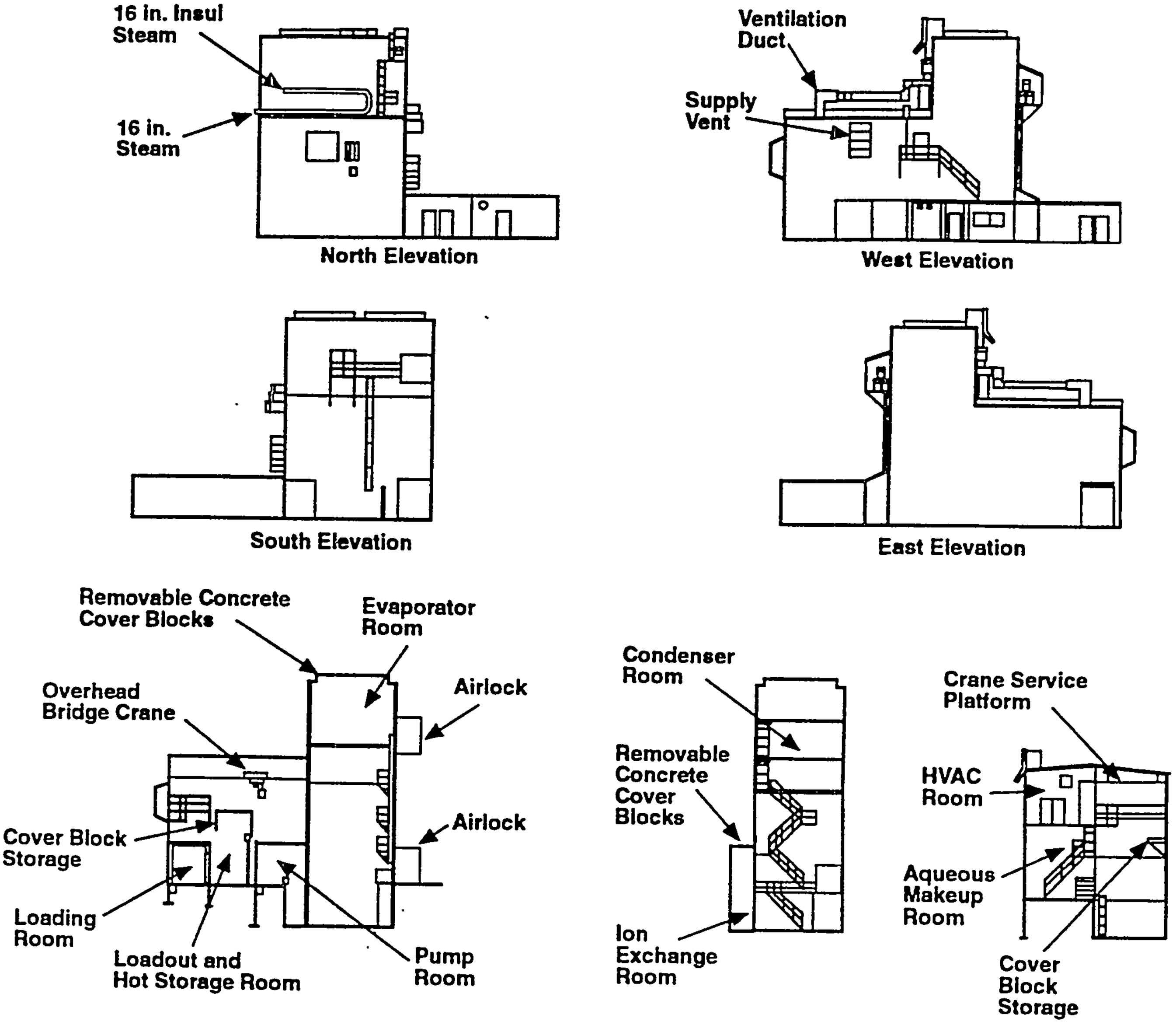
Figure 2-4. The 242-A Evaporator Second Floor Plan.



Scale 1/16 = 1'-0"
HVAC = Heating, Ventilation, and Air Conditioning

29301012.13

Figure 2-5. Elevations of Buildings 242-A and 242-AB.



HVAC = Heating, Ventilation, and Air Conditioning

29301012.11

Structure B of Building 242-A is separated from Structure A by a seismic joint. It houses operating and personnel support areas. The roof consists of metal decking supported by structural steel members spanning to reinforced concrete block walls. The foundations for structure B are continuous strip footings. This structure measures 3.35 m (11 ft) high with approximate plan dimensions of 12.8 m (42 ft) by 14.3 m (47 ft). It was constructed in accordance with Uniform Building Code (UBC 1991) requirements.

Building 242-AB houses the control room for the evaporator. The roof consists of metal decking supported by structural steel members spanning to reinforced concrete block walls. This structure is 12.2 m (40 ft) by 13.1 m (43 ft), with a height close to that of structure B. Building 242-AB was constructed in accordance with UBC requirements.

Building 242-A-81 is the water services building for the 242-A E/C facility. This building houses the valves and filters for supplying raw process water to the 242-A Evaporator. Building 242-A-81 is an insulated pre-engineered metal building placed on a concrete slab. The building is approximately 6.1 m (20 ft) by 8.5 m (28 ft) and has a nominal height of 3.05 m (10 ft). Building 242-A-81 was constructed in accordance with UBC requirements.

There are six 265,000-L- (70,000-gal-) capacity cement retention basins located east of the evaporator building. These are designated as the 207-A Retention Basins. Each basin is approximately 12.2 m (40 ft) wide by 27.4 m (90 ft) long and 1.5 m (5 ft) deep. The north three basins are used for holding steam condensate from the 242-A Evaporator before discharge to the B Pond system. Each of these three basins, as part of the recent 242-A facility upgrade, has been fitted with a high-density polyethylene protective liner and cover that will serve as an additional containment barrier. The design of these barriers was based on the composition of the steam condensate waste stream and the rate at which the basin could be emptied. The purpose of the steam condensate retention basins is to retain the condensate while sample analyses are being performed. A portion of the condensate is sampled in the condenser room before discharge to the basins. In addition, basin samples are drawn before discharge to B Pond. A laboratory analysis of the sample is performed to verify compliance with environmental regulations. The other three basins were, in the past, used to hold process condensate from the 242-A Evaporator. These three basins will not be used in the future and are scheduled for closure.

The 207-A Building is an enclosed pump pit containing the pumps, piping, and diversion control valving required for handling the steam condensate stream. The steam condensate (SC) gravity flows from 242-A to the 207-A Building. The SC can be routed to any one of the three SC retention basins by opening the appropriate motor-operated valve (MOV). The pumps can move SC in the basins to either the B Pond system or back to the 242-A Evaporator feed tank (241-AW-102) via the A-350 catch tank. The building is constructed of reinforced concrete.

For a more detailed facility description, refer to SD-WM-SAR-023, *242-A Evaporator/Crystallizer Safety Analysis Report* (WHC 1988a).

2.2 PROCESS DESCRIPTION

The 242-A Evaporator is the primary waste concentrator for Hanford Site waste that is stored in underground double-shell tanks (DST). Low-heat-generating liquid waste (<0.1 Btu/h/gal) that contains relatively small amounts of fission products is stored in the DSTs. The 242-A Evaporator uses evaporative concentration to reduce the volume of waste, thus reducing the amount of tank space required for storage. The facility receives a mixed waste stream containing radionuclides in excess of release limits as well as organic and inorganic constituents. It separates the waste into two streams as follows:

1. One waste stream (concentrated slurry stream) containing essentially all of the radionuclides and inorganic constituents (an extremely hazardous waste)
2. One waste stream (process condensate) containing volatile organic materials and greatly reduced concentrations of radionuclides.

The 242-A Evaporator receives a mixed blend feed from DST 241-AW-102. The feed consists of unprocessed and processed waste and recycled liquid that is removed from storage tanks after solids have settled. The feed is pumped into the recirculation line on the upstream side of the reboiler at a rate controlled to maintain a constant liquid level in the vapor-liquid separator. As the feed enters the recirculation line, it blends with the main process slurry stream that flows to the reboiler. A simplified schematic of the 242-A Evaporator process is shown in Figure 2-6 and a simplified flow diagram is shown in Figure 2-7.

In the reboiler, the mixture is heated slightly to a specific operating temperature, normally 38 to 77 °C (100 to 170 °F), by using 0.20-0.68 atm. gauge [3 to 10 lbf/in.^2 (gauge)] steam. The low-pressure steam provides adequate heat input, and the resulting low temperature differential across the reboiler helps minimize scale formation on the heat transfer surfaces.

The heated slurry stream is discharged from the reboiler to the vapor-liquid separator, which is maintained at a pressure of 35 to 85 torr [0.68 to 1.64 lbf/in.^2 (absolute)]. Under this reduced pressure, a fraction of the water in the heated slurry flashes to steam and is drawn through two wire-mesh deentrainer pads into a 1.06-m- (42-in.-) diameter vapor line that leads to the primary condenser. As evaporation takes place in the separator vessel, the slurry becomes supersaturated. This supersaturation promotes the growth of existing crystals and forms some new salt crystals in the slurry liquor. After the process slurry has remained in the vapor-liquid separator approximately 2 min, the slurry flows to the recirculation pump (P-B-1) suction via the bottom of the separator vessel and the lower recirculation line. The recirculation pump discharges the slurry back to the reboiler through the upper recirculation line, thus completing the process circuit. The process is continuous with typical stream flow rates of 303 to 454 L/min (80 to 120 gal/min) from the feed tank, 76 to 227 L/min (20 to 60 gal/min) for the condensate, and 114 to 227 L/min (30 to 60 gal/min) for the slurry discharge.

Figure 2-6. The 242-A Evaporator Simplified Process Schematic.

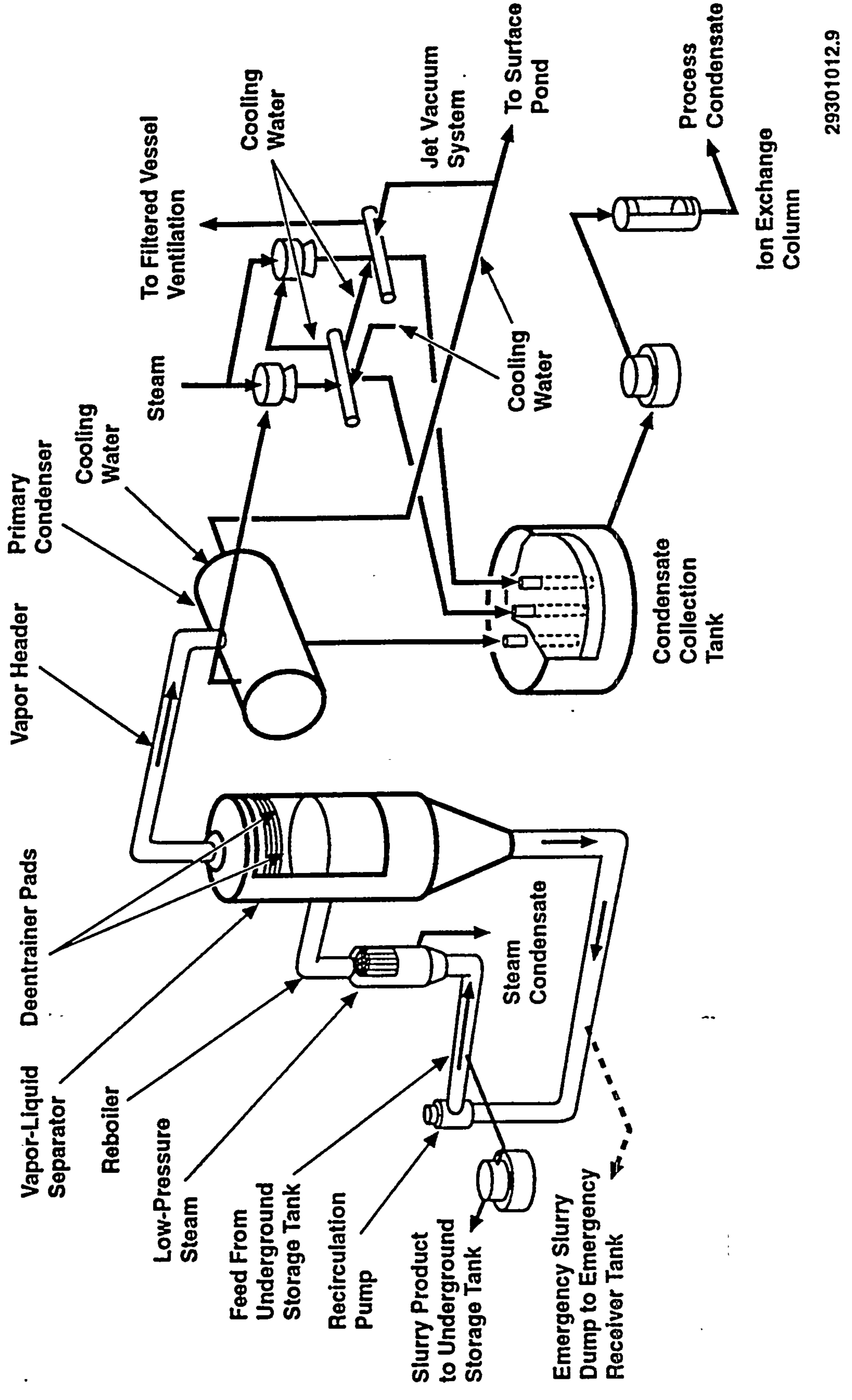
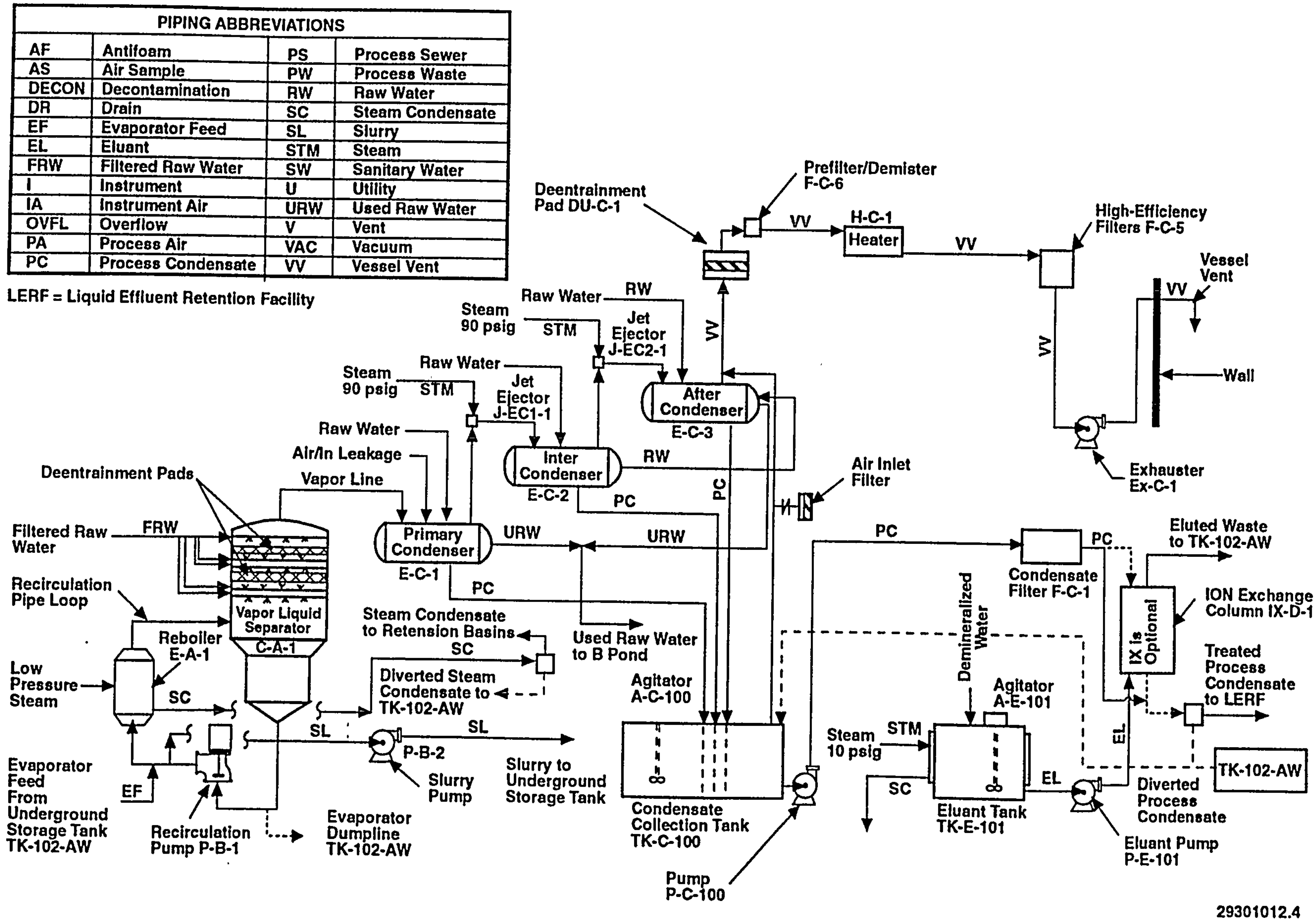


Figure 2-7. The 242-A Evaporator Simplified Process Flow Diagram.



PIPING ABBREVIATIONS			
AF	Antifoam	PS	Process Sewer
AS	Air Sample	PW	Process Waste
DECON	Decontamination	RW	Raw Water
DR	Drain	SC	Steam Condensate
EF	Evaporator Feed	SL	Slurry
EL	Eluant	STM	Steam
FRW	Filtered Raw Water	SW	Sanitary Water
I	Instrument	U	Utility
IA	Instrument Air	URW	Used Raw Water
OVFL	Overflow	V	Vent
PA	Process Air	VAC	Vacuum
PC	Process Condensate	VV	Vessel Vent

LERF = Liquid Effluent Retention Facility

The recirculation pump moves waste at high velocities through the reboiler to accomplish the following:

- Improve the heat transfer coefficient
- Reduce fouling of heat transfer surfaces
- Keep solids in suspension
- Permit transfer of large quantities of heat with only a small change to the temperature of the solution being heated.

The static pressure of the solution above the reboiler is sufficient to suppress the boiling point so the solution will not boil in the reboiler tubes. Boiling occurs only near or at the liquid surface in the vapor-liquid separator.

When the process solution has been concentrated to the desired specifications, a small fraction is withdrawn from the upper recirculation line upstream of the feed addition point and is pumped by the slurry pump (P-B-2) to underground storage tanks. In the storage tanks the slurry is allowed to separate into solid and liquid layers by settling. The liquid layer is removed and may be set aside, or returned to the feed tank and mixed with other evaporator waste feed stocks.

Because of the potential formation of solids in the slurry, the transfer lines from the evaporator to the tank farm settling tanks have the potential to plug. The slurry pump is designed for high pressures so the slurry can be transferred at high velocities to minimize the potential for this to occur.

Pressure in the vapor-liquid separator is maintained at approximately 35 to 85 torr [0.68 to 1.64 lbf/in.^{2} (absolute)] via the primary condenser and process vapor line by a two-stage steam-jet eductor system. Steam from the primary jet and the secondary jet, respectively, discharges to the intercondenser and after condenser. Both condensers drain to the process condensate collection tank (TK-C-100), while noncondensables are filtered and discharged to the atmosphere via the vessel vent system.

2.3 IDENTIFICATION AND CHARACTERIZATION OF POTENTIAL SOURCE TERMS

This section provides information that identifies and characterizes all potential process source terms present in the facility. The source terms are the types and quantities of mixed waste brought into the facility and the process chemicals that are stored in the facility.

2.3.1 Background Information

Waste to be treated at the facility is received from DSTs via the evaporator feed tank (DST 102-AW). The waste stored in the DSTs is classified as a mixed waste because it contains both radioactive and dangerous chemical components. The waste is a dangerous waste (DW) because of its corrosivity and toxicity characteristics and nonspecific source listed waste and is an extremely hazardous waste (EHW) caused by toxicity (state criteria only), carcinogenicity, and persistence under the state mixture rule.

The 242-A Evaporator facility receives this mixed waste stream and separates the waste into two streams as follows:

- One waste stream containing essentially all of the radionuclides and inorganic constituents (an extremely hazardous mixed waste)
- One waste stream containing water and greatly reduced concentrations of radionuclides and the volatile organic materials (a DW containing minimal quantities of radionuclides).

These two streams exit the 242-A Evaporator treatment process. One stream (the slurry) contains most of the radionuclides and inorganics. It is recycled back to the DST system for storage and/or further treatment. The other stream (the process condensate) contains the volatile organics and water. It is pumped to the Liquid Effluent Retention Facility (LERF) where it is stored to await further treatment by the Effluent Treatment Facility (ETF). Under normal operating circumstances, neither of these streams is discharged to the environment so the streams are not considered effluents.

2.3.2 Evaporator Feed Types

Waste is processed through the 242-A Evaporator in different batches according to its classification by total organic content, transuranic (TRU) content, and/or effects on the evaporation process. Dilute complex waste was received from the processing operations of B Plant, while a mixture of noncomplexed waste is received from a number of operations, including the Plutonium-Uranium Extraction (PUREX) Plant, single-shell tank saltwell pumping, and N Reactor. A feed-type flowchart is shown in Figure 2-8.

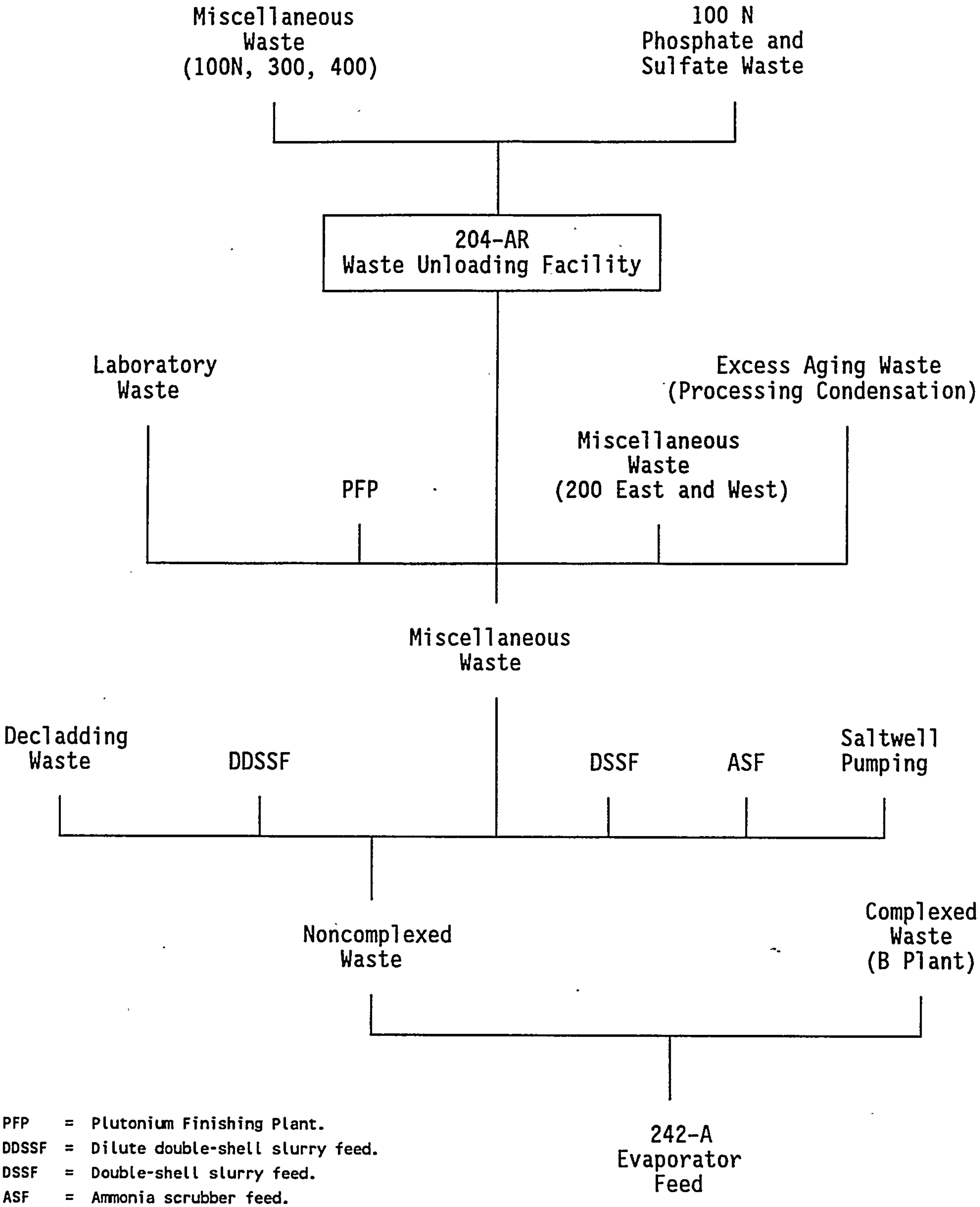
Waste stored in the DST facilities and treated by the 242-A Evaporator includes the following:

1. **Complexed Waste**: The complexed waste that is processed was generated during B Plant processing. This waste contains high amounts of total organics such as the complexants ethylenediamine tetraacetic acid (EDTA) and hydroxy ethylenediaminetetraacetic acid (HEDTA). This waste must be processed separately in the 242-A facility because of its adverse effects on the evaporation process and the potential for high TRU contents.

2. **Dilute Noncomplexed Waste**: This waste is the composite of a number of wastes. This waste may be mixed during collection and storage before treatment. It includes the following:

   - PUREX nonaging waste or low-level waste including neutralized decladding waste supernate and ammonia scrubber feed (ASF)

Figure 2-8. Evaporator Feed Types.



PFP = Plutonium Finishing Plant.
DDSSF = Dilute double-shell slurry feed.
DSSF = Double-shell slurry feed.
ASF = Ammonia scrubber feed.

- Plutonium Finishing Plant (PFP) low-level processing supernate
- B Plant process and miscellaneous waste including cell drainage and vessel cleanout waste
- 222-S Laboratory and decontamination waste
- T Plant spent decontamination solutions
- 300 Area laboratory and fuels fabrication waste
- 400 Area equipment decontamination waste
- 100-N dilute phosphate decontamination waste and 100 Area spent fuel storage basin sulfate waste from ion exchange regeneration and sand filter backwashing (no longer generated)
- Single-shell tanks saltwell pumping waste
- Laboratory waste and decontamination solutions generated at Reduction/Oxidation (REDOX) Complex
- Dilute double-shell slurry feed (DDSSF)
- Double-shell tank slurry feed (DSSF).

Feed concentrations and chemical composition will vary from run to run depending on the waste source, the degree to which the waste has previously been concentrated in the evaporator, and blending with other feeds. The largest portion of this waste is aqueous salts. The four primary feeds into the evaporator are consolidations of the waste sources listed above. These are the cladding removal waste (CRW) feed, the ASF, saltwell feed, and linked run feeds.

Radionuclide and nonradionuclide potential source terms within the facility are located within the evaporator/separator and reboiler process loop.

2.3.3 Evaporator Radiological Potential Source Terms

Table 2-1 contains the bounding source term used for the evaporator. The bounding source term is the derived maximum possible term and is not necessarily the actual concentration present during everyday operation. These data were developed and presented in WHC-SD-SAR-023, 242-A Evaporator Safety Analysis Report (WHC 1988a). This memo states that the radionuclide concentrations included in this source term are based on results from actual waste samples, historical evaporator campaigns, and projected operations. Those radionuclides which contributed very little to dose consequences were not included in the bounding source term developed in this memo.

The third column (the "Maximum separator inventory" column) is the quantity (represented in curies) of the particular radionuclide that could be

Table 2-1. Maximum Evaporator Separator Vessel Radionuclide Source Term.

Radionuclide	Maximum concentration (μCi/mL)	Maximum separator inventory (Ci)
^{14}C	0.26	35.0
^{60}Co	1.2	161.7
^{79}Se	0.078	10.5
^{90}Sr	220	29,644
^{94}Nb	0.098	13.2
^{99}Tc	2.0	269.5
^{106}Ru	53	7,141.5
^{129}I	0.0026	0.35
^{134}Cs	15	2,021
^{137}Cs	1,500	202,119
^{154}Eu	5.0	673.7
^{155}Eu	7.0	943.2
^{226}Ra	0.033	4.45
^{238}Pu	0.0013	0.18
^{239,240}Pu	0.16	21.6
^{241}Pu	15	2,021
^{241}Am	1.0	134.7
^{244}Cm	0.013	1.75

The following definitions are provided to help the reader understand the various units used in Table 2-1.

1. Ci is an abbreviation for curie, which is the unit used for measuring radioactivity and is defined as a unit of radioactivity; one curie is equal to 37 billion (3.7 x 10^{+10}) disintegrations per second (37 billion Bq). Note that because of the direct relationship between curies and the mass of a radionuclide, curies give the quantity of the material present as well as the activity (i.e., any activity expressed in curies not only gives the activity from a sample of a radionuclide, but also the amount of the nuclide present).
2. μCi represents 1/1,000,000 of a curie.
3. ml represents 1/1000 of a liter.

present at any time in the separator at its maximum capacity of 134,746 L (35,600 gal). This column was derived by multiplying the maximum concentration value (found in the previous column) by the maximum evaporator vessel volumetric capacity.

2.3.4 Evaporator Nonradiological Potential Source Terms

Certain chemicals (referred to as nonradionuclides in this FEMP) are reportable under the CERCLA if any one regulated material (chemical) that is discharged or released over a 24-hour period from a facility exceeds 100% of the RQ as listed in 40 CFR 302.4 (EPA 1991c). To ascertain if there is a potential for any such discharges or releases, it was first determined which chemicals are present in measurable quantities in the separator vessel. The tabulation of these chemicals is called an "inventory at risk" and is presented in Table 2-2. In other words, Table 2-2 is a list of those constituents that could become reportable under CERCLA if the entire contents of the separator vessel were released to the environment. This table was derived from, and is an extract from, the nonradionuclide source term presented in Table 2-3. Note that the second and third columns of Table 2-2 contain values that are equivalent but are expressed in different units. This method of tabulation is for the reader's convenience. Note also that the values contained in Column 4 were calculated by multiplying the concentration values of the third column by the maximum evaporator separator capacity of 134,746 L.

The process of developing the nonradionuclide source term involved determining the maximum possible concentration for each nonradionuclide that might be processed in the evaporator vessel and, subsequently, calculating, in kilograms, the total vessel inventory possible for each nonradionuclide. Table 2-3 is a tabulation of these concentrations.

Table 2-3 was developed from the data presented in Tables 2-4 and 2-5. The "Maximum separator inventory" column in Table 2-3 is the quantity (represented in kilograms) of each particular nonradionuclide constituent that could be present at any one time in the separator. This column was derived by multiplying the maximum concentration value (found in the previous columns) by the maximum evaporator vessel volumetric capacity. The final column in this table lists the CERCLA RQ for each chemical as found in 40 CFR 302.4. If the value in this column is released to the environment during a 24-hour period, it then becomes reportable under CERCLA.

An asterisk in the "Maximum separator inventory" column denotes that the maximum possible separator inventory for that particular constituent exceeds the CERCLA RQ.

Table 2-2. Evaporator Separator Nonradionuclide Inventory at Risk.

Chemical	Constituent maximum concentration (ppb)	Constituent maximum concentration (g/L)	Maximum separator inventory (kg)	CERCLA reportable quantity (kg)
Cyanide (CN-)	98,000	0.098	13.2	4.54
Lead	72,000	0.072	9.7	0.454
Mercury	16,000	0.016	2.2	0.454
Nickel	53,000	0.053	7.1	0.454
Phosphorus	4.9 E+6	4.9	660.3	0.454
Sodium	3.4 E+8	340	45,813.6	4.54
Sodium Fluoride	1.26 E+8	126.0	16,978.0	454
Sodium Hydroxide	2.6 E+8	260.0	35,033.96	454
Sodium Nitrite	3.384 E+8	338.4	45,598.05	45.4
Sodium Phosphate	8.2 E+7	82.0	11,049.17	2,270

Table 2-3. Evaporator Separator Nonradionuclide Source Term. (4 sheets)

Chemical	Constituent maximum concentration (ppb)	Constituent maximum concentration (g/L)	Maximum separator inventory (kg)	CERCLA reportable quantity (kg)
Aluminum	2.14 E+7	21.4	2,883.6	no RQ
Ammonium hydroxide	6.77 E+5	0.677	91.22	454
Aluminum oxide (AlO_2-)	5.8 E+7	58	7,815.3	no RQ
Ammonium	5.36 E+6	5.36	722.2	no RQ
Barium	82,400	0.0824	11.1	454
Boron	1.04 E+5	0.104	14.0	no RQ
Calcium	1.46 E+6	1.46	196.7	no RQ
Cadmium	16,000	0.0160	2.16	4.54
Carbonate (CO_3)	2.95 E+7	29.5	3,975.0	no RQ
Chloride (Cl-)	9.6 E+6	9.6	1,293.6	no RQ
Chromium	8.5 E+5	0.85	114.5	2,270
Copper	4.71 E+6	4.71	634.7	2,270
Cyanide (CN-)	98,000	0.098	13.2*	4.54
Fluoride (F-)	3.67 E+7	36.7	4,945.2	no RQ
Hydroxide (OH-)	9.9 E+7	99.0	13,339.9	no RQ
Iron	70,000	0.07	9.4	no RQ
Lead	72,000	0.072	9.7*	0.454
Magnesium	29,000	0.029	3.9	no RQ
Manganese	29,000	0.029	3.9	no RQ
Mercury	16,000	0.016	2.2*	0.454
Molybdenum	88,000	0.088	11.9	no RQ
Nickel	53,000	0.053	7.1*	0.454
Nitrate (NO_3-)	2.9 E+8	290	39,076	no RQ
Nitrite (NO_2-)	8.4 E+7	84	11,318.7	no RQ
Phosphate (PO_4)	2.96 E+7	29.7	3,988.5	no RQ
Phosphorus	4.9 E+6	4.9	660.3*	0.454
Potassium	4.04 E+7	40.4	5,443.7	no RQ

Table 2-3. Evaporator Separator Nonradionuclide Source Term. (4 sheets)

Chemical	Constituent maximum concentration (ppb)	Constituent maximum concentration (g/L)	Maximum separator inventory (kg)	CERCLA reportable quantity (kg)
Silicon	2.71 E+9	2,710	365,161.7	no RQ
Sodium	3.4 E+8	340	45,813.6*	4.54
Sodium aluminate	2.049 E+8	204.9	27,609.46	no RQ
Sodium carbonate	2.438 E+8	243.8	32,851.07	no RQ
Sodium chloride	7.5 E+5	0.705	95.0	no RQ
Sodium fluoride	1.26 E+8	126.0	16,978.0*	454
Sodium hydroxide	2.6 E+8	260.0	35,033.96*	454
Sodium nitrate	3.57 E+8	357.0	48,104.32	no RQ
Sodium nitrite	3.384 E+8	338.4	45,598.05*	45.4
Sodium phosphate	8.2 E+7	82.0	11,049.17*	2,270
Sodium sulfate	4.2 E+7	42.6	5,740.18	no RQ
Sulfate (SO_4)	7.94 E+6	7.94	1,069.9	no RQ
Tungsten	2.1 E+5	0.21	28.3	no RQ
Uranium	1.2 E+5	0.12	16.2	45.4
Zinc	1.68 E+5	0.168	22.6	454
Acetone	2,100	0.0021	0.28	2,270
Alkyl, hydroxymethylbenzene	1,800	0.0018	0.24	no RQ
Butanedioic acid	4.2 E+5	0.42	56.6	no RQ
C3-Alkylbenzene	3.2 E+5	0.32	43.1	no RQ
Chloroethyl, 2-hydroxymethyl, BA	13,000	0.013	1.8	no RQ
2-Chloromethylhydroxymethylbenzene	12,000	0.012	1.6	no RQ
2-Chloromethyloxylene	6,600	0.0066	0.89	no RQ
Citric acid	53,000	0.053	7.14	no RQ
Diethylphthalates	6,600	0.0066	0.89	454
Dimethyltoluidine	12,000	0.012	1.6	no RQ
Dioctylphthalate	24,000	0.024	3.23	no RQ

Table 2-3. Evaporator Separator Nonradionuclide Source Term. (4 sheets)

Chemical	Constituent maximum concentration (ppb)	Constituent maximum concentration (g/L)	Maximum separator inventory (kg)	CERCLA reportable quantity (kg)
Dodecane	4,000	0.004	0.54	no RQ
Dodecanoic acid	950	0.00095	0.13	no RQ
Ethanedioic acid	4.2 E+6	4.2	565.93	no RQ
Ethyl, 2-methylhydroxymethylbenzenes	64,000	0.064	8.6	no RQ
Ethylbenzaldahyde	6.9 E+5	0.69	92.97	no RQ
ED3A	18,000	0.018	2.4	no RQ
EDTA	85,000	0.085	11.5	2,270
Ethylxylene	320	0.00032	0.043	no RQ
Heptadecanoic acid	2,400	0.0024	0.32	no RQ
Heptanedioic acid	27,000	0.027	3.6	no RQ
Hexadecanoic acid	830	0.00083	0.11	no RQ
Hexanedioic acid	64,000	0.064	8.6	no RQ
Hexanoic acid	43,000	0.043	5.8	no RQ
Hydroxyacetic acid	46,000	0.046	6.2	no RQ
2-Hydroxymethylbenzoic acid	27,000	0.027	3.6	no RQ
Methylbenzaldahyde	6.9 E+5	0.69	92.97	no RQ
2-Methylbenzoic acid	18,000	0.018	2.4	no RQ
2-Methyl, hydroxymethyl benzene	3.5 E+5	0.35	47.2	no RQ
Methyltoluidine	3,500	0.0035	0.47	no RQ
n-C22H46 C40H82	20,000	0.02	2.7	no RQ
HEDTA	20,000	0.02	2.7	no RQ
MAIDA	5.8 E+5	0.58	78.2	no RQ
MICEDA	30,000	0.03	4.04	no RQ
Nitrilotriacetic acid	7,500	0.0075	1.01	2,270

Table 2-3. Evaporator Separator Nonradionuclide Source Term. (4 sheets)

Chemical	Constituent maximum concentration (ppb)	Constituent maximum concentration (g/L)	Maximum separator inventory (kg)	CERCLA reportable quantity (kg)
Octodecanoic acid	410	0.00041	0.055	no RQ
Pentadecane	3,700	0.0037	0.5	no RQ
Pentadecanoic acid	35,000	0.035	4.7	no RQ
Pentanedioic acid	70,000	0.07	9.4	no RQ
Propylbenzene	1,800	0.0018	0.24	no RQ
Tetradecane	9,000	0.009	1.2	no RQ
Tetrahydrofuran	27	2.7 E-5	0.0036	454
Tributyl phosphate	27,000	0.027	3.6	no RQ
Trinbutyl(diol)-phosphate	11,000	0.011	1.5	no RQ
Tridecane	15,000	0.015	2.02	no RQ
1,3,5 Trimethyl benzene	78,000	0.078	10.5	no RQ
Undecane	3,300	0.0033	0.44	no RQ
Unknown phthalates	21,000	0.021	2.8	no RQ

Table 2-4. Evaporator Separator Nonradionuclide Data.

Compound	Chemical formula	Evaporator feed concentration *	Slurry feed concentration *	Slurry feed maximum concentration **	Average evaporator feed concentration ***	Maximum evaporator feed concentration	Maximum separator inventory
		(M)	(M)	(M)	(g/L)	(g/L)	(kg)
			(g/L)	(g/L)			
Sodium chloride					0.705	0.705	95.0
Sodium hydroxide	NaOH	3.9	5.5	6.5	15.5	260.0	35,033.96
				260.0			
Sodium nitrate	$NaNO_3$	2.8	4.0	4.2	38.2	357.0	48,104.32
				357.0			
Sodium nitrite	$NaNO_2$	1.8	2.5	4.9	9.58	338.4	45,598.05
				338.4			
Sodium aluminate	$NaAlO_2$	1.8	2.5	2.5		204.9	27,609.46
				204.9			
Sodium carbonate	Na_2CO_3	0.7	0.9	2.3		243.8	32,851.07
				243.8			
Sodium sulfate	Na_2SO_4	0.2	0.3			42.6	5,740.18
			42.6				
Sodium phosphate	Na_3PO_4	0.5	0.15	0.5	0.589	82.0	11,049.17
				82.0			
Ammonia	NH_3	0.11	0.1	0.1		1.7	229.07
				1.7			
Ammonium hydroxide	NH_4OH				0.677	0.677	91.22
Sodium fluoride	NaF	0.07	0.1	3.0	3.45	126.0	16,978.0
				126.0			

NOTE: *WHC-SD-WM-SAR-023, 242-A Evaporator Safety Analysis Report (WHC 1988a)
**WHC-SD-WM-PSE-008, 242-A Evaporator Hazard Classification (WHC 1991b)
***DOE/RL-90-42, Rev. 0, 242-A Evaporator Dangerous Waste Permit Application, Table 3-5 (DOE-RL 1990).

Table 2-5. Evaporator Separator Nonradionuclide Data. (3 sheets)

(1) Chemical	(2) Evaporator feed concentration (ppb)	(3) Evaporator slurry concentration (ppb)	(4) AN-103 DSS (ppb)	(5) AN-106 DSSF (ppb)	(6) AW-101 DSSF (ppb)
Aluminum	2.14 E+7	2.07 E+7			
Aluminum oxide			5.8 E+7	1.1 E+7	2.6 E+7
Ammonium	5.36 E+6	5.70 E+5			
Barium		82,400			14,000
Boron	18,400	1.04 E+5		17,000	
Calcium	2.67 E+5	1.46 E+6	86,000	67,000	65,000
Cadmium			16,000		
Carbonate	2.19 E+7	2.95 E+7	9 E+6	2.3 E+7	5.1 E+6
Chloride (Cl-)	4.38 E+6	5.13 E+6	9.6 E+6	2.9 E+6	6.8 E+6
Chromium	1.61 E+5	1.92 E+5	8.5 E+5	6.1 E+5	3.5 E+5
Copper	4.71 E+6	58,600	12,000	1,800	
Cyanide (CN-)			34,000	13,000	98,000
Fluoride (F-)	1.86 E+7	3.67 E+7	7.4 E+5	34,000	
Hydroxide (OH-)	65,900	7.72 E+7	9.8 E+7	1.2 E+7	9.9 E+7
Iron	65,900	15,900	70,000	9,400	39,000
Lead			72,000		68,000
Magnesium	7,330	15,300	29,000		
Manganese			29,000		
Mercury			16,000		35
Molybdenum			88,000	32,000	60,000
Nickel				53,000	27,000
Nitrate (NO$_3$-)	1.36 E+8	2.03 E+8	1.6 E+8	7.9 E+7	2.9 E+8
Nitrite (NO$_2$-)	7.79 E+7	6.12 E+7	1.4 E+8	3.4 E+7	8.4 E+7
Phosphate (PO$_4$-)	3.17 E+6	2.96 E+7	9.3 E+5	1.4 E+7	8.9 E+5
Phosphorus	6.92 E+5	8.10 E+5		4.9 E+6	
Potassium	4.04 E+7	2.68 E+7	1.5 E+7	1.2	3.9 E+7
Silicon	1.36 E+5	2.71 E+9	2.7 E+5		1.1 E+5
Sodium	1.45 E+8	1.77 E+8	3.4 E+8	1.2 E+8	2.6 E+8
Sulfate (SO$_4$-)	7.94 E+6	6.63 E+6	1.6 E+6	2.9 E+6	4.2 E+6
Tungsten			2.1 E+5		
Uranium			1.2 E+5	14,000	92,000
Zinc	16,900	1.68 E+5	48,000		

Table 2-5. Evaporator Separator Nonradionuclide Data. (3 sheets)

(1) Chemical	(2) Evaporator feed concentration (ppb)	(3) Evaporator slurry concentration (ppb)	(4) AN-103 DSS (ppb)	(5) AN-106 DSSF (ppb)	(6) AW-101 DSSF (ppb)
Alkyl, hydroxymethylbenzene			1,800		
Butanedioic acid			4.2 E+5		
C3-Alkylbenzene			3.2 E+5		
Chloroethyl, 2-hydroxymethyl,BA			13,000		
2-Chloromethylhydroxymethylbenzene			12,000		
2-Chloromethyloxylene			6,600		
Citric acid			18,000	32,000	53,000
Diethylphthalates					6600
Dimethyltoluidine			12,000		
Dioctylphthalate			24,000		1,800
Dodecane			4,000		1,700
Dodecanoic acid					950
Ethanedioic acid			4.2 E+6		
Ethyl, 2-methylhydroxymethylbenzenes			64,000		
Ethylbenzaldahyde			6.9 E+5		
ED3A			4,800		18,000
EDTA			85,000	4,800	11,000
Ethylxylene			320		
Heptadecanoic acid			2,400		
Heptanedioic acid			27,000		
Hexadecanoic acid					830
Hexanedioic acid			64,000		7,100
Hexanoic acid			43,000		
Hydroxyacetic acid				46,000	
2-Hydroxymethylbenzoic acid			27,000		
Methylbenzaldahyde			6.9 E+5		
2-Methylbenzoic acid			18,000		
2-Methyl, hydroxymethylbenzene			3.5 E+5		

Table 2-5. Evaporator Separator Nonradionuclide Data. (3 sheets)

(1) Chemical	(2) Evaporator feed concentration (ppb)	(3) Evaporator slurry concentration (ppb)	(4) AN-103 DSS (ppb)	(5) AN-106 DSSF (ppb)	(6) AW-101 DSSF (ppb)
Methyltoluidine			3,500		
n-C22H46 C40H82			15,000		20,000
HEDTA				20,000	
MAIDA			5.8 E+5		
MICEDA			30,000		
Nitrilotriacetic acid			4,600		7,500
Octodecanoic acid					410
Pentadecane			3,700		800
Pentadecanoic acid			35,000		
Pentanedioic acid			70,000		
Propylbenzene			1,800		
Tetradecane			9,000		7,400
Tetrahydrofuran		27			
Tributyl phosphate		530	18,000		27,000
Trinbutyl(diol) phosphate			11,000		
Tridecane			15,000		14,000
1,3,5 Trimethylbenzene			78,000		
Undecane			580		3,300
Unknown phthalates			21,000		5,400

Tables 2-4 and 2-5 present the data that were used to develop Table 2-3. Tables 2-4 and 2-5 were generated from available data. The data in Table 2-4 were gathered from the sources referenced below and identified in the column headers by the number of asterisks (*).

*WHC-SD-WM-SAR-023, *242-A Evaporator Safety Analysis Report* (WHC 1988a)

**WHC-SD-WM-PSE-008, *242-A Evaporator Hazard Classification* (WHC 1991b)

***DOE/RL-90-42, Rev.0, *242-A Evaporator Dangerous Waste Permit Application*, Table 3-5 (DOE-RL 1990).

The "Maximum separator inventory" column of Table 2-4 contains the maximum concentration of the particular tabulated chemicals that could potentially be present within the evaporator vessel. The method used to determine this maximum concentration is as follows.

1. The maximum concentration values of the constituents in the evaporator and slurry feeds were determined and expressed in units of *molarity** (M). These values are listed in columns 3, 4, and 5 of Table 2-4.

2. These values, in turn, were converted to units of grams per liter (g/L) and specified under the corresponding molar value in that column for the particular constituent. Molarity is converted to grams per liter (g/L) by multiplying the value expressed in molar units by the molecular weight of the chemical.

3. These g/L values were compared to the g/L values in the next column entitled "Average evaporator feed concentration."

4. The largest of these values were then tabulated in column 7, entitled "Maximum evaporator feed concentration."

5. The values listed in the column entitled "Maximum separator inventory" were obtained by multiplying the value in column 7 by the maximum volumetric capacity (134,746 L) of the evaporator separator vessel and then dividing the resulting value by 1,000 to convert the resultant answer to kilograms.

