FINAL SAFETY ANALYSIS REPORT
242-A EVAPORATOR
LIQUID EFFLUENT RETENTION FACILITY

WESTINGHOUSE HANFORD COMPANY
For the U.S. Department of Energy
Contract DE-AC06-87RL10900

April 4, 1991

This page intentionally left blank.

CONTENTS

CONTENTS (continued)

CONTENTS (continued)

CONTENTS (continued)

CONTENTS (continued)

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF TERMS

A/E	Architect-Engineer
ALI	allowable limit of intake
ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
ATP	acceptance test procedure
BED	Building Emergency Director
CAM	Continuous Air Monitor
CBT	Computer Based Training
CDR	Conceptual Design Report
CFA	Current Files Area
CFR	Code of Federal Regulations
ft^3/min	cubic feet per minute
ft^3/s	cubic feet per second
CPE	Certified Process Engineer
DAC	Derived Air Concentration
DCG	Derived Concentration Guide
DOE	U.S. Department of Energy
DOE-HQ	U.S. Department of Energy-Headquarters
DOE-RL	U.S. Department of Energy-Richland Operations
DST	Double-Shell Tank
ECM	Engineering Configuration Management
ECN	engineering change notice
EDE	effective dose equivalent
EII	equipment installation instructions
EPA	Environmental Protection Agency
EP/APC	Emergency Procedures/Abnormal Plant Conditions
ERDA	Energy Research and Development Administration
FDC	Functional Design Criteria
FSAR	final safety analysis report
GENII	Generation II Model For Environmental Dose Calculations
GRCO	General Radiochemical Operations
HAMTC	Hanford Atomic Metal Trades Council
HEHF	Hanford Environmental Health Foundation
HDPE	high-density polyethylene
HMS	Hanford Meteorological Station
HP	Health Physics
HPT	Health Physics Technician
ICRP	International Council for Radiation Protection
IDLH	Immediately Dangerous to Life or Health
IRM	Information Resource Management
JCS	Job Control System
KEH	Kaiser Engineers Hanford
LCO	Limiting Condition for Operation
LERF	Liquid Effluent Retention Facility
LOI	Letter of Instruction
MGRIDS	machine generated record inventory and disposal schedule
mrem	millirem
msl	mean sea level
NAD	Nuclear Accident Dosimeter
NCR	nonconformance report

LIST OF TERMS (continued)

NPO	Nuclear Process Operator
NS	Nuclear Safety
NSSR	Nuclear Safety Standards and Requirements
OAC	Official Acceptance of Construction
OJT	on-the-job training
ORR	Operational Readiness Review
OSL	Operational Safety Limit
OSR	Operational Safety Requirements
OSS	Operations Support Services
OTP	Operability Test Procedure
PAG	Protective Action Guideline
PAPR	powered air purifying respirator
PC	process condensate
PCM	personnel contamination monitor
PMD	Project Management Division
PMF	probable maximum flood
PMP	preventive maintenance procedure
PMP	project management plan
PNL	Pacific Northwest Laboratory
POP	plant operating procedure
ppb	parts per billion
ppm	parts per million
PSAD	preliminary safety assessment document
PSE	Preliminary Safety Evaluation
PUREX	202-A Plutonium-Uranium Extraction
QA	quality assurance
QAPP	quality assurance program plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RIDS	record inventory and disposal schedule
RWP	radiation work procedure
SAR	safety analysis report
SCBA	self-contained breathing apparatus
SDC	Standard Design Criteria
SEAC	Safety and Environmental Advisory Council
SL	Safety Limit
SOP	standard operating procedure
SOW	Statement of Work
SPC	special protective coating
STEL	short-term exposure limit
SWP	special work procedure
TBD	to be determined
TLD	thermoluminescent dosimeter
TLV	threshold limit value
TLV-C	threshold limit value-ceiling
TRU	transuranic
TWA	time weighted average
UHF	ultra high frequency
VLDPE	very low density polyethylene
WAC	Washington Administrative Code
Westinghouse Hanford	Westinghouse Hanford Company

1.0 INTRODUCTION AND GENERAL DESCRIPTION OF THE PLANT

1.1 INTRODUCTION

For the past 45 yr, the Hanford Site has used the favorable site characteristics of isolation, low precipitation, deep water table, and retentive or sorptive properties of the soil to discharge large amounts of water containing low levels of radionuclides and stable chemicals to the soil column. The present U.S. Department of Energy (DOE) policy requires that the use of soil columns to treat and retain suspended or dissolved radionuclides from liquid waste be discontinued.

The operation of the 242-A Evaporator is vital to conducting the Hanford Site mission. The evaporator is used to substantially reduce the quantity of waste stored in double-shell storage tanks through a process of evaporative concentration. Operation of the evaporator has been restructured because the 242-A Evaporator process condensate (PC) stream is regulated by the Washington Administrative Code (WAC) 173-303 (Ref. 1) due to the presence of acetone, methyl isobutyl ketone, butyl alcohol, and ammonia in the form of dissolved gas. Refer to environmental documentation in the *Liquid Effluent Retention Facility Dangerous Waste Permit Application* (Ref. 5).

Interim retention is needed to provide capability to store 13 Mgal (45 ML) of effluent waste from the 242-A Evaporator until a proposed treatment/disposal facility becomes operational. The purpose of the Liquid Effluent Retention Facility (LERF) is to provide Resource Conservation and Recovery Act (RCRA) permittable interim retention capacity until a treatment and disposal system can be designed and constructed. The State of Washington, as an Agreement State through the Washington Administrative Code, is responsible for facility environmental approvals rather than the U.S. Environmental Protection Agency (EPA).

Three 6.5 Mgal (25 ML), double-lined basins are constructed partly below grade within the eastern periphery of the 200 East Area. A detailed description of the project is contained in the Functional Design Criteria (Ref. 2). Upon completion and operation of LERF, the boundary of the 200 East Area was expanded to include these facilities. The basins will be operated such that RCRA required contingency space will be available within the three basins.

This FSAR is written based on the guidelines of Regulatory Guide 3.26 (Ref. 3), with minor format modifications as noted herein to specifically address the Liquid Effluent Retention Facility design. This FSAR documents analyses of the facility in terms of potential hazards and the means to protect against the hazards. This includes evaluating the site and its relation to accidents from natural phenomena, evaluating radiation shielding, confinement and control of radioactive material, effluent treatment, projected effluent quantities and concentrations, reliability of the systems essential to safety, and the radiological impact associated with normal operations, abnormal conditions, and accidents. Safety analyses evaluate the potential hazards of the interim retention basins.

Chapter 2.0 of this report is a summary of conclusions. This chapter describes the potential hazards of the basins, the safety analyses performed, and the results of the safety analyses.

Chapter 3.0 is a brief description of the Hanford Site, and the LERF location relative to the Hanford Site.

Chapters 4.0 and 5.0 discuss the design criteria and the basin design, with emphasis on the key safety features. There are no safety class systems as defined in DOE Order 6430.1A (Ref. 4) required to protect employees, the public, or the environment.

Chapters 6.0 and 7.0 are provided to discuss Process Systems and Waste Confinement and Management, respectively, as they apply to the LERF.

Chapter 8.0 describes the radiation protection design features and programs implemented to assure occupational exposures are ALARA.

Chapter 9.0 discusses accidents, hazard classification, and impact of the interim retention basins on the public and employees. Environmental impacts are evaluated in the *Liquid Effluent Retention Facility Dangerous Waste Permit Application* (Ref. 5).

Chapter 10.0 describes the Hanford Site operating organizations, training programs, emergency plan, and decommissioning program.

Chapter 11.0 describes Operational Safety Requirements/Operational Safety Limits (OSRs/OSLs).

Chapter 12.0 provides a general discussion of the Quality Assurance applied to the LERF.

1.2 GENERAL PLANT DESCRIPTION

Three 6.5 Mgal (25 ML), double-lined basins are constructed partly below grade on a site located east of the current 200 East Area. The current boundary of the 200 East Area will be expanded to include these facilities prior to the operation of the LERF. The basins will be operated such that RCRA required contingency space will be available within the three basins. Each basin has a double composite liner with a leachate collection system installed between the two liners. Chapter 5.0 provides a more detailed description of the LERF.

1.3 GENERAL PROCESS DESCRIPTION

Waste from the 242-A Evaporator will be transferred to the LERF. The effluent stream is the condensate resulting from the evaporation process that reduces the volume of waste stored in double-shell tanks. The LERF feed is pumped to the basins through double-encased, fiberglass-reinforced epoxy thermoset resin pipelines. The line from the evaporator is a 3-in. process line encased in 6-in. containment pipe, and has leak detection capability.

1.4 IDENTIFICATION OF AGENTS AND CONTRACTORS

The LERF has been designed and constructed, and is owned by the DOE. Westinghouse Hanford Company (Westinghouse Hanford) has been contracted by the DOE to be the prime operator of the Hanford Site and this facility. Kaiser Engineers Hanford (KEH) has been contracted by the DOE to be the prime architect/engineer for the Hanford Site and this facility.

1.5 REQUIREMENTS FOR FURTHER TECHNICAL INFORMATION

The design of the LERF has been completed. This FSAR documents the safety of the final design of the facility. There are no items which require further development.

1.6 COMPARISON OF FINAL AND PRELIMINARY INFORMATION

The preliminary design of the LERF included four basins to provide interim retention storage for effluent waste from both the 242-A Evaporator and the 202-A PUREX plant. The PUREX Plant effluent piping and basin design has been placed on hold and the basins, piping, and equipment associated with the PUREX facility and waste streams are no longer within the scope of this FSAR. The number of basins has been reduced to three. The basins will be operated such that RCRA required contingency space will be available within the three basins. The source term and the Operational Safety Requirements have been revised to reflect only the 242-A Evaporator process condensate waste stream. Refer to the *Preliminary Safety Assessment Document, Evaporator and PUREX Interim Retention Basins* (Ref. 6).

This page intentionally left blank.

2.0 SUMMARY SAFETY ANALYSIS

2.1 SITE ANALYSIS

The LERF is constructed on a site located east of the old 200 East Area boundary. After construction of the LERF, the boundary of the 200 East Area was expanded to include this facility.

2.1.1 Natural Phenomena

Natural site natural phenomena, e.g., wind and seismic events, affecting the design of the LERF were evaluated. See Chapter 3.0 for a detailed discussion of site natural phenomena and Chapter 9.0 for accident safety analysis.

2.1.2 Site Characteristics Affecting the Safety Analysis

There are no significant site characteristics affecting the safety analysis for the LERF. See Chapter 3.0 for a detailed discussion of site characteristics.

2.1.3 Effect of Nearby Industrial, Transportation, and Military Facilities

There are no nearby industrial, transportation, or military facilities affecting the safety analysis for the LERF. See Chapter 3.0 for a detailed discussion of nearby facilities.

2.2 RADIOLOGICAL AND TOXICOLOGICAL IMPACTS OF NORMAL OPERATIONS

Normal operations impacts for onsite and offsite receptors are well below the threshold of interest. See Chapters 8.0 and 9.0 for detailed discussions. Environmental impacts are evaluated in the *Liquid Effluent Retention Facility Dangerous Waste Permit Application* (Ref. 5).

2.3 RADIOLOGICAL AND TOXICOLOGICAL IMPACTS FROM ABNORMAL OPERATIONS

Consequences associated with radiological/toxicological exposures for offsite, onsite, and in-facility personnel associated with abnormal operations were analyzed and found within acceptable guideline values. See Chapter 9.0 for detailed discussion of the safety analysis and see Table 9-1 for risk acceptance guidelines. Environmental impacts are evaluated in the *Liquid Effluent Retention Facility Dangerous Waste Permit Application* (Ref. 5).

2.4 ACCIDENTS

Consequences associated with radiological/toxicological exposures to offsite, onsite, and in-facility personnel associated with accidents were analyzed and found within acceptable guideline values. See Chapter 9.0 for detailed discussion of the safety analysis and see Table 9-1 for risk acceptance guidelines.

2.5 CONCLUSIONS

It is concluded that the operation of the LERF does not pose a significant threat offsite, onsite, or to in-facility operations.

3.0 SITE CHARACTERISTICS

The LERF is constructed on a site located east of the old 200 East Area boundary. Prior to initiating operation of the LERF, the boundary of the 200 East Area was expanded to include this facility.

This section describes those features of the 200 East Area which are relevant to the operation of the LERF. This information is based on the detailed Hanford Site descriptions contained in the *Standardized Input for Hanford Environmental Impact Statements*, Part 2 (Ref. 7) and the *Hanford Site National Environmental Policy Act (NEPA) Characterization* (Ref. 8).

3.1 GEOGRAPHY AND DEMOGRAPHY OF SITE SELECTED

3.1.1 Site Location

The DOE's Hanford Site lies at 117.5° west longitude and 47.5° north latitude within the Pasco Basin of the Columbia Plateau in southeastern Washington State (Figure 3-1). The Hanford Site occupies an area of 1,476 km^2 (570 mi^2) north of the confluence of the Snake and Yakima Rivers with the Columbia River.

3.1.2 Site Description

The 200 East Area is a controlled area of approximately 8.4 km^2 located near the middle of the Hanford Site. The 200 East Area is about 10 km from the Columbia River and 18 km from the nearest site boundary to the west, south, or east.

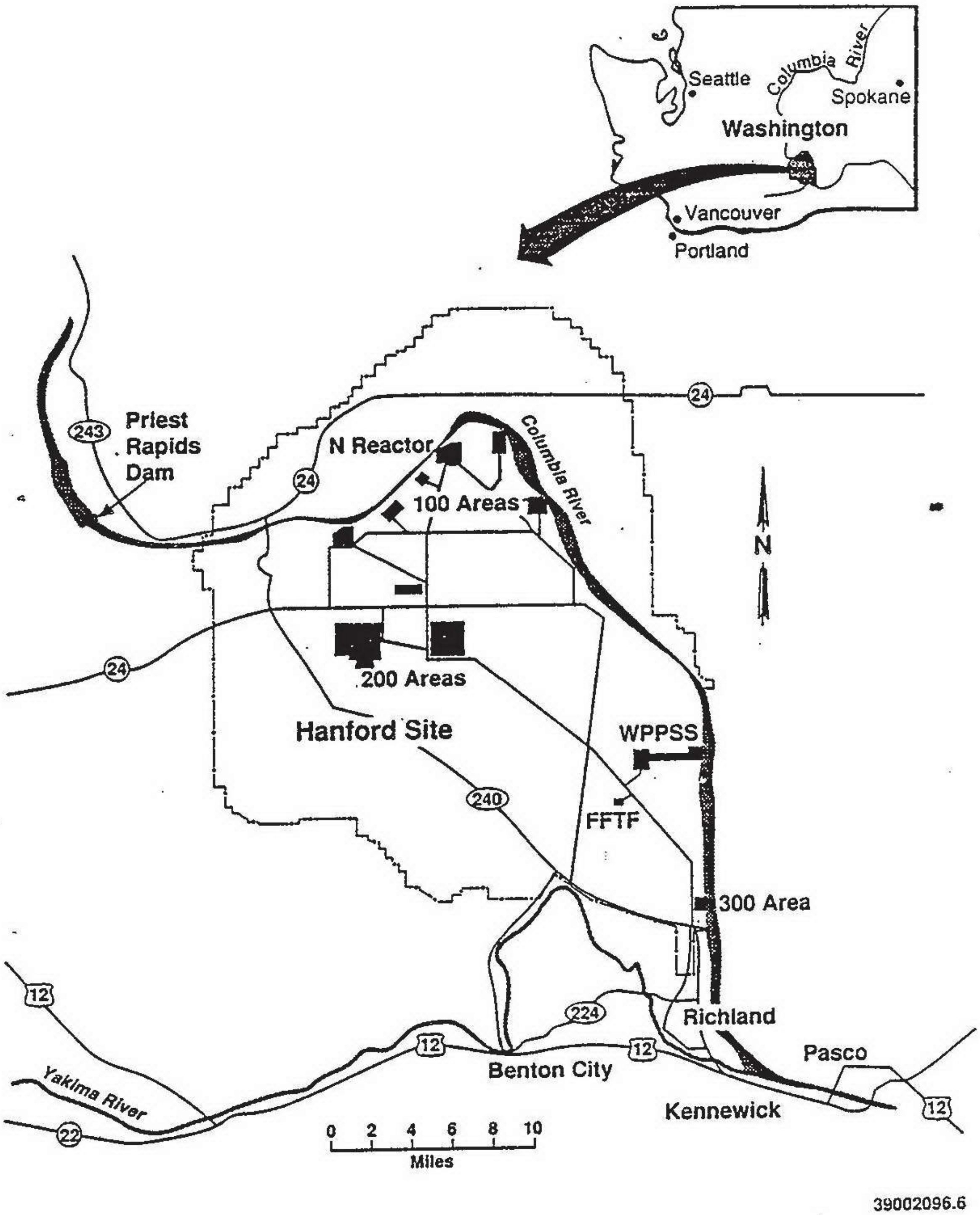
The 200 East Area is located on a plateau at an elevation ranging from approximately 190 to 245 m above mean sea level. The surface slopes from southwest to northeast, with a maximum difference in elevation across the site of about 55 m. There are no naturally occurring surface water bodies within the 200 East Area. However, some aqueous wastes are discharged to an impoundment (B Pond) located 4,100 ft east of the area.

3.1.3 Population, Distribution and Trends

The population distribution in the area surrounding the Hanford Site is nonuniform. Most of the adjacent area to the east, north and west is farm or range land with scattered farming communities.

The Tri-Cities of Kennewick, Pasco, and Richland located to the south and southeast of the site comprise the major population center of the area. The three cities and adjacent suburban areas are estimated to have a combined population of approximately 102,000 based on 1988 estimates. Other population centers of note within an 80-km radius include the cities of Moses Lake, located NNE in the 64 to 80-km (40 to 50-mi) sector and Yakima at about the

Figure 3-1. Hanford Site Layout Drawing.



same distance to the west. The Yakima River Valley, stretching in an arc from the city of Yakima to the Tri-Cities, is a relatively densely populated agricultural area with a number of small towns. The nearest residence to the 200 East Area is approximately 19 km east across the Columbia River. The Richland, Washington city limits are about 27 km to the southeast.

Several population projections for the area surrounding the Hanford Site have been published. The projections generally assume continued population growth based primarily on energy development and irrigated agriculture, with its allied supply and processing industries. Population distributions centered on the principal research and development areas at the Hanford Site are provided in the *Standardized Input for Hanford Environmental Impact Statements*, PNL-3509 (Ref. 7).

3.1.4 Uses of Nearby Land and Waters

Most of the area adjacent to the Hanford Site to the east, north, and west is farm or range land with scattered farming communities. Other land uses in the area surrounding the site include residential, industrial, commercial, scenic, and recreational uses.

3.2 NEARBY INDUSTRIAL, TRANSPORTATION AND MILITARY FACILITIES

Figure 3-2 shows the layout of the 200 East Area, the designations of the various facilities, and the location of the LERF. Land uses within the 200 East Area consist of fuel reprocessing and waste processing and disposal activities. The peak daytime working population of the 200 East Area is approximately 1,650.

3.2.1 Industrial Facilities

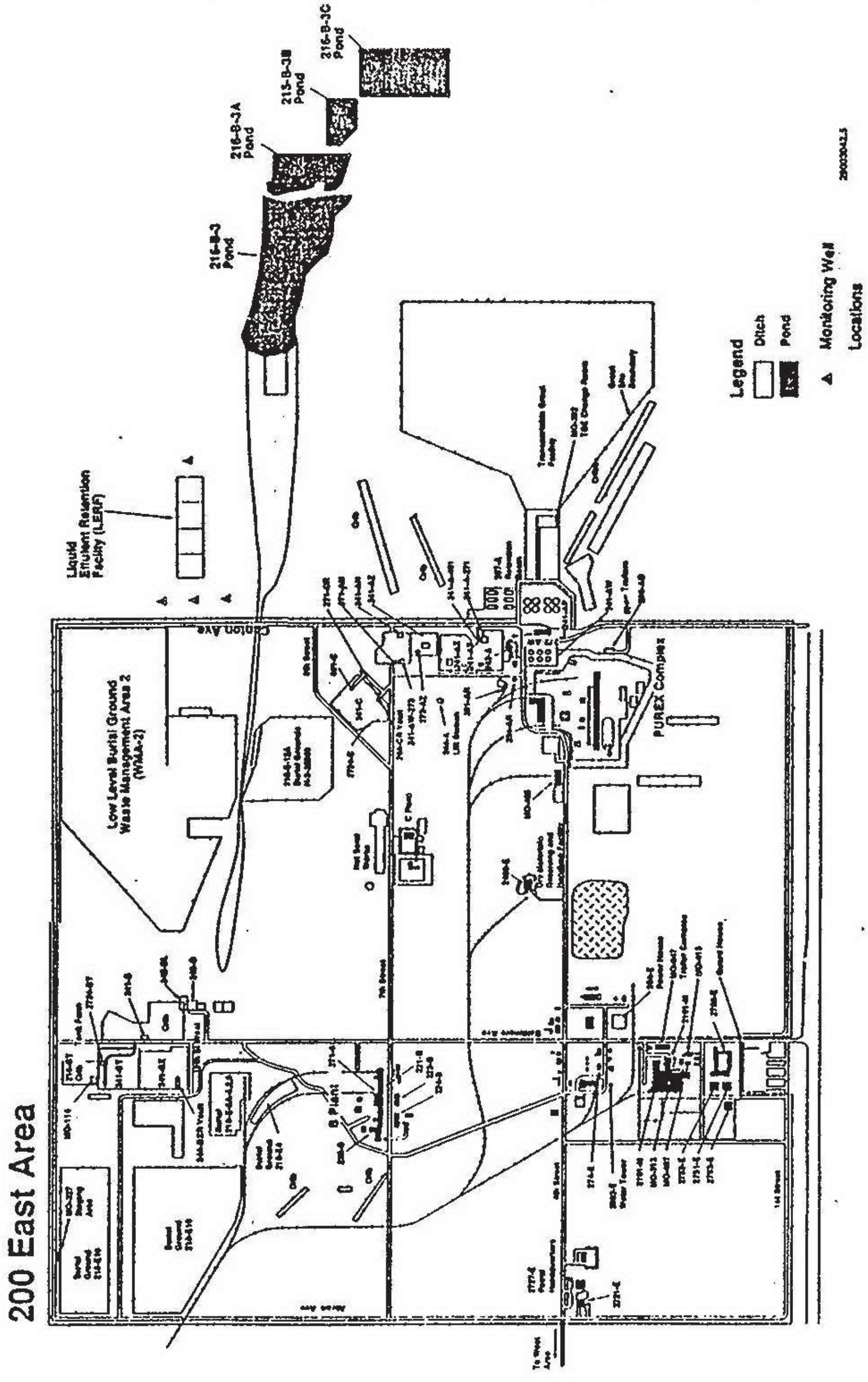
Current major facilities on the site include inactive plutonium production reactors, fuel reprocessing and waste management facilities, the Fast Flux Test Facility, and support facilities. The Washington Public Power Supply System is operating one commercial reactor on an area leased from the DOE.

3.2.2 Military Facilities

The United States Army Yakima Firing Center (Firing Center) is under the command of Fort Lewis and is used for maneuvers and weapons training as identified in *Yakima Firing Center Proposed Land Acquisition* (Ref. 9).

Future plans for the Firing Center will place additional emphasis on weapons systems with longer ranges, improved accuracy, and greater destructive capability. Live firing of all such weapons with explosive warheads is directed into a centrally located impact area within the Firing Center boundary. Therefore, the U.S. Army contends that no safety threat exists for

Figure 3-2. 200 East Area Layout Drawing.



those residents living adjacent to the Firing Center or for those residents living on the east bank of the Columbia River. Administrative controls on firing live ammunition at the Firing Center minimize this hazard.

3.3 METEOROLOGY

3.3.1 Regional Climatology

The Hanford Site is located in a semiarid region of southeastern Washington State. The Cascade Mountains beyond Yakima to the west greatly influence the climate of the Hanford Area due in part to the rain shadow effect of this range resulting in relatively low rainfalls and also by serving as a source of cold air drainage, which has a considerable effect on the wind regime on the Hanford Site.

Summers are typically sunny, warm, and dry. Winters are variable but characteristically mild by comparison with the rest of the inland Pacific Northwest. Frequent changes of weather are caused by Pacific storm systems moving inland; occasionally arctic air masses moving southward from Canada bring periods of cold. High winds are not uncommon at Hanford. They are usually due to squall lines, frontal passages, strong pressure gradients, or thunderstorms.

3.3.2 Local Meteorology

Continuous observation and recording of meteorological data has been carried out at the Hanford Meteorological Station (HMS), located near the 200 West Area, since 1945. Climatological conditions on the 200 Area plateau are significantly different from those on the south end of the site, especially during the winter months when the incidence of low clouds and fog is much greater at the HMS. A compilation of results of the HMS observations for the 200 East Area have been published in PNL-3509, Part 2 (Ref. 7) and PNL-6415 (Ref. 8).

The average daily maximum temperature in July, the hottest month of the year, is 33.2 °C (91.8 °F); the average minimum is 16.1 °C (61.0 °F). During January, the coldest month, the average maximum is 2.6 °C (36.6 °F), and the average minimum is -5.6 °C (21.9 °F). The daily temperature range is about 8.2 °C (14.7 °F) in January and 17.1 °C (30.8 °F) in July.

The average annual precipitation for the Hanford Site is about 16 cm (6.25 in.). Most of the precipitation occurs during the winter season with nearly half of the annual amount occurring in the months of November through February. Days with greater than 1.3 cm (0.5 in.) precipitation occur less than 1% of the year. Rainfall intensities of 1.3 cm/h (0.5 in./h) persisting for 1 h are expected once every 10 yr. Rainfall intensities of 2.5 cm/h (1.0 in./h) for 1 h are expected only once every 500 yr. The greatest amount of rainfall recorded in a 24-h period was 4.85 cm (1.9 in.). Winter monthly average snowfall ranges from 0.8 cm (0.3 in.) in March to 13.5 cm (5.3 in.) in January. The greatest amount of snowfall recorded in a 24-h period is 18.0 cm

(7.1 in.) and the maximum depth of snow recorded is 30.7 cm (12.1 in.). Snowfall accounts for about 38% of all precipitation during the months of December through February.

The relative humidity of the area is moderate. The average annual relative humidity at the HMS is 54%. It is highest during the winter months, averaging about 75%, and lowest during the summer, averaging about 35%.

The predominant wind direction over most of the region is southwesterly. However, because of local topographic influences, the predominant wind direction at the HMS and over much of the Hanford Site including the 200 Area Plateau is northwesterly. Monthly average wind speeds are lowest during the winter months, averaging 10 to 11 km/h (6.2 to 6.8 mph), and highest during the summer, averaging 14 to 16 km/h (8.7 to 9.9 mph). Peak wind gusts of 97 km/h (60.2 mph) or more are expected on the average of once every 2 yr. The all-time record peak wind recorded at the 15 m (49.2 ft) level of the HMS tower was a gust of 130 km/h (80.7 mph) which occurred during the Hanford windstorm of January 11, 1972. The peak gust recorded January 8, 1990 at the HMS tower was 100 km/h (62.2 mph). A gust of 137 km/h (85.1 mph) would be expected to occur once in every 100 yr.

The average occurrence of thunderstorms is 10/yr. They are most frequent during the summer but thunderstorms have occurred in each month of the year. Only 1.9% of all thunderstorms observed at the HMS have been classified as "severe" based upon the National Weather Service criteria of wind gusts of 93 km/h or greater.

The entire State of Washington averages less than one tornado per year. Those that do occur are less severe than those affecting the Great Plains and Gulf State areas. From PNL-6415 (Ref. 8), the estimated probability of a tornado striking a point at Hanford is 9.6×10^{-6}/yr. The HMS climatological summary and the National Severe Storms Forecast Center list 22 tornado occurrences within 161 km (100 mi) of the Hanford Site from 1916 through August 1982; none of the tornadoes have resulted in major damage to property or loss of life. Within an 80-km (50 mi) radius of the Hanford Site, only five small tornados have been recorded between 1950 and 1970.

3.3.3 Onsite Meteorological Measurement Program

An intensive program is in place to meet the meteorologic and climatological monitoring needs of DOE and its contractors for the Hanford Site. In particular, the program calls for the measurement, observation, and storage of various meteorologic data; continuous monitoring of regional weather conditions by a staff of professional meteorologists; and around-the-clock forecasting of weather conditions for the Hanford Site.

The heart of the Hanford Meteorology Monitoring Program is the Hanford Meteorology Station (HMS). The station is centrally located on the Hanford Site between the 200 West and 200 East operating areas. Meteorologic parameters measured or observed at the station include air temperature, relative humidity, precipitation, atmospheric pressure, solar radiation, cloud cover, visibility, and subsurface temperatures. Wind direction, wind speed, and air temperature are measured at multiple levels on a 410-ft (125.0 m) tower. Wind and air temperature measurements are made at 30-ft (9.1 m), 50-ft (15.2 m), 100-ft (30.5 m), 200-ft (61.0 m), 300-ft (91.5 m), and 400-ft (122 m) above ground. Near surface winds and temperatures are measured a short distance from the 410-ft (125 m) tower at heights of 7-ft (2.1 m) and 3-ft (0.9 m), respectively. Winds aloft and the depth of the atmosphere's mixed layer are measured remotely from the meteorology station by a Doppler acoustic sounder. Meteorologic instrumentation and data collection methods at the HMS are described in more detail in *The Data Collection Component of the Hanford Meteorologic Monitoring Program*, PNL-6684 (Ref. 10).

In addition to the monitoring at the HMS, measurements of winds and air temperatures are made at 24 other locations on the Hanford Site and in the surrounding area. Data collected at the automated monitoring stations are transmitted to the HMS via UHF radio transmission for processing and archival. Three of the automated monitoring stations are equipped with 200 ft (61 m) instrumented towers. These towers are located near the 300 Area, Fast Flux Test Facility, and 100-N Area. Wind directions and speeds are measured at three levels on the towers: 30-ft (9.1 m), 82-ft (25 m), and 200-ft (61 m). Air temperatures are measured at three levels on the tower; 5-ft (1.5 m), 30-ft (9.1 m) and 200-ft (61 m). The dew point temperature is also measured at the 5-ft (1.5 m) level. Short towers are deployed at most of the monitoring stations; winds are typically measured at 30-ft (9.1 m) above the ground and air temperatures at 5.5-ft (1.7 m) above the ground. Precipitation is also monitored at several of the stations. Meteorologic instrumentation and methods of data collection at the automated monitoring stations are described in more detail in PNL-6684 (Ref. 10).

The database generated by the Hanford Meteorology Monitoring Program provides a detailed characterization of the climate at the Hanford Site. Climatological data are used to design new Hanford Site facilities, schedule operations, model potential environmental impacts, and prepare environmental reports. A detailed presentation of the climatological data for the HMS was most recently published in *Climatological Summary for the Hanford Area* (Ref. 11). A detailed presentation of climatological data collected from the automated monitoring stations is contained in the *Climatological Summary of Wind and Temperature Data for the Hanford Meteorological Monitoring Network* (Ref. 12).

3.3.4 Short-Term (Accident) Diffusion Estimates

3.3.4.1 Basis. A Hanford Dose Overview Program has been established to ensure that all Hanford-related radiation dose calculations are performed using comparable methods and data. The Hanford Dose Overview Program provides a set of recommended computer codes for calculating radiation doses. These codes contain approved and internally consistent models and data files. The codes are documented and controlled in accordance with appropriate quality assurance requirements. Hanford Site-specific input data and assumptions are utilized in the models to calculate Hanford Site doses. Data and assumptions, if required, are modified by the Dose Overview Committee.

When doses are calculated for a postulated accident scenario, radionuclide release rates are factored into an atmospheric dispersion model, GENII, the *Hanford Environmental Radiation Dosimetry Software System* (Ref. 13). Output from the model provides an estimation of the concentration of radionuclides airborne in the vicinity of a specific site. The transport and diffusion of airborne radionuclides are calculated by utilizing site-specific measurements of wind speed, wind direction, and atmospheric stability.

Tables 3-1 and 3-3, respectively, provide the results of GENII calculations to develop direction specific acute atmospheric dispersion coefficients (X/Q values) for locations 100 m from the LERF site, and at the site boundary. These results indicate that the maximum X/Q values for 100 m (onsite) calculations is 3.3 E-02 s/m^3, with the equivalent direction either to the west-northwest or due north. Maximum site boundary X/Q value is 1.0 E-05 s/m^3, with the equivalent direction either to the east-northeast or to the east. These maximum quantities are used for calculations performed for the Chapter 9.0, Accident Analysis, and represent a conservative consideration of atmospheric dispersion.

3.3.4.2 Calculations. Chapter 9.0 of the FSAR provides a more detailed explanation of the methodology employed in calculating the magnitude of airborne releases from postulated accident scenarios. The accidental release scenarios are based on assumptions of credible worst-case short-term (acute) atmospheric conditions, utilizing the direction of maximum X/Q values. Similarly, GENII calculations of atmospheric dispersion coefficients can be used with toxicological constituent releases to determine acute onsite and offsite toxicological concentrations. More simplistic calculational techniques were employed to determine in-facility personnel doses as illustrated in Chapter 9.0. Environmental impacts are further evaluated in the *Liquid Effluent Retention Facility Dangerous Waste Permit Application* (Ref. 5).

3.3.5 Long-Term Diffusion Estimates

3.3.5.1 Basis. Methods utilized for calculating the dose impacts of routine site-specific radionuclide releases are quite similar to those used to calculate short-term accident diffusion estimates. However, for routine diffusion estimates, dose impacts are predicted on average meteorological conditions (i.e., chronic) rather than worst-case scenarios.

Tables 3-2 and 3-4, respectively, provide the results of GENII calculations to develop direction specific chronic atmospheric dispersion coefficients (X/Q values) for locations 100 m from the LERF site, and at the site boundary. These results indicate that the maximum chronic X/Q values for 100 m (onsite) calculations is 3.5 E-04 s/m^3, with the equivalent direction to the east-southeast. Maximum site boundary X/Q value is 8.6 E-08 s/m^3, with the equivalent direction to the east. These maximum quantities are used for calculations performed for Chapter 8.0, Radiation Protection, and represent a conservative consideration of atmospheric dispersion for analysis of routine releases.

Table 3-1. 100 m Distance - Direction Specific X/Q Values Acute Release Scenario.

Sector Index	Wind Toward:	Distance	GENII X/Q Value
1	South	100 m	2.9 E-02
2	South-southwest	100 m	2.6 E-02
3	Southwest	100 m	2.9 E-02
4	West-southwest	100 m	3.1 E-02
5	West	100 m	3.1 E-02
6	West-northwest	100 m	3.3 E-02
7	Northwest	100 m	3.0 E-02
8	North-northwest	100 m	3.1 E-02
9	North	100 m	3.3 E-02
10	North-northeast	100 m	3.2 E-02
11	Northeast	100 m	2.9 E-02
12	East-northeast	100 m	2.3 E-02
13	East	100 m	2.3 E-02
14	East-southeast	100 m	1.5 E-02
15	Southeast	100 m	1.5 E-02
16	South-southeast	100 m	2.8 E-02

Note: Maximum X/Q values are shown in highlighted boxes.