Table 2-5 lists other chemical constituent concentration data for the evaporator feed and slurry. These values are expressed in concentration units of parts-per-billion** (ppb). The values in Columns 2 and 3 of this table were obtained from those listed in DOE/RL-90-42, Rev.0, *242-A Evaporator Dangerous Waste Permit Application*, Tables 3-2 and 3-6 (DOE-RL 1990). The

---

*The "M" stands for *Molar* which is actually one mole of a substance per liter. A mole is defined as the quantity of a substance having a mass in grams equal to its molecular weight.

**If the solution is dilute, it can be assumed that the specific gravity of the solution is 1. If this is assumed, a g/L is equal to 1,000,000 ppb.

final three columns are values obtained from Internal Memo 29510-091-002, from Evaporator Restart SAR Development, dated March 1, 1991, subject: *Normal Operating Source Term For The 242-A Evaporator*, Tables 4 and 5 (WHC 1991c).

2.3.5 Process Condensate Nonradiological Potential Source Terms

Certain chemicals (referred to as nonradionuclides in this FEMP) are reportable under the CERCLA if any one regulated material (chemical) that is discharged or released over a 24-hour period from a facility exceeds 100% of the RQ as listed in 40 CFR 302.4 (EPA 1991c). To ascertain if there is a potential for any such discharges or releases, it was first determined which chemicals are present in measurable quantities in the separator vessel. The tabulation of these chemicals is called an "inventory at risk" and is presented in Table 2-6. Table 2-6 lists those constituents that could become reportable under CERCLA if released to the environment. This table was derived from, and is an extract from, the nonradionuclide source term presented in Table 2-7. Note, the third column of Table 2-6 shows that if the entire contents in a completely full process condensate tank C-100 (17,800 gal or 67,373 L) were to be released, only ammonia would become reportable. However, the fifth column shows that if the evaporator process were operating at the maximum process condensate generation rate of 227 L/min (60 gal/min), and if this entire volume were to be released within a 24-hour period, phosphorus and sodium would also become reportable. During the 94-2 campaign, the maximum process condensate generation rate was 62.5 gpm.

Table 2-6. Process Condensate Nonradionuclide Inventory at Risk.

Chemical	Maximum concentration (ppb)	Maximum C-100 inventory (kg)	CERCLA Reportable quantity (kg)	Maximum quantity per day (kg)
Ammonia	2.19 E+6	147.55*	45.4	716.2*
Phosphorus	6,195	0.4174	0.454	2.0259*
Sodium	51,497	3.4695	4.54	16.8408*

The process of developing the nonradionuclide source term involved the determining the maximum possible concentration for each nonradionuclide that might be processed in the evaporator vessel and, subsequently, calculating the total vessel inventory (in kilograms) possible for each nonradionuclide. Table 2-7 is a tabulation of these concentrations.

Table 2-7 tabulates the maximum concentrations of the listed constituents from the data tabulated in Table 2-8 and compares these values to the CERCLA RQ value. The columns in Table 2-7 are defined as follows.

The "Maximum concentration" column is the maximum concentration of the constituent listed in each row of Table 2-8. Note that the unit ppb is used in this column. It is assumed that the solution is dilute, thus it can be assumed that the specific gravity of the solution is 1.

Table 2-7. Process Condensate Nonradionuclide Source Term. (3 sheets)

Chemical	Maximum concentration (ppb)	Maximum C-100 inventory (kg)	CERCLA Reportable quantity (kg)	Maximum quantity per day (kg)
Aluminum	4,992	0.336	no RQ	1.633
Ammonium	9.35 E+6	629.9	no RQ	3,057.7
Ammonia	2.19 E+6	147.55*	45.4	716.2*
Arsenic (EP toxic)	50	0.0034	0.454	0.0164
Barium (EP toxic)	232	0.0156	454	0.0759
Barium	8	0.0005	454	0.0026
Boron	151	0.0102	no RQ	0.0494
Cadmium	10	0.0007	4.54	0.0033
Calcium	8,320	0.5605	no RQ	2.7208
Carbonate	7.5 E+5	50.53	no RQ	245.268
Chloride	2,300	0.1550	no RQ	0.7522
Chromium	156	0.0105	2,270	0.0510
Copper	127	0.0086	2,270	0.0415
Fluoride (IC)	2,100	0.1415	no RQ	0.6868
Fluoride (IS E)	65	0.0044	no RQ	0.0213
Fluoride	12,273	0.8269	no RQ	4.0136
Iron	503	0.0339	no RQ	0.1645
Lead	50	0.0034	0.454	0.0164
Magnesium	4,030	0.2715	no RQ	1.3179
Manganese	5	0.0003	no RQ	0.0016
Mercury (EP toxic)	10	0.0007	0.454	0.0033
Mercury	0.7	4.7 E-5	0.454	0.0002
Nickel	17	0.0011	0.454	0.0056
Nitrate	5,000	0.3369	no RQ	1.6351
Phosphorus	6,195	0.4174	0.454	2.0259*
Potassium	19,238	1.2961	no RQ	6.2913
Selenium (EP toxic)	50	0.0034	45.4	0.0164
Silicon	985,819	66.4	no RQ	322.3865
Silver (EP toxic)	50	0.0034	454	0.0164
Sodium	51,497	3.4695	4.54	16.8408*
Strontium	30	0.0020	no RQ	0.0098
Sulfate	13,000	0.8758	no RQ	4.2513
Sulfide	66,000	4.4466	no RQ	21.5836
Uranium	2.03	0.0001	45.4	0.0007
Vanadium	7	0.0005	no RQ	0.0023

Table 2-7. Process Condensate Nonradionuclide Source Term. (3 sheets)

Chemical	Maximum concentration (ppb)	Maximum C-100 inventory (kg)	CERCLA Reportable quantity (kg)	Maximum quantity per day (kg)
Zinc	44	0.0030	454	0.0144
Acetone	5,100	0.3436	2,270	1.6678
Benzyl alcohol	18	0.0012	no RQ	0.0059
Benzaldehyde	23	0.0015	no RQ	0.0075
2-Butoxyethanol	920	0.0620	no RQ	0.3009
1-Butanol or butyl alcohol	1.21 E+5	8.1521	2,270	39.570
2-Butanone or methylethylketone	120	0.0081	2,270	0.0392
Butoxyglycol	810	0.0546	no RQ	0.2649
Butoxydiglycol	27	0.0018	no RQ	0.0088
Butoxytri-ethyleneglycol	35	0.0024	no RQ	0.0114
Butraldehyde	230	0.0155	no RQ	0.0752
Chloroform or 1,1,1-Trichloromethane	27	0.0018	4.54	0.0088
Caproic acid	70	0.0047	no RQ	0.0229
3,5-Dimethylpyridine	24	0.0016	2,270	0.0078
Dimethylnitrosamine	57	0.0038	0.454	0.0186
Dodecane	46	0.0031	no RQ	0.0150
Ethoxytriethylene glycol	150	0.0101	no RQ	0.0491
Ethanol or ethyl alcohol	2	0.0001	0.454	0.0007
Hexanoic acid	70	0.0047	no RQ	0.0229
Hexadecane	17	0.0011	no RQ	0.0056
2-Hexanone	79	0.0053	no RQ	0.0258
Heptadecane	18	0.0012	no RQ	0.0059
Methoxydiglycol	52	0.0035	no RQ	0.0170
Methoxytriglycol	370	0.0249	no RQ	0.1210
M-Methoxymethanamine	120	0.0081	no RQ	0.0392
Methlene chloride	180	0.0121	454	0.0589
Methyl Nitrate	240	0.0162	no RQ	0.0785
Methyl N-propyl ketone	12	0.0008	no RQ	0.0039
Methyl N-butyl ketone or 2-Pentanone	79	0.0053	no RQ	0.0258
Methylisobutylketone (MIBK-Hexone)	68	0.0046	2,270	0.0222
2-Methylnonane	17	0.0011	no RQ	0.0056

Table 2-7. Process Condensate Nonradionuclide Source Term. (3 sheets)

Chemical	Maximum concentration (ppb)	Maximum C-100 inventory (kg)	CERCLA Reportable quantity (kg)	Maximum quantity per day (kg)
Methyl vinyl ketone	22	0.0015	no RQ	0.0072
N-Nitrosodim-ethylamine	57	0.0038	4.54	0.0186
Nitromethane	8	0.0005	no RQ	0.0026
Pentadecane	20	0.0013	no RQ	0.0065
Phenol	33	0.0022	454	0.0108
2-Propenol	39	0.0026	0.454	0.0128
Pyridine	550	0.0371	454	0.1799
Tetradecane	440	0.0296	no RQ	0.1439
Tetrahydrofuran	170	0.0115	454	0.0556
Tributyl phosphate	21,000	1.4148	no RQ	6.8675
1,1,1-Trichlorethane	5	0.0003	454	0.0016
Tridecane	350	0.0236	no RQ	0.1145
Triglyme	90	0.0061	no RQ	0.0294
Undecane	950	0.0640	no RQ	0.3107

Table 2-8. Process Condensate Nonradionuclide Source Term Data. (3 sheets)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Chemical	LERF (ppb)	EFSD (ppb)	CRW (ppb)	LINK (ppb)	ASF (ppb)	SALT (ppb)	DWP (ppb)
Aluminum	4,992	4,992	1,470	1,650	1,770	642	1,800
Ammonia			1. E+6	2.5 E+5	2.19 E+6	8.89 E+4	
Ammonium	9.35 E+6	9.35 E+6					2.2 E+6
Arsenic (EP toxic)					50		
Barium (EP toxic)					232		
Barium	8	8	6	6	8		8
Boron	151	151			13		1.3
Cadmium				5	10		5
Calcium	8,300	7,900	7,880	4,370	8,320	447	8,300
Carbonate	7.5 E+5	7.5 E+5					
Chloride	2,300	2,300	932	1,170	2,300		2,300
Chromium	156	156			50		
Copper	127	127		73	12		73
Fluoride (IC)							2,100
Fluoride (IS E)							65
Fluoride	12,273	1,200		35	1,070		
Iron	503	503		156	67		160
Lead					50		
Magnesium	3,670	3,670	71	4,030	748		4,000
Manganese	5	5			5		
Mercury (EP Toxic)					10		
Mercury	0.69	0.7	0.69	0.48	0.56	0.23	0.69
Nickel	17	17		17	14	13	17
Nitrate	5,000	4,980		4,980			5,000
Phosphorus	6,195	6,195					
Potassium	19,238	19,238		1,710	15,700	5,280	16,000
Selenium (EP toxic)					50		
Silicon	985,819	985,819			9,400		9,400
Silver (EP toxic)					50		
Sodium	51,497	51,497		25,600	33,200	2,730	33,000
Strontium					30		

Table 2-8. Process Condensate Nonradionuclide Source Term Data. (3 sheets)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Chemical	LERF (ppb)	EFSD (ppb)	CRW (ppb)	LINK (ppb)	ASF (ppb)	SALT (ppb)	DWP (ppb)
Sulfate	13,000			13,000	3,900		13,000
Sulfide	66,000	65,600		65,600			
Uranium			1.35	0.475	2.03		
Vanadium	7	7		5	7		
Zinc			5	34	17	44	44
Acetone	5,100	5,100	2,570	5,100	2,160	1,200	5,100
Benzyl alcohol	18	18	18	10	17	11	18
Benzaldehyde	23	23		23			
2-Butoxyethanol	920	920	840	920	490	98	92
1-Butanol or butyl alcohol	88,000	88,000	88,000	1,130	1.21 E+5	525	88,000
2-Butanone or methylethyl ketone	120	120	90	120	93	44	120
Butoxyglycol	810	810	540	130	360	806	810
Butoxydiglycol	27	27		11	27		
Butoxytriethyl-eneglycol	35	35			35		
Butraldehyde	230	230					
Chloroform or 1,1,1-trichloromethane	27	27					
Caproic acid	70	70					
3,5-Dimethyl-pyridine	24	24	24				
Dimethylnitrosamine	57	57					
Dodecane	46	46		46			
Ethoxytriethylene glycol	150	150		150		120	
Ethanol or ethyl alcohol	2	2			2		
Hexanoic acid				70			
Hexadecane	17	17		17			
2-Hexanone			11	20	79	10	
Heptadecane	18	18		18			

Table 2-8. Process Condensate Nonradionuclide Source Term Data. (3 sheets)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Chemical	LERF (ppb)	EFSD (ppb)	CRW (ppb)	LINK (ppb)	ASF (ppb)	SALT (ppb)	DWP (ppb)
Methoxydiglycol	52	52		28		52	
Methoxytriglycol	370	370		370		65	
M-Methoxymethanamine		120					
Methylene chloride	180	180					
Methyl nitrate		240					
Methyl N-propyl ketone	12	12					12
Methyl N-butyl ketone or 2-pentanone	79	79	12	11			79
Methyl isobutyl ketone (MIBK-hexone)	68	68	5	68		8	68
2-Methylnonane	17	17			17		
Methyl vinyl ketone		22					
N-Nitrosodi-methylamine				57			
Nitromethane		8					
Pentadecane	20	20		20			
Phenol	33	33		33			
2-Propenol	39	39	39	22	24	34	39
Pyridine	550	550		550			
Tetradecane	440	440	26	440	25	320	440
Tetrahydro-furan	170	170	18	30	81	170	170
Tributyl phosphate	21,000	21,000	6,800	20,600	10,100	6,150	21,000
1,1,1-Trichlorethane	5	5					
Tridecane	350	350	18	350	28	300	350
Triglyme	90	90		90			
Undecane		950					

Therefore, one gram/liter is equal to 1,000,000 ppb. This conversion was used to calculate the values tabulated in the third and the fifth columns.

The "Maximum C-100 inventory" column is the total possible quantity of the constituent present in the Process Condensate Collection Tank (C-100) calculated on the tanks maximum capacity of 17,800 gal or 67,373 L.

The "CERCLA" column is the RQ that, if released in a 24-hour period, is reportable under CERCLA.

An asterisk (*) denotes the existence of the possibility that a constituent might be CERCLA reportable if released.

At a process condensate generation rate of 227 L/min (60 gal/min), it is possible to generate 327,024 L/day (86,400 gal). The "Maximum quantity per day" column has been included to identify any constituents that could become reportable under CERCLA if the process condensate were to be released to the environment during an entire 24-hour period.

Table 2-8 presents the data that were used to develop Table 2-7. Table 2-8 lists nonradionuclide constituents in the process condensate. The data in each of the columns have been compiled from the following references.

Column (1) LERF:	Reference--**Internal Memo 86132-91-MOA-006**; Dated January 22, 1991; From Effluent Technology; Subject: *Re-submittal of Data for Inclusion in the W-105 Functional Design Criteria* (**Table A-1**, *Liquid Effluent Retention Facility Effluent Characterization Data*) (WHC 1991f).
Column (2) EFSD:	Reference--**WHC-SD-C018-001, Rev 1**, Table C-1, *Effluent Characterization Data* (WHC 1990e).
Column (3) CRW:	Cladding Removal Waste (CRW) Feed: reference--**WHC-EP-0342, Addendum 15**, *242-A Evaporator Process Condensate Stream-Specific Report* (WHC 1990c).
Column (4) LINK:	Linked Run Feed: reference--**WHC-EP-0342, Addendum 15**, *242-A Evaporator Process Condensate Stream-Specific Report*.
Column (5) ASF:	Ammonia Scrubber Feed: reference--**WHC-EP-0342, Addendum 15**, *242-A Evaporator Process Condensate Stream-Specific Report*.
Column (6) SALT:	Saltwell Feed: reference--**WHC-EP-0342, Addendum 15**, *242-A Evaporator Process Condensate Stream-Specific Report*.
Column (7) DWP:	Reference--**DOE/RL-90-42**, *242-A Evaporator Dangerous Waste Permit Application* (DOE-RL 1990).

The recommended safety source term of ammonium in the evaporator process condensate is 3.0 x 10^{+07} ppb [reference--Internal Memo 86132-91-MOA-006 (Table A-3, *LERF Effluent Characterization Data*), dated January 22, 1991; From: Effluent Technology; Subject: RE-SUBMITTAL OF DATA FOR INCLUSION IN THE W-105 FUNCTIONAL DESIGN CRITERIA] and is the proposed LERF inventory control operational safety requirement maximum allowable concentration (Technical Basis Document, WHC-SD-WM-TI-448) (WHC 1990). This value is not used because the available data do not show ammonium to exist at this concentration.

2.3.6 Process Condensate Radiological Potential Source Terms

Table 2-9 lists alpha and beta radionuclide constituents in the process condensate. The data in each of the columns have been compiled from the following references:

Column (1) CRW:	Cladding Removal Waste (CRW) Feed: reference--**WHC-EP-0342, Addendum 15,** *242-A Evaporator Process Condensate Stream-Specific Report* (WHC 1990c)
Column (2) LINK:	Linked Run Feed: reference--**WHC-EP-0342, Addendum 15,** *242-A Evaporator Process Condensate Stream-Specific Report*
Column (3) ASF:	Ammonia Scrubber Feed: reference--**WHC-EP-0342, Addendum 15,** *242-A Evaporator Process Condensate Stream-Specific Report*
Column (4) SALT:	Saltwell Feed: reference--**WHC-EP-0342, Addendum 15,** *242-A Evaporator Process Condensate Stream-Specific Report.*

Table 2-9. Process Condensate Radionuclide Data.

Effluent	(1) CRW (μCi/mL)	(2) LINK (μCi/mL)	(3) ASF (μCi/mL)	(4) SALTWELL (μCi/mL)	Maximum (μCi/mL)
Alpha	2.78 E-10	1.62 E-09	1.01 E-09		1.62 E-9
Beta	1.09 E-06	4.34 E-06	1.25 E-05	1.61 E-06	1.25 E-5

Table 2-10 contains data on process condensate radionuclide constituents from the following sources:

For 1987/1988/1989 values: reference--**WHC-EP-0141-0/-1/-2,** *Westinghouse Hanford Company Effluent Discharges and Solid Waste Management Report for 1987/1988/1989: 200/600 Areas* (WHC 1988d, 1989f, 1990a)

For 1984/1985/1986 values: reference--**WHC-SD-WM-SAR-023,** *242-A Evaporator Safety Analysis Report* (WHC 1988a).

Table 2-10. Process Condensate Radionuclide Data.

Effluent	Year						Maximum
	1984	1985	1986	1987	1988	1989	
Total volume (L)	5.3 E+7	4.9 E+7	5.0 E+7	2.45 E+7	4.92 E+7	1.34 E+7	5.3 E+7
	(µCi/mL)	(µCi/mL)	(µCi/mL)	(µCi/mL)	(µCi/mL)	(µCi/mL)	(µCi/mL)
				(Ci)	(Ci)	(Ci)	
Alpha	1.3 E-8	1.7 E-8	2.4 E-8	2 E-8	2 E-8	1.1 E-8	2.4 E-8
				6 E-4	7 E-4	1.4 E-4	
Beta	4.1 E-7	2.1 E-6	5.0 E-6	2 E-6	4 E-6	2.0 E-6	5.0 E-6
				4 E-2	2 E-2	2.7 E-2	
^{3}H	2.4 E-2	1.1 E-2	1.1 E-2	6 E-3	6 E-3	8.7 E-3	2.4 E-2
				1.5 E+2	1.3 E+2	1.2 E+2	
^{241}Am					c	2.8 E-8	2.8 E-8
						3.7 E-4	
^{137}Cs	1.6 E-7	4.6 E-7	5.6 E-7	2 E-7	3 E-7	8.0 E-8	5.6 E-7
				5 E-3	2 E-2	1.1 E-3	
^{147}Pm	4.4 E-7	1.8 E-6	1.1 E-6				1.8 E-6
^{129}I			1.9 E-8	6 E-8	3 E-8	2.4 E-8	6 E-8
				1 E-3	2 E-3	3.2 E-4	
Uranium	8.5 E-8	3.1 E-8	1.2 E-9		c	c	8.5 E-8
^{239,240}Pu					c	1.5 E-8	1.5 E-8
						2.0 E-4	
^{106}Ru					2 E-6	4.5 E-7	2 E-6
					9 E-2	6.0 E-3	
^{147}Pm					c		
^{103}Ru					c		
^{113}Sn				6 E-7	3 E-7		6 E-7
				2 E-2	2 E-2		
^{89,90}Sr	8.7 E-8	3.4 E-7	3.8 E-7	2 E-7	3 E-8	1.6 E-8	3.8 E-7
				6 E-3	2 E-3	2.2 E-4	

c = analysis was not necessary (as determined from inventory, effluent history, and/or gross alpha/beta analyses).

Table 2-11 contains data concerning process condensate radionuclide constituents. The data in each of the columns have been compiled from the following references.

Column (1)	Reference--**Internal Memo 86132-91-MOA-006** (Table A-1, *LERF Effluent Characterization Data*), dated January 22, 1991; From: Effluent Technology; Subject: RE-SUBMITTAL OF DATA FOR INCLUSION IN THE W-105 FUNCTIONAL DESIGN CRITERIA (WHC 1991f).
Column (2)	Reference--**Internal Memo 86132-91-MOA-006** (Table A-2, *LERF Effluent Characterization Data*), dated January 22, 1991; From: Effluent Technology; Subject: RE-SUBMITTAL OF DATA FOR INCLUSION IN THE W-105 FUNCTIONAL DESIGN CRITERIA (WHC 1991f). Proposed LERF inventory control operational safety requirement maximum allowable concentration (Technical Basis Document, WHC-SD-WM-TI-448) (WHC 1990i).
Column (3)	Reference--**WHC-SD-C018-001, Rev 1** (Table C-1, *Effluent Characterization Data*) (WHC 1990e).

Table 2-12 compares the maximum process condensate radionuclide constituents from each row of Tables 2-9, 2-10, and 2-11.

Table 2-13 contains the process condensate radionuclide constituent source term values derived from Table 2-12 and compares these values to the maximum possible inventory (curies) in a full process condensate collection tank (C-100) which has a maximum capacity of 67,373 L (17,800 gal). Also included is the total quantity (in curies) possible within a 24-hour timeframe, calculated on a 227-L/min (60-gal/min) rate of process condensate generation. This process rate produces 327,024 L/day (86,400 gal/day).

Table 2-11. Process Condensate Radionuclide Data.

Radionuclide	(1) (μCi/mL)	(2) (μCi/mL)	(3) (μCi/mL)	Maximum (μCi/mL)
Alpha	7.5 E-07		9.5 E-07	9.5 E-7
Beta	7.4 E-05		7.4 E-05	7.4 E-5
^{90}Sr	8.100 E-06	4.91 E-04	8.1 E-05	4.91 E-4
^{106}Ru	1.78 E-05	9.92 E-03	1.78 E-05	9.92 E-3
^{137}Cs	2.6 E-06	4.16 E-04	2.6 E-05	4.16 E-4
^{147}Pm	4.1 E-06	1.23 E-03	4.1 E-06	1.23 E-3
Uranium (gross)	1.40 E-07	1.89 E-05	1.4 E-07	1.89 E-05
^{3}H	2.4 E-02	5.29 E+00	2.4 E-02	5.29 E+00
^{239}Pu	2.4 E-12	3.49 E-10	2.4 E-12	3.49 E-10
^{113}Sn	2.50 E-06	5.10 E-04	2.5 E-06	5.10 E-04
^{155}Eu	1.4 E-06	1.32 E-03	1.4 E-07	1.32 E-03

Table 2-12. Process Condensate Radionuclide Data.

Effluent	Maximum (μCi/mL)			Maximum (comparison) (μCi/mL)
	Table 2-10	Table 2-11	Table 2-12	
Alpha	2.4 E-08	1.62 E-9	9.5 E-7	9.5 E-7
Beta	5.0 E-06	1.25 E-5	7.4 E-5	7.4 E-5
^{3}H	2.4 E-02		5.29 E+00	5.29
^{241}Am	2.8 E-08			2.8 E-8
^{137}Cs	5.6 E-07		4.16 E-4	4.16 E-4
^{147}Pm	1.8 E-06		1.23 E-3	1.23 E-3
^{129}I	6 E-08			6 E-8
Uranium	8.5 E-08		1.89 E-05	1.89 E-5
^{239,240}Pu	1.5 E-08		3.49 E-10	1.5 E-8
^{106}Ru	2 E-06		9.92 E-3	9.92 E-3
^{113}Sn	6 E-07		5.10 E-04	5.1 E-4
^{89,90}Sr	3.8 E-07		4.91 E-4	4.91 E-4
^{155}Eu			1.32 E-03	1.32 E-3

Table 2-13. Process Condensate Radionuclide Source Term.

Effluent	Maximum		
	(μCi/mL)	C-100 (Ci)	24 H (Ci)
Alpha	9.5 E-7	0.0001	0.0003
Beta	7.4 E-5	0.0050	0.024
^{3}H	5.29	356.4	1,729.96
^{241}Am	2.8 E-8	1.89 E-6	9.16 E-6
^{137}Cs	4.16 E-4	0.028	0.14
^{147}Pm	1.23 E-3	0.083	0.402
^{129}I	6 E-8	4.04 E-6	1.96 E-5
Uranium	1.89 E-5	0.0013	0.0062
^{239,240}Pu	1.5 E-8	1.01 E-6	4.91 E-6
^{106}Ru	9.92 E-3	0.67	3.24
^{113}Sn	5.1 E-4	0.034	0.167
^{89,90}Sr	4.91 E-4	0.033	0.161
^{155}Eu	1.32 E-3	0.089	0.432

3.0 APPLICABLE REGULATIONS

This section presents information on the regulations governing effluent monitoring requirements for radioactive, nonradioactive hazardous, and mixed waste materials in effluents. It also focuses on applicable environmental standards and statutes, including WHC effluent monitoring requirements.

3.1 REGULATIONS

Several regulatory agencies including the U.S. Environmental Protection Agency (EPA), DOE, Washington State, and the Benton-Franklin-Walla Walla Counties Air Pollution Control Authority have developed regulations pertaining to effluent releases at the Hanford Site. A summary of applicable regulations and standards is presented in Table 3-1. Because the regulations enforced by these agencies sometimes are different and WHC may enforce more restrictive requirements as a matter of policy, WHC has documented the policies for compliance in the environmental compliance manual, WHC-CM-7-5 (WHC 1992i). This document is the controlling reference for WHC environmental protection criteria.

3.1.1 Protection of the Public and the Environment

To ensure the public's health and safety, DOE-controlled facilities are required to monitor effluents that have the potential of containing regulated materials. Regulations pertaining to the monitoring and environmental surveillance of effluents typically are based on effluent release limits for specific materials that are associated with their risks to the public. Monitoring requirements and associated limitations also may be based on best available technology (for liquid control technology, best available airborne control technology for airborne control technology), best practical control technology currently available, or other technology-based criteria. In addition, some monitoring requirements and associated limitations are based on environmental protection criteria, such as water-quality-based discharge standards. The effluent release limits for nonradioactive and radioactive materials are designed to ensure that the risk to the public and the environment posed by these facilities is reduced to an acceptable level.

As documented in 40 CFR Part 61, "National Emission Standards for Hazardous Air Pollutants," (EPA 1991b) effluent release limits for benzene and radioactive materials are based on limiting risk to the public by limiting the potential dose to the maximally exposed member of the public. Similarly, for most nonradioactive materials, the risk to the public and the environment is controlled by limiting the quantities of materials released.

In the case of nonradioactive effluents, monitoring requirements also may exist to protect the worker. To provide a safe workplace environment, monitoring of nonradioactive effluents is based on the level or quantity of material present at the point of generation within the facility. Currently, an accurate method does not exist for projecting from the inventory at risk to the estimated release source term at the discharge point.

Table 3-1. Applicable Regulations and Standards.

Agency/Originator	Regulation No.	HA	HL	RA	RL	Summary/Application
U.S. Department of Energy, (DOE) Washington, D.C.	DOE Order 5400.1, 1988 General Environmental Protection Program	X	X	X	X	Outlines effluent monitoring requirements
	DOE Order 5400.5, 1990 Radiation Protection of the Public and Environment			X	X	Protects public/environment from radiation associated with DOE operations
	DOE Order 5480.4, 1989 Environmental Protection, Safety, and Health Protection Standards	X	X	X	X	Sets requirements for the application of the mandatory environmental protection, safety, and health (ES&H) standards; lists reference ES&H standards
	DOE Order 5484.1, 1981 Environmental Protection, Safety, and Health Protection Information Reporting Requirements	X	X	X	X	Sets requirements for reporting information having environmental protection, safety and health protection significance
	DOE Order 5820.2A, 1988 Radioactive Waste Management	X	X	X	X	Sets radioactive waste management requirements
	DOE/EH-0173T, January 1991 Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance			X	X	
U.S. Environmental Protection Agency, (EPA) Washington, D.C.	40 CFR 61, 1989 National Emission Standards for Hazardous Air Pollutants	X		X		Sets national emission standards for hazardous air pollutants (NESHAP)
	40 CFR 61, 1989 Subpart A General Provisions	X				Regulates hazardous pollutants
	40 CFR 61, 1989 Subpart H National Emission Standards for Emissions of Radionuclides other than Radon from Department of Energy Facilities			X		Sets emissions standards/monitoring requirements for radionuclides
	40 CFR 122, 1983 EPA Administered Permit Programs: The National Pollutant Discharge Elimination System		X			Governs release of nonradioactive liquids
	40 CFR 141.16, 1989 Safe Drinking Water Act (National Interim Primary Drinking Water Regulations)				X	Sets maximum contaminant levels in public water systems
	40 CFR 261, 1989 Identification and Listing of Hazardous Waste		X			Identifies and lists hazardous wastes
	40 CFR 302.4, 1980 Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA): Designation, Reportable Quantities and Notification	X	X	X	X	Designates hazardous materials, reportable quantities, notification process
	40 CFR 355, 1987 Superfund Amendments and Reauthorization Act of 1986 (SARA): Emergency Planning and Notification	X	X			Identifies threshold planning quantities for extremely hazardous substances

Table 3-1. Applicable Regulations and Standards.

Agency/Originator	Regulation No.	HA	HL	RA	RL	Summary/Application
EPA (Cont'd)	40 CFR 403-471, 1990 Effluent Guidelines and Standards		X			Sets pretreatment standards for wastewater discharged to Public-Owned Treatment Works (POTW)
American National Standards Institute, (ANSI) New York, New York	N 13.1 - 1969* Guidance to Sampling Airborne Radioactive Materials in Nuclear Facilities			X		Sets standards for effluent monitoring systems
	N 42.18*, 1974 Specification and Performance of On-site Instrumentation for Continuously Monitoring Radioactivity in Effluents			X	X	Recommendations for the selection of instrumentation for the monitoring of radioactive effluents
Washington State Department of Ecology, (Ecology) Olympia, Washington	WAC 173-216, 1989 State Waste Discharge Permit Program		X			Governs discharges to ground and surface waters
	WAC 173-220, 1988 National Pollutant Discharge Elimination system Permit		X		X	Governs wastewater discharges to navigable waterways; controls NPDES permit process
	WAC 173-240, 1990 Submission of Plans and Reports for Construction of Wastewater Facilities		X			Controls release of nonradioactive liquids
	WAC 173-303, 1989 Dangerous Waste Regulations		X			Regulates dangerous wastes; prohibits direct release to soil columns
	WAC 173-400, 1991 General Regulations for Air Pollution Sources	X		X		Sets emissions standards for hazardous air pollutants
	WAC 173-480 Utilities and Transportation Commission	X		X		Endorses the 10/mrem/yr EDE-EPA Standard (40 CFR 61, Subpart H)
Washington State Department of Health, Olympia, Washington	WAC 246-247 Radiation Protection - Air Emission	X		X		Sets standards for registration, permitting, notification, new source review, monitoring and reporting
Benton-Franklin Walla-Walla Counties Air Pollution Control Authority, (APCA) Richland, Washington	General Regulation 80-7, 1980	X				Regulates air quality

HA = hazardous airborne.
HL = hazardous liquid.
RA = radioactive airborne.
RL = radioactive liquid.
*Refers to standards that are referenced in the DOE and EPA regulations.

The EPA NESHAPs require that radionuclide emissions from each DOE site shall not cause any individual (maximally exposed individual) to receive a dose of greater than 10 mrem/yr EDE. A single site or facility, as used here, means all the buildings, structures, and operations within one contiguous site. For example, the entire DOE facility at the Hanford Site, rather than each building, must meet the 10 mrem/yr EDE standard. In DOE Order 5400.5, paragraph II.1.b (DOE 1990b), the dose from airborne radioactivity is limited to 10 mrem EDE, which is consistent with the EPA standards.

DOE Order 5400.5, "Radiation Protection of the Public and the Environment" (DOE 1990b), provides dose limits from all DOE sources of radiation and all exposure modes of 100 mrem/yr EDE and 5 rem/yr dose equivalent limit for any tissue (including the skin and lens of the eye) to the public from operations at DOE facilities. These limits apply to doses originating from exposures to radiation sources during routine activities, as well as to exposures from remedial actions in progress on the same site. Although the current limit is 100 mrem/yr, it is recommended that a FEMP be prepared as if the NESHAPs will be instituted with the 10 mrem/yr EDE limit. Effluent monitoring and the associated plan would be required at a level of 1% of the 10 mrem/yr EDE standards; that is, at 0.1 mrem/yr EDE.

The limit of 100 mrem/yr EDE is the sum of the EDE (or deep dose equivalent, if dosimeter data are used) from exposures during the year to radiation sources external to the body plus the committed EDE from radionuclides taken into the body. The calculation of doses from routine DOE activities should be based on a "reference man," as defined by the International Commission on Radiation Protection (ICRP) and the dosimetry models and parameters presented in ICRP Publication 30 (ICRP 1979) and subsequent publications. The weighing factors and time periods for integrating doses endorsed by the ICRP are to be used for dose commitment calculations. Other requirements are presented, including how doses from other synthetic or enhanced natural radionuclide sources must be addressed.

The DOE Order 5400.5, Chapter II, Paragraph 1.b. (DOE 1990b) limits exposure of the public to radioactive materials from all DOE sources of radiation. The order states that DOE activities shall not cause any member of the public to receive, in a year, a dose equivalent greater than 100 mrem to the whole body. The order also stipulates that DOE must comply with legally applicable requirements, including 40 CFR 61 (NESHAP) (EPA 1991b) for airborne emissions. Doses attributed to ^{220}Rn, ^{222}Rn, and their respective decay products are specifically excluded from the NESHAP dose standard. However, they are regulated by DOE Order 5400.5.

To demonstrate compliance with the dose limit requirements using analytical techniques, evaluations of potential doses to individuals through the air pathway shall be evaluated using only AIRDOSE/RADRISK (Beres 1990) or other computer codes or models specifically approved by EPA, as specified in NESHAP. Compliance also may be demonstrated through environmental measurements taken using approved techniques. When using this method to determine compliance, estimated doses are for individuals who are assumed to reside in an unrestricted area at the point of maximum annual air concentration.

3.2 REGULATIONS PERTAINING TO MONITORING REQUIREMENTS AT U.S. DEPARTMENT OF ENERGY FACILITIES

The monitoring requirements for effluents resulting from the operation of DOE-controlled sites can be presented in two categories related to the effluent release pathway: airborne or liquid. In addition, information on monitoring requirements is presented whether the effluent is radioactive or nonradioactive material. Before presenting this material, however, it is useful to review in detail the requirements outlined by DOE for FEMPs.

3.2.1 U.S. Department of Energy Facility Effluent Monitoring Plan

Requirements for a FEMP are provided in DOE Order 5400.1, "General Environmental Protection Program" (DOE 1988). The order provides specific information in Chapter IV on the requirements for effluent monitoring systems and programs at the Hanford Site. Environmental monitoring requirements are different for new and existing facilities.

For a new facility with the potential for adverse impact on the environment, an environmental survey must be conducted before actual startup. This survey shall establish background levels of radioactive and toxic pollutants, characterize pertinent environmental and ecological parameters, and identify potential pathways for human exposure or environmental impact as a basis for determining the nature and extent of the subsequent routine operational effluent and environmental monitoring program.

For existing facilities, radioactive and nonradioactive pollutant effluents released at the Hanford Site shall be monitored to determine compliance. Their monitoring is performed to evaluate the effectiveness of effluent treatment and control, inventory radioactive material, and determine compliance with all DOE, EPA, state, and local requirements pertaining to effluents and pollutant impact on the environment. Radioactive material released to onsite waste treatment or disposal systems shall be monitored to assess the effectiveness of treatment and control and to provide both a qualitative and quantitative annual summary of the radioactive material released onsite.

DOE Order 5400.1 (DOE 1988) also provides guidance on effluent monitoring. As a general rule, monitoring should be conducted in a manner that provides accurate measurements of the quantity and/or concentration of liquid and airborne pollutants in effluents as a basis for:

- Determining compliance with applicable discharge and effluent control limits, including self-imposed administrative limits designed to ensure compliance with in-plant operating limits, effluent standards, or guides; and with environmental standards and guides
- Evaluating the adequacy and effectiveness of containment and waste treatment and control, as well as of efforts toward achieving levels of radioactivity that are as low as reasonably achievable (ALARA) considering technical and economical constraints

- Compiling an annual inventory of the radioactive material released in effluents and onsite discharges.

Because the requirements in DOE Order 5400.1 (DOE 1988) are relatively general, interpretation of the requirements is necessary to determine the effluent monitoring practices required to meet the intent of the order and associated regulations. For airborne releases, 40 CFR 61 (EPA 1991b), ANSI N13.1-1969 (ANSI 1969), and associated documents provide specific requirements and guidelines for effluent monitoring and sampling. For liquid releases, however, currently accepted guidance does not provide consolidated, detailed requirements. Therefore, required practices are based on industry-accepted standards and good practices that are sufficient to meet the intent of the regulations, including the primary requirement that all effluent samples obtained be representative of the effluent released. The following discussion summarizes the primary monitoring and sampling practices that are necessary to comply with DOE Order 5400.1 (DOE 1988) and associated regulations.

Effluent monitoring data collected as close as possible to the point of discharge should include volume, rate of discharge, and content. Effluent monitoring data pertaining to the release of nonradioactive pollutant material should include the total quantity (amount). Effluent monitoring data pertaining to the release of radioactive material is to include the total activity (number of curies) released in airborne and liquid effluents and the specific radionuclides comprising a significant portion (>10%) of the radiation dose. Although exceptions exist, this requirement indicates that the measurement should be made at the point of discharge. When a portion of the effluent stream is close to the point of generation, measurement then could provide a more accurate estimate of the hazardous material being released from the facility, and an exception may be allowed.

Effluents should be monitored at the point at which the applicable standards apply. For example, onsite discharges may be monitored at the waste treatment and disposal system. Effluents may be monitored at the point after all treatment and control, including retention and decay, has occurred. In many cases, the monitoring location is specified in the discharge or operating permit.

The sampling method and frequency should be determined by considering the purpose or need for the data collected. Data are collected to

- Evaluate the effectiveness of waste treatment and control
- Demonstrate compliance with operating limits of applicable effluent or performance standards
- Compile and trend effluent characteristics.

Continuous or proportional sampling is recommended and may be required where the concentrations and mixtures of potential pollutants in the effluent stream vary significantly. Periodic sampling may be adequate when the concentrations and mixtures are reasonably constant and the likelihood of unusual variations is minimal. Similarly, proportional sampling may be necessary when effluent flow rates fluctuate, whereas a representative grab-sample may suffice for batch discharges. The method of sampling usually is specified in the applicable regulation or permit.

In reporting radiological data, gross radioactivity measurements are generally inadequate. However, they can be appropriate when

- Gross radioactivity releases are a small fraction of the offsite Radioactivity Concentration Guides (RCG) for "unidentified mixtures" and have no health or environmental significance
- The relative concentrations of specific radionuclides are so well known by other means that gross radioactivity measurements are truly indicative of the activity being released
- The activity of waste streams is so low as to preclude specific radionuclide measurements.

For radioactive effluents, onsite discharge monitoring and reporting must be adequate to provide an annual average concentration and an annual summary of the quantities of radioactive materials released. The summary should include all significant or reportable releases. It is required, therefore, that the annual average flow and pollutant concentration be determined for each waste stream.

The EPA regulations pertaining to the release of hazardous substances from DOE facilities are presented in 40 CFR 302, "Designation, Reportable Quantities, and Notification" (EPA 1991c). This regulation, in accordance with Sections 101(14) and 102(a) of CERCLA, designates those substances in the statutes of CERCLA, identifies reportable quantities of those substances, and sets forth the notification requirements for releases of these substances. This regulation also sets forth reportable quantities for hazardous substances designated under Section 311(b)(2)(A) of the *Clean Water Act of 1977.*

3.2.2 Airborne Effluents

Airborne emissions of radioactive materials from DOE-controlled facilities at the Hanford Site are subject to EPA regulations. The primary regulation is 40 CFR Part 61 (NESHAP) (EPA 1991b). The list of hazardous air pollutants regulated under the NESHAP is provided in Subpart A, "General Provisions." The specific emissions standards and monitoring requirements for radionuclides are contained in Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities," of the proposed 40 CFR Part 61. Subpart H standards cover all DOE operations that emit radionuclides other than radon to the air, except for facilities subject to 40 CFR Part 191, Subpart B (disposal of spent nuclear fuel, high-level, and transuranic radioactive wastes) (EPA 1991d) and 40 CFR Part 192 (uranium and thorium mill tailings) (EPA 1991e).

Subpart H of the NESHAP presents detailed requirements for emissions monitoring and test procedures (61.93), compliance and reporting (61.94), record-keeping requirements (61.95), and exemptions from the reporting and testing requirements of 40 CFR Part 61.10 (61.97) (EPA 1991b). Radionuclide emission rates from stacks and vents must be measured at all release points that have the potential to release radionuclides into the air in quantities that could cause an EDE in excess of 1% of the standard. The potential to release radionuclides must be based on the emissions from the effluent stream that would result if all pollution control equipment did not exist, but facility operation(s) was otherwise normal [40 CFR part 61.93 (b)(4)(ii)]. For release points that have a potential to release radionuclides into the air, but have effluents below the continuous monitoring standard, periodic confirmatory measurements must be made to verify low emissions. Also, all radionuclides that could contribute greater than 10% of the potential EDE for each release point must be measured. With prior EPA approval, alternative methods to the one described, including process knowledge, can be substituted for measurement to determine the emission levels of individual radionuclides.

Subpart H, Section 61.93, specifies the monitoring requirements for determining radionuclide emission rates. These requirements include sampling points, appropriate sampling methods, flow rate determinations, sampling frequency, analytical methods, and quality assurance procedures. Direct measurement of air concentrations of radionuclides at the receptor point is acceptable if the criteria in Section 61.93(b)(5) are met. These criteria include continuous monitoring of released radionuclides, satisfactory detection limits, quality assurance, and prior EPA approval.

The NESHAPs require that plants monitor their operations continuously and keep records of the results of their onsite monitoring for 5 yr. WHC would have to certify semiannually that there have been no changes in operations that would require new testing. Although the report is based on the calendar year, the emission limit applies to any period of 12 consecutive months.

Additional EPA requirements on hazardous substances are contained in 40 CFR Part 302.4 (EPA 1991c). This regulation provides information on reportable quantities of nonradioactive hazardous substances. Unlisted hazardous substances designated by 40 CFR Part 302.4 are regulated in accordance with the EPA toxicity of the contaminant.

Several DOE orders provide requirements for monitoring of radioactive and nonradioactive emissions from DOE facilities at the Hanford Site. These orders state that DOE-controlled facilities must comply with 40 CFR Part 61 (NESHAP) (EPA 1991b). The principal orders are DOE Order 5400.5, "Radiation Protection of the Public and the Environment" (DOE 1990b), and DOE Order 5400.1, Chapter IV, "Environmental Monitoring Requirements" (DOE 1988).

In Washington State, airborne emissions are regulated by the *Clean Air Act of 1977*. General regulations for air-pollution sources are presented in WAC 173-400 (Ecology 1990c), including emission standards for sources emitting hazardous air pollutants in WAC 173-400-075 (Ecology 1990c).

The WAC 246-247, *Radiation Protection Air Emissions* (Ecology 1990f), specifies new source review, notification, registration, and permitting requirements associated with any source of radioactive airborne emissions in Washington State, including those on the Hanford Site. One requirement listed in WAC 246-247 is the semiannual (twice yearly) reporting of emissions from each registered stack or vent onsite. By agreement with the Washington State Department of Health, only annual reporting is required.

The WAC 173-480, *Ambient Radionuclides* (Ecology 1990g), defines maximum allowable levels for radionuclides in the ambient air and defines required levels of control of emissions. The regulation was last revised May 7, 1986, and is enforced by Ecology.

While both the WAC 246-247 and 173-480 list outdated maximum EDE standards, each contains a caveat stating that any more stringent federal standards take precedence over the EDE standard specified by the WAC. Therefore, each effectively endorses the 10 mrem/yr EDE standard of the 40 CFR 61, subpart H.

The U.S. Department of Energy, Richland Operations Office, (RL) contractor policies for radioactive airborne releases are discussed in WHC-CM-7-5 (WHC 1992i). This environmental compliance manual refers to the applicable regulations governing the monitoring of radioactive emissions in NESHAP (EPA 1991b). Other regulations, including DOE orders, state that DOE facilities must comply with the requirements set forth in the NESHAP. Other regulations include: 40 CFR Part 52, "Approval and Promulgation of Implementation Plans" (EPA 1991f); and DOE Orders 5400.1 (DOE 1988), 5400.5 (DOE 1990b), and 5484.1 (DOE 1981).

3.2.3 Liquid Effluents

Requirements limiting the exposure of the public to radioactive materials from DOE-controlled activities through the drinking water pathway are presented in DOE Order 5400.5, Chapter II, paragraph 1.d (DOE 1990b). Although the radiological criteria of the public community drinking water standards of 40 CFR Part 141 (EPA 1991g) are not applicable to DOE-operated drinking water systems, it is DOE's policy to provide an equivalent level of protection for all persons consuming the water from a drinking water supply operated by, or for, DOE. These systems shall not cause any person consuming the water to receive an EDE greater than 4 mrem/yr, excluding naturally occurring radionuclides. In addition, DOE facility operators shall ensure that the liquid effluents from DOE activities shall not cause private or public drinking water systems downstream of the facility discharge to exceed the drinking water radiological limits of 40 CFR Part 141.

The dose limit is consistent with the drinking water criteria in 40 CFR 141, "National Interim Primary Drinking Water Regulations" (Safe Drinking Water Act) (EPA 1991g). The dose limit is the EDE to an individual whose exclusive source of drinking water contains a radionuclide, or a mixture of radionuclides, at a level of 4% of the appropriate derived concentration guide (DCG) value. The maximum contaminant levels in public water systems are found in 40 CFR 141.15 (generally radium and alpha emitters) and in 40 CFR 141.16 (beta and gamma emitters) (EPA 1991g).

Liquid effluents from DOE-controlled facilities that have the potential for radioactive contamination must be monitored in accordance with the requirements of DOE Orders 5400.1 (DOE 1988) and 5400.5 (DOE 1990b). Facility operators must provide monitoring of liquid waste streams adequate to

- Demonstrate compliance with the applicable requirements of DOE 5400.5, Chapter II
- Quantify radionuclide released from each discharge point
- Alert affected process supervisors of upsets in processes and emissions controls.

Depending on where a liquid effluent (waste water) is discharged, certain regulations apply. These regulations are implemented through issuance of permits by federal, state, and/or local agencies. It is the responsibility of the facility, through RL, to apply for the permit appropriate to the effluent being discharged. Before applying for any permits, the applicant must know the sources of its waste water discharges and where the waste water is being discharged. The following regulations apply based on where the waste water is discharged:

- Waste water discharged to a Publicly-Owned Treatment Works (POTW) is subject to federal regulations found in 40 CFR Parts 403 to 471 (EPA 1991h) and may also be subject to local regulations and limitations. Permits for such discharges are obtained from the local sewerage agency into which the effluent is discharged, or in some cases, from the state. DOE Order 5400.5, paragraph II.3.d (DOE 1990b), sanitary sewage also addresses discharges to sewage systems.
- Waste water discharged into a navigable waterway is subject to Washington State regulations (Ecology 1990d) under the National Pollution Discharge Elimination System (NPDES). The EPA issues NPDES permits for such discharges.
- Washington State controls discharges to ground and surface waters of the state, under Chapter 173-216 WAC (Ecology 1990e). The state issues permits for such discharges. A permit of this type would be necessary for any discharges to land that could infiltrate to groundwater.

Each type of discharge permit identified above typically will contain discharge limitations and monitoring requirements. However, the limitations and monitoring requirements will vary depending on the source and type of waste water being discharged. For those processes that have been categorized by EPA, discharges to a POTW will be subject to pretreatment standards that are based on the production process that generates the waste water. Categorical processes are identified in 40 CFR Parts 403-471 (EPA 1991h). Specific limitations and monitoring and reporting requirements have been issued for each categorical process. In addition to EPA's requirements, the State and local sewerage agency may impose additional limitations and monitoring and reporting requirements. Discharges to a navigable waterway also will be subject to certain standards based on the industrial process that generated the waste water; certain additional limitations also are imposed in the NPDES permit. In all cases, the specific pollutants to be monitored and the frequency of monitoring and reporting will be based on the applicable regulations and the language of the permit.

The RL contractor policies for nonradioactive and radioactive liquid effluents are discussed in WHC-CM-7-5 (WHC 1992i). This environmental compliance manual describes current contractor requirements for monitoring and restricting liquid effluents. Applicable requirements are discussed in Section 3.4 of this document.

3.2.4 Hazardous Mixed Wastes

Currently no regulations pertain to "mixed waste" in effluents. Radioactive and dangerous/extremely hazardous contaminants in effluent streams are handled as individual components in effluent regulations and in effluent monitoring.

WHC policies on mixed waste are presented in Section 7.0 of WHC-CM-7-5 (WHC 1992i).

3.3 STANDARDS/REFERENCES

DOE Order 5480.4, *Environmental Protection, Safety, and Health Protection Standards* (DOE 1984), presents a listing of mandatory statutory policies on environmental standards.

3.4 WESTINGHOUSE HANFORD COMPANY EFFLUENT MONITORING REQUIREMENTS

WHC policy for monitoring effluents is presented in the *Environmental Compliance Manual*, WHC-CM-7-5 (WHC 1992i). The WHC manual contains some requirements that are more restrictive than those found in the regulations.

The purpose of the *Environmental Compliance Manual* is to establish guidelines to be used by WHC.

3.5 FACILITY REQUIREMENTS FOR ORGANIC EMISSION STANDARDS

Facilities that operate under a Subtitle C Permit (40 CFR Part 261.3) (EPA 1991i) are required to meet specific organic emission standards as part of an EPA regulatory requirement. These would include hazardous waste treatment, storage, and disposal (TSD) facilities. Included in the final rule are organic emissions from recycling units that do not require a *Resource Conservation and Recovery Act of 1976* (RCRA) permit, but are part of a TSD facility that is required to have a Subtitle C Permit. If a hazardous waste management facility that manages wastes has an annual average total organic concentration of 10 ppmw or greater, the facility is required to reduce the total organic emissions from all processes to below 3 lb/hr or 3.1 tons/yr, or install and operate a control device that reduces the total organic emissions by 95%. Facilities that are in compliance are not required to install control devices or to monitor their emissions if it can be shown that organic emissions will never exceed the established limits. The effective date of the final rulemaking was December 21, 1990.

This page intentionally left blank.

4.0 IDENTIFICATION AND CHARACTERIZATION OF EFFLUENT STREAMS

This section identifies and characterizes the effluent streams for the 242-A Evaporator facility.

4.1 FACILITY EFFLUENT STREAMS

This section provides a brief description of the effluent streams existing at the 242-A Evaporator facility. Refer to the block diagram of Figure 4-1.

4.1.1 Gaseous Streams

One major airborne effluent release point for the 242-A Evaporator facility is the 296-A-22 stack (vessel ventilation system). The 296-A-21 stack ("hot area" building ventilation system) is a second release point. A third separate air system supplies the noncontaminated (cold) area and exhausts through miscellaneous dampers and vents.

4.1.1.1 Vessel Ventilation. Noncondensed vapors from the vacuum condenser and process condensate systems are filtered and discharged to the atmosphere via the vessel vent system (refer to Figures 4-1 and 4-2). The after-condenser and the condensate collection tank (TK-C-100) are vented to the atmosphere through this system. An air intake filter (F-C-7) is used to bleed building air into the vessel vent system to maintain proper ventilation balance and prevent deadheading of the vessel vent exhauster.

An air sampling pump (P-AS-1) draws air through various room radiation samplers. The air sampling pump discharges into the vessel ventilation stack just below the fourth floor in the condenser room. The air sampling pump draws air from samplers in the following rooms:

- Aqueous makeup (AMU) room
- Change room
- Control room
- Condenser room
- Evaporator room
- Pump room
- Loadout and hot equipment storage room
- Loading room
- Ion exchange column room.

Figure 4-1. The 242-A Evaporator Block Diagram.

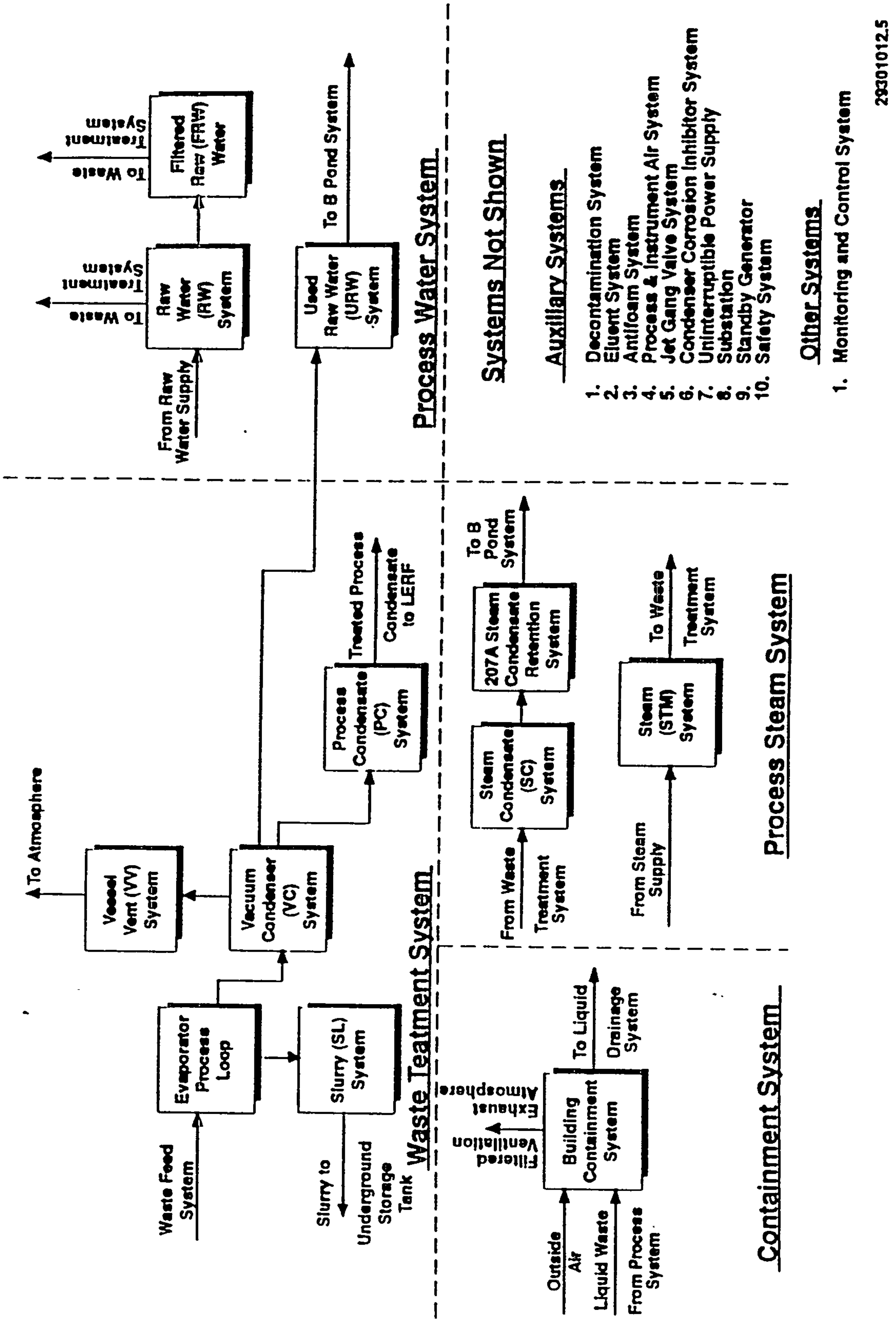
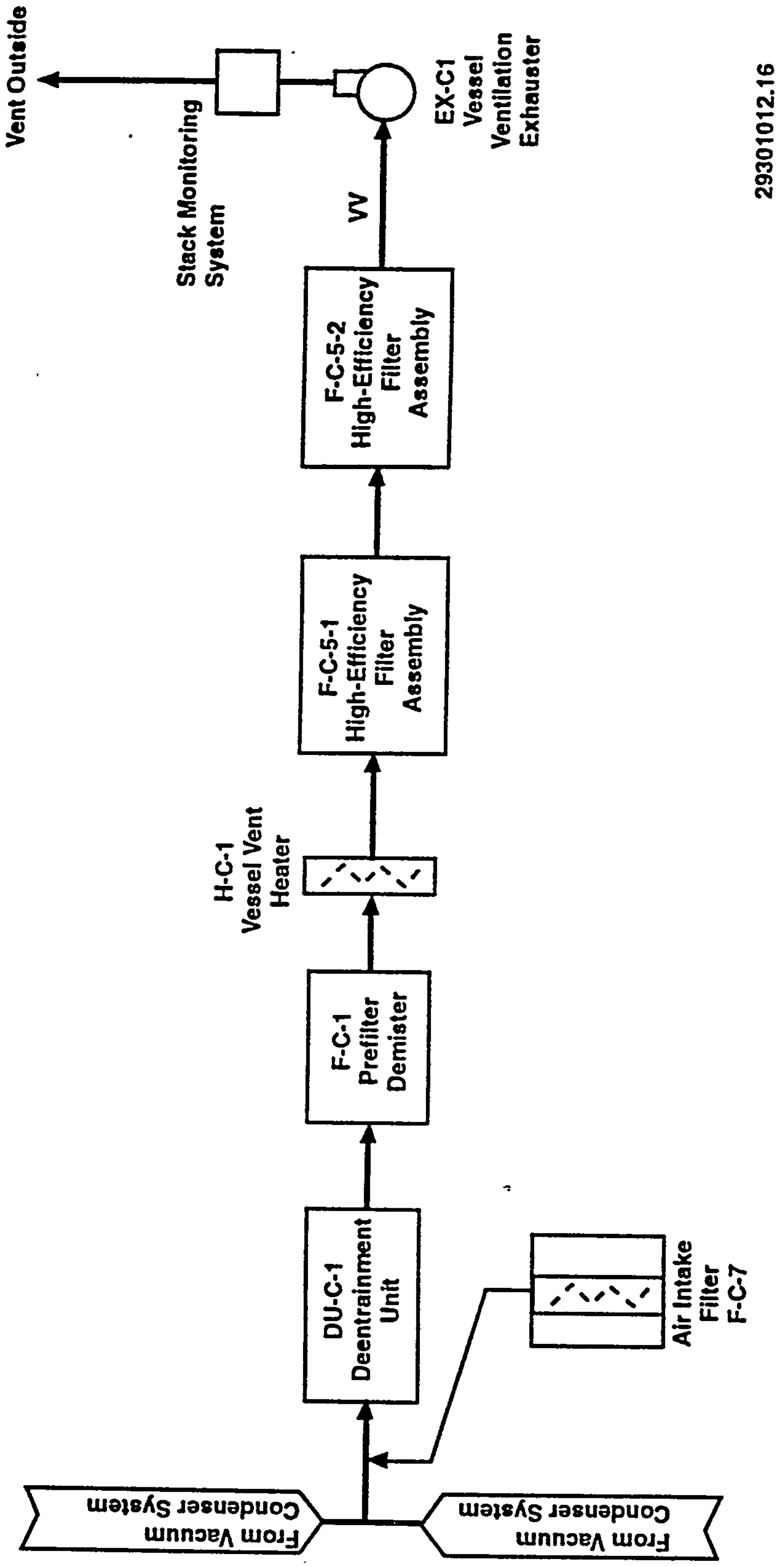


Figure 4-2. The 242-A Evaporator Vessel Vent System.



PIPING ABBREVIATIONS

AF	Antifoam	PS	Process Sewer
AS	Air Sample	PW	Process Waste
DECON	Decontamination	RW	Raw Water
DR	Drain	SC	Steam Condensate
EF	Evaporator Feed	SL	Slurry
EL	Eluant	STM	Steam
FRW	Filtered Raw Water	SW	Sanitary Water
I	Instrument	U	Utility
IA	Instrument Air	URW	Used Raw Water
OVFL	Overflow	V	Vent
PA	Process Air	VAC	Vacuum
PC	Process Condensate	VV	Vessel Vent

4.1.1.2 Building Ventilation. The 242-A Building ventilation system is divided into four ventilation zones, each of which is supplied by a separate air system. These zones are as follows:

- The office
- The cold (noncontaminated) area, which has a low potential for the release of airborne contaminants
- The hot (contaminated) area, which has a greater potential of releasing airborne contaminants
- The control room.

The airborne effluent stream discharged to the atmosphere via the 296-A-21 stack results from ventilation of the contaminated zones of the 242-A Building. The building ventilation system for the 242-A Evaporator is designed for air to flow from noncontaminated to progressively more contaminated areas. This barrier is accomplished by holding the contaminated areas at a negative pressure and the noncontaminated areas at a positive pressure.

The hot area ventilation system (the building ventilation) serves the following rooms:

- Condenser room
- Pump room
- Evaporator room
- Ion exchange room
- Loading room
- Loadout and hot equipment storage room.

The hot area is supplied with approximately 524 m^3/min (18,500 ft^3/min) of outside air from an intake fan (K1-5-1) and approximately 23 m^3/min (800 ft^3/min) of air inleakage from the loading room. Air from the intake fan passes through a preheat coil (K1-2-1), dust filters (K1-7-1 and K1-11-1), air washer (K1-3-1), and reheat coils (K1-4-1 through K1-1-7).

The hot area is maintained at a negative pressure so that air enters the potentially contaminated areas rather than exits to the progressively cleaner areas of the building. In addition, individual room air pressures are maintained so that the pressure in highly contaminated rooms is less than in rooms with less potential for contamination.

The noncontaminated zones of the facility are supplied by the cold area ventilation system. This system serves the HVAC room, AMU room, change rooms, corridors, survey room, lunch room, rest rooms, clean- and soiled-clothes storage areas, and supply and storage room. The cold area is pressurized by an intake fan (K2-5-1) that supplies approximately 368 m^3/min (13,000 ft^3/min) of outside air and 23 m^3/min (800 ft^3/min) of recycled air to the area. Intake air is drawn through a preheat coil (K2-2-1), two filters (K2-1-1 and K2-7-1), reheat coils (K2-4-1 through K2-4-3), and an air washer (K2-3-1) before entering the area. The AMU room receives approximately 65% of the intake air, while the remaining air is circulated throughout the other noncontaminated area rooms. Of the outside air intake, approximately 62% is exhausted from the AMU room exhaust fan (K2-5-2) and approximately 32% is exhausted from the cold area roof exhauster (K2-5-3). The remaining air exits to the 242-AB Building or to the atmosphere via leakages.

The control room and office are separately supplied with fresh air and maintained at a slightly positive pressure by a vent duct from the 242-A facility air supply system. Temperature control in the 242-AB control room is provided using two computer-room air conditioning units.

Radiation areas at the 242-A Evaporator are defined depending on contamination, airborne radioactivity, and source dose rates. Controlled areas act as buffer zones between the nonradiation areas and the radiation source. The controlled areas provide space for stepoff pads, special work permit (SWP) laundry hampers, and survey instrumentation. The health physics technician (HPT) field office is centrally located within Building 242-A.

Personnel entering the noncontaminated areas of the building from the contaminated zones are required to be surveyed to prevent the spread of radioactive contamination to these areas. Portable radiation detection instruments are used to detect and measure alpha, beta, gamma, and neutron radiation, as deemed necessary. The DOE's Pacific Northwest Laboratory (PNL), operated by Battelle Memorial Institute, operates an instrument pool to provide instruments that are exchanged and recalibrated on a regular basis. Table 4-1 lists the instruments available from the central pool. Portal monitors and hand and foot counters are stationary instruments by which personnel can check their clothing, hands, and feet for contamination. These instruments are never used as a substitute for personal surveys, but function as a last checkpoint for radiation workers and office and administrative personnel.

Because the cold area and control room of the facility have little potential to become contaminated, the noncontaminated area exhausts are not addressed further in this FEMP.

4.1.2 Liquid Effluent Streams

Two primary liquid effluent streams associated with the 242-A Evaporator facility are discharged to the environment and are addressed in this FEMP. These are the cooling water, or used raw water (URW), stream and the steam condensate stream. Other liquid streams leaving the facility are either not discharged to the environment or are exempt from monitoring requirements because no process wastewater enters that stream. Nevertheless, the following streams are briefly discussed in this section:

- Process condensate stream
- Evaporator slurry (treated waste)
- 242-A Building drainage
- Sanitary waste
- 242-A-81 Building drainage
- Storm drain/facility grounds runoff.

Table 4-1. Portable Radiation Detection and Measurement Instruments.

Type of detector	Radiation type detected	Instrument range	Accuracy
Air ion chamber	β, γ	0-5,000 mR/hr	-5 to +10%
Air ion chamber	β, γ	0-5,000 mR/hr	-5 to +10%
Thimble-type air ion chamber	γ	0-10,000 R/hr 0-5,000 rads/hr	NR
Thimble-type air ion chamber	γ	0-500 R/hr	-5 to +10%
Thimble-type air ion chamber	γ	0-50 R/hr	-5 to +10%
BF_3 proportional counter surrounded by moderator	β, γ	0-2,000 mrem/hr	±25%
Geiger-Müeller	β, γ	0-100,000 cpm	NA
Geiger-Müeller	β, γ	0-500,000 cpm	NA
ZnS scintillator	α	0-100,000 cpm	NA
Air proportional	α	0-100,000 cpm	NA
Air proportional	α	0-500,000 cpm	NA

NOTE: cpm = counts per minute.
NA = not applicable.
NR = not rated.

4.1.2.1 Used Cooling Water Stream. The 242-A URW waste stream is given the Hanford Site stream code of *ACW*. This waste stream consists primarily of cooling water exiting the primary, intermediate, and after condensers (E-C-1, -2, and -3). The proposed waste stream designation is that this stream is not a dangerous waste, pursuant to the WAC 173-303, *Dangerous Waste Regulations* (WAC 1989). A combination of process knowledge and sampling data was used to make this determination [WHC-EP-0342, Addendum 21, 242-A Evaporator Cooling Water Stream-Specific Report (WHC 1990b)].

Figure 4-3 is a schematic of the URW system. Nine contributors feed the 242-A Evaporator cooling water waste stream. These contributors, in order of volumetric rate contribution to the stream, are as follows.

1. **Condenser cooling water** [13,626 L/min (3,600 gal/min)]--Raw cooling water flows through the condensers. No chemicals are introduced into the water by this cooling process. To ensure flow, the cooling water in each of the three condensers is maintained at a positive pressure of 5.6 kg/cm^2 (80 lbf/in^2). The vacuum side of the condensers (process condensate side) is maintained with a vacuum of approximately 63.5 cm (25 in.) of water. This differential pressure

across the condenser cooling water tubes prevents the process condensate from entering the cooling water stream in the event of tube leakage. An in-line radiation monitor and proportional sampler (R-C-2) is located downstream of the condensers.

2. **Air compressor cooling water** [37.9 L/min (10 gal/min)]--Single-pass raw water cools two air compressors providing process and instrument air. No chemicals are added.

3. **Emergency steam turbine condensate** [30.3 L/min (8 gal/min) when running]--Following the loss of the normal HVAC system fan, steam drives an emergency turbine fan that maintains safe ventilation (and air pressure differentials) in the various facility zones. The steam condensate contains only water and nonhazardous carryover chemicals.

4. **Steam trap condensate** [less than 37.9 L/day (10 gal/day)]--The HVAC system steam traps feed the HVAC room drain funnel. Steam condensate collected contains no hazardous wastes. Chemicals added to the boiler makeup water contain no hazardous wastes.

5. **Compressed air dryer discharges** [less than 37.9 L/day (10 gal/day)]--An air dryer processes compressed air for use in the instrument air system. No chemicals are added and fresh atmospheric air is filtered before compression.

6. **Water filter catch pan drainage** [less than 37.9 L/day (10 gal/day)]--Raw water and oversized particles from the raw water filters are collected in the catch pans. The filters provide filtered water for the deentrainment pads and the desuperheater. No chemicals are introduced. No sampling or monitoring is provided for this effluent stream.

7. **HVAC room floor drains** [less than 3.785 L/day (1 gal/day)]--These floor drains contribute wastewater to the cooling water waste stream on a periodic basis. No chemicals or hazardous materials are stored in the room serviced by the floor drains.

8. **Steam system relief valve discharges** [less than 3.785 L/day (1 gal/day)]--If the HVAC system steam relief valves over pressurize, steam vents to the drain funnel. No hazardous chemicals are contributed by the steam.

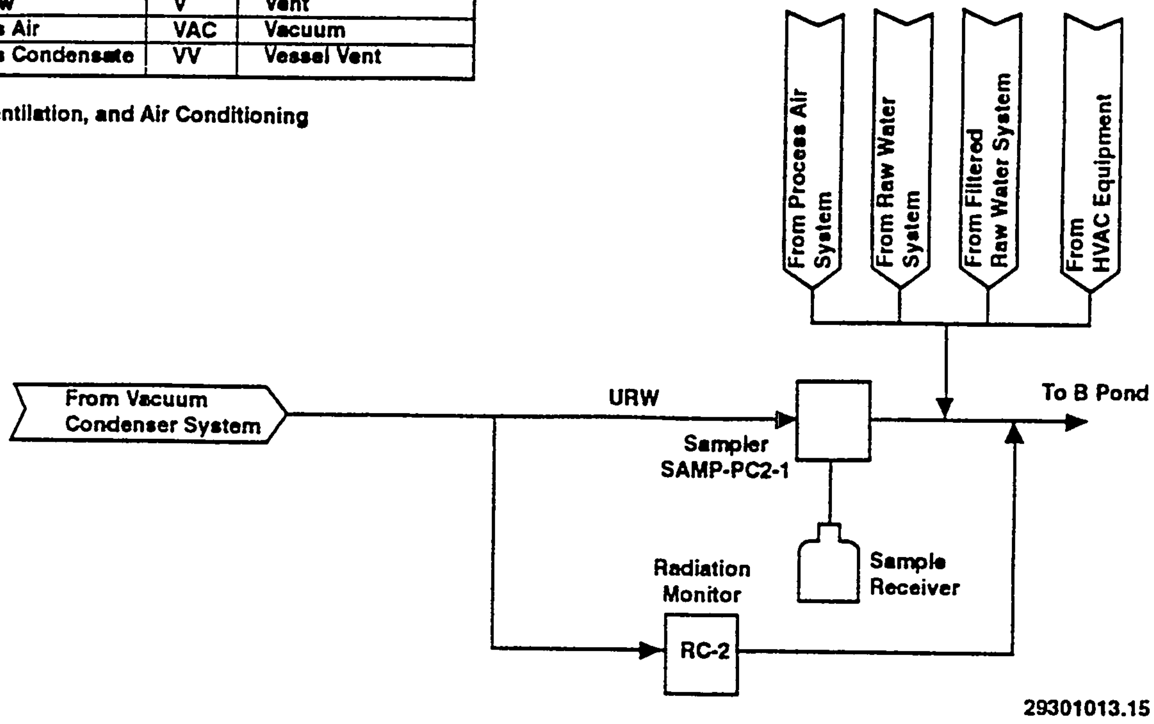
9. **Compressed air receiver condensate** [less than 3.785 L/day (1 gal/day)]--The air receiver or air storage tank is periodically drained. Air condensate contributes no hazardous waste.

During evaporator processing operations, all nine contributors are potentially adding liquid to the stream. During shutdown and maintenance periods, however, the condenser cooling water and the water filter catch pan drainage will not contribute to the stream. Shutdowns of the facility process operations can vary in length from one month to several months or even years, as in the case of the current facility upgrade shutdown period.

Figure 4-3. Process Configuration for the 242-A Cooling Water Stream.

PIPING ABBREVIATIONS			
AF	Antifoam	PS	Process Sewer
AS	Air Sample	PW	Process Waste
DECON	Decontamination	RW	Raw Water
DR	Drain	SC	Steam Condensate
EF	Evaporator Feed	SL	Slurry
EL	Eluant	STM	Steam
FRW	Filtered Raw Water	SW	Sanitary Water
I	Instrument	U	Utility
IA	Instrument Air	URW	Used Raw Water
OVFL	Overflow	V	Vent
PA	Process Air	VAC	Vacuum
PC	Process Condensate	VV	Vessel Vent

HVAC = Heating, Ventilation, and Air Conditioning



The condenser cooling water from the evaporator subsequently flows into a 61-cm- (24-in.-) diameter pipe where it combines with the other eight contributors to form the overall 242-A Evaporator cooling water effluent stream. This combined effluent is then routed to the 216-B-3 Pond, which receives liquids for soil column disposal. The 216-B-3 Pond covers an area of 123,348 m^2 (100 acres) and is used as a percolation pond. Because the condenser cooling water is the only stream with a potential to contribute hazardous waste to the 242-A Evaporator cooling water stream, the effluent discharge point is located (by definition) at the R-C-2 sampler and monitor point.

4.1.2.2 Steam Condensate Stream. The 242-A Evaporator steam condensate waste stream is given the Hanford Site stream code of *ASC*. This waste stream consists primarily of steam condensate exiting the reboiler section of the evaporator process. The proposed waste stream designation is that this stream is not a dangerous waste, pursuant to the WAC 173-303, *Dangerous Waste Regulations* (WAC 1989). A combination of process knowledge and sampling data was used to make this determination.

As shown in Figure 4-4, 10 contributors feed the 242-A Evaporator steam condensate waste stream:

1. **Reboiler Steam Condensate:** 22.7 L/min (≃6 gal/min)--Steam is required in the evaporation process to heat the process fluids for evaporation and concentration. Steam pressure is reduced in several stages to the necessary pressure before it enters the 40.6-cm- (16-in.-) diameter feed line to the reboiler. Before use in the reboiler, and to ensure saturation, the steam temperature is lowered by adding filtered raw water in a desuperheater (DS-H-1).

2. **Steam Condensate and Raw Water from Heating and Cooling Jackets:** 264.95 L/hr (70 gal/hr)--Decontamination Solution Tank TK-E-104 and Eluant Tank TK-E-101 are equipped with heating jackets that allow the contents of these tanks to be maintained at desired temperatures. The flowout of these jackets is combined and discharged into the steam condensate effluent stream.

3. **Purging System Steam Trap Condensate:** [negligible flow, 3.785 L/hr (<1 gal/hr)]--A purging system is used to clear instrument piping needed to obtain specific gravity measurements of tank waste. The steam supply used for this system is equipped with a steam trap that drains into the steam condensate effluent stream.

4. **Steam Strainer Condensate:** Condensate from the steam strainers in the supply line to the steam ejector system drain into the waste stream. The steam ejectors are used to maintain a vacuum in the evaporator vessel. This condensate flows into a 5-cm (2-in.) drain funnel that drains into the main steam condensate line.

5. **Steam Separator Condensate:** Condensate from the steam separator in the steam ejector system drains into the waste stream. This condensate flows into the drain funnel.

6. **Steam Separator Strainer Blowdown:** Condensate from blowdowns of the steam separator strainer flows into the waste stream. This condensate flows into the drain funnel.

7. **Seal Water Pressure Control Valve Discharge:** Seal water from the process pumps is bled into the waste stream when excessive pressure is present. If the seal water pressure exceeds 10.6 kg/cm^2 (150 lbf/in^2) (gauge), the seal water pressure control valve opens to bleed water to the waste stream. This valve remains open until the pressure is below 10.6 kg/cm^2 (150 lbf/in^2) (gauge). The discharge from this stream also flows into the drain funnel.

8. **Microfilter Catch Pan Drainage:** Drainage from the microfilters drains to a catch pan, which in turn drains to the drain funnel discussed above. These microfilters are required to filter raw water used in the deentrainer pad spray for the evaporator.

9. **Seal Water Pumps and Filter Catch Pan Drainage:** Leakage from the pump seal water system and drainage from the seal water pump filters drain into a catch pan and subsequently drain into the waste stream.

10. **R-C-1 Sampler/Monitor Cooler Raw-Water Discharge:** 37.9 L/hr (10 gal/hr)--Raw water used in the cooler for the R-C-1 sampler drains into the main condensate line to Tank C-103.

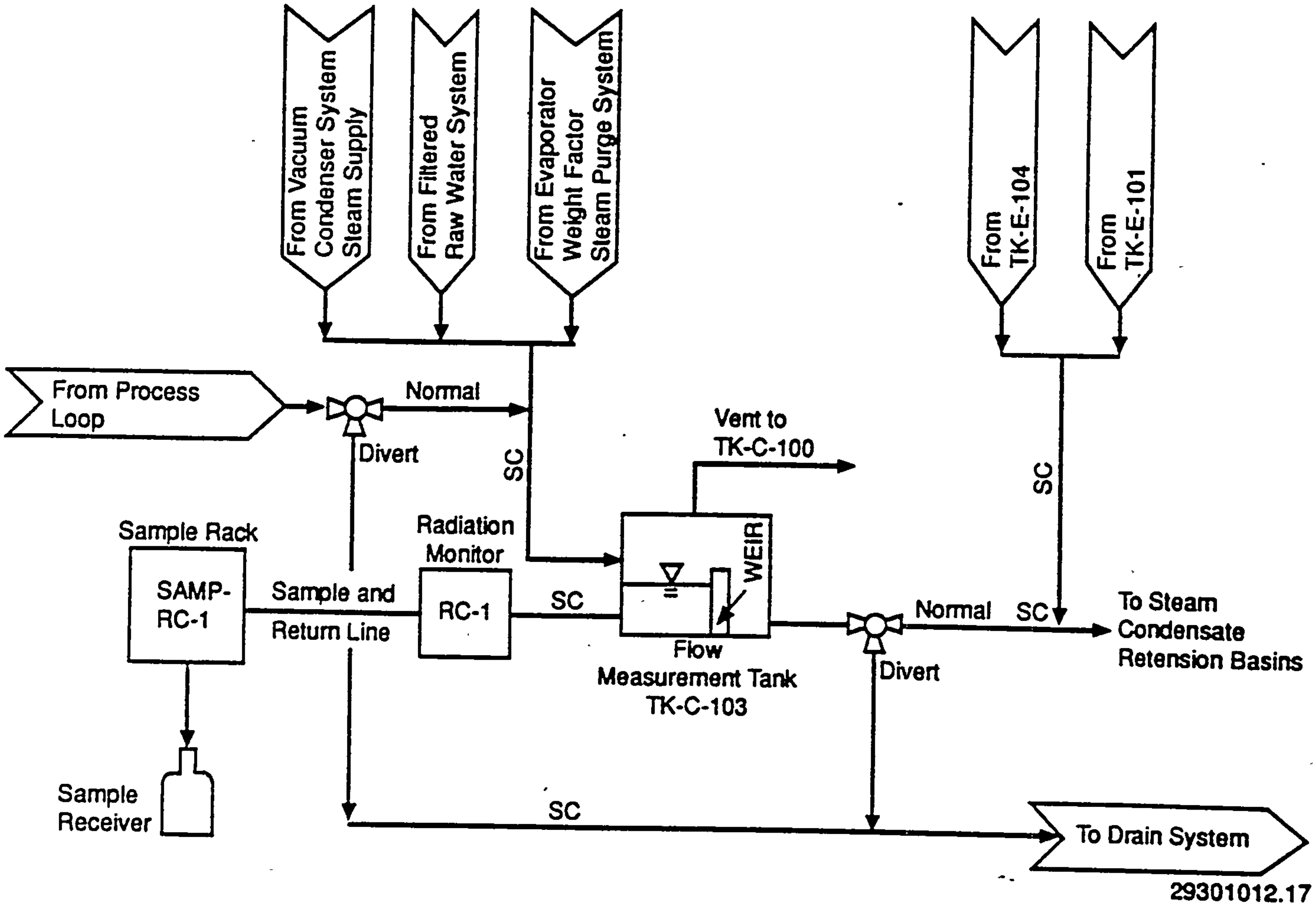
All contributors to the waste stream, except the heating and cooling jacket streams for eluant Tanks TK-E-101 and TK-E-104, converge and then pass through an in-line radiation monitor (RE-EA1-1) before flowing into a 1,892.5-L (500-gal) flow measuring tank (TK-C-103). Diversion valves are provided before the flow measurement tank (valve HV-EA1-2) and after the tank (valve HV-RC1-3). These valves are capable of diverting the flow to the process drain system and ultimately to the waste feed tank (241-AW-102 DST) in the case of an upset condition, particularly if high radiation is detected in the stream. These valves direct stream flow to the 207-A Retention Basins during normal operations.

The steam condensate flows into one of the three cells at the 207-A Retention Basins until that cell has reached operational capacity. At that time the steam condensate flow is diverted to one of the two remaining cells. Samples are taken at the RC-1 sampler. These samples are analyzed at the 222-S Laboratory for radionuclides as an indication of process control or the 222-S Laboratory FEMP for more information on procedures and analytical methods). The steam condensate from the full cell is then discharged to the 216-B-3 Pond (located northeast of the 200 East Area) if the analytical results are within set radionuclide limits.

The effluent discharge point for the 242-A Evaporator steam condensate stream is located at the 207-A Retention Basins sample point. This is the point where final sampling and diversion capabilities exist for the stream before discharge to the environment.

Figure 4-4. 242-A Evaporator Steam Condensate Waste Stream.

Piping Abbreviations			
AF	Antifoam	PS	Process Sewer
AS	Air Sample	PW	Process Waste
DECON	Decontamination	RW	Raw Water
DR	Drain	SC	Steam Condensate
EF	Evaporator	SL	Slurry
EL	Eluant	STM	Steam
FRW	Filtered Raw Water	SW	Sanitary Water
I	Instrument	U	Utility
IA	Instrument Air	URW	Used Raw Water
OVFL	Overflow	V	Vent
PA	Process Air	VAC	Vacuum
PC	Process Condensate	VV	Vessel Vent



4.1.2.3 Process Condensate Stream. The 242-A Evaporator process condensate waste stream is given the Hanford Site stream code *AFPC*. This waste stream is a collection of the condensable materials carried over from the evaporation process into the condensers. These materials collect within the facility in Tank TK-C-100 where they are pumped out for filtration of radionuclides and disposal. The proposed waste stream designation for the 242-A Evaporator process condensate waste stream is that this stream is a dangerous waste, pursuant to the WAC 173-303, "Dangerous Waste Regulations" (WAC 1989). A combination of process knowledge and sampling data was used to make this determination.

Process condensate from the 242-A Evaporator will be stored temporarily at the LERF that is currently under construction. The waste will be stored until the ETF is operational. The ETF is under construction and testing at this time. The LERF consists of three identical 24.6-ML (6.5-Mgal) surface impoundments (retention basins). Two of the basins will be used to store process condensate (PC). The third will be kept empty and used as contingency space. The process condensate waste stream will be piped directly through dual-encasement buried lines to the treatment facility when it is operational.

Following treatment, the stream will be disposed of to a Washington State-approved soil disposal site or to the Columbia River.

For the purposes of this FEMP, the 242-A Evaporator process condensate stream is not considered as a facility effluent because it will not be discharged/released to the environment. For more information concerning the process condensate stream, reference may be made to WHC-EP-0342, Addendum 15, *242-A Evaporator Process Condensate Stream-Specific Report* (WHC 1990c).

4.1.2.4 Evaporator Slurry Stream. The evaporator slurry stream is the treated waste stream from the facility that contains essentially all of the radionuclides and inorganic constituents. After treatment in the vapor-liquid separator, the waste (slurry) is transferred through two encased lines (pipe-in-pipe) from the 242-A Evaporator to one of two valve pits in the 242-AW Tank Farm. The two encased lines are equipped with leak detectors between the primary and encasement piping. The detection of any leak will automatically shut off the slurry pump, thus preventing leaks into the environment.

For this FEMP, the evaporator slurry (treated waste) stream is not considered as an effluent because it is fed back through dual-encasement transfer lines into the DST system for further treatment. This stream is not discharged to the environment.

4.1.2.5 242-A Building Drainage Stream. Four branches of the drainage piping system provide drainage for the 242-A Evaporator building. Figure 4-5 presents a flow diagram of the drainage system.

The first branch is a 15.2-cm- (6-in.-) dia, schedule 40, carbon steel pipe that drains the AMU, the survey room, the condenser room, and the ion exchange column room.

The second branch is a schedule 40S, stainless steel pipe ranging in diameter from 3 to 10 in. This branch drains the loading room, the loadout and hot equipment storage room, the HVAC room, and other miscellaneous drains to the pump room sump, which is located in the northwest corner of the pump room. The following streams drain to the pump room sump:

- Loading room 7.6-cm (3-in.) floor drain
- Ten-inch raw-water line backflow preventer drain
- Slurry pump drip pan
- Slurry pump seal water
- Recirculation pump seal water
- Feed sample drain
- Slurry sample drain
- Evaporator room 7.6-cm (3-in.) floor drain:
  - Vacuum breaker drain
  - Filtered raw-water line backflow preventer drain
  - Two-inch raw-water line backflow preventer drain
  - Two-inch decontamination line vacuum breaker drain.

From the sump, liquids are either moved to the feed tank (241-AW-102) using a sump jet gang valve system or allowed to drain by gravity.

The third drain branch is a 7.6 cm- (3-in-) diameter, schedule 40, carbon steel pipe that drains the ion exchange column. The drain is encased in a 15.2-cm- (6-in.-) dia pipe for secondary containment when it exits the building. The pipe joins the pump room sump drain outside the building.

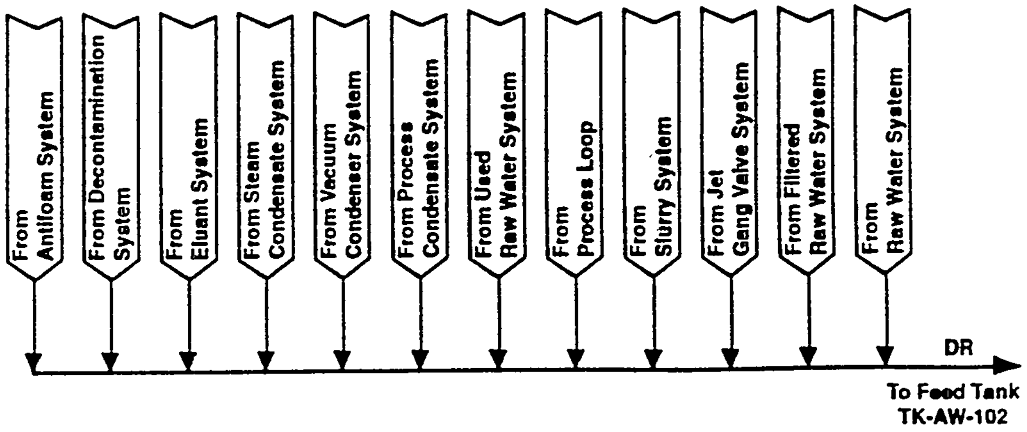
The fourth drain has a remotely operated valve (HV-CA1-7) that allows the vapor-liquid separator to be drained to the feed tank from a connection on the recirculation line. The drain is a 304L stainless steel schedule 40S pipe. Outside the 242-A Building, the pipe diameter is increased to 25.4 cm (10 in.) and encased in a 30.5-cm- (12-in.-) diameter carbon steel pipe for secondary containment.

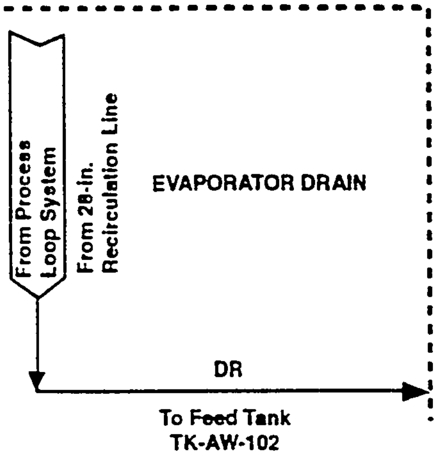
All waste liquids, which enter the building drainage piping, gravity drain with sufficient hydraulic head to the 242-A Evaporator feed tank (TK 241-AW-102). Thus, loss of facility power does not affect the ability of the system to contain waste or waste constituents.

For the purposes of this FEMP, the 242-A Building drainage stream is not considered an effluent because it is fed back through dual-encasement transfer lines into the DST system for further treatment. This stream is not discharged to the environment.

4.1.2.6 242-A Building Sanitary Waste Stream. Nonradiological, nonhazardous liquid wastes are emitted from the 242-A facility via the sanitary sewer. The sanitary sewer flow originates in the men's and women's change room from the toilets, showers, and wash basins. The sewer line extends underground east of the 242-A Evaporator facility and under Canton Street to an underground septic tank and tile field ground disposal system.

Figure 4-5. 242-A Evaporator Drain System.





PIPING ABBREVIATIONS			
AF	Antifoam	PS	Process Sewer
AS	Air Sample	PW	Process Waste
DECON	Decontamination	RW	Raw Water
DR	Drain	SC	Steam Condensate
EF	Evaporator Feed	SL	Slurry
EL	Eluant	STM	Steam
FRW	Filtered Raw Water	SW	Sanitary Water
I	Instrument	U	Utility
IA	Instrument Air	URW	Used Raw Water
OVFL	Overflow	V	Vent
PA	Process Air	VAC	Vacuum
PC	Process Condensate	VV	Vessel Vent

29301012.14

The sanitary sewer system is isolated from the other facility systems. The only radioactive discharge that might reasonably occur would result from inadequate survey of personnel leaving contaminated areas and their subsequent bathing. The release to the environment under these circumstances would be negligible. To prevent this situation from occurring, personal surveys are conducted by trained health physics technicians at all step-off pads.

Administrative controls prohibit the dumping of chemicals into the 242-A Evaporator sanitary sewer system. Contributors to this stream are considered nonhazardous.

4.1.2.7 242-A-81 Building Drainage. Liquids collected in the 242-A-81 Raw-Water Building are drained from the building via a 15.2-cm- (6-in.-) diameter carbon steel pipe to a 30.5-cm- (12-in.-) diameter chemical sewer serving the 200 East Area. No hazardous materials enter Building 242-A-81. The building is not used for storage and is kept locked. The building has no potential for contributing hazardous wastes to this stream.

4.1.2.8 Storm Drain and Facility Grounds Runoff. The 242-A facility grounds have sufficient slope to allow storm runoff to drain with gravity flow to its perimeter. There are no underground storm drains at the grounds. Because the building itself is designed and exists as a containment system for all process liquids, there is no contribution of radioactive or hazardous materials to this stream.

4.1.3 242-A Building Solid Waste

Solid waste from the facility consists primarily of laundry, rubber gloves, paper, plastics, and failed or replaced HEPA filters. The rubber gloves, paper, and plastics must be disposed of in accordance with WHC-CM-5-16, *Hazardous Waste Management* (WHC 1989b). These wastes are usually low-level radioactive wastes. Currently, low-level solid waste is stored at the 209E Building in the 200 East Area. Failed or replaced HEPA filters, as well as other process equipment, must be packed and buried in accordance with WHC-CM-5-16. Laundry is collected daily and stored temporarily until it can be sent to the laundry.

Laundry, if contaminated above allowable levels (radiation protective clothing contaminated in excess of 40,000 disintegrations per minute alpha or 50 mRad/hr), must be disposed of as contaminated waste. If below disposal limits, it is labelled appropriately and sent to the laundry for cleaning.

Uncontaminated, nonhazardous wastes are buried at the central landfill. The nonradioactive, nonhazardous solid wastes are manually collected in standard waste containers, plastic bags, and paper board boxes. These containers are emptied into a dumpster. The dumpsters are periodically emptied into large compactor trucks, where the waste is compacted and transported to the Hanford Site central landfill. Periodically, the nonhazardous, nonradioactive wastes are monitored by an HPT to ensure that the wastes are nonradioactive. During monitoring by the HPT, a visual check is made to ensure that the solid wastes do not contain hazardous materials. A sample is taken of solid waste when the presence of hazardous materials is suspected. If the sample results confirm that the waste contains hazardous materials at concentrations above the requirements found within WAC 173-303 (WAC 1989), the waste is designated as nonradioactive, hazardous waste, accumulated in approved 208-L (55-gal) containers and stored in the 200 West Area until the drum can be transported offsite to a state-approved hazardous waste burial site.

4.2 IDENTIFICATION AND CHARACTERIZATION OF SOURCE TERMS CONTRIBUTING TO EACH EFFLUENT STREAM

There are four effluent streams discharged into the environment from the 242-A Evaporator (as described in the previous section) that require further examination. These streams are the focus of the rest of this FEMP. These streams are as follows:

- The airborne effluent stream discharged from the vessel vent stack 296-A-22
- The airborne effluent stream discharged from the building exhaust stack 296-A-21
- The liquid steam condensate effluent stream
- The liquid used cooling water effluent stream.

This section is provided to characterize the discharges of these streams during both nominal and upset conditions. Historical data are used for this purpose. Sections 6.0 through 9.0 discuss the monitoring and sampling performed on these streams.

4.2.1 Routine Operating Conditions

This section characterizes the effluents from the four streams during normal operating conditions.

4.2.1.1 Vessel Vent Stack 296-A-22: Radionuclide emission data from the evaporator vessel vent stack during normal operating conditions were presented in Revision 0 and 1 of this FEMP. The emissions given, were those that were actually reported in the annual emission reports (see Section 8.1.1 for reference to those reports). From these emissions, a potential public effective dose equivalent (EDE) was calculated using a HEPA filter decontamination factor of 3000 along with the appropriate computer model (CAP-88) conversion factors. The original potential public EDE came to 0.13 mrem/yr (see Table 4-2). Since that time EPA has rejected the decontamination factor used, declaring that a factor of 3000^n is more appropriate - where n stand for the number of HEPAs in series. Applying this new 3000^n factor changes the original 0.13 result to 390 mrem/yr.

Because the original method was rejected and since the NESHAP regulations require that the potential public EDE be established for each emission point on the Hanford site, this EDE assessment was re-accomplished for all Tank Farm stacks, including 296-A-22, in WHC-SD-WM-EMP-031, *Determination of NESHAP*

Status of Tank Farm Stacks Based on Calculations Using 40 CFR, Part 61, Appendix D Factors. WHC-SD-WM-EMP-031 used Appendix D factors in determining the potential EDE for the following reasons:

- The method was a regulatory given method. No specific approvals had to be acquired to use it. By regulation, use of any other method required regulatory approval.
- A method was needed that could be used in a variety of situations existing around Tank Farms. Appendix D is designed to be used in that way.
- It is generally believed that the Appendix D method is extremely conservative. This is because the release fractions allowed are extremely conservative. The real purpose, however, in determining the potential public EDE was to determine if the potential existed to exceed 0.1 mrem/yr. If the results were conservative, they would still be acceptable.
- It was not known if all the possible specific radionuclides were being measured. This affected the decision to use the real emission approach. Because it wasn't known if all possible radionuclides were being measured, then it wouldn't be known if the results using a decontamination factor of 3000" would be valid.
- It was not known how efficient the sampling systems were and if real emission data would give reasonable results. For instance, if the sampling collection efficiency was low, then the results using real emission data could be off significantly. This would raise questions in those cases where the potential EDE were close to the 0.1 mrem limit.
- The Appendix D method was tied to use of a source term and would prove beneficial in providing a basis for which specific radionuclides had to be measured.
- Other scientific methods were explored which based emissions on available source term. The results were not that much different from the results generated from the Appendix D method.

In use of Appendix D in WHC-SD-WM-EMP-031, the source term data presented in Table 2-1 of this FEMP were decayed to September 1993. After applying the appropriate CAP-88 conversion factors the resultant potential EDE came to 50.2 mrem/yr.