Table 3-2. 100 m Distance - Direction Specific X/Q Values Chronic Release Scenario.

Sector Index	Wind Toward:	Distance	GENII X/Q Value
1	South	100 m	1.7 E-04
2	South-southwest	100 m	9.4 E-05
3	Southwest	100 m	7.9 E-05
4	West-southwest	100 m	7.1 E-05
5	West	100 m	1.1 E-04
6	West-northwest	100 m	1.2 E-04
7	Northwest	100 m	1.2 E-04
8	North-northwest	100 m	1.1 E-04
9	North	100 m	1.4 E-04
10	North-northeast	100 m	1.1 E-04
11	Northeast	100 m	1.4 E-04
12	East-northeast	100 m	2.4 E-04
13	East	100 m	3.4 E-04
14	East-southeast	100 m	3.5 E-04
15	Southeast	100 m	2.9 E-04
16	South-southeast	100 m	1.8 E-04

Note: Maximum X/Q values are shown in highlighted boxes.

Table 3-3. Site Boundary Distance - Direction
Specific X/Q Values Acute Release Scenario.

Sector Index	Wind Toward:	Distance	GENII X/Q Value
1	South	21.6 km	8.2 E-06
2	South-southwest	19.2 km	8.5 E-06
3	Southwest	19.2 km	9.5 E-06
4	West-southwest	22.0 km	8.7 E-06
5	West	22.0 km	8.7 E-06
6	West-northwest	22.9 km	9.0 E-06
7	Northwest	21.8 km	8.5 E-06
8	North-northwest	22.0 km	8.7 E-06
9	North	22.0 km	9.5 E-06
10	North-northeast	24.7 km	7.8 E-06
11	Northeast	18.7 km	9.8 E-06
12	East-northeast	15.0 km	1.0 E-05
13	East	15.0 km	1.0 E-05
14	East-southeast	21.0 km	4.1 E-06
15	Southeast	25.6 km	3.1 E-06
16	South-southeast	22.9 km	7.3 E-06

Note: Maximum X/Q values are shown in highlighted boxes.

Table 3-4. Site Boundary Distance - Direction Specific X/Q Values Chronic Release Scenario.

Sector Index	Wind Toward:	Distance	GENII X/Q Value
1	South	21.6 km	2.1 E-08
2	South-southwest	19.2 km	1.4 E-08
3	Southwest	19.2 km	1.1 E-08
4	West-southwest	22.0 km	8.7 E-09
5	West	22.0 km	1.4 E-08
6	West-northwest	22.9 km	1.5 E-08
7	Northwest	21.8 km	1.7 E-08
8	North-northwest	22.0 km	1.5 E-08
9	North	22.0 km	1.9 E-08
10	North-northeast	24.7 km	1.3 E-08
11	Northeast	18.7 km	2.5 E-08
12	East-northeast	15.0 km	4.9 E-08
13	East	15.0 km	8.6 E-08
14	East-southeast	21.0 km	5.3 E-08
15	Southeast	25.6 km	3.2 E-08
16	South-southeast	22.9 km	2.2 E-08

Note: Maximum X/Q values are shown in highlighted boxes.

3.3.5.2 Calculations. The GENII (Ref. 13) computer model identified in Subsection 3.3.4.1 can be used to combine average annual atmospheric dispersion parameters (i.e., pollutant concentration/pollutant release rate) and routine plant release levels to calculate estimates of average radionuclide concentrations in the surrounding air. Similarly, GENII calculations of atmospheric dispersion coefficients can be used with toxicological constituent releases to determine chronic onsite and offsite toxicological concentrations.

3.4 SURFACE HYDROLOGY

3.4.1 Hydrologic Description

The major surface hydrologic characteristic of the Hanford Site is the Columbia River, which runs through or adjoins the site over approximately 65 km of its length. Additionally, the Yakima River borders part of the southern boundary and there are several ponds and ditches located in the 200 and 300 Areas. Two ephemeral streams located within the site, Cold Creek and Dry Creek, have relatively short reaches, on the order of 1 km (3,280 ft), but may increase to several times that length during periods of high runoff.

There are no naturally occurring surface water bodies in the 200 East Area. The waste drainage ditch leading from the site to B Pond and the B Pond are the only surface waters. The B Pond is located 1,250 m (4,100 ft) east of the 200 East Area boundary. Gable Mountain Pond is another nearby waste disposal pond and is located 3 km (9,840 ft) north of 200 East. West Lake is a small natural lake located about 4 km (13,120 ft) north of the area.

3.4.2 Floods

Large Columbia River floods have occurred in the past, but the likelihood of recurrence of large-scale flooding has been reduced by the construction of several flood control/water storage dams upstream of the Hanford Site. Major floods on the Columbia River are typically the result of rapid melting of the winter snowpack over a wide area augmented by above-normal precipitation. The maximum historical flood on record occurred June 7, 1894, with a peak discharge at the Hanford Site of 21,000 m^3/s (742,000 ft^3/s). The largest recent flood for the Columbia River below Priest Rapids Dam was 20,000 m^3/s (706,000 ft^3/s) in 1948. Based on records of annual peak flows below Priest Rapids Dam for the years 1913-1965, a peak flow of about 20,000 m^3/s (706,000 ft^3/s) is estimated to have a recurrence frequency of once per 100 yr, while a peak flow of 24,000 m^3/s (848,000 ft^3/s) would occur once every 500 yr. Daily average flow rates during the spring runoff period range 4,530 to 18,400 m^3/s (160,000 to 650,000 ft^3/s).

The Yakima River is physically separated from the LERF site by the Rattlesnake Hills, which would prevent major flooding of that site from the river.

3.4.3 Probable Maximum Flood on Streams and Rivers

Based on a study of Probable Maximum Floods (PMF) by the U.S. Army Corps of Engineers (Ref. 14), it was determined that the 200 East Area was well above dangerous flood levels. The PMF river flow for locations on the Columbia River within the Hanford reservation is 4.1×10^4 m^3/s (1.44×10^6 ft^3/s) (Ref. 15). This would produce a water surface elevation of about 119 m (390 ft) msl (Ref. 14). Since 200 East Area elevation is 192 m to 244 m (630 ft to 800 ft) msl, it is safely above PMF levels.

3.4.4 Potential Dam Failures (Seismically Induced)

In 1951, the Washington D.C. Army Corps of Engineers performed a seismic analysis of Grand Coulee Dam (Ref. 16). The studies covered a spectrum of conditions in terms of breach openings and hydrologic conditions which might prevail at the time of an enemy attack. Although this criteria (enemy attack) does not apply to nuclear facilities, and is not applicable to the LERF, as it is not considered a natural phenomenon (Ref. 17), the first scenario provides a "limiting case" assessment of the conservatism of the facility elevation. This flood would have an outfall peak of 249,188 m^3/s (8,800,000 ft^3/s) at Grand Coulee Dam at the moment of breaching and a peak discharge of 135,921 m^3/s (4,800,000 ft^3/s) at Hanford. A base flow of 1416 m^3/s (50,000 ft^3/s) was assumed. This would produce a water surface elevation of 129 m (422 ft) msl (Ref. 18). This would be 63 m to 115 m (208 ft to 378 ft) below the 200 East Area elevation.

In 1970, the Bureau of Reclamation reported that an earthquake would result in potential cracking along lift lines at the upstream face of Grand Coulee Dam and possible failure of some appurtenant structures such as elevator towers. The investigation also indicated that failure or malfunction of equipment could conceivably cause unintentional releases from the reservoir. However, any combination of such events would produce a total discharge well below the 33,980 m^3/s (1,200,000 ft^3/s) design basis flood for Grand Coulee Dam (Ref. 14).

A Westinghouse report, dated April 16, 1971 concluded that since Hanford and Grand Coulee Dam are both included in Seismic Zone II (a zone of moderate earthquake activity). A flood resulting from dam failure approaching the 41,000 m^3/s (1,440,000 ft^3/s) level at Hanford appeared to be the most severe case (Ref. 14). Again, this flood level would produce a surface water elevation below the 200 East Area elevation.

3.4.5 Probable Maximum Surge and Seiche Flooding

The Hanford Site is not located near any body of water with the potential to produce surge or seiche flooding of the site.

3.4.6 Probable Maximum Tsunami Flooding

The Hanford Site is not located near any body of water with the potential to produce tsunami flooding of the site.

3.4.7 Ice Flooding

The Hanford Site is not located near any body of water with the potential to produce ice flooding of the site.

3.4.8 Water Canals and Reservoirs

There are no water canals or reservoirs in the 200 East Area nor in the LERF design.

3.4.9 Channel Diversions

The possibility of a landslide resulting in river blockage and flooding along the Columbia River has been examined in PNL-6415 (Ref. 8) for an area bordering the east side of the river upstream of the city of Richland. The possible landslide area considered was the 75 m (246 ft) high bluff generally known as White Bluffs. Calculations were made for an 8 x 10^5 m^3 landslide volume with a concurrent flood flow of 17,000 m^3/s (600,000 ft^3/s) resulting in a wave crest 122 m (400 ft) above mean sea level. Flooding in the Hanford area would be similar to that caused by the PMF discussed in Section 3.4.3, well below the 200 East Area (Ref. 8).

3.4.10 Flooding Protection Requirements

Flooding protection requirements are not required for the LERF as flooding of the facility is not considered probable.

3.4.11 Low Water Considerations

The LERF and its support facility do not rely upon a source of water for operation; therefore, low water considerations will not have an impact on the facility.

3.4.12 Environmental Acceptance of Effluents

No effluents are expected to be discharged to the ground. Refer to Chapter 5.0, Facility Design and the *Liquid Effluent Retention Facility Dangerous Waste Permit Application* (Ref. 5)

3.4.13 Chemical and Biological Composition of Adjacent Watercourses

The Washington State Department of Ecology classified the Columbia River as Class A (excellent) between Grand Coulee Dam and the mouth of the river near Astoria, Oregon. The Hanford reach of the Columbia River is the last free-flowing portion of the river in the United States, although flow is regulated by Priest Rapids Dam immediately upstream from the Hanford Site.

The Columbia River supports a large and diverse community of plankton, benthic invertebrates, fish, and other communities. Plankton populations in the Hanford reach are influenced by communities which develop in the reservoirs of upstream dams, particularly Priest Rapids Reservoir. Plankton populations are also influenced by the manipulation of water levels resulting from dam operations in downstream reservoirs. Phytoplankton and zooplankton at the Hanford Site are largely transient, flowing from one reservoir to another. There is generally insufficient time for endemic groups of phytoplankton and zooplankton to develop in the Hanford reach.

Some of the temporary waste water ponds and ditches on the Hanford Site have been in existence for four decades and have developed ecological communities. However, there are no bodies of water within the 200 East Area which support significant aquatic ecosystems.

3.5 SUBSURFACE HYDROLOGY

3.5.1 Regional and Area Characteristics

The groundwater below the Pasco Basin is in an unconfined aquifer that ranges between about 105 m above msl at the Columbia River to about 145 m above msl at the west boundary of the Hanford Site. The depth of the water table varies greatly from place to place, depending chiefly on local topography, and ranges from a few centimeters to more than 100 m below the land surface. Current estimates of the maximum saturated thickness of the unconfined aquifer is about 70 m. Beds of fractured basalt and occasionally permeable sediments between some of the basalt beds underlying the region form confined aquifers at various depths in the basalt. These confined aquifers are important sources of water in many parts of the Pasco Basin.

3.5.2 Site Characteristics

The water table beneath the 200 East Area occurs within the sand and gravel deposits of the Middle Ringold Formation at a depth of 55 to 100 m and slopes toward the Columbia River. The natural recharge of the aquifer is from precipitation and runoff from the hills to the west of the Hanford Site and from Cold Creek and Dry Creek which are ephemeral streams in the Yakima River drainage to the south. Past practices involving surface disposal of waste waters from the 200 Areas has created an artificial recharge of the aquifer with a 9 m local elevation of the water table under the 200 Area plateau.

3.5.3 Contaminant Transport Analysis

The dry nature of the climate at Hanford and the limited natural surface recharge available from precipitation minimizes the probability of leachate formation and migration. The groundwater flows downgradient eastward discharging into the Columbia River although there is some groundwater flow to the north between Gable Mountain and Gable Butte.

Groundwater monitoring is conducted by a program meeting the requirements of WAC 173-303, Sections 400 and 645 (Ref. 1) and 40 CFR, Part 265 (Ref. 19). This ensures detection of breaches in the LERF liner systems. See Section 5.2.2.3 and Figure 3-2.

3.6 GEOLOGY AND SEISMOLOGY

3.6.1 Basic Geologic and Seismic Information

The Hanford Site lies within the Columbia Plateau of southeastern Washington State. Deformation of the basaltic lava flows which form the Columbia Plateau has formed a number of topographic basins. The Hanford Site lies within the Pasco Basin.

The 200 Area Plateau, upon which the 200 East Area is located, is a gravel bar deposited by the post-glacial flood waters. A thin surface layer of windblown silts and sands covers the Hanford Formation sediments which consist mainly of well-sorted coarse sands. On the east side of the area, those deposits give way to a slightly silty and pebbly coarse sand. The Hanford Formation sediments are about 70 m thick. They directly overlie the Middle Ringold Formation which consists of well-rounded pebbles and cobbles with interstitial spaces filled with medium sand. The Upper Ringold Formation is not generally present beneath the 200 East Area, having apparently been eroded away.

The water table beneath the 200 East Area lies under the top of the Middle Ringold Formation at a depth which varies from about 100 m in the southwest to 55 m in the northeastern portion. Middle Ringold Formation sediments are unconsolidated and have a relatively high permeability. The depth to basalt bedrock under the 200 East Area is about 120 m.

Eastern Washington is a region of low-to-moderate seismicity which lies between the more active seismic zones of western Washington and western Montana.

3.6.2 Vibratory Ground Motion

Based on seismic history since 1840, the U.S. Coast and Geodetic Survey has designated Eastern Washington as Zone 2 seismic probability, implying a potential for moderate damage from earthquakes. The strongest earthquakes recorded on the Hanford Site within historic times have been a factor of 10 below the seismic probability of Zone 2.

3.6.3 Surface Faulting

Surface faulting is not known to occur at the Hanford Site.

3.6.4 Stability of Subsurface Materials

The soil characteristics of the 200 East Area are such that differential compaction or liquefaction as a result of seismic shocks are considered very unlikely.

3.6.5 Slope Stability

There are no slopes within several kilometer of the 200 East Area which could produce landslides during an earthquake.

3.7 SUMMARY OF CONDITIONS AFFECTING FACILITY CONSTRUCTION AND OPERATING REQUIREMENTS

There are no significant site characteristics affecting the selection of design bases for the LERF.

4.0 PRINCIPAL DESIGN CRITERIA

4.1 PURPOSE OF PLANT

The purpose of LERF is to provide RCRA permittable interim retention capacity for waste streams from the 242-A Evaporator until a treatment and disposal system can be designed and constructed. The State of Washington, as an Agreement State through the Washington Administrative Code (WAC), is responsible for facility environmental approvals rather than the EPA. This interim retention capacity consists of three 6.5 Mgal (25 ML) surface impoundment retention basins (Ref. 2).

4.1.1 Plant Feed

The LERF feed consists of process condensate (PC) from the 242-A Evaporator which is generated during the concentration of waste from underground storage tanks.

Vapors removed from the vapor-liquid separator in the evaporator are condensed, collected and passed through a filter to remove solids. The condensate then flows down an ion exchange column to further reduce the cesium and strontium content. After flowing through an in-line strainer, it then feeds into the LERF facility. A list of the PC contents feeding into LERF can be found in Chapter 9.0.

4.1.2 Plant Products and Byproducts

The LERF is an interim retention facility. Operation of the LERF will not result in the generation of products or byproducts by design processes, however the facility will generate wastes from normal expected maintenance and operational practices.

4.1.3 Facility Functions

The LERF provides RCRA permittable interim retention capacity until a treatment and disposal system can be designed and constructed. Three 6.5 Mgal (25 ML), double-lined retention basins provide storage of waste from the 242-A Evaporator. The basins will be operated such that RCRA required contingency space will be available within the three basins.

The LERF feed is pumped to the basins through double-encased, fiberglass-reinforced epoxy thermoset resin pipelines. The capability exists to transfer the contents of one basin into another basin. Sampling ports are provided at the basin perimeters and the leachate collection system.

4.2 STRUCTURAL AND MECHANICAL SAFETY CRITERIA

Structures, systems and components for the LERF have been designated as no greater than Safety Class 3, which is consistent with the facility hazard classification of "low," and the analyzed consequences of onsite and offsite releases. The LERF was designed to meet applicable environmental regulations and standards. Refer to the *Liquid Effluent Retention Facility Dangerous Waste Permit Application* (Ref. 5). General structural and mechanical design criteria for the facility, including natural forces and environmental service conditions, are consistent with SDC 4.1, "Standard Arch-Civil Design Criteria, Design Loads for Facilities" (Ref. 15) and SDC 5.1, "Standard Design Criteria for Heating Ventilation, and Air Conditioning" (Ref. 20) for a low hazard nuclear facility.

4.2.1 Wind Loadings

Wind load design for the LERF facilities is in accordance with SDC 4.1, "Standard Arch-Civil Design Criteria, Design Loads for Facilities" (Ref. 15) and ANSI A58.1, *Minimum Design Loads for Buildings and Other Structures*, Section 6 (Ref. 21) in accordance with the following criteria:

Fastest Mile Wind Speed	70 mph
Importance Factor	1.07
Exposure Category	C

4.2.2 Tornado Loadings

The wind loadings specified in Section 4.2.1 incorporate all wind design criteria for Safety Class 3 structures. This uniform treatment of wind loads accommodates extreme, hurricane, and tornado winds; therefore, no specific design criteria are provided for either tornado winds or tornado-generated missiles.

4.2.3 Water Level (Flood) Design

The LERF site is well above the Probable Maximum Flood level. Accordingly, no specific criteria for flood design mitigation features are required.

4.2.4 Missile Protection

As discussed in Section 4.2.2, above, no specific design criteria are provided for tornado-generated missiles. There are no rotating components which could produce equipment-generated missiles with sufficient energy to affect the basins or the transfer piping. Accordingly, no specific criteria for equipment-generated missiles are required.

4.2.5 Seismic Design

Seismic design is in accordance with the requirements specified in SDC 4.1, "Standard Arch-Civil Design Criteria, Design Loads for Facilities" (Ref. 15).

4.2.6 Snow Loadings

The maximum recorded depth of snow is 30.7 cm. Live loads due to snow have been calculated in accordance with the requirements specified in SDC 4.1 (Ref. 15).

4.2.7 Process and Equipment Derived Loads

Process and equipment derived loads are in accordance with the requirements specified in SDC 4.1 (Ref. 15).

4.2.8 Combined Load Criteria

Load combinations are in accordance with the requirements specified in SDC 4.1 (Ref. 15).

4.2.9 Subsurface Hydrostatic Loadings

The LERF site is well above the maximum groundwater level. Accordingly, no specific criteria for subsurface hydrostatic loadings are required. A leachate collection system operates automatically, maintaining hydrostatic pressure between the basin composite liners of one foot, or less.

4.3 SAFETY PROTECTION SYSTEMS

4.3.1 General

Based on the safety assessment provided in Section 9.0, no items have been identified which require special design consideration due to site selection, process selection or safe shutdown requirements. The DOE Order 6430.1A, *General Design Criteria* compliance comparison was performed for LERF (Ref. 22). This comparison evaluated the design of the facility to the 99 Sections and Division 13 of DOE 6430.1A. This comparison identified nine criteria for which LERF is non-compliant. The nine criteria are listed below:

- 1300-1.4.4 Monitoring of Releases
- 1300-3.2 Safety Class Items
- 1300-6.5.2 Air Monitoring and Warning Systems
- 1300-6.5.3 Personnel Monitoring and Warning Devices
- 1300-6.5.4 Ionizing Radiation Monitoring System
- 1300-6.8 Change Rooms

- 1300-9 Effluent Control and Monitoring
- 1300-12 Human Factors Engineering
- 1323-6.3 Effluents.

Based on the analyses performed in Chapters 8.0 and 9.0 and the environmental permitting documentation, justifications for exempting LERF from these nine non-compliant criteria are provided in Appendix B.

4.3.2 Protection by Multiple Confinement Barriers

The LERF design uses a dual confinement barrier concept (i.e., dual basin composite liners and pipe-in-a-pipe transfer piping systems) to minimize the potential for accidental releases to the environment. The line from the 242-A Evaporator is a 3-in. process line encased in 6-in. containment pipe. The piping above each catch basin is single pipe and the basins are curbed to contain possible releases into the catch basins.

Periodic maintenance activities, which could result in breach of LERF confinement barriers, result in conditions which are bounded by the design basis and "bounding" accidents evaluated in Chapter 9.0 of this document.

4.3.3 Protection by Equipment and Instrumentation Selection

Consequences of potential accidents and abnormal occurrences have been evaluated as credible events and the consequences have been found to be within guideline values. Therefore, no specific equipment or instrumentation is necessary.

4.3.4 Nuclear Criticality Safety

The LERF is a low hazard nuclear facility for which nuclear criticality is not a concern. According to WHC-CM-4-29, *Nuclear Criticality Safety Manual* (Ref. 23), the LERF is exempt from criticality control as it contains less than the 15 g administrative requisite for fissile material criticality control.

4.3.5 Radiological Protection

The low activity presented by the LERF contents precludes the need for shielding to protect personnel from direct radiation exposure. Environmental protection is assured through design features which meet the requirements of applicable federal and state regulations.

4.3.6 Toxicological Protection

The low concentrations of toxicological materials present in LERF contents precludes the need for special design features to address toxicological constituents as verified by Chapter 9.0, Accident Analysis.

4.3.7 Fire and Explosion Protection

Fire and explosion are not expected to be a hazard of LERF.

4.3.8 Fuel and Radioactive Waste Handling and Storage

There is no fuel at the LERF facility. There are no process wastes expected to be generated by the LERF. Miscellaneous radioactive wastes (i.e., SWP clothing, rags, disposable tools, and like materials) generated by operations or maintenance at LERF are addressed by normal site practices. Refer to Chapter 7.0, Waste Confinement and Management. Ultimate disposal of the contents of the interim retention basins will be addressed by future facility development (Project C-018, 242-A/PUREX Plant Condensate Treatment Facility).

4.3.9 Industrial and Chemical Safety

The LERF facility will not be handling special chemicals as a part of its operations. As discussed in detail in Chapter 9.0, Accident Analysis, ammonium has been identified as the limiting toxicological component in the LERF fluid inventory. No worker exposure to ammonium is expected during normal operation. Toxicological consequences of accidents and abnormal occurrences have been evaluated in Chapter 9.0, Accident Analysis, and found to be acceptable.

4.4 CLASSIFICATION OF STRUCTURES, COMPONENTS, AND SYSTEMS

The LERF was concluded to be a low hazard nuclear facility by the *242-A Evaporator Interim Retention Basin Hazard Classification Analysis*, WHC-SD-WM-PSE-004 (Ref. 24) and the *Preliminary Safety Evaluation, Project W-105, Evaporator and PUREX Interim Retention Basin*, WHC-SD-WM-PSE-006 (Rev. ?). In accordance with the classification of LERF as a low hazard nuclear facility, and the results of the analyses presented in Section 9.0, Accident Analysis, demonstrating that no mitigating features are required to maintain offsite or onsite radiological or toxicological consequences within guideline values, there are no Safety Class 1 or Safety Class 2 systems, structures, or components at LERF. Therefore, in accordance with the definitions contained in DOE Order 6430.1A (Ref. 4) there are no "Safety Class Items" associated with the LERF facility. However, LERF has been designed to meet all applicable environmental regulations and standards (Ref. 5).

4.5 DECOMMISSIONING

The LERF basins have the potential for clean closure and reuse to support other projects or facilities. Decontamination and preparation for reuse will be accomplished in accordance with applicable requirements in the *Environmental Compliance Manual*, WHC-CM-7-5 (Ref. 26). Once the facility has been declared surplus, it will enter a decommissioning program which conforms with WHC-CM-7-5, Part Z, Surplus Facility Decontamination and Decommissioning.

Westinghouse Hanford manual WHC-CM-7-5 endorses the requirements of the DOE document *Defense Decontamination and Decommissioning Program Management Plan* (Ref. 27). This manual identifies the activities required for the management, surveillance, maintenance, and decontamination and decommissioning of surplus facilities managed under the DOE Defense Program.

5.0 FACILITY DESIGN

5.1. SUMMARY DESCRIPTION

5.1.1 Location and Facility Layout

The facility occupies approximately 20 acres of land northeast of the old 200 East Area site boundary. The location of the project was determined by the Site Evaluation Report, WHC-SD-W049-SE-001 (Ref. 28). A Hanford Site location drawing has been included as Figure 3-1. A site plan of the 200 East Area, showing the LERF location, is provided as Figure 3-2. Facility diagrams are included in Appendix A.

The facility is located such that its capacity can be increased in size if required. During construction, the site was outside the 200 East Area protected fence; when the construction was completed, the fence was moved to enclose the facility.

The waste stream from the 242-A Evaporator is pumped through encased pipes to the LERF. This effluent transfer line from the 242-A Evaporator is a new pipeline, installed as part of the LERF project.

Access roads for this project consist of:

- A 20-ft wide perimeter road.
- A 20-ft wide graveled patrol road around the outside perimeter fence.
- A 20-ft wide graveled service road, running north-south through the project area, connecting with the service roads running around the surface retention basins.

A graveled parking area for 10 vehicles is located at the basin operations facility change trailer. An additional parking area for three vehicles is provided at the storage building.

An operational security fence totally encloses LERF. This controls personnel access and excludes deer and other large animals from entering the facility. Additionally, the facility is surrounded on three sides by a second fence, which is the 200 East perimeter fence.

5.1.2 Principal Features

The LERF consists of three retention basins, associated transfer piping, sampling ports, valves, instrumentation and controls, and a basin support facility which includes a change trailer, a step-off pad area, and a storage building. The retention basins have a capacity to hold 6.5 Mgal (25 ML) each. The basins receive and temporarily retain low level, low hazard liquid waste until permanent treatment and disposal facilities are complete (Ref. 29).

5.2 LIQUID EFFLUENT RETENTION BASINS

Each of the three surface retention basins is categorized as a surface impoundment per WAC regulations. The facility complies with applicable RCRA requirements per WAC for this category of facility.

The WAC 173-303-650, "Surface Impoundments" (Ref. 1) defines criteria to prevent migration of wastes out of an impoundment to the adjacent subsurface soil or groundwater or surface water anytime during the active life of the impoundment. These criteria are as follows:

1. Install a double-lined system,
2. Construct with appropriate materials compatible with the chemical and radiological environment,
3. Monitor for leakage, and
4. Place on foundation or base to support the liner and contents.

Compliance with these criteria is discussed in the following sections.

5.2.1 Interim Retention Basins

The three basins meet the requirements of the codes and standards listed in Section 4.0 of this document, and specifically EPA/530-SW-85-014, "Minimum Technology Guidance on Double Liner Systems for Landfills and Surface Impoundments - Design, Construction, and Operation" (Ref. 30). The key design criteria and requirements are imposed through WAC 173-303 (Ref. 1) which complies with 40 CFR 264, Subpart K (Ref. 31). Key design requirements imposed in 40 CFR 264, Subpart K, are related to the liner design and the monitoring capability. Additional regulatory requirements are imposed in 40 CFR 264.221 and 264.226, and WAC 173-303. The design life of the basin and associated piping systems is a minimum of 30 yr.

The basins have an active condensate retention volume of 19.5 Mgal (74 ML); 13 Mgal (49.2 ML) for 242-A Evaporator process condensate and 6.5 Mgal (24.6 ML) for contingency use. Finish dimensions at the top of the basin are 337 ft by 277 ft (102 m by 82 m). For overflow and spill prevention, a minimum of 4 ft (1.2 m) of freeboard is provided at the top of each basin. The basin depth ranges from 24 to 27 ft (7.3 to 8.2 m), resulting in a maximum fluid depth of 20 to 23 ft (6.1 to 7 m). Manual level indicators are provided in each basin.

Each retention basin consists of the following: (1) cover and sample ports, (2) top composite liner, (3) bottom composite liner, and (4) leachate collection system. The leachate collection system is discussed in Section 5.2.2. A catch basin is provided at the northwest corner of each retention basin for the unencased transfer piping, vent piping and filter, leachate collection pump piping, and the manifolds for the contingency transfer pumps.

5.2.1.1 Cover and Sample Ports. Each basin has a mechanically tensioned cover. Covers are of Very Low Density Polyethylene (VLDPE) construction and are anchored to the perimeter concrete ring wall of the basins with batten plates. The covers were manufactured to be ultraviolet resistant. Excess slack in the cover is controlled through the use of tensioning towers located around the perimeter of the basin. The devices keep tension across the cover. The excess cover is gathered at the perimeter of the retention basin. Trapped gas can be vented to the atmosphere from underneath the cover through a single vent outlet and activated charcoal filter located at each catch basin. If necessary, the cover is designed and constructed to allow manual removal of accumulated debris.

Eight sampling ports are located around the perimeter of each basin. The minimum size of each port is 6 in. The sample ports allow representative samples to be taken from any depth in the basin. Perforated pipe is used to allow free flow of the basin contents into and out of the sample port. The sample port risers are sealed to prevent air leakage through the penetration of the cover and through the sample port when not in use. Personnel access to the sample ports is from the perimeter area of the basins.

5.2.1.2 Top Composite Liner. The effluent rests on the top composite liner. The top composite liner consists of a high-density polyethylene (HDPE) liner 60-mil thick over a 1/4-in. layer of low permeability bentonite carpet liner. The edge of the composite liner is anchored around the entire perimeter of each basin. Slack in the HDPE liner is provided to prevent thermal contraction damage to the liner. The HDPE liners have sufficient slack to compensate for thermal expansion and contraction caused by ambient temperature variations of from -40 °F to +115 °F (-40 °C to +46 °C). The composite liner extends down the side, across the bottom, and up the opposite side to the perimeter anchors. Batten plates and bolts anchor the composite liner to a concrete ring wall that surrounds the entire perimeter of the basin.

The bentonite carpet liner is installed under the primary liner and over the geotextile. The secondary liner is installed under the leachate system. Refer to Section 5.2.2.2 for a description of the basin leachate collection system. The low permeability bentonite carpet liner has an in-place saturated hydraulic conductivity of 1×10^{-7} cm/s or less. The carpet liner is a high-swelling clay that expands to form a monolithic seal when hydrated with water. In the hydrated state, the clay will increase in size up to 15 times its dry volume providing excellent impermeability and great resistance to flow.

5.2.1.3 Bottom Composite Liner. The bottom composite (secondary) liner consists of an upper 60-mil HDPE liner (identical in construction and material to the top HDPE composite liner) overlying a 36-in. thick or greater layer of compacted, low-permeability bentonite/soil with a saturated hydraulic conductivity of 1×10^{-7} cm/s or less. The surface of the low-permeability soil is backfilled to a 2% minimum slope to allow drainage of leachate to the removal system. See Figure 5-1 for the liner system schematic.

The compacted low-permeability soil is free of large rocks, fractured stone, rubbish, and roots or foreign material which would increase hydraulic conductivity. Lifts did not exceed 6-in. (12-in. for the first lift) before compaction to optimize the effectiveness of compaction throughout the lift thickness. Each lift was scarified in preparation for the next. The necessary precautions were taken to assure that the desired moisture content was maintained in the compacted liner to avoid desiccation cracking.

The foundation subsoil that underlies the compacted low-permeability soil component was structurally immobile during construction and will remain so during operation of the basin, including the post-closure monitoring period.

A passive gas removal system in the drainage layer in the side slopes of each basin will remove gas which may accumulate between the composite liners. This gas will escape to the air space between the primary liner and the cover through vents in the primary liner located above the liquid level. Release of this gas will be via the activated charcoal filters in the cover system.

5.2.2 Basin Leakage Monitoring Systems

Monitoring for leakage is provided by three systems: (a) a level measuring system is provided to manually monitor the liquid level in the basin; (b) a leachate collection system is provided to extract leachate from between the composite liners; and (c) groundwater monitoring wells are provided in the vicinity of the basins (Ref. 2).

5.2.2.1 Basin Level Measuring System. The manual basin level measuring system provides direct indication of interim retention basin level, locally at the basin, for reading by LERF operations personnel.

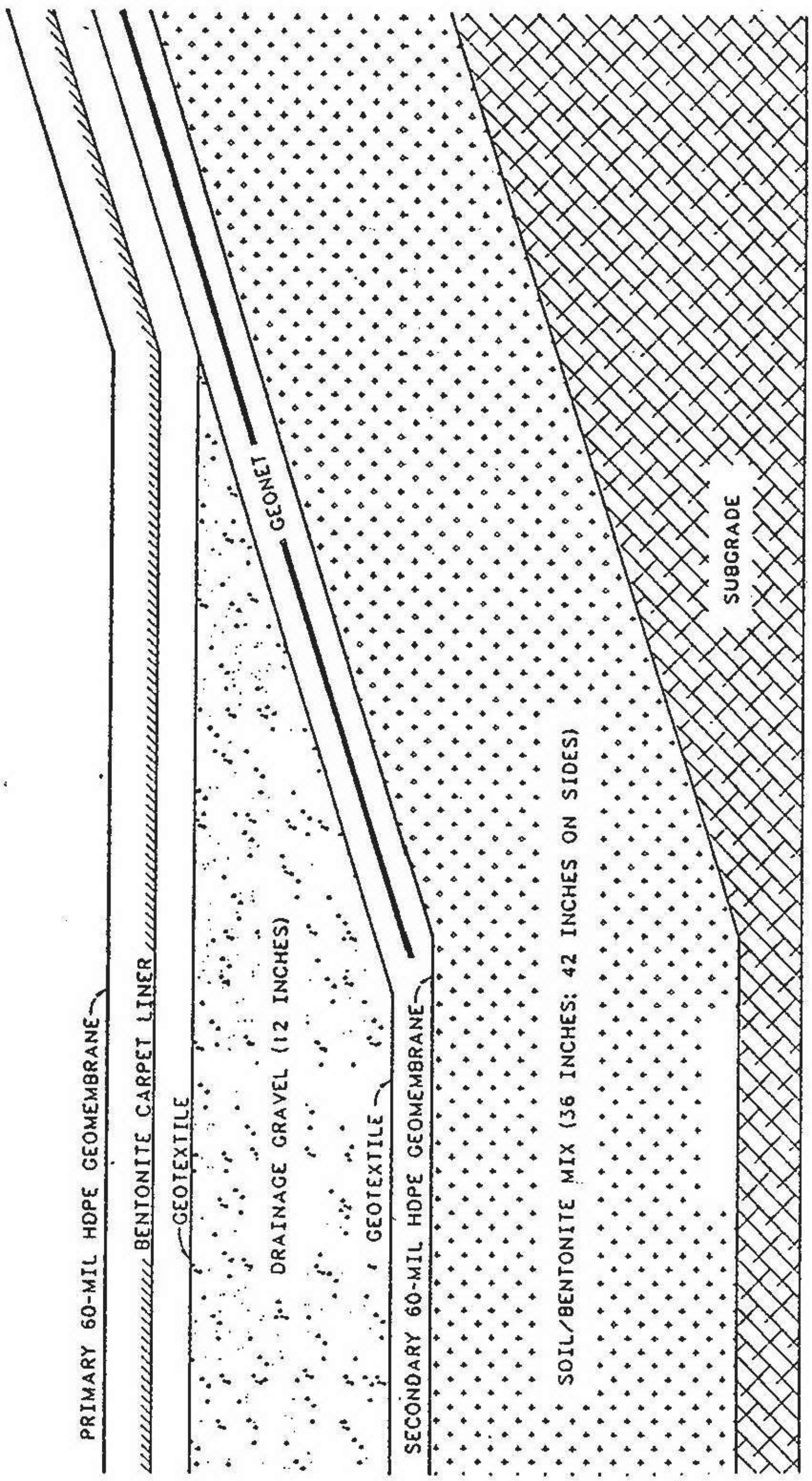
5.2.2.2 Leachate Collection and Removal System. The leachate collection system collects leachate from between the composite liners of each basin. The basin slopes to the leachate collection sump which collects any leakage through the top composite liner. A caisson extends down between the two liners and a submersible pump is installed into the caisson. Leachate is pumped through a piping system back to the basin. A level detector causes the pump to auto-start when needed, keeping the leachate liquid level below 1 ft. Leachate pump controls are located near the basins.