Table 4-2 was left in this FEMP for historical purposes. Because the evaporator has only recently started up again (April 15, 1994) new emission data is being acquired and will become available at the end of 1994.

Table 4-2. Stack 296-A-22 Gaseous Radioactive Effluent Emissions.

Emission	Maximum (μCi/mL)	Annual release with controls (Ci)	Annual release without controls (Ci)	CAP-88 conversion factor	CAP-88 offsite dose (mrem)	% of total dose
^{137}Cs	1 E-14	1.03 E-07	0.0003	2.39 E-02	7.39 E-06	0.006
^{129}I	2 E-11	2.06 E-04	2.06 E-04[1]	2.91 E-01	6.0 E-05	0.05
^{106}Ru	2 E-10	2.06 E-03	6.18	2.09 E-02	0.13	98.9
^{103}Ru	4 E-14	4.12 E-7	0.0012	1.42 E-03	1.76 E-6	0.001
^{113}Sn	4 E-13	4.12 E-06	0.012	1.18 E-03	1.46 E-05	0.01
^{89,90}Sr	4 E-14	4.12 E-07	0.0012	4.38 E-02[2]	0.0001	0.08
^{125}Sb	1 E-11	1.03 E-04	0.31	4.15 E-03	0.0013	1.0
Total offsite dose					0.13	

[1] The 3000 factor is not used here because iodine is gaseous and would pass through the HEPA filters. The quantity of iodine released should, therefore, be the same with or without HEPA filters.

[2] Conversion factor good for ^{90}Sr only. ^{89}Sr is not listed.

The following information is provided to help the reader understand the units used in Tables 4-2 and 4-3:

- Ci is an abbreviation for curie which is the unit used for measuring radioactivity
- A μCi is 1/1,000,000 of a curie
- A mL is 1/1000 of a liter.

4.2.1.1.1 **Radionuclide emissions of concern from the Vessel Vent Stack 296-A-22**: The regulations (40 CFR 61.93) requires continuous measurement of all radionuclides that could contribute 10% or greater to the potential public EDE if that particular emission point has the potential to cause an EDE of 0.1 mrem/yr or greater. The results given WHC-SD-WM-EMP-031 provides the first step, in a two step approach being used to determine what these 10% contributors are. The second step is to compare real emission data to what Appendix D predicts. If any radionuclides are not present in this data, they will be eliminated from the future measurement process. Listed below are the major contributors given WHC-SD-WM-EMP-031 for the 296-A-22 stack:

Radionuclide	EDE	Percent
$^{89/90}$Sr	1.239	2.468
^{106}Ru/Rh	41.90	83.47
^{129}I	0.1019	0.2012
^{137}Cs	4.630	9.223
$^{239/240}$Pu	0.1873	0.3731
^{241}Pu	0.2530	0.5040
^{241}Am	1.759	3.504

Ruthenium-106 has not been seen above detection limits in the double-shell tank emissions for the last couple of years. Since ^{106}Ru has a relatively short half life of about one year, it is not known if the emission data (or lack of it) indicates that this radionuclide has decayed and/or volatilized away, or if it has just settled to the bottom of the tanks. It is expected that evidence as to which happened should be provided in the 1994 annual emissions. With the recent processing at the evaporator, the waste is now being stirred up and if ^{106}Ru has indeed settled to the bottom of the tanks, it should be present in the 1994 emission data, if still there. If not, maybe its gone. If it is truly gone or lower than expected, the new percentages will need to be determined. These may be as follows:

Radionuclide	EDE	Percent
$^{89/90}$Sr	1.239	14.9
^{129}I	0.1019	1.2
^{137}Cs	4.630	55.8
$^{239/240}$Pu	0.1873	2.2
^{241}Pu	0.2530	3.0
^{241}Am	1.759	21.2

If this is the case, $^{89/90}$Sr, ^{137}Cs, and ^{241}Am will be the major contributors. These values will need to be adjusted to reflect real emission data, not the Appendix D values.

4.2.1.1.2 Potential Tritium Emissions from the Vessel Vent Stack 296-A-22: Continuous tritium sampling is not currently accomplished in this stack. Because, from time to time the question arises as to whether tritium sampling is necessary, this section will address this subject.

As discussed above, continuous measurement is required for all radionuclides that could contribute 10% or greater to the potential offsite dose consequence if that particular emission point has the potential to cause a public EDE 0.1 mrem/yr or greater. Also given above were the method and results for those 10% contributors. However, Table 2-1 shows tritium levels were not established in the source term for this stack. Therefore, emission consequences or percentages to those consequences cannot be computed for tritium using the method given in 40 CFR 61, Appendix D. As such, a different method is used here.

As a conservative approach, note that the lowest possible limit which would require a radionuclide to be continuously measured is if the potential public EDE for that potential radionuclide resulted in 0.01 mrem/yr. This would be the case if the potential EDE for that emission point, as a whole, resulted in 0.1 mrem/yr. For this discussion, this is assumed to be the potential public EDE (0.01 mrem) that must be exceeded for the continuous measurement requirement to be invoked.

Tritium sampling was conducted from the 296-A-22 stack on February 7, February 8, March 1, and March 7 of 1989. The analytical results of this sampling were discussed in Internal Memo 12715-ASL-136 (WHC 1989d). The results in this memo determined the concentration of tritium in this stack to be 8.9E-09 μCi/ml. From this and the volumetric flow data given in Table 8-1 (1.03E+10 L or an average of 692 CFM) a total annual release can be calculated. This quantity computes to 9.2E-02 Ci. To determine the potential EDE, this release must be determined with no engineering controls in place (no HEPA filtration). Tritium is gaseous. As such, HEPA filters would provide little or no control over its release. HEPAs are primarily designed to control the release of particulate matter. Consequently the 9.2E-02 Ci annual release quantity would represent those emissions with no controls in place and thus the potential tritium emissions. To convert this quantity to the public EDE requires multiplication by the CAP-88 conversion factor of 2.19E-05 mrem/Ci. The product of these two quantities results in 2.0E-06 mrem/yr.

In conclusion: This dose consequence is far below any regulatory required measuring mandate. Therefore, tritium sampling in this stack is not required.

4.2.1.1.3 Nonradionuclide Emissions From the Vessel Vent Stack. Nonradionuclide analysis data are not currently available for the vessel vent effluent. However, emission calculations were provided for certain chemicals by Westinghouse Environmental and Geotechnical Services, Inc.

Nonradionuclide emissions originate as gases in the process condensate collection tank (tank C-100). These gases are vented and released through the vessel vent stack. The highest permitted temperature in the process condensate collection tank is 145 °F (335 K). An alarm is set to activate at this temperature. Using this fact and figures prepared as part of a model in DOE/RL-90-42 (DOE-RL 1990), Table 4-4 was developed and shows what might be released. The second and third columns in this table are equivalent, but use different units and release times. The third column is important because it shows how much might be released in a 24-hour period. The last column within this table contains the CERCLA RQ limits. The quantities are not sufficient to cause concern. However, these values are provided for completeness.

Release data for ammonia are available. Ammonia samples (Drager tube* samples) were taken from the vessel vent system between the dates of January 1, 1989, and March 24, 1989. For each sample, ammonia releases were an average of 0.36 kg (0.797 lb) and a maximum of 19.5 kg (42.875 lb). A mean rate was calculated as 0.36 kg/day (0.797 lb/day) [reference: Internal Memo 1331-90-012; (WHC 1990f)]. The total amount of ammonia released from the

---

*Drager tube is a trademark of Dragerwerk, AG.

Evaporator Stack in 1989, as reported in the *Superfund Amendments and Reauthorization Act of 1986* (SARA) 313 Report, was 59 lb (the 1988 quantity was 200 lb).

Table 4-4. Stack 296-A-22 Gaseous Nonradioactive Emissions.

Chemical	Emission rate at maximum concentration of process condensate (lb/hr)	Maximum daily emission rate (kg/24 hr)	CERCLA reportable quantity (kg)
Acetone	2.42 E-2	0.2640	2,270
1-Butanol or butyl alcohol	1.817 E-1	1.9822	2,270
2-Hexanone	8.727 E-5	0.0010	none
Methyl isobutyl ketone (MIBK-Hexone)	1.654 E-3	0.0180	2,270

4.2.1.2 Building Ventilation Stack (291-A-21): Airborne effluents from the building process and support zones are discharged to the atmosphere via the 296-A-21 Building ventilation stack. Emissions from this stack are reported annually. The most recent reports are identified as follows:

- DOE/RL-91-10, *Calendar year 1990 Air Emissions Report for the Hanford Site*
- DOE/RL-92-30, *Radionuclide Air Emission Report for the Hanford Site Calendar Year 1991*
- DOE/RL-93-36, *Radionuclide Air Emission Report for the Hanford Site Calendar Year 1992*
- DOE/RL-94-51, *Radionuclide Air Emission Report for the Hanford Site Calendar Year 1993*

The potential to emit from this stack was determined in WHC-SD-WM-EMP-031, *Determination of the NESHAP Status of Tank Farm Stacks Based on Calculations Using 40 CFR, Part 61, Appendix D Factors*. Appendix D to Part 61 of 40 CFR provides methods for estimating radionuclide emissions. These methods can be used for dose calculations instead of measuring the actual emissions. Two parameters for each radionuclide must be known: the activity level and the physical state. The activity level is determined from the inventory of radionuclides involved. Appendix D provides release factors that depend on the physical state of the radionuclide. These factors are "1" for gases, "1E-3" for liquids or particulates, and "1E-6" for solids. The activity level is multiplied by the release factor to calculate the amount of activity for each radionuclide that would be available for emission to the atmosphere if no controls (e.g., HEPA filtration) were available. The releasable amount is multiplied by a dose conversion factor (i.e., the CAP-88 factor) for that radioisotope to estimate the potential offsite dose due to that specific radioisotope. The potential doses for all of the radioisotopes are added to calculate the total potential offsite dose due to entire source inventory involved.

The source inventory used WHC-SD-WM-EMP-031 for the 296-A-21 stack was derived by basing the radionuclide inventory on levels for "high contamination level" in accordance with WHC-CM-1-6 assuming worse case alpha (^{241}Am) and Beta (^{90}Sr/^{90}Y) as representative. This level of contamination was then assumed to be uniformly distributed over all ventilated surface areas. The following are those surface areas.

Room	Length m (ft)	Width m (ft)	Height m (ft)	Total surface area (sq cm)
Pump	6.77 (22.2)	5.49 (18)	3.81 (12.5)	1.68E+06
Evaporator	6.77m (22.2)	7.74 (25.4)	2.82 (71.6)	7.38E+06
Condenser	7.32 (24)	8.23 (27)	2.82 (71.6)	7.99E+06
Loadout/Hot storage	6.77 (22.2)	3.66 (12)	11.09 (36.4)	2.81E+06
Loading	7.28 (23.9)	3.66 (12)	3.35 (11)	1.27E+06
Total surface area (sq cm)				2.11E+07

WHC-CM-1-6 defines "high contamination level" as

> An area where contamination levels are greater than 100 times the values specified in Section 2.0, Table 2-3 of this manual.

Table 2-3 of WHC-CM-1-6 gives these values as 20 dpm/100 sq cm for transuranics (applicable for ^{241}Am) and 1,000 dpm/100 sq cm for beta-gamma emitters (applicable for ^{90}Sr and ^{90}Y). This method (used WHC-SD-WM-EMP-031) derived a total radionuclide inventory that would be available as:

^{241}Am	1.89E-04 Ci
^{90}Sr	9.50E-03 Ci
^{90}Y	9.50E-03 Ci.

From these values, the potential offsite EDE calculated to 2.896E-06 mrem/yr.

During revision 2 of this FEMP it was decided to evaluate the reasonability of the method used in WHC-SD-WM-EMP-031. As such, on September 29, 1994, the evaporator was visited to ascertain what contamination levels might actually be present.

As expected, levels varied from no removable contamination in some rooms to others having varing levels. To be conservative in this evaluation and because the exact amount of surface area per level of contamination could not be determined*, the highest level found was assumed to be spread uniformly through out the room it was found in. These highest room removable contamination levels were found to be as follows (in dpm/hr per 100 sq cm):

Evaporator room second level	45k
Pump room	7k
Loadout room on the sample hood	30k.

*The Radiation Control Technician (RCT) on duty at the time said that the areas of contamination were not known and that all counts were beta-gamma - no alpha.

Using this extremely conservative approach resulted in a source term of 1.9E-03 Ci. Since this value is less then the values derived in WHC-SD-WM-EMP-031, the method used was assumed to be reasonable.

As mentioned above, the potential EDE for this stack was determined to be 2.896E-06 mrem/yr. NESHAP requires that if any one emission point could potentially cause any member of the public to be exposed to greater than or equal to 0.1 mrem/yr, then that emission point must measure the emissions continuously according to those methods and standards specified in the regulations. The regulations go on to state that if the emission point is shown to result in potentially less than or equal to 0.1 mrem/yr, than only periodic confirmatory measurements are required. Because the determined emission levels are below the 0.1 mrem limit, further regulatory evaluation is not necessary.

4.2.1.3 Steam Condensate. Radionuclide source term data for the 242-A Evaporator steam condensate stream are presented in Section 8.1.3, Table 8-3.

Column (2) in Table 4-5 contains the maximum values listed in Table 8-3.

Column (3) contains data from WHC-EP-0342, Addendum 26, *242-A Evaporator team Condensate Stream-Specific Report* (WHC 1990).

From these two columns, the maximum specific radionuclide release, in curies, over a 24-hour period were calculated. This was done by taking (from Table 8-3) the maximum recorded flow for the year ($8.5 \times 10^{+07}$ L) and dividing this figure by 365 day/yr to give a daily flow rate of 232,876 L/day. This value was used to calculate the figures in the next column (4).

Table 4-5. Steam Condensate Radionuclide Source Terms.

(1) Effluent	(2) Maximum from Table 8-3 (µCi/mL)	(3) WHC-EP-0342 (µCi/mL)	(4) Maximum 24-hr release (Ci)
Alpha	9.1 E-09	9.44 E-10	2.12 E-06
Beta	8.5 E-08	6.27 E-09	1.98 E-05
^{14}C		4.5 E-09	1.05 E-06
^{3}H	1.2 E-04		0.028
^{137}Cs	7 E-08		1.63 E-05
Uranium	2.9 E-09		6.75 E-07
^{234}U		2.01 E-10	4.68 E-08
^{238}U		1.78 E-10	4.14 E-08
$^{239,240}Pu$	1.3 E-08		3.03 E-06
$^{89,90}Sr$	2 E-08	6.88 E-10	4.66 E-06

Table 4-6 contains the nonradionuclide source term for the 242-A Evaporator steam condensate stream. The data in this table were obtained from WHC-EP-0342, Addendum 26, *242-A Evaporator Steam Condensate Stream-Specific Report* (WHC 1990d).

From Table 8-3, the maximum yearly total recorded flow was 8.5 x 10^{+07} L. This figure divided by 365 day/yr gives a daily flow rate of 232,876 L/day. This value was used to determine if the CERCLA RQ values are exceeded.

The following information is provided to help the reader understand the units used in the table below.

- g is the abbreviation for gram.
- kg is the abbreviation for kilogram and is equal to 1,000 g.
- L is the abbreviation for liter.
- mL is the abbreviation for milliliter. 1,000 mL are equivalent to 1 liter.
- ppb is the abbreviation for parts per billion.

Table 4-6. Steam Condensate Nonradionuclide Source Terms. (2 sheets)

Chemical	Concentration (ppb)	Daily release rate (kg/day)	CERCLA reportable quantity (kg/day)
Aluminum	180	0.042	none
Ammonia	81	0.019	45.4
Arsenic (EP toxic)	500	0.12	0.454
Barium	33	0.0077	454
Barium (EP toxic)	1,000	0.23	454
Boron	23	0.0054	none
Calcium	20,700	4.82	none
Cadmium	4	0.0009	4.54
Cadmium (EP toxic)	100	0.023	4.54
Chloride (Cl-)	1,300	0.30	none
Chromium	10	0.0023	2,270
Chromium (EP toxic)	500	0.1164	2,270
Copper	13	0.0030	2,270
Fluoride (F-)	132	0.031	none
Iron	211	0.049	none
Lead (EP toxic)	500	0.1164	0.454
Lead	7	0.0016	0.454
Magnesium	4,710	1.097	none
Manganese	42	0.0098	none
Mercury (EP toxic)	20	0.0047	0.454
Mercury	0.12	2.79 E-05	0.454
Nickel	14	0.0033	0.454
Nitrate (NO_3-)	600	0.14	none
Potassium	827	0.19	none
Selenium (EP toxic)	500	0.12	45.4
Silicon	2,690	0.63	none
Silver (EP toxic)	500	0.12	454
Sodium	2,340	0.54	4.54

Table 4-6. Steam Condensate Nonradionuclide Source Terms. (2 sheets)

Chemical	Concentration (ppb)	Daily release rate (kg/day)	CERCLA reportable quantity (kg/day)
Strontium	102	0.024	none
Sulfate (SO_4)	10,800	2.52	none
Uranium	0.621	0.0001	45.5
Zinc	29	0.0068	454
2-Butanone or methylethyl ketone	18	0.0042	2,270
Dichloromethane	170	0.040	none
Phenol	35	0.0082	454
Tetra-hydrofuran	17	0.0040	454

If the solution is dilute, it can be assumed that the specific gravity of the solution is 1. If this is assumed, a concentration of 1 g/L is equal to 1,000,000 ppb.

4.2.1.4 Used Cooling Water. Table 8-4 in Section 8.1.4 contains the data used to calculate the radionuclide source terms for the used cooling water waste stream.

Table 4-7 contains the maximum values tabulated in Section 8.1.4.

Column 4 contains the maximum potential curies that might be released during a day. This was calculated by taking the maximum recorded total yearly flow for the year of $6.34 \times 10^{+09}$ L from Table 8-4. This figure divided by 365 day/yr gives a daily flow rate of 17,369,863 L/day.

The following information is provided to help the reader understand the units used in the tables that follow.

- Ci is an abbreviation for curie, the unit used for measuring radioactivity
- A μCi is 1/1,000,000 of a curie
- A mL is 1/1,000 of a liter.

Table 4-7. Cooling Water Radionuclide Source Term.

(1) Effluent	(2) Maximum from Table 8-4 (μCi/mL)	(3) WHC-EP-0342 (μCi/mL)	(4) Maximum potential 24-h release (Ci)
Alpha	6.9 E-09	1.59 E-09	
Beta	9.4 E-08	3.19 E-08	
^{3}H	5 E-05		0.8685
^{137}Cs	6 E-08		0.0010
^{239,240}Pu	1.7 E-08		0.0003
^{89,90}Sr	2 E-08		0.0003

Table 4-8 contains the nonradionuclide data for the used cooling water waste stream. The data in this table were obtained from WHC-EP-0342, Addendum 21, *242-A Evaporator Cooling Water Stream-Specific Report* (WHC 1990b).

From Table 8-4, the maximum recorded total yearly flow was 6.34 x 10^{+09} L. This figure divided by 365 day/yr gives a daily flow rate of 17,369,863 L/day. This figure was used to determine if the CERCLA RQ values are exceeded.

The following information is provided to help the reader understand the units used in Table 4-8.

- g is the abbreviation for gram.
- kg is the abbreviation for kilogram and is equal to 1,000 grams.
- L is the abbreviation for liter.
- mL is the abbreviation for milliliter. 1,000 milliliters are equivalent to 1 liter.
- ppb is the abbreviation for parts per billion.

If the solution is dilute, it can be assumed that the specific gravity of the solution is 1. If this is assumed, a concentration of 1 g/L is equal to 1,000,000 ppb.

Table 4-8. Cooling Water Nonradionuclide Source Term.

Chemical	Concentration (ppb)	Daily release rate (kg)	CERCLA reportable quantity (kg)
Barium	32	0.558	454
Calcium	21,200	368.24	none
Cadmium	2	0.35	4.54
Chloride (Cl-)	1,070	18.6	none
Chromium	12	0.21	2,270
Copper	97	1.68	2,270
Iron	194	3.37	none
Lead	15.8	0.27	0.454
Magnesium	4,860	84.42	none
Manganese	20	0.35	none
Nickel	16	0.28	0.454
Nitrate (NO_3-)	3,620	62.88	none
Potassium	840	14.59	none
Sodium	2,680	46.55 *	4.54
Sulfate (SO_4)	11,500	199.75	none
Uranium	0.767	0.0133	45.4
Zinc	67	1.16	454
1-Butanol	11	0.19	2270
Dichloromethane	170	2.95	none

*Indicates constituent is over the CERCLA RQ value. See raw-water data in Table 4-9.

CERCLA = *Comprehensive Environmental Response, Compensation and Liability Act of 1980.*

4.2.1.5 Raw Water. Table 4-9 contains the nonradionuclide data for the raw water. The data in this table were obtained from WHC-EP-0342, Addendum 21, *242-A Evaporator Cooling Water Stream-Specific Report* (WHC 1990).

From Table 8-4, the maximum recorded total yearly flow was $6.34 \times 10^{+09}$ L. This figure divided by 365 day/yr gives a daily flow rate of 17,369,863 L/day. This figure was used to determine whether the CERCLA RQ values are exceeded.

4.2.1.6 Cooling Water/Raw Water Nonradionuclide Comparison. Raw water is supplied for the cooling water at the 242-A Evaporator. Tables 4-10 and 4-11 list the nonradionuclide source terms for the used cooling water and the raw water respectively. Of these constituents, and because of the quantity of water used, only sodium could possibly be reportable under CERCLA. For comparison, these values are repeated in Table 4-10. Because the sodium in the used cooling water is in similar quantities to that in the raw water, it is reasonable to assume that no further addition of this regulated constituent was or is added during the evaporator process. It can, therefore, be concluded that these discharges are not regulated as RQs under CERCLA.

4.2.2 Upset Operating Conditions

This section is intended to present any additional hazardous or radioactive material releases to the environment that might occur during upset conditions. For purposes of this discussion, upset conditions are defined as any breach of a single (one) barrier.

A thorough examination of the *242-A Evaporator Facility Safety Analysis Report* (WHC 1988a) was conducted to identifying upset conditions. Only one such condition meeting the criterion definition of breach of a single barrier was noted. The following is a discussion of this.

Scenario: Excessive ammonia concentrations--The presence of ammonia (NH_3) in evaporator feed stems from N Reactor fuel dissolution operations at PUREX. To dissolve the zircalloy fuel cladding a boiling solution of ammonium fluoride and ammonium nitrate is used. The liquid waste that results is neutralized with sodium hydroxide solution and sent to tanks TK-103-AW or TK-105-AW in the AW Tank Farm for eventual routing to the 242-A Evaporator. This waste, referred to as neutralized cladding removal waste (NCRW), contains approximately 30% of the ammonium ions charged to the dissolvers.

Approximately 70% of the ammonium ions charged to PUREX dissolvers is converted to ammonia gas and is either adsorbed in the dissolver condensate or scrubbed from the dissolver offgas. Past practice has been to transfer all dissolver condensate and scrub liquid, collectively referred to as ASF, to a small evaporator within the PUREX Plant. The bottoms from this evaporator, containing concentrated radionuclides, were sent to Tank Farms; the overheads, containing essentially all of the ammonia present in ASF, were condensed and sent to a crib while noncondensables were released out the stack.

Environmental regulations limit the quantities of ammonia that may be discharged to the atmosphere to 45.5 kg/24 hr (100 lb/24 hr), and the concentration and quantities of ammonium hydroxide permissible in liquid effluent streams are limited to 454.5 kg/24 hr (1,000 lb/24 hr). Consequently, ASF is no longer processed at the PUREX Plant. Instead, as an interim step towards regulatory compliance, ASF is sent to tank TK-103-AP in the AP Tank Farm for eventual routing to the 242-A Evaporator. Methods for destroying the ammonia content of both NCRW and ASF within PUREX Plant (such as reacting acidified ASF with sodium nitrite) are being investigated.

Table 4-9. Raw Water Nonradionuclide Source Term.

Chemical	Concentration (ppb)	Daily release rate (kg)	CERCLA reportable quantity (kg)
Barium	28	0.49	454
Calcium	18,400	319.6	none
Cadmium	2.4	0.042	4.54
Chloride (Cl-)	871	15.12	none
Copper	10.6	0.18	2,270
Iron	63.6	1.10	none
Magnesium	4,190	72.78	none
Manganese	9.8	0.017	none
Nickel	10.4	0.18	0.454
Nitrate (NO_3-)	996	17.3	none
Potassium	795	13.81	none
Sodium	2,260	39.26*	4.54
Sulfate (SO_4)	10,600	184.12	none
Uranium	0.726	0.013	45.4
Zinc	20	0.35	454
Trichloromethane	11.8	0.21	2,270
Alpha (μCi/mL)	8.85 E-10	NA	NA
Beta (μCi/mL)	4.47 E-09	NA	NA

*Indicates constituent is over the CERCLA RQ value. See discussion in Section 4.2.1.6.

Table 4-10. Raw Water/Cooling Water CERCLA RQ Comparison.

Constituent	24-hour Raw-water quantity supplied (kg)	24-hour Cooling water quantity released (kg)
Sodium	39.26	46.55

To ensure that liquid and gaseous effluents from the 242-A Evaporator do not exceed the ammonia and ammonium hydroxide discharge limits, NCRW (0.1 to 0.5 M) and ASF (0.2 to 0.4 M) are blended with nonammonia-bearing waste in tank TK-102-AW to produce an evaporator feed stream with a low NH_3 concentration (0.08 M). Blending protocols are established by process engineering based on ammonia content of the waste to be blended. Before pumping the blended feed to the evaporator, Tank TK-102-AW is sampled and analyzed to verify an acceptable NH_3 concentration.

The accident scenario is postulated in which an error in blending NCRW with nonammonia-bearing waste leads to a higher than expected ammonia concentration in tank TK-102-AW. The NCRW was selected for analysis over ASF because it typically has a higher ammonia content. A failure to detect or correct the blending error is assumed to occur so that the contents of tank TK-102-AW are fed to the evaporator resulting in elevated ammonia releases. A failure of routine sampling to detect this error at an early stage allows the release to continue for several hours.

Source Term--The ammonia concentration in NCRW ranges typically from 0.1 to 0.5 M. Given an error in blending, it is estimated that a concentration of 0.4 M could be achieved in tank TK-102-AW. This estimate is based on the assumption that 0.5 M NCRW is mistakenly blended as if it were 0.1 M.

A validated model for estimating ammonia release as a function of the feed concentration and other critical parameters (e.g., feed rate, operating pressures and temperatures, condenser efficiencies) does not exist. Estimates can be made, based on sampling data from previous evaporator operations. Given nominal feed and boiloff rates 302.8 and 151.4 L/min (80 and 40 gal/min, respectively), a 0.4 M feed concentration, and conservatively assuming that all of the ammonia in the feed is converted to ammonia gas in the evaporator (as opposed to an expected 90%), the estimated ammonia concentration released out the vessel vent stack is 2,500 ppm [57.3 kg/24 hr (126 lb/24 hr)]. This value is believed to be conservative in that it was linearly extrapolated from low-feed concentration (0.04 M) data. Computer modeling has shown that a linear relationship does not exist and that a higher ammonia feed stream will have a smaller percentage of the ammonia go with the vessel vent offgas.

In the past, ammonia releases from the 242-A Evaporator were measured at the vessel vent stack using ammonia detector tubes and an ammonia gas absorption apparatus. A continuous ammonia monitor is installed.

Detector tubes may be inserted periodically into the vessel vent airflow to provide an instantaneous measure of the ammonia concentration. Although only accurate to ±30%, the detector tube results are adequate for process control needs.

The gas absorption sampling apparatus collected an ammonia sample by bubbling a portion of the vessel vent airflow through a boric acid solution. This solution is titrated to quantitatively determine the ammonia content. This method is accurate to ±10%, and the result, available in approximately 4 hours, is used to document regulatory compliance.

This page intentionally left blank.

5.0 EFFLUENT POINT OF DISCHARGE DESCRIPTION

This section will identify, describe, and characterize all effluent discharge points (actual and potential) for the facility. In addition, the locations of monitoring/sampling points are identified.

Effluent discharge points are the final point where effluents are monitored, sampled, diverted, otherwise controlled, or where the stream exits the facility into the environment.

5.1 GASEOUS EFFLUENT STREAMS

As previously described in Section 4.1.1, the major airborne effluent release point for the 242-A Evaporator facility is the 296-A-22 stack (vessel ventilation system). A second effluent stream is the 296-A-21 stack ("hot area" building ventilation system). A third separate air system supplies the noncontaminated (cold) area and exhausts through miscellaneous dampers and vents. Table 5-1 lists these major and minor gaseous effluent streams.

Table 5-1. 242-A Evaporator/Crystallizer Gaseous Effluent Streams.

Stream	Function	EDP Code
296-A-22 Stack	Filtered exhaust air vessel vent system	E643
296-A-21 Stack	Building containment exhaust system	E645
K2-5-2 Fan	Aqueous makeup unit room exhaust	N/A
K2-5-3 Fan	"Cold" area roof exhaust	N/A
MK-9863 Damper	Control room air exit	N/A
MK-9861 Damper	Office barometric relief damper	N/A

NOTE: EDP = electronic data processing.

5.1.1 Vessel Ventilation System

The vessel ventilation system is located in the southeast corner of the condenser room and extends in elevation from 220 m (722 ft, 6 in.), to the stack exhaust point at 230 m (753 ft, 6 in.). The system consists of a deentrainment unit (DU-C-1), prefilter/demister (F-C-6), heater (H-C-1), HEPA filter assemblies (F-C-5-1 and F-C-5-2), an exhauster (EX-C-1), and a stack monitoring system.

Noncondensed vapors from the vacuum condenser and process condensate systems are filtered and discharged to the atmosphere via the vessel vent system. Also, the after condenser drain and the condensate collection tank (TK-C-100) are vented to the atmosphere through this system. An air intake filter (F-C-7) is used to bleed building air into the vessel vent system to maintain proper ventilation balance and prevent deadheading of the vessel vent exhauster.

The deentrainment unit and prefilter each measure 41.9 cm by 36.8 cm by 17.8 cm (16.5 in. by 14.5 in. by 7 in.) and are designed to remove large particulates and moisture that may damage or reduce the efficiency of the HEPA filters. Raw water is supplied to the deentrainment unit. The deentrainment pad is provided with a lower raw-water spray and an upper spray nozzle.

The vessel vent system has an electric heating unit designed to maintain a minimum 38 °C (50 °F) temperature differential across its coil. The heater ensures that the ventilation stream humidity is acceptable and that vapors do not condense on and damage the downstream HEPA filters. A temperature-indicating controller senses the entering and exiting stream temperatures and controls the heater to add heat as necessary to maintain the desired temperature differential. A temperature safety switch shuts off the ventilation heater when the temperature exceeds 93 °C (200 °F). In addition, a high temperature alarm is interlocked to shut off the vessel ventilation heater. The vessel ventilation heater is also interlocked to shut off if the exhaust fan shuts down.

The two in-series HEPA filters are used to filter noncondensed vapors from the evaporator, vacuum condenser, and process condensate systems. These units have replaceable cartridges that measure 61.0 cm by 61.0 cm by 29.2 cm (24 in. by 24 in. by 11.5 in.). Each filter has an efficiency greater than 99.95% for particles 0.3 μm in diameter or larger. Differential pressure across the HEPA filters is continuously monitored. High or low differential pressure is alarmed and interlocked to shut down the process system.

5.1.1.1 Vessel Ventilation Stack. The 296-A-22 vessel vent stack is associated with the 242-A Evaporator Crystallizer facility and the record sampler for this stack has been given the Hanford Site electronic data processing (EDP) Code E643.

The 296-A-22 vessel vent stack is a cylindrical vertical stack. The stack begins on the third floor of the condenser room above the exhauster fan. This floor is 9.3 m (30 ft, 6 in.) above ground level, which is 210.9 m (692 ft) above sea level. At 0.96 m (37 5/8 in.) above the floor, the stack flares out to an inside diameter of 20.3 cm (8 in.). At 5.38 m (17 ft, 8 in.) above the floor, the stack makes a 90 degree turn to horizontal and penetrates through the exterior wall of the building. Once outside, it makes another 90 degree turn back to vertical and terminates at an elevation of 18.75 m (61 ft, 6 in.) above ground level.

5.1.1.2 Vessel Ventilation Stack Flow. Vessel ventilation gases are exhausted through the 296-A-22 stack. The vessel ventilation exhauster nominally delivers 19.82 m^3/min (700 ft^3/min) at 25.4 cm (10 in.) of water gage. An induction electric motor, which operates on 3-phase, 460 V electric power and develops 2.2 kW (3 hp) of power, drives the exhauster. The vessel vent exhauster fan (EX-C-1) can be operated remotely by selector switch

HS-EXC-3 and locally by hand switches HS-EXC-1 and HS-EXC-2. The exhaust fan is interlocked to shut down automatically should the following occur:

- High radiation is detected in the vessel vent stack
- High differential pressure is detected at the vessel vent filters.

Stack flow rates are currently measured using Hanford Maintenance Procedure 7-GN-56, Airflow Capacity and Distribution Tests, Revision 2, Change A in conjunction with guidance/data sheets developed by Engineering. A stack specific flow rate measurement procedure is being written to incorporate the guidance and to comply with the regulatory procedure mandated by 40 CFR 61.93 and called out in 40 CFR 60, Appendix A, Method 2C. Recent flow rate data are listed below:

296-A-22 STACK FOR 242-A VESSEL VENT

DATE	FLOW (CFM)	WP#
06/03/93	661	2E-93-00672
10/18/93	585	2E-93-01381
03/18/94	495	2E-94-00345
6/16/94	503	EE-94-00607
AVERAGE	561	
VARIABILITY	-11%/+18%	
STANDARD DEVIATION		78
95% CONFIDENCE INTERVAL		248 (44%)
RANGE		312 to 809

The location chosen for the measurement is specified in the guidance. This location is located two feet above the sampling probe and consists of two perpendicular flow measurement ports.

5.1.1.3 Vessel Ventilation Stack Radionuclides Monitoring/Sampling. Vessel ventilation gases are exhausted through the 296-A-22 stack. The vessel vent exhaust air is continuously sampled and monitored for radioactive materials. Samples are drawn from the stack using a near isokinetic sampling system (a perfect isokinetic system would draw the sample from the stream at exactly the same velocity as the stream).

The sampling point is on the stack at 3.96 m (13 ft) above the third level of the condenser room. The appropriateness of this location has been analyzed and is discussed in Section 14.1.1.2.

A sampler probe draws air from the vessel vent stack at a designed flow rate of 6.2 std ft^3/min. The sampler probe incorporates the use of two nozzles for sampling the stack flow [refer to drawing H-2-69316 (AEC 1977)]. The appropriateness of the existing sample extraction systems has been analyzed and is discussed in Section 14.1.1.3.

A sample transport line extends from the probe connection flange to the monitoring instruments located on shelves near the stack. The sample transport line is heat traced [operating at 43 °C (110 °F)] to inhibit condensation of moisture and resultant sample flow retardation by maintaining the temperature above the dew point. The sample transport line was selected and installed in a manner designed to minimize particle loss attributed to gravity settling, turbulent impaction, and electrostatic effects. The run lengths, bend radii, and tube transition severity of the sample transport line are minimized to the extent practical.

The sample air flows into the vessel vent radiation monitoring system instrumentation rack. The monitoring rack is located adjacent to the stack in the southeast corner of the third level of the condenser room. The sample stream passes through a flow splitter and is divided into two parts:

1. One part passes through a record sample filter. The record sampler collects effluent particulates on a 47-mm-diameter filter (millipore SM or equivalent). The record sample filter is exchanged weekly and evaluated for gross alpha and gross beta activities and for specific radionuclides by laboratory analyses. The record sampler provides an indication of the amount and concentrations of radioactive particulates being discharged. The record samples provide the basis for reporting the amount and concentration of radionuclides released to the environment. These reports are forwarded to all appropriate organizations and agencies.

   From there, the record sample loop passes through one silver zeolite cartridge filter. This filter collects volatile radionuclides. Silver zeolite filters are designed to collect ^{129}I, ^{131}I, ^{125}Sb, ^{113}Sn, ^{103}Ru, and ^{106}Ru. The cartridge filters are exchanged and sent to the laboratory weekly.

   Downstream of the filters, the record sample loop passes in turn through a flowmeter, a flow integrator indicator (totalizer), a pressure indicator, a flow regulator, and a vacuum return pump. The record sampling system has sample flow-rate indicating (local and remote) and totalizing (m^3 ±10%) capabilities. The flow-rate regulator is provided for daily adjustment to maintain a flow rate of 2.2 std ft^3/min (±10%) through the collection filter assembly to compensate for filter loading effects. Audible and visible alarm signals indicating low sample flow (≤ 1.25 ft^3/min) are provided locally (bell and beacon) and remotely on the Monitor and Control System (MCS) in the 242-A Control Room. The record sample flow rate is sized to provide optimum samples for laboratory analyses.

2. The second part of the sample stream is divided into two more streams by another flow splitter. One portion passes through a beta/gamma CAM* equipped with remote (control room) and local alarms. The CAM (RM-VV-2) continuously monitors particulate matter buildup on a 47-mm-diameter filter paper (millipore SM or equivalent) for the detection and measurement of beta and gamma radiation. The filter paper is exchanged weekly and analyzed in the field for gross beta and gamma concentrations. This information is logged by Health Physics (HP) personnel.

   The second portion passes through an alpha CAM that is similar to the beta/gamma CAM. It is equipped with remote (control room) and local alarms. This CAM (RM-VV-1) continuously monitors for alpha radionuclide buildup on 47-mm-diameter sample filter papers. Filter papers are exchanged weekly and analyzed in the field for gross alpha concentration. This information is logged by HP personnel.

   The CAM loops (beta/gamma and alpha) within the 296-A-22 stack EMS have flow-rate-indicating and regulating capabilities. A flow-rate regulator is provided on each loop for daily adjustment to maintain a flow rate of 2.0 std ft^3/min (±10%)through the collection filter assembly to compensate for filter loading effects. The CAM systems have local readout count-rate meters and remote strip chart recording capability in the control room. Audible and visible alarms, including high airborne radiation, instrument malfunction, and low sample flow indications ($\leq$1.25 ft^3/min), are provided locally and on the MCS in the 242-A Control Room. In addition, high-stack radiation and high-stack alpha radiation alarms are annunciated on the Computer Automated Surveillance System (CASS). An exhaust alpha monitor failure alarm is also tied to the CASS. An elapsed time meter is interlocked with stack blower-fan operation to provide a measure of exhaust stack operation time. The record sample vacuum pump is ganged to exhaust fan operation via a switched receptacle in the system cabinet. The CAM vacuum pumps operate continuously via the unswitched receptacle in the cabinet.

Independent vacuum pumps are provided for each loop of the system. Redundant vacuum systems are not furnished, but failure annunciation (low flow rates) is provided and checked periodically to demonstrate operability.

5.1.1.4 Vessel Vent Sampling/Monitoring Environmental Conditions. The sampling and monitoring instrumentation for the vessel ventilation system is subjected to the environmental conditions in the condenser room and the control room of the facility. Typical temperatures within the condenser room are 26.7 ±5.6 °C (80 °F ±10 °F). The design operating temperature range in

---

* Continuous air monitors serve as warning devices to alert personnel to releases that exceed normal operating parameters. The CAMs collect particulates on a filter monitored continuously by a radiation detector. The CAM filter may be used as a backup for the record sample.

the condenser room is from 23.9 °C (75 °F) to 32.2 °C (90 °F). The control room is temperature and humidity controlled with a separate ventilation system.

5.1.1.5 Ammonia Monitoring. Each loop of the sample stream, after passing through its particular sampler/monitor and flow control systems, is pumped by individual vacuum pump through a line that discharges back into the vessel vent stack at a point approximately 2 ft below the sampler probe position.

High NH_3 concentrations in certain feeds have increased the potential for releases of ammonia gas from the vessel vent stack. In the past, ammonia releases from the vessel vent stack were measured by ammonia detector tubes (Drager tubes) and an ammonia gas absorption apparatus (bubbler sampling). The methods used were based on those required by the *Clean Air Act of 1977*.

The Drager tube samples are taken from a port in the vessel vent stack located on the fourth level of the condenser room approximately 1 ft above the sampler probe position on the stack. The detector tubes are inserted manually into the vessel vent airflow and provide an instantaneous measurement of the ammonia concentration. Although only accurate to ±30%, the results provide a timely basis for process control.

The frequency of ammonia sampling varied depending on the phase of the process operation. During startup, ammonia sampling was performed hourly until acceptable ammonia releases were confirmed. Then, the sampling frequency was reduced.

An automatic real-time ammonia monitoring system is installed in the stack above the radiation monitoring port. With this continuous ammonia monitor installed, the gas absorption apparatus has been removed because it will not be used in the future. With the new system, the NH_3 concentration of the vessel vent stream are monitored continuously with an infrared analyzer. Alarms are adjustable and have normally opened/normally closed (NO/NC) relay contacts. The system is enclosed within a weather resistant, temperature controlled and ventilated enclosure. The system is not adversely affected by extended operation in ambient temperatures between -28.9 °C and 43.3 °C (-20 °F and 110 °F) and ambient humidities of less than 90%.

This system has the following capabilities:

- Extraction of exhaust stack air stream samples using stainless steel sample probes
- Determination of ammonia concentration with an accuracy and repeatability within ±10 ppm for NH_3 concentrations between 0 and 1,000 ppm and within ±50 ppm for NH_3 concentrations between 1,000 and 5,000 ppm
- Automatic calibration at specified intervals using calibration gas blends of certified ammonia concentration (±2 ppm).

The ammonia monitor was used as planned during the first campaign in 1994 which began in April. The ammonia emissions averaged during this period about 0.35 lb/day. With the beginning of the second campaign, the ammonia emissions increased to a maximum of around 40 lb/day (while processing ASF wastes from 101-AP).

A backup plan to be implemented during NH_3 monitor failure is developed in the event of failure. The plan developed involves use of drager tube sampling once per shift and immediately after any significant process adjustments such as an increase or decrease in the feed rates and stack flow rate. Procedure TO-020-045 is used for this drager tube sampling.

The ammonia data acquired during the various campaigns is totalized and reported in the annual emissions reports.

5.1.1.6 **ORGANIC SAMPLING.** Organic samples were taken from the vessel vent stack during the first campaign. The samples were taken in accordance with procedure LO-080-013. The samples were collected using summa canisters from the port located 24 in. above the radionuclide sampling probe insertion into the stack. The results of this sampling effort, were not available during the revision of this FEMP because they were undergoing validation by analytical services. Samples will be taken in future campaigns according to instruction provided in WHC-SD-WM-DQO-014, *242-A/LERF DQO.*

5.1.2 Building Ventilation System

The hot/contaminated areas of the building are discharged to the atmosphere through the 296-A-21 Building ventilation stack. The hot area is supplied with approximately 8.73 x 10^6 cm^3/s (18,500 ft^3/min) of outside air from an intake fan (K1-5-1) and approximately 3.78 x 10^5 cm^3/s (800 ft^3/min) of air in-leakage from the loading room. Air from the intake fan passes through a preheat coil (K1-2-1) and dust filters (K1-7-1 and K1-11-1); 4.25 x 10^5 cm^3/s (900 ft^3/min) of the intake air passes through an air washer (K1-3-1), and two reheat coils (K1-4-1 and K1-1-7) before entering the loading room. 4.58 x 10^6 cm^3/s (9700 ft^3/min) of the intake air passes through the air washer (K1-3-1) and reheat coil K1-4-2 before entering the condenser room; 3.07 x 10^6 cm^3/s (6500 ft^3/min) of the intake air passes through reheat coils K1-4-3 and K1-4-5 before entering the evaporator room. 6.61 x 10^5 cm^3/s (1400 ft^3/min) of the intake air passes through reheat coils K1-4-4 and K1-4-6 before entering the pump room.

All air is discharged into a main line, which splits into two parallel filter trains before it is discharged to the atmosphere via the 296-A-21 stack. Each train consists of one [870 National Bureau of Standards (NBS)] dust filter (K1-15-1 or K1-15-2) and two HEPA filters (K1-6-1 and K1-6-3 or K1-6-2 and K1-6-4) in series. The HEPA filters have a minimum efficiency of 99.97% as tested individually at the Hanford Environmental Health Foundation (HEHF). The efficiency of the installed filters is required to be 99.95% for particles 0.3 μm or larger. The differential pressures (DP) across both the first and second HEPA filters are monitored. A low DP across either the first or second filters could indicate a failure resulting from loss of all or part of the filter media, while a high DP across the first filter would indicate filter pluggage with a potential for filter failure. Each condition is annunciated in the control room.

The air exits through a 9.1 x 10^6-cm^3/s- (19,300-ft^3/min-) capacity electric exhaust fan (K1-5-3) into the 242-A-21 stack. A steam turbine-driven fan (K1-5-2) of identical capacity is available as a backup. Failure of the electric exhaust fan to maintain a specific flow will initiate the shutdown of the electric fan and startup of the steam turbine-driven fan.

The hot area is maintained at a negative pressure so that air enters the potentially contaminated areas rather than exits to the progressively cleaner areas of the building. In addition, individual room air pressures are maintained such that the pressure in highly contaminated rooms is less than in rooms with less potential for contamination. Negative pressure in the area is normally maintained by operating the electric exhaust fan. After the exhaust fan has been started, the intake fan starts automatically when the pressure in the condenser room approaches the required negative value. The amount of supply air is limited to a preset value and is controlled by adjusting dampers in the intake ducts of the intake air system. A signal from a flow-measuring element in the intake fan duct controls the dampers. A loss of flow from the intake fan signals shutdown of the intake motor.

5.1.2.1 Building Ventilation Stack. The 296-A-21 Building exhaust stack is associated with the 242-A Evaporator Crystallizer facility and the record sampler has been given the Hanford Site EDP Code E645.

The 242-A-21 Building exhaust stack is a 106.7-cm- (42-in.) diameter, cylindrical, vertical duct located at the end of the parallel building exhaust trains on the concrete HVAC equipment pad outside the northwest corner of Building 242-A. The top of the stack is 5.8 m (22 ft) above ground level, which is 210.9 m (691 ft, 6 in.) above sea level.

The 242-A Evaporator Building ventilation system is equipped with room air sampling and radiation monitoring systems (refer to Section 4.1.1.2). The exhaust stack also is equipped with a radiation monitoring and sampling system. A high radiation reading in the exhaust stream initiates safety interlock shutdown of both the electric and steam turbine exhaust fans, which in turn initiates shutdown of the intake fan on loss of negative pressure in the hot zones. This interlock effectively shuts down the hot area ventilation system to prevent release of air contaminants.

5.1.2.2 Building Ventilation Stack Flow. The building ventilation system has a nominal volumetric flow rate of 19,300 ft^3/min. The following table contains flow measurement data and average, maximum, and minimum measured airflow through the 296-A-21 stack.

296-A-21 STACK FOR 242-A BUILDING VENT

DATE	FLOW (CFM)	WP#
01/07/91	20,263	NONE
04/07/91	22,106	2E 35007
05/22/91	21,329	NONE
08/22/91	19,207	NONE
06/14/93	15,610	2E-90-03676
10/18/93	14,872	2E-93-01381
02/08/94	17,557	2E-93-01987
06/16/94	14,271	EE-94-00607
09/21/94	15,844	EE-94-00707
AVERAGE	17,895	
VARIABILITY	-20%/+24%	
STANDARD DEVIATION		2,930
95% CONFIDENCE INTERVAL		6,756 (38%)
RANGE		11,139 to 24,651

Stack flow rates are currently measured using Hanford Maintenance Procedure 7-GN-56, Airflow Capacity and Distribution Tests, Revision 2, Change A in conjunction with guidance/data sheets developed by Engineering. A stack specific flow rate measurement procedure is being written to incorporate the guidance. The location chosen for the measurement is specified in the guidance. This location is located 45 in. below the sampling probe and consists of two perpendicular flow measurement ports.

5.1.2.3 Building Ventilation Stack Monitoring/Sampling. The building ventilation exhaust stack is equipped with a radiation monitoring and sampling system. A high radiation reading in the exhaust stream initiates safety interlock shutdown of both the electric and steam turbine exhaust fans, which in turn initiates shutdown of the intake fan on loss of negative pressure in the hot zones. This interlock effectively shuts down the hot area ventilation system to prevent release of air contaminants.