The leachate collection system measures fluid volumes pumped from the leachate collection sump of each basin. This provides indication of total leachate flow and potential leaks in the top liner. There is sampling capability in the leachate collection system to determine if liquid is leachate or moisture in the air within the liner system.

The leachate collection and removal system uses a synthetic geonet and gravel to provide space for leachate collection between the top and bottom composite liners. The geonet is placed along the sides of each basin beneath the geotextile extending to the intersection of the drainage gravel and the bottom. The purpose of the net is to provide a preferential flow path for any leachate or leak along the sides to the leachate pump.

5.2.2.3 Retention Basin Monitoring Wells. Groundwater monitoring is conducted by a program meeting the requirements of WAC 173-303, Sections 400 and 645 (Ref. 1), and 40 CFR Part 265 (Ref. 19) for number, location, and type of groundwater monitoring wells. The monitoring program is outlined in the

Figure 5-1. Liner System Schematic.



"Interim Status Groundwater Monitoring Plan for the 200 East Area Liquid Effluent Retention Facility" (Ref. 32). This provides for detection of significant breaches in the LERF interim retention basin liner systems. The locations of the monitoring wells are shown in Figure 3-2.

5.2.3 Material Compatibility

The LERF pump discharge piping material is constructed of fiberglass-reinforced epoxy thermoset resin. The liners and all wetted pump surfaces are constructed of materials which are compatible with basin contents. The concrete catch basins are coated with special protective coating (SPC).

5.3 LIQUID EFFLUENT TRANSFER PIPING

The LERF feed is pumped to the basins through double-encased, fiberglass-reinforced epoxy thermoset resin pipelines. The line from the 242-A Evaporator is a 3-in. process line encased in 6-in. containment pipe. The ASME/ANSI B31.3 piping code (Ref. 33) was used to design, fabricate and test the piping systems. Facility diagrams depicting these lines are provided in Appendix A.

The 242-A Evaporator transfer piping ties into the existing 2-in. PC-556-M42 line. The inner and outer pipes of the transfer line penetrate the wall of the 242-A Evaporator building. The piping runs below grade from the 242-A Evaporator Building to the 242AL-43 basin.

Portions of the permanently installed piping, augmented by pre-engineered temporary piping, can be used to transfer the entire volume of a retention basin from one basin to another. Portable pumps are provided, rated at a combined total flow of 700 gal/min. These portable pumps are submersible with wetted parts constructed of materials compatible with the basin contents. This pump flow rate provides capability of emptying a full basin within 7 d.

Existing lines for the 242-A Evaporator PC stream are capped and isolated in place. The LERF is designed to facilitate future decontamination and decommissioning with the intent of meeting the requirements for clean closure.

5.3.1 Leak Detection Along the Pipelines

The transfer piping is provided with a leak detection system. Single point leak detectors are placed every 1,000 ft along the line and monitor for leakage in the annulus between the process pipe and the encasement pipe. There are encasement test (swab) risers every 100 ft along the line for manual leak detection. The leak detection system in the line is interlocked with the P-C100 pump that feeds the effluent from the facility. If a leak is detected, the pump will shut down and annunciation will be made in the 242-A Evaporator control room. Motor-operated valves at the 242-A Evaporator (HV-RC3-3 valve) and the retention basin (MOV-43-1 valve) will close, stopping the flow of effluent to the retention basins and diverting to the TK-C-100 or 102-AW tank.

5.4 BASIN SUPPORT FACILITY

The basin support facility includes a change trailer, a step-off pad area, and a storage building.

The change trailer is a 28- by 70-ft portable facility which provides an area for workers to change from street clothes to blue coveralls and special work procedure (SWP) clothing. The facility is a dry trailer, in that it is not provided with sanitary water or sewer services.

The facility provides separate change-room areas for men and women. The men's area accommodates a minimum of ten persons, while the women's area accommodates a minimum of five persons. Change-rooms are separated into two areas: a clean area for changing into blue coveralls from street clothes, and an SWP change-room.

The trailer also has an operations office (for working on procedures and required records), a dirty blue coverall clothing bin storage area, a mechanical room, a separate clean SWP clothing storage room located near the SWP change-rooms, and a vestibule with portal monitors. The portal monitors are located between the clean change-room and the SWP change-room.

The trailer is insulated and provided with appropriate entry doors, windows, lighting, electrical power, heating, ventilation, and air-conditioning system.

Telephone communications is installed in the operations office of the support facility for both onsite and offsite communications.

The step-off pad is located at the exit from the basin area. It is an exterior concrete pad with bins for dirty SWP clothing. A fenced SWP control area is located between the step-off pad and the change trailer.

An 18- by 28-ft insulated, pre-engineered, metal building is provided to store clean and contaminated basin equipment and supplies. Any contaminated material stored in this facility will be bagged, or otherwise contained, in accordance with Hanford Site practices, and will not pose a releasable contamination problem for the facility. The building has an overall eave height of 12 ft, and is constructed on a 2-ft high concrete curb for building protection and to facilitate cleanup. Except for doors, the curb spans the entire base of the building.

The storage building has an 8- by 10-ft roll-up door and a 3- by 7-ft insulated personnel door. Interior metal wall-liner panels are provided, along with R-11 insulated walls and roof. The concrete curb and floor are painted with a special protective coating (SPC). The building is provided with two electric unit heaters for heating, and a roof-mounted exhaust fan with a damper-equipped wall intake louver for ventilation. It is also provided with interior lighting and an exterior exit light. Fire extinguishers are provided per standard site practices.

5.5 INSTRUMENTATION AND CONTROL SYSTEMS

Existing in-line monitoring, sampling, and shutdown of 242-A process equipment is monitored at the 242-A Evaporator. Leak detection alarms for the 242-A transfer line are located in the 242-A control room. Refer to Section 5.2.2, Basin Leakage Monitoring Systems.

5.6 ELECTRICAL POWER

Electrical power is supplied from the 13.8 kV 200 East Area distribution line (C8-L6). This overhead line extends from the existing 13.8 kV line to the basin retention facility. Pole-mounted, fused disconnect switches are installed at the line near the facility. At the disconnect switches, the overhead line transitions to conduit and is routed to a 150 kVA transformer. The transformer provides electrical power for the basin retention facility.

A 15 kVA mini power center is mounted near each catch basin. These provide 208 V power for heat tracing of aboveground piping; 120 V power for instrumentation; and 120 V power for catch basin lighting and convenience receptacles.

A 60 kVA transformer is mounted near the double-wide change trailer and storage building to provide 208/120 V electrical power for lights, heating, cooling, and interior and exterior lighting.

Lighting for the interim retention basin area is provided by 55 W low-pressure sodium, 480 V ballasts with photocells. Lighting for the 200 East Area Limited Access perimeter security fence is provided by 55 W, low-pressure sodium, 480 V ballasts with photocells.

5.7 CHANGES FROM THE PSAD

The preliminary design of the LERF included four basins to provide interim retention storage for effluent waste from both the 242-A Evaporator and the 202-A PUREX plant. The PUREX Plant effluent piping and basin design has been placed on hold and the basins, piping, and equipment associated with the PUREX facility and waste streams are no longer within the scope of this FSAR. The number of basins has been reduced to three. The basins will be operated such that RCRA required contingency space will be available within the three basins. The source term and the Operational Safety Requirements have been revised to reflect only the 242-A Evaporator process condensate waste stream. Refer to the *Preliminary Safety Assessment Document, Evaporator and PUREX Interim Retention Basins* (Ref. 6).

6.0 PROCESS SYSTEMS

Facility diagrams for the LERF facility are provided in Appendix A. All facility details for LERF are provided in Section 5.0, Facility Design.

LERF is a passive facility which receives effluent from the 242-A Evaporator. The effluent stream is the condensate resulting from the evaporation process in the 242-A Evaporator that reduces the volume of waste stored in double-shell tanks. The 242-A Evaporator effluent is pumped to the basins through double-encased, fiberglass-reinforced epoxy thermoset resin pipelines. The effluent is transferred through a 3-in. process line encased in 6-in. containment pipe at approximately 30 to 60 gal/min. The transfer line and the interim retention basins have leak detection systems (Ref. 2).

This page intentionally left blank.

7.0 WASTE CONFINEMENT AND MANAGEMENT

7.1 WASTE MANAGEMENT CRITERIA

Control and disposal of miscellaneous wastes resulting from normal expected maintenance and operational practices is controlled in accordance with standard site practices and applicable orders and regulations including WAC 173-303 (Ref. 1) and DOE Order 5820.2A (Ref. 34).

Chapter 4.0 discusses the facility design criteria.

Chapter 8.0 discusses the radiation protection considerations used to minimize the operational radiological doses.

Control and disposal of wastes generated during facility decontamination and decommissioning will be addressed in the decommissioning program once the facility has been declared surplus.

7.2 RADIOLOGICAL WASTES

The operation of the LERF will not create radiological wastes, except those generated as a result of normal expected maintenance and operational practices. These wastes may include contaminated equipment from the LERF process systems. Control and disposal of these miscellaneous wastes is controlled in accordance with standard site practices, including WHC-CM-7-5, *Environmental Compliance Manual* (Ref. 26), WAC 173-303, *Dangerous Waste Regulations* (Ref. 1), and DOE Order 5820.2A, *Radioactive Waste Management* (Ref. 34). Equipment will be decontaminated, or otherwise handled in accordance with standard site practices prior to repair/replacement or disposal, as necessary.

The mechanically tensioned floating covers, which are provided to suppress emissions, minimize evaporation and suppress algal growth, also serve to prevent such external items as dirt, plants, rubbish, etc., from entering the basins and thus developing contaminated sludge.

7.3 NON-RADIOLOGICAL WASTES

The operation of the LERF will not create non-radiological wastes, except those generated as a result of normal expected maintenance and operational practices. Control and disposal of these miscellaneous wastes is controlled in accordance with standard site practices, including WHC-CM-7-5, *Environmental Compliance Manual* (Ref. 26) and WAC 173-303, *Dangerous Waste Regulations* (Ref. 1).

7.4 VENTILATION

7.4.1 Operating Characteristics

Trapped gases or generated vapors can be vented from underneath the basin cover. A 3-in. ventilation pipe is provided from the retention basin to a flange in the catch basin. Flexible ducting connected to the flange routes any escaping gases to a passive, low pressure, activated carbon filter. The filters are modular, prefabricated canisters and are designed for ease of replacement. Each filter contains about 150 lb of activated carbon (charcoal) and has a flow capacity of approximately 100 ft^3/min. The filters provide adsorption of odors, toxic vapors, irritants, and corrosive gases.

The storage building, where contaminated equipment is stored, is provided with a roof-mounted exhaust fan with damper-equipped wall intake louvers for ventilation.

7.4.2 Safety Criteria and Assurance

Potential discharges of gaseous effluents via the filtered basin vents have been evaluated. The analysis in the *Hazards Classification*, WHC-SD-WM-PSE-004 (Ref. 24), the *Preliminary Safety Evaluation* (Ref. 25), and the accident analysis in Chapter 9.0 of this document envelope these potential discharges. The resulting consequences have not exceeded limits prescribed in DOE Order 5400.5 *Radiation Protection of the Public and the Environment* (Ref. 35).

7.5 LIQUID WASTE RETENTION

Operation of the LERF will not result in creation of liquid radioactive wastes except those generated from normal expected maintenance and operational practices. Control and disposal of these wastes is in accordance with standard site practices, including WHC-CM-7-5, *Environmental Compliance Manual* (Ref. 26) and WAC 173-303, *Dangerous Waste Regulations* (Ref. 1). The LERF does not contain any equipment for use in processing or retention of these normal liquid wastes.

7.6 LIQUID WASTE SOLIDIFICATION

The LERF does not contain any equipment for use in volume reduction and/or solidification of liquid wastes.

7.7 SOLID WASTES

The operation of the LERF will not create solid wastes, except those generated as a result of normal expected maintenance and operational practices which may include contaminated equipment from the LERF process systems. Control and disposal of these miscellaneous wastes is controlled in accordance with standard site practices, including WHC-CM-7-5, *Environmental Compliance Manual* (Ref. 26) and WAC 173-303, *Dangerous Waste Regulations* (Ref. 1). Equipment will be decontaminated, or otherwise handled in accordance with standard site practices prior to repair/replacement or disposal, as necessary.

7.7.1 Characteristics, Concentrations and Volumes of Solid Wastes

The solid wastes generated are a result of normal expected maintenance and operational practices. These wastes may include items such as contaminated SWP clothing, tape, rags, disposable tools, and like materials. These wastes may also include contaminated equipment from the LERF transfer systems.

7.7.2 Packaging

Packaging of solid wastes is performed in accordance with the following:

- WHC-CM-4-9, *Radiological Design Criteria Manual* (Ref. 36)
- WHC-CM-4-10, *Radiation Protection Manual* (Ref. 37)
- WHC-CM-4-11, *ALARA Program Manual* (Ref. 38)
- WHC-CM-7-5, *Environmental Compliance Manual* (Ref. 26)
- WHC-EP-0063-2, *Hanford Radioactive Solid Waste Packaging, Storage, and Disposal Requirements* (Ref. 39).

7.7.3 Storage Facilities

An 18- by 28-ft insulated, pre-engineered, metal building is provided to store clean and contaminated basin equipment and supplies. Any contaminated material stored in this facility will be bagged, or otherwise contained, in accordance with Hanford Site practices, and will not pose a releasable contamination problem for the facility. The building is constructed on a 2-ft high concrete curb for building protection and to facilitate cleanup. Except for doors, the curb spans the entire base of the building. The concrete curb and floor are painted with a special protective coating (SPC). The building is provided with a roof-mounted exhaust fan with a damper-equipped wall intake louver for ventilation.

The storage facilities are in accordance with the following:

- WHC-CM-4-9, *Radiological Design Criteria Manual* (Ref. 36)
- WHC-CM-4-10, *Radiation Protection Manual* (Ref. 37)
- WHC-CM-4-11, *ALARA Program Manual* (Ref. 38)

- WHC-CM-7-5, *Environmental Compliance Manual* (Ref. 26), and
- WHC-EP-0063-2, *Hanford Radioactive Solid Waste Packaging, Storage, and Disposal Requirements* (Ref. 39).

7.8 CHANGES FROM THE PSAD

The preliminary design of the LERF included four basins to provide interim retention storage for effluent waste from both the 242-A Evaporator and the 202-A PUREX Plant. The PUREX Plant effluent piping and basin design has been placed on hold and the basins, piping, and equipment associated with the PUREX facility and waste streams are no longer within the scope of this FSAR. The number of basins has been reduced to three. The basins will be operated such that RCRA required contingency space will be available within the three basins. The source term and the Operational Safety Requirements have been revised to reflect only the 242-A Evaporator process condensate waste stream. Refer to the *Preliminary Safety Assessment Document, Evaporator and PUREX Interim Retention Basins* (Ref. 6).

8.0 RADIATION PROTECTION

8.1 OCCUPATIONAL RADIATION PROTECTION

This chapter describes features of the Liquid Effluent Retention Facility (LERF) which ensure occupational radiation exposures are as low as reasonably achievable (ALARA). Pertinent features of the ALARA Program include policy, design, and operational considerations.

8.1.1 Policy Considerations

In compliance with the U.S. Department of Energy (DOE) orders and to support radiation protection, Westinghouse Hanford has established a company-wide ALARA Program applicable to the pre-operational, operational, and post-operational phases of all projects. The program goal is to minimize human exposures (occupational and public) to radiological and non-radiological hazards and conditions ALARA, commensurate with sound economics and operating practices. The program focuses on those activities with significant risk because of the presence of radiation, toxic substances, or hazardous conditions.

The Westinghouse Hanford ALARA Program is established by WHC-CM-1-3, *Management Requirements and Procedures* (Ref. 40), Section MRP 5.37, and is described in WHC-CM-4-11, *ALARA Program Manual* (Ref. 38). The Westinghouse Hanford policy on radiation protection is described in WHC-CM-1-3 (Ref. 40), Section MRP 5.38 and WHC-CM-4-10, *Radiation Protection Manual* (Ref. 37).

8.1.1.1 As Low As Reasonably Achievable Organizational Structure. Responsibility for ensuring implementation of ALARA practices and principles is assigned to the Westinghouse Hanford ALARA Program Office within the Safety Function. A Westinghouse Hanford ALARA Committee is responsible for coordinating administrative aspects of ALARA activities company-wide, and ALARA facility teams are established to implement ALARA practices and principles on an operational level. The ALARA surveillances are periodically conducted by the Radiological Engineering and ALARA Section of the Health Physics group to ensure that ALARA measures are implemented in day-to-day activities. The Westinghouse Hanford programs for safety audits and appraisals are described in WHC-CM-4-30, *Nuclear Safety Manual* (Ref. 41).

8.1.2 Design Considerations

Refer to Section 5.0, Facility Design for a description of the LERF facilities. The LERF facility was designed to applicable requirements. Given the low hazard nature of the contents and function of LERF, only minimal design guidance was necessary for implementation of acceptable ALARA principles. The LERF design complies with requirements and recommendations established in DOE Order 5480.11 (Ref. 42), DOE Order 6430.1A (Ref. 4), WHC-CM-7-5 (Ref. 26) and other applicable regulations.

8.1.2.1 Liquid Confinement. The LERF design uses a dual confinement barrier concept (i.e., dual basin liners and pipe-in-a-pipe transfer piping systems) to minimize the potential for accidental releases to the environment and to minimize human exposures. A leachate detection, collection and removal system and basin covers are also designed to reduce possible environmental or personnel exposures.

8.1.2.2 Shielding. Analyses of direct doses resulting from LERF contents have substantiated that the direct radiation exposure from LERF contents does not require special shielding for operator protection. Calculations have been performed to assess direct radiation doses from piping containing LERF fluids, using appropriately conservative source terms. Refer to Section 9.2.1 for a discussion of source terms and substantiation for the use of 5,000 DCG concentrations of ^{137}Cs for performance of design basis direct radiation exposure calculations.

Based on these dose assessments presented in Section 8.4, shielding is not required for LERF piping and other fluid-containing components. The radiological exposures to in-facility personnel will also meet the goals established in the *ALARA Program Manual*, WHC-CM-4-11 (Ref. 38) of reducing exposures to as low as reasonably achievable.

8.1.2.3 Reduce Radiation Levels and Time Spent Where Maintenance is Required. The design elements which may require maintenance (e.g., leachate level sensors, leachate sump pumps and associated components, controls, and instrumentation) are designed and located so they can be removed or maintained with ALARA exposure to workers and minimal disturbance to the site operation.

Other design elements (such as the HDPE liners and the leachate collection pipes) will be protected during installation and are designed to withstand weight pressures and other environmental stresses put upon them so that they will not require further maintenance.

8.1.2.4 Contamination Control. The radioactive material handling equipment (leachate system components and waste piping) designs conform to WHC-CM-4-9, *Radiological Design Criteria Manual* (Ref. 36). Special design features include the following:

- VLDPE floating cover to contain effluent and preclude introduction of foreign material.
- Radiation, ultra-violet, and ozone-resistant cover material.
- Double-wall effluent piping with leak detection.
- Stainless steel components to reduce corrosion and plate-out, and facilitate decontamination on all wetted surfaces of pumps.
- Easily decontaminated (SPC) paint on cement surfaces in the leachate equipment operating area.

8.1.3 Operational Considerations

A number of administrative controls are in place to assure safety during maintenance activities. In particular, WHC-CM-4-3, Standards A-3 and A-7 (Ref. 43), provide for pre-job planning, a job hazards analysis and the dual function of providing a responsible review of the work scope and zone as well as heightening operator awareness of personal safety.

Operations and maintenance activities within the LERF are governed by written procedures which incorporate ALARA and safety concerns. Westinghouse Hanford operating procedures are known as either standard operating procedures (SOP) or plant operating procedures (POP). The LERF process activities are governed by procedures based on Westinghouse Hanford experience. Maintenance activities are covered by preventive maintenance procedures (PMP).

In addition to safety guidance provided in operation and maintenance procedures, activities which involve radiological exposure must be performed in compliance with the protective measures identified in the WHC-CM-4-10, *Radiation Protection Manual* (Ref. 37) and WHC-CM-4-15, *Radiation Work Requirements and Permits Manual* (Ref. 44). Entry into and the work performed in any radiologically controlled area is governed by the provisions of the Radiation Work Procedure (RWP) that is issued for that specific job or area. Health Physics issues RWPs with the review and concurrence signature of Tank Farm Project, Facility Operations management. The RWP must be strictly followed by any person involved in the scope of operations described in the permit and only work specified in the RWP may be performed.

8.2 RADIATION SOURCES

The sources of radiation used as the basis for radiation protection are described in this section.

8.2.1 Contained Sources

Only sealed radioactive materials (for calibration purposes) will be allowed in this facility. Sealed sources for the purpose of response checking of portable field survey instruments are allowed, and controlled in health physics procedures. Contained sources in the LERF are the stored liquid waste within the basins, piping, and leachate collection system components and piping.

8.2.2 Airborne Radioactive Material Sources

The LERF design and maintenance is focused on preventing airborne radioactive sources. Normal LERF operations will not require Operations personnel to be present. Radiological concentrations in maintenance accessible only areas are expected to remain very low. Respiratory protection may not be required for normal conditions; however, the air will be monitored prior to entry, and respiratory protection will be available for maintenance and other operations if required by Health Physics.

The normal release path for the LERF is from vaporization of LERF contents under the LERF basin cover, with a consequent release path through the basin ventilation filters, diffusion through the basin cover, and through the sample ports when opened.

The maximum expected flow rate through the basin ventilation filter is expected to be less than 1 ft^3/min. The peak flow rate through the filter was based on the weight of the cover which acts upon the free volume of vapor around the perimeter of the storage basin. The flow resistance of the vent system was based on the vendor-supplied data of the charcoal filter. Due to the intrinsic partition coefficient for particulate emission via an evaporation pathway (at least 1.0 E-07, refer to Chapter 9.0), and the presence of an activated charcoal filter in the ventilation pathway, the only normally emitted radionuclide will be tritium. For purposes of conservatism, the 90 percentile confidence interval value from the FDC (Ref. 2) and shown below have been used for analytical purposes.

Radionuclide	Inventory 90% confidence interval (μCi/mL)	Adjusted inventory*
^{3}H	6.3 E-03	6.3 E-03
^{90}Sr	7.6 E-07	7.6 E-14
^{106}Ru	1.1 E-05	1.1 E-12
^{113}Sn	7.7 E-07	7.7 E-14
^{137}Cs	5.4 E-07	5.4 E-14
^{147}Pm	1.6 E-06	1.6 E-13
^{155}Eu	1.4 E-06	1.4 E-13
U (Gross)	3.3 E-08	3.3 E-15
^{239}Pu	6.8 E-13	6.8 E-20

*Partition coefficients are reflected.

Calculated consequences of airborne radioactivity for accident scenarios are included in Chapter 9.0, Accident Analysis.

8.3 RADIATION PROTECTION DESIGN FEATURES

This section details radiation protection design features applicable to the LERF Facility including facility design and shielding.

8.3.1 Facility Design Features

The facility is designed to provide unattended operation and provide work areas appropriate for operational activities, satisfying the requirements of WHC-CM-4-9, *Radiological Design Criteria Manual* (Ref. 36), Section 2.0, "Facility Layout."

Leachate collection systems are installed with pump status indication and local totalizing flowmeters. Additionally, a local sampling port is provided. The design of the multi-layer liner system, leachate drainage, detection, and collection systems are described in detail in Chapter 5.0, Facility Design.

Features have been incorporated into the LERF design to facilitate decontamination and decommissioning. The contamination control criteria in WHC-CM-4-9, *Radiological Design Criteria Manual* (Ref. 36), have been incorporated into the design to enhance decontamination efforts. Design features which simplify decontamination include the use of stainless steel components for the leachate system and painted concrete surfaces.

8.3.2 Shielding

An evaluation of the expected radiation sources from the LERF indicates that no shielding will be required at this facility. Refer to Section 8.4 for a discussion of analyses of direct radiation doses from LERF contents and piping.

8.3.3 Ventilation

Provision has been made for a charcoal filtration system to be included at the basin cover vents which exhaust non-condensable gases from under the LERF basin floating covers. This ventilation path will preclude the accumulation of non-condensable gases under the cover. The only anticipated emissions through this ventilation path are expected to be volatile gases and water vapor containing only tritium as a radionuclide of interest.

8.3.4 Area Radiation and Airborne Radioactivity Monitoring Instrumentation

Portable monitoring equipment may be utilized in support of the Radiation Protection Program developed for the LERF operational phase to detect, record and disseminate results of radiation/contamination surveys conducted within and around the facility. Monitoring may be performed prior to operations or maintenance activities involving surface contaminated areas and if appropriate, respiratory protection must be used.

Air sampling will be performed as required by the particular operations being conducted under the criteria put forth in WHC-CM-4-10, *Radiation Protection Manual* (Ref. 37).

8.4 ESTIMATED MAN-REM ONSITE DOSE ASSESSMENT

During normal operation of the facility, airborne releases will occur at the filtered vents, migration through the liner and through the sample ports when opened. Airborne releases are expected to be very low as only liquid radioactive materials are contained in this facility.

The maximum expected flow rate through the basin ventilation filter is expected to be less than 1 ft^3/min. The peak flow rate through the filter was based on the weight of the cover which acts upon the free volume of vapor around the perimeter of the storage basin. The flow resistance of the vent system was based on the vendor-supplied data of the charcoal filter. Due to the intrinsic partition coefficient for particulate emission via an evaporation pathway (at least 1.0 E-07, refer to Chapter 9.0), and the presence of an activated charcoal filter in the ventilation pathway, the only normally emitted radionuclide will be tritium. The source terms used to calculate the estimated onsite and facility worker doses are provided in Section 8.2.2.

Using the 90 percentile confidence value for tritium, an emission rate of 7.54 E-02 Ci/year has been calculated. Based on this annual emission rate, the calculated inhalation dose to the maximally exposed onsite individual, at 100 m in the direction with the maximum X/Q, is <<0.1 mrem EDE.

Three dose assessments were performed for facility workers. The first analyzed the dose to workers in the vicinity of the LERF transfer pipe. The second analyzed the dose to workers in the middle of the basin and the third analyzed the dose to workers during sampling activities.

Calculations have been performed to assess direct radiation doses from piping containing LERF fluids, using appropriately conservative source terms. Refer to Section 9.2.1 for a discussion of source terms and substantiation for the use of 5,000 DCG concentrations of ^{137}Cs for performance of design basis direct radiation exposure calculations.

The direct radiation dose from LERF piping has been calculated to be 2.71 mrem/h at 1 cm from piping containing the limiting values of ^{137}Cs, and 8.25 E-02 mrem/h at 1 m (see Appendix C). Comparison of the design basis values for ^{137}Cs with the 90 percentile confidence interval values for ^{137}Cs indicates that, for normal LERF operations, the expected doses from piping would be a factor of approximately 30 lower than the calculations performed using design basis ^{137}Cs values. This would put direct radiation doses from piping, at 1 cm, in the range of 0.1 mrem/h, with corresponding decreases in other radionuclides.

The direct radiation dose from a LERF basin has also been calculated for a location 1 m directly above the center of the basin using 5,000 DCG concentration of ^{137}Cs. The calculated dose for the basin, using a slab model, was 16.1 mrem/hr (see Appendix C). Using the 90 percentile confidence interval source term value for ^{137}Cs and the conversion factor developed in the preceding paragraph, a maximum dose of 0.54 mrem/h has been calculated.

Calculations have been performed to determine the dose to workers due to airborne releases during routine sampling operations. It was estimated that the sample ports would be open to the environment for 48 h/yr. This estimate is based on one hour per sample, three basins, eight sample ports per basin, and two samples per year. The doses calculated are based on the 90 percentile confidence interval values shown in Section 8.2.2. It can be seen from the results shown below that sampling activities will not contribute significantly to a facility worker's total annual dose.

Radionuclide	Inventory 90% confidence interval (μCi/mL)	Adjusted inventory[a]	Calculated dose (Rem)[b]
^{3}H	6.3 E-03	6.3 E-03	2.5 E-03
^{90}Sr	7.6 E-07	7.6 E-14	3.1 E-10
^{106}Ru	1.1 E-05	1.1 E-12	1.8 E-09
^{113}Sn	7.7 E-07	7.7 E-14	3.1 E-12
^{137}Cs	5.4 E-07	5.4 E-14	6.2 E-12
^{147}Pm	1.6 E-06	1.6 E-13	2.2 E-11
^{155}Eu	1.4 E-06	1.4 E-13	2.8 E-11
U (Gross)	3.3 E-08	3.3 E-15	1.3 E-09
^{239}Pu	6.8 E-13	6.8 E-20	2.8 E-13
Total Dose (Rem)			2.5 E-03

[a]Partition coefficients are reflected.
[b]Based on DAC values provided in WHC-CM-4-10 (Ref. 37).

Based on these calculated doses, the annual occupational whole body dose for personnel involved directly with LERF operations is expected to be well below the design goals contained in WHC-CM-4-9 of 1 rem/yr effective dose equivalent (see Section 8.2.2) (Ref. 36). As all normal emissions are bounded by basin evaporation accident scenarios which resulted in negligible dose consequences for onsite personnel (refer to Chapter 9.0, Accident Analysis), it is concluded that normal LERF operation poses no adverse consequences for onsite personnel.

The LERF is routinely unstaffed and is designed for unattended operation for extended time periods (several hours). This operating methodology will help to ensure low personnel doses. Chapter 10.0 describes administrative requirements for off-normal events and Chapter 5.0 describes the systems required to be operable during normal operations of the facility.

8.5 HEALTH PHYSICS PROGRAM

This section provides information on the Westinghouse Hanford Health Physics Program organization, procedures, equipment, instrumentation, and facilities.

8.5.1 Organization

This section describes the Health Physics group at Westinghouse Hanford. A descriptive summary of the group's responsibilities, as well as the authority, responsibility, qualifications, and required experience for specific positions, is included.

8.5.1.1 Health Physics Organizations. Safety functions are part of the Environment, Safety, Health and Quality Assurance organization which has the overall responsibility for the Radiation Protection Program. The manual, WHC-CM-1-2 (Ref. 45), establishes the charter and describes responsibilities and authorities for the Safety Function. Two groups have been delegated principal responsibility for support and overview of the Radiation Protection and ALARA Programs; the Health Physics group and the Nuclear Safety group.

Health Physics has responsibility for:

- Day-to-day operational support
- Conducting audits and monitoring of compliance with DOE Orders, Washington Administrative Codes, standards, and other pertinent requirements
- Maintaining a trained staff and equipment capable of response to incidents involving control and containment of radioactive materials
- Maintaining a health physics support service which provides the radiological measurements, surveys, and dosimetry program necessary to ensure radiological safety
- Administering a comprehensive program which ensures that ALARA practices and principles are applied to the control of radiological hazards
- Providing expert advice to assist all Westinghouse Hanford organizations in effectively meeting their radiation protection program responsibilities.

Within this organization, Waste Management Area Health Physics has responsibility for providing operational support to the LERF.

Nuclear Safety performs an independent oversight role. This organization has responsibility for conducting annual safety appraisals of each Westinghouse Hanford nuclear facility to ensure compliance with DOE Order 5480.5 (Ref. 46) and DOE-RL Order 5480.5 (Ref. 47). Examples of activities covered by this organization include readiness reviews, design reviews, audits and appraisals, facility inspections, and operational surveillance assessments.

8.5.1.2 Safety Positions. The following are positions within Safety. Qualifications and responsibilities of each position are included.

Manager, Environment, Safety, Health and Quality Assurance. The Manager, Environment, Safety, Health and Quality Assurance, directs all safety programs at Westinghouse Hanford and reports to the President, Westinghouse Hanford. Qualifications include safety management and nuclear engineering experience.

Manager, Safety. The Manager, Safety, is responsible for administering all Westinghouse Hanford operational safety programs. Organizations within Safety which administer programs at the LERF include Health Physics and Industrial Safety and Fire Protection. The manager of Safety reports to the manager of Safety, Quality Assurance, and Security. Qualifications include experience in nuclear engineering, nuclear safety, and/or industrial safety.

Manager, Waste Management Health Physics. The Manager, Health Physics, directs and administers the Operational Radiation Protection Program for Westinghouse Hanford. This manager reports to the Manager, Safety. Qualifications include experience in administration, safety, and/or radiation protection.

Manager, Area Health Physics. The Manager, Area Health Physics, is responsible for applied health physics program support for Westinghouse Hanford facilities in the 300 and 400 Areas, as well as all other Westinghouse Hanford facilities south of the Wye Barricade. This manager reports to the Manager, Health Physics. Qualifications include a degree in engineering or science or equivalent, experience related to radiation protection, and demonstration of management and administrative skills.

Supervisor, Area Health Physics. The supervisor is responsible for field implementation of the Radiation Protection Program. Other responsibilities include administration of technical and personnel matters. The supervisor(s) reports to the Manager, Area Health Physics. Qualifications include a degree in engineering or science or equivalent and experience related to radiation protection.