Building exhaust stack 296-A-21 is equipped with an air sampling probe placed into the stack 1.07 m (42 in.) below the top of the stack. The appropriateness of this location has been analyzed and is discussed in Section 14.1.2.2.

A sample stream is withdrawn from the exhaust stream through the sampler probe, which contains five nozzles. The appropriateness of the existing sample extraction systems has been analyzed and is discussed in Section 14.1.2.3.

The sample is drawn through a line that is heat traced (maintained at a temperature of 43 °C or 110 °F) to prevent moisture condensation within the sampler line. This line carries the sample to the sampler cabinet located on the HVAC equipment pad adjacent to the 296-A-21 stack.

Sample transport lines were selected and installed in a manner designed to minimize particle loss attributed to gravity settling, turbulent impaction, and electrostatic effects. Sample transport line runs, bends, and tube transitions are minimized to the extent practical. Sample transport line bend radii are at least 10 times the inside diameter of the transport line. Sample transport lines are supported to minimize wind-induced vibration effects.

The sampler/monitor system consists of a record sampler, alpha CAM, and a beta/gamma CAM. The flow from the sampler line is split into two separate flows. One flow loop goes through the record sampler. The other flow is again split, with one line going to the alpha CAM and the other going to the beta/gamma CAM. Each of the two CAM flow loops has its own regulated vacuum pump that draws approximately 9.44×10^2 cm^3/s (2 ft^3/min) of air. The record sample loop also has a separate regulated vacuum pump that draws approximately 1.04×10^3 cm^3/s (2.2 ft^3/min) of air. The total flow rate at the sampler probes is approximately 1.98×10^3 cm^3/s (6.2 ft^3/min).

The record sampler collects effluent particulates on a 47-mm-diameter filter paper (millipore SM or equivalent) that is exchanged weekly and evaluated for gross alpha and gross beta activities and for specific radionuclides by laboratory analyses. The record sampler provides an indication of the amount and concentrations of radioactive particulates being discharged. The record samples provide the basis for reporting the amount and concentration of radionuclides released to the environment. Downstream of the filters, the record sample loop passes in turn through a flowmeter, a flow integrator indicator (totalizer), a pressure indicator, a flow regulator, and a vacuum return pump.

The record sampling loop has sample flow-rate indicating (local and remote) and totalizing (m^3 ±10%) capabilities. A flow-rate regulator is provided for daily adjustment to maintain a flow rate of 2.2 std ft^3/min (±10%) through the collection filter assembly to compensate for filter loading effects. Audible and visible alarm signals indicating low sample flow [≤ 1.25 ft^3/min (0.035 m^3/min)] are provided locally (bell and beacon) and remotely (MCS in the 242-A Control Room). The record sample flow rate is sized to provide optimum samples for laboratory analyses.

The beta/gamma CAM (RM-K1-2) continuously monitors particulate matter buildup on a 47-mm-diameter filter paper (millipore SM or equivalent) for beta and gamma radiation. The filter paper is exchanged weekly and analyzed in the field for gross beta and gamma concentrations. This information is logged by HP personnel.

The alpha CAM is similar to the beta/gamma CAM. This CAM (RM-K1-1) continuously monitors for alpha radionuclide buildup on the sample filter papers. Filter papers are exchanged weekly and analyzed in the field for gross alpha concentrations. This information is logged by HP personnel.

Count-rate meters associated with each radiation monitor loop relay data to beta/gamma and alpha recorders in the control room.

The CAM loops (beta/gamma and alpha) have flow-rate indicating and regulating capabilities. A flow-rate regulator is provided on each loop for daily adjustment to maintain a flow rate of 2.0 std ft^3/min (±10%) through the collection filter assembly to compensate for filter loading effects. The CAM systems have local readout count-rate meters and remote strip chart recording capability in the control room. Audible and visible alarms, including high airborne radiation, instrument malfunction, and low sample flow indications, are provided locally and in the 242-A control room. In addition, high stack radiation and high stack alpha radiation alarms are annunciated on the CASS for both the vessel vent and building ventilation stacks. A building exhaust alpha monitor failure alarm is also tied to the CASS.

An elapsed-time meter is interlocked with stack blower fan operation to provide a measure of exhaust stack operation time. The record sample vacuum pump is ganged to exhaust fan operation via a switched receptacle in the system cabinet. The CAM vacuum pumps operate continuously via the unswitched receptacle in the instrument cabinet.

Independent vacuum pumps are provided for each loop of the system. Redundant vacuum systems are not furnished, but failure annunciation (low flow rates) is provided and checked periodically to demonstrate operability.

5.1.2.4 Building Ventilation Sampling/Monitoring Environmental Conditions. The building ventilation stack monitoring and sampling instruments are located outside the building. As a result, these monitoring/sampling systems and their respective instruments and components are installed in a weather-resistant cabinet. Other system-related instruments are located within the control room, which has a controlled environment. The cabinet environmental features consist of the following items:

- Thermostatically controlled heater.
- Thermostatically controlled exhaust fan.
- Thermostatically controlled inlet air damper.
- Fluorescent light for illumination.
- Weatherproof doors and latch.
- Temperature out-of-limit alarms.

The environment within the cabinet is controlled by two thermostats. As the temperature in the cabinet drops below 18.3 ±2.8 °C (65 ±5 °F), the cabinet heater is activated causing the cabinet temperature to increase to the upper temperature limit of 23.8 ±2.8 °C (75 ±5 °F), at which point the power to the heater is switched off. The lower temperature setting for the thermostat controlling the heater is set above a lower limit of 10 °C (50 °F) to avoid moisture condensation problems. A second thermostat prevents the cabinet temperature from increasing to above an upper limit of 51.7 °C (125 °F) for proper operation of the monitor. Temperatures above 35 ±2.8 °C (95 ±5 °F) will activate the blower and the damper causing outside air to be drawn through the cabinet as a cooling mechanism. Enclosure temperatures exceeding 51.7 °C (125 °F) or falling below 12.8 °C (55 °F) will trip alarm switches that activate a local alarm light mounted on the cabinet alarm panel (labeled "HI-LOW MONITOR TEMP), a beacon mounted on the cabinet, and a remote temperature-out-of-range alarm in the control room. Hot summer temperatures occasionally cause the cabinet temperature to exceed 51.7 °C (125 °F). The installation of an 8,000 Btu/hr refrigerated air conditioning unit on the cabinets is planned.

5.2 LIQUID EFFLUENT STREAMS

As discussed in Section 4.0, two primary liquid effluent streams associated with the 242-A Evaporator facility are discharged to the environment: the used cooling water stream and the steam condensate stream.

5.2.1 Used Cooling Water Stream

The 242-A cooling water waste stream is given the Hanford Site stream code ACW. This waste stream consists primarily of cooling water exiting the primary, intermediate, and after condensers (E-C-1, -2, and -3). The condenser cooling water from the evaporator subsequently flows into a 24-in. pipe where it combines with eight other nonhazardous contributors (refer to Section 4.1.2.1) to form the overall 242-A Evaporator cooling water effluent stream. All of the contributing streams consist of noncontact cooling water or steam condensate. The 242-A Evaporator process does not involve the intentional addition of hazardous constituents to the steam condensate stream or any of its contributors. Tank Farm Operations limits the use of hazardous materials at its facilities by the use of administrative controls (i.e. procedures that govern the use of such materials in the workplace).

The eight smaller streams flowing into the waste cooling water 24-in.-diameter pipe come from the HVAC equipment floor drains, steam condensate from the steam turbine, the drip pans of the raw-water filters, the HVAC relief valve condensate lines, the HVAC steam condensate traps, the air compressor cooling water, the compressed air after cooler heat exchanger, and the compressed air separator. This combined effluent is then routed to the 216-B-3 Pond which receives liquids for soil-column disposal. The 100-acre 216-B-3 Pond is used as a percolation pond.

5.2.1.1 Used Cooling Water Flow Rate. During evaporator processing operations, all nine used cooling water contributors described above and in Section 4.1.2.1. are potentially adding liquid to the stream. During shutdown and maintenance periods, however, the condenser cooling water and the water filter catch pan drainage will not contribute to the stream. The 242-A Evaporator runs in campaigns and not year round. Thus, the average flow rate for the cooling water stream varies a great deal over a sustained period of time. The flow rate during evaporator campaigns is approximately 13,815 L/min (3,650 gal/min). During shutdown/standby configuration, the used raw-water stream flow rate is approximately 37.85 L/min (10 gal/min). Operation of the 242-A Evaporator during 1988 was representative of process capability. During 1988, the total volume of cooling water discharged from the facility was $6.34 \times 10^{+09}$ L ($1.67 \times 10^{+09}$ gal).

Flow rate for the used raw-water stream is measured on the 12-in.-diameter used raw-water line upstream of the sample flush valve. The flow rate of the used condenser cooling water contributor is measured by flow indicators FI-C1-1 and FI-RC2-1. The flow rates of the eight minor contributors of the stream are not monitored.

5.2.1.2 Used Cooling Water Monitoring/Sampling. Used raw water from the condensers is monitored for radiation to detect potential contamination from the waste treatment system, an indication of condenser tube failure. The radiation monitoring sample line feeds a continuous portion of the used raw-water stream through the R-C-2 shielded radiation monitoring enclosure, which contains a scintillation-type radiation element (RE-RC2-1) coupled to a photomultiplier and amplifier tube assembly. The detector crystal and phototube/amplifier are protected by a stainless steel outer liner. A programmer automatically diverts the sample flow to bypass the radiation cell for 5 minutes each hour allowing the cell to drain so the radiation background reading may be checked. Radiation information is monitored on the MCS by radiation indicator RI-RC2-1. Shutdown of the 242-A Evaporator is required if radiation exceeds a specified level. Also, a proportional sample of the stream can be taken for laboratory analysis by sampler SAMP-RC2-1. Because the condenser cooling water is the only stream with a potential to contribute hazardous waste to the 242-A Evaporator cooling water stream, the effluent discharge point is located (by definition) at the R-C-2 sampler and monitor point.

The laboratory sample stream and the radiation monitoring sample stream are continuously passed through the RC-2 sampling/monitoring rack located along the north wall on the second floor elevation of the condenser room [Elevation: 214 m (702 ft, 6 in.)]. Figure 5-1 is a simplified flow diagram of the used raw-water effluent monitoring/sampling system.

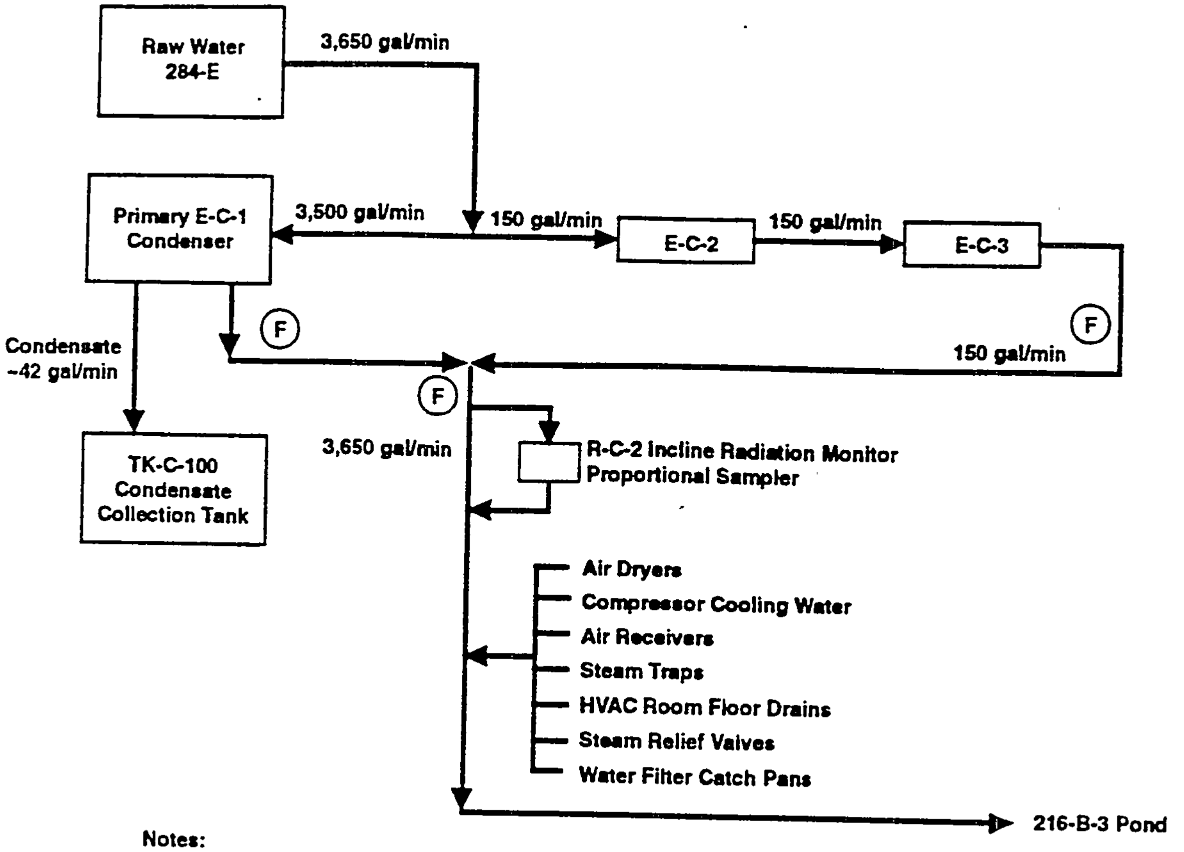
Samples of the stream are taken periodically with the R-C-2 sampling system and are analyzed for process control requirements. The proportional sampling system consists of an Isolok®* "plunger-type" sampler mounted on the 30.5-cm- (12-in.-) dia used raw-water line. This sampler (SAMP-RC2-1) is located downstream from the point where the two condenser streams (E-C-1 primary condenser and E-C-3 after condenser) combine. The sampler is a composite sampler that automatically takes liquid samples after a predetermined volume has been discharged. The sample obtained is proportional to the flow. The sampler is activated by a Proportional Sample Controller that is integrated with the flow measuring systems. When activated, a plunger is forced into the effluent stream by compressed air and then similarly forced to retract, at which time it withdraws a sample. The sampler withdraws a sample at a preset interval. A measuring subassembly in the upper assembly includes a transparent measuring chamber scaled in millimeters for setting sample volume, a sensor for determining when the measuring chamber is full, and associated valves and tubing. The sampler can extract a measured volume from the line and allow it to drain to a 53-L (14-gal) polyethylene compositing bottle located within the RC-2 sampling/monitoring rack. The sampler is located in the northwest corner of the second floor of the condenser room at an elevation of 217 m (712 ft, 4 in.) above sea level [3 m 19 ft, 10 in.) above floor grating].

Laboratory samples are withdrawn from the sample receiving tank in accordance with plant operating procedures (POP). When the evaporator is operating, used raw-water samples are taken daily form the RC-2 sample receiving tank to ensure that the condenser tubes are not leaking and activity

---

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

Figure 5-1. The 242-A Evaporator Used Raw Water System.



Notes:

1. R-C-2 sampler is activated by a predetermined volume of cooling water flow.
2. If R-C-2 is triggered, a plant shutdown is required.
3. An analysis of the cooling water before it enters the process can be found in Appendix A.
4. In the past, the main condenser has leaked cooling water into the procress condensate system. The leak rate has ranged from 0.1 to 40 gal/min.
5. The primary condenser, E-C-1, has been replaced by a spare carbon steel condenser and is not expected to leak.
6. Sampling data for this report were taken at the R-C-2 Radiation Monitor.

Ⓕ Flow Measuring Device

29301012.8

is below limits. Two samples are required: a 1-L sample and a 1-mL composite sample. These samples are analyzed at the 222-S Environmental Laboratory for total alpha and total beta. Sample results are recorded in the Sample Log Data Book at the facility.

The limits for activity for the samples are as follows:

- Total alpha (TA): 6.0×10^{-5} μCi/L
- Total beta (TB): 2.0×10^{-2} μCi/L.

These limits are specified in Tank Farm Operating Procedure TO-630-060, *Sample Cooling Water from 242-A Via Receiver Carboy RC-2* (WHC 1992e). These limits are set to meet the requirements of WHC-CM-7-5 Part A, Part B, Part F and Appendix A (WHC 1992i).

If sample results exceed activity limits, supervision is notified and the laboratory is requested to rerun the sample analysis. Normally, URW is routed to 216-B-3 Pond. Contamination above the specified limits requires full evaporator shutdown because of the inability to divert the routing of URW from 216-B-3 Pond.

The radiation monitoring sample point also exists on the 30.5-cm (12-in.) URW line. This point is located upstream of the proportional sampler at an elevation of 219 m (720 ft) [5.3 m (17 ft, 6 in.) above the second-level floor grating]. The sample line feeds a continuous stream to the RC-2 sample rack. A programmer automatically diverts the sample flow to bypass the radiation cell (RE-RC2-1) for 5 minutes each hour while the cell is allowed to drain to check the radiation background reading. A high radiation reading on the cooling water stream is not anticipated and no diversion capability is directly associated with this monitor.

All sampling/monitoring streams passing through the RC-2 sample rack (except the laboratory sample bottle) are discharged to the condenser room floor drain and into the building drainage system, which dumps into DST TK-241-AW-102 and is addressed in this FEMP with the building drainage stream.

5.2.1.3 Used Cooling Water Monitoring/Sampling Environmental Conditions. The sampling and monitoring instrumentation for the used cooling water system is subjected to the environmental conditions in the condenser room and the control room of the facility. Typical temperatures within the condenser room are 26.7 ±5.6 °C (80 °F ±10 °F). The design operating temperature range in the condenser room is from 23.9 °C (75 °F) to 32.2 °C (90 °F). The control room is temperature and humidity controlled with a separate ventilation system.

5.2.2 Steam Condensate Stream

The 242-A Evaporator steam condensate waste stream is given the Hanford Site stream code ASC. This waste stream consists primarily of steam condensate exiting the reboiler section of the evaporator process. The proposed waste stream designation is that this stream is not a dang%rous waste, pursuant to the WAC 173-303, *Dangerous Waste Regulations* (WAC 1989). A combination of process knowledge and sampling data was used to make this determination.

A total of eleven contributors feed the 242-A Evaporator cooling water waste stream as described in Section 4.1.2.2.

All contributors to the waste stream, except the heating and cooling jacket streams for TK-E-101 and TK-E-104, converge and then pass through an in-line radiation monitor (RE-EA1-1) before flowing into a 1,893-L (500-gal) flow-measuring tank (TK-C-103). Diversion valves are provided before the flow measurement tank (valve HV-EA1-2) and after the tank (valve HV-RC1-3). These valves are capable of diverting the flow to the process drain system and ultimately to the waste feed tank (241-AW-102 DST) in case of an upset condition. These valves divert stream flow to the 207-A Retention Basins during normal operations.

The steam condensate flows into one of the three cells at the 207-A Retention Basins until that cell has reached operational capacity (approximately 24 hours during full operation). At that time the steam condensate flow is diverted to one of the two remaining cells. While a cell is being filled, the proportional sampler (R-C-1) is obtaining a sample from the measuring weir (TK-C-103) and compositing it in a large plastic carboy. Once the first cell has been filled, the composite sample is immediately sent to the 222-S Laboratory for radionuclide analysis as an indication of process control. The steam condensate from the full cell is then discharged to the 216-B-3 Pond System (located northeast of the 200 East Area) if the analytical results are within set radionuclide limits. The capability also exists to take bottle samples at the 207-A Retention Basins.

The effluent discharge point for the 242-A Evaporator steam condensate stream is located at the 207-A Retention Basin sample point. This is the point where final sampling and diversion capabilities exist for the stream before discharge to the environment.

5.2.2.1 Steam Condensate Flow Rate. During evaporator processing operations, all 11 steam condensate contributors are potentially adding liquid to the stream. During shutdown and maintenance periods, however, the only active contributor to this waste stream is the room air-sampler pump seal water. This contributor leads to an overall flow of approximately 340 L/hr (90 gal/hr).

The 242-A Evaporator runs in campaigns and not year round. Thus, the average flow rate for the steam condensate stream varies greatly over a sustained period of time. Operation of the 242-A Evaporator during 1988 was continuous and, therefore, more representative of process capability than other years. During 1988, the total volume of steam condensate discharged to the 207-A Retention Basins from the facility was 6.55 x 10^{+07} L (1.7 x 10+07 gal).

Flow rate for the steam condensate stream is measured at the flow measurement tank (TK-C-103). The waste stream is deposited in TK-C-103 where the flow quantity is measured by a measuring weir contained within the tank. Flow depth over the weir is measured by a weight-factor dip tube assembly and converted to flow quantity by the MCS totalizer FIQ-RC1-1. After a certain volume has passed over the weir, a proportional sampler is signaled to take a sample.

5.2.2.2 Steam Condensate Monitoring/Sampling. The steam condensate is monitored and sampled only for radioactive contamination as an indication of contamination by dangerous waste constituents. Because the 242-A Evaporator is designed and operated to ensure that in any areas where steam may be contaminated by dangerous waste constituents the steam is at a greater pressure than these constituents, contamination is unlikely.

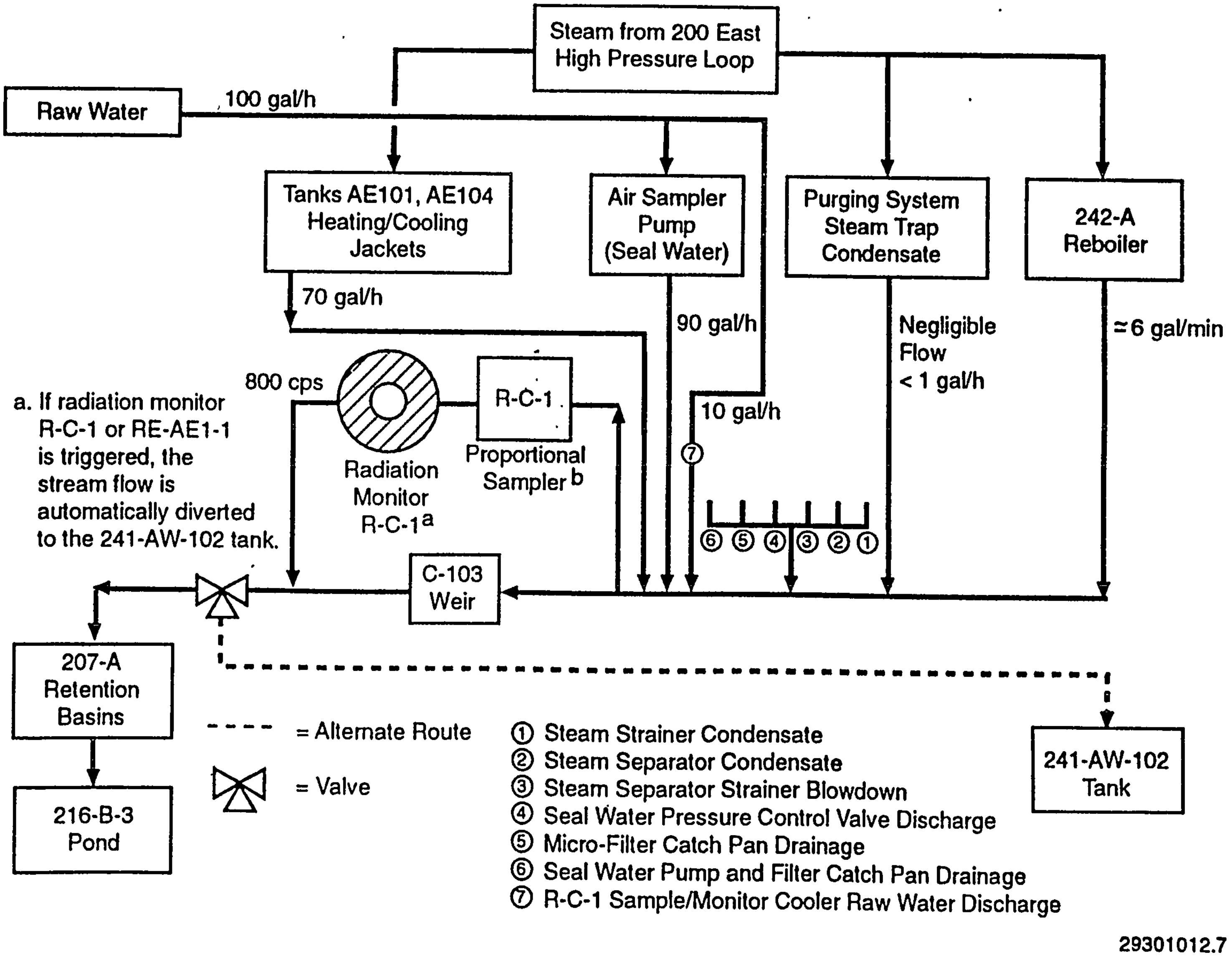
A portion of the steam condensate flow is pumped at a flow rate of 15 L/min (4 gal/min) by sample pump P-RC1-1 from TK-C-103 through a proportional sampler/radiation monitor system (R-C-1) and returned to TK-C-103. A flow-indicating device (FIAS-RC1-1) is monitored by the central MCS to ensure a portion of the steam condensate stream flows through the R-C-1 system. Figure 5-2 is a simplified configuration diagram for the steam condensate sampling/monitoring system.

The sampler on the steam condensate system is a composite sampler that automatically takes liquid samples after a predetermined volume has been discharged. The sampler is driven by a total flow determined from the measured flow rate. Thus, the sample obtained is proportional to the flow. Samples of the steam condensate are taken by the proportional sampler (SAMP-RC1-1) into a 18.9-L (5-gal) receiver bottle for laboratory analyses. The sampler is located within the R-C-1 sample rack on the 210.9-m (692-ft) elevation in the southeast corner of the condenser room.

Samples for laboratory analyses are withdrawn from the steam condensate sample receiving Tank RC-1 after steam condensate has been diverted to another retention basin while the evaporator system is in normal operation and when requested by Tank Farm Process Engineering, in accordance with POPs. The applicable procedure for the steam condensate stream is POP-TO-630-040, *Sample/Fill/Drain 242-A Steam Condensate* (WHC 1990h). In addition, samples of the steam condensate may be obtained from the SC retention basins on the direction of supervision. After sampling is complete, the samples are sent to 222-S Laboratory where they are analyzed for total alpha and total beta. If total alpha is less than 6.0×10^{-5} μCi/L and total beta is less than 2.0×10^{-2} μCi/L, the condensate is drained to 216-B-3 Pond. These limits are specified in the operating procedure (WHC 1990h). The limits are set to meet the requirements of WHC-CM-7-5 Part A, Part B, Part F and Appendix A (WHC 1992i).

Steam condensate from the reboiler discharges past an in-line radiation monitor (RE-EA1-1) at the flow measurement weir (TK-C-103). A portion of the steam condensate flow is pumped from the tank through the R-C-1 sampling and monitoring system and returned to TK-C-103. A radiation detector and sample cell (RE-RC1-1) is in place as part of the R-C-1 sampling system. The radiation detectors are used to identify any potential leaks of radioactive material into the waste stream. If either radiation monitor detects radiation at a predetermined setpoint above normal background levels, then local and remote high radiation alarms are activated and a signal is sent to an

Figure 5-2. The 242-A Evaporator Steam Condensate System.



a. If radiation monitor R-C-1 or RE-AE1-1 is triggered, the stream flow is automatically diverted to the 241-AW-102 tank.

associated two-way diversion valve to divert the flow to the process drain system and ultimately to the evaporator feed tank (241-AW-102). This prevents discharge of the stream to the 207-A Retention Basins until the radiation contamination has been identified and the cause of the contamination corrected. This unit is located directly adjacent to the RC-1 sample rack.

The count-rate meter in the steam condensate monitor system will activate alarms and diversion capability at 80 cps on increasing radiation. A flow-indicating device (FIAS-RC1-1) is monitored by the central MCS to ensure a portion of the steam condensate stream flows through the monitor. Alarms indicate low-flow conditions of 1.1 L/min (0.30 gal/min) or less.

Low steam condensate flow-measurement weir levels in tank C-103 (>17 in. below top of tank) and overflow of tank C-103 are conditions that activate alarms in the control room and on the MCS.

5.2.2.3 Steam Condensate Sampling/Monitoring Environmental Conditions. The sampling and monitoring instrumentation for the steam condensate system is subjected to the environmental conditions in the condenser room and the control room of the facility. Typical temperatures within the condenser room are 26.7 °C ±5.6 °C (80 °F ±10 °F). The design operating temperature range in the condenser room is from 23.9 °C (75 °F) to 32.2 °C (90 °F). The control room is temperature and humidity controlled with a separate ventilation system.

This page intentionally left blank.

6.0 EFFLUENT MONITORING/SAMPLING SYSTEM DESIGN CRITERIA

6.1 NEW FACILITIES

No new facilities that release effluent streams to the environment exist at the 242-A Evaporator.

6.2 EXISTING FACILITIES

6.2.1 Gaseous Effluent Streams

As described in Section 5.1, the one major airborne effluent release point for the 242-A Evaporator facility is the 296-A-22 stack (vessel ventilation system). The 296-A-21 stack ("hot area" building ventilation system) is a second but minor emission source. Both these streams are sampled and monitored.

6.2.1.1 Effluent Monitoring System General Design. The vessel vent stack (296-A-22) and the building ventilation stack (296-A-21) monitoring systems have been designed and are fabricated from criteria established for the Hanford Site generic stack monitoring/sampling system. The Hanford Site generic stack sampler/monitor system was developed to provide system design and operating capabilities as required in current DOE orders and directives, ANSI guidelines, and Rockwell Hanford Operations Environmental Protection Standards. Hanford Site drawings H-2-92486 through H-2-92504 (RHO 1981a) show the generic systems in detail. The generic stack sampling and monitoring system was designed to provide fixed filter head radioactive particulate record sampling and airborne radiation monitoring capabilities.

The generic stack sampling design provides five combinations of airborne effluent sampling and monitoring. Each option comprises commercially available off-the-shelf components. The site-specific option chosen for the 242-A Evaporator airborne effluent streams is a design that includes a combination of record sample, alpha monitor, and beta/gamma monitor. The original design criteria for the systems was developed in 1980 and published in RHO-CD-1092, *200 Area Stack Sampler-Monitor Systems Upgrade: Generic Systems Applications* (RHO 1980a). These criteria were further developed in 1984 as part of an upgrade of 200 Area stack systems and were published in SD-WM-CR-016, *FY 1985 200 Area Stack Sampler/Monitor Systems Upgrade* (RHO 1984).

The design criteria specify that, whenever the stack flow rate varies routinely by more than ±20%, a stack effluent flow-rate monitor with flow-totalizing capability shall be provided. The following is also specified in the design criteria:

- The stack flow-rate monitoring system shall have a flow-rate sensing element located within the stack in a location that will not interfere with the effluent sample extraction probes. The flow-rate transmitter shall provide an electrical signal that is proportional to the stack flow rate, thus controlling a flow-rate indicator and totalizer.

- Flow-probe sensing lines shall be protected from condensation of moisture.
- Should the stack flow rate not vary routinely by ±20%, then periodic flow-rate measurements shall be conducted to verify this condition.
- The sample extraction probes within the stacks shall follow, in general, design guidelines as presented in ANSI N13.1, 1969, *Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities* (ANSI 1969). Sample probes shall be designed to provide a near-isokinetic representative sample extraction based on the average stack velocity.
- The average stack velocity shall be determined from velocity profile measurements taken at or near the point of sample extraction.
- Sample probes shall be located a minimum of five duct diameters downstream and two duct diameters upstream of major flow disturbance points in the exhaust stack, unless the suitability of an alternate location can be demonstrated through repeatable flow profile measurements.
- Sample extraction probes shall be flange mounted to the stack to facilitate periodic removal, inspection, and cleaning activities.
- Sample transport lines shall extend from the probe connection flange to the instrument cabinet located near the stack. Sample transport lines shall be selected and installed in a manner designed to minimize particle loss attributed to gravity settling, turbulent impaction, and electrostatic effects. Sample transport line runs, bends, and tube transitions shall be minimized to the extent practical. Sample transport line bend radii shall be at least ten times the inside diameter of the transport line. Provisions shall be made to inhibit condensation of moisture within sample transport lines. Sample transport lines shall be supported to minimize wind-induced vibration effects.
- Generic system assemblies shall be selected to provide fixed-filter-head record sampling and airborne radiation monitoring capabilities. The type of airborne radiation monitoring required is site specific and shall be appropriate for the radionuclides normally expected in exhaust stack effluents.
- The record sample airstream shall be routed through a 47-mm filter to obtain a buildup sample for laboratory analysis. The record sampling system shall have sample flow-rate indicating and totalizing capabilities. A flow-rate regulator shall be provided to maintain a constant flow rate through the collection filter

assembly to compensate for filter-loading effects. Audible and visible alarm signals indicating low sample flow shall be provided locally and to an area subject to frequent or continuous occupancy. The record sample flow rates shall be sized to provide optimum samples for laboratory analyses. The product of the sample flow rate (inft^3/min) and the sample collection time (in hours) shall be at least 370 ft^3/min-hr. Sample flow rates, however, shall not exceed 4 ft^3/min to maintain filter and sample integrity.

- The CAM system shall have flow rate indicating and regulating capabilities. A flow-rate regulator shall be provided to maintain a constant flow rate through the collection filter assembly to compensate for filter loading effects. The CAM system shall have local readout count-rate meters with strip chart recording capability to a remote area where alarms are to be located. Audible and visible alarms including, but not limited to, high airborne radiation, instrument malfunction, and low sample flow indications, shall be provided locally and in an area subject to frequent or continuous occupancy.

- Monitoring systems shall have the capability to alarm at the time-integrated equivalent concentration equal to a 4-h release at 5,000 times the DCG-Public as noted in Appendix A of WHC-CM-7-5, *Environmental Compliance Manual* (WHC 1992i). Monitoring systems shall alarm at release concentrations as low as possible without resulting in an excessive number of alarms caused by normal fluctuations in background or normal fluctuations in releases.

- The stack sampler/monitor system shall operate continuously using the same emergency power backup capabilities as the stack blower fan(s). An elapsed time meter shall be ganged with stack blower-fan operation to provide a measure of exhaust stack operation times. The record sample vacuum pump shall be ganged to exhaust fan operation via a switched receptacle in the system cabinet. The CAM vacuum pump will operate continuously via the unswitched receptacle in the cabinet.

- Particular attention shall be given to the maintainability, testability, and, therefore, reliability of CAM systems. Failure annunciation shall be provided, and the CAM system shall be checked periodically to verify total system response.

- Independent vacuum pumps shall be provided for each loop of the system. Redundant vacuum systems need not be furnished, but failure annunciation (low flow rates) shall be provided and checked periodically to demonstrate operability.

- All gaseous effluent sampling and monitoring system equipment shall be protected from, or resistant to, environmental conditions that may cause damage to the equipment or operation thereof. Routine maintenance shall be performed. Performance evaluations of CAM instrumentation against a known standard shall be done periodically.

6.2.2 Liquid Effluent Streams

The steam condensate effluent stream and the used raw-water effluent stream are continuously monitored with in-line radiation monitoring systems and are periodically sampled with flow-proportional samplers. This section describes the design criteria required for adequate monitoring and representative sampling.

6.2.2.1 Effluent Monitoring/Sampling General Design Criteria. The general design criteria for liquid effluent sampling and monitoring systems are presented in WHC-CM-4-9, *Radiological Design*, Section 10.0, REV 0, "Sampling and Monitoring," (WHC 1990g). For sampling systems, the following criteria apply:

1. Sampling systems shall be provided for all liquid effluents that have a potential for exceeding concentrations equivalent to the Drinking Water Standards contained in 40 CFR 141 (EPA 1991g).
2. Sampling systems shall be designed to take a representative sample of the effluent stream. The sample location shall be as close to the environmental discharge point as practical and downstream of the effluent control systems. The sampler should sample only what is discharged to the environment. Samples of a stream diverted from environmental discharge should not be combined with the samples of the discharged effluent.
3. Automatic samplers should operate on a flow-proportional basis as controlled by a flow measurement system. The flow-metering device should be equipped with a flow totalizer for recording total effluent volume released from a given source.
4. Sampling probes should be suspended in the water so as not to pick up particulate matter from the bottom or top of the stream, pond, or basin.
5. The sampler should have a sufficiently high transport velocity to ensure accurate collection and transport of suspended solids to the sample collector. Lengths of sample tubing should be minimized.
6. The sampling system should ensure that no unsampled releases occur as a result of power failure (the sampler shall have backup power).
7. The sampler should be equipped to minimize cross contamination by sample line flushing or other methods.
8. For a batch discharge system, mechanical mixing or other design should ensure reasonable homogeneity of a batch before sampling. The system should have the means for accurate determination of batch volumes to permit volume-weighted compositing of grab (taken at random as opposed to continuous) samples.

For monitoring and diversion systems, the following criteria apply.

1. Monitoring systems shall be provided for all discharged liquid effluents that have the potential of exceeding four times the applicable administrative control limits in WHC-CM-7-5, *Westinghouse Hanford Company Environmental Compliance Manual* (WHC 1992i).
2. Monitoring shall be provided for each radionuclide with the potential for exceeding the values in (1) above unless an increase in one radionuclide concentration is accompanied by proportional increases in another type.
3. Monitoring systems should be placed upstream from diversion systems and downstream from effluent treatment systems.
4. Monitors should have distinguishable, audible, and visible high-radiation alarms capable of alarming in an area subject to frequent or continuous occupancy.
5. Monitors should have distinguishable, audible, and visible detector-failure alarms capable of alarming in an area subject to frequent or continuous occupancy. The monitoring system electronics should include a low-count alarm. This module monitors the count rate provided by the electronics and alarms if the count rate drops below a selected level. This acts as a failure alarm for the system components.
6. Monitors should have distinguishable, audible, and visible loss-of-sample alarms capable of alarming in an area subject to frequent or continuous occupancy.
7. Monitors should have distinguishable capability to transmit a real-time measurement to a remote location.
8. Accessibility and maintainability should be considered with respect to the system configuration to accommodate periodic in-place calibration and maintenance.
9. A diversion and retention system shall be coupled with the monitoring system if the potential exists for exceeding the limits contained in WHC-CM-7-5, *Westinghouse Hanford Company Environmental Compliance Manual* (WHC 1992i).
10. Retention capacity shall be sufficient to retain the volume of liquid that exceeds the applicable limits based on a safety analysis postulated upset. The retention basin should be covered.
11. It should be possible to flush or decontaminate the monitor if a buildup of contamination raises the background radiation levels.

Delivery of a representative portion of the effluent stream to the sampler or monitor depends on the design of the transport line. The following are guidelines for the design of sampler or monitor system transport lines.

- The sampler and monitor should be located as far upstream as practical.
- Traps should be avoided and uphill runs kept as short as practical upstream of the sampler or monitor.
- Grab sample valves, throttling valves, and flow alarms should be downstream of the sampler and monitor.
- To reduce the number of fittings needed, tubing should be used instead of piping. Sample tubing should be as short as practical, have as few valves and bends as possible, and contain no traps.
- Transport velocity in systems with horizontal or uphill runs should be 61 cm/s (2 ft/s) or greater to ensure transport of suspended solids.
- If a heat exchanger is used, it should be sized to maintain the desired transport velocity and, if practical, the sample should flow downhill.
- The sampler should be upstream of the monitor if both units are on the same transport line.
- The sampler should be separate or separable from the monitor. The two capabilities may be on the same system if either can be isolated by maintenance bypass loops.

Specific design criteria for the in-line radiation monitor systems (denoted as RC1 for the steam condensate stream and RC2 for the used raw-water stream) may be found in B-100-P7, *Procurement Specification for In-line Radiation Monitoring System - Building 242-A - Project B-100* (ARCHO 1974). This specification states the technical requirements for in-line radiation monitoring systems used to monitor the steam condensate, process condensate, and used raw-water streams. This specification calls for a detector assembly that uses a scintillation crystal and photomultiplier tube.

7.0 CHARACTERIZATION OF CURRENT EFFLUENT MONITORING SYSTEMS

7.1 INSTRUMENTATION DESCRIPTION

7.1.1 Gaseous Effluent Streams

This section describes the specific monitoring instrumentation associated with the vessel vent stack (296-A-22) and the building ventilation stack (296-A-21) at the 242-A Evaporator facility.

7.1.1.1 Components of Generic Sampling/Monitoring System. The major components of the generic sampling/monitoring system are described as follows. Figure 7-1 shows the major components.

A. Sample Points from the Exhaust Stack.

- Pick-up probes located inside the stack.
- The sample line is split once to separate the record sample loop from CAM radiation monitoring loop.
- The CAM radiation monitoring loop is split once to separate the alpha CAM loop from the beta/gamma CAM loop.

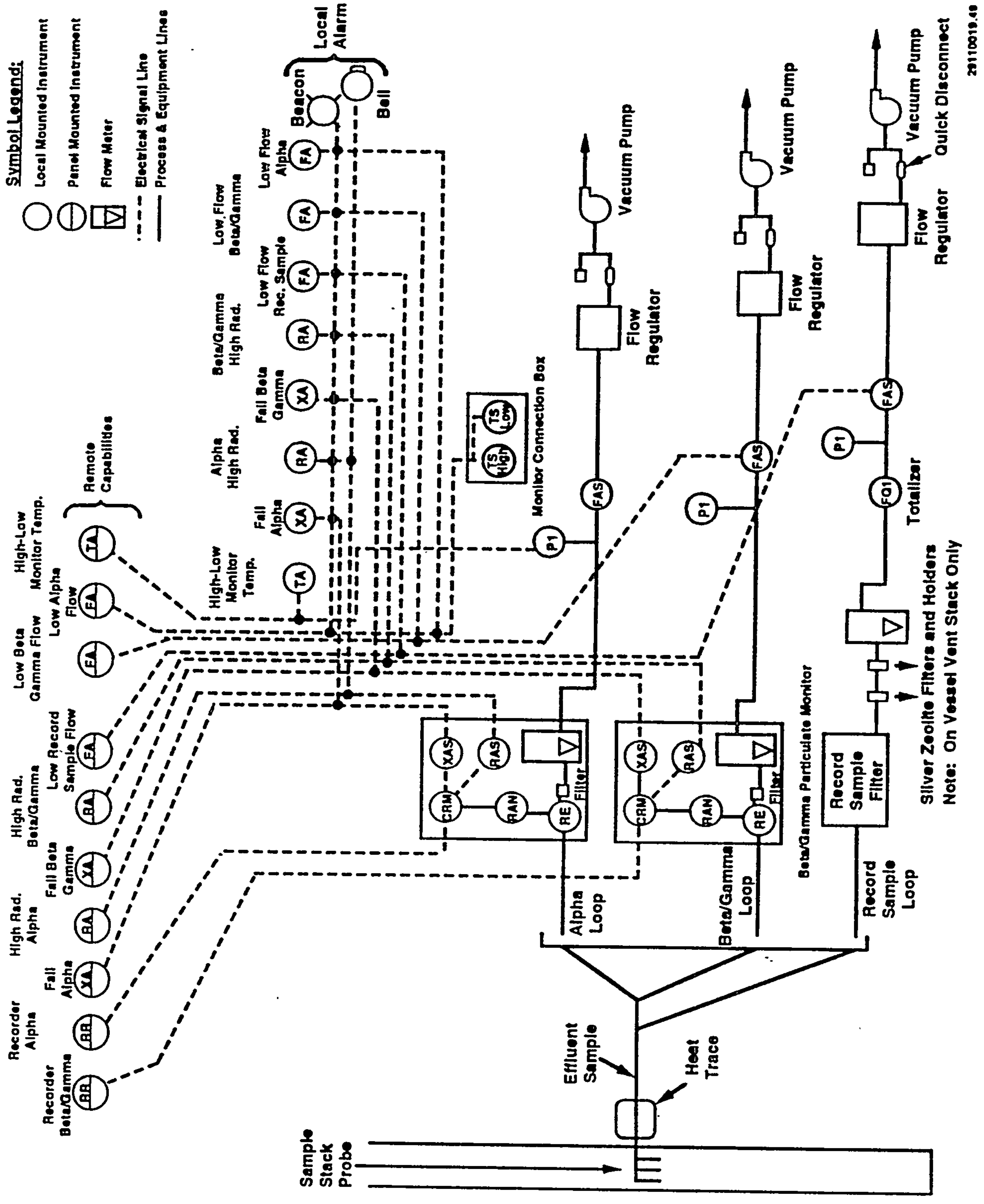
B. Record Sample Holder.

- Large outside diameter with knurled outer ring for ease of opening.
- Rubber "O" ring gaskets used to seal the sample holder.
- Fine mesh screen behind the sample filter to keep the sample a constant distance from the inlet.
- Sample vacuum side is connected by a flexible line for ease of access.

C. Stack Monitoring CAMs.

- Industry standard CAMs. Currently Eberline AMS-3 for beta/gamma, Eberline Alpha 5 for alpha.
- Hard plumbed into the sample system.
- Hard wired to the central alarm relay system.
- Wired for remote failure alarm.

Figure 7-1. Generic Airborne Effluent Sampling and Monitoring System.



- Electric 30-d linear chart recorders are provided at the control room monitoring alarm panel. The recorders have a scale range of 0 to 100 with an accuracy of 2% of full scale, a chart speed of 1.9 cm/hr (0.75 in./hr), and a response time of 1 s (full scale).

D. Record Sample Vacuum System consists of the following.

- **Rotameter (FI):** Reads out in ft^3/hr of airflow through the sample paper.
- **Gas Meter Totalizer (FIQ):** Industry standard gas meter. Reads out in m^3. Measures the total volume of air pulled through the sample filter.
- **Flow Alarm Switch (FAS):** Trips an alarm at the loss of flow resulting from vacuum pump failure and/or sample filter clogging.
- **Vacuum Line to the Vacuum Pump:** Equipped with a standard quick disconnect for connection to alternative pumps and for sample filter retrieval.
- **Stack Flow Switch:** Controls a "switched" power outlet providing power to the record sample vacuum pump. Automatically shuts down the record sample vacuum when the stack fans cease operation.
- **Record Sample Timer:** Provides integrated timing of power supplied to the "switched" power outlet. Resettable 5-digit switch to 99999. Normally reset to zero when the record sample is exchanged.

E. CAM Sample Vacuum System consists of the following.

- **Rotameter (FI):** Located in the CAM.
- **Vacuum Gauge (PIV)--Industry Standard:** Provides an indication of filter plugging resulting from particle buildup.
- **Flow Alarm Switch (FAS):** Trips an alarm at the loss of flow resulting from vacuum pump failure and/or sample filter clogging.
- **Vacuum Line to the Vacuum Pump:** Equipped with a standard quick disconnect for connection to alternative pumps and for sample filter retrieval.

F. Alarm Relay Panel Features.

- Provides for simultaneous alarms, local and remote.

- Neon lamps indicate alarming condition at the stack monitoring/sampling cabinet.

- Provided with a reset switch to clear the remote alarm.

- Alarms: (1) Loss of record sample or CAM vacuum, (2) CAM failures, (3) Cabinet over temperature, and (4) Cabinet low temperature trip the cabinet warning strobe and their respective remote alarms.

- Alarms for high radiation trip the strobe, alarm bell, and their respective remote alarms.

G. Vacuum Supply consists of the following.

- **3 Gast Moto Air-Type Pumps**: The pumps are of the centrifugal type with sealing vanes of replaceable graphite.

- **Air Sample Flow Regulator**: This device bleeds air into the vacuum system to maintain a constant flow through the filter as pluggage occurs. Airflow is adjusted via a set screw on the side of the regulator.

- **Bleed-In Air Filter**: Filters dirt out of the bleed-in air to the sample pump to prevent pump damage.

- **Muffler**: Quiets pump exhaust and provides a final filter for sample air before being exhausted to the environment. (Note: The building exhaust stack sample air and the vessel vent stack sample air are fed back into their respective stacks and therefore do not require muffler systems).