Analyst, Health Physics. The analyst is responsible for technical and procedural review of the Radiation Protection Program and providing specifications for procurement of health physics instrumentation. The analyst reports to the Manager, Health Physics. Qualifications include a degree in engineering or science or equivalent and experience related to radiation protection.

Health Physics Technician. The HPTs are trained and certified in accordance with DOE Order 5480.11 (Ref. 42) and are responsible for the day-to-day field implementation of the Radiation Protection Program. The Area HPTs report to the Supervisor, Area Health Physics. Qualifications include an associate degree in engineering or science or equivalent, completion of certification requirements, and a specific certification for radiation protection at the LERF.

8.5.2 Equipment, Instrumentation, and Facilities

The following sections provide information on the various health physics-related equipment, instrumentation, and facilities available to support the Radiation Protection Program for the LERF. The design, installation, operation, and calibration of health physics instrumentation will be in accordance with WHC-CM-4-9, *Radiological Design Criteria Manual* (Ref. 36); WHC-CM-4-10, *Radiation Protection Manual* (Ref. 37); and WHC-IP-0692, *Health Physics Procedures Manual* (Ref. 48).

8.5.2.1 Portable Surveillance Instruments. Portable radiation monitoring and surveillance instruments are provided to all Hanford Site contractors from a central Hanford Site instrument pool operated for DOE by PNL. All instruments are readily available to the HPTs and other personnel in Health Physics. The frequency and method of calibrations of portable surveillance instruments are defined in WHC-CM-4-10, *Radiation Protection Manual* (Ref. 37), and PNL-MA-562, *Radiation Protection Instrument Manual* (Ref. 49).

8.5.2.2 Air Sampling Instruments. No stationary air-sampling instrumentation is required for the LERF. Refer to Appendix B. Health Physics may use portable air samplers. These devices usually operate on alternating current line voltage, but a few are battery powered. All have flowmeters and accept standard nominal 2-in. fiberglass filters. Gooseneck and high-volume grab samplers are used to provide long- and short-term sampling, respectively, of areas which do not qualify for live-time monitoring or are not readily accessible by the live-time units.

8.5.2.3 Area Radiation Monitors. Area radiation monitors are not required at the LERF. Refer to Appendix B.

8.5.2.4 Personnel Survey Instruments. Semi-portable rate meters for monitoring shoes and clothing are available at the LERF. As needed, both scintillation and\or Geiger-Mueller detectors are available for use at the LERF. Personnel contamination monitors (PCM) which detect alpha and beta radiation will be located near the access control stations.

8.5.2.5 Laboratory Counting Equipment. The 222-S Health Physics counting laboratory has an automated, twin silicon diode (alpha-beta) spectrometer for air sample counting, an alpha mini scaler, and a beta-gamma mini scaler.

8.5.2.6 Personnel Dosimeters. Two dosimetry programs are used at Westinghouse Hanford to monitor personnel dose. The major program uses a thermoluminescent dosimeter (TLD) badge device that provides the legal record of an individual's radiation dose history. A supplementary dosimetry program uses self-reading gamma pencil dosimeters to provide a real-time tracking system for an individual to note and control his/her exposure totals on a short-term basis. The use of dosimeters is described in WHC-CM-4-10 (Ref. 37).

Five types of dosimeters are used by Westinghouse Hanford personnel: (1) Hanford Site basic dosimeters, (2) Hanford Site multipurpose dosimeters, (3) extremity dosimeters, (4) supplemental dosimeters, and (5) personal nuclear accident dosimeters. As applicable, the design, calibration, and use of these dosimeters complies with ANSI N13.5-1972, *Performance Specifications for Direct Reading and Indirect Reading Pocket Dosimeters for X and Gamma Radiation* (Ref. 50); ANSI N319-1976, *Personnel Neutron Dosimeters (Neutron Energies Less Than 20 MeV)* (Ref. 51); and ANSI N322-1977, *Inspection and Test Specifications for Direct and Indirect Reading Quartz Fiber Pocket Dosimeters* (Ref. 52).

8.5.2.7 Instrument Storage, Calibration, and Maintenance. All portable surveillance instruments are maintained, repaired, and calibrated at the central Hanford Site instrument pool operated by PNL. Standard calibration procedures are used by PNL. Portable Continuous Air Monitors (CAM) are serviced by the PNL Calibrations Laboratory. All tests and calibrations are performed in accordance with ANSI N323-1978, *Radiation Protection Instrumentation Test and Calibration* (Ref. 53).

8.5.2.8 Health Physics Facilities. There is a portable facility support trailer provided for Operations, Maintenance, and Health Physics personnel at the LERF.

8.5.2.9 Protective Clothing. Protective clothing available for routine use at the LERF includes cloth coveralls, laboratory coats, caps, shoe covers, boots, and gloves. In addition, plastic-coated and rubber gloves, rubbers, british leggings, rubber boots, and plastic-coated cloth suits are available. Clothing will be available in the trailer change room at LERF. Clothing is decontaminated, cleaned, and sanitized in the central Protective Equipment Decontamination Facility located in the 200 West Area. Used clothing is collected at contamination control area exit points and transferred to the Hanford Site Contaminated Laundry Facility.

8.5.2.10 Respiratory Protective Equipment. Supplies of appropriate types of respiratory protective equipment are tested, maintained, and controlled by the Personnel Protective Equipment Administrator. These include Full Face Mask Mechanical Filter Respirators to be used in routine maintenance and operation tasks. Requirements for use of these devices are determined by the Operations and Health Physics organizations and usage is implemented by RWPs. Powered Air-Purifying Respirators (PAPR) are also supplied. The PAPRs can be half- or full-face respirators or hoods, providing a positive pressure through an air-purifying cartridge and a battery-powered blower. Self-Contained Breathing Apparatus (SCBA) units consist of a full facepiece equipped with a pressure-reducing valve connected to a cylinder of compressed air.

All respiratory protective equipment is decontaminated, cleaned, sanitized, and repaired in the central Protective Equipment Decontamination Facility in the 200 West Area. A central mask fitting and testing facility is operated by HEHF to perform mask fits.

8.5.2.11 Personnel and Equipment Decontamination. As the LERF has no water supply, provisions for decontamination will be provided by the Tank Farms. Persons needing decontamination will be transported to the Tank Farms. In vivo whole body radiation surveys for internal depositions are also done in Richland at the PNL lung and whole body counters.

A special equipment decontamination facility is not provided at LERF, however, equipment can be packaged for contamination control and removed to nearby decontamination facilities.

8.5.3 Procedures

Westinghouse Hanford has developed a number of documents which describe requirements and procedures relative to radiological and environmental protection. A brief overview of relevant documents and summaries of various radiological protection procedures applicable to LERF activities are provided below.

- WHC-CM-7-5, *Environmental Compliance Manual* (Ref. 26). This manual provides detailed standards for controlling the release of radioactive and nonradioactive materials to air, water, and land; environmental surveillance criteria; and effluent sampling and monitoring program requirements.

- WHC-CM-4-10, *Radiation Protection Manual* (Ref. 37). Radiation protection policies, standards, requirements, and guidelines in effect at Westinghouse Hanford facilities are detailed in this manual.

- WHC-CM-4-12, *Operational Health Physics Practices Manual* (Ref. 54). This manual provides methods, routine practices, controls, exposure guides, supporting data, and other information developed to assist radiation monitoring personnel in establishing and maintaining a uniform and sound radiation control program.

- WHC-CM-4-15, *Radiation Work Requirements and Permits Manual* (Ref. 44). This manual details the regulations and practices for radiological protection with respect to specific types of work in radiation areas.

- WHC-CM-4-16, *Dosimetry Manual* (Ref. 55). This manual describes policy and specific procedures followed by Health Physics and other personnel involved in implementing the Westinghouse Hanford Dosimetry Program.

- WHC-IP-0692, *Health Physics Procedure Manual* (Ref. 48). Specific procedures followed by Operational Health Physics personnel, including those for instrument calibration and supplemental dosimetry, are provided in this manual.

8.5.3.1 Health Physics Surveys. The methods, frequencies, and procedures for conducting radiation surveys are determined based on the characteristics of materials handled (i.e., form, element, isotope) and the radiological condition and type of operations conducted (i.e., dose rate, contamination level, or airborne potential). The *Health Physics Procedures Manual*, WHC-IP-0692 (Ref. 48), contains specific procedures followed by Operational Health Physics personnel.

8.5.3.2 Contamination Control. Bases and methods to control contamination are discussed in WHC-CM-4-10 (Ref. 37). Actions to be taken if defined limits of contamination control are exceeded address personnel contamination and subsequent decontamination and documentation, along with control of equipment and surfaces which exhibit contamination. The basic policy is to preclude contamination by facility design including mechanical constraints such as the VLDPE cover, air filtration, and temporary maintenance enclosures.

8.5.3.3 Safety Training. Safety training is provided to all employees who work at the LERF. The site-wide Westinghouse Hanford Safety Training Program consists of courses in general safety awareness, nuclear safety, hazardous materials and waste, in addition to radiation protection training. Responsibility for providing this training is assigned to the Safety Training Section of the Technical Training Organization. Section 200 of the *Site Support Manual*, WHC-CM-8-6 (Ref. 56) describes procedures for course development and maintenance, scheduling, instructor certification, training delivery, student evaluation, and maintenance of training records.

The Safety Training Program includes a multi-tiered radiation protection training program which provides a level of training commensurate with an individual's classification as a radiation worker/non-radiation worker, as well as the individual's specific work assignment. Requirements for radiation protection training are stated in WHC-CM-4-10 (Ref. 37) and are consistent with the requirements stated in DOE Order 5480.11 (Ref. 42).

8.5.3.4 Personnel Exposure Monitoring. The Westinghouse Hanford Dosimetry Program establishes site-wide requirements for measuring and recording personnel exposure. This program is described in WHC-CM-4-15, Section 4 (Ref. 44), and in WHC-CM-4-16, *Dosimetry Manual* (Ref. 55). A summary of these requirements is provided below.

External Exposure Monitoring. Westinghouse Hanford procedures require that all employees, visitors, and vendors be issued and use an assigned record dosimeter at all times when in a Westinghouse Hanford radiologically controlled facility. These dosimeters provide an official measurement of an individual's radiation exposure. All record dosimeters used at Westinghouse Hanford are accredited by the DOE Laboratory Accreditation Program. In addition to the Hanford Site multipurpose dosimeters, radiation workers may be required to wear supplemental devices to monitor highly localized doses. These devices may include finger rings, two-chip dosimeters, wrist dosimeters, or special beta-photon dosimeters.

Internal Exposure Monitoring. Exposure to internally deposited radionuclides is assessed by in vitro (excreta analysis) or in vivo (whole body or chest count) bioassay measurements. A baseline bioassay determination of internal radionuclides is performed for employees, visitors, and vendors as a prerequisite to any work assignment that involves the potential for internal deposition of radioactive material. Based on a review of the radionuclides and activity levels involved, Health Physics Dosimetry determines the appropriate type of surveillance and establishes a routine internal exposure surveillance schedule. Guidelines for indication of internal contamination and emergency response procedures are described in WHC-CM-4-16, Section 5.1 (Ref. 55). Sampling programs for all workers will be performed in accordance with WHC-CM-4-16.

Nuclear Accident Monitoring. There is no need for criticality detection in the LERF areas as determined by Nuclear Safety based on WHC-CM-4-29 (Ref. 23) criteria. However, Nuclear Accident Dosimeters (NAD) will be required to be posted at the LERF regardless of criticality detection requirements for the LERF as other operations in the 200 East area will have sufficient fissile and fissionable material to require criticality detection systems, and a criticality in those areas could affect personnel at the LERF.

8.5.3.5 Occupational Radiation Exposure Records System. The *Occupational Radiation Exposure Records System*, WHC-CM-4-10 (Ref. 37), was developed to maintain complete, accurate, and private personnel exposure data. The data include whole body dose (neutron, beta, and gamma), extremity dose (beta and gamma to fingers), and internal depositions. All Hanford Site employees have annual whole body doses measured and radiation workers have quarterly whole body doses measured, at a minimum.

8.5.3.6 Airborne Radioactivity Controls. Detailed methods and procedures for evaluating and controlling airborne radioactivity are discussed in WHC-CM-4-10 (Ref. 37). Health Physics will employ portable instrumentation to evaluate airborne radioactivity concentrations. Alpha-, beta-, and gamma-emitters in air samples, as well as plutonium, noble gases and iodine will be measured. Samples will be analyzed routinely, and results will be reported to the Health Physics, Facility Operations, Radiological Engineering, and ALARA organizations.

Control of airborne radioactivity concentrations will be accomplished by employing the design requirements of WHC-CM-4-9 (Ref. 36) and implementing the control criteria of WHC-CM-4-10 (Ref. 37).

Respiratory protection equipment may be required under special circumstances. Refer to WHC-CM-4-10 (Ref. 37).

8.6 ESTIMATED MAN-REM OFFSITE DOSE ASSESSMENT

During normal operation of the facility, airborne releases will occur at the filtered vents, migration through the liner and through the sample ports when opened. Airborne releases are expected to be very low as only liquid radioactive materials are contained in this facility. Furthermore, the consequence analysis performed in Section 8.4 has determined that the onsite dose consequences are negligible, i.e., <<0.1 mrem EDE. Therefore, based on the location of the maximum offsite individual, offsite consequences will be insignificant. Additionally, accident analyses performed in Chapter 9.0 indicate no adverse offsite impacts from operation of the LERF.

As all normal emissions are bounded by basin evaporation accident scenarios which resulted in negligible dose consequences for offsite personnel (refer to Chapter 9.0, Accident Analysis), it is concluded that normal LERF operation poses no adverse consequences for offsite personnel.

8.6.1 Effluent and Environmental Monitoring Program

Numerous special and routine studies of radioactivity in the Hanford Site environs have been conducted since the beginning of Hanford Site operations. The results of these studies constitute unusually large amounts of data which are available for review. These surveys will continue to be made in compliance with DOE Order 5484.1, Chapter III, Effluent and Environmental Monitoring and Reporting, and Chapter IV, Occupational Radiation Exposure Information (Ref. 57).

8.6.1.1 Gas Effluent Monitoring. Unfiltered gaseous effluent releases from LERF can occur from the sample ports during routine sampling; however, based on the analysis performed in Section 8.4 these releases are insignificant. Therefore, no stationary monitoring is required.

8.6.1.2 Liquid Effluent Monitoring. Detection of the loss of integrity of the liner will be accomplished by a leachate detection and collection system. All liquids will be collected in the leachate collection system and will be returned to the LERF basins.

8.6.1.3 Solid Waste Monitoring. The operation of the LERF will not create solid wastes, except those generated as a result of normal expected maintenance and operational practices. Monitoring of these wastes is in accordance with standard site practices including WHC-CM-7-5, *Environmental Compliance Manual* (Ref. 26) and WAC 173-303, *Dangerous Waste Regulations* (Ref. 1).

8.6.1.4 Environmental Monitoring. The LERF is a low hazard facility that contains liquid radioactive effluents; therefore, airborne releases will be insignificant. The LERF will not release to the environment more than 10% of the total Hanford Site limit. Additionally, an ongoing Environmental Surveillance Program evaluates all significant potential pathways to the environment, ensuring that LERF does not exceed this limit. Summaries of the data are published in a series of annual reports by PNL (e.g., Jaquish 1988, Ref. 58).

8.6.2 Analysis of Multiple Contributions

Hanford Site environmental monitoring reports will address dose contributions from all sources on the Hanford Site. These are issued annually and provide the mechanism to ensure that all contributions from all site facilities are evaluated. The contributions presented by LERF operations to the overall emissions from the Hanford Site are deminimus.

8.6.3 Estimated Exposures

Maximum expected exposures due to normal operations and postulated accidents have been analyzed. Exposures to offsite maximum individuals were considered to be negligible, i.e., <<0.1 mrem EDE (see Section 8.2.2). Refer to Chapter 9.0, Accident Analysis, for a discussion of accident scenarios and bounding terms.

8.6.4 Liquid Release

There are no planned releases of radioactive liquid effluents from the LERF.

8.6.4.1 Rain Runoff. The arid climate of the Hanford area encourages rapid evaporation of any accumulated precipitation. While short term water collection may exist on the cover, the net evaporation rate at the Hanford Site will minimize the time water is present.

8.6.4.2 Laundry Waste. All laundry from LERF is shipped to the Protective Equipment Decontamination Facility in the 200 West Area. No liquid laundry waste will be generated at the LERF.

9.0 ACCIDENT SAFETY ANALYSIS

9.1 ACCIDENT SCENARIOS

Design of the LERF provides multiple barriers between LERF fluids and potential airborne or waterborne release pathways. Mechanisms for breach of the redundant barriers and ultimate dissipation of LERF fluids have been evaluated.

Based upon LERF design, postulated breach of barriers were considered in determining credible accidents which may occur during facility life. In performing this evaluation, single barrier failures were assigned an annual probability of failure of 10^{-3} per year, which is representative of the failure rate for components (generally refer to IEEE-500, "IEEE Guide to the Presentation of Electrical, Electronic, Sensing Component and Mechanical Equipment Reliability Data for Nuclear Power Generating Stations"). Based on criteria which assign all events with annual failure probabilities of 10^{-6} or less to being incredible (Ref. 59), this effectively assigns only potential accidents involving a single barrier failure to credible status. Additionally, external events were considered which could result in barrier breach, including events which could result in the breach of multiple barriers.

The LERF consists of encased (i.e., pipe-in-a-pipe) transfer piping from the 242-A Evaporator to the LERF basins; and the three interim retention basins themselves. All piping which is not encased is located within structures providing secondary confinement, or is routed in catch basins which will retain any spilled fluid. The LERF basins are provided with double confinement to prevent release of LERF fluids to the soil column. The LERF basins have a single layer cover. Accordingly, based on the LERF design, the following single barrier breaches have been deemed to be credible:

- Release via evaporation of a portion of the contents of a LERF basin following loss of the single layer cover.
- Release from LERF transfer piping, through minor leaks from valve packings, flanges, etc., utilizing the potential energy available from the transfer pumping source.
- Breach of a single basin liner, resulting in release of LERF fluids to the leachate collection system.
- Spills of LERF fluids, through inadvertent breaches in un-encased piping, and potential maintenance activities, to confinement structures and/or catch basins.

Random double failures, which were considered to not be credible, include:

- Double breach of encased piping (i.e., pipe-in-a-pipe) resulting in direct release of LERF fluid to the soil column/environment.
- Double breach of the basin liners resulting in direct release of LERF fluid to the soil column.

However, single external events which lead to double breaches were evaluated.

The most probable single external event resulting in breach of the primary and secondary pipe encasements from the 242-A Evaporator to the LERF would be an inadvertent digging event. This event was considered highly unlikely based on the combination of: (a) administrative controls exercised over all digging on the Hanford Reservation; (b) the presence of swab risers every 100 ft along the transfer line, which will be visible from any potential location along the line; and, (c) the required human error to pierce the transfer line and secondary confinement piping. Additionally, in the highly unlikely probability this event should occur, it is expected that any piping breach would be immediately noticed by the digging team, leading to a rapid manual termination of flow through the line. The resulting spill was not specifically evaluated for airborne releases, but consequences would be bounded by the basin evaporation accident based on the volume of liquids spilled, and the contamination caused by the fluid release is expected to be remediable.

Similarly, the most probable mechanism for piercing both LERF basin liners would be a transportation accident resulting in introduction of a vehicle into the basin. The combination of: (a) LERF basin access control and fencing; (b) above ground berms surrounding the basins; and (c) the required human errors necessary to support this event are likewise, extremely unlikely.

Potential impacts of Design Basis Earthquakes (DBEs) have been considered as possible accident initiators for LERF basin failure. Breach of the basin berms has been evaluated as being extremely unlikely due to the following: (a) the basin berm is constructed of soil compacted to applicable State of Washington Department of Transportation criteria, precluding loose soil type failures; (b) the width of the berm is 38 ft, at the top, providing ample area to support LERF basin fluid loads; and, (c) the lack of evidence of surface faulting at the LERF location. The most probable DBE induced mechanism for release of LERF contents is sloshing and consequent basin cover failure, which is bounded by the loss of basin cover accident. However, consequences to onsite and public personnel as a result of berm, liner and cover failures from a DBE are insignificant.

The specific accident scenarios selected for evaluation for LERF accidents are described in the following section.

9.1.1 Postulated Confinement Breaches

The confinement barriers present at LERF have been evaluated for credible mechanisms which could result in release of LERF contents. The barriers, and the potential mechanisms for barrier breach, are as follows:

- Basin Liner--Breach of the basin liner would result in release of LERF fluid to the leachate collection system, which directly pumps the fluid back to the basin. While this leak path is not desirable, this pathway does not result in the release of LERF fluids to either airborne or waterborne pathways. In the event of a breach, the contents will be transferred to the contingency space.

  As discussed above, simultaneous breach of both basin liners is not considered credible.

- Basin Cover--Loss of LERF contents through tears in the basin cover is bounded by the postulated case where the basin cover is lost. The most credible scenario for basin cover loss would be due to high wind. Loss of the basin cover would result in the evaporation of LERF fluids and transport via an airborne pathway to postulated occupational, onsite and offsite receptors.

- LERF Piping (Leakage)--Leakage of LERF fluids from the piping systems during transfer may occur. All transfer piping at LERF, except that which is within confinement structures/catch basins or over the LERF basins, is pipe-in-a-pipe. This assures that pipe leakage is collected, and directed to appropriate collection points for return to the LERF basins.

  As discussed above, simultaneous breach of both the process pipe and the secondary confinement pipe is not considered credible.

  Potential airborne releases may occur from the evaporation of LERF fluid which has leaked from the transfer piping to confinement structures/catch basins; however this is bounded by the consequences of the abnormal occurrences/accidents for basin evaporation and/or spills.

- LERF Piping (Spray)--Potential release paths from the piping systems were evaluated using energy/barrier analysis (Ref. 6). The largest energy source within the LERF during normal operation is the pumping energy used to transfer fluids from the 242-A Evaporator to the LERF basins. A leak in the piping during such pressurized transfer could result in an aerosolized release of LERF fluid.

- Miscellaneous System Breaches (Spills)--In addition to the failures noted above resulting in release of LERF fluids, there are events which may be expected to result in the release of LERF fluids due to expected activities during facility operation. This type of release includes expected leakage from operation (for example, valve packing leakage) and intentional breaches of the LERF confinement barriers for maintenance or expected operations.

Accordingly, there are three credible confinement breaches for the LERF facility which are analyzed for potential radiological or toxicological consequences to onsite or offsite personnel. These events are: (a) a spill; (b) a spray leak from the LERF piping; and (c) a loss of the LERF basin cover resulting in evaporation of basin contents. The specific scenarios selected for modeling these confinement breaches are considered in following sections.

9.1.2 Risk Acceptance Guidelines

In evaluating the risk of facility operations, and developing the acceptance guidelines for assessing the consequences of potential radiological and toxicological releases, it is necessary to evaluate the occurrence probability of the three confinement breach events identified above.

For simplicity, these will be subdivided into two categories. The first is occurrences which are not part of normal operations, but which are expected to occur during facility operation. These **abnormal operations** are generally considered to have annual occurrence probabilities in the range of 1.0 E+00 to 1.0 E-02, which is reasonable for occurrences which may occur over the 30 yr design life of the LERF basins. For purposes of comparison with risk acceptance guidelines, a conservative annual occurrence probability of 1.0 E+00 will be used as the limiting consequence guideline for abnormal operations.

Accidents are considered those occurrences which the facility can accommodate, but which are not expected to occur as a part of normal operation or expected deviations from normal operation. In accordance with the definition provided above for **abnormal occurrences, accidents** include all credible occurrences which have annual occurrence probabilities less than 1.0 E-02. For purposes of comparison with risk acceptance guidelines, a conservative annual occurrence probability of 1.0 E-02 will be used as the limiting consequence guideline for accidents.

The applicable risk acceptance guidelines for radiological and toxicological consequences from abnormal operations and accidents associated with onsite and offsite exposures were developed in accordance with the *Nonreactor Facility Safety Analysis Manual* (Ref. 59), and are tabulated in Table 9-1. No specific criteria exist for providing guideline values for in-facility personnel radiation exposure following postulated accidents. For purposes of this evaluation, it has been assumed that "low" exposure values, relative to permissible occupational radiation exposure limits, provides a valid bounding value for in-facility worker doses. In the radiological consequence tables, this criteria has been summarized as "ALARA," indicating "as-low-as-reasonably-achievable. Additionally, Immediately Dangerous to Life or Health (IDLH) values are used as a bounding value for in-facility worker toxicological exposure from postulated abnormal occurrences and accidents. These values are also tabulated in Table 9-1.

Table 9-1. Liquid Effluent Retention Facility Risk/Acceptance Guidelines.

Receptor Location	Abnormal Occurrence	Accident
Offsite Individual - assumed located at Hanford Site Boundary with maximum X/Q	Radiological Guideline[1]: 0.1 Rem EDE[5] Toxicological Guideline[3]: 17 mg/m^3 Ammonia	Radiological Guideline[2]: 0.5 Rem EDE Toxicological Guideline[4]: 36 mg/m^3 Ammonia
Onsite Individual - assumed located 100 m from release point with maximum X/Q	Radiological Guideline[1]: 0.5 Rem EDE Toxicological Guideline[3]: 24 mg/m^3 Ammonia	Radiological Guideline[2]: 5 Rem EDE Toxicological Guideline[4]: 60 mg/m^3 Ammonia
Occupational Exposure - assumed located within facility	Radiological Guideline: Assumed bounded by ALARA principles Toxicological Guideline: Assumed bounded by IDLH Value of 355 mg/m^3 Ammonia	Radiological Guideline: Assumed bounded by ALARA principles Toxicological Guideline: Assumed bounded by IDLH Value of 355 mg/m^3 Ammonia

[1]Abnormal Occurrence Radiological Risk Acceptance Guideline values based on WHC-CM-4-46, *Nonreactor Facility Safety Analysis Manual* (Ref. 59), Figure 4-1, for an annual occurrence probability of 1.0 E+00.

[2]Accident Radiological Risk Acceptance Guideline values based on WHC-CM-4-46, *Nonreactor Facility Safety Analysis Manual* (Ref. 59), Figure 4-1, for an annual occurrence probability of 1.0 E-02

[3]Abnormal Occurrence Toxicological Risk Acceptance Values based on WHC-CM-4-46, *Nonreactor Facility Safety Analysis Manual* (Ref. 59), Figure 4-2 and Table 4-2, for an annual occurrence probability of 1.0 E+00.

[4]Accident Toxicological Risk Acceptance Values based on WHC-CM-4-46, *Nonreactor Facility Safety Analysis Manual* (Ref. 59), Figure 4-2 and Table 4-2, for an annual occurrence probability of 1.0 E-02.

[5]Effective Dose Equivalent

9.2 SOURCE TERMS

Source terms for the LERF project have been developed by Westinghouse Hanford Effluent Technology and included as a revision to the FDC (Ref. 2). These source terms are tabulated in Tables 9-2 and 9-3.

9.2.1 Radiological Source Terms

Limiting source terms for the LERF project abnormal occurrence and accident analyses have been developed based on the *Environmental Compliance Manual* (Ref. 26), which requires that "liquid effluent streams... be shut down if the instantaneous radionuclide concentration exceeds 5,000 times DCG-public." The maximum LERF influent source strength will be such that the sum of the DCG quantities for each radionuclide will not exceed a total of 5,000. This value is consistent with 242-A Evaporator operation and associated Operational Safety Requirements (OSRs), and with the existence of and the setpoint for diversion capability at the Evaporator. Five thousand DCG concentrations of the predominant radionuclides expected to be present in LERF are provided in Table 9-3. This is consistent with the LERF Safety Limit (SL), provided in Chapter 11.0, using the "unity" rule as defined in the SL.

Appropriate source terms were determined as follows:

- Direct Fluid Emission Inhalation/Deposition GENII Runs--The sum of each radionuclide divided by its DCG (water) value shall not exceed 5,000 for all radionuclides present at LERF. For the purpose of analysis, it is necessary to determine which of the probable radionuclides will present the "worst-case" consequences if it, alone, was present in a concentration equal to 5,000 DCGs (water).

  Table 9-4 presents the inhalation radiological consequences of an assumed offsite release of 5,000 DCG concentrations for each radionuclide present in the LERF inventory as analyzed by the GENII code. For abnormal occurrences/accidents analyzed using the GENII code, biological consequences of releases from LERF are maximized utilizing U (Gross) as the isotope for analytical purposes. Gross Uranium is evaluated as though it were all ^{234}U for conservatism. Note that use of gross Uranium is for analytical purposes only, effectively setting the analytical envelope in the most conservative fashion, and does not imply that 5,000 DCGs of gross Uranium will ever be present in the LERF or transfer lines to LERF.

  A source strength of 5,000 DCGs (liquid) of gross Uranium equates to a value of 2.5 E-03 μCi/ml.

- Direct Radionuclide Emission--Comparison with DAC Calculations - For abnormal occurrences/accidents analyzed using comparison to airborne concentration values, it is necessary to compare the DCG values for liquids (i.e., the basis for the 5,000 DCG maximum LERF fluid radionuclide concentration) with the DCG values for inhalation.

Table 9-2. Liquid Effluent Retention Facility Design Basis Source Strength.

Constituent	Average value (μCi/ml)	90 Percentile confidence interval values (μCi/ml)
^{3}H	5.6 E-03	6.3 E-03
^{90}Sr	5.2 E-07	7.6 E-07
^{106}Ru	1.1 E-05	1.1 E-05
^{113}Sn	5.4 E-07	7.7 E-07
^{137}Cs	4.4 E-07	5.4 E-07
^{147}Pm	1.3 E-06	1.6 E-06
^{155}Eu	1.4 E-06	1.4 E-06
U (Gross)*	2.0 E-08	3.3 E-08
^{239}Pu	3.7 E-13	6.8 E-13
Ammonia	Maximum value is 3.0 E+04 ppm	

*Gross Uranium was taken to be ^{234}U for conservatism.

Table 9-3. Liquid Effluent Retention Facility Radionuclide 5,000 DCG Values.

Constituent	DCG Value[1] (μCi/ml)	5,000 DCG Value[2] (μCi/ml)
^{3}H	2.0 E-03	1.0 E+01
^{90}Sr	1.0 E-06	5.0 E-03
^{106}Ru	6.0 E-06	3.0 E-02
^{113}Sn	5.0 E-05	2.5 E-01
^{137}Cs	3.0 E-06	1.5 E-02
^{147}Pm	1.0 E-04	5.0 E-01
^{155}Eu	1.0 E-04	5.0 E-01
U (Gross)[3]	5.0 E-07	2.5 E-03
^{239}Pu	3.0 E-08	1.5 E-04

[1]The DCG values from the *Environmental Compliance Manual* (Ref. 26).

[2]The 5,000 DCG concentrations represent the maximum possible concentration on an isotope specific basis. Based on the Unity Rule, the maximum concentration of LERF fluid will contain a total of 5,000 DCGs of radionuclides.

[3]Gross Uranium was assumed to be ^{234}U for conservatism.

Table 9-4. Comparison of Consequences from Normalized 5,000 DCG Releases of Each Radionuclide Present in LERF.

Radionuclide	Total for accident (μCi/yr)[1]	Dose consequences (EDE-REM)
^{3}H	4.3 E+01	4.2 E-08
^{90}Sr[2]	2.2 E-02	5.1 E-08
^{106}Ru	1.3 E-01	6.5 E-07
^{113}Sn	1.1 E+00	1.3 E-07
^{137}Cs	6.5 E-02	2.1 E-08
^{147}Pm	2.2 E+00	9.4 E-07
^{155}Eu	2.2 E+00	9.7 E-07
U (Gross)[3]	1.1 E-02	1.6 E-05
^{239}Pu	6.5 E-04	2.2 E-06

[1]Representative release is based on an assumed release of 4.3 mL of LERF fluid, which contains 5,000 DCGs of the specific nuclide as a source term. The X/Qs for each GENII analysis were identical. [Note: the analytical assumptions used are identical to those for the 100 gal "splash" abnormal occurrence.] The EDE includes ingestion.

[2] ^{90}Sr source term includes ^{90}Y daughter product with a 1:1 branching ratio.

[3]Uranium is assumed to be ^{234}U for conservatism.

[4]Shaded box represents limiting value.

[5]The insoluble form of the Pu isotope was used.

Table 9-5 provides the results of such a comparison, which indicates that release of LERF fluid containing 5,000 DCG (liquid) for ^{234}U will result in the highest dose consequences evaluated. This conclusion is based on inhalation of airborne concentrations of radionuclides. Note that, for purposes of analysis of occupational workers (i.e., in-facility worker) the actual comparison is made based on Derived Air Concentration (DAC) values. This analytical methodology does not invalidate the comparison performed, and for inhalation purposes, gross Uranium assumed to be ^{234}U is still the limiting inhalation radionuclide.

A source strength of 5,000 DCGs (liquid) of gross Uranium equates to a value of 2.5 E-03 μCi/ml.

- Radionuclide Emission via Evaporation--For scenarios which utilize evaporation as the release path for LERF basin contents, as discussed further in Section 9.4.2, tritium has a partition factor of 1, while all other radionuclides have a partition factor of 10^{-7}. GENII calculations have been run which demonstrate that, taking into account the partition factor, for basin evaporation abnormal occurrences and accidents, tritium becomes the predominate radionuclide of concern.

  A source strength of 5,000 DCGs (liquid) of tritium equates to a value of 1.0 E+01 μCi/ml.

- Direct Exposure to LERF Fluids--Direct exposure consequences of exposure to LERF fluids is maximized utilizing ^{137}Cs (with its daughter product Ba-137M) as the isotope for analytical purposes. Analysis of representative LERF nuclides indicated that approximately 98% of direct exposure from LERF fluids arises from ^{137}Cs. Again, the use of ^{137}Cs is for analytical purposes only, again setting the analytical envelope in the most conservative fashion.

  A source strength of 5,000 DCGs of ^{137}Cs equates to a value of 1.5 E-02 μCi/ml.

Consideration was given to evaluation of dose consequences using the evaporator surge source term defined in the 242-A Evaporator SAR (Ref. 65). Analysis, using the GENII code, for a representative inhalation scenario (specifically the spill accident scenario) using identical parametric data, indicates that the dose consequences from using such an evaporator surge source term is bounded by the analyses performed later in this Section using the radiological source terms defined above (i.e., 5,000 DCG values of gross Uranium as ^{234}U). Accordingly, the analyses presented in this document fully bound the consequences of equivalent accidents using evaporator surge source terms.

Table 9-5. Comparison of Airborne to Liquid DCG Values.

Radionuclide	DCG (water) (μCi/ml)	DCG (air) (μCi/ml)	DCG(w)/DCG(a)
^{3}H	2.00 E-03	1.00 E-07	2.00 E+04
^{90}Sr[1]	1.00 E-06	9.00 E-12	1.11 E+05
^{106}Ru	6.00 E-05	3.00 E-11	2.00 E+06
^{113}Sn	5.00 E-05	1.00 E-09	5.00 E+04
^{137}Cs	3.00 E-06	4.00 E-10	7.50 E+03
^{147}Pm	1.00 E-04	3.00 E-10	3.33 E+05
^{155}Eu	1.00 E-04	3.00 E-10	3.33 E+05
^{239}Pu	3.00 E-08	2.00 E-14	1.50 E+06
U (Gross)[2]	5.00 E-07	9.00 E-14	5.56 E+06

[1] ^{90}Sr source term includes ^{90}Y daughter product with a 1:1 branching ratio

[2] Gross Uranium is taken to be ^{234}U for conservatism.

[3] Shaded box represents limiting value.

9.2.2 Toxicological Source Terms

As all releases from LERF are direct fluid releases to an airborne pathway, comparison of LERF toxicological material concentrations to applicable Threshold Limit Values (TLVs) provides a direct indication of the toxicological constituents of the LERF fluid of interest for accident and abnormal occurrence investigation. The results of this comparison are provided in Table 9-6. This table uses the 242-A Evaporator source terms provided for LERF from the LERF Functional Design Criteria (FDC) (Ref. 2). Where tabulated in the FDC, maximum values were used. Where only average values were tabulated, the average value was used. Threshold Limit Values were obtained from *Threshold Limit Values and Biological Exposure Indices for 1989-1990* (Ref. 59).

As can be seen from the tabulation in Table 9-6, the highest toxicological constituent, relative to TLV values, for LERF fluid is ammonia. Ammonia will be used as the toxicological constituent for evaluation of abnormal occurrence/accident consequences for this FSAR. Based on the maximum concentration of ammonia relative to its TLV value, if the ammonia concentrations are acceptable all other toxicological constituent concentrations will also be acceptable.

The maximum ammonia concentration present in LERF contents is that associated with an evaporator surge. This value is 3.0 E+04 ppm (Ref. 65), which is approximately a factor of three above the maximum values expected from normal 242-A Evaporator effluent per the FDC (Ref. 2). This source term represents the maximum expected concentration of ammonia present in any discharge from the 242-A Evaporator to the LERF, and in addition is used for evaluation of releases from the LERF basins.

9.3 NORMAL OPERATIONS

9.3.1 Spill/Splash Occurrences

9.3.1.1 Event Description. Potential spills of LERF fluid have been evaluated, including those resulting either from leaks in the process confinement boundary or through maintenance activities which, while performed in accordance with appropriate procedures and practices, result in the release of small amounts of LERF fluid from the confinement boundary. The source term giving rise to personnel exposure from this type of accident is the aerosolized amount given off when the falling liquid contacts a surface. A representative upper bound value for the amount of liquid discharged during this type of event, estimated based on engineering judgement, is 100 gal. Larger "spills" may be credible, however those typically are not "splash" type accidents (e.g., sump overflow, non-energetic release of liquids to catch basins/floors, etc.) and are bounded by the evaluation of basin evaporation discussed in Section 9.4.2.

Table 9-6. Comparison of Maximum Toxicological Concentrations Present in LERF with Threshold Limit Values. (3 sheets)

Component	Max. conc. (ppb)	Max. conc. (mg/ml)	TLV (mg/m^3)	Ratio max. conc./TLV
Aluminum	4.99 E+03	4.99 E-03	2.00 E+00	2.50 E-03
Ammonium	9.35 E+06	9.35 E+00	1.70 E+01	5.50 E-01
Barium	8.00 E+00	8.00 E-06	5.00 E-01	1.60 E-05
Boron	1.51 E+02	1.51 E-04	1.00 E+01	1.51 E-05
Cadmium	0.00	0.00	5.00 E-02	0.00
Calcium	7.90 E+03	7.90 E-03	5.00 E-02	1.58 E-01
Carbonate	7.50 E+05	7.50 E-01	N/A	-----
Chloride	2.30 E+03	2.30 E-03	N/A	-----
Chromium	1.56 E+02	1.56 E-04	5.00 E-02	3.12 E-03
Copper	1.27 E+02	1.27 E-04	1.00 E+00	1.27 E-04
Cyanide	0.00	0.00	5.00 E+00	0.00
Fluoride	1.20 E+03	1.20 E-03	2.50 E+00	4.80 E-04
Iron	5.03 E+02	5.03 E-04	1.00 E+00	5.03 E-04
Magnesium	3.67 E+03	3.67 E-03	1.00 E+01	3.67 E-04
Manganese	0.00	0.00	1.00 E+00	0.00
Mercury	7.00 E-01	7.00 E-07	5.00 E-02	1.40 E-05
Phosphorus	6.20 E+03	6.20 E-03	1.00 E-01	6.20 E-02
Nickel	1.70 E+01	1.70 E-05	1.00 E-01	1.70 E-04
Nitrate	4.20 E+03	4.20 E-03	N/A	-----
Potassium	1.92 E+04	1.92 E-02	2.00 E+00	9.62 E-03
Silicon	9.86 E+05	9.86 E-01	1.00 E+01	9.86 E-02
Sodium	5.15 E+04	5.15 E-02	2.00 E+00	2.57 E-02
Sulfate	0.00	0.00	N/A	-----
Sulfide	6.56 E+04	6.56 E-02	N/A	-----
Uranium	0.00	0.00	2.00 E-01	0.00
Vanadium	7.00 E+00	7.00 E-06	5.00 E-02	1.40 E-04
Zinc	0.00	0.00	5.00 E+00	0.00

Table 9-6. Comparison of Maximum Toxicological Concentrations Present in LERF with Threshold Limit Values. (3 sheets)

Component	Max. conc. (ppb)	Max. conc. (mg/ml)	TLV (mg/m^3)	Ratio max. conc./TLV
Acetone	5.10 E+03	5.10 E-03	1.78 E+03	2.87 E-06
Benzyl alcohol	1.80 E+01	1.80 E-05	N/A	-----
Benzaldehyde	2.30 E+01	2.30 E-06	N/A	-----
2-Butoxyethanol	9.20 E+02	9.20 E-04	1.20 E+02	7.67 E-06
Butoxyglycol	8.10 E+02	8.10 E-04	N/A	-----
Butoxydiglycol	2.70 E+01	2.70 E-05	N/A	-----
Butoxytriethylene glycol	3.50 E+01	3.50 E-05	N/A	-----
Butraldehyde	2.30 E+02	2.30 E-04	N/A	-----
Butyl alcohol	8.80 E+04	8.80 E-02	1.52 E+02	5.79 E-04
Butyl Nitrate	0.00	0.00	N/A	-----
Chloroform	2.70 E+01	2.70 E-05	4.90 E+01	5.51 E-07
Caproic acid	7.00 E+01	7.00 E-05	N/A	-----
Decane	0.00	0.00	N/A	-----
3,5-Dimethylpyridine	2.40 E+01	2.40 E-05	N/A	-----
Dimethylnitrosamine	5.70 E+01	5.70 E-05	N/A	-----
Dodecane	4.60 E+01	4.60 E-05	N/A	-----
Ethoxytriethylene glycol	1.50 E+02	1.50 E-04	N/A	-----
Ethyl alcohol	0.00	0.00	1.89 E+04	0.00
Hexadecane	2.00 E+00	2.00 E-06	N/A	-----
Heptadecane	1.70 E+01	1.70 E-05	N/A	-----
Isophorone	1.80 E+01	1.80 E-05	2.80 E+01	6.43 E-07
Methoxydiglycol	5.20 E+01	5.20 E-05	N/A	-----
Methoxytriglycol	3.70 E+02	3.70 E-04	N/A	-----
Methylene chloride	1.80 E+02	1.80 E-04	1.74 E+02	1.03 E-06
Methylethyl ketone	1.20 E+02	1.20 E-04	5.90 E+02	2.03 E-07
Methyl nitrate	0.00	0.00	N/A	-----
Methyl n-propyl ketone	1.20 E+01	1.20 E-05	7.05 E+02	1.70 E-08

Table 9-6. Comparison of Maximum Toxicological Concentrations Present in LERF with Threshold Limit Values. (3 sheets)

Component	Max. conc. (ppb)	Max. conc. (mg/ml)	TLV (mg/m^3)	Ratio max. conc./TLV
Methyl n-butyl ketone	7.90 E+01	7.90 E-05	2.00 E+01	3.95 E-06
Methyl vinyl ketone	0.00	0.00	N/A	-----
MIBK (Hexone)	6.80 E+01	6.80 E-05	2.05 E+02	3.32 E-07
2-Methylnonane	1.70 E+01	1.70 E-05	N/A	-----
Pentadecane	2.00 E+01	2.00 E-05	N/A	-----
Phenol	3.30 E+01	3.30 E-05	1.90 E+01	1.74 E-06
2-Propanol	3.90 E+01	3.90 E-05	2.50 E+02	1.56 E-07
Pyridine	5.50 E+02	5.50 E-04	1.60 E+01	3.44 E-05
Tetradecane	4.40 E+02	4.40 E-04	N/A	-----
Tetrahydrofuran	1.70 E+02	1.70 E-04	5.90 E+02	2.88 E-07
Tributyl Phosphate	2.10 E+04	2.10 E-02	2.20 E+00	9.55 E-03
1,1,1-Trichlorethane	5.00 E+00	5.00 E-06	2.69 E+02	1.86 E-08
Tridecane	3.50 E+02	3.50 E-04	N/A	-----
Triglyme	9.00 E+01	9.00 E-05	N/A	-----

[1]Shaded box represents limiting value.

Using the methodology of NUREG-1320 (Ref. 61), assuming a model which has the 100 gal of fluid drop as a single mass from a height of 3 m (i.e., approximately 10 ft which is representative of the maximum expected potential all height for LERF fluids) onto the floor, the amount of the spill volume aerosolized has been calculated in accordance with the formula:

$$F=2.3E\text{-}05\,[Arch^{0.44}]\left[\frac{\rho_{air}}{\rho_{liq}}\right]^{2.37}[Fr^{0.38}]$$

Where:

F	= Fraction Airborne (dimensionless)
ρ_{air}	= air density, (g/cm^3) = 0.00118
ρ_{liq}	= solution density (g/cm^3) = 1.0
Arch	= Archimedes Number = $\rho_{liq}{}^2 h^3 \frac{g}{u^2}$
h	= drop height (cm) = 300
g	= gravity constant (cm/s^2) = 981
u	= solution viscosity, poise = 0.01 g/cm-s
Fr	= Froude Number = $\frac{V^2}{gR}$
V	= impact velocity = $\sqrt{2gh}$, cm/s
R	= radius of liquid drop = $(\frac{3}{4}\pi\ Vol)^{\frac{1}{3}}$
Vol	= volume of solution (cm^3) = 100 gal = 3.79 E+05 cm^3.

This results in a fraction aerosolized of 1.14 E-05, which is equivalent to the aerosolization of 4.31 cm^3 of LERF fluid. This release is assumed to occur over a time period of one (1) second in accordance with the assumptions in NUREG-1320 (Ref. 61).

Note that the fraction of the spill aerosolized increases when the spill volume and spill height increase. As realistic spill scenarios would have a smaller quantity and lesser spill height, this fraction is considered to be a conservative bounding value for evaluation of this abnormal occurrence. Note that this conclusion holds true also for the case where the total volume remains fixed, but the spill is composed of many smaller droplets.

9.3.1.2 Analysis. Analysis of spill type accidents is provided to envelope all potential liquid releases from the LERF facility. This includes small "drip type" leaks from fluid confinement boundaries such as valve packing leaks, expected maintenance activities in which small amounts of LERF fluid may be released, and basin activities such as insertion or removal of temporary transfer pumps from the basin. Based on engineering judgement, the 100 gal volume analyzed envelopes the expected volume of released LERF fluid which will "splash" for any of these postulated scenarios, and the calculational methodology using a 100 gal single mass and a 3 m drop height provides calculational conservatism for the fraction of the mass aerosolized.

Maximum individual onsite (calculated at 100 m) and offsite (site boundary) radiological dose consequences were calculated using the GENII computer program (Ref. 13). To ensure conservatism, maximum X/Qs were determined for the onsite and offsite receptor locations. The X/Q represents the atmospheric dispersion coefficient as calculated by the GENII computer program. The radiological constituent used in the GENII computer calculation was the gross Uranium (taken to be ^{234}U) source term described in Section 9.2. This source term represents the "worst-case" radiological consequences associated with any 5,000 DCG mixture of LERF radiological constituents, and is not intended to imply that 5,000 DCGs of gross Uranium is anticipated or expected during postulated accidents or abnormal occurrences. This results in a total release of 4.31 mL of LERF fluid containing 2.5 E-03 µCi/ml, or a total of 1.1 E-02 µCi of ^{234}U. Autumn radioactive isotope releases, which are the most conservative based on GENII runs, were used for the offsite, acute-release, ingestion runs.

The occupational radiological consequences to the in-facility worker were evaluated based on the "worst-case" release of a 5,000 DCG source of gross Uranium (taken to be ^{234}U). These quantities were assumed to be released into a 3 m x 3 m x 3 m volume (i.e., a cube bounded by the spill fall height). The concentrations derived were then compared against the Derived Air Concentrations for Controlling Occupational Exposure (DAC) limits specified in WHC-CM-4-10, *Radiation Protection Manual* (Ref. 37), and equated to an Effective Dose Equivalent (EDE). Direct exposure from a radionuclide emission from the pool are considered to be insignificant relative to the contribution from the "splash" source.

Toxicological consequences have also been evaluated for offsite, onsite and in-facility personnel. In accordance with the selected toxicological source term defined in Section 9.2.3, evaluation was based on the ammonium present in the LERF fluids, 3.0 E+04 ppm. The quantity of ammonium was calculated in accordance with the same methodology used to calculate total quantities of radiological constituents released from the spill. Release was assumed to occur over a period of one second, in accordance with the assumptions provided in NUREG-1320 (Ref. 61).

For offsite and onsite personnel, the appropriate receptor toxicological concentration is determined using the acute X/Q parameters developed by the GENII code (Version 1.485) for the offsite and onsite receptor, respectively. Refer to Sections 3.3.4 and 3.3.5. Calculation of release rates, coupled with GENII developed X/Q values, result in concentrations which can be compared against the limiting values tabulated in Table 9-1. Plume correction factors were not used. For in-facility personnel, it is assumed that the toxicological constituents are released into a 3 m x 3 m x 3 m volume, again representing a cube bounded by the spill fall height. The resulting concentrations are compared against the guideline value for exposure tabulated in Table 9-1. The following GENII files and libraries were used:

- Input file name: \A01.IN
- GENII Default Parameter Values (28-Mar-90 RAP)
- Radionuclide Master Library (11/28/90 RAP)
- External Dose Factors for GENII in person Sv/yr per Bq/n (8-May-90 R
- Internal Dose Increments, PNL Solubility Choices Rerun 12/3/90 PDR
- EXTGAM - Gamma Energies by Group for Finite Plume (13-May-90 RAP)
- 200 AREA - 10 M - Pasquill A - F (1983 - 1987 Average).

9.3.1.3 Radiological Consequences. The onsite and offsite radiological consequences of this abnormal occurrence are tabulated in Table 9-7.

The radiological consequences of this abnormal occurrence for in-facility workers are tabulated and explained in Table 9-7.

9.3.1.4 Toxicological Consequences. Toxicological consequences are tabulated in Table 9-8.

9.3.1.5 Conclusions. Comparison of the consequences of this abnormal occurrence against the applicable guideline values contained in Table 9-1 provides the following conclusions:

- Offsite radiological and toxicological consequences are well below the limiting risk/acceptance values. Accordingly, no significant offsite hazard exists.

- Onsite radiological and toxicological consequences are well below the limiting risk/acceptance values. Accordingly, no significant onsite hazard exists.

- No mandatory guidelines exist for evaluation of in-facility radiological or toxicological risk. The unmitigated event analyzed leads to a conservatively determined whole body dose of approximately 5.7 mrem for a 30 min exposure period. Toxicological consequences result in toxicological concentrations less than the applicable threshold limit value (time weighted average) for ammonia. These results are, when coupled with the radiological and industrial safety controls and practices associated with operation of the LERF facility, deemed to represent acceptable risks.

9.3.2 Partial Uncovering of a LERF Basin

Partial breaches of the LERF Basin cover are expected to occur over the design life of the LERF facility. A bounding breach of the basin cover has been assumed, resulting in the full breach of a longitudinal seam in the cover (i.e., a breach of a full 100 m cover seam). Although the cover material is extremely flexible (elongation at tear a minimum of 500%), an assumed opening

Table 9-8. Toxicological Consequences of Spill/Splash Abnormal Occurrence.

Exposure category	Calculated exposure (mg/m^3 - Ammonia)	Risk acceptance guideline value (mg/m^3 - Ammonia)	Acceptable/ unacceptable
Offsite individual	1.3 E-03	17	Acceptable
Onsite individual (i.e., at 100m)	4.3 E+00	24	Acceptable
In-facility worker	4.79	N/A	N/A

Offsite and onsite exposures were calculated by taking the release (mg/sec) and multiplying by the appropriate X/Q value.

In-facility worker exposures were calculated by taking the release and expanding it into a 3 m cube, i.e.,

$$\frac{4.31 \times 10^{-3} \text{ kg of solution} * 3.0 \times 10^{4} \text{ mg ammonium/kg of solutio}}{24 \text{ m3}}$$

area of 10% of the basin width is assumed. This results in a opening in the basin cover bounded by a parallelogram, 100 m in length, and 8.2 m in width - equivalent to an area of 820 m^3, equivalent to 10% of the total basin surface.

Clearly any cover breach would result in an accident which is totally bounded by the accident scenario associated with total uncovering of a LERF basin. Complete loss of the basin cover is analyzed in Section 9.4.2.

9.4 ACCIDENTS

9.4.1 Spray Leaks

9.4.1.1 Event Description. This scenario assumes that a piping leak exists in the LERF transfer piping during a transfer of 242-A Evaporator effluents. A cracked pipe or a leaking flange is postulated as the initiating event. The piping leak is assumed to occur for a total period of one shift (i.e., 8 h). This postulated accident scenario is conservatively assumed to result in a spray aerosolization resulting in maximum respirable particles. Evacuation of in-facility personnel potentially exposed to radiological and toxicological releases is assumed to occur within 30 min.

9.4.1.2 Analysis. The bounding value for aerosol release is determined by the orifice size resulting in maximum quantity of respirable particles. Calculations were developed for an orifice diameter of 0.063 in. (the approximate orifice size which produces the largest amount of respirable particles for operating pressures in the range expected for LERF transfer pumps).

The methodology for determining release from an appropriately sized orifice indicates that the orifice flow increases as the square root of the pressure increases. Although the actual pipeline pressures in LERF may vary from less than 50 lb/in^2 to greater than 100 lb/in^2, 100 lb/in^2 is used here as a conservative value. It is estimated that 170 L/h of LERF fluid would be released through the optimally sized orifice, of which only approximately 0.15% would be in the respirable particle range. This equates to 0.26 L/h of respirable particles being expelled, which is used as input to GENII (Ref. 13) calculations (refer to Ref. 6).

The GENII computer program was used to determine onsite and offsite radiological consequences for the spray leak accident. Refer to Section 9.3.1.2 for GENII calculational assumptions. Ratioed source terms and calculated X/Q values have been determined for GENII input to account for each 8 hour day of exposure by the onsite receptor. The adjusted source term ratio of 9.1 E-04 is the ratio of hours of exposure per day (8 h) to total hours of release time in one year (8,760 h). In each case, the exposure is based on the maximum LERF fluid inventory capable of being carried in a mist/fog. The radiological constituent used in the GENII computer calculation was the gross Uranium (i.e., ^{234}U) source term described in Section 9.2. This source term represents the "worst-case" radiological consequences associated with any 5,000 DCG mixture of LERF radiological constituents, and is not intended to imply that 5,000 DCGs of ^{234}U is anticipated or expected during postulated accidents/abnormal occurrences. This results in a release rate of 260 mL/h of LERF fluid containing 2.5 E-03 µCi/ml, or a release rate of 6.5 E-01 µCi/h of ^{234}U. Autumn radioactive isotope releases, which are the most conservative based on the GENII Code, were used for the offsite, acute-release, ingestion runs.

The postulated exposure to a LERF facility worker standing in the spray discharge path has been analyzed. It is postulated that the concentration of liquid in the air is approximately 10 mg/m^3, which is typical for fogs and mists as determined in PNL-2844, *Source Term and Radiation Dose Estimates for Postulated Damage to the 102 Building at the General Electric Vallecitos Nuclear Center* (Ref. 63). LERF fluid was assumed to make up the full mist concentration. In accordance with the discussion provided in Section 9.2, Source Terms, a 5,000 DCG (liquid) concentration of ^{234}U is assumed as the release source. The radiological consequences derived were then compared against the DCG limit specified in WHC-CM-7-5, *Environmental Compliance Manual* (Ref. 26) and equated to an EDE.

Toxicological concentrations are determined in the same fashion, using the toxicological source term provided in Section 9.2 of 3.0 E+04 ppm ammonia. The concentration of ammonia that an exposed LERF facility worker sees is determined by assuming the maximum concentration of LERF fluid in the fog is 10 mg/m^3. The resulting values are compared with guideline values from Table 9-1.

9.4.1.3 Radiological Consequences. The onsite and offsite radiological consequences of this spray accident are tabulated in Table 9-9.

The radiological consequences of this spray accident for in-facility workers are also tabulated and explained in Table 9-9.

9.4.1.4 Toxicological Consequences. Toxicological consequences are tabulated and explained in Table 9-10.

9.4.1.5 Conclusions. Comparison of the consequences of this spray accident against the applicable guideline values contained in Table 9-1 provide the following conclusions:

- Offsite radiological and toxicological consequences are well below the limiting risk/acceptance values. Accordingly, no significant offsite hazard exists.
- Onsite radiological and toxicological consequences are well below the limiting risk/acceptance values. Accordingly, no significant onsite hazard exists.
- No mandatory guidelines exist for evaluation of in-facility workers radiological or toxicological risks. The unmitigated event analyzed leads to a conservatively determined whole body dose of approximately 1.6 mrem for a one-half hour exposure period. Toxicological exposures for in-facility workers have been calculated and compared against guideline values for onsite and offsite

Table 9-9. Radiological Consequences of Spray Accident.

Exposure Category	Calculated Dose (Rem EDE)	Risk Acceptance Guideline Value (Rem EDE)	Acceptable/ Unacceptable
Offsite Individual	2.3 E-06	0.5	Acceptable
Onsite Individual (i.e., at 100m)	7.6 E-03	5.0	Acceptable
In-facility Worker	As determined below 0.35 mrem	N/A	N/A

In-facility Personnel Limiting Dose was calculated as follows:

$$(10mg/m^3)*(U\text{-}234\ Concentration) = Airborne\ Concentration\ mg/m^3$$

Limiting radionuclide is 5,000 DCG (liquid) concentration of ^{234}U in accordance with Section 9.2, Source Terms.

$$\left(\frac{10mg}{m^3}\right)*\left(\frac{2.5E\text{-}03\ \mu Ci}{ml}\right)*\left(\frac{1ml}{gram}\right)*\left(\frac{1gram}{1000mg}\right) = 2.5E\text{-}05\ \mu Ci/m^3$$

$$\left(\frac{(2.5E\text{-}05\ \mu Ci/m^3)*(1m^3/10^6ml)}{2.0E\text{-}11\ \mu Ci/ml}\right) = 1.25E{+}00\ DACs$$

Dose is calculated based on methodology provided in WHC-CM-4-10 (Ref. 37).

$$Dose = (5\ Rem/year)*(Exposure\ Timein\ years)*(Total\ DACs)$$

$$Dose = (5)*(0.5/8766)*(1.25E{+}00) = 3.56E\text{-}04\ Rem = 0.35mrem$$

Based on an exposure time, prior to evacuation, of 30 min; the resulting unmitigated dose to operations personnel from a spill would be approximately 0.35 mrem. This is a low dose, which is deemed to be acceptable.

Table 9-10. Toxicological Consequences of Spray Accident.

Exposure Category	Calculated Exposure (mg/m^3 - Ammonia)	Risk Acceptance Guideline Value (mg/m^3 - Ammonia)	Acceptable/ Unacceptable
Offsite Individual	<0.03	70	Acceptable
Onsite Individual (i.e., at 100m)	<0.03	141	Acceptable
In-facility Worker	0.03	N/A	N/A

<u>In-Facility Consequences</u>: In-facility consequences were determined by taking a release of LERF fluid with maximum source term ammonia and assuming a maximum aerosol transport ability for the air of 10 mg/m^3, which is representative of fogs and mists.

$$\text{Ammonia: } \left(10\frac{mg}{m^3}\right)*\left(\frac{3x10^4 mg\ Ammonia}{10^6 mg\ fluid}\right) = 0.03\frac{mg}{m^3}$$

<u>Onsite and Offsite Consequences</u>: Onsite and offsite dispersion will result in a significant decrease in the toxicological concentrations determined for in-facility receptors. As the toxicological concentration for in-facility workers is well within the guideline toxicological concentrations provided in Table 9-1 for both onsite and offsite receptors, it can be concluded that toxicological concentrations at onsite and offsite receptor locations are acceptable without further analysis.

personnel, which are well below the TLV-TWA values. As toxicological exposures are well below such guideline values, no infacility hazard exists. These results, when coupled with the radiological and industrial safety controls and practices associated with the operation of the LERF facility, are deemed to represent acceptable risk.

9.4.2 Basin Evaporation

9.4.2.1 Event Description. This scenario assumes that one LERF basin becomes uncovered and is evaporated at a constant rate, representative of the LERF basin size and the expected maximum monthly average worst case evaporation at the Hanford Site. It is assumed that the maximum duration the basin would be uncovered would be one month. This is consistent with the required time to empty a leaking basin, as a limiting case. It is expected that either a replacement cover could be installed within the one month time frame, or the basin would be emptied.

9.4.2.2 Analysis. The design basis monthly maximum average evaporation rate has been determined to be 11 in/mo of LERF basin fluid (Ref. 66). Values in the range 1.0 E-11 to 1.0 E-7 are typical partition coefficients for the Hanford Site (Ref. 64). For conservatism, a value of 1.0 E-07 has been used for all radionuclides present in LERF fluid, except for tritium where a partition coefficient of 1 was used. Resuspension of LERF fluids was not used because consequences were considered insignificant.

As noted in Section 9.2.1, the analysis of basin evaporation uses the 5,000 DCG tritium values. This value, as has been explained, is used because following consideration of the partition factor applied to other LERF basin radiological constituents, tritium will predominate.

The GENII computer program was used to determine offsite radiological consequences for this accident. It is assumed that the accident terminates after one month. Accordingly, the release assumed is the evaporation rate, multiplied by the time duration of one month, multiplied by the 5,000 DCG value for tritium. Refer to Section 9.3.1.2 for GENII calculational assumptions. Because basin evaporation is maximized during the summer, summer radioactive isotope releases were used for offsite, acute-release, ingestion runs.

The postulated exposure to both onsite workers and a LERF facility worker during a basin evaporation accident has been analyzed by comparing actual tritium concentrations to DAC values. A constant wind, assumed to be at a velocity of 1m/sec in accordance with Hanford Site practice, traverses the long dimension of the LERF basin (82 m x 100 m) in 100 s. Radionuclide concentrations are assumed dispersed horizontally evenly over the 82 m basin width, and vertically over a height of 3 m, which represents the minimum basin free board plus the assumed 2 m height of a facility worker standing on the basin berm. Worker evacuation is assumed after 30 min of exposure for the in-facility worker, and exposure is assumed for the entire month period for the onsite worker. Refer to Table 9-11 for a discussion of the calculational methodology used for onsite workers.

Table 9-11. Radiological Consequences of Basin Evaporation Accident. (2 sheets)

Exposure category	Calculated dose (REM EDE)	Risk acceptance guideline value (REM EDE)	Acceptable/ unacceptable
Offsite individual	7.0E-03 REM	0.5 REM	Acceptable
Onsite individual (i.e., at 100 m)	As determined below 0.72 REM	5.0 REM	Acceptable
In-facility worker	As determined below <1 mrem	N/A	N/A

<u>In-facility Personnel Limiting Dose was calculated as follows:</u>

GENII analyses performed for offsite consequences for this accident document that the significant radionuclide for this accident is tritium. This result is to be expected due to the effect of the partition coefficient imposes on other LERF fluid radionuclides. Using only tritium simplifies the dose analysis for in-facility workers, and will be used for this calculation. Release rate per second of tritium:

$$(\text{Evap. Rate}) * (\text{Tritium Con.}) = \text{Tritium Release/Second}$$

$$\text{Evap Rate} = \frac{(11\ \epsilon}{\text{mo}})\,(\frac{0.054\ \text{m}}{\epsilon})\,(82\ \text{m})\,(100\ \text{m})\,(\frac{1\ \text{mo}}{30\ \text{d}}(\frac{1\ \text{d}}{24\ \text{h}})\,(\frac{1\ \text{h}}{3{,}600\ \text{s}}) = 8.8$$

$$(8.8\ \text{E-04}\ \text{m}^3/\text{s}) * (10^6\ \text{mL/m}^3) * (1.0\ \text{E+01}\ \mu\text{Ci/ml} = 8.8\ \text{E+03}\ \mu\text{Ci/s}$$

As discussed in Section 9.4.2.2, this constant release rate of tritium is dispersed by a 1 m/s wind requiring 100 s to sweep the basin, and delivered to a receptor standing on the basin berm. It is assumed that the tritum concentration is dispersed equally across the basin dimension, and for conservation is totally contained within 3 m of the basin surface. This effectively expands the release into a total volume of 2.46 E+04 m^3. The resulting concentration is:

$$\left(\frac{(8.8\ \text{E+03}\ \mu\text{Ci/s}) * (100\ \text{S})}{(246\ \text{m}^2) * (100\ \text{m})}\right) = 3.6\ \text{E+01}\ \mu\text{Ci/m}^3$$

Table 9-11. Radiological Consequences of Basin Evaporation Accident. (2 sheets)

$$\left(\frac{3.6\ E{+}01\ \mu Ci/m^3)\ *\ (1\ m^3/10^6\ ml)}{2.0\ E{-}05\ \mu Ci/ml}\right) = 1.7\ E{+}00\ DACs$$

Dose is calculated based on methodology provided in WHC-CM-4-10 (Ref. 37).

Dose = (5.0 REM/yr) * (Exposure Time in years) * (Total DACs)

Dose = (5) * (0.5/8766) * (1.7 E+00) = 4.8 E-04 REM $<$ 1 mrem

Based on an exposure time, prior to evacuation, of one-half hour, the resulting unmitigated dose to operations personnel from exposure to tritium from basin evaporation would be <1 mrem, which is deemed acceptable.

Onsite Personnel Limiting Dose was calculated as follows:

Normally, onsite radiological consequences would be determined by using the GENII code. In this case, such a calculational methodology would result in an incorrect model for dose consequences, based on the following modelling fault:

> The determination of the X/Q value is based on a "point" source. Characterization of a 100 m by 82 m basin as a point source for an individual 15.4 km away at the site boundary is a reasonable assumption. Just as clearly, it is not appropriate to consider a 100 m by 82 m basin to be a point source for a receptor located only 100 m distant from the basin.

It was assumed that the concentration of radiological constituents at 100 m was identical to that present for the in-facility receptor located on the basin berm, and the exposure continued for a period of 31 d. This results in a dose of:

Dose (1/2 h)*(31 d)*(48 1/2 h periods/d) = Monthly Dose

(4.8 E-04 REM)*(31)*(48) = 7.2 E-01 REM = 720 mrem

The calculated value of 0.72 rem is not significant compared with the allowable value of 5.0 rem.

Table 9-12. Toxicological Consequences of Basin Evaporation Accident. (2 sheets)

Exposure category	Calculated exposure (mg/m^3 - Ammonia)	Risk acceptance guideline value (mg/m^3 - Ammonia)	Acceptable/ unacceptable
Offsite individual	0.26	36	Acceptable
Onsite individual (i.e., at 100 m)	30 - 107.1	60	Acceptable (see following Discussion)
In-facility worker	30 - 107.1	N/A	N/A

Offsite Consequences:

Offsite consequences are calculated in accordance with the following:

$$(8.8\ E{-}04\ \frac{m^3}{s})(10^6\ \frac{mL}{m^3})(10^3\ \frac{mg}{gm})(1\ \frac{g}{mL})(\frac{3.0 \times 10^4}{10^6}) = 2.64 \times 10^4\ \frac{mg}{s}$$

$$(2.64 \times 10^4\ mg/s)*(9.9\ E{-}06\ s/m^3) = 2.6 \times 10^{-1}\ mg/m^3$$

In-Facility Consequences:

In-facility Personnel Limiting Toxicological Exposure was calculated as follows:

As discussed in Section 9.4.2.2, this constant release rate of ammonia is swept by a 1 m/s wind requiring 100 seconds to sweep across the basin, and delivered to a receptor standing on the basin berm. It is assumed that the ammonia concentration is dispersed equally across the basin dimension, and for conservatism is totally contained within 3 m of the basin surface. This effectively expands the release into a total volume of 2.46 E+04 m^3. Resulting concentration is:

$$\left(\frac{(2.64\ E{+}04\ mg/s)*(100\ S)}{(246\ m^2)*(100\ m)}\right) = 107.1\ mg/m^3$$

Table 9-12. Toxicological Consequences of Basin Evaporation Accident. (2 sheets)

Onsite Consequences:

Normally, onsite concentration would be determined by multiplying the release rate by the appropriate X/Q value for a 100 m release distance. In this case, such a calculational methodology would result in a concentration of greater than 200 mg/m^3. Such a result, where the concentration at 100 m is greater than the concentration at the facility boundary is clearly incorrect, and is the result of the following modelling fault:

> The determination of the X/Q value is based on a "point" source. Characterization of a 100 m by 84 m basin as a point source for an individual 15.4 km away at the site boundary is a reasonable assumption. Just as clearly, it is not appropriate to consider a 100 m by 82 m basin to be a point source for a receptor located only 100 m distant from the basin.

It is assumed that the dispersion from the 107 mg/m^3 present at the basin edge, due to air mixing/dilution and fan dispersion of the vapor present, will result in a decrease in concentration from the concentration present at the basin edge. Assuming no dispersion, i.e., a concentration equivalent to that at the basin boundary, will result in acceptable concentrations relative to risk acceptance guidelines. Review of the decrease in the value for X/Q between the 100 m value of 3.2 E-02 and the 200 m value of 1.0 E-02 (i.e., a factor of 3.2) indicates actual concentrations would be in the range of 30 to 100 mg/m^3. It is therefore concluded that the toxicological concentration of ammonia at the 100 m site is acceptable.

Toxicological consequences have also been evaluated for offsite, onsite and in-facility personnel. Toxicological consequences have been determined in accordance with the toxicological source term defined in Section 9.2. Evaluation was based on the 3.0 E+04 ppm ammonia value.