- **Quick Disconnects**: Installed on the vacuum inlet of the regulator. One is in use at all times, the second is a spare. If one vacuum pump becomes disabled, system flow can be maintained by disconnecting the vacuum line from the disabled pump and connecting that line to one of the spare inlet quick disconnects on another pump. A decreased flow rate is sometimes found when operating in this mode, so the disabled pump is repaired as soon as is practically possible. To maintain near-isokinetic flow, the record sample loop is always run on an individual pump.

- **Exhaust Lines**: Vacuum pumps are exhausted back to the exhaust stack in most installations. Exhaust is always routed to the outside of the cabinet.

7.1.1.2 Continuous Air Monitors. Continuous air monitoring and sampling systems can best be described as an air sampling system designed to sample an air space or air stream by drawing a representative portion of that air through a filter or chamber, coupled with radiation detection instrumentation capable of measuring the radionuclides of interest contained in that air. Together, within the limitations of the detection instrumentation, the two systems are capable of "real-time" monitoring of the sample filter or chamber contents as air is being drawn through it. These systems are commonly referred to as CAMs. When the CAM system has been properly calibrated and the alarm set point adjusted to compensate for naturally occurring radioactivity, the CAM can provide alarm capability to alert personnel to an abnormal condition.

The performance specifications for these airborne EMSs are based on the performance of the CAMs and are outlined in Hanford Works Standards HWS-10192, *Procurement Specification for Alpha Air Sampler/Monitor* (RHO 1978a), and HWS-10193, *Procurement Specification for Beta-Gamma Particulate Air Monitor* (RHO 1978b). The system operating ranges for the detection of radionuclides depends on the ranges and accuracy of the CAMs, the count-rate meters, and the strip chart recorders. The CAM system specifications used for monitoring the vessel vent and the building ventilation exhausts are described in the following paragraphs.

Eberline AMS-3 beta/gamma monitor

- **Detectors:** Pancake-type geiger tube, 4.44-cm- (1.75-in.-) diameter, mica window with a density thickness of 1.4 to 2.0 mg/cm^2
- **Range:** 10 to 100,000 cpm on a 4-decade logarithmic scale
- **Linearity:** Within ±10% of reading
- **Response Time:** Varies with count rate to provide constant statistical fluctuation
- **Alarm Point:** Adjustable over full instrument range
- **Temperature Stability:** The instrument is operational from 10 °C to 37.8 °C (50 °F to 100 °F) with less than ±10% change in calibration and less than ±20% change in alarm point
- **Airflow Meter:** 10 to 100 L/min
- **Count-Rate Meter:** ±1% accuracy

Eberline "Alpha-5" alpha monitor

- **Detector:** Silicon-diffused junction type with 490 mm^2 area
- **Range:** 1 to 10,000 cpm (single logarithmic range)
- **Linearity:** Within ±5% of reading
- **Response Time:** Varies with count rate to provide constant statistical fluctuation
- **Alarm Point:** Adjustable over full instrument range

- **Temperature Stability**: The instrument is operational from -7 °C to 55 °C (20 °F to 130 °F) with less than ±5% total change in system gain
- **Airflow Meter**: 10 to 100 L/min
- **Count-rate Meter**: ±1% accuracy.

7.1.1.3 Acceptance Test Procedure. A generic acceptance test procedure (ATP-G-999-00010) (RHO 1981) is initially used at the Hanford Site to verify stack sampling system operability. This procedure provides electrical, mechanical, and alarm function checks as identified in RHO-MA-241, *Installation Criteria for the Generic Airborne Radioactive Contamination Sampling and Monitoring System* (RHO 1980b). Applicable sections of this acceptance test procedure are applied to facility-specific airborne effluent monitoring/sampling systems (EMS).

7.1.1.4 Effluent Monitoring System Inspections, Calibrations, and Periodic Testing. Inspections of gaseous EMSs are routinely scheduled and performed by HPTs using procedures in WHC-IP-0718, Section 3.3.2, Gaseous Effluent Monitoring System and Sample Exchange, *Health Physics Procedures Manual* (WHC 1992g).

7.1.1.5 CONTINUOUS AIR MONITORING ALARM SET POINTS

The amount or quantity of material released from a stack effluent stream is of primary importance in emission reporting. For radionuclides, these quantities are normally reported in units of curies (abbreviated as Ci). From these quantities, dose consequences can be and are calculated. Regulatory limits are set to dose limits. Not only are the regulations concerned with the quantity emitted, they are also interested in any increased emissions. CAMs can be used as indicators of increased emissions. Since this is the case, it is logical to assume, that the alarm set point should be based on increased quantities. The Environmental Compliance Manual, WHC-CM-7-5, Section 2.0, *Air Quality* discusses alarm set points as follows:

> "Monitoring systems shall alarm at emission concentrations as low as possible without resulting in an excessive number of alarms due to normal fluctuations in background or normal fluctuations in emissions. The alarms are intended to provide timely warnings when the radionuclide concentration or content of emissions has increased significantly so that corrective actions are required to prevent their exceeding the discharge limits. The alarm settings for a specific facility may be selected by the cognizant engineer of the facility who has detailed knowledge of both its process design and its operating experience."

WHC-CM-7-5, Section 2.0 also states:

> "Monitoring systems shall, as a minimum, have the capability to alarm at less than or equal to the time-integrated equivalent concentration equal to a 4-hour release at 5,000 times the DCG-public value, as noted in Appendix C of this manual."

Though WHC-CM-7-5 Manual is used for environmental compliance purposes, the alarm set points are actually established and set by the field HPTs via the methods established in WHC-IP-0718 (Appendix I), Section 4.2, *Continuous Air Monitoring*. What this document has to say about alarm set points is:

> "Alarm set points for environmental release points are determined by Radiological Engineering."
>
> "Continuous air monitors should be capable of measuring 1 DAC when averaged over 8 hours (8 DAC-hours) under laboratory conditions."
>
> "Because of ALARA: The CAM ASP shall be set at the lowest practical level possible to indicate loss of containment or the need for corrective action without resulting in a significant number of false alarms (i.e., false alarms should not exceed one per month)."

What is given in these two documents, though contradictory on responsibilities for establishing alarm settings and use of concentration values (DAC vs DCG - defined next), actually do lead to the same results - setting the alarm to the lowest practical level. The DAC and the DCG are defined as follows:

DERIVED AIR CONCENTRATION (DAC): The concentration of a radionuclide in air that, if breathed over the period of a work year, would result in the ALI for that radionuclide being reached. The DAC is obtained by dividing the ALI by the volume of air breathed by an average worker during a working year (2400 m^3). DACs are listed in 10 CFR 20, Appendix B.

ANNUAL LIMIT ON INTAKE (ALI): The quantity of a single radionuclide which, if inhaled or ingested in 1 year, would irradiate a person (represented by reference man as defined in Publication 23 of the International Commission on Radiological Protection [ICRP 1974]) to the limiting value for control of the workplace. In DOE 5480.11, DACs instead of ALIs are given for controlling exposures.

DERIVED CONCENTRATION GUIDES (DCG): The DCG values are listed WHC-CM-7-5, APPENDIX C. DCGs were derived for the purpose of relating concentrations of radionuclides in the environment to a human dose. The DCG values relate to a 100 mrem dose only when applied at the point of exposure to humans. When a standard person is exposed continuously for 1 year to air concentrations at one times the DCG values, they will receive an effective committed dose equivalent of 100 mrem. Similarly, if a standard person consumes the standard amount of water (as noted in ICRP 23) each day for 1 year, they will receive an effective committed dose equivalent of 100 mrem. When more than one radionuclide is involved in the exposure, the fractional relationship of the concentration of each radionuclide to its respective DCG value must be summed to determine the total dose from the radionuclide mix.

With that said, the rest of this discussion is devoted to examination of how the alarm set point is established, recommendation of what the alarm set points should be, and to explain what the alarm set point really means.

7.1.1.5.1 EMISSIONS LIMITS

WHC-CM-7-5 establishes emissions limits as follows:

> The annual average concentration of radionuclides released to the environment shall not exceed an Administrative Control Value (ACV) of 1 times the DCG-public value (unity rule applies) at the point of emission (the exit of the stack).
>
> The weekly average (any consecutive 7-day period) concentration of radionuclides released to the environment in airborne emissions should not exceed 10 times the annual average ACV concentration specified for that stack at the point of emission.

The emission limits for the 242-A Evaporator Vessel Vent stack 296-A-22 are specified at the facility in the OSD-T-151-00012, *Operating Specifications for the 242-A Evaporator-Crystallizer* as follows:

Annual average concentration limit is:

^{239}Pu (total alpha)	- 2.0E-14 μCi/ml
^{90}Sr (total beta)	- 9.0E-12 μCi/ml

Weekly average concentration limit is:

^{239}Pu (total alpha)	- 2.0E-13 μCi/ml
^{90}Sr (total beta)	- 9.0E-11 μCi/ml

Maximum Instantaneous Concentration, averaged over a 4 hour period is:

^{239}Pu (total alpha)	- 1.0E-10 μCi/ml
^{90}Sr (total beta)	- 4.5E-08 μCi/ml

Note that the maximum instantaneous OSD limits are 5,000 times the annual average, which is the DCG values for these radionuclides. This is because maximum instantaneous values used to be given in WHC-CM-7-5 as 5,000 times the DCG for a 4-hour period. Now, also as noted above, WHC-CM-7-5 only requires that the CAM be sensitive enough to alarm at this value.

7.1.1.5.2 Alarm Set Point Derivation

The amount of material that is released from a stack effluent stream can be determined by multiplying the concentration of that material in the effluent stream by the total volume of the effluent stream that was release. This can be expressed mathematically as follows:

$$Tr = \rho_k * V_k$$

Where:

Tr is the total amount released

ρ_k is the concentration of the material in the effluent stream

V_k is the released volume of the effluent stream

The released volume, can be found from the flow rate of the effluent stream and the operating time of the system.

$$V_k = Q_k*t$$

Where:

Q_k is the flow rate, and

t is the length of time that the system operated

Tr is therefore,

$$Tr = \rho_k*Q_k*t \qquad [1]$$

Tr is a quantity, normally expressed in units of Ci. It is Tr that is important in emission reporting. If the CAMs are to be used as indicators of increased emissions, it is logical to assume, then, that the alarm set points should be based on increased quantities.

Alarm set points are established on concentrations. From equation 1 above, it is readily apparent that Tr is directly related to the concentration and the stack flow rate. Therefore, as long as the stack flow rate remains the same, increased emissions would be indicated by increased stack concentrations. The CAM can be used to indicate when this happens.

The CAM unit is designed to draw a portion of the stack effluent through a collection filter paper at certain sample flow rates. A radiation detector head is installed as part of the CAM unit and used to monitor the activity collected on this filter. The concentration inside the CAM is determined by dividing the activity seen by the detector head by the sample flow volume, which is the sample flow rate multiplied by the time the system was collecting the sample. This is expressed mathematically as follows:

$$\rho_o = \frac{A}{Q_o \times t}$$

Where:

ρ_o = the concentration of material seen in the CAM

A = the activity seen on the CAM's collection filter by the CAM's detector

Q_o = the flow rate thru the CAM

The variable of interest, though, is that concentration in the stack - recall that an increase in the concentration being released is what the alarm set point should be set to. Therefore the variable of interest, as given in equation 1 is ρ_k. In order to assume that ρ_o (the concentration collected in the sample) is equivalent to ρ_k (the concentration in the stack), the losses and efficiencies must be known or estimated. The expression of these losses or efficiencies can be done as follows:

$$\epsilon * \rho_k = \rho_o$$

Where ϵ represents the efficiency of the sample collection and detection process. ϵ can be further broken down as follows:

ϵ_c = the sample collection efficiency
ϵ_f = the filter collection efficiency
ϵ_d = the detector efficiency

Where $\epsilon = \epsilon_c * \epsilon_f * \epsilon_d$

Recall that the variable of interest here is ρ_k, the concentration in the stack. With this:

$$\rho_k = \frac{A}{Q_o \times t \times \epsilon_c \times \epsilon_f \times \epsilon_d} \qquad [2]$$

The CAM reads out in counts per minute (cpm), which is an activity. As such, the alarm set point can be set to "A", the activity collected on the filter paper. Solving for "A" now gives:

$$A = \rho_k * Q_o * t * \epsilon_c * \epsilon_f * \epsilon_d \qquad [3]$$

DISCUSSION OF THE VARIABLES: Now that an appropriate equation is derived, a brief discussion of the variables involved is in order:

From the discussion above, ρ_k is usually expressed as a DCG or a DAC which has units of μCi/ml.

ϵ_d is the detector efficiency, expressed as a ratio of cpm/dpm - dpm is the abbreviation for disintegrations per minute. Since ρ_k is expressed in units of μCi/ml, a conversion factor is necessary to convert dpm to μCi. One μCi is equivalent to 2.22E+06 dpm. ϵ_d is determined in the field. WHC-IP-0718 (Appendix I), Section 4.2, *Continuous Air Monitoring* gives instructions to reject the CAM if the efficiencies do not meet the criteria given, or if any of the alarm circuitry is inoperable. The efficiencies given are:

Alpha CAM efficiency performance should always be >7% and <20%.

Beta CAM efficiency performance should always be >10% for Cs^{137}, and >15% for $Sr\text{-}Y^{90}$.

ϵ_f is the collection efficiency of the filter paper. The manufacturers efficiency given for the VERSAPOR 3000 filter paper is 91%. If another filter paper is used, this manufacturer's efficiency rating must be used.

ϵ_c is the collection efficiency of the sample probe and transport line. These values have been derived in WHC-SD-WM-ES-291, Rev 1. These values are however dependant upon the particle size. For purposes of calculating the alarm set point of the CAM, there are two possible particle sizes which might be used to ascertain the possible collection efficiency factor to use. These are as follows:

- During normal operation, there is no reason to assume that the particles will be large. WHC-SD-WM-ES-291 justified use of a 3.5 μm sized particles for collection efficiencies.
- If the HEPAs were to fail, however, large particles might exist in the effluent stream. As such, the correct efficiency factor to use would be for the 10 μm sized particles. These collection efficiencies are given in WHC-SD-WM-ES-291 as follows:

STACK	ϵ_c for 3.5 μm	ϵ_c for 10 μm
296-A-21	89%	49
296-A-22	87%	16

The variable "t" is the time the sampler/monitor was running (i.e., the time since a fresh, clean filter was installed); "t" is usually expressed in units of hours.

Q_o is the variable for the sample flow rate. Normally this variable is set to 2 ft^3 per minute or 120 ft^3 per hour (abbreviated as CFH). Because ρ_k is expressed in units of μCi/ml, a conversion factor is necessary, to use the CFH unit in this equation. One ft^3 is equivalent to 2.83168E+04 ml.

With the variables defined and the conversion factors determined, equation 3 can be rewritten as follows:

$$A = \rho_k{*}Q_o{*}t{*}\epsilon_c{*}\epsilon_f{*}\epsilon_d{*}2.832\text{E+04 ml/ft}^3{*}2.22\text{E+06 dpm}/\mu\text{Ci}$$

$$= \rho_k{*}Q_o{*}t{*}\epsilon_c{*}\epsilon_f{*}\epsilon_d{*}6.286\text{E+10 (ml)(dpm)/(ft}^3)(\mu\text{Ci})$$

Another way to express this is to put the conversion factor into the denominator as follows:

$$A = \frac{\rho_k \times Q_o \times t \times \epsilon_c \times \epsilon_f \times \epsilon_d\ (dpm)\,(ml)}{1.591\times10^{-11}\ (ft^3)\,(uCi)} \qquad [4]$$

Note that in equation 4, one still has to put the units in for variables ρ_k, Q_o, t, and ϵ_d. These units should be:

- μCi/ml for ρ_k,
- CFH for Q_o,

- ϵ_d cpm/dpm.

A similar equation to equation 4 is given in WHC-IP-0718 (Appendix I), Section 4.2 as:

$$ASP = \frac{(DAC)(V)(E)(DAC\text{-}hrs)}{2E\text{-}11} \qquad [5]$$

where:

ASP = Alarm Set Point (cpm)

DAC = Derived Air Concentration for the isotope of concern (μCi/ml)

V = flow rate of the air through the CAM (ft^3/hr)

E = CAM counting efficiency (decimal form, cpm/dpm)

DAC-hrs = value retrieved from the Appendix of WHC-IP-0718

2E-11 = conversion constant ($\mu Ci \bullet ft^3/dpm \bullet ml$)

Note that equation 5 is identical to equation 4 except for the conversion factor of 2E-11 and a couple efficiency factors. This is because the missing efficiency factors in equation 5 have been combined into the conversion factor. In fact the conversion factor of 2E-11 is different from that in equation 4 by about a factor of 0.8. This means that in the derivation of equation 4, ϵ_c and ϵ_f were assumed to be equivalent to about 0.8.

7.1.1.5.3 DETERMINATION OF THE ALARM SET POINT

To determine an alarm set point, the radionuclide of concern must be determined. This is provided in Section 4.2.1.1.1 of this FEMP. The radionuclides of concern (particulate in nature - neither CAM will see ^{106}Ru) are ^{90}Sr, ^{137}Cs, and ^{241}Am. As noted above, the OSD limit is for ^{90}Sr and for ^{239}Pu. This is acceptable because the value for ^{239}Pu is the same as the DCG value for ^{241}Am.

As noted above, emission limits are established on annual, weekly, and for the OSD, instantaneous bases. These limits are established because the regulations are concerned with increased emissions. Annual limits are easily verified as being in or out with review of the annual reports. The weekly values are not so easily viewed, however, unless one has access to the laboratory analysis values. It can be done though. Therefore, it is suggested that the CAM alarm set points be set as low as possible without spurious alarms, but between the weekly and instantaneous limits. The following table provides these alarm set points for both the vessel vent stack 296-A-22 and the building ventilation stack 296-A-21. Set points for both the weekly and instantaneous emission limits are provided. For illustrative purposes, the effective dose equivalent for the public due to the instantaneous limit being violated for an entire year is also provided. The alarm set points were calculated using the following values and assumptions:

- The DCG value of 9E-12 μCi/ml was used in the variable ρ_k for the beta CAM assuming ^{90}Sr to be the radionuclide of concern.
- The DCG value of 2E-14 μCi/ml was used in the variable ρ_k for the alpha CAM assuming ^{241}Am to be the radionuclide of concern.
- For both the alpha and beta alarm set point calculations, an additional factor of 10 was applied to the ρ_k variable in the weekly results.
- For both the alpha and beta alarm set point calculations, an additional factor of 5,000 was applied to the ρ_k variable in the instantaneous results.
- A value of 120 CFH was used for the variable Q_o.
- A value of 168 hours was used for the variable "t" in the weekly calculations.
- A value of 4 hours was used for the variable "t" in the instantaneous calculations.
- The value of 0.16 was used for the variable ϵ_c in calculations for the 296-A-22 stack. This assumes that the increased emissions were caused by a HEPA filter failure or some other cause creating large particles.
- The value of 0.49 was used for the variable ϵ_c in calculations for the 296-A-21 stack. This assumes that the increased emissions were caused by a HEPA filter failure or some other cause creating large particles.
- The value of 0.91 was used the variable ϵ_f.
- The lowest beta efficiency factor for ^{90}Sr of 0.15 was used for the variable ϵ_d in the beta CAM alarm set point calculations.
- The lowest alpha efficiency factor of 0.07 was used for the variable ϵ_d in the alpha CAM alarm set point calculations.

As suggested above, it is suggested that the CAM alarm set points be set as low as possible without spurious alarms, but between the weekly and instantaneous values listed in the following table:

Large Particle Release Alarm Set Point			
Stack/CAM	Weekly (cpm)	Instantaneous (cpm)	EDE (mrem/yr)
296-A-22 Beta CAM	2,490	29,655	0.024
296-A-22 Alpha CAM	2.6	31	0.016
296-A-21 Beta CAM	7,630	90,820	0.7
296-A-21 Alpha CAM	7.9	94.2	0.5

The EDE for the 296-A-22 stack is based on a maximum annual exhausted volume of 1.2E+10 liters. The EDE for the 296-A-21 stack is based on a maximum annual exhausted volume of 3.7E+11 liters. These volumes are based on the 95% confidence intervals established in sections 5.1.1.2 and 5.1.2.2.

7.1.1.5.4 INTERPRETATION OF THE ALARM SET POINT

Three subjects will be discussed:

1. Normal release alarm settings
2. Interpretation of alarms and CAM readouts
3. Conversion of alarms and CAM readouts to actual releases

NORMAL RELEASE ALARM SETTINGS

The values given in the "Large Particle Release Alarm Set Point" table above represent those settings necessary to indicate large particle releases at the weekly and instantaneous limits. These values are a result of using the lowest possible value for ϵ_c calculated for 10 μm sized particles. Under normal circumstances, however, large particles may not be present. The word "may" is used because no particle size studies have been accomplished in these stacks. As noted in Section 7.1.1.5.2 under the heading *"Discussion of the Variables"* during normal circumstances, a 3.5 μm sized particle has been justified. Consequently, under normal circumstances the values given in the table above could be adjusted to the following:

Normal Particle Release Alarm Set Point		
Stack/CAM	Weekly (cpm)	Instantaneous (cpm)
296-A-22 Beta CAM	13,539	161,249
296-A-22 Alpha CAM	14	169
296-A-21 Beta CAM	13,859	164,959
296-A-21 Alpha CAM	14	171

Until it is ruled out that large particles will not be present in these stacks, and because the purpose of the alarm set point is to provide an indication of increased emissions, the values given in the former table titled "Large Particle Release Alarm Set Point" are suggested for use and not the values given here. The values given here, may be used, however, to interpret the CAM readouts, under normal circumstances, as indication of the emissions being under the weekly release limit values.

INTERPRETATION OF ALARMS AND CAM READOUTS

When interpreting the CAM's readouts and alarm settings, understanding the mechanism at work is important. The CAMs do not read the concentration directly. Since a new, clean collection filter was installed, the activity collected is being read. The following is provided to illustrate the importance of understanding this:

- Assume that the CAM alarm set point has been set to the 4-hour release of 5,000 times the DCG.
- The collection filters are normally exchanged weekly (168 hours). Assume, then, that the alarm annunciated just before change out.
- **Interpretation:** A 4-hour release at 5,000 times the DCG (for ^{90}Sr) amounts to an average release concentration of 4.5E-08 μCi/ml. But if the alarm did not annunciate until just before the filter was exchanged (168 hours), the actual concentration released would have averaged 1.07E-09 μCi/ml - a much lower concentration.

The intent of this illustration was to make it apparent that interpretation of the reading of the CAM or an alarm indication is dependant upon the length of time the collection filter has been in place.

CONVERSION OF ALARMS AND CAM READOUTS TO ACTUAL RELEASES

As noted above, the concentration observed in the sampling system is not, necessarily, that present in the stack effluent unless the losses or efficiencies have been accounted for. Equation 2 was provided to accomplish this. This equation can be used to estimate the concentration in the stack from the readout of the CAM or to signify what alarm set point would represent a particular stack concentration. To quantify this concentration, however, it is necessary to combine equation 2 with equation 1. Equation 6 provided below, is that combination.

$$T_r = \frac{A \times Q_k \times t_k}{Q_o \times t_o \times \epsilon_c \times \epsilon_f \times \epsilon_d} \tag{6}$$

where:

t_o = the length of time that a clean filter paper has been installed. It is important to understand that if the alarm goes off, t_o is the length of time the filter has been installed, not the time used to calculate the alarm set point.

t_k = the length of time that the exhaust fan has been operating. For purposes of estimating emissions during the time the filter was in place, t_k would be equal to t_o. In this case time cancels out of the equation. The two "t" variables are useful, however, if one wants to know the resulting emissions for longer periods of time at specific CAM settings or readouts.

7.1.1.6 Vessel Vent Instrumentation. The alpha and beta CAMs specifications used in the vessel vent monitoring system are discussed in Section 7.1.1.2. This section itemizes other specific instrumentation in the exhaust sampling/monitoring systems.

Stack 296-A-21 Alpha Loop.			
Instrument	Make/model	Inst. No.	Loop No.
Vacuum gauge	Marsh	PI-K1-1-2	AE 048 5
Flow switch	CHEM-TEC	FSL-K1-2	AE 048 3

Stack 296-A-21 Beta/gamma Loop.			
Instrument	Make/model	Inst. No.	Loop No.
Vacuum gauge	Marsh	PI-K1-1-1	AE 048 Y
Flow switch	CHEM-TEC 500	FSL-K1-1	AE 048 C

Stack 296-A-21 Record Sample Loop.			
Instrument	Make/model	Inst. No.	Loop No.
Rotameter	Dmyer 103PF	FI-K1-1	AE 048 W
Gasmeter	Rockwell MR9	FQI-K1-1	AE 048 1
Vaccum gauge	Marsh	PI-K1-1-3	AE 048 6
Flow switch	CHEM-TEC 500	FSL-K1-3	AE 048 Z

Stack 296-A-22 Alpha Loop.			
Instrument	Make/model	Inst. No.	Loop No.
Vacuum gauge	Marsh	PI-VV-1	AE 721 2
Flow switch	CHEM-TEC	FSL-VV-1	AE 721 1

Stack 296-A-22 Beta/gamma Loop.			
Instrument	Make/model	Inst No.	Loop No.
Vacuum gauge	Marsh	PI-VV-2	AE 720 2
Flow switch	CHEM-TEC 500	FSL-VV-2	AE 720 1

Stack 296-A-22 Record Sample Loop.			
Instrument	Make/model	Inst. No.	Loop No.
Rotameter	Dmyer RM-B54-SSV	FI-VV-1	AE 722 1
Gasmeter	Rockwell MR9	FQI-VV-1	AE 722 2
Vaccum gauge	Marsh	PI-VV-3	AE 722 4
Flow switch	CHEM-TEC 500	FSL-VV-3	AE 722 3

7.1.1.7 Building Ventilation Instrumentation. The alpha and beta CAM specifications used in the building ventilation monitoring system are discussed in Section 7.1.1.2.

7.1.2 Liquid Effluent Streams

This section describes the specific monitoring instrumentation associated with the used cooling water stream (ACW) and the steam condensate (ASC) at the 242-A Evaporator facility.

7.1.2.1 Components of Liquid Sampling/Monitoring Systems. The liquid monitor systems for the ACW and ASC streams are labeled RC-2 and RC-1, respectively. The monitors are identical in design. A sodium iodine (NaI) crystal (detector) and photomultiplier tube are encased in stainless steel. The end of the encased detector is placed within a well. This well is created by the stainless steel canister through which the effluent stream passes. The entire detector system is located within the lead-shielded pig. A preamplifier is located on the outside of the pig within the sampler/monitor rack. The remaining instrumentation (i.e., power supply, amplifier, single-channel analyzer, ratemeter) and alarms are located in the control room.

7.1.2.2 Effluent Monitoring System Inspections, Calibrations, and Periodic Testing. The instrumentation within these systems is calibrated periodically to ensure that operation is within the required ranges. Functional tests, cleaning, and required maintenance are also performed. Written procedures are followed in the performance of these tasks. Associated maintenance procedures are found within the 7-GN (generic) series of Hanford Site maintenance procedures. The calibration procedures followed are found in the Component-Based Recall System (CBRS) which is a system established to support the calibration and control of measuring and test equipment (M&TE). The CBRS program uses a computerized database to document and forecast plant-installed instrument and equipment calibrations and verifications.

Rockwell Hanford Operations supporting document SD-SQA-TI-003, *Liquid Effluent Monitor Calibration for the 242-A Evaporator* (RHO 1985), presents the technical information concerning calibration of the liquid effluent monitors at the 242-A Evaporator. The calibration consists of obtaining a correlation-relating monitor reading to radioactivity concentrations. This is accomplished by making use of sealed sample canisters containing NBS-equivalent traceable solutions of ^{137}Cs, which allows for maintenance of identical source-to-detector geometry. The correlation curve is plotted as activity (counts per second) versus concentration of calibration standards (microcuries of ^{137}Cs/mL).

Functional tests are conducted periodically and calibration of the radiation monitoring system are conducted annually. Operability verification is conducted daily on the steam condensate system. Alarms are tested and set points adjusted monthly. Periodically, system performance is evaluated based on regulatory limits. Applicable procedures and their frequencies are listed in Tables 7-1 and 7-2.

7.1.2.3 Effluent Monitoring Systems Alarming/Diversion Set Points. Limits for radionuclide releases in the steam condensate and cooling water effluent streams are specified in OSD-T-151-00012, *Operating Specifications for the Operation of the 242-A Evaporator-Crystallizer* (WHC 1988b). Radionuclide releases up to the specification limits are set to meet the requirements of WHC-CM-7-5, *Environmental Compliance Manual* (Parts A, B, F and Appendix A) (WHC 1992i), and are considered safe for the environment. The maximum instantaneous concentration limit for ^{137}Cs is 1.5×10^{-2} μCi/mL. As discussed in Section 7.1.2.2., the liquid monitor systems at the facility are calibrated using a ^{137}Cs source. Reference to the detector calibration correlation curve found in RHO-QA-TI-003, *Liquid Effluent Monitor Calibration for the 242-A Evaporator* (RHO 1985), shows that the limit corresponds to a radioactivity of 800 cps.

The monitor on the steam condensate stream is set to alarm at 480 cps on increasing radiation. This stream is also diverted to the evaporator feed tank (TK-102-AW) should activity levels reach this threshold.

The monitor on the used cooling water stream is set to alarm at 7.5 cps on increasing radiation. The cooling water sampling and monitoring system, RC-2, has no diversion capabilities, thus high levels of radiation detected in this stream require immediate evaporator shutdown.

7.1.2.4 Cooling Water Instrumentation. Radiation information is monitored on the MCS by radiation indicator RI-RC2-1. A count-rate meter is self-contained with a range of 10 to 1.0 x 10^{+6} cpm (±2.0%) on an adjustable linear or logarithmic scale. Radiation alarms are activated at 7.5 cps (10^2 scale) on increasing radiation.

Table 7-1 displays the instrumentation related to the sampling/monitoring systems for the used raw-water stream. Instrument locations, calibration frequencies, and alarming or diversion set points are included in this matrix. Drawing No. H-2-98994 (Figure 7-2) is an instrument flow diagram for the used raw-water system.

Table 7-1. Monitoring Instrumentation for 242-A Evaporator Used Raw Water System Waste Stream. (Hanford Site Stream Code ACW) (3 sheets)

Instrument type	Physical location	Calibration type, frequency, and procedure No.	Alarming or diversion set points
FIAS-RC2-1 used raw-water sampler/monitor low-flow indicator alarm switch	2nd level of condenser room RC-2 sample and monitor rack	12-mo limited calibration Maint: 7-GN-38 Cal: PSCP-1-062	Decreasing cooling H_2O sample flow-rate activates switch at 0.3 gal/min
FSL-RC2-1 used raw-water sampler/monitor low-flow rate (MCS Input)	Control room: (MCS)	N/A	<0.3 gal/min cooling H_2O sample flow
FE-RC2-1 Cooling H_2O flow element on used raw-water line fabricated (0-200 in. H_2O)	2nd Level of condenser room	Pre-calibration Certification. Maint: 7-GN-38	N/A
FT-RC2-1 Cooling H_2O flow to 216-B Pond Elec. Diff. pressure transmitter (0-4,000 gal/min)	3rd Level of condenser room	12-mo overall calibration: PSCP-6-188 Maint: 7-GN-38	N/A
FI-RC2-1 used raw-water flow to 216-B Pond flow indicator MCS Input Range: 0-4,000 gal/min	Control Room: • MCS	N/A	N/A
RE-RC2-1 Cooling water radiation element Range: 0 to 10 cps	2nd level of condenser room in RC-2 sample and monitor rack	Radioactive source alignment: 6-TF-045 12-mo overall cal: PSCP-3-102 Maint: 7-GN-38	Alarm High: 7.5 cps above background
RX-RC2-1 Preamplifier Range: 0-50 cps	2nd level of condenser room in RC-2 sample and monitor rack	6-mo functional check: job card	N/A

Table 7-3. Monitoring Instrumentation for 242-A Evaporator Used Raw Water System Waste Stream. (Hanford Site Stream Code ACW) (3 sheets)

Instrument type	Physical location	Calibration type, frequency, and procedure No.	Alarming or diversion set points
RX-RC2-2 amplifier	Control room	12-mo overall cal: PSCP-3-102	N/A
RX-RC2-3 Pulse height analyzer	Control room	6-mo functional test: PSCP-3-017 12-mo overall cal: PSCP-3-102	N/A
RXAS-RC2-1 Cooling H_2O fail alarm switch	Control room	6-mo functional test: job card	Switches upon failure of radiation monitoring system
RXS-RC2-1 URW radiation system failure alarm	Control room: • MCS	6-mo functional test: job card	N/A
RIAS-RC2-1 Cooling H_2O lin/log count-rate meter Range: 0-100%	Radiation cabinet Control room	Monthly functional test: job card 12-mo overall cal: PSCP-3-102	Activates at 7.5 cps on increasing radiation
RXA-RC2-1 Radiation alarm	Control room	Monthly functional test: job card	Alarm high: 7.5 cps
RI-RC2-1 Used raw-water (URW) sampler radiation MCS input	Control room: • MCS	Monthly functional test: job card	Alarm low: inactive
RSH-RC2-1 URW high radiation alarm	Monitor control system (MCS)	Monthly functional test: job card	Alarm high: 7.5 cps
RAH-RC2-1 URW high radiation alarm	CASS	Monthly functional test: job card	Alarm High: 7.5 cps
PT-EC1-9 URW Outlet pressure transmitter (0 to 120 lbf/in.^{2}) (gauge)	1st Level of condenser room	12-mo calibration PSCP-6-196 Maint: 7-GN-38	N/A

Table 7-3. Monitoring Instrumentation for 242-A Evaporator Used Raw Water System Waste Stream. (Hanford Site Stream Code ACW) (3 sheets)

Instrument type	Physical location	Calibration type, frequency, and procedure No.	Alarming or diversion set points
PI-RC2-1 URW sampler air sparge pressure indicator 0-30 lbf/in.^{2} (gauge)	2nd Level of condenser room	12-mo maintenance: 7-GN-38	Local indication
PI-RC2-2 URW sample air supply pressure indicator 0-30 lbf/in.^{2} (gauge)	2nd level of condenser room	12-mo maintenance: 7-GN-38	Local indication
YS-RC2-6 RC2 radiation bypass switch	MCS	NA	MCS Primary alarm
Stationary composite sampler	2nd Level of condenser room in RC-2 sample and monitor rack	PSCP-3-029	N/A
JC-RC2-1 Power controller	Control room	12-mo overall cal: PSCP-3-102	N/A

NOTE: CASS = computer automated surveillance system.
cps = counts per second.
MCS = monitor control system
URW = used raw water.

Table 7-2. Monitoring Instrumentation for 242-A Steam Condensate System Waste Stream. (Hanford Site Stream Code ASC) (4 sheets)

Instrument type	Physical location	Alarming or diversion set points	Calibration type, frequency, and procedure number
FIAS-RC1-1 Steam condensate rad. monitor low flow alarm switch	1st floor of condenser room	Alarms upon low-flow condition of 0.30 gal/min	Limited calibration: (12-mo) PSCP-1-062
FSL-RC1-1 SC sampler flow low alarm	Control room: • MCS	Alarms upon low-flow condition of 0.30 gal/min	N/A
RE-RC1-1 Steam condensate rad. monitor	1st floor of condenser room	<u>Alarm</u>: High radiation at 80 cps <u>Diversion</u>: SC diverted to feed tank 102-AW	Daily verification: TF-OR-OFR-001 92-day functional test: TF-FT-680-018 12-mo loop cal: TF-CC-690-008
RX-RC1-1 radiation preamplifier	1st floor of condenser room, Sample/monitor cabinet	N/A	Daily verification: TF-OR-OFR-001 92-day functional test: TF-FT-680-018 12-mo loop cal: TF-CC-690-008
RX-RC1-2 Radiation amplifier	Control room	N/A	Daily verification: TF-OR-OFR-001 92-day functional test: TF-FT-680-018 12-mo loop cal: TF-CC-690-008

Table 7-4. Monitoring Instrumentation for 242-A Steam Condensate System Waste Stream. (Hanford Site Stream Code ASC) (4 sheets)

Instrument type	Physical location	Alarming or diversion set points	Calibration type, frequency, and procedure number
RX-RC1-3 Radiation pulse height analyzer	Control room	N/A	Daily verification: TF-OR-OFR-001 92-day functional test: TF-FT-680-018 12-mo loop cal: TF-CC-690-008
RIAS-RC1-1 Lin/log ratemeter alarm switch Range: 0-100%	Control room	High radiation alarm at 80 cps	Daily verification: TF-OR-OFR-001 92-day functional test: TF-FT-680-018 12-mo loop cal: TF-CC-690-008
JC-RC1-1 RC1 radiation monitor power control	Control room	N/A	Daily verification: TF-OR-OFR-001
RXAS-RC1-1 Radiation fail alarm switch	Control room	N/A	Daily verification: TF-OR-OFR-001 92-day functional test: TF-TF-680-018 12-mo loop cal: TF-CC-690-008
RXA-RC1-1 SC sampler radiation alarm	Control room	High radiation alarm at 80 cps	92-day functional test: TF-FT-680-018
RAH-RC1-1 Radiation alarm high	CASS	High radiation alarm at 80 cps	92-day functional test: TF-FT-680-018

Table 7-4. Monitoring Instrumentation for 242-A Steam Condensate System Waste Stream. (Hanford Site Stream Code ASC) (4 sheets)

Instrument type	Physical location	Alarming or diversion set points	Calibration type, frequency, and procedure number
RI-RC1-1 SC sampler radiation indicator	Control room: • MCS	High radiation alarm at 80 cps	Daily verification: TF-OR-OFR-001 92-day functional test: TF-FT-680-018
LEL-RC1-1 Weir level low element	Tank C-103	Weir level low alarms at 17 in. below top of tank	Operational check: (12-mo) 7-GN-42
LYL-RC1-1 Weir level Low alarm switch	Tank C-103	Weir level low alarms at 17 in. below top of tank	System test: (12-mo) 7-GN-42 PSCP-6-011
LSL-RC1-1 Weir box level low alarm	Control room: • MCS	Weir level low alarms at 17 in. below top of tank	System Test: (12-mo) 7-GN-42
LEL-C103-1 Weir box overflow trap level element	Basement of condenser room Tank C-103 overflow trap	N/A	Precal./cert. functional test: (12-mo) 7-GN-38
LYL-C103-1 Weir box overflow trap level relay	Control room	N/A	Precal./cert. functional test: (12-mo) 7-GN-38
FQI-RC1-D Diverted SC totalizer 0-99999 gal/min	MCS	N/A	N/A
FQI-RC1NM Weir box flow totalizer 0-99999 gal/min	MCS	N/A	N/A
FQIC-RC1 RC1 sampler controller 0-100 gal/min	MCS	N/A	N/A

Table 7-4. Monitoring Instrumentation for 242-A Steam Condensate System Waste Stream. (Hanford Site Stream Code ASC) (4 sheets)

Instrument type	Physical location	Alarming or diversion set points	Calibration type, frequency, and procedure number
FAL-RC1-1 Steam condensate: flow-rate alarm: high and low	CASS	N/A	N/A
FI-RC1-1 SC flow to SC basin 0 to 104 gal/min	MCS	Indicates SC flow to retention basins	Overall calibration: 12-mo
FT-RC1-1 SC elec. flow transmitter	1st floor of condenser room	N/A	Overall calibration: (12-mo) PSCP-6-188

NOTE: CASS = computer automated surveillance system.
cpm = counts per minute.
cps = counts per second.
MCS = monitor control system.
SC = steam condensate.

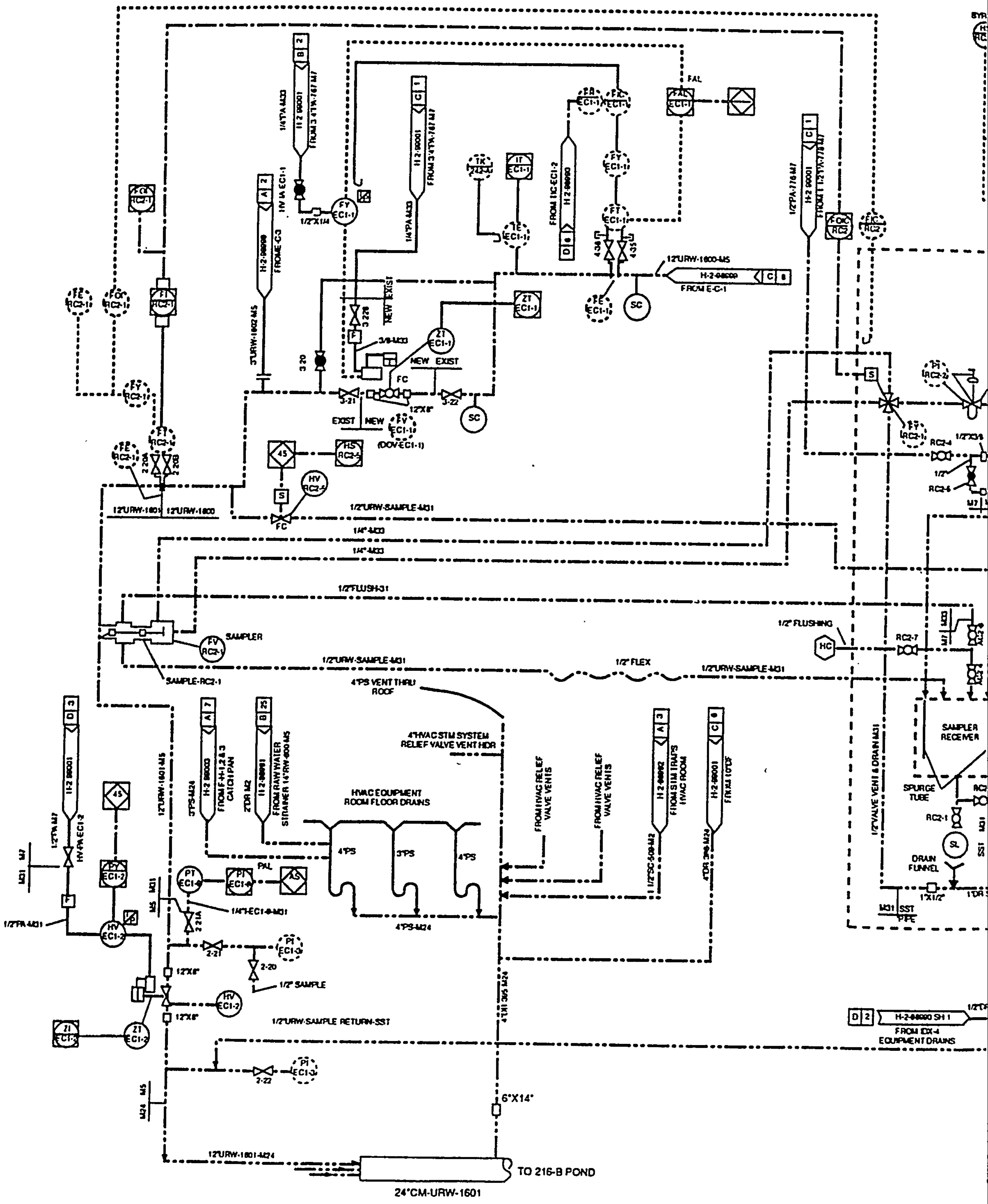
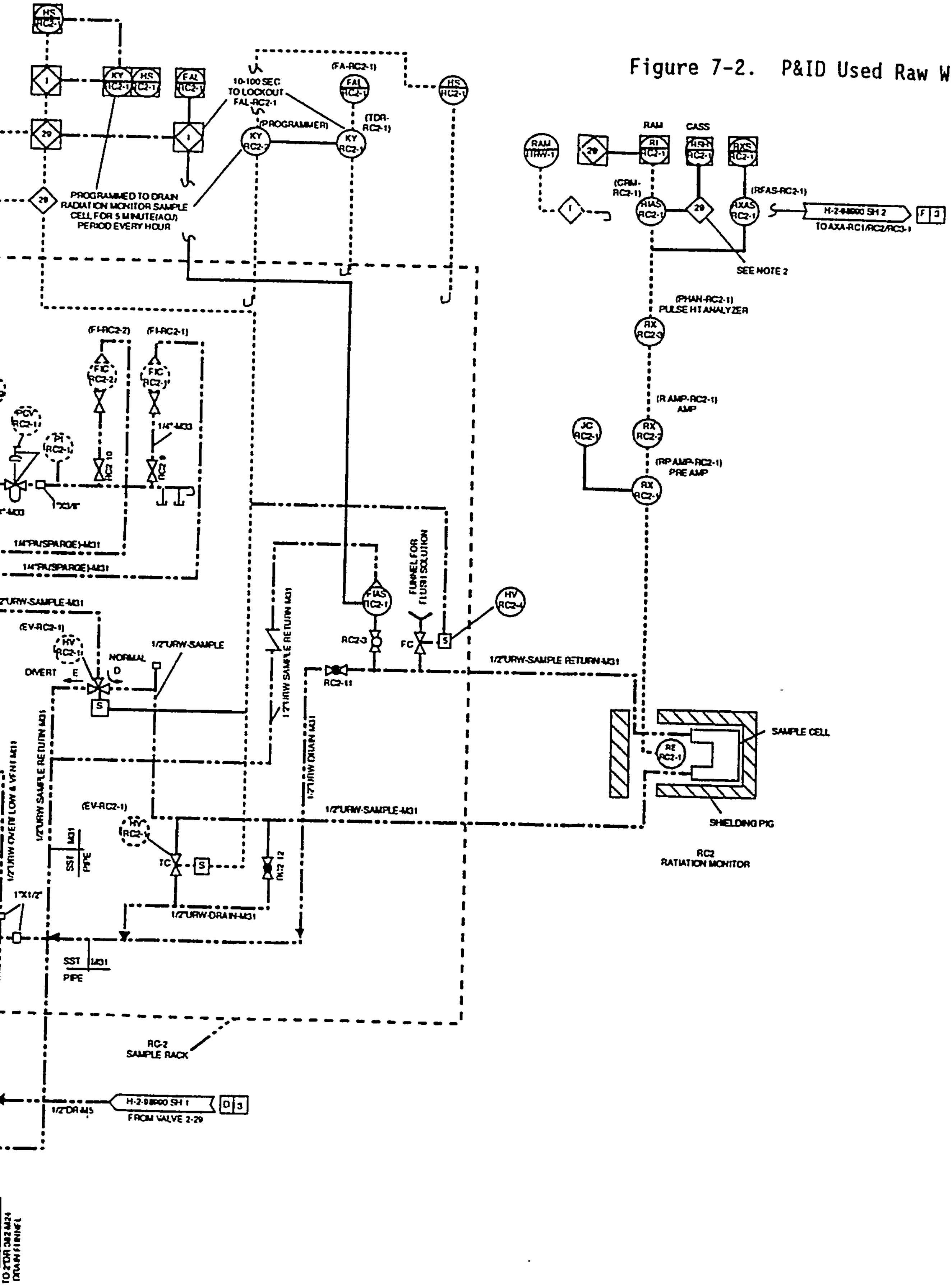

FQI RC2-1
FE RC2-1
FQI RC2-1
FI RC2-1
FY RC2-1
FT RC2-1
FE RC2-1
2-20A
2-20B
12"URW-1601
12"URW-1600
1/4"PA-M33
H-2-98001
FROM 3-4"PA-767-M7
B 2
1/V IA EC1-1
1/2"X1/4
FY EC1-1
A 2
H-2-98098
FROM E-C3
3"URW-1602-M5
3-20
1/4"PA-M33
H-2-98001
FROM 3/4"PA-767-M7
C 1
3-22B
NEW EXIST
F
3/8-M33
ZT EC1-1
NEW EXIST
FC
3-21
12"X8"
3-22
SC
EXIST NEW
FY EC1-1
(DOV-EC1-1)
45
HS RC2-5
S
HV RC2-5
FC
1/2"URW-SAMPLE-M31
1/4"-M33
1/4"-M33
TK 242-A
IT EC1-1
TE EC1-1
FROM 1IC-EC1-2
H-2-98090
D 6
FR EC1-1
FIC EC1-1
FY EC1-1
FT EC1-1
4-34
4-35
FE EC1-1
SC
12"URW-1600-M5
H-2-98099
C 8
FROM E-C-1
ZT EC1-1
FAL
FAL EC1-1
1/2"PA-776-M7
H-2-98001
FROM 1 1/2"PA-776-M7
C 1
FQIC RC2
FIC RC2
BYR
HV RC2
S
PI RC2-2
FY RC2-1
RC2-4
1/2"X3/8
1/2"
RC2-6
M7
1/2"FLUSH-31
1/2" FLUSHING
HC
RC2-7
M33
M7
SAMPLER
FV RC2-1
SAMPLE-RC2-1
1/2"URW-SAMPLE-M31
1/2" FLEX
1/2"URW-SAMPLE-M31
4"PS VENT THRU ROOF
4"HVAC STM SYSTEM RELIEF VALVE VENT HDR
D 3
H-2-98001
1-2"PA-M7
HV-PA-EC1-2
M7
M31
F
1/2"PA-M31
45
PY EC1-2
HV EC1-2
12"URW-1601-M5
A 7
H-2-98003
FROM F-H-1,2 & 3 CATCH PAN
3"PS-M24
B 25
H-2-98081
FROM RAW WATER STRAINER 14"RW-600-M5
2"DR M2
HVAC EQUIPMENT ROOM FLOOR DRAINS
4"PS
3"PS
4"PS
4"PS-M24
PT EC1-6
PI EC1-6
PAL
AS
M31
M5
2-21A
1/4"-EC1-6-M31
2-21
PI EC1-3
2-20
1/2" SAMPLE
12"X8"
HV EC1-2
12"X8"
ZI EC1-2
ZT EC1-2
1/2"URW-SAMPLE RETURN-SST
2-22
PI EC1-3
M5
M24
FROM HVAC RELIEF VALVE VENTS
FROM HVAC RELIEF VALVE VENTS
A 3
H-2-98092
FROM STM TRAPS HVAC ROOM
1 1/2"SC-509-M2
C 6
H-2-98001
FROM 10"DF
4"DR 396-M24
4"TK1 395 M24
6"X14"
12"URW-1601-M24
24"CM-URW-1601
TO 216-B POND
SAMPLER RECEIVER
SPURGE TUBE
RC2-1
SL
DRAIN FUNNEL
1"X1/2"
1"DR
M31
SST
M31 SST PIPE
1/2"VALVE VENT & DRAIN M31
D 2
H-2-98090 SH 1
FROM DX-4 EQUIPMENT DRAINS
1/2"DR

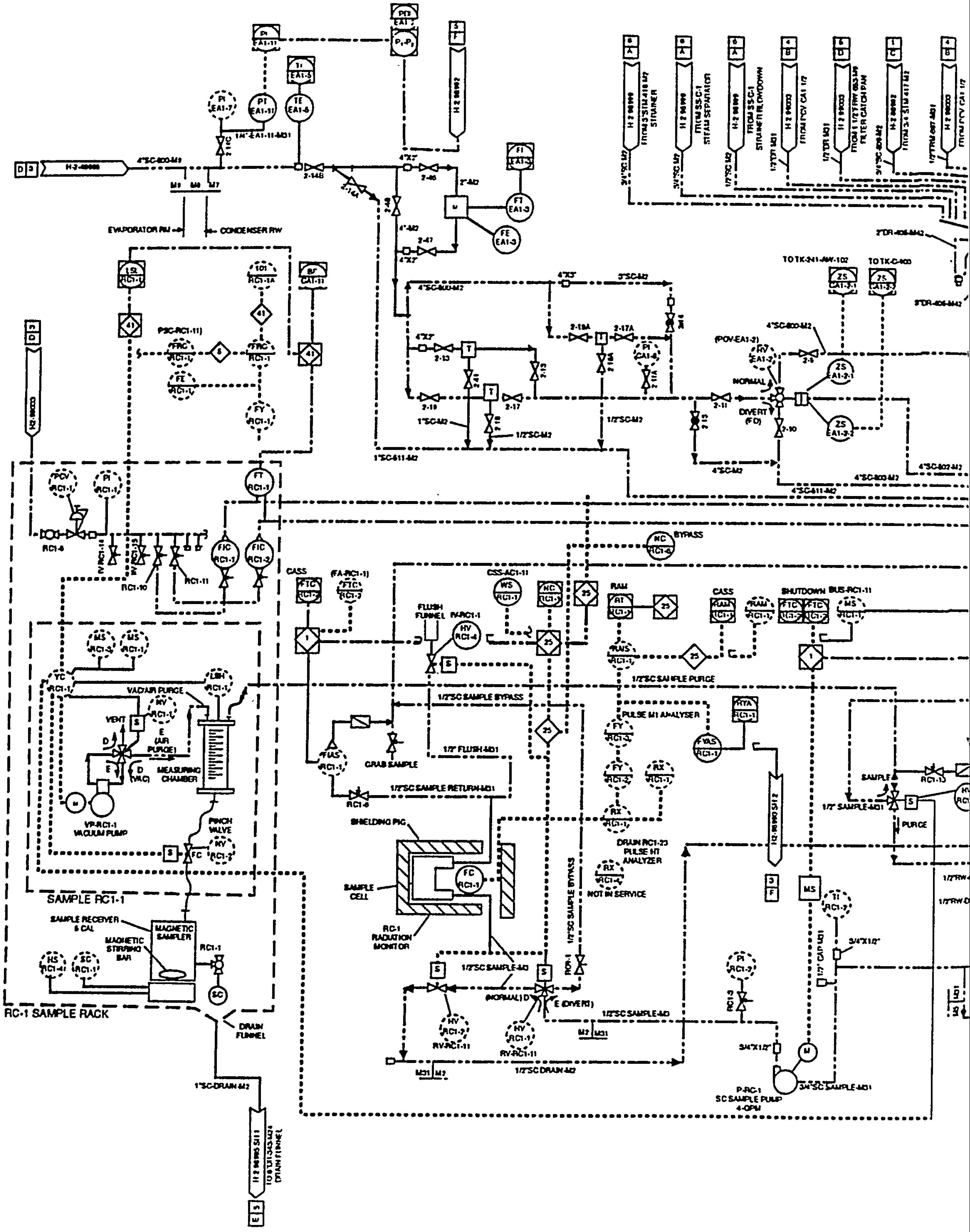
Figure 7-2. P&ID Used Raw Water System.

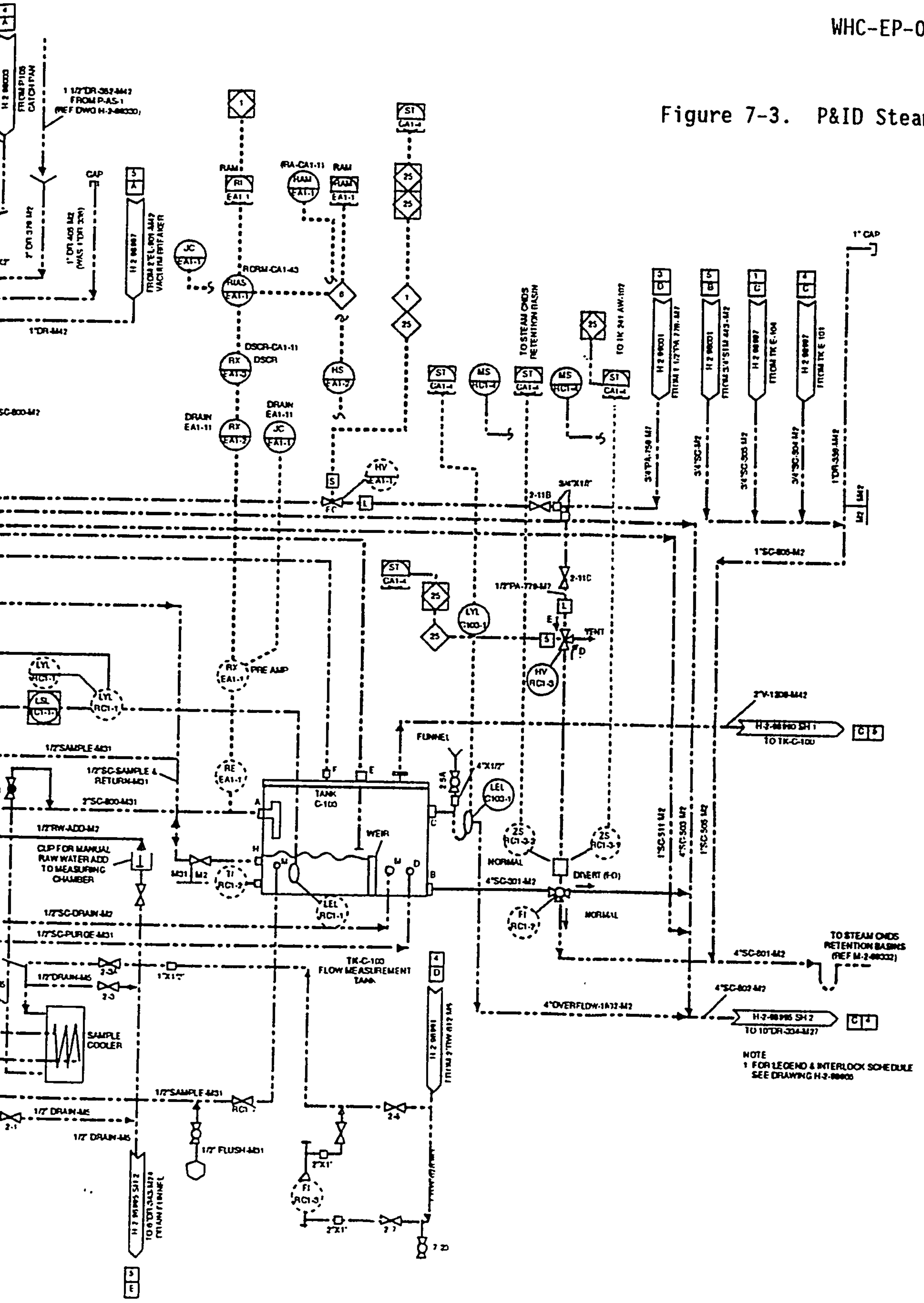


29301012.2

7.1.2.5 Steam Condensate Instrumentation. Radiation information is monitored on the MCS by radiation indicator RI-RC1-1. A count-rate meter is self-contained with a range of 10 to 1.0 x 10^{+6} cpm (±2.0%) on an adjustable logarithmic scale. Radiation alarms are activated at 80 cps on increasing radiation. Table 7-2 displays the instrumentation related to the sampling/monitoring systems for the steam condensate stream. Instrument locations, calibration frequencies, and alarming or diversion set points are included in this matrix. Drawing No. H-2-98993 (Figure 7-3) is an instrument flow diagram for the steam condensate system.

This page intentionally left blank.


4"SC-800-M9
EVAPORATOR RW
CONDENSER RW
1/4"-EA1-11-M31
PI EA1-7
PT EA1-11
TE EA1-6
2-14B
2-14A
2-46
2-47
2-48
4"X2"
2"-M2
4"-M2
FT EA1-3
FE EA1-3
FI EA1-3
LSL RC1-1
TDI RC1-1A
BF CAT-11
(PSC-RC1-11)
FRC RC1-1
FE RC1-1
FY RC1-1
4"SC-800-M2
3"SC-M2
2-13
2-19
2-17
2-18A
2-17A
PI CA1-8
1"SC-M2
1/2"SC-M2
1"SC-611-M2
(POV-EA1-2)
HV EA1-2
NORMAL
DIVERT (FO)
2-11
2-10
2-9
ZS EA1-2-1
ZS EA1-2-2
TO TK-241-AW-102
TO TK-C-100
ZS CA1-2-1
ZS CA1-2-2
2"DR-406-M42
3"DR-406-M42
4"SC-M2
4"SC-802-M2
4"SC-803-M2
4"SC-611-M2
FROM 3"STM 418 M2 STRAINER
FROM SS-C-1 STEAM SEPARATOR
FROM SS-C-1 STRAINER BLOWDOWN
FROM PCV CA1 1/2
FROM 1 1/2"FRW 653-M9 FILTER CATCH PAN
FROM 3/4 STM 417 M2
3/4"SC M2
1/2"SC M2
1/2"DR M31
PCV RC1-1
PI RC1-1
RC1-8
RC1-10
RC1-11
FT RC1-1
FIC RC1-1
FIC RC1-2
MS RC1-3
MS RC1-1
YC RC1-1
LSH RC1-1
VAC/AIR PURGE
HV RC1-1
VENT
E (AIR PURGE)
D (VAC)
MEASURING CHAMBER
VP-RC1-1 VACUUM PUMP
PINCH VALVE
HV RC1-2
FC
SAMPLE RC1-1
SAMPLE RECEIVER 6 CAL
MAGNETIC SAMPLER
MAGNETIC STIRRING BAR
HS RC1-4
SC RC1-1
RC1-1
SC
RC-1 SAMPLE RACK
DRAIN FUNNEL
1"SC-DRAIN-M2
TO 6"131-343-M24 DRAIN FUNNEL
NC RC1-6
BYPASS
CASS
FTC RC1-2
(FA-RC1-1)
FTC RC1-3
FLUSH FUNNEL
IV-RC1-1
HV RC1-4
CSS-AC1-11
WS RC1-1
NC RC1-1
RAM
RI RC1-1
RAM RC1-1
RAS RC1-1
SHUTDOWN
BUS-RC1-11
FTC RC1-3
FTC RC1-2
MS RC1-1
1/2"SC SAMPLE PURGE
1/2"SC SAMPLE BYPASS
PULSE M1 ANALYSER
RYA RC1-1
FYAS RC1-1
FY RC1-3
FY RC1-2
RX RC1-1
FIAS RC1-1
GRAB SAMPLE
1/2" FLUSH-M31
1/2"SC SAMPLE RETURN-M31
RC1-6
SHIELDING PIG
SAMPLE CELL
FC RC1-1
RC-1 RADIATION MONITOR
DRAIN RC1-23
PULSE HT ANALYZER
RX RC1-4
NOT IN SERVICE
1/2"SC SAMPLE BYPASS
1/2"SC SAMPLE-M31
(NORMAL) D
E (DIVERT)
HV RC1-2
RV-RC1-11
HV RC1-1
RV-RC1-11
1/2"SC DRAIN-M2
M31 M2
M2 M31
PI RC1-2
RC1-3
3/4"X1/2"
P-RC-1 SC SAMPLE PUMP 4-GPM
3/4"SC SAMPLE-M31
MS
TI RC1-2
1/2" CAP M31
SAMPLE
RC1-13
1/2" SAMPLE-M31
PURGE
1/2"RW
D 3
H-2-40000
S F
3 F
E 5



NOTE
1 FOR LEGEND & INTERLOCK SCHEDULE SEE DRAWING H-2-98905

Figure 7-3. P&ID Steam Condensate System.

29301012.1

8.0 HISTORICAL MONITORING/SAMPLING DATA FOR EFFLUENT STREAMS

8.1 NORMAL CONDITIONS

This section provides a brief summary of pertinent historical data accumulated under normal operating conditions. These data are used to verify that the projected effluent characteristics are defensible.

8.1.1 Vessel Vent

Radionuclide effluent emission data for the vessel vent stack 296-A-22 are presented in Table 8-1. The data contained within this table were obtained from the following sources.

- 1984, 1985, and 1986 Average Release Concentration: reference--WHC-SD-WM-SAR-023, *242-A Evaporator Safety Analysis Report* (WHC 1988a)
- 1987 Average Release Concentration: reference--WHC-EP-0141, *Westinghouse Hanford Company Effluent Discharges and Solid Waste Management Report for 1987: 200/600/1100 Areas* (WHC 1988d)
- 1988 Average Release Concentration: reference--WHC-EP-0141-1, *Westinghouse Hanford Company Effluent Discharges and Solid Waste Management Report for 1988: 200/600 Areas* (WHC 1988e)
- 1989 Stack Release Concentration/Quantity: reference--WHC-EP-0141-2, *Westinghouse Hanford Company Effluent Discharges and Solid Waste Management Report for 1989: 200/600 Areas* (WHC 1990a).

No data exists on airborne releases for CYs 1991, 1992, and 1993 because the facility did not operate. The evaporator started operating again on April 15, 1994. The 1994 annual emissions report will have new emissions data for this stack.

8.1.2 Building Ventilation

Data for emissions from this stack (296-A-21) can be found in:

- WHC-EP-0141, *Westinghouse Hanford Company Effluent Discharges and Solid Waste Management Report for 1987: 200/600/1100 Areas*
- WHC-EP-0141-1, *Westinghouse Hanford Company Effluent Discharges and Solid Waste Management Report for 1988: 200/600/1100 Areas*
- WHC-EP-0141-2, *Westinghouse Hanford Company Effluent Discharges and Solid Waste Management Report for 1989: 200/600/1100 Areas*
- DOE/RL-91-10, *Calendar year 1990 Air Emissions Report for the Hanford Site*

- DOE/RL-92-30, *Radionuclide Air Emission Report for the Hanford Site Calendar Year 1991*
- DOE/RL-93-36, *Radionuclide Air Emission Report for the Hanford Site Calendar Year 1992*
- DOE/RL-94-51, *Radionuclide Air Emission Report for the Hanford Site Calendar Year 1993*

Table 8-1. Stack 296-A-22 Gaseous Radioactive Effluent Emissions Data.

Emission	1984	1985	1986	1987	1988	1989
Total volume (L)	7.7 E+09	9.7 E+09	9.4 E+09	1.02 E+10	1.03 E+10	4.81 E+09
	(μCi/mL)	(μCi/mL)	(μCi/mL)	(μCi/mL)	(μCi/mL)	(μCi/mL)
	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)
Alpha	1.9 E-14	3.5 E-15	4.6 E-15	3.5 E-15	4.0 E-15	3.5 E-15
	1.4 E-7	3.4 E-8	4.32 E-8	3.57 E-8	4.13 E-08	1.68 E-08
Beta	4.0 E-12	9.3 E-13	2.1 E-12	2.8 E-14	6.49 E-13	2.04 E-12
	3.1 E-5	9.0 E-6	1.97 E-5	2.82 E-7	6.69 E-06	9.81 E-06
^{241}Am					c	c
^{137}Cs		8 E-15*	1 E-14*	8 E-15	6 E-15	9.32 E-15
				9.81 E-06	6.18 E-08	4.5 E-08
^{129}I	ND	ND	ND	5.5 E-12	2 E-11	1.57 E-11
					2.1 E-04	7.6 E-05
^{131}I	ND	ND	ND			
^{239,240}Pu					c	c
^{106}Ru	ND	ND	ND	3.5 E-13	2 E-10	1.21 E-10
					2.1 E-3	5.8 E-04
^{103}Ru	ND	ND	ND	4 E-14		
^{113}Sn	ND	ND	ND	8.5 E-14	4 E-13	3.61 E-13
					4.12 E-06	1.7 E-06
^{89,90}Sr		4 E-14*	2 E-15*	3.75 E-15	3 E-15	3.56 E-15
					3.1 E-08	1.7 E-08
^{125}Sb	ND	ND	1.0 E-11*	3 E-13	2 E-12	1.63 E-12
			9.4 E-5		2.1 E-5	7.9 E-06

NOTE:
1. Stack was not operational in 1990 or 1991.
2. ND = not detected.
3. c = analysis is not necessary (as determined from inventory, effluent history, and/or gross apha/beta analyses).
4. *Values were obtained from documents numbered RHO-HS-SR-85-13P (RHO 1986), RHO-HS-SR-86-13 (RHO 1987b), and RHO-HS-SR-86-2 4QGAS P (RHO 1987a)

8.1.3 Steam Condensate

Radionuclide effluent release data for the 242-A Evaporator steam condensate stream are compiled in Table 8-2. These data were taken from the following referenced documents.

- For 1987/1988/1989 values: reference--WHC-EP-0141 /-1/-2, *Westinghouse Hanford Company Effluent Discharges and Solid Waste Management Report for 1987/1988/1989: 200/600 Areas*
- For 1984/1985/1986 values: reference--WHC-SD-WM-SAR-023, *242-A Evaporator Safety Analysis Report.*
- For 1990 values: reference--WHC-EP-0527, *Environmental Releases for Calendar Year 1990* (WHC 1991j).
- For 1991 values: reference--WHC-EP-0527-1, *Environmental Releases for Calendar Year 1991* (WHC 1992k)

Table 8-2. Steam Condensate Radionuclide Effluent Release Data.

Effluent	1984	1985	1986	1987	1988	1989	1990	1991
Total volume (L)	6.6 E+07	8.5 E+07	6.8 E+07	4.9 E+07	6.55 E+07	1.70 E+07	4.1 E+06	3.5 E+05
	(µCi/mL)	(µCi/mL)	(µCi/mL)	(µCi/mL)	(µCi/mL)	(µCi/mL)	µCi/mL	µCi/mL
				(Ci)	(Ci)	(Ci)	(Ci)	(Ci)
Alpha	5.3 E-09	9.1 E-09	4.7 E-09	3 E-09	3 E-09	2.1 E-09	2.0 E-08	1.4 E-09
					2 E-04	3.6 E-05	8.5 E-05	4.8 E-07
Beta	2.6 E-08	4.8 E-08	8.5 E-08	1 E-08	6 E-08	3.7 E-08	1.5 E-07	1.3 E-08
					4 E-03	6.4 E-04	6.4 E-04	4.7 E-06
^{3}H	8.3 E-06	1.2 E-04	2.7 E-05	2 E-06	4 E-05	7.4 E-07	9.1 E-07	2.2 E-06
					3 E+00	1.3 E-02	3.8 E-03	7.5 E-04
^{241}Am					c	2.5 E-08	2.7 E-08	<2.2 E-08
					c	4.2 E-04	1.1 E-04	ND
^{137}Cs	ND	ND	ND	6 E-08	7 E-08	5.2 E-08	7.6 E-08	<5.8 E-08
					5 E-03	8.8 E-04	3.1 E-04	ND
^{147}Pm	ND	ND	ND				c	c
^{129}I			ND		c	c	c	c
Uranium	ND	ND	ND		c	2.9 E-09	1.4 E-09	8.0 E-10
					c	4.9 E-05	5.6 E-06	2.8 E-07
^{239,240}Pu					c	1.3 E-08	1.1 E-08	<1.1 E-08
					c	2.2 E-04	4.7 E-05	ND
^{89,90}Sr	ND	ND	ND	2 E-08	2 E-08	1.5 E-08	2.9 E-08	1.9 E-08
					1 E-03	2.6 E-04	1.2 E-04	6.7 E-06

NOTE: ND = not detected.
c = analysis is not necessary (as determined from inventory, effluent history, and/or gross alpha/beta analyses).

8.1.4 Cooling Water

Table 8-3 contains the radioactive effluent release data used to calculate the radionuclide source terms for the used cooling water waste stream. These data were obtained from the following sources.

- For 1987/1988/1989 values: reference--WHC-EP-0141 /-1/-2, *Westinghouse Hanford Company Effluent Discharges and Solid Waste Management Report for 1987/1988/1989: 200/600 Areas*
- For 1984/1986/1986 values: reference--WHC-SD-WM-SAR-023, *242-A Evaporator Safety Analysis Report.*

Because the 242-A Evaporator was not operating from 1989 to the present, there was no cooling water discharge from the facility to report for 1990 or 1991.

Additional data for the alpha and beta concentrations potentially contained within the cooling water are provided by WHC-EP-0342, Addendum 21, *242-A Evaporator Cooling Water Stream-Specific Report* (WHC 1990b). These values are 1.59×10^{-09} μCi/mL for alpha and 3.19×10^{-08} μCi/mL for beta.

8.2 UPSET CONDITIONS

Upset conditions that occurred in the past and are relevant to future operations at the facility are presented in the following paragraphs. Each applicable event is discussed briefly. The discussion provides a description of each event and lists the type and amount of material involved. The pathway of any release and the resulting monitoring/sampling data obtained during the event are also provided.

A thorough examination of any documented unusual events was conducted. The following are the events that are relevant to this FEMP.

1. On December 9, 1989, approximately 16 oz of nitric acid leaked in the AMU room from the decontamination tank (E-104). The CERCLA RQ is 4.54 kg (10 lb). The leakage was from a valve on the tank. The leakage drained down the drain in the AMU room and ultimately to the evaporator feed tank (TK-102-AW). It was neutralized and cleaned up within 15 minutes.

2. On December 7, 1989, 0.53 lb of nitric acid or NOX was discharged to the environment via heating of the decontamination tank (E-104). The fumes were discharged out of the tank vent header, which exits outside, north of the building. Drager tube samples were taken to determine the leak concentration. The amount that leaked was calculated in Internal Memo 13331-89-482 from Waste Concentration Process Engineering Unit, dated December 13, 1989, subject: Nitric "Acid Released During 242-A Evaporator Flush" (WHC 1989c). This memo also calculated the equivalent release that would have occurred at room temperature. This release, over a 24-hour period, equates to 9.5×10^{-03} lb/day. The CERCLA RQ is 10 lb/day.

Table 8-3. Cooling Water Radioactive Effluent Release Data.

Effluent	1984	1985	1986	1987	1988	1989
Total volume (L)	2.9 E+09	3.5 E+09	3.7 E+09	5.35 E+09	6.34 E+09	1.89 E+09
	(μCi/mL)	(μCi/mL)	(μCi/mL)	(μCi/mL)	(μCi/mL)	(μCi/mL)
					(Ci)	(Ci)
Alpha	4.4 E-09	6.9 E-09	5.8 E-09	3 E-09	2 E-09	2.0 E-09
					2 E-02	3.8 E-03
Beta	2.5 E-08	2.5 E-08	9.4 E-08	3 E-08	4 E-08	1.1 E-08
					3 E-01	2.0 E-02
^{3}H	ND	3.1 E-06	1.1 E-05	5 E-05	2 E-05	5.2 E-07
					1 E+02	9.8 E-01
^{241}Am					c	3.3 E-08
						6.3 E-02
^{137}Cs	ND	ND	ND	5 E-08	6 E-08	5.1 E-08
					4 E-01	9.6 E-02
^{239,240}Pu					c	1.7 E-08
						3.3 E-02
^{89,90}Sr	ND	ND	ND	2 E-08	2 E-08	1.6 E-08
					1 E-01	3.1 E-02

NOTE: ND = not detected.
c = analysis is not necessary (as determined from inventory, effluent history, and/or gross alpha/beta analyses).

3. On August 31, 1987, process condensate that was high (greater than CERCLA RQ limits) in NH_4OH was released to the 216-A-37-1 crib. The release was caused by processing CRW waste high in NH_3. The evaporator was shut down as a result. Levels varied from 0.07 mol/L to 0.3 mol/L. In addition, the stack exceeded the NH_3 CERCLA limits. Release amounts were calculated at 135 lb out the stack and 1,580 lb to the crib.

4. On September 25, 1989, a 5 to 50% separable organics layer was discovered in tank C-100. The tank was flushed (back to the tank farms) to remove the organics.

5. On July 31, 1984, process condensate that was over administrative limits in total beta and ^{90}Sr was discharged to the 216-A-37-1 crib.

6. On July 25, 1980, high radiation readings in the vessel vent initiated alarms and interlocks, which resulted in a shutdown of the evaporator process. It is believed that contaminated steam vented through a dry seal loop on the steam condensate weir overflow and entered the vessel vent stack past the HEPA filters. The contaminated steam was generated by the pump room sump jetting operation. The seal loop is now filled weekly via the maintenance tickler system.

This page intentionally left blank.

9.0 SAMPLING ANALYSIS

This section provides information on the sample exchange processes, chain of custody procedures, and laboratory analytical procedures for the 242-A Evaporator facility effluent streams.

9.1 VESSEL VENT AND BUILDING VENTILATION SAMPLE EXCHANGE PROCESS

Each effluent sample type is assigned a specific number, called an Electronic Data Processing (EDP) code, by the Effluent Monitoring group. This number is used to track the analysis of each stream. The codes for the airborne effluent streams at the evaporator are

For the vessel vent stack 296-A-22

- Record Sampler: EDP code E643
- Silver Zeolite Cartridge AgX-1: EDP code E001
- Silver Zeolite Cartridge AgX-1: EDP code E002 (not currently installed)
- Alpha CAM: EDP code E465
- Beta/Gamma CAM: EDP code E642

For the building ventilation stack 296-A-21

- Record Sampler: EDP code E645
- Alpha CAM: EDP code E466
- Beta/Gamma CAM: EDP code E991.

The sample from the record sampler and CAM in both the vessel vent stack and the building ventilation stack are collected on a filter paper. These filters and the silver zeolite cartridges are currently exchanged weekly. Instructions, including chain-of-custody protocol, for the filter exchange are given in WHC-IP-0718, Section 3.3.2, Rev. 1, *Gaseous Effluent Monitoring System Inspection and Sample Exchange*. The silver zeolite cartridges are exchanged during the same time and per the same chain-of-custody protocol, but there currently exists no formal procedure which provides detailed instructions. Mostly this exchange occurs in accordance with facility specific desk instructions kept in the field.

The samples are taken to the 222-S Laboratory for analysis. Instructions for the type of analyses to be performed are given to the laboratory once a year by the Effluent Monitoring group with input from the facility Environmental Engineering group.

The specific procedures which are used at the laboratories are explained in WHC-EP-0536-1, *Quality Assurance Program Plan for Radionuclide Airborne Emissions Monitoring*.

Once a year, the Effluent Monitoring group compiles the analysis data into emission reports. These reports are published and available upon request.

9.2 STEAM CONDENSATE SAMPLE PROCESS

Plant Operating Procedure TO-630-040, *Sample, Fill, and Drain Steam Condensate* provides instructions for sampling the 242-A steam condensate and for filling and draining the steam condensate basins.

9.3 COOLING WATER SAMPLE PROCESS

Plant Operating Procedure TO-630-060, *Sample Cooling Water from the 242-A via Receiver Carboy RC-2 and Flush RC-2 Receiver Carboy and Monitoring Pig* provides instructions for sampling the 242-A used cooling water.

10.0 NOTIFICATIONS AND REPORTING

Notifications and reporting of specific events related to environmental releases and/or events involving effluents and/or hazardous materials shall be made in accordance with DOE Orders 5400.1 (DOE 1990a) and 5000.3A. Implementation of the orders is accomplished via *Management Requirements and Procedures Manual* (MRP) WHC-CM-1-3, 5.14, (WHC 1992h). Specific implementation, where required, is included in the appropriate facility's "Occurrence Categorization, Notification and Reporting" procedure. Implementation of environmental limits and requirements is found in the ECM, WHC-CM-7-5 (WHC 1992i).

10.1 REQUIREMENTS

10.1.1 Occurrence Identification and Immediate Response

Each employee shall identify events and conditions and shall notify management promptly of such occurrences by

- Calling 911 if immediate help such as fire, ambulance, or patrol is required
- Calling 3-3800 (the Patrol Operations Center) if assistance other than fire, ambulance, or patrol is required
- Notifying, after requesting necessary outside assistance, the supervisor, who shall notify the facility manager, the building emergency director, and the Occurrence Notification Center (6-2900).

Operations personnel shall take appropriate immediate action to stabilize or return the facility/operation to a safe condition. The oversight organizations shall notify their RL counterparts of the event after receiving notifications from, and discussing the event with, the facility manager.

10.1.2 Occurrence Categorization

Occurrences (environmental) shall be categorized as soon as practical using the following specific criteria for radioactive and hazardous materials release. These categorizations should be made within 2 hours of identification. Occurrences shall be categorized by their seriousness. If categorization is not clear, the occurrence initially shall be categorized at the higher level being considered. The occurrence categorization then shall be either evaluated, maintained, or lowered as information becomes available.

10.2 OCCURRENCE CATEGORIZATION

10.2.1 Radioactive Releases

10.2.1.1 Emergency.

- Any release of radioactive material to controlled or uncontrolled areas in concentrations which, if averaged over a 24-hour period, would exceed 5,000 times the DCG.
- Any release of radioactive material offsite that is not a normal monitored release and could reasonably be expected to result in an annual dose or dose commitment greater than 500 mrem to any member of the general population.

10.2.1.2 Unusual Occurrence.

- Release of radionuclide material that violates environmental requirements in permits, regulations, or DOE standards as determined by Westinghouse Hanford Environmental Protection.
- Any other release below emergency levels that requires immediate reporting to regulatory agencies or triggers outside agency specific action levels as determined by Westinghouse Hanford Environmental Protection.

10.2.1.3 Off-Normal.

- Any release of radionuclides that is not a normally monitored release.
- Any discovery of radionuclides where they are not expected (e.g., storm sewers, sanitary sewers) and for which no immediate explanation is available.
- Any statistically significant increase in normally monitored releases of radionuclides to an uncontrolled area.
- Any release of radionuclides that will be reported to an outside agency (excluding normal reporting) but is not classified as an unusual occurrence.
- Any controlled and monitored gaseous radionuclide release exceeding a WHC administrative control value on an annual basis or 10 times the administrative control value on a weekly basis.
- Any controlled and monitored (instantaneous) gaseous radionuclide release exceeding 5,000 times the DCG during any 4-hour period.

- Any controlled and monitored liquid radionuclide releases exceeding the WHC-established administrative control value on an annual basis or two times that value on a monthly or weekly basis.
- Any controlled and monitored liquid radionuclide release exceeding 5,000 times DCG instantaneously.

10.2.2 Hazardous Substances Releases

10.2.2.1 Emergency.

- Any actual or potential release of material to the environment that results in or could result in significant offsite consequences (i.e., need to relocate people, major wildlife kills, woodland degradation, aquifer contamination, or the need to secure downstream water supply intakes).

10.2.2.2 Unusual Occurrence.

- Release of a hazardous substance, regulated pollutant, or oil that exceeds a reportable quantity, federal permits, DOE standards, or levels requiring immediate reporting to outside agencies as determined by Westinghouse Hanford Environmental Protection.

10.2.2.3 Offnormal.

- Any unmonitored release of hazardous substance or regulated pollutant as determined by Westinghouse Hanford Environmental Protection.
- Any statistically significant increase of hazardous substance in normally monitored releases.
- Any discovery of toxic or hazardous substance where it is not expected.
- Any release of hazardous substance or oil that is not classified as an unusual occurrence but will be reported to outside agencies (excluding normal reporting) as determined by Westinghouse Hanford Environmental Protection.

10.2.3 Discovery of Radioactive or Hazardous Material Contamination Due to U.S. Department of Energy Operations

10.2.3.1 Emergency.

- Discovery of contamination that could result in significant consequences (i.e., exceeding safe exposure limits to workers or public).

10.2.3.2 Unusual Occurrence.

- Discovery of offsite contamination due to DOE operations that does not represent an immediate threat to the public.
- Any discovery of groundwater contamination not previously known or suspected.

10.2.3.3 Off-Normal.

- Discovery of any onsite contamination that is not previously known or expected and is attributable to DOE operations.

10.2.4 Agreement/Compliance Activities

10.2.4.1 Unusual Occurrence.

- Any agreement, compliance, remediation, permit-mandated activity, or notification received from a relevant regulatory agency specifying that a site plan is not satisfactory, or that a site is considered not to be in compliance with schedules or requirements.
- Any occurrence under any agreement or compliance area that requires notification of an outside agency within 4 hours or less, or triggers an outside regulatory agency action level, or otherwise indicates specific interest/concern from such agencies.

10.2.4.2 Off-Normal.

- Any occurrence under any agreement of compliance area that will be reported to outside agencies in a format other than routine monthly or quarterly reports.
- Any changes to existing agreements or permit-mandated activities.
- Development of new agreements or permit-mandated activities.

11.0 INTERFACE WITH THE OPERATIONAL ENVIRONMENTAL SURVEILLANCE PROGRAM

11.1 DESCRIPTION

The sitewide Environmental Monitoring Plan (EMP), as described in the FEMP management plan (WHC 1991d), consists of two distinct but related components: environmental surveillance conducted by PNL and effluent monitoring conducted by WHC The responsibilities for these two portions of the EMP are delineated in a Memorandum of Understanding (PNL/WHC 1989). Environmental surveillance, conducted by PNL, consists of surveillance of all environmental parameters to demonstrate compliance with regulations. Effluent monitoring includes both in-line and facility effluent monitoring, as well as near-field (near-facility) operational environmental monitoring. Projected EDEs, reported in this FEMP, are the products of in-line effluent monitoring. Near-field monitoring is required by Part O, "Environmental Monitoring," *Environmental Compliance Manual* (WHC 1992i), and procedures are described in *Operational Environmental Monitoring* (WHC 1988c).

11.2 PURPOSE

The purpose of near-field (operational environmental) monitoring is to determine the effectiveness of environmental controls in preventing the unplanned spread of contamination from facilities and sites operated by WHC or DOE. Effluent monitoring and reporting, monitoring of surplus and waste management units, and monitoring near-field environmental media are, therefore, conducted by WHC or the purposes of: controlling operations, determining the effectiveness of facility effluent controls, measuring the adequacy of containment at waste transportation and disposal units, detecting and monitoring upset conditions, and evaluating and upgrading effluent monitoring capabilities.

11.3 BASIS

Near-field environmental surveillance is conducted to (1) monitor employee protection; (2) monitor environmental protection; and (3) ensure compliance with local, state, and federal regulations. Compliance with parts of DOE Orders 5400.1, *General Environmental Protection Program* (DOE 1990a); 5400.5, *Radiation Protection of the Public and the Environment* (DOE 1990b); 5484.1, *Protection, Safety, and Health Protection Information Reporting System* (DOE 1981); 5820.2A, *Radioactive Waste Management* (DOE 1988); and DOE/EH-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE 1991), are addressed through this activity.

11.4 MEDIA SAMPLED AND ANALYSES PERFORMED

Procedure protocols for sampling, analysis, data handling, and reporting are specified in WHC-CM-7-4 (WHC 1988c). Media include ambient air, surface water, groundwater, external radiation dose, soil, sediment, vegetation, and animals at or near active and inactive facilities and/or waste sites. Parameters monitored include the following, as needed: pH, water temperature, radionuclides, radiation exposure, and hazardous constituents. Animals that are not contaminated, as determined by a field instrument survey, are released at the capture location.

11.5 LOCATIONS

Samples are collected from known or suspected effluent pathways (e.g., downwind of potential releases, liquid streams, or proximal to release points). To avoid duplication, WHC relies on existing sample locations where PNL has previously established sample sites (e.g., air samplers in the 300 Area). There are 38 air samplers (4 in the 100 Area and 34 in the 200/600 Areas), 35 surface water sample sites (22 in the 100 Area and 13 in the 200/600 Areas), 110 groundwater monitoring wells (20 in the 100 Area, 89 in the 200/600 Areas, and 1 in the 300/400 Areas), 299 external radiation monitor points [182 survey points and 41 thermoluminescent dosimeter (TLD) sites in the 100 Area, 61 TLD sites in the 200/600 Areas, and 15 TLD sites in the 300/400 Areas], 157 soil sample sites (32 in the 100 Area, 110 in the 200/600 Areas, and 15 in the 300/400 Areas), and 95 vegetation sample sites (40 in the 100 Area, 40 in the 200/600 Areas, and 15 in the 300/400 Areas). Animal samples are collected at or near facilities and/or waste sites. Specific locations of sample sites are found in WHC-CM-7-4 (WHC 1988c).

Additionally, surveys to detect surface radiological contamination, scheduled in WHC-CM-7-4 (WHC 1988c), are conducted near and on liquid waste disposal sites (e.g., cribs, trenches, drains, retention basin perimeters, pond perimeters, and ditch banks), solid waste disposal sites (e.g., burial grounds and trenches), unplanned release sites, tank farm perimeters, stabilized waste disposal sites, roads, and firebreaks in the operations areas. There are 391 sites in the operations areas (100 in the 100 Area, 273 in the 200/600 Areas, and 18 in the 300/400 Areas) where radiological surveys are conducted.

11.6 PROGRAM REVIEW

The near-field (operational environmental) monitoring program will be reviewed at least annually to determine that the appropriate effluents are being monitored and that the monitor locations are in positions that best determine potential releases.

11.7 SAMPLER DESIGN

Sampler design (e.g., air monitors) will be reviewed at least biannually to determine equipment efficiency and compliance with current EPA and industry [e.g., ANSI and American Society for Testing and Materials (ASTM)] standards.

11.8 COMMUNICATION

The operations and engineering contractor and the research and development contractor will compare and communicate results of their respective monitoring programs at least quarterly and as soon as possible under upset conditions.

11.9 REPORTS

Results of the near-field operational environmental monitoring program are published in the document series *Westinghouse Hanford Company Environmental Surveillance Annual Report* (WHC 1988e). Results of routine radiological surveys are published in the document series WHC-SP-0665, *Quarterly Environmental Radiological Survey Summary* (Huckfeldt 1992). The radionuclide values in these reports are expressed in curies, or portions thereof, for each radionuclide per unit weight of sample (e.g., picocuries per gram) or in field instrument values (e.g., counts per minute) rather than EDE, which is calculated as the summation of the products of the dose equivalent received by specified tissues of the body and a tissue-specific weighting factor.

This page intentionally left blank.

12.0 QUALITY ASSURANCE

Quality Assurance (QA) is an essential portion of the FEMP effort. WHC-EP-0536, *Quality Assurance Program Plan for Radionuclide Airborne Emissions Monitoring* (WHC 1991h), was prepared to meet the QA performance requirements of 40 CFR, part 61, Appendix B, Method 114.

12.1 PURPOSE

This QA plan describes the quality assurance requirements associated with implementing FEMPs. The plan identifies the FEMP activities and assigns the appropriate quality assurance requirements defined by the *Westinghouse Hanford Quality Assurance Manual*, WHC-CM-4-2 (WHC 1989f). This QA Plan shall be consistent with the requirements in DOE Order 5700.6C, "Quality Assurance" (DOE 1991b). In addition, QA requirements in 40 CFR 60, Appendix A, "Reference Methodologies" (EPA 1986b) shall be considered when performing monitoring calculations and establishing monitoring systems.

12.2 OBJECTIVE

The objective of this plan is to provide a documented QA plan describing QA requirements for the 242-A Evaporator Facility.

12.3 REQUIREMENTS

A quality assurance project plan (QAPjP) (WHC 1992f) has been developed to implement the overall QA program requirements defined by WHC-CM-4-2 (WHC 1989f). The QAPjP applies specifically to the field activities, laboratory analyses, and continuous monitoring performed for all FEMPs conducted by WHC. Plans and procedures referenced in the QAPjP are available for regulatory review on request by the direction of the Westinghouse Hanford Environmental Assurance Manager. A QAPP for radioactive airborne emissions was prepared (WHC 1991h) to address the QA elements of 40 CFR 61 and was submitted to the EPA.

12.4 FACILITY-SPECIFIC REQUIREMENTS

The QAPjP includes a list of analytes of interest and analytical methods for liquid effluent monitoring at the Hanford Site. The analytes of interest applicable to the 242-A Evaporator have been identified in the QAPjP. The airborne effluent analytes of interest and analytical methods also are included in the QAPjP. Procedures are performed by health physics personnel and are referenced in the HP procedures manual (WHC 1992g).

This page intentionally left blank.

13.0 INTERNAL AND EXTERNAL PLAN REVIEW

DOE Order 5400.1, "General Environmental Protection Program," Chapter IV.4 (DOE 1990b) requires the FEMP to be reviewed annually and updated every 3 years. The FEMP should be reviewed and updated as necessary after each major change or modification in the facility processes, facility structure, ventilation and liquid collection systems, monitoring equipment, waste treatment, or a significant change to the safety analysis reports.*

Facility operators will have to assess that no changes have occurred in operations that would require new testing semiannually. Although the report is based on the calendar year, the emission limits apply to any period of 12 consecutive months. Westinghouse Hanford Environmental Protection prepares an annual effluent discharges report for each area on the Hanford Site that covers airborne and liquid release pathways (WHC 1990a). In addition, a report on the air emissions and compliance to the *Clean Air Act of 1977* (NESHAP) is prepared by Westinghouse Hanford Environmental Protection for the RL for submittal to EPA as well as DOE Headquarters (DOE-RL 1992).

Facility management will obtain approval from the Effluent and Emissions Monitoring group for all changes to the FEMPs, including those generated in the annual review and update. In addition, QA and Regulatory Analysis shall review the FEMP.

---

*Facility management is responsible for ensuring that the reviews and updates are performed. Records retention shall be in accordance with the QAPP.

This page intentionally left blank.

14.0 EFFLUENT MONITORING/SAMPLING ASSESSMENT

The purpose of this section is threefold and accomplishes the following.

1. Assesses compliance of the facility effluent monitoring/sampling systems with the regulatory requirements, the referenced standards, and DOE orders.
2. Addresses any exemptions for which application has been made.
3. Addresses system upgrades required for compliance.

14.1 COMPLIANCE ASSESSMENT

Regulatory compliance assessments are conducted within this section for the gaseous and liquid streams at the 242-A Evaporator facility. Point-by-point comparisons with applicable regulations are accomplished for each of the streams identified in this FEMP.

14.1.1 Regulations Governing Airborne Emissions

Airborne emissions of radioactive materials from DOE-controlled facilities at the Hanford Site are subject to 40 CFR Part 61, *National Emissions Standards for Hazardous Air Pollutants* (NESHAPs) (EPA 1991b) as stated in DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (DOE 1990b), and DOE Order 5400.1, Chapter IV, *Environmental Monitoring Requirements* (DOE 1990a). The list of hazardous air pollutants regulated under the NESHAPs is provided in Subpart A, *General Provisions.* The specific emissions standards and monitoring requirements for radionuclides are contained in Subpart H, *National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities.* Subpart H covers all DOE operations that emit radionuclides other than radon to the air, except for facilities subject to 40 CFR Part 191, Subpart B (EPA 1991d), and 40 CFR Part 192 (EPA 1991e).

Title 40 CFR Part 61 (EPA 1991b), Subpart H, presents detailed requirements for emissions monitoring and test procedures (61.93), compliance and reporting (61.94), record keeping requirements (61.95), and exemptions from the reporting and testing requirements of 40 CFR Part 61.10 (61.97). Radionuclide emission rates from stacks and vents must be measured at all release points that have the potential to discharge radionuclides into the air in quantities that could cause an EDE in excess of 1% of the standard of 10 mrem/yr* specified in 40 CFR 61.92. This standard establishes the continuous monitoring and measurement requirement at 0.1 mrem/yr.

---

*A mrem is 1/1000 of a rem.

To determine compliance with the radionuclide emission standard specified in 40 CFR 61.92, radionuclide emissions must be determined and the potential EDE to members of the public from particular release points must be calculated. If this EDE at this particular release point is in excess of 1% of the standard (>0.1 mrem/yr), radionuclide emission measurements must be accomplished per those methods and standards specified in 40 CFR 61.93. The potential EDE was accomplished in WHC-SD-WM-EMP-031. The potential EDE result for the 296-A-22 stack was 50.2 mrem/yr. This value is given in Section 4.2.1.1. The potential EDE result for the 296-A-21 stack was 2.896E-06 mrem/yr. This value is given in Section 4.2.1.2. Therefore, radionuclide emission measurements must be accomplished continuously on the 296-A-22 stack those methods and standards specified 40 CFR 61.93. Only periodic confirmatory measurements are necessary of the 296-A-21 stack. Because no specific methods and standards apply to periodic confirmatory measurements, the 296-A-21 stack sampling system will not be discussed further. Additional details of this system are, however, given in WHC-SD-WM-291, Rev 1, *Tank Farm Stack Sampling System Configuration and Efficiency Study.*

The 40 CFR 91.93 regulation also specifies that relative to release points potentially providing an offsite EDE in excess of 1% of the standard, all radionuclides that could contribute greater that 10% of the potential EDE for each release point must be measured. This was discussed in section 4.2.1.1.1. For the vessel vent, those radionuclides that might contribute 10% are ^{106}Ru/Rh, $^{89/90}$Sr, ^{137}Cs, and ^{241}Am.