For offsite personnel, the appropriate receptor toxicological concentration is determined using the acute X/Q parameters developed by the GENII code for offsite and onsite receptors, respectively, resulting in concentrations which can be compared against the limiting values tabulated in Table 9-1. Plume correction factors were not used. Refer to Table 9-12 for a discussion of the conclusions regarding onsite personnel. For in-facility personnel, toxicological consequences were determined in the same manner as for radiological consequences.

9.4.2.3 Radiological Consequences. The onsite, offsite and in-facility worker radiological consequences of this basin evaporation accident are tabulated in Table 9-11.

9.4.2.4 Toxicological Consequences. Toxicological consequences for this accident are tabulated and explained in Table 9-12.

9.4.2.5 Conclusions. Comparison of the consequences of this evaporation accident against the applicable guideline values contained in Table 9-1 provide the following conclusions:

- Offsite radiological consequences are well below the guideline values. Toxicological consequences were extrapolated from in-facility toxicological consequences and were found to be insignificant. Accordingly, no significant offsite hazard exists.

- Onsite radiological consequences are well below the guideline values. Toxicological consequences were extrapolated from in-facility toxicological consequences and were found to be insignificant. Accordingly, no significant onsite hazard exists.

- No mandatory guidelines exist for evaluation of in-facility radiological or toxicological risk. This unmitigated accident leads to a conservatively calculated negligible whole body dose for a 30 min exposure. This is deemed to be acceptable.

  Toxicological exposures for in-facility workers have been calculated and compared against guideline values for onsite and offsite personnel. The hypothetical ammonia concentrations are above TLV values but are less than 1/3 of an IDLH value. Therefore, it is concluded that no in-facility toxicological hazard exists. These results, when coupled with expected protective measures during periods when the LERF basins are uncovered, is deemed to present an acceptable risk.

10.0 CONDUCT OF OPERATIONS

This chapter highlights the Liquid Effluent Retention Facility (LERF) operating, support and administrative organizations, and activities which ensure continued and safe plant operations. The LERF is designed to be managed from the 242-A Evaporator facility as a course of normal Evaporator operations. Conduct of operations for the 242-A Evaporator are discussed in the Safety Analysis Report for the 242-A Evaporator, SD-WM-SAR-023 (Ref. 65). A majority of the LERF support organizations including engineering, operations, safety, and quality assurance, are the same organizations which routinely provide services to the Tank Farms and 242-A Evaporator. All activities conducted at LERF are in accordance with Tank Farms Operations Safety Program outlined in Section 1.3 of WHC-CM-5-7 (Ref. 70). The applicable health and safety requirements of the U.S. Department of Energy (DOE), specifically all 5400 and 5480 series DOE orders, will be complied with. The operation of the LERF does not present a unique organizational challenge or require organizational restructuring.

10.1 ORGANIZATIONAL STRUCTURE

10.1.1 Corporate and Westinghouse Hanford Organizations

The Westinghouse Hanford is the Operations and Engineering Contractor for the Department of Energy (DOE) at DOE's Hanford Site in Richland, Washington. Westinghouse Hanford is a wholly-owned subsidiary of Westinghouse Electric Corporation which reports to Westinghouse Electric Corporation's Energy and Utility Systems Division. Figure 10-1 illustrates the relationship of Westinghouse Hanford to Westinghouse Electric Corporation.

10.1.1.1 Corporate Functions, Responsibilities and Authorities. Westinghouse Hanford is the Department of Energy's Operations and Engineering Contractor at DOE's Hanford Site with certain contractual responsibilities, subject to the availability of funding and of DOE approval, for Defense Programs, Engineering and Development, Safety, Quality Assurance and Security and Site Support Services.

10.1.1.2 Westinghouse Hanford Organization. Figure 10-2 describes the major structure of Westinghouse Hanford. Detailed organization charts are located in the *Organization Charts and Charters*, WHC-CM-1-2 (Ref. 45).

The LERF is operated under the direction of the Vice President, Waste Tank Safety, Operations and Remediation via the direct reporting Tank Farm Project organization. The LERF is supported by other Westinghouse Hanford organizations which provide training, safety review and guidance (Industrial Safety, Fire Protection, Radiological Safety, Nuclear Facility Safety), maintenance, quality assurance, engineering, laboratory support, safeguards and security.

Figure 10-1. Westinghouse Electric Corporation
Relationship to Westinghouse Hanford.

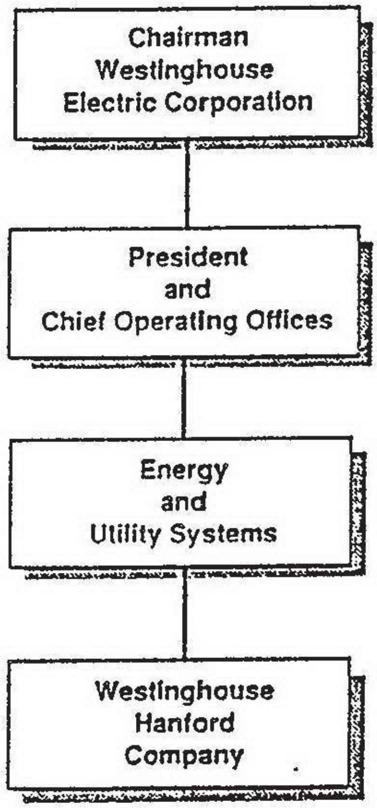
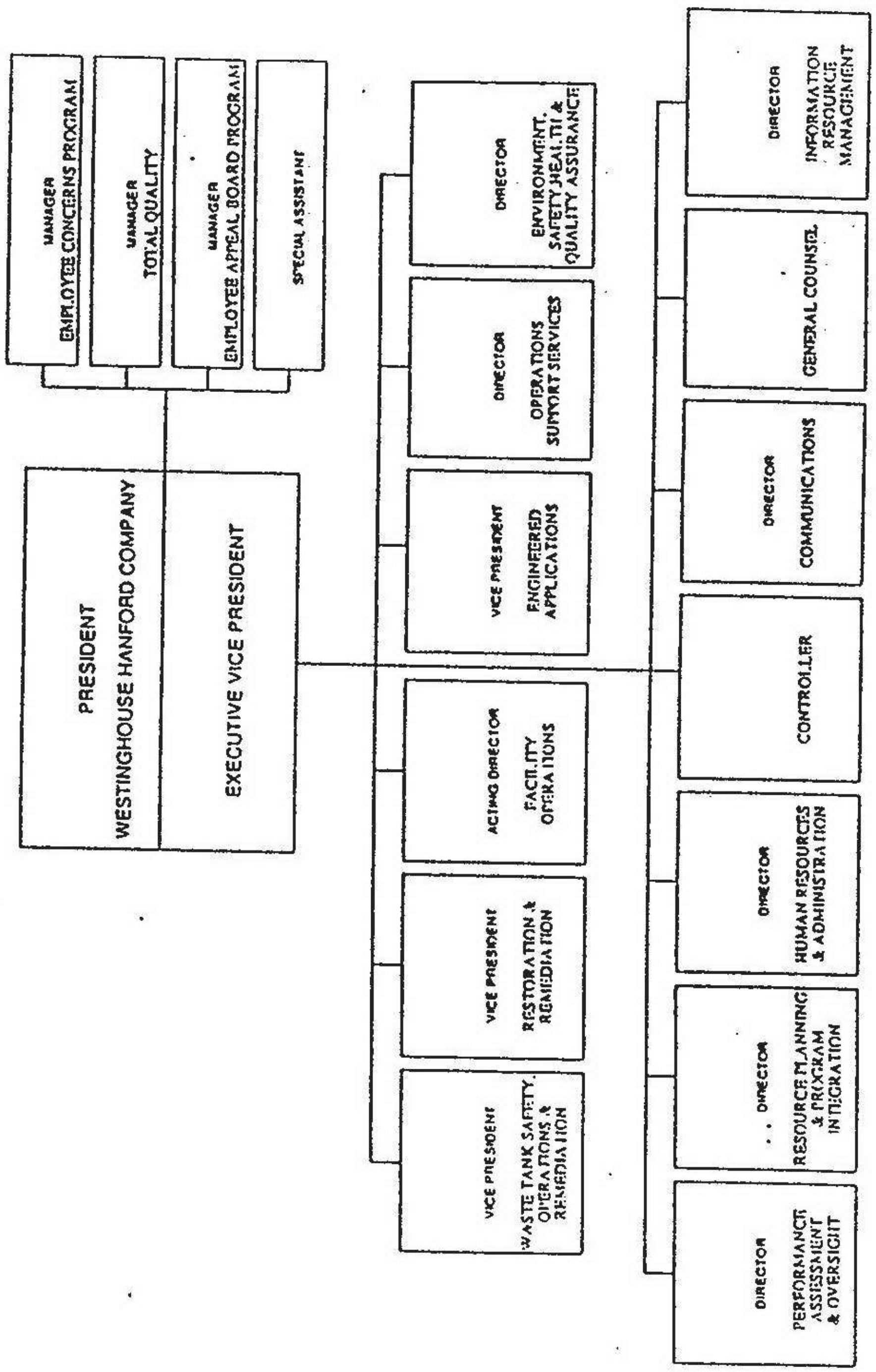


Figure 10-2. Westinghouse Hanford Organization.



The following describes the functional relationships among the support organizations.

10.1.1.2.1 Engineering. The Engineering and Projects group provides technology development and develops process flowsheets for Tank Farm Project organization. They provide expertise for waste management facilities and processes. Process engineering and technical support for plant operations includes: technical direction for operating facilities; integration of technical and engineering inputs into operations and facilities; technical input into operating and safety documentation; and preparation of operating procedures and other selected operating documentation.

The Tank Farm Upgrades organization examines proposed changes to operating facilities and processes. Engineering studies are performed to define scope and need, evaluate alternatives, and recommend appropriate action. Where capital projects are recommended, this organization prepares and issues the functional design criteria.

The Plant Engineering organization, in particular the Evaporator Restart Group, provides the direct, day to day process engineering and technical support for the LERF and other Tank Farm operations.

The Westinghouse Hanford Engineering Department provides a central engineering organization for Westinghouse Hanford. In addition to preparing, maintaining, and controlling the *Standard Engineering Practices*, WHC-CM-6-1 (Ref. 67), this organization provides specialized technical services to the operating divisions on an as-needed basis. Such services include mechanical and systems engineering, engineering analysis (e.g., structural, seismic, material and fluid systems), and instrumentation and control engineering.

10.1.1.2.2 Operations Support Services. This department provides the physical security for the LERF and other Tank Farm Project facilities via the Safeguards and Security organization. The Manager, Safeguards and Security, reports directly to the Manager, Operations Support Services.

10.1.1.2.3 Environment, Safety, Health and Quality Assurance. This department includes organizations which provide direct and indirect support and independent oversights to the operating facilities. See Figure 10-3 for organization components germane to the LERF.

Environmental Assurance. This organization is responsible to provide oversight, assurance and verification that the LERF is constructed and operated in compliance with all applicable state and federal environmental regulations.

Waste Tank Environment, Safety, Health and Quality Assurance. This organization has both support and independent oversight for Tank Farm Project operations which includes the LERF basins. The support and independent oversight responsibilities include industrial hygiene and safety, nuclear safety, and health physics by the Waste Tank Safety organization; quality engineering by the Waste Tank Quality Engineering organization; environmental/safety/quality assurance, surveillances, corrective action

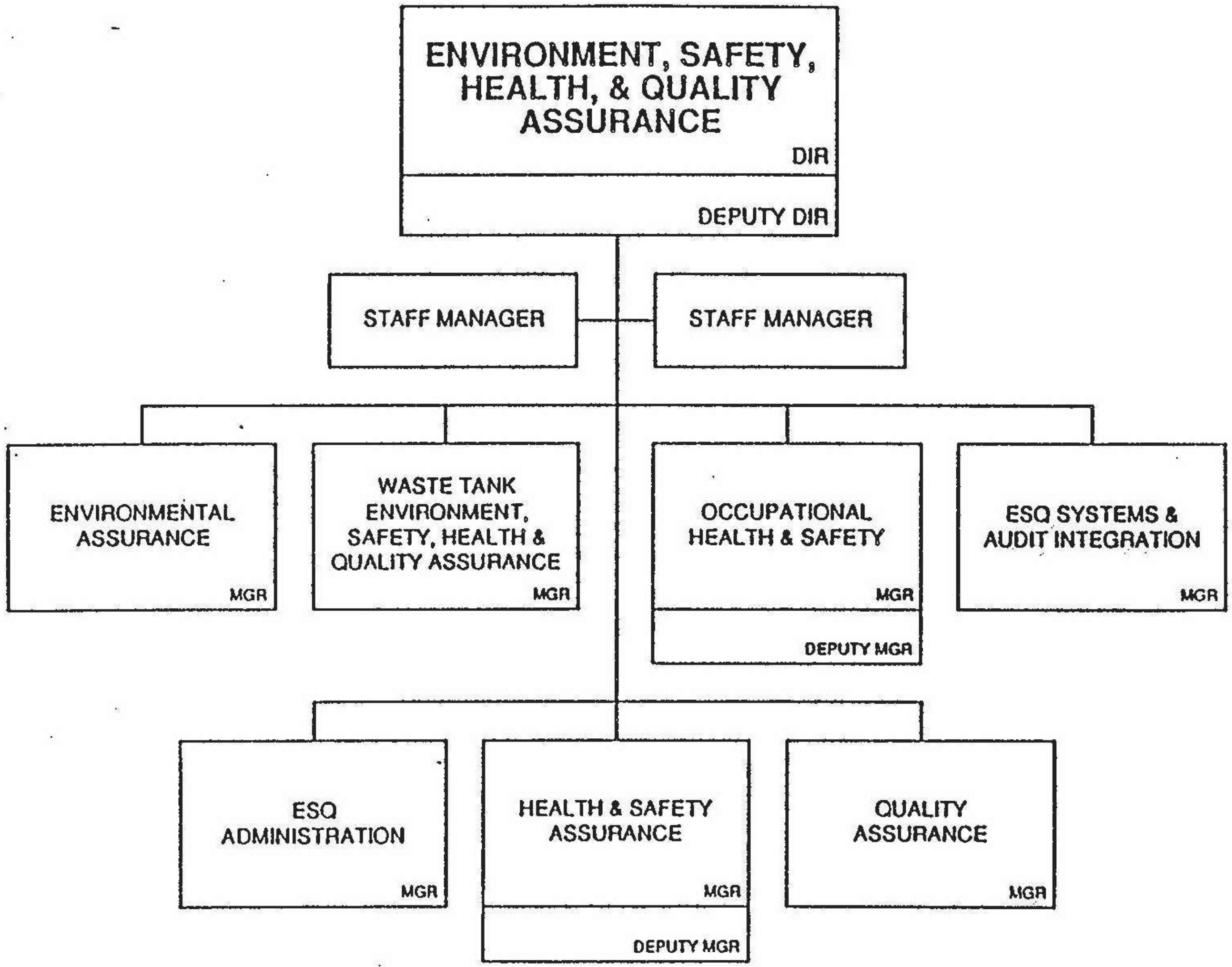


Figure 10-3. Environment, Safety, Health and Quality Assurance Organization.

management, readiness review integration by the Waste Tank Environment Assurance and Integration organization; and inspection by the Waste Tank Quality Control organization.

Occupational Health and Safety. This organization provides the radiological and industrial hygiene and safety monitoring in support of the Tank Farm Project operations. The radiological monitoring is done by Health Physics Technicians from the Waste Tank Health and Safety organization. The industrial hygiene and safety monitoring is performed by the Industrial Hygiene and Safety organization. Oversight for the ALARA Program is provided by the Hazards Awareness and ALARA organization within the Health and Safety Services organization.

Quality Assurance. The Quality Assurance (QA) organizations provide independent oversight, inspection, surveillance, review and approval of Tank Farm Project activities which affect the quality of the facilities, plant equipment and operations to ensure compliance with ANSI/ASME NQA-1, *Quality Assurance Program Requirements for Nuclear Facilities* (Ref. 68).

10.1.1.2.4 Engineered Applications. The 222-S Laboratories Operations report to the Process and Analytical Laboratory. These organizations support the LERF by providing analytical services and environmental analyses of stored wastes and leachates.

10.1.1.2.5 Environmental Division. This organization provides support, guidance and oversight for all Westinghouse Hanford organizations to ensure compliance with Federal, State, and local environmental regulatory requirements. This includes technology development and engineering support for environmental activities, and liaison and formal communications between Westinghouse Hanford, DOE-RL, other Hanford Site contractors and regulatory agencies on environmental issues and reporting. This organization prepares, issues, and maintains the *Environmental Compliance Manual*, WHC-CM-7-5 (Ref. 26).

10.1.1.2.6 Projects Department. The Manager, Projects reports directly to the Manager, Engineered Applications Division. The Projects organization is the Westinghouse Hanford agency responsible for efficient and effective management of all assigned Westinghouse Hanford construction projects, project activities and nonproject construction work. The project department prepares, issues, and maintains the *Projects Department Management Manual*, WHC-CM-6-2 (Ref. 69), to ensure project management complies with all DOE and Westinghouse Hanford policy and directives.

10.1.1.3 Inter-Relationships with Contractors and Suppliers. Westinghouse Electric Corporation corporate personnel are available for technical assistance when requested. Westinghouse Electric Corporation is also operating manager of several government-owned contractor-operated nuclear sites, including Westinghouse Savannah River, Westinghouse Materials Company, Westinghouse Idaho Nuclear Company, West Valley Nuclear Services Company, and the Waste Isolation Division. This provides an extensive pool of resources and technical expertise to call upon as needed.

Other offsite personnel are occasionally used for appraisal and review purposes. These resources are available through the normal procurement cycle.

Westinghouse Hanford deals with the DOE-RL through functional and programmatic offices. In particular, safety and QA organizations interface directly with DOE-RL.

Kaiser Engineers Hanford (KEH) provides onsite architect-engineer (A/E) services through a contract with DOE-RL. Major projects may utilize an offsite A/E, but KEH would be involved as the Site inspection and construction services contractor. Project and cognizant engineers for Westinghouse Hanford interface with the A/E on the development and progress of construction projects.

Pacific Northwest Laboratories (PNL) has the prime responsibility for providing personnel monitoring services to the site. This includes personnel dosimetry, internal dosimetry, dosimetry record management, and dose evaluation in case of emergencies. The PNL has a contract with DOE-RL to provide support in the radiation instrumentation monitoring program. This includes the evaluation of new instruments, post-purchase QA on instruments, maintenance of emergency response kits and instruments, and the routine calibration of all radiation survey instruments used by operational HP.

Personnel health and occupational medicine services are provided by the Hanford Environmental Health Foundation (HEHF) under contract with DOE-RL. The HEHF provides on call emergency medical support and operates the Emergency Decontamination Facility and the whole body counting facility.

Westinghouse Hanford conducts cost-effective procurement and materials management operations through its Purchasing organization. Purchasing is responsible for providing procurement services for the acquisition of a broad range of materials, services and equipment. Only Purchasing personnel have the responsibility and authority for making contractual commitments for the Company with outside vendors and suppliers.

10.1.2 Operating Organization

The LERF is a Tank Farm Project facility. The Manager, Facility Operations, is responsible for operating this facility, as well as other Tank Farm Project facilities for processing, storage and disposal of Hanford radioactive liquid wastes. The Manager, Facility Operations; the Manager, Engineering and Projects, (who is responsible for technical support to the LERF as well as to other Tank Farm Project facilities); and the Manager, Maintenance report to the Westinghouse Hanford Manager of the Tank Farm Project Division.

This section describes the Facility Operations organization responsible for operating the LERF. Note that the operation of LERF involves several activities including: receipt of effluents and associated valving operations; surveillance to meet requirements for safe storage; sampling of effluents; transfer of effluents between basins; support for scheduled and corrective maintenance; and maintenance of waste records.

10.1.2.1 Facility Operations Organization. The Manager, Facility Operations, ensures the safe, efficient operation of the LERF and other assigned Tank Farm Project facilities. A staff of operations, operations support, and administrative support personnel are maintained and delegated to manage, operate, and assist in the operation of these facilities. The operating organization is shown in Figure 10-4.

The Manager, Operations Support, reports directly to the Manager, Facility Operations. This organization is responsible for administrative, Occurrence reporting and project scheduling support for the Facility Operations organization. This organization maintains the *Tank Farms, Grout, and Solid Waste Management Administration Manual*, WHC-CM-5-7 (Ref. 70). This manual provides direction, guidance and procedures to ensure that Tank Farm Project operations are conducted in accordance with DOE orders, applicable government regulations and Westinghouse Hanford Policies and Procedures. The authority for this organization includes: approving procedure changes to the WHC-CM-5-7 manual, approving required Management Control System documentation per the *Management Control System*, WHC-CM-2-5 (Ref. 71), and approving planning and work schedules.

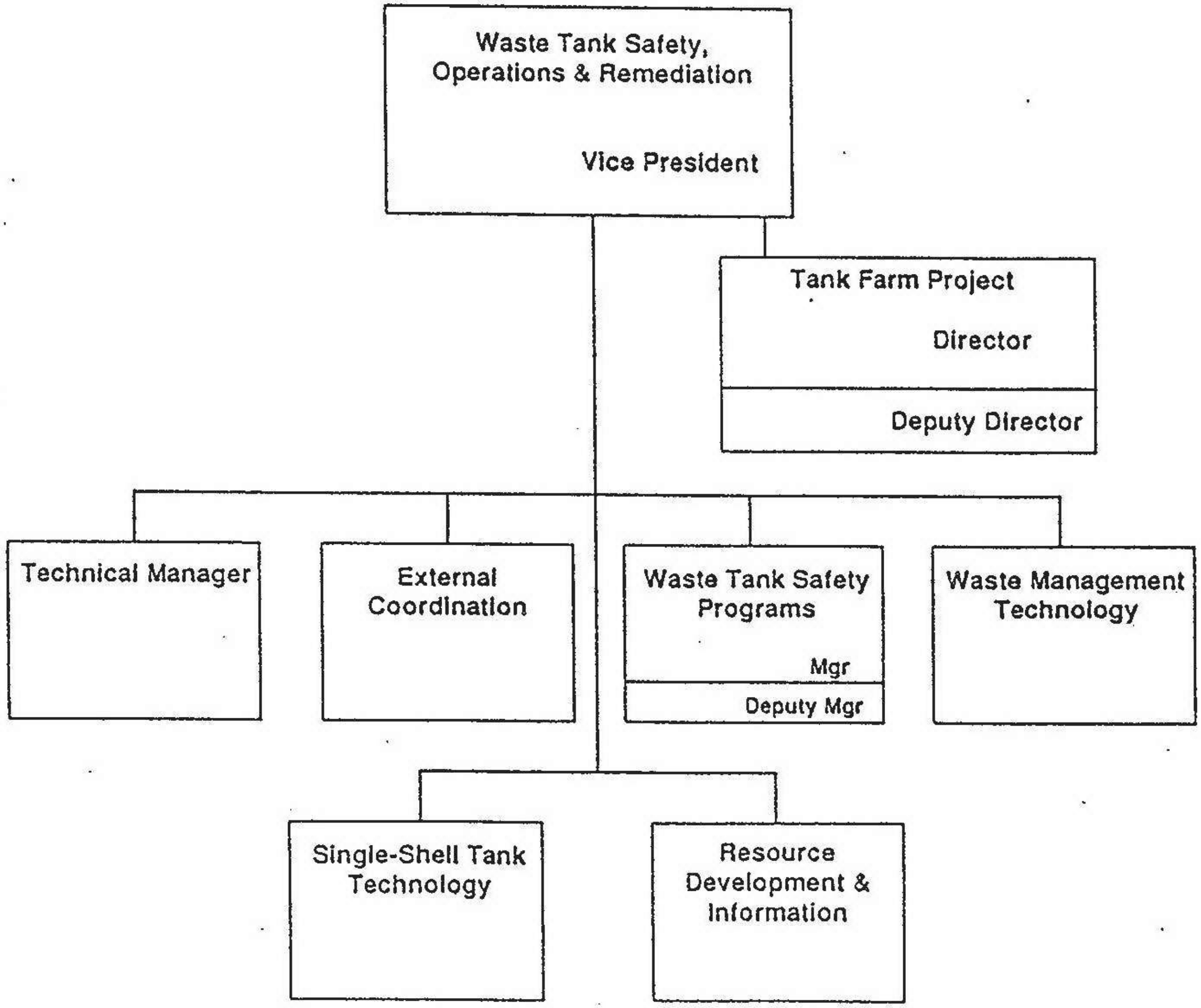
The Manager, Tank Farm Production Control, reports directly to the Manager, Maintenance. This organization is responsible for production control services through detailed plans, schedules, work orders, resource coordination, material acquisition, tracking/control for Job Control System documentation, and field activity workload planning. This organization has the authority to approve all planning, design, and facility work directly or indirectly impacting the operational safety and effectiveness of Tank Farm Project operations.

The Manager, Project Planning and Control, directly reports to the Manager, Tank Farm Project. This organization provides the programmatic direction and control for Tank Farm activities. Responsibilities include:

- Development and implementation of program plans, cost accounts, milestones and schedules to accomplish programmatic goals and report program cost and schedule progress.
- Interfacing with DOE for matters pertaining to the Tank Farms.
- Performing strategic planning for existing and proposed Tank Farm programs.

The Manager, Facility Operations, reports directly to the Manager, Tank Farm Project. This organization includes the management and operating personnel who actually operate the Tank Farm facilities. The Manager, East Tank Farm Operations, reports to the Manager, Facility Operations, and is primarily responsible for the operation of facilities in the 200 East Area including the LERF. The Manager, West Tank Farm Operations, also reports to the Manager, Facility Operations and is responsible for the operation of the 200 West Area Tank Farm facilities. The West Tank Farm Operations organization provides operations surveillance and other operational support

Waste Tank Safety, Operations and Remediation



.0.0 1/30/91

Figure 10-4. Tank Farm Project Organization. (1 of 8 sheets)

Tank Farm Project

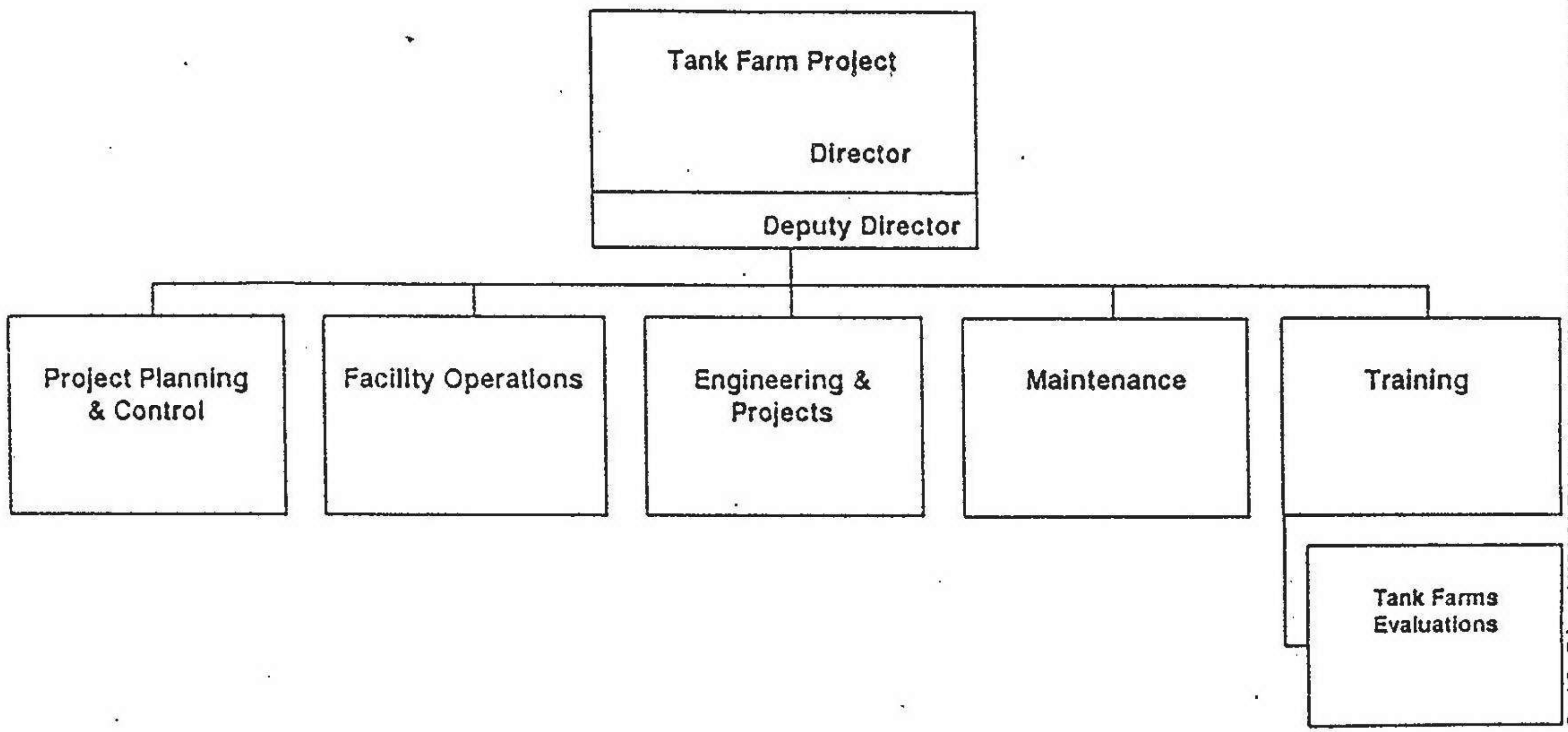


Figure 10-4. Tank Farm Project Organization. (2 of 8 sheets)

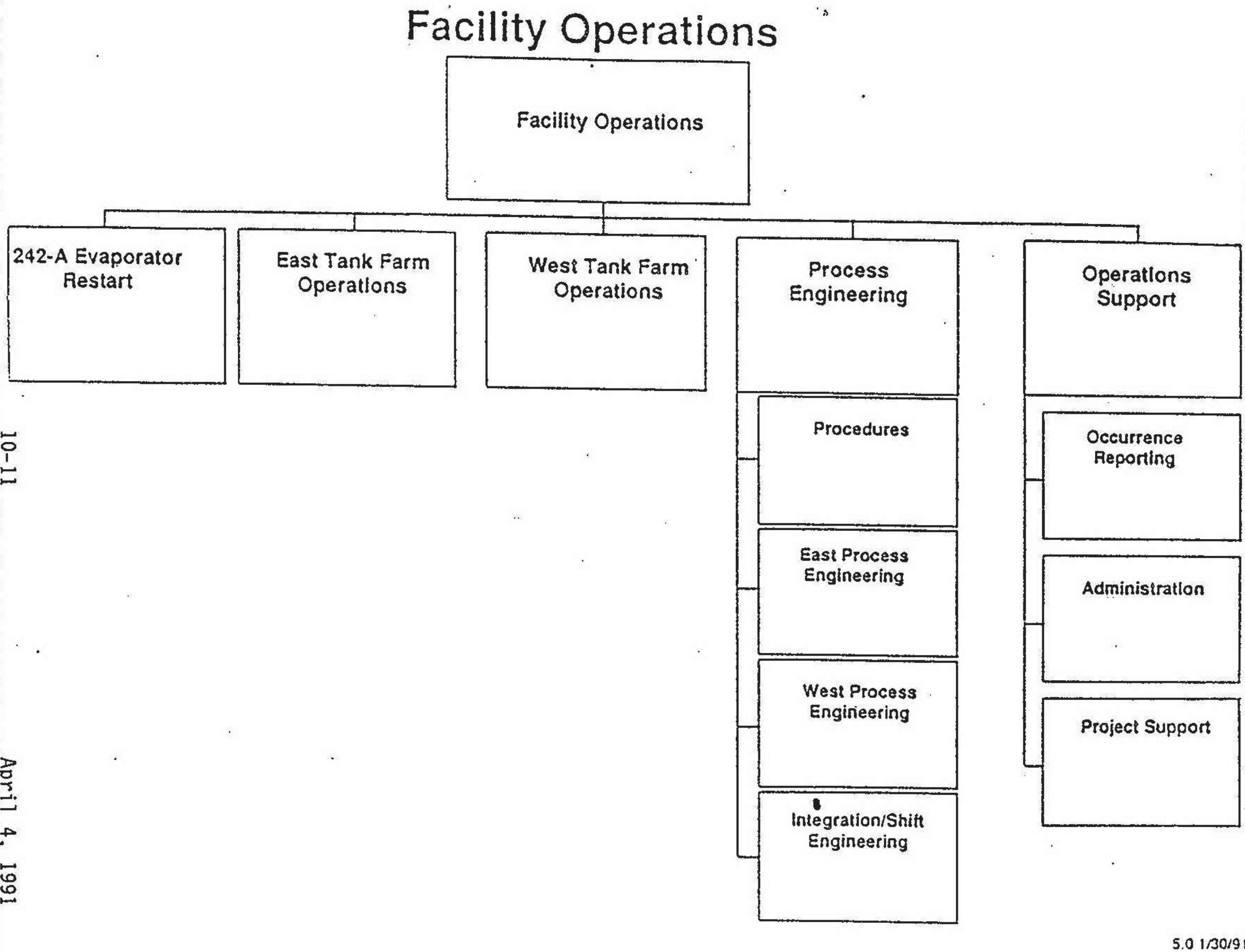
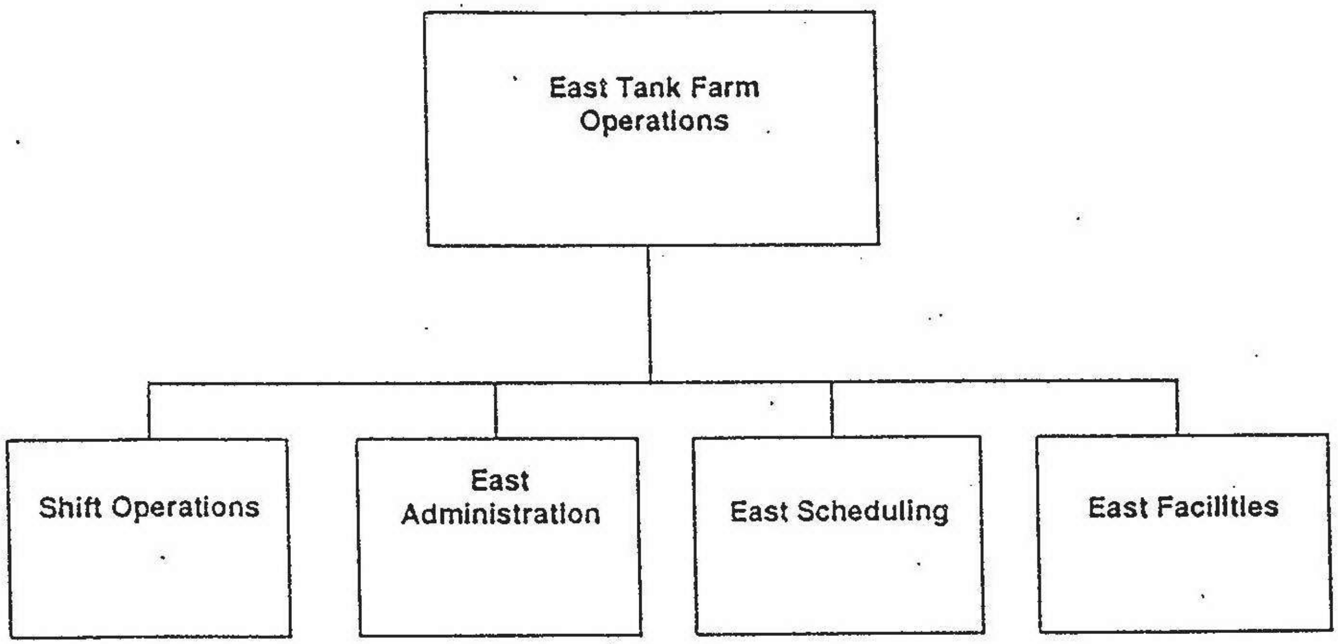


Figure 10-4. Tank Farm Project Organization. (3 of 8 sheets)

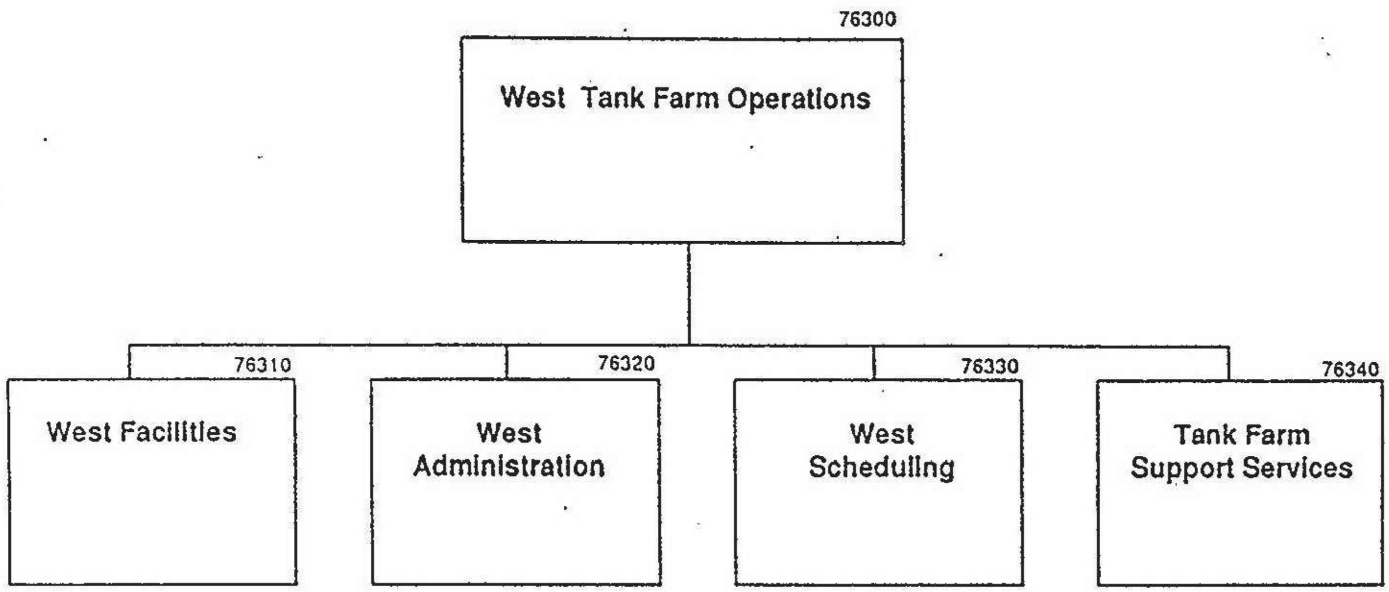
Facility Operations



5.1 1/30/91

Figure 10-4. Tank Farm Project Organization. (4 of 8 sheets)

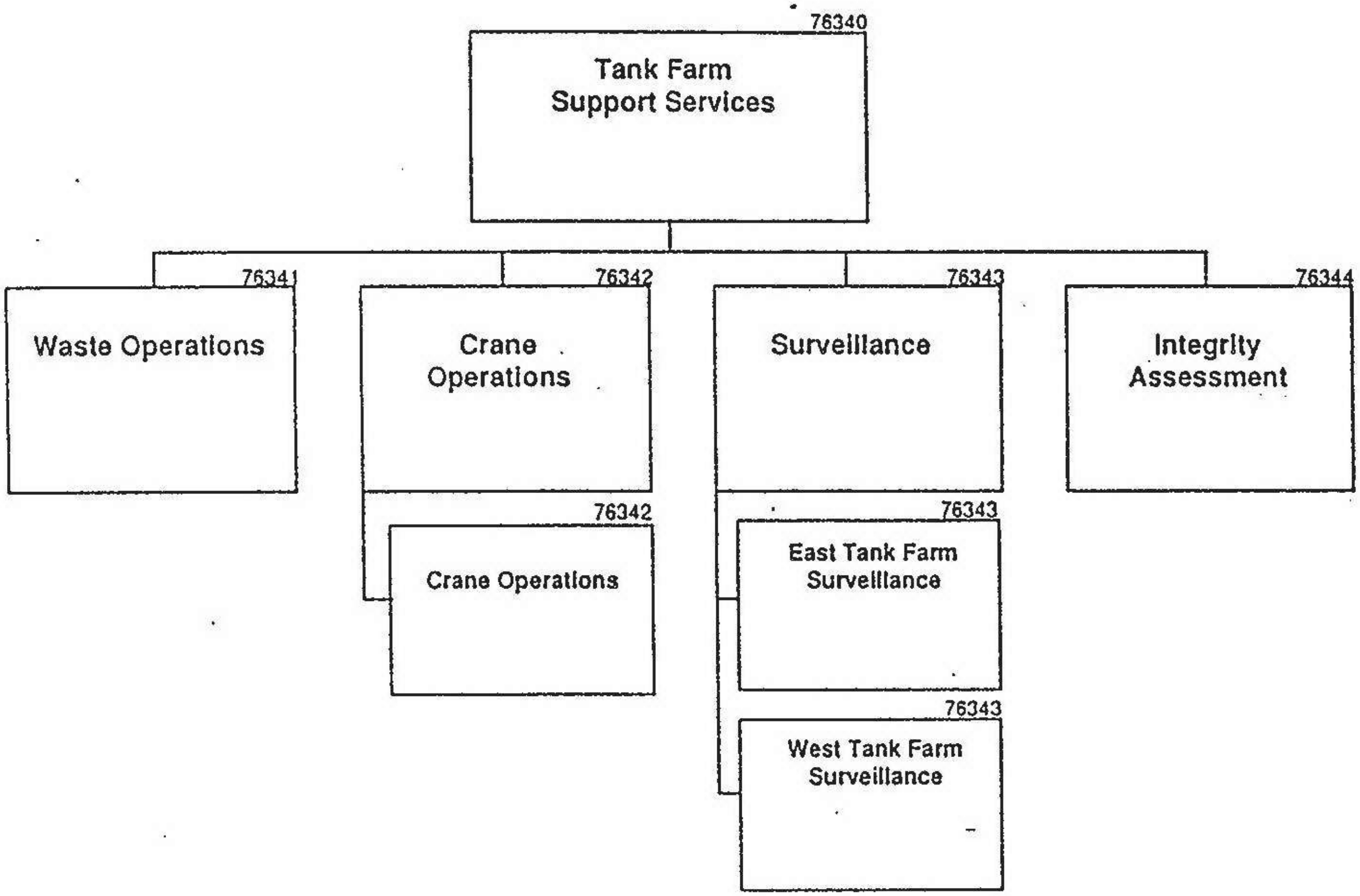
Facility Operations



5.2 1/30/91

Figure 10-4. Tank Farm Project Organization. (5 of 8 sheets)

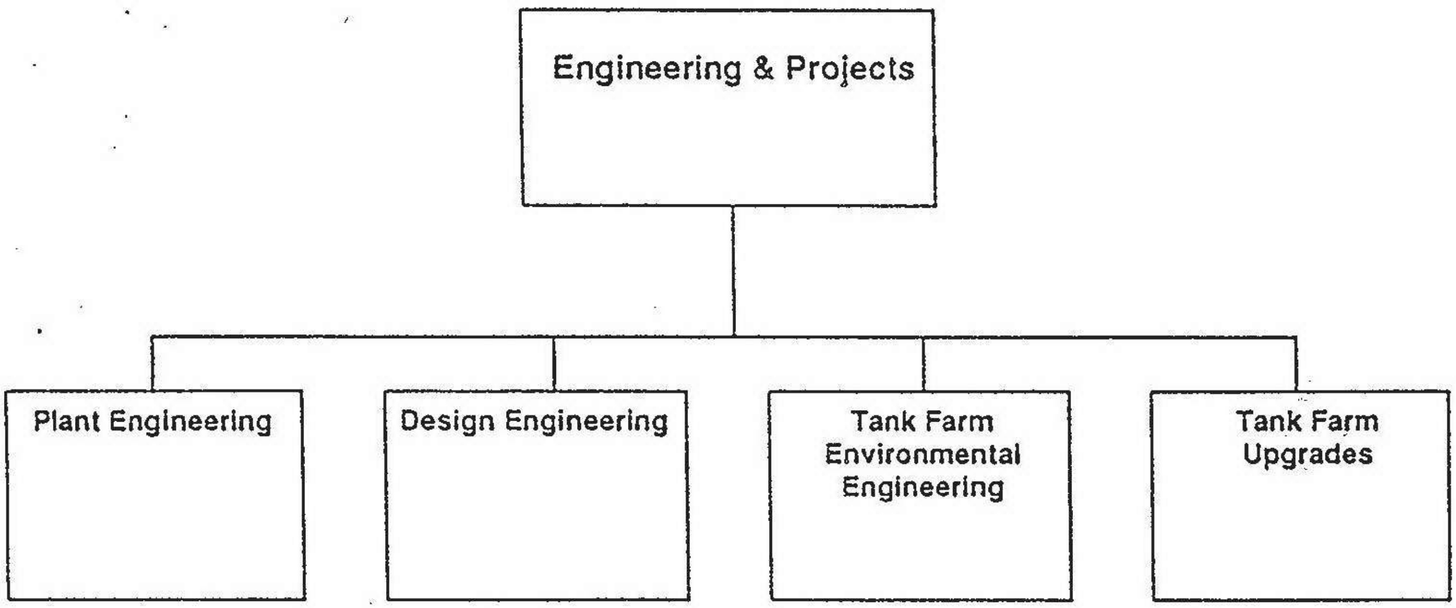
Facility Operations



5.2.2 1/30/91

Figure 10-4. Tank Farm Project Organization. (6 of 8 sheets)

Engineering & Projects



6.0 1/30/91

Figure 10-4. Tank Farm Project Organization. (7 of 8 sheets)

Maintenance

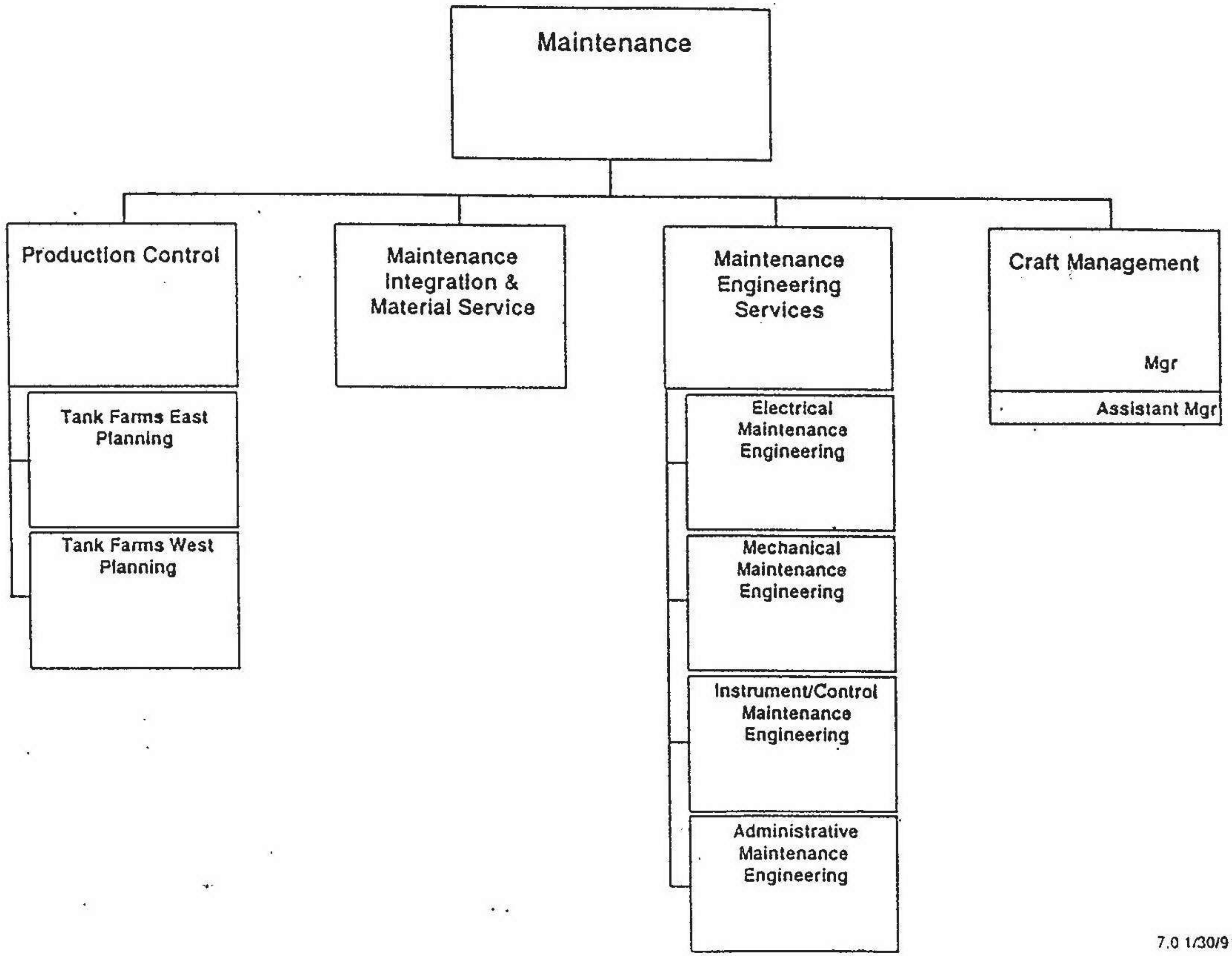


Figure 10-4. Tank Farm Project Organization. (8 of 8 sheets)

services directly for the Tank Farm Operations. These operational support services are provided by the Tank Farm Support Services organization reporting to the Manager, West Tank Farms Operations.

The Manager, Shift Operations reports to the Manager, East Tank Farm Operations. Shift Operations is in charge of both East and West Tank Farm facilities. Each rotating shift (A, B, C, or D) has a manager and at least one supervisor with approximately 10 nuclear operators reporting to them. This staff is responsible for performing the LERF operations as needed as well as the operation of the other facilities noted previously in this section. This chain of command does not change when the shift is on day shift (i.e., the shift manager is always the person in charge for Tank Farm Operations). During absences of the assigned shift manager, an alternate is assigned to the position.

The Manager, East Facilities, reports to the Manager, East Tank Farm Operations. The East Facilities organization is a day shift crew with a manager, six supervisors and approximately 30 nuclear operators. This organization performs certain tasks independent of the shift manager (e.g., supports project construction, operates waste removal truck, supports crane crews and diversion box work, and performs special operations, etc.). The organization also provides day shift absence relief to the shift crew. However, personnel assigned to shift relief take direction from the shift manager and shift supervisors.

The Manager, Tank Farm Surveillance, reports to the Manager, Tank Farm Support Services who reports to the Manager, West Tank Farms Operations. The Surveillance organization is a day shift crew with responsibilities to obtain surveillance data on East and West Area single-shell tanks, double-shell tanks, ponds, cribs, ditches and the purgewater modules. This organization will perform surveillance activities at the LERF as required.

The primary responsibility for safe operation of Westinghouse Hanford facilities rests with the line management of the operating organization. However, the Waste Management Technology organization (which reports to the Manager, Waste Tank Safety, Operations and Remediation); the Process Engineering organization (a part of the Facilities Operations organization); and the Safety organizations provide strong safety support. The Waste Management Technology organization prepares the process flowsheets. The Process Engineering organization prepares operating procedures. The Safety Analysis organization defines the operating limits for the safety envelope and documents them in the Operational Safety Requirements, Safety Limits, and Limiting Conditions of Operations documentation.

In addition, the Environment, Safety, Health and Quality Assurance organization provides support to several primary areas:

- Radiation Protection through the Operational Health Physics and Nuclear Facility Safety Organizations
- Industrial Safety and Fire Protection through that organization and the Hanford Site Fire Department

- Support for the preparation of facility safety analyses. The Safety Support Services organization provides this support.

- Support to ensure compliance with all applicable environmental regulations through the Environmental organization

- Support in assurance that all activities which could affect safety and reliability are conducted in accordance with the Quality Assurance Program. These activities are conducted through the Quality Assurance organization

The safety organization is also responsible for the independent safety review program. An independent safety review is required for the following areas:

- Documents/procedures used to conduct the design, construction, operation, maintenance, and modification of nuclear facilities

- Nuclear facility and equipment design documents.

The Nuclear Safety Standards and Requirements organization implements this program by requiring that the above media be reviewed by NSSR staff. When NSSR comments are satisfactorily resolved, the media is approved by NSSR management.

10.1.2.1.1 The Safety Council. Westinghouse Hanford has established a Safety and Environmental Advisory Council (SEAC) to provide independent advice to the President and other senior Westinghouse Hanford executives on matters of safety and environmental protection.

The SEAC and permanent subcouncils augment the Westinghouse Hanford independent safety review system and ensure compliance with company policies *Management Policies*, WHC-CM-1-1 (Ref. 72) and DOE Orders 5480.1B (Ref. 73) and DOE 5481.1B (Ref. 74).

Specific reviews by the Council may be performed by the full SEAC, by one of four permanent subcouncils cognizant of designated Westinghouse Hanford activities, or by an ad hoc subcommittee appointed for a particular review.

The SEAC and subcouncils interface with the line organizations directly, as needed, to perform their review functions and their assessments and conclusions are provided directly to the line organization and to the President of Westinghouse Hanford. Subcouncils may refer major reviews or significant issues to the full SEAC for consideration as judged appropriate. The SEAC subcouncil chairman signs reviewed documents as approved after all subcouncil comments have been satisfactorily resolved.

10.1.2.2 Personnel Functions and Responsibilities. As described previously, the Manager of Facility Operations, the "Plant Manager," has the overall responsibility and authority for the safe and efficient operation of Tank Farm Project facilities. In the planned absence of the Manager, Facility

Operations, the position responsibility and authority is delegated in writing by him to a member of his or her staff. In the event of an unplanned absence, the Manager, Tank Farm Project, will make this delegation.

During normal operations, the Plant Manager delegates responsibility and authority to act for him in predesignated areas to the Manager, East Tank Farm Operations and, in turn, to the Manager, Shift Operations. The *Tank Farms, Grout, and Solid Waste Management Administration Manual*, WHC-CM-5-7 (Ref. 70) contains procedures which describe the responsibility of all Tank Farm operating personnel during normal and emergency conditions. These procedures include 3.12, "Conduct of Operations," which governs normal operation, and 1.2, "Emergency Preparedness and Response Program," which addresses emergency situations.

The Westinghouse Hanford Emergency Preparedness Program flows from Management Policy 5.13, WHC-CM-1-1 (Ref. 72) and Management Procedure 5.13, WHC-CM-1-3 (Ref. 40) to the Westinghouse Hanford *Emergency Plan Manual*, WHC-CM-4-1 (Ref. 72). The requirements of the Emergency Plan Manual are implemented via the aforementioned 1.2 procedure and the subtier procedure WHC-IP-0263-ETF, *Westinghouse Hanford Building Emergency Plan for 200 East Area Tank Farms* (Ref. 76). The Plant Manager is the Building Emergency Director (BED) for Tank Farm facilities under this plan. As noted previously, the Manager, Shift Operations is the person in charge of Tank Farm facilities on off-shifts. The shift manager is the designated Alternate BED and will assume the BED duties and responsibilities during off-shifts.

10.1.3 Personnel Qualifications

Personnel qualifications include those which an individual brings to a Westinghouse Hanford position and those acquired while employed by Westinghouse Hanford. A person may be qualified by education and related industry experience to start in a management position, but that individual will also undergo company training while in the position.

As stated earlier in this chapter, the LERF is operated by personnel assigned to the 242-A Evaporator facility. Operation of the LERF does not present a unique challenge for qualified Evaporator personnel. Though LERF-specific training is mandatory for all associated operations personnel, unique qualification requirements beyond those necessary for Evaporator operation have not been identified. Westinghouse Hanford training and acquired qualification requirements are discussed in Section 10.3.

10.1.3.1 Minimum Qualification Requirements. Operation of the LERF and other Tank Farm Project facilities requires a staff of qualified, competent personnel to conduct routine and long-range activities. The ultimate authority regarding a candidate's qualifications for a position rests with the Manager, Tank Farm Project.

10.1.3.2 Qualifications of Tank Farm Personnel. The qualifications of plant management personnel for operations, engineering and maintenance are presented in document WHC-SD-WM-RD-008 (Ref. 77). This information includes the education, training and experience for the position incumbents.

10.1.4 Liaison with Outside Organizations

Westinghouse Hanford frequently establishes contracts with outside suppliers to perform specialized services in areas where the expertise or staffing is not immediately available in-house. Such contracts are negotiated by the Westinghouse Hanford purchasing organization subject to DOE-RL approval, and the contracts and follow-on agreements such as statements of work specify the interfaces and deliverables. Also see Section 10.1.1.3, Inter-Relationships with Contractors and Suppliers.

Westinghouse Hanford also has interface, primarily in the environmental compliance area, with the Washington State Department of Ecology and with the United States Environmental Protection Agency (EPA). The DOE-RL is the Hanford Site signatory authority for agreements with such agencies and Westinghouse Hanford participates only with the knowledge and approval of DOE-RL. The Regulatory Compliance organization within the Environmental Division of Westinghouse Hanford has the primary responsibility for reporting releases and acting as liaison to DOE-RL on compliance issues.

10.2 PRE-OPERATIONAL TESTING AND OPERATION

This section discusses specific tests which LERF components and systems will undergo at construction completion.

10.2.1 Administrative Procedures for Testing New Facilities

Facilities constructed for DOE are tested to ensure that, as constructed, they meet functional and design requirements. This testing is mandated currently by DOE Order 4700.1 *Project Management System* (Ref. 78) and DOE-RL Order 5700.2A, *Project Management System* (Ref. 79). Both of these orders require that the specific project management plan provide for a comprehensive test program. Westinghouse Hanford implements these requirements via the Projects Department which issues and maintains the *Projects Department Management Manual*, WHC-CM-6-2 (Ref. 69) and the *Projects Department Procedures*, WHC-CM-6-12 (Ref. 80).

10.2.1.1 Project Tests. As a minimum, new facilities undergo two types of tests. Acceptance Test Procedures (ATPs) are performed by the vendor and/or construction contractor to assure that design media requirements have been met. These tests verify that the facility/equipment/instruments have been provided, installed, and are functional as specified. Systems are leak tested, continuity tested, and pressure tested with ATPs. Operability Test Procedures (OTPs) are performed by the operating contractor, Westinghouse Hanford, to determine that all functional requirements, e.g., flowrates, heating/cooling duty, etc., have been met. The LERF, with its limited number of components and control systems, is tested through a combination of ATPs and OTPs under the mutual coordination of the constructor (KEH) and the operator (Westinghouse Hanford).

10.2.1.2 Readiness Reviews. The DOE Orders *Safety of Nuclear Facilities*, DOE 5480.5 (Ref. 46) and *Safety Analysis and Review System*, DOE-RL 5481.1 (Ref. 81) require that for new facilities, and for facilities significantly modified or out of service for longer than 1 yr, an Operational Readiness Review (ORR) be performed prior to authorization of facility operation. The ORR is to be based on an analytical method such as presented in DOE 76-45 SSDC-1, "Occupancy-Use Readiness Manual" (Ref. 82) and/or SSDC-4 "Management Oversight and Risk Tree Users Manual" (Ref. 83). The ORR, in addition to determining the readiness of the facility hardware, also assesses organizational and personnel readiness such as staffing, training, and procedures.

Westinghouse Hanford implements the DOE orders via Management Policy 5.16, WHC-CM-1-1 (Ref. 72) and Section 5.50 of WHC-CM-1-3 (Ref. 40), both titled Operational Readiness Reviews. These require that a formal ORR Program be developed and utilized, and specify the responsibilities of facility/plant management, the Readiness Review Board and independent review organizations. The independent review organizations (Environment, Safety, Health and Quality Assurance organization; the Environmental Division; and the Safety and Environmental Advisory Council) conduct parallel but independent reviews in their respective areas of responsibility. The sum of these reviews then constitutes the overall independent review.

10.2.1.3 Liquid Effluent Retention Facility Readiness Review Scope.

10.2.1.3.1 Background/Planned Actions. The Readiness Review Plan establishes the approach for the startup of the LERF following completion of project W-105, "242-A Evaporator Interim Retention Basins". The Readiness Review will be conducted in accordance with WHC-CM-1-3, *Management Requirements and Procedures*, Section 5.50 (Ref. 40).

10.2.1.3.2 Scope. The Readiness Review scope will encompass all hardware, personnel, and documentation necessary to certify the readiness of the LERF to operate in accordance with Department of Energy, Westinghouse Hanford, State of Washington, and Environmental Protection Agency requirements and agreements.

10.2.1.3.3 Determination of Readiness Review. A readiness Review is "a formal, structured process for determining the readiness of a facility, system, or process for subsequent planned operations. The review includes appropriate physical, administrative, and procedural activities required for safe, proficient operations." Westinghouse Hanford manual WHC-CM-1-3, MRP 5.50 (Ref. 40) provides the guidance for conduct of readiness reviews.

10.2.1.3.4 Objective. The objective of the Readiness Review is to assess the readiness of the LERF to begin operation. Specific certification requirements include:

- Hardware
  - Construction, installation, and testing activities are complete or are included on the restart punchlist
  - Equipment maintenance and functional testing activities are complete or are included on the restart punchlist.
- Personnel
  - Sufficient trained operating, maintenance, engineering, and support personnel are available and assigned.
- Documentation
  - Operating procedures are complete and available
  - Safety documentation is complete
  - Environmental documentation is complete.
- Regulatory Requirements
  - All required documentation meeting DOE, State of Washington, Environmental Protection Agency, and Westinghouse Hanford requirements is in place.

10.2.1.3.5 Conduct of Readiness Review. The Readiness Review will be conducted in accordance with WHC-CM-1-3, MRP 5.50 (Ref. 40), "Operational Readiness Reviews." The Readiness Review Board will prepare and approve the Readiness Review Checklist and Acceptance Criteria for those items which must be resolved prior to operation of the LERF.

The Safety, Quality Assurance, and Environmental organizations will approve the Readiness Review Plan, Readiness Review Checklist, and Acceptance Criteria. In addition, they will participate in the Readiness Review Board activity as observers and facilitate timely identification and resolution of safety, quality, or environmental-related issues. Upon completion of the review, each organization will issue a letter to the Manager, Tank Farm Project documenting its independent assessment of operational readiness.

The Readiness Review Board will review and approve the appropriate documentation submitted as auditable evidence of resolution of Checklist items, and upon completion of the Readiness Review, submit a formal recommendation of the Board's assessment of operational readiness to the Manager, Tank Farm Project, who has the start-up approval authority for this action. When it has been determined that preparations are complete, the Manager, Tank Farm Project will request approval from DOE-RL authorizing startup of the LERF.

10.2.1.3.6 Completion of the Readiness Review. The Readiness Review will be complete when the Board's recommendation is complete and submitted to the Manager, Tank Farm Project. Remaining items specific to the scope of the Review will be transferred to a trackable open items list. Issues raised during the course of the Readiness Review which are outside the review's scope will be reported in writing to the Plant Manager as part of the Certification Package transmittal. Upon completion of the Readiness Review the Certification Package and auditable records will be indexed and transferred to the Plant Manager.

10.2.2 Test Program Description

The LERF is designated as a low hazard nuclear facility and contains no Safety Class items as defined by DOE Order 6430.1A (Ref. 4). Systems and components within the LERF are tested to verify conformance to the operating requirements presented in the project *Functional Design Criteria* (Ref. 2), to verify that process operating characteristics are controllable and within the parameters assumed by the accident analyses (Chapter 9.0), and that the Safety Limits (SL) described in the Operational Safety Requirements (OSRs) of Chapter 11.0 of the FSAR are not exceeded.

The acceptability of LERF system and component operation is based upon the functional and definitive design criteria presented in design documents. The criteria provide specific LERF design and operating characteristics and constraints. Deviations from design parameters are evaluated for impact upon the safety margins of the facility design. If deviations are determined to be acceptable, design documentation is revised through approved procedures utilizing a review and approval cycle commensurate with that of the original design. Deviations which pose an unacceptable risk to facility safety or operation are resolved through a system of documented nonconformances which may require system rework or repair.

Prior to testing of the LERF and associated systems, prerequisite conditions are required to be established. The conditions are dictated by the scope of individual test procedures and are specifically identified within the procedures. General prerequisites include flush, closure, and hydrostatic testing of all piping systems, and instrument calibration.

10.2.3 Test Discussion

Testing is performed to verify system and component operation within prescribed limits. A majority of LERF tests are functional tests which require verification of not only system end function, but also transmitter output, display status, and indicator position/condition associated with a simulated or actual input variable. The functionality and operability of the LERF will be verified upon completion of the acceptance and operability testing procedures. The scope of each procedure is defined in the *Projects Department Management Manual*, WHC-CM-6-2 (Ref. 69) and the *Projects Department Procedures*, WHC-CM-6-12 (Ref. 80). The acceptance criteria and margin of acceptability are found in the design documentation (Ref. 2 and Ref. 29). The scope of the two types of tests differ; however, the compliance verification activities may be completed under one procedure.

10.2.3.1 Acceptance Test Procedure 4788 "Evaporator/LERF Instrument and Electrical Systems." This test is written and performed to verify the function of the LERF Leak Detection System and Leachate Level Sensors. Included is verification of leak detector continuity, logic, status indication, and pump activation and valve control. Also within the test scope is verification of leachate pump logic, level detection, starter pump status indication and heat trace (Ref. 84).

As part of the ATP performance, the LERF Leak Detection and Leachate Level Sensor systems will demonstrate that:

- Leak detection circuits are operable
- Leaks are detected and annunciated, and the location (zone) of the leak correctly identified
- Upon detection of leak, Process Condensate Pump is stopped, MOV-43-1 closes, and condensate is diverted to Tank TK-C-100 through positioning of diversion valve HV-RC3-3
- Leachate level sensors will energize leachate pumps at predetermined level
- Leachate pumps can be manually started and stopped
- Leachate pump status lights operate correctly
- Logic associated with portable pump starter is correct
- Basin heat trace system thermostat operates correctly and heat trace circuits are continuous and without electrical short circuits
- Security gate alarms operate upon gate opening.

10.2.3.2 Acceptance Test Procedure "Composite Samplers at 242-A Evaporator, PUREX, and Liquid Effluent Retention Facility." This test is written and performed to verify the function of the automatic composite sampler at the LERF. Included within the test scope is verification of the sampling capabilities and the ability of the sampler to backpurge off a pressurized line (Ref. 85). This test procedure also discusses composite samplers for the 242-A Evaporator and the PUREX Facility. Only those portions of the test procedure applicable to the LERF are within the scope of this FSAR.

In response to test procedure performance, the automatic composite sampler will demonstrate that:

- Liquid flows into the sample bottles correctly
- Sampling occurs correctly for selected duration and interval

- Automatic bottle switching occurs correctly
- Temperature within the refrigerated compartment is maintained at the selected level
- Peristaltic pump positively seals the sample line at the end of each sample sequence.

10.2.3.3 "Liquid Effluent Retention Facility Test Fill Plan." This plan (Ref. 86) is written and performed to provide evidence that the soil/bentonite liners of the LERF basins do not exceed the required permeability rate of 10 E-07 cm/s (Ref. 30). Test fills serve as models for construction of the LERF basins and are produced using the same types of materials, compaction equipment and techniques as used in the basin construction and are in accordance with approved mixing, hauling and placement procedures. The various test fills are constructed using different combinations of compaction equipment and requirements, percentage of bentonite in the mix, and time lapse before spreading (Ref. 88). Field and laboratory documentation is compiled into a test report also containing analyses and recommendations as to which combination of materials, equipment and techniques serves as the model for liner construction.

Field testing includes field permeability, field density and moisture content at compaction. Laboratory testing includes bentonite content, liquid limit, plastic limit, plasticity index, particle size analysis, and laboratory permeability testing.

10.2.3.4 "Operability Test Procedure for the Liquid Effluent Retention Facility." The operability verification of the LERF is conducted in two phases; preoperational and operational testing according to the "Operability Test Procedure for the Liquid Effluent Retention Facility" (Ref. 87). The plan has been developed in accordance with *Standard Engineering Practices*, WHC-CM-6-1 (Ref. 67). Preoperational testing is performed in preparation for operational testing. During preoperational testing, components, subsystems and systems are operated at defined parameters to ensure that they are ready for full operational testing. When the components, subsystems and systems have been tested sufficiently at the defined parameters to indicate that normal operating parameters can be achieved, they are tested at designated higher parameters. At completion of preoperational testing, the test results are evaluated and a determination to move into operational testing is made. The preoperational evaluations are made continually as the OTP is being completed.

The preoperational tests demonstrate that:

- The leak detection elements will activate an alarm on the 242-A Motor Control System and correctly identify the activated zone.
- The valving configuration at the basins will correctly react to changing signals indicating various discharge flow rates.

- The manually controlled valves at the basins will operate as required for the different transfer routes.

- The roads, parking, fences, lighting, operations facility and associated equipment, storage facility and associated equipment, the catch basins and motor control centers conform to all appropriate human factors and industrial safety engineering requirements.

The operational tests will demonstrate that:

- The transfer piping and associated valving from the 242-A Evaporator will react to various discharge flow rates and keep the discharge line full of liquid.

- Water will be placed in each basin to ensure that any permeability/leak rate is acceptable for operation with hazardous material.

- The pumps and transfer piping will move liquids between basins.

- The gauges, valves and controls operate appropriately while transferring liquids.

- The integrity of basin piping and liners is intact.

- The leachate piping, pumps and controls are operable.

- The basin cover and cover tension systems are operable.

The acceptance, preoperational and operational tests are coordinated to minimize duplication and maximize personnel involvement. The steps of each test are verified during various phases of construction and post construction since the testing activities must coincide with specific facility configuration.

10.3 TRAINING PROGRAMS

10.3.1 Program Description

The training programs for Tank Farm personnel are designed to provide the knowledge required to operate the plant in a safe, efficient manner. This section discusses unique LERF training programs for operations, engineering and maintenance. While all employees are required to take various levels of generic training, it is these three organizations which require both generic and plant specific training. Operational Health Physics training is discussed in Chapter 8.0.

The Tank Farm Training Program is developed and implemented through a joint, coordinated effort between the Tank Farm organizations and support organizations such as Westinghouse Hanford Training and Westinghouse Hanford

Safety departments. The Tank Farm Project organization maintains full responsibility for ensuring the safe operation of the facilities and for ensuring that plant training needs are satisfied.

The Manager, Tank Farm Project, ensures that Tank Farm personnel are trained completely and adequately to perform their assigned work and that training is maintained current at all times. The Manager, Tank Farm Project, approves the qualification requirements of operating personnel and establishes the desired and minimum number of certified operating personnel. Certification and recertification of personnel is also the responsibility of the Manager, Tank Farm Project.

Tank Farm Project functional managers are responsible to ensure that all assigned personnel are trained completely and adequately for their assignments. Also, they are responsible for the identification of new or updated training needed to achieve required skills and performance levels. Managers are responsible for scheduling their personnel to attend required training classes and for ensuring that staff training is maintained current with applicable training requirements. Tank Farm Operations Managers are responsible for evaluating the training progress of assigned personnel and recommending the certification or recertification of personnel possessing satisfactory levels of knowledge and skill.

The Manager, Tank Farms, ensures that personnel certified through the training program are technically competent and capable of performing Tank Farm plant/facility operations. The Tank Farms Manager is responsible for the development, conduct, evaluation, and documentation of training which specifies qualification prerequisites, requirements and records in accordance with DOE Order 5480.5 *Safety of Nuclear Facilities* (Ref. 46).

The staff training coordinator is responsible for the overall coordination and administration of the OJT programs under the direction of the appropriate operations (group) manager.

The Manager, Engineering and Projects, is responsible for providing accurate, complete, and current technical documents, drawings, and specifications in support of operator training requirements. The Manager, Engineering and Projects, is also responsible for providing technical review and approval of selected elements of the training program.

The training program for operations begins at the new hire level and extends through operations management. The program is described in detail in document WHC-WD-56110-001, *200 Areas Nuclear Operator Training Program Description* (Ref. 89) and document WHC-WD-56110-002, *200 Areas Operations Supervisors/Managers Training Program Description* (Ref. 90).

The Nuclear Operator Training Program consists of three parts: Generic training, Progression training, and Job certification.

10.3.1.1 Operator Generic Training. To achieve initial certification, Nuclear Operators are required to complete non-facility specific, generic training requirements. Generic training is conducted by non-plant forces within the Technical Training organization. Satisfactory completion is required as part of the overall Nuclear Operator Training Program. Each operator must also meet Hanford Environmental Health Foundation (HEHF) mask fit requirements.

10.3.1.2 Operator Progression Training. The program provides training for General Radiochemical Operations and Plant Specific Operations, which include emergency procedures and abnormal plant conditions.

1. General Radiochemical Operations (GRCO) Training--this training provides general operator knowledge that applies to all operating facilities.

   Using the basic knowledge obtained from this training, the operator is ready to apply this same information to specific situations at the plant to which the employee is assigned and ultimately, to the tasks associated with the employee's individual job assignments and responsibilities.

2. Plant Specific Operation--Plant Specific Operations training is provided for each operating facility. This is accomplished through Plant Specific Operations training manuals developed for each facility. These manuals elaborate on GRCO subjects applicable to individual plants. The following topics are covered in the Plant Specific Operations Manuals:

   - Introduction
   - Emergency Procedures
   - Criticality and Radiation Safety
   - Industrial Safety (including hoisting, rigging, and hazardous waste)
   - Operational Safety Requirements
   - Security
   - Processes and Equipment
   - Glossary
   - Study Questions (separate handout).

Under Progression Training, operators are required to successfully complete written examinations on a periodic basis. Examinations are required at 6 mo, 18 mo, 30 mo, 42 mo, and 54 mo. The Nuclear Process Operator (NPO) examination requires the demonstration of comprehensive knowledge on the following:

- General Radiochemical Operations (GRCO)
- Plant Specific Operations
- Emergency Procedures and Abnormal Plant Conditions (EP/APC).

After an operator has successfully completed the 54-mo NPO examination, certification in at least two job specialties and retesting is required every 2 yr to maintain the NPO level. In alternate years, the NPO is required to successfully complete the EP/APC examination.

10.3.1.3 Operator Job Certification. Documented formal and OJT examinations, satisfactory demonstrations of job knowledge, and demonstrations of manipulative skills are required to achieve job certification.

Job Certification is the practical, on-the-job portion of the Nuclear Operator Training Program. Operators are required to successfully complete a written examination and a walk-through evaluation demonstrating their competence in performing a specific job. Recertification is required every 2 yr.

The training requirements for LERF Nuclear Operators beyond those required for Tank Farm Nuclear Operators are included in Section 5.3 of Course Number 060672, "242-A Evaporator Certifications."

10.3.1.4 Operations Manager/Supervisor Training. Tank Farm Project, Facility Operations managers and supervisors, as well as Tank Farm Project support staff also are required to take generic and plant specific training. The training program for operations managers and supervisors is detailed in document WHC-WD-56110-002, *200 Areas Operations Supervisors/Managers Training Program Description* (Ref. 90). This training is in greater depth than that required for Nuclear Process Operators. The LERF specific training requirements for LERF supervisory and other support staff are listed in Table 10-3.

10.3.1.5 Process Engineering Training. The intent of this program is to ensure that selected process engineering personnel possess the basic knowledge necessary to provide safe and technically competent advice, direction, and support for the operation of the LERF and other Tank Farm Project facilities.

The Process Engineering training consists of three phases:

- Phase I is generic and taken by all process engineering exempt personnel and selected technicians
- Phase II is facility specific certification training
- Phase III is process specific certification training.

Table 10-1. Company - General Training Matrix.

Company-General Training Matrix.

Course	Type	Target Audience																
		PM	PO	OM	NO	MM	CM	PE	PC	HP	HPT	LM	CT	QA	QC	SF	HZ	FD
Radiation safety training	I	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Radiation safety requalification	C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hanford Site general employee training	C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
New employee safety training	I	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
On-the-job training instructor training	I	-	-	3	3	3	3	-	3	3	3	3	3	-	3	-	-	-
Environmental and hazardous material safety training requirements	I,C	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Building emergency director training	C	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Basic crane and rigging training	C	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-
Orientation to DOE Order 5000.3A occurrence reporting	I	X	X	X	X	X	-	X	X	X	-	X	-	X	X	X	X	-

Target audience abbreviations				Legend	
PM	Tank Farms manager and deputy manager	HPT	Health physics technician	I	Introductory course
PO	Tank Farms operations manager and assistant manager	LM	Laboratory manager and chemists/scientists	C	Continuing course
OM	Shift operations manager, shift support, supervisors, and surveillance manager	CT	Chemical technologists	X	Required course
NO	Nuclear operators	QA	Quality assurance manager and engineers	-	Not applicable
MM	Maintenance manager, supervisors, and engineers	QC	Quality control manager and inspectors	1	Completed as part of job-specific certification
CM	Maintenance craft	SF	Industrial safety manager and engineers	2	Required only for new employees
PE	Plant engineering manager and engineers	HZ	Environmental compliance manager and environmental control officer, waste handling control group manager and engineer and hazardous materials coordinator	3	Required as determined by management for designated personnel
PC	Process engineering manager and engineers	FD	Hanford Fire Department		
HP	Health physics supervisor				

Table 10-2. Plant-Specific Training Matrix.

Plant-Specific Training Matrix

Course	Type	Target Audience																
		PM	PO	OM	NO	MM	CM	PE	PC	HP	HPT	LM	CT	QA	QC	SF	HZ	FD
Orientation - Tank Farms *	I	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Building emergency plan checklist	C	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Tank Farms plant-specific occurrence reporting	I	X	X	X	X	X	-	X	X	X	-	-	-	-	-	-	-	-

Target audience abbreviations				Legend	
PM	Tank Farms manager and deputy manager	HPT	Health physics technician	I	Introductory course
PO	Tank Farms operations manager and assistant manager	LM	Laboratory manager and chemists/scientists	C	Continuing course
OM	Shift operations manager, shift support, supervisors, and surveillance manager	CT	Chemical technologists	X	Required course
NO	Nuclear operators	QA	Quality assurance manager and engineers	-	Not applicable
MM	Maintenance manager, supervisors, and engineers	QC	Quality control manager and inspectors	6	Required only for personnel assigned to unit
CM	Maintenance craft	SF	Industrial safety manager and engineers	*	All other Westinghouse Hanford personnel in a supporting capacity, other than visitors, must complete this course
PE	Plant engineering manager and engineers	HZ	Environmental compliance manager and environmental control officer, waste handling control group manager and engineer and hazardous materials coordinator		
PC	Process engineering manager and engineers	FD	Hanford Fire Department		
HP	Health physics supervisor				

Table 10-3. Job-Specific Training Matrix. (1 of 3 sheets)

Job-Specific Training Matrix. (sheet 1 of 3)

	Type	Target Audience																
		PM	PO	OM	NO	MM	CM	PE	PC	HP	HPT	LM	CT	QA	OC	SF	HZ	FO
General radio-chemical operator training	C	·	·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·
Tank Farms processes and services plant-specific training	C	·	·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·
Nuclear operator certifications	C	·	·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·
Tank Farms operator certification	C	·	·	X[a]	X	·	·	·	·	·	·	·	·	·	·	·	·	·
Console qualification - 242-A Evaporator	C	·	·	X[a]	X	·	·	·	·	·	·	·	·	·	·	·	·	·
Tank Farms operator certification-routines	C	·	·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·
Tank Farms operator certification-surveillance liquid-level monitoring	C	·	·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·
Tank Farms nuclear operator emergency procedures and abnormal plant conditions training	C	·	·	·	X[b]	·	·	·	·	·	·	·	·	·	·	·	·	·
Tank Farms certification-process operations manager	C	·	X	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Tank Farms operational safety requirement	C	X	X	X	X	X	X	X	X	·	·	·	·	X	·	·	·	·
Tank Farms conduct of operations	C	·	X	X	X	·	·	·	·	·	·	·	·	·	·	·	·	·
Tank Farms process operations manager emergency procedures and abnormal plant conditions training	C	·	X	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Phase I process engineering certification (site-generic training)	C	·	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·
Phase II process engineering certification (plant-specific training)	C	·	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·
Phase III process engineering certification (process-specific training)	C	·	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·
Tank Farms process engineering emergency procedures and abnormal plant conditions training	C	·	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·
Tank Farms maintenance emergency procedures and abnormal plant conditions training	C	·	·	·	·	X	X	·	·	·	·	·	·	·	·	·	·	·
Chemical technologist qualification	C	·	·	·	·	·	·	·	·	·	·	·	X	·	·	·	·	·
Health physics technician-trainee certification	I	·	·	·	·	·	·	·	·	·	X[c]	·	·	·	·	·	·	·
Health physics technician-trainee general on-the-job training	C	·	·	·	·	·	·	·	·	·	X[d]	·	·	·	·	·	·	·

Table 10-3. Job-Specific Training Matrix. (2 of 3 sheets)

Job-Specific Training Matrix. (sheet 2 of 3)

Course	Type	Target Audience																
		PM	PO	OM	MO	MM	CM	PE	PC	HP	HPT	LM	CT	QA	QC	SF	HZ	FO
Health physics technician-trainee Tank Farms on-the-job training	C	•	•	•	•	•	•	•	•	•	X[d]	•	•	•	•	•	•	•
Health physics technician certification	C	•	•	•	•	•	•	•	•	•	X[e]	•	•	•	•	•	•	•
Health physics technician general on-the-job training	C	•	•	•	•	•	•	•	•	•	X[f]	•	•	•	•	•	•	•
Health physics technician Tank Farms on-the-job training	C	•	•	•	•	•	•	•	•	•	X[f]	•	•	•	•	•	•	•
Senior health physics technician certification	C	•	•	•	•	•	•	•	•	•	X[g]	•	•	•	•	•	•	•
Senior health physics technician general on-the-job training	C	•	•	•	•	•	•	•	•	•	X[g]	•	•	•	•	•	•	•
Senior health physics technician Tank Farms on-the-job training	C	•	•	•	•	•	•	•	•	•	X[g]	•	•	•	•	•	•	•
Tank Farms health physics technicians emergency procedures and abnormal plant conditions training	C	•	•	•	•	•	•	•	•	•	X[h]	•	•	•	•	•	•	•

Table 10-3. Job-Specific Training Matrix. (3 of 3 sheets)

Job-Specific Training Matrix. (sheet 3 of 3)

				Legend	
PM	Tank Farms manager and deputy manager	HPT	Health physics technician	I	Introductory course
PO	Tank Farms operations manager and assistant manager	LM	Laboratory manager and chemists/scientists	C	Continuing course
OM	Shift operations manager, shift support, supervisors, and surveillance manager	CT	Chemical technologists	X	Required course
NO	Nuclear operators	QA	Quality assurance manager and engineers	X[a]	Required for shift support supervisors designated by Tank Farms management
MM	Maintenance manager, supervisors, and engineers	QC	Quality control manager and inspectors	X[b]	Nuclear process operations must complete this course in alternating years in conjunction with the general radio-chemical operator
CM	Maintenance craft	SF	Industrial safety manager and engineers	X[c]	Required only for those health physics technicians hired into the company at the junior health physics technician level
PE	Plant engineering manager and engineers	HZ	Environmental compliance manager and environmental control officer, waste handling control group manager and engineer and hazardous materials coordinator	X[d]	Required for junior health physics technicians, health physics technicians, and senior health physics technicians
PC	Process engineering manager and engineers	FD	Hanford Fire Department	X[e]	Required only for health physics technicians hired into the company at the health physics technician level or who progress from the junior health physics technician level
HP	Health physics supervisor			X[f]	Required for health physics technicians and senior health physics technicians
				X[g]	Required for senior health physics technicians only
				X[h]	Required for health physics technician-trainees, health physics technicians, and senior health physics technicians

The process engineering training for the Tank Farm Project and Engineered Applications organizations is designed to be in compliance with the employee training requirements specified in Westinghouse Hanford policy manuals WHC-CM-8-6, *Site Support Manual* (Ref. 56) and WHC-CM-4-29, *Nuclear Criticality Safety Manual* (Ref. 23). Process Engineering training, Phase I Site Generic training is based on the training requirements of DOE Order 5480.5, *Safety of Nuclear Facilities*, Chapter V, Part 10, "Personnel Selection and Training," (Ref. 46).

This program applies to the following Tank Farm Plant Engineering exempt personnel: Process engineers, Unit managers, Task analysts, Rotational trainees, and Scientists (designated by management).

Phase I training is a self-study program combined with classroom instruction. A written examination is given to test the students' understanding of materials presented. This training is based on existing technical documents, training manuals, administrative manuals, and operating documents.

When Phase I training is completed, Process Engineering personnel may be eligible for Phase II and Phase III training. Phase II and Phase III training is facility specific and process specific, respectively, in its presentation and ensures that process engineering exempt personnel are knowledgeable about specific plant operations, environmental regulations, and safety policies which need to be addressed to assure safe and productive work practices.

To qualify for Phase II and Phase III certification training, the individual must hold the position of engineer, task analyst, scientist, or manager in the Engineered Applications or Waste Tank Safety Operations and Remediation organizations and be designated as a certification candidate by his/her immediate manager.

Phase II training is Tank Farm specific and addresses all aspects of Tank Farm operation including the LERF. Refer to study guide SD-RE-TR-013, "Tank Farm and Evaporator Process Control PCET and C Phase II, Plant Specific" (Ref. 91) for a detailed description of Phase II training.

On successful completion of Phase II and the prerequisite courses and their subsequent written examinations, the candidate becomes a Certified Process Engineer/II (CPE/II) for the LERF.

The Certification training program for the CPEs is intended to allow safe but effective utilization of CPE staff as they gain experience and knowledge and to facilitate recertification as CPEs are reassigned to cover different process areas or plants. If reassigned to another facility, a CPE would need to successfully complete the CPE/II requirements applicable to that facility.

Phase III training is process specific and divided into areas of specialization. The number of specialized areas depends on the complexity and risk level of the various processes and how process control coverage is assigned at the facility. Not all areas of the facility are required to be covered by Phase III certified personnel. Topics covered in Phase III include details of the process flowsheet, operating specifications, process equipment and relevant operating procedures. Each specialized area identified must list all the subsystems/areas it covers. The training and qualification course for the LERF is to be developed before operation of the LERF (Ref. 92.)

The Phase III Process Specific training is scheduled as the job assignment requires. On receiving a job assignment to a designated Phase III area, the engineer or unit manager together with his/her immediate manager, determine an appropriate time schedule for the completion of the applicable Phase III certification.

Study guides are also provided for the Phase III training areas. These provide a study outline, reading/self-study checklist, and learning objectives. The study guide for the LERF Training course is SD-WM-TR-002, "Process Engineer Certification Training Phase II and III Number 18-1837 Phase III LERF-Process Specific" (Ref. 92). The Phase III certification exam can be either a walk-through/demonstration exam, a written exam, or a combination of both.

10.3.1.6 Maintenance Training. The Tank Farm Project organization utilizes maintenance personnel from a variety of crafts for repair, modification, and installation of equipment and systems. These crafts represent, but are not limited to, pipefitters, millwrights, instrument technicians, electricians, and painters (who are assigned to the plant), boilermakers, sheetmetal workers, and carpenters (who operate from a central shop in the 200 West Area). Each craftsperson belongs to two unions. A craft union controls apprentice programs and journeyman qualifications, while the Hanford Atomic Metal Trades Council (HAMTC) represents the individual as a Hanford bargaining unit worker.

The WHC-CM-8-7, *Operations Support Services*, Section 603, Maintenance Training Program (Ref. 93) provides the implementation requirements for the maintenance training program.

The Manager, Maintenance is responsible for providing trained and qualified maintenance personnel to properly maintain Tank Farm Project, Facility Operations equipment and systems.

To work in Tank Farm Project maintenance management and crafts, personnel must take and pass criticality safety and radiation worker training as well as take the Tank Farm facility orientation course.

There are two types of specific training taken by maintenance personnel: essential equipment training and general training. Essential equipment training is that training given to maintenance personnel on the safe and proper maintenance of essential systems and equipment components. Essential systems and equipment are those that, if improperly maintained or calibrated, could jeopardize employee safety, result in an unacceptable release of hazardous or radioactive material to the environment, or in some way jeopardize public safety. Maintenance on this equipment is restricted to maintenance personnel who have completed an equipment/system specific qualification program.

General training are those classes which are required for the appropriate crafts as deemed necessary by management procedures and state or federal regulations. Examples of general training are Lock and Tag training, which is required for all crafts, or Electrical Worker Safety as required for electricians and instrument technicians.

General Training classes are listed in Table 10-1 and are required to be taken on the frequency stated in the table.

Essential Equipment Training is that training given to each craftsperson on specific components, systems, and processes germane to tasks as specified in Table 10-3. The number of persons to receive each specialized course is determined by the Tank Farm Maintenance Manager. This training will normally be accompanied by a skills checklist.

10.3.2 Retraining Program

Westinghouse Hanford maintains a philosophy of retraining in all its key programs which support qualification and certification training as well as in those courses which deal with safety. As an example, radiation worker and criticality training are performed on a 2-yr basis. Each of the designated training programs listed have retraining requirements. These requirements are consistent with the Westinghouse Hanford concept of maintaining total quality in everything that is accomplished.

10.3.2.1 Operations Retraining. It is the responsibility of all operations managers to ensure that their personnel, as well as themselves, are retrained within the time frame allowed by the course requirements for any specific training subject.

10.3.2.2 Supervisor Requalification/Retraining Program. The purposes of the Supervisor Requalification and Retraining Programs are to ensure that supervisory personnel maintain a sufficient level of knowledge and proficiency to safely operate each facility in compliance with approved procedures, operational safety requirements, appropriate Department of Energy Orders and applicable state and federal requirements.

Supervisor Requalification Program. All certified supervisors shall participate in the Requalification Program. The program established for Tank Farms is described in the SAR for the 242-A Evaporator (Ref. 65).

10.3.2.3 Process Engineering Retraining. The Phase I Generic training does not require retraining by a process engineer. Phase II and III certifications expire 2 yr from the date granted.

For a Phase II or III CPE to fulfill his/her job assignment, the appropriate Phase I/III certification and its prerequisites must be current.

10.3.2.4 Maintenance Retraining. Retraining is required biannually for all crafts personnel who perform work on essential equipment/systems.

An individual who has been away from the craft or plant/area for greater than 1 yr shall not be assigned to work on essential equipment/systems until the successful completion of the classroom and skills portion of the essential equipment training course.

10.3.3 Administration and Records

The administrative responsibilities for training for Tank Farm Project and support organizations lie with a technical training group working in conjunction with staff trainers. The responsibilities, as discussed in prior sections, are divided into technical, formal training, and records-keeping by the technical training group, and on-the-job-training performed by the staff OJT trainers.

10.3.3.1 Operations Training Records. Training records are used to document the status of completed training actions. Also, they are used to flag when requalification training is due. Official training records for all categories of training are maintained by the Training Records Organization. The records are available via computer network Computer Based Training (CBT) records.

10.3.3.2 Process Engineering Training Records. Training Records also maintains the records for Process Engineering Training on CBT. These training records are the official records; therefore, the training/exam renewal is not officially documented until the renewal is properly reported.

The CBT informs engineering managers of the training status of their personnel and alerts the manager when an engineer is due for a specific course renewal. The system is designed to give engineers sufficient notice to allow recertification to be completed before the expiration date assigned to the subject.

10.3.3.3 Maintenance Training Records. Maintenance training records are kept in the Maintenance Current Files Area (CFA). When training records are received by the Technical Training sections for Maintenance, they are transmitted to the CFA within five working days. Unofficial or field training records are maintained by Technical Training for all plant specific training and by the staff training delegate for training status of all Tank Farm Project, Facility Operations personnel.

In addition, special training status updates are provided to managers for their use, including reports identifying those individuals requiring training classes within the next 90 d. Training status reports are distributed weekly to cognizant managers.

10.4 NORMAL OPERATIONS

10.4.1 Operating Specifications

Operating specifications establish limits on the operation of LERF which, if violated, could jeopardize the safety of personnel and could damage equipment, facilities, the environment, or adversely affect product quality. The detailed requirements and authority for preparing, reviewing, releasing and revising operating specifications are covered in GA-3.7, of WHC-CM-5-5, *Operations - General Administration* (Ref. 95).

The specifications for LERF assure that the radioactive constituent concentrations do not exceed the Safety Limits. Also, sampling requirements in the basins, sample analyses, concentration trend analyses action levels and surveillance activities are specified in the Operating Specification Document (Ref. 94).

Violations of specifications are to be immediately reported to the manager of Tank Farm Operations by the responsible supervisor and to managers of Plant Engineering and Quality Engineering. Additional notifications will be made according to WHC-CM-5-7, Section 1.22 "Tank Farms Occurrence Reporting and Processing of Operations Information" (Ref. 70).

10.4.2. Plant Procedures

Westinghouse Hanford maintains a policy that all operations be conducted in accordance with written procedures. Management Policy 1.6 of manual WHC-CM-1-1 (Ref. 72) states that a controlled system of written management directions in the form of policies, requirements, and procedures shall be established to govern activities of employees. Management Requirements Procedure 2.16 of manual WHC-CM-1-3 (Ref. 40) denotes that all managers are responsible to ensure that work performed in their area of responsibility be accomplished in accordance with established procedures, and that controlled copies of procedures and instructions be available at the work locations. Procedure GA-2.4 of manual WHC-CM-5-5 (Ref. 95) emphasizes that all facilities under the control of the Tank Farm Project are to be operated in accordance with formalized, approved procedures.

Liquid Effluent Retention Facility procedures are identified, prepared, reviewed, approved, revised, and distributed in accordance with the system described for all Tank Farm and 242-A Evaporator procedures, and included in Chapter 10.0 of the Evaporator SAR (Ref. 65). A listing of LERF operating procedures is included in Table 10-6. Maintenance of the LERF complies with maintenance procedures and calibration procedures. Maintenance Engineering provides and revises the maintenance and calibration procedures. The LERF shall be operated in compliance with applicable federal, state and local environmental regulations and with Westinghouse Hanford environmental procedures.

Table 10-4. Environmental and Hazardous Material Safety Initial Training Matrix.

Environmental and Hazardous Material Safety Initial Training Matrix.

Employee Category[a]	Course Title: Hazardous Communication and Waste Orientation (1 hour)	Generator Hazards Safety Training (4 hours)	Hazardous Materials Waste Job-Specific Training[b]	Radiation Worker Training (8 hours)	Waste Site-Basic (16 hours)	Scott SKA-PAK[c] Training (2 hours)	Cardiopulmonary Resuscitation (4 hours)	Fire Extinguisher Safety (1 hour)	Waste Site Advanced (24 hours)	Waste Site Field Experience (24 hours)	Hazardous Waste Shipment Certification (24 hours)	Certification of Hazardous Material Shipments (8 hours)	Hazardous Waste Site Supervisor/Manager (8 hours)	Compliance Category[d]	Total Hours
1. All Employees	X														1
2. General Worker		X	X											1	5 + unit-specific training
3. General Supervisor/ Manager		X	X											1	5 + unit-specific training
4. General Nonradiological Shipper		X	X								X			1,2	29 + unit-specific training
5. General Hazardous Material Shipper		X	X									X		1,2	13 + unit-specific training
6a. Hazardous Waste Worker (known hazards)		X	X	X	X									1,3	28 + unit-specific training + field experience
6b. Hazardous Waste Worker (unknown hazards)		X	X	X		X	X	X	X	X				1,4	44 + unit-specific training + field experience
7. Hazardous Waste Supervisor/Manager		X	X	X		X	X	X	X	X			X	1,5	52 + unit-specific training + field experience
8. Hazardous Waste Shipper		X	X	X		X	X	X	X	X	X	X		1,2,4	76 + unit-specific training + field experience

[a] Category definitions are in Table 8-7.
[b] Length varies for each waste management unit.
[c] Scott SKA-PAK is a trademark of Figgie International, Incorporated.
[d] Compliance categories:

1 WAC 173-303, 29 CFR 1910.1200
2 49 CFR 173
3 29 CFR 1910.120 (24-hour requirement)
4 29 CFR 1910.120 (40-hour requirement)
5 29 CFR 1910.120 (40-hour plus 8-hour requirement)

H9008028.1C

Table 10-5. Environmental and Hazardous Material Safety Retraining Matrix.

Employee Category[a]	Course Title (length/frequency)				
	Generator Hazards Safety Training (4 hours/2 years)	Hazardous Materials Waste Job-Specific Training (1 year)[b]	Hazardous Waste Site Retraining (8 hours/1 year)	Hazardous Waste Shipment Certification (24 hours/1 year)	Certification of Hazardous Material Shipments (8 hours/2 years)
1. All Employees			Not Required		
2. General Worker	X	X			
3. General Supervisor/Manager	X	X			
4. General Nonradiological Shipper	X	X		X	
5. General Hazardous Material Shipper	X	X			X
6a. Hazardous Waste Worker (known hazards)	X	X	X		
6b. Hazardous Waste Worker (unknown hazards)	X	X	X		
7. Hazardous Waste Supervisor/Manager	X	X	X		
8. Hazardous Waste Shipper	X	X	X	X	X

[a] Category definitions are in Table 8-7
[b] Length varies for each unit

H9008028.2B

Table 10-6. Liquid Effluent Retention Facility Operating Procedures.

Category	Title
TO-670-010	Operate 242-A Composite Sampler
TO-670-010	Perform Sampling at the LERF Basins
TO-670-020	Waste Transfers Within the LERF Basins
TO-670-030	Perform LERF Inspections

10.4.2.1 System Surveillance Operating Procedure. The Tank Farm Plant Operating Procedure, TO-670-030, "Perform Liquid Effluent Retention Facility Inspections" (Ref. 96) provides instructions for inspections of the LERF to identify and prevent malfunctions, deteriorations, operator errors, and discharges which may cause a release of LERF contents to the environment. To ensure safety, the LERF is inspected daily by operations personnel when the basins contain waste. If the basins do not contain waste, the basins are inspected weekly to ensure compliance with applicable federal and state regulations. The LERF is also inspected after significant precipitation events. The procedure also provides instructions for performing an Annual Safety and Emergency Equipment Inventory for the LERF.

10.4.2.2 Work Authorization System. The Work Authorization/Job Control System is used to control corrective maintenance and modification of existing Westinghouse Hanford facilities and equipment. The JCS lead document is WHC-CM-8-8, *Job Control System* (Ref. 97) which is authorized by Management Policy 5.3, WHC-CM-1-1 (Ref. 72) and established by Management Requirements and Procedures 6.11, WHC-CM-1-3 (Ref. 40). The implementing document for Tank Farm Project, Facility Operations is Procedure 2.14 of WHC-CM-5-7 (Ref. 70).

The JCS provides the procedures needed to ensure that work for the tank farms is adequately planned, reviewed, authorized, performed, evaluated, closed out, and documented in a controlled manner. The Tank Farm Project JCS is administrated by the Tank Farm Production Control organization. The planners, schedulers, and job control administrators are part of Facility Operations. Standard work forms are used to ensure thorough, consistent processing of work packages.

10.4.3 Plant Records

Westinghouse Hanford has established a Records Management Program as directed by Management Requirements and Procedures 3.3 in manual WHC-CM-1-3 (Ref. 40). The Program is controlled by *Records Management*, WHC-CM-3-5 (Ref. 98) and complies with the applicable 1324 series of DOE and DOE-RL Orders (Ref. 99). The purpose is to ensure that important and necessary information is properly identified and easily retrieved when needed and information is disposed of when it no longer serves a useful purpose.

Managers are responsible for identifying all record and non-record material for their organization. Any organization retaining records for Tank Farm Project follows the guidelines in WHC-CM-3-5 (Ref. 98) where the records are listed in the Record Inventory and Disposal Schedule (RIDS) or Machine Generated RIDS (MGRIDS). These schedules also show retention periods. Retention periods are established for records of temporary or non-record value (material that an organization is retaining for reference purposes which other organizations are responsible for retaining and which can be discarded without authority; i.e., catalogs, trade journals, transmittal sheets). Non-record items are evaluated to determine their retention periods. Short periods (less then 3 yr and often not more than 1 yr) are established for non-record items, since they are for convenience or reference only and are usually duplicated elsewhere within the plant or organization. These retention periods are a maximum rather than a minimum; therefore, the items may be discarded prior to the end of the retention period.

Records which pertain to an organization's function, policies, decisions, procedures, operations, or other activities of Tank Farms are considered Record Material. The records will be stored in the shift office, 272 AW, 200 East Area. The material may be preserved for legal record purposes or for the value of informational data.

Some operational records such as Job Controlled Maintenance, Operational Safety Requirements (OSR) compliance are considered to be QA records and are controlled according to the guidelines in *Quality Assurance Manual*, WHC-CM-4-2 (Ref. 100). The Quality Assurance organization concurs in classifying records as QA Records. Quality Assurance records are controlled throughout their life from the time of authentication.

Records may be transferred to records storage areas operated by Information Resource Management (IRM) for a predetermined storage period. The organization generating the records is responsible for determining the required storage period and indexing and logging records which are transferred to storage. The records can be retrieved and reviewed at the IRM storage area and copies may be made for official use. Quality Assurance records cannot be removed from the records storage area. A listing of operational records is shown in Table 10-7.

10.5 EMERGENCY PLANNING

10.5.1 Emergency Response

The *Emergency Plan Manual*, WHC-CM-4-1 (Ref. 75), in compliance with the 5500 series of the DOE Orders: DOE Order 5500.1A, *Emergency Management System* (Ref. 101); DOE Order 5500.2A, *Emergency Notification, Reporting, and Response Levels* (Ref. 102); DOE Order 5500.3, *Reactor and Nonreactor Nuclear Facility Emergency Planning, Preparedness and Response Program for DOE Operations* (Ref. 103); DOE Order 5500.4, *Public Affairs Policy and Planning Requirements for Emergencies* (Ref. 104); DOE Order 5500.7A, *Vital Records Protection Program* (Ref. 105) and related DOE-RL directives, *Emergency Response Plan* (Ref. 106) and *Emergency Procedures* (Ref. 107) have been prepared which specify the Hanford Site emergency plan. The plan establishes the management organization and plans for managing emergencies, establishes the criteria and requirements for area emergency control, and building emergency plans and procedures. The plan applies to all Westinghouse Hanford operations, vendors, visitors, and non-Westinghouse tenants in Westinghouse Hanford-controlled facilities. The plan establishes a Westinghouse Hanford Emergency Response Organization to manage and respond to credible emergency conditions, a method for requesting emergency assistance, and a method for informing Westinghouse

Table 10-7. Operating Records.

Records	Custodian
Daily Operating (Shift) Logs	Facility operations
Operating Procedures History	Engineering & Project, Plant Engineering
Operating Procedures Data Sheets	Engineering & Project, Plant Engineering
Sample Log	Engineering & Project, Plant Engineering
OSR Compliance Maintenance	Engineering & Project, Plant Engineering
Job Controlled Maintenance	Central Files
Preventative Maintenance	Maintenance, Engineering Services
Process Instrument Surveillances, Maintenance, Calibration and Evaluation System (PISCES) Calibration	Engineering Services
Project Records	Engineering & Project, Plant Engineering
Laboratory Analyses	Laboratory Organizations
Effluent Release Data	Environmental Protection
Environmental Survey Data	Environmental Protection
Tank Farm Facilities Surveillance Data	Tank Farm Support Services
Unusual Occurrence Reports	Central Files

Hanford management, the DOE-RL and other site tenants of such events. The plan was coordinated with the emergency preparedness plans of DOE-RL, other DOE-RL contractors, and local and state authorities. Taken as a whole, these plans provide an integrated emergency response capability for the Hanford Site.

The Liquid Effluent Retention Facility has been included in WHC-IP-0263-ETF, *Westinghouse Hanford Building Emergency Plan for 200 East Area Tank Farms* (Ref. 76). The LERF does not present a significant hazard such that additional LERF specific response plans are warranted. A detailed description of the 242-A Emergency Response Plan, as well as the Hanford Site integrated response plan and organization are contained in the 242-A Evaporator SAR, SD-WM-SAR-023 (Ref. 65).

10.5.2 Emergency Response Training

Emergency Preparedness is responsible for establishing and conducting the training program for Westinghouse Hanford Emergency Organization and responsible for the documentation and retention of training program results. Emergency Operations Support is responsible for program development and provides