40 CFR 61.93 specifies that radionuclides shall be collected and measured using procedures based on principles of measurements described in 40 CFR 61, Appendix B, Method 114. This same section of the regulation also specifies that a QA program shall be conducted that meets the performance requirements described in this same method. A comparison of this method, including the QA portion, is compared to the 296-A-22 activities, the design of sampling system, sample exchange protocol, and radionuclide analysis techniques in WHC-EP-0536-1, *Quality Assurance Program Plan for Radionuclide Airborne Emissions Monitoring.*

14.1.2 Gaseous Streams Point-By-Point Comparison Assessment

Because, as discussed above the potential emissions from the 242-A evaporator vessel vent stack 296-A-22 are above the 0.1 mrem/yr limit, radionuclide measurement must be accomplished according to those methods and standards specified in 40 CFR 61.93. This section is, therefore, provided to compare those regulatory methods and standards to the design and operation of the 296-A-22 sampling system. This comparison is provided solely for historical purposes, as Richard, W. Poeton, EPA has stated in a letter dated January 18, 1994 to James D. Bauer, DOE/RL:

> "Based on the information provided, I have determined that the monitoring system for the 296-A-22, as modified, meets the requirements of 40 CFR 61.93."

Subpart H Section 61.93 (a) -- To determine compliance with the standard, radionuclide emissions shall be determined and effective dose equivalent values to members of the public calculated using EPA approved sampling procedures, computer models CAP-88 or AIRDOS-PC, or other procedures for which EPA has granted prior approval. DOE facilities for which the maximally exposed individual lives within 3 kilometers of all sources of emissions in the facility, may use EPA's COMPLY model and associated procedures for determining dose for purposes of compliance.

> Comparison: WHC-SD-WM-EMP-031 calculates the potential dose from this facility to be 50.2 mrem/yr. Section 4.2.1.1 of this FEMP discusses this calculation. The calculation is based on 40 CFR 61, Appendix D and the CAP-88 conversion factors for the 200 East Area.

Subpart H Section 61.93 (b) -- Radionuclide emission rates from point sources (stacks or vents) shall be measured in accordance with the following requirements or procedures for which EPA has granted prior approval:

Subpart H Section 61.93 (b)(1) -- Effluent flow rate measurements shall be made using the following methods:

Subpart H Section 61.93 (b)(1)(i) -- Reference Method 2 of appendix A to part 60 shall be used to determine velocities and volumetric flow rates for stacks and large vents.

> Comparison: Method 2 is for stacks larger than 12 inches. This stack is smaller than the 12 in. applicability criteria; it is only 8 in. (20.32 cm). Method 2C is applicable for small stacks. See discussion under Method 2C below.

40 CFR 60, Appendix A, Reference 2C, Determination of Stack Gas Velocity and Volumetric Flow Rate in Small Stacks or Ducts: This method allows for the following:

1. the selection of the measurement site per Method 1A in Appendix A of 40 CFR 60.
2. the selection of the number of traverse point measurements per Figure 1-2, "Minimum number of traverse points for velocities (nonparticulate) traverses," in Method 1 in Appendix A of 40 CFR 60.
3. the location of the individual traverse measurement points per Table 1-2, "Location of Traverse Points in Circular Stacks" of Method 1, of Appendix A of 40 CFR 60.
4. apparatus
5. procedure

> Comparison: See the discussion below under *"Method 1A, Section 2.1.1: PM Measurement" for selection of the measurement site and requirements.* There are two perpendicular ports where this measurements site is located.. This site is 24 in. above the sampling probe and 32 in. below the elbow which diverts the stack flow to the outside of the building. This location is 3 duct diameters downstream and 4 duct diameters upstream of any flow disturbances. Figure 1-2 of Method 1 in Appendix A of 40 CFR 60 specifies 16 measurements if the flow disturbances upstream of the site is less than 6 duct diameters. Measurements are actually taken on each of 16 annular traverse points located according to Table 1-2, "Location of Traverse Points in Circular Stacks" of Method 1, of Appendix A of 40 CFR 60. This is done in each of the two perpendicular flow measurement ports.
>
> As far as the actual procedure goes, a standard pitot tube is used as specified in the regulatory method. However, the procedure is not quite compliant. The current procedure is 7-GN-56, *Airflow Capacity and*

Distribution Tests, Revision 2, Change A. Used in conjunction with this procedure are guidance/data sheets developed to identify the location to use and number of traverse points to take. A new procedure is under development which will be compliance with the regulatory procedure. The guidance/data sheets used now will be incorporated into this new procedure.

Subpart H Section 61.93 (b)(1)(ii) -- Reference Method 2A of appendix A to part 60 shall be used to determine velocities and volumetric flow rates through pipes and small ducts.

Comparison: Method 2A is not applicable for stacks. If is applicable for pipes and ducts where the entire effluent is run through a measuring device. This method may be applicable to the sampling systems themselves.

Subpart H Section 61.93 (b)(1)(iii) -- The frequency of flow rate measurements shall depend upon the variability of the effluent flow rate. For variable flow rates, continuous or frequent flow rates measurements shall be made. For relatively constant flow rates only periodic measurements are necessary.

Comparison: The following flows were obtained from this facility. Note, where available, the Job Control System Work Package number and date the measurement was taken is given:

296-A-22 STACK FOR 242-A VESSEL VENT

DATE	FLOW (CFM)	WP#
06/03/93	661	2E-93-00672
10/18/93	585	2E-93-01381
03/18/94	495	2E-94-00345
06/16/94	503	EE-94-00607
AVERAGE	561	
VARIABILITY	-11%/+18%	
STANDARD DEVIATION		78
95% CONFIDENCE INTERVAL		248 (44%)
RANGE		312 TO 809

Though the regulations do not specifically define variable vs constants flow rate, a flow rate with a variability of less than ±20% has been defined at Hanford as being continuous. This criteria is specified in **SD-WM-CR-016**, *Design Criteria: FY 1985 200 Area Stack Sampler-Monitor System Upgrade*. The flow rates given above are therefore, variable (with a 95% confidence interval on 44%). The schedule for taking these flows is quarterly. Though the quarterly schedule is not always met, the requirement at Hanford is to take flow rates at least annually when the exhauster is running. This exhauster usually always run.

Subpart H Section 61.93 (b)(2) -- Radionuclides shall be directly monitored or extracted, collected and measured using the following methods:

Subpart H Section 61.93 (b)(2)(i) -- Reference Method 1 of Appendix A part 60 shall be used to select monitoring or sampling sites.

40 CFR 60, Appendix A, Method 1, Sample and Velocity Traverses for Stationary Sources

Method 1, Section 1.2: Applicability -- This method is applicable to flowing gas streams in ducts, stacks, and flues. This method cannot be used when: (1) flow is cyclonic or swirling (see section 2.4); (2) a stack is smaller than about 0.30 meters (12 in.) in diameter, or 0.071 m^2 (113 $in.^2$) cross-sectional area; or (3) the measurement site is less than two stack or duct diameters downstream or less than a half diameter upstream from a flow disturbance.

> Comparison: This stack is smaller than the 12 in. applicability criteria; it is only 6 inches (15.24 cm). See Method 1A below.

40 CFR 60, Appendix A, Method 1A, Sample and Velocity Traverses for Stationary Sources with Small Stacks or Ducts -- This method is applicable to stacks or ducts less than about 0.30 meters (12 in.) in diameter, or 0.071 m^2 (113 $in.^2$) cross-sectional area, but equal to or greater than about 0.10 meter (4 in.) in diameter or 0.00812 m^2 (12.57 $in.^2$) in cross-sectional area.

Method 1A, Section 2.1.1: PM Measurement -- Method 1A calls for the sampling sites to be preferably located at least 8 equivalent stack or duct diameters downstream and 10 equivalent diameters upstream from any flow disturbances. The velocity measurement location is recommended to be at a site located 8 equivalent stack or duct diameters downstream of the sampling site. This method further stipulates that if such locations are not available, then the sampling site should be located at least 2 equivalent stack or duct diameters downstream and 2½ stack diameters upstream from any flow disturbances. The velocity measurement device should then be located 2 equivalent stack diameters downstream from the sampling site.

> Comparison: The sample probe location within the vessel vent stack is located on the fourth floor of the condenser room. The closest flow disturbances are:
>
> - Downstream--the sample return line enters the stack approximately 61 cm (2 ft) below the probe location. This equates to three stack diameters.
> - Upstream--the elbow in the vessel vent which takes the stack outside the building is approximately 1.4 m (56 in.) above the probe. This equates to seven stack diameters.
>
> As discussed above under the heading titled "40 CFR 60, Appendix A, Reference 2C, Determination of Stack Gas Velocity and Volumetric Flow Rate in Small Stacks or Ducts", the stack flow measurements are taken from two perpendicular ports located 24 inches above the sample probe location.

Subpart H Section 61.93 (b) (2) (ii) -- The effluent stream shall be directly monitored continuously with an in-line detector or representative samples of the effluent stream shall be withdrawn continuously from the sampling site following the guidance presented in ANSI N13.1-1969 "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities" (including the guidance presented in Appendix A of ANSIN13.1).

ANSI N13.1-1969, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities

> The guidance of this standard starts in Section 4. Principles. Section 4.1 is General, Section 4.2 is Representative Samples, Section 4.2.1 is Samples Representative According to Spacial Location, Section 4.2.1.1 is Sampling in a Zone Occupies by Workers. The first section in this ANSI standard applicable to the comparison of this document is 4.2.1.2.

ANSI N13.1-1969, Section 4.2.1.2 -- Sampling point should be a minimum of five diameters (or 5 times the major dimension for rectangular ducts) downstream from abrupt changes in flow direction or prominent transitions.

Comparison: Not applicable. 40 CFR 61.93 (b)(2)(i) specifies the site location. See comparison under "Method 1A, Section 2.1.1: Selection of Measurement Site."

ANSI N13.1-1969, Section 4.2.2 -- Samples should be representative with respect to physical and chemical composition of airstream.

Comparison: No particle size studies have been done at this facility, though a particle loss determination has been informally (at this time) accomplished. Information given in WHC-SD-WM-EMP-031, Rev 0 and discussed in section 4.2.1.1.1 of this FEMP suggest that the sample should consist mainly of $^{89/90}$Sr, ^{106}Ru/Rh, ^{137}Cs, and ^{241}Am. All these radionuclides, except ^{106}Ru/Rh are particulate -not volatile. ^{106}Ru/Rh may be volatile.

ANSI N13.1-1969, Section 4.3, Sample Programming -- Many factors enter into the design of a sampling program. The sampling program includes the frequency, duration, and volume rate of sampling. In most cases the selection of these three elements in programming will be a compromise between idea values and those which provide safety and yet are technically, economically, and conveniently achieved.

ANSI N13.1-1969, Section 4.3.1, Sensitivity of Detection and Measurement -- Sensitivity and accuracy of the analytical or counting method will determine the minimum volume of air which must be sampled to obtain the requisite accuracy and precision of results.

ANSI N13.1-1969, Section 4.3.2, Permissible Levels at Point of Sampling -- If possible, the sample should be large enough to permit 1/10 the permissible level to be determined with reliability.

ANSI N13.1-1969, Section 4.3.3, Radioactivity Decay -- The radioactive half-life of the nuclide to be measured is an important consideration. . . .

ANSI N13.1-1969, Section 4.3.4, Natural Radioactive Materials -- The presence of natural radioactive materials of short-half-life may mask the presence of significant quantities of longer-lived materials, necessitating delays between collection and counting at subsequent times, or requiring special methods; for example, energy discrimination, pseudo-coincidence counting, or particle size discrimination sampling methods such as the annular impactor and particle size selective filter technique. . . .

Comparison: A 40 CFR, 61, Appendix B, Method 114, Test Methods for Measuring Radionuclide Emissions from Stationary Sources point-by-point comparison is provided in the WHC-EP-0536-1, *Quality Assurance Program Plan for Radionuclide Airborne Emissions Monitoring*, Appendix G.

Detectable quantities are collected by passing a minimum volume of air through the sampling system. This is done by setting the flow rates nominally to 2 CFM and allowing the sample to accumulate for a full 168 hours. If a sample is collected less than 8 hours, the data is usually not used, because from historical knowledge detectable quantities are not collected.

As of 1994, analysis will be accomplished to look for ^{90}Sr, ^{129}I, ^{106}Ru, ^{239}Pu, ^{241}Am, and GEA. Typically the minimum GEA analysis is for ^{137}Cs. If a specific radionuclide does not show up, 1995 analysis instructions will be readjusted. Limits are established at the Hanford Site in WHC-CM-7-5, Environmental Compliance Manual.

The samples are usually exchanged on a weekly basis. Occasionally a full weeks sample is not possible, so it has been determined that samples will not be analyzed if it has been collected for less than 8 hours. In this case t = 480 minutes. On the weekly samples, when only alpha, beta, and gamma are looked for, the samples are counted after each sample exchange. In this case t = 10,080 minutes. When specific radionuclides are of interest, the samples are accumulated and analyzed quarterly. In this case t = 120,960 minutes.

__ANSI N13.1-1969, Section 4.3.5, Specific Nature of the operation or Process__ -- The nature of the operation which creates the potential for airborne radioactive materials may influence the sampling program. . . . .

__Comparison__: Continuous sampling is accomplished.

__ANSI N13.1-1969, Section 5, Methods__

__ANSI N13.1-1969, Section 5.1, General__ -- Two forms of airborne radioactive materials are particulate and gases; the particles can be solid or liquid, although particulates are generally considered to be very small fragments of solids. . . . . .

__Comparison__: As discussed above under the heading titled "ANSI N13.1-1969, Section 4.2.2", information regarding this subject is given in WHC-SD-WM-EMP-031, Rev 0 and discussed in section 4.2.1.1.1 of this FEMP. This information suggests that the sample should consist mainly of $^{89/90}$Sr, ^{106}Ru/Rh, ^{137}Cs, and ^{241}Am. All these radionuclides, except ^{106}Ru/Rh are particulate - not volatile. ^{106}Ru/Rh may be volatile.

__ANSI N13.1-1969, Section 5.2, Particles__

__ANSI N13.1-1969, Section 5.2.1, Sample Delivery__ -- Principles concerning the removal of a representative portion of a contained stream, as from a large duct, have been presented in Section 4. . . .

__ANSI N13.1-1969, Section 5.2.2, Particle Collectors without Significant Size Differentiation__ -- Various collectors are applicable to sampling airborne radioactive materials. . . .

__ANSI N13.1-1969, Section 5.2.2.1, Filters__ -- Air filtration is most be frequently employed in sampling atmospheres for radioactive particulates. . . .

__Comparison__: A 47 mm Versapor 3000 or equivalent air sample filter is used for the record sampler. This filter is a membrane filter good for collecting 0.3 μm size particles with a collection efficiency of 95.8% - manufacturer recommended collection efficiency is 91%.

__ANSI N13.1-1969, Section 5.2.2.1.7__ -- Filter holders and support should be chosen for proper chemical compatibility, mechanical strength, sealing, and ease of operation in changing filters. Sample air movers should have the capability of delivering the necessary air flow against the resistance of the sampling system. Proper location and choice of flow measurement device and flow rate control is important.

Comparison: The Record Sample Holder is described as follows:

- Large outside diameter with knurled outer ring for ease of opening.
- Rubber "O" ring gaskets used to seal the sample holder.
- Fine mesh screen behind the sample filter to keep the sample a constant distance from the inlet.
- Sample vacuum side is connected by a flexible line for ease of access.

The rest of the sampling system consists of:

- The sampling probe withdraws the sample from the stack.
- The sample transport line transports the sample to a sample collection (the record sampler) and/or other detection devices (the CAMs).
- The collection and/or detection devices collect the sample.
- The rotameter measures the flow through the system.
- The gasmeter or totalizer totals the sample flow.
- The pressure or vacuum gauge measures the vacuum in the system.
- The flow switch indicates when the sample flow falls below established limits.
- The flow regulator is used to adjusts the flow to maintain established flow rates within the system.
- The vacuum pump supplies the flow through the system.
- The timer indicates the length of time the collection devices have operating.

Refer to Section 5 of WHC-SD-WM-ES-291, Rev 1 for a more detailed description of the sampling system instrumentation.

The next applicable section for this point-by-point is 5.3.

ANSI N13.1-1969, Section 5.3, Gases -- Airborne radioactive volatile materials and so-called "permanent gases such as tritium are frequently important contaminants and their sampling and collection requires techniques and methods differing from those used in particle sampling. . . .

Comparison: As discussed above in the heading titled "ANSI N13.1-1969, Section 5.1, General", Ru/Rh-106 may be present and is volatile. As such, a silver zeolite cartridges is part of the sampling system. Silver zeolite cartridges are designed to collect ^{129}I, ^{131}I, ^{125}Sb, ^{113}Sn,

^{103}Ru, and ^{106}Ru. Also as discussed above in the heading titled "ANSI N13.1-1969, Section 4.3.4, Natural Radioactive Materials", analysis is also conducted for ^{129}I.

The gross filter efficiency of a silver zeolite is based on the particular absorbed/adsorbed radionuclide being evaluated and the porosity of the filter. For uses at the Hanford Site (i.e., ruthenium, iodine), the efficiency is 99.2 to 99.98 (taken from Table O-2 of *Air Sampling Instruments*, American Conference of Governmental Industrial Hygienists, seventh edition [ACGIH 1989]).

The next applicable section for this point-by-point is the appendixes.

ANSI N13.1-1969, Appendix A, Section A1 -- Minimization of the length and bends of sample delivery lines will contribute to representative sampling.

Comparison: The sample line is approximately 10.5 feet long. The tubing is 1 in. O.D. X 0.065 W. There are two 45 degree bends designed with a bend radius of 10 in.

ANSI N13.1-1969, Appendix A, Section A2 -- The distance from the last upstream disturbance to the point of sample extraction should be a minimum of five and preferably ten or more duct diameters downstream. Sampling from a vertical run avoids stratification due to gravity settling. Sampling as far downstream as possible avoids most transient variation in airstream quality.

Not applicable. 40 CFR 61.93 (b)(2)(i) specifies the site location. See comparison under "Method 1A, Section 2.1.1: Selection of Measurement Site."

ANSI N13.1-1969, Appendix A, Section A3.1 -- Velocity and flow distribution should be known for the sampling point, and particle and gaseous composition should be representative.

Comparison: Velocity measurements are accomplished by **Facilities Maintenance Support Services Preventive Maintenance Procedure 7-GN-56, Rev 2**, *Airflow Capacity and Distribution Tests* in conjunction with supplemental GUIDANCE/DATA SHEET, 242-A EVAPORATOR VESSEL VENT EXHAUST STACK (296-A-22 FLOW MEASUREMENT. From the heading above titled "Subpart H Section 61.93 (b)(1)(iii)," the average flow rate was 561 CFM. For an 8 in. stack, this amounts to a velocity of 27 ft/sec. According to Table A1 in the ANSI N13.1-1969 Standard laminar flows occur below 0.68 ft/sec. Above that, turbulent flows exist. Again according to ANSI N13.1-1969 Section A3.3.2 "as the flow becomes more turbulent, the velocity becomes more nearly uniform across the duct." Because of this and the fact that the flow disturbances are significant duct diameters away (see comparison discussion under "Method 1A, Section 2.1.1: PM Measurement" above) it can be assumed that the flow and the concentration profile is fairly uniform across the cross-section area of the stack at the sampling location.

In addition, the guidance/data sheets for this stack provide the velocity at each of the 16 traverse points from each of the two ports used. These data show that the velocity profile varies slightly. For example, on June 4, 1994 these values varied from -17% to +11% from the average.

ANSI N13.1-1969, Appendix A, Section A3.2 -- A multiple number of withdrawal points each representing approximately equal areas based on the duct or stack dimensions is desirable.

Comparison: The sampling probe consists of two nozzles. This is as recommended in this Standard for an 8-in. circular stack. The center of the two equal annual areas recommended are:

- At the center of the stack
- At 3.4 inches from the center

The design drawing shows the nozzles are located at these positions.

ANSI N13.1-1969, Appendix A, Section A3.3 -- The velocity distribution across the duct or stack should be known in order to establish isokinetic flow and representative sample points.

Comparison: The velocity distribution is not known. However, uniform distribution may be assumed (see discussion under "ANSI N13.1-1969, Appendix A, Section A3.1" above).

The designed isokinetic flow rate in the stack is 775 CFM, based on a sample flow of 2.2 CFM through the record sampler and 2 CFM through each of the two CAMs. However, it should not be expected that the design flow is maintained. To determine the true or actual operating conditions, isokinetic flow rate sample data as well as instrumentation errors must be accounted for. From 1992 data, it can be shown that the actual sample flow at the sample nozzle openings (taking into account variability in the readings and instrumentation errors) is from 1.3 to 2.5 CFM. From this, the actual or operating isokinetic flow rate in the stack is from 488 to 938 CFM. Section Subpart H Section 61.93 (b)(1)(iii) above gives the actual flow rates measured in the stack. The average of this data is 561 with a 95% confidence that this flow rate will be between 312 to 809 CFM.

ANSI N13.1-1969, Appendix A, Section A3.4 -- Sampling probe configuration is recommended by figures in this ANSI Standard, with minimum radius bends and precisely tapered probe end edges.

Comparison: The center nozzle has an ID of 0.453 inches. The standard recommends that the length and radius should be 5 times this dimension. This equates to a radius on length of at least 2.27 in. The design drawing gives this nozzle with a 3.75 in.-radius and a 5-in. length.

The outside nozzle has an ID of 0.55 inches. Five times this equates to 2.77 inches. The design drawing gives this nozzle with a 5-in. radius and a 3.75-in. length.

In addition, both nozzles are tapered to a knife edge.

ANSI N13.1-1969, Appendix B, Particle Deposition in Sample Lines

Comparison: WHC-SD-WM-ES-291, Rev 1, *Tank Farm Stack Sampling System Configuration and Efficiency Study* was written to document the losses determined in the tank farm stack sampling systems, including the 296-A-22 stack. These losses are the same that are discussed in the subject appendix of the standard. The determination made for these stacks were made using an up-to-date computer software program. The program title is "DEPOSITION 2.0" and is referenced as Anand, N. K., McFarland, A.R., Wong, F.S, Kocmound C.J., DEPOSITION 2.0, NRC NuReg/GR-006, Serial No. 2145, March 8, 1993, Aerosol Technology Laboratory, Department of Mechanical Engineering, Texas A&M University College Station, TX 77843.

Because particle sizes are not known a spread of particle sizes were used - 10, 3.5 and 1 micron in size. The results are as follows:

Figure 14-1a. Stack Number 296-A-22 Sampling System Particle Penetration Percentage.

	PARTICLE SIZE					
Range	10 μm		3.5 μm		1 μm	
	Probe	Total	Probe	Total	Probe	Total
Minimum	82.7	15.8	94.8	87.0	98.5	97.8
Average	88.6	40.8	95.9	90.0	98.7	98.1
Maximum	100.9	66.3	98.3	93.8	99.1	98.6

The variables used to determine the values presented in the above table are as follows:

Stack diameter 8 in = 0.2032 m
Area = πR^2 = 0.032429 m^2

Stack Stream Velocity (m/s): 8.51 to 9.62

Average: 9.07

Probe equivalent radius = 0.3578 in
Probe equivalent diameter = 0.7156 in = 18.17697898 mm
Sample designed flow rate = 6.2 CFM = 175.56416 LPM

Sample flow rate (LPM): 110.43 to 212.37

Average: 161.41

Line length = 10.5 ft = 3.2 m
Tube ID = 0.870 in = 22.098 mm
Two 45 degree bends.

ANSI N13.1-1969, Appendix C, Errors Due to Anisokinetic Sampling

Comparison: These losses were also evaluated with the software discussed above under ANSI N13.1-1969, Appendix B, Particle Deposition in Sample Lines. These efficiencies can be seen in the column titled "Probe" of the above table titled "STACK NUMBER 296-A-22 SAMPLING SYSTEM PARTICLE PENETRATION PERCENTAGE."

Subpart H Section 61.93 (b) (2) (iii) -- Radionuclides shall be collected and measured using procedures based on the principles of measurements described in Appendix B, Method 114.

Comparison: A 40 CFR, 61, Appendix B, Method 114, Test Methods for Measuring Radionuclide Emissions from Stationary Sources point-by-point comparison is provided in the WHC-EP-0536-1.

Subpart H Section 61.93 (b) (2) (iv) -- A quality assurance program shall be conducted that meets the performance requirements described in Appendix B, Method 114.

Comparison: A Quality Assurance Plan has been developed. It is referenced as WHC-EP-0536-1, Quality Assurance Program Plan for Radionuclide Airborne Emissions Monitoring.

Subpart H Section 61.93 (b) (3) -- When it is impractical to measure the effluent flow rate at an existing source in accordance with the requirements of Paragraph (b)(1) of this section or to monitor or sample an effluent stream at an existing source in accordance with the site selection and sample extraction requirements of paragraph (b)(2) of this section, the facility owner or operator may use alternative effluent flow rate measurements procedures or site selection and sample extraction procedures provided that:

Subpart H Section 61.93 (b) (3) (i) -- It can be shown that the requirements of paragraph (b)(1) or (2) of this section are impractical for the effluent stream.

Subpart H Section 61.93 (b) (3) (ii) -- The alternative procedure will not significantly underestimate the emissions.

Subpart H Section 61.93 (b) (3) (iii) -- The alternative procedure is fully documented.

Subpart H Section 61.93 (b) (3) (iv) -- The owner or operator has received prior approval from EPA.

Comparison: N/A - As mentioned above in section 14.1.2, EPA has determined that this system meets the requirements of 40 CFR 61.93.

Subpart H Section 61.93 (b) (4)(i) -- Radionuclide emission measurements in conformance with the requirements of paragraph (b) of this section shall be made at all release points which have a potential to discharge radionuclides into the air in quantities which could cause an effective dose equivalent in excess of 1% of the standard. All radionuclides which could contribute greater than 10% of the potential dose equivalent for a release point shall be measured. With prior EPA approval, DOE may determine these emissions through alternative procedures. For other release points which have the potential to release radionuclides into the air, periodic confirmatory measurements shall be made to verify the low emissions.

Subpart H Section 61.93 (b) (4)(ii) -- To determine whether a release point is subject to the emission measurements requirements of paragraph (b) of this section, it is necessary to evaluate the potential for radionuclide emissions for that release point. In evaluating the potential of a release point to discharge radionuclides into the air for purposes of this section, the estimated radionuclide release rates shall be based on the discharge of the effluent stream that would result if all pollution control equipment did not exist, but the facilities operations were otherwise normal.

Comparison: Refer to comparison under Subpart H Section 61.93 (a) above.

Subpart H Section 61.93 (b) (5) -- Environmental measurements of radionuclide air concentrations at critical receptor locations may be used as an alternative to air dispersion calculations in demonstrating compliance with the standard if the owner or operator meets the following criteria:

Comparison: Not applicable to the discussion within this point-by-point.

14.3 SYSTEM UPGRADES REQUIRED FOR COMPLIANCE

14.3.1 Summary of Gaseous Effluent Sampling/Monitoring Deficiencies and Recommendations

Because EPA has stated that the 296-A-22 system meets the requirements of 40 CFR 61.93, it is tempting to believe that no deficiencies exist. On the contrary, however, EPA has only addressed the adequacy of the system and not its operation. Stack flow measurements are directly related to this operation. In fact, the only major deficiencies existing for this system is in the area of stack flow measurements. These deficiencies are

- The current procedure is not compliant. However, the procedure is being rewritten.
- The frequency of flow measurement is not compliant.

A recommendation was made in WHC-SD-WM-ES-291, Rev 1, to use the 95% confidence interval stack flow rate in the emission calculations. If this recommendation is acceptable to the regulators, the stack flow measurement frequency deficiency mentioned above will be taken care of at least for the interim.

A new compliant state-of-the-art sampling and monitoring system is being designed. It is planned to install the prototype of this new system on the AP Tank Farm Stack 296-A-40 by the end of 1996. This new system will automatically totalize the stack flow and report this and the sample flow in terms of mass flow. The new system requirements collecting at least 50% of 10 micron sized particles. Table 14-1 and "ANSI N13.1-1969, Appendix B, Particle Deposition in Sample Lines" show this system's minimum collection efficiency for 10 micron sized particles is only 15.8%. It is, therefore, recommended that eventually the 296-A-22 stack sampling system be upgraded to this new compliant system.

14.3.2 Steam Condensate Monitoring Compliance Assessment

The steam condensate EMS determines whether the stream has come into contact with dangerous waste sources in the 242-A Evaporator process. The 242-A Evaporator is designed and operated to ensure that in any areas where steam may be contaminated by dangerous waste constituents the steam is at a greater pressure than these constituents. Therefore, contamination is unlikely. The steam condensate EMS meets the required criteria specified in Section 6.2.2.

This page intentionally left blank.

15.0 SUMMARY AND CONCLUSIONS

This document was developed because the calculated, potential offsite doses for the 242-A Evaporator Vessel Vent Stack exceed 0.1 mren/year. The effluents covered were the following:

- Airborne vessel vent stream
- Airborne building ventilation stream
- Liquid steam condensate stream
- Liquid cooling water stream.

This page intentionally left blank.

16.0 REFERENCES

AEC, 1977, "Instrumentation Arrangement Elevations and Details," Drawing No. H-2-69316, Atomic Energy Commission.

ANSI, 1966, *Practice for Occupational Radiation Exposure Records Systems* ANSI N13.6 - 1966, American National Standards Institute, New York, New York.

ANSI, 1969, *Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities*, ANSI N13.1 - 1969, American National Standards Institute, New York, New York.

ANSI, 1974, *Specifications and Performance of On-Site Instrumentation for Continuously Monitoring Radioactivity in Effluents*, ANSI N42.18-1974, American National Standards Institute, New York, New York.

ANSI, 1980, *Performance Criteria for Instrumentation Used for Inplant Plutonium Monitoring*, ANSI N317-1980, American National Standards Institute, New York, New York.

ARHCO, 1974, *Procurement Specification for In-line Radiation Monitor System - Building 242-A - Project B-100, B-100-P7, 242-A Evaporator-Crystallizer Facilities*, Atlantic Richfield Hanford Company, Richland, Washington.

Beres, D. A., 1990, *The Clean Air Act Assessment Package - 1988 (CAP-88). A Dose and Risk Assessment Methodology for Radionuclide Emissions to Air*, Vols. 1-3, U.S. Environmental Protection Agency, Washington, D.C.

Clean Air Act of 1977, as amended, 41 USC 7401, et seq.

Clean Water Act of 1977, as amended, 33 USC 1251, et seq.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 USC 9601, et seq.

DOE, 1981, *Environmental Protection, Safety, and Health Protection Information Reporting Requirements*, DOE Order 5484.1, U.S. Department of Energy, Washington, D.C.

DOE, 1988, *General Environmental Protection Program*, DOE Order 5400.1, U.S. Department of Energy, Washington, D.C.

DOE, 1990a, *Radioactive Waste Management*, DOE Order 5820.2A, U.S. Department of Energy, Washington, D.C.

DOE, 1990b, *Radiation Protection of the Public and the Environment*, DOE Order 5400.5, U.S. Department of Energy, Washington, D.C.

DOE, 1991a, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*, DOE/EH-0173T, U.S. Department of Energy, Washington, D.C.

DOE, 1991b, *Quality Assurance*, DOE Order 5700.6C, U.S. Department of Energy, Washington, D.C.

DOE-RL, 1990, *242-A Evaporator Dangerous Waste Permit Application*, DOE/RL-90-42, U.S. Department of Energy Field Office, Richland, Washington.

DOE-RL, 1991, *Calendar Year 1990 Air Emissions Report for the Hanford Site*, DOE/RL-91-10, U.S. Department of Energy-Richland Operations Office, Richland, Washington.

DOE-RL, 1992, *Radionuclide Air Emissions Report for the Hanford Site*, DOE/RL-92-30, U.S. Department of Energy-Richland Operations Office, Richland, Washington.

Ecology, 1990a, "Dangerous Waste Regulations," *Washington Administrative Code*, Chapter 173-303, as amended, Washington State Department of Ecology, Olympia, Washington.

Ecology, 1990b, "Records, Monitoring, and Reporting," *Washington Administrative Code*, WAC 173-400-105, as amended, Washington State Department of Ecology, Olympia, Washington.

Ecology, 1990c, "General Regulations of Air Pollution," *Washington Administrative Code*, Chapter 173-400, as amended, Washington State Department of Ecology, Olympia, Washington.

Ecology, 1990d, "National Pollutant Discharge Elimination System Permit Program," *Washington Administrative Code*, Chapter 173-220, Washington State Department of Ecology, Olympia, Washington.

Ecology, 1990e, "State Waste Discharge Permit Program," *Washington Administrative Code*, Chapter 173-216, as amended, Washington State Department of Ecology, Olympia, Washington.

Ecology, 1990f, "Radiation Protection Air Emissions," *Washington Administrative Code*, Chapter 246-247, as amended, Washington State Department of Ecology, Olympia, Washington.

Ecology, 1990g, "Ambient Radionuclides," *Washington Administrative Code*, Chapter 173-480, as amended, Washington State Department of Ecology, Olympia, Washington.

Ecology, E.P.A, and D.O.E., 1994, *Hanford Federal Facility Agreement and Consent Order*, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

EPA, 1986a, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, SW-846, Third Edition, EPA Standard Method 0030, "Volatile Organic Sampling Train," U.S. Environmental Protection Agency, Office of Solid Waste, and Emergency Response, Washington, D.C.

EPA, 1986b, *Reference Methodologies*, Title 40, Code of Federal Regulations, Part 60, Appendix A, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1990, *Quality Assurance Methods*, Title 40, Code of Federal Regulations, Part 60, and Appendix A, "Reference Methodologies," U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1991a, Letter from Gary O'Neal, Director Air Toxics Division of U.S. Environmental Protection Agency to E. A. Bracken, Director, Environmental Restoration Division, U.S. Department of Energy, June 3, 1991.

EPA, 1991b, "National Emissions Standards for Hazardous Air Pollutants" (NESHAPs), as amended, Title 40, *Code of Federal Regulations*, Part 61, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1991c, "Designation, Reportable Quantities, and Notification", Title 40, *Code of Federal Regulations*, Part 302, as amended, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1991d, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Waste," Title 40, *Code of Federal Regulations*, Part 191, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1991e, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," Title 40, *Code of Federal Regulations*, Part 192, as amended, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1991f, "Approval and Promulgation of Implementation Plans," Title 40, *Code of Federal Regulations*, Part 52, as amended, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1991g, "National Interim Primary Drinking Water Regulations" (Safe Drinking Water Act), EPA-570/9-76/003, Title 40, *Code of Federal Regulations*, Part 141, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1991i, "Identification and Listing of Hazardous Waste," Title 40, *Code of Federal Regulations*, Part 261, as amended, U.S. Environmental Protection Agency, Washington, D.C.

FR 1990, "Final Rule, Air Emission Standards Finalized for Hazardous Waste TSD Facilities," *Federal Register*, Vol. 55, No. 120, Thursday, June 21, 1990, Rules and Regulations 25455, U.S. Environmental Protection Agency, Washington, D.C.

Huckfeldt, C. R., 1992, *Quarterly Environmental Radiological Survey Summary Second Quarter 1991 100, 200, 300, and 600 Areas*, WHC-SP-0665-02, Westinghouse Hanford Company, Richland, Washington.

ICRP, 1979, *Limits on Intakes of Radionuclides by Workers*, Publication 30, International Commission on Radiological Protection, Elmsford, New York, July 1979.

Moss, S. S., 1990, *Quality Assurance Program Plan for the Chemical Analysis of Environmental Samples*, WHC-SD-CP-QAPP-003, Westinghouse Hanford Company, Richland, Washington.

Napier, B. A., R. A. Peloquin, D. L. Strenge, and J. V. Ramsdell, 1988, *GENII - The Hanford Environmental Radiation Dosimetry Software System*, PNL-6584, Vols. 1-3, Pacific Northwest Laboratory, Richland, Washington.

Nuclear Waste Policy Act of 1982, 42 USC 10101, et seq.

PNL/WHC, 1989, "Memorandum of Understanding," Pacific Northwest Laboratory and Westinghouse Hanford Company, July, 1989, Richland, Washington.

Resource Conservation and Recovery Act of 1976, as amended, 42 USC 6901, et seq.

RHO, 1978a, *Procurement Specification for Alpha Air Sampler/Monitor*, HWS-10192, Rockwell Hanford Operations, Richland, Washington.

RHO, 1978b, *Procurement Specification for Beta-Gamma Particulate Air Monitor*, HWS-10193, Rockwell Hanford Operations, Richland, Washington.

RHO, 1980a, *200 Area Stack Sampler-Monitor Systems Upgrade: Generic Systems Applications*, RHO-CD-1092, Rockwell Hanford Operations, Richland, Washington.

RHO, 1980b, *Installation Criteria for the Generic Stack Monitoring System*, RHO-MA-241, Rockwell Hanford Operations, Richland, Washington.

RHO, 1981, *Test Procedure for Generic Design Exhaust Stack Sampler/Monitor Application to 200 Area Exhaust Stacks*, Acceptance Test Procedure ATP-G-999-00010, Rev. A-0, Rockwell Hanford Operations, Richland, Washington.

RHO, 1981a, Hanford Site Drawings H-2-92486 through H-2-92504, Rockwell Hanford Operations, Richland, Washington.

RHO, 1984, *FY 1985 200 Area Stack Sampler/Monitor Systems Upgrade*, SD-WM-CR-016, Rockwell Hanford Operations, Richland, Washington.

RHO, 1985, *Liquid Effluent Monitor Calibration for the 242-A Evaporator*, SD-SQA-TI-003, Rockwell Hanford Operations, Richland, Washington.

RHO, 1986, *Rockwell Hanford Operations Environmental Surveillance Annual Report: Calendar Year 1985*, RHO-HS-SR-85-13P, Rockwell Hanford Operations, Richland, Washington.

RHO, 1987a, *Radioactivity in Gaseous Waste Discharged from the Separations Facilities During 1986*, RHO-HS-SR-86-2-4QGAS P, Rockwell Hanford Operations, Richland, Washington.

RHO, 1987b, *Rockwell Hanford Operations Environmental Surveillance Annual Report: Calendar Year 1986*, RHO-HS-SR-86-13P, Rockwell Hanford Operations, Richland, Washington.

SARA, 1986, *Superfund Amendments and Reauthorization Act of 1986* (SARA). 42 USC 11001, et seq.

Svancara, G. B., 1991, *Analytical Chemistry Services Laboratories Quality Assurance Plan*, WHC-SD-CP-QAPP-001-ENG, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

UBC, 1991, *Uniform Building Code*, International Conference of Building Officials, Whittier, California.

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

WAC, 1990a, "National Pollutant Discharge Elimination System Permit Program," *Washington Administrative Code*, 173-220, Washington State Department of Ecology, Olympia, Washington.

WAC, 1990b, "State Waste Discharge Permit Program," *Washington Administrative Code*, 173-216, Washington State Department of Ecology, Olympia, Washington.

WAC, 1991, "General Regulations for Air Pollution Sources," *Washington Administrative Code*, 173-400, Washington State Department of Ecology, Olympia, Washington.

Weast, 1976, *The Handbook of Chemistry and Physics*, 57 Edition, CRC Press, Inc., Cleveland, Ohio.

WHC Maintenance Engineering Services Procedures, Westinghouse Hanford Company, Richland, Washington.

- PSCP-3-002, "Eberline Beta Air Monitor, Models AMS-3, AMS-3A, And 700300."
- PSCP-3-003," Eberline Alpha-4, -5, and 5A."
- PSCP-4-007, "Rockwell Type Gas Meter."
- PSCP-4-091, "Pressure and Vacuum Gauges."
- PSCP-6-029, "Chem-Tec Adjustable Flow Switch Model 500."
- PSCP-7-001, "Air Rotameter."
- PSCP-7-001, Rev. 1, 1989, "Calibration Procedure, Air Rotameter."

WHC Controlled Manuals, Westinghouse Hanford Company, Richland, Washington.

- WHC-CM-1-3, *Management Requirements and Procedures*, as amended.
- WHC-CM-4-12, *Health Physics Practices Manual*, as amended.
- WHC-CM-5-7, *Tank Farms, Grout, and Solid Waste Management Administration Manual*.

WHC, 1988a, *242-A Evaporator Safety Analysis Report*, WHC-SD-WM-SAR-023, Westinghouse Hanford Company, Richland, Washington.

WHC 1988b, *Operating Specifications for the Operation of the 242-A Evaporator-Crystallizer*, OSD-T-151-00012, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988c, *Operational Environmental Monitoring*, WHC-CM-7-4, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988d, *Westinghouse Hanford Company Effluent Discharges and Solid Waste Management Report for 1987: 200/600/1100 Areas*, WHC-EP-0141, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988e, *Westinghouse Hanford Company Environmental Surveillance Annual Report: 200/600 Areas, Calendar Year 1987*, WHC-EP-0145, Westinghouse Hanford Company, Richland, Washington.

WHC, 1989a, *Airflow Capacity and Distribution Tests*, Maintenance Engineering Services Maintenance Procedure, 7-GN-56, Rev. 1, Westinghouse Hanford, Richland, Washington.

WHC, 1989b, *Hazardous Waste Management*, WHC-CM-5-16, Westinghouse Hanford Company, Richland, Washington.

WHC, 1989c, Internal Memo 13331-89-482; from Waste Concentration Process Engineering Unit; dated December 13, 1989; subject: *Nitric Acid Released During 242-A Evaporator Flush*.

WHC, 1989d, Internal Memo 12715-ASL-136; dated April 6, 1989; from Analytical Systems Laboratories to C. M. Winkler; *Tritium Content of the 242-A Evaporator Stack Gases*.

WHC, 1989e, *Westinghouse Hanford Company Effluent Discharges and Solid Waste Management Report for 1988: 200/600 Areas*, WHC-EP-0141-1, Westinghouse Hanford Company, Richland, Washington.

WHC, 1989f, *Westinghouse Hanford Company Quality Assurance Manual*, WHC-CM-4-2, Westinghouse Hanford Company, Richland, Washington.

WHC, 1990a, *Westinghouse Hanford Company Effluent Discharges and Solid Waste Management Report: 200/600 Areas, Calendar Year 1989*, WHC-EP-0141-2, Westinghouse Hanford Company, Richland, Washington.

WHC, 1990b, *242-A Evaporator Cooling Water Stream-Specific Report*, WHC-EP-0342, Addendum 21, Westinghouse Hanford Company, Richland, Washington.

WHC, 1990c, *242-A Evaporator Process Condensate Stream-Specific Report*, WHC-EP-0342, Addendum 15, Westinghouse Hanford Company, Richland, Washington.

WHC, 1990d, *242-A Evaporator Steam Condensate Stream-Specific Report*, WHC-EP-0342, Addendum 26, Westinghouse Hanford Company, Richland.

WHC, 1990e, *Functional Design Criteria for the 242-A Evaporator and Purex Plant Condensate Treatment Facility*, WHC-SD-C018-FDC-001, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

WHC, 1990f, Internal Memo 1331-90-012; Dated January 8, 1990; From Waste Concentration Process Engineering; Subject: *Notification of Continuous Release of Ammonia and Ammonia Hydroxide Hazardous Substances.*

WHC, 1990g, *Radiological Design Criteria*, Section 10.0, Rev. 0, *Sampling and Monitoring*, WHC-CM-4-9, Westinghouse Hanford Company, Richland, Washington.

WHC, 1990h, *Sample/Fill/Drain 242-A Steam Condensate*, POP-TO-630-040, Westinghouse Hanford Company, Richland, Washington.

WHC, 1990i, *Technical Basis Document, LERF Inventory Control OSR*, WHC-SD-WM-TI-448, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC, 1991a, *A Guide for Preparing Hanford Facility Effluent Monitoring Plans*, WHC-EP-0438-1, Westinghouse Hanford Company, Richland, Washington.

WHC, 1991b, *242-A Evaporator Hazard Classification*, WHC-SD-WM-PSE-008, Westinghouse Hanford Company, Richland, Washington.

WHC, 1991c, Internal Memo 76400-91-028, Rev. 1, from Tank Farm Process Engineering, dated August 16, 1991; Subject: *242-A Evaporator Safety Analysis Report Bounding Source Term.*

WHC, 1991d, *Management Plan for Facility Effluent Monitoring Plan Activities*, WHC-EP-0491, Westinghouse Hanford Company, Richland, Washington.

WHC, 1991e, Internal Memo 29510-091-002; Dated March 1, 1991; From Evaporator Restart SAR Development; Subject: *Normal Operating Source Term For The 242-A Evaporator.*

WHC, 1991f, Internal Memo 86132-91-MOA-006; Dated January 22, 1991; From Effluent Technology; Subject: *Re-submittal of Data for Inclusion in the W-105 Functional Design Criteria.*

WHC, 1991g, *242-A Evaporator Comparison With 40 CFR 61, Subpart H, and Other Referenced Guidelines For Stack 296-A-22*, WHC-EP-0542, Westinghouse Hanford Company, Richland, Washington.

WHC, 1991h, *Quality Assurance Program Plan for Radionuclide Airborne Emissions Monitoring*, WHC-EP-0536, Westinghouse Hanford Company, Richland, Washington.

WHC, 1991i, *Facility Effluent Monitoring Plan for the 222-S Laboratory*, WHC-EP-0480, Westinghouse Hanford Company, Richland, Washington.

WHC, 1991j, *Environmental Releases for Calendar Year 1990*, WHC-EP-0527, Westinghouse Hanford Company, Richland, Washington.

WHC, 1992a, *242-A Evaporator Steam Condensate Sampling and Analysis Plan*, WHC-SD-WM-EV-079, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

WHC, 1992b, *242-A Evaporator Cooling Water Sampling and Analysis Plan*, WHC-SD-WM-EV-078, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

WHC, 1992c, *Liquid Effluent Sampling Quality Assurance Project Plan*, WHC-SD-WM-QAPP-011 Rev.1, Westinghouse Hanford Company, Richland, Washington.

WHC, 1992d, *Operational Health Physics Practices Manual*, WHC-CM-4-12, RELEASE 25, Westinghouse Hanford Company, Richland, Washington.

WHC, 1992e, *Sample Cooling Water from 242-A Via Receiver Carboy RC-2*, TO-630-060, Westinghouse Hanford Company.

WHC, 1992f, *Quality Assurance Project Plan for Facility Effluent Monitoring Plan Activities*, WHC-EP-0446, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

WHC, 1992g, *Health Physics Procedures*, WHC-IP-0718, Westinghouse Hanford Company, Richland, Washington.

WHC, 1992h, *Management Requirements and Procedures Manual*, WHC-CM-1-3, Westinghouse Hanford Company, Richland, Washington.

WHC, 1992i, *Environmental Compliance Manual*, WHC-CM-7-5, Westinghouse Hanford Company, Richland, Washington.

WHC, 1992j, *Management Policies*, WHC-CM-1-1, Westinghouse Hanford Company, Richland, Washington.

WHC, 1992k, *Environmental Releases for Calendar Year 1991*, WHC-EP-0527-1, Westinghouse Hanford Company, Richland, Washington

WHC, 1992l, *242-A Evaporator Comparison with 40 CFR 61, Subpart H, and Other Referenced Guidelines for Stack 296-A-22*, WHC-EP-0542, Westinghouse Hanford Company, Richland, Washington.

WHC, 1992m, *Quality Assurance Project Plan for Radioactive Airborne Emissions Data Compilation and Reporting*, WHC-EP-0528, Westinghouse Hanford Company, Richland, Washington.

DISTRIBUTION

Number of Copies

ONSITE

6	U.S. Department of Energy Field Office, Richland	
	J. D. Bauer	A5-15
	R. G. Holt	A5-15
	E. B. Dagan	A5-19
	S. D. Stites	A5-19
	Public Reading Room (2 copies)	H2-53
7	Pacific Northwest Laboratory	
	W. J. Bjorklund	P7-68
	T. D. Chikalla	P7-75
	G. R. Hoenes	P7-78
	R. E. Jaquish	K1-30
	G. A. Simiele	P7-79
	R. K. Woodruff	K6-13
	Technical Files	K1-11
37	Westinghouse Hanford Company	
	D. D. Bachand	R1-52
	R. L. Brown	R3-12
	G. M. Crummel	R1-51
	L. P. Diediker	T1-30
	T. P. Frazier (10)	T1-30
	L. A. Garner	R2-86
	B. P. Geckler	T1-30
	C. J. Geir	R2-36
	R. D. Gustavson	R1-51
	D. L. Kelly	S5-20
	P. J. Martell	H6-30
	L. W. Vance	H4-16
	D. D. Volkman	H4-16
	Central Files	L8-04
	Document Processing and Distribution (2)	L8-15
	O.S.T.I. (2)	L8-07

This page intentionally left blank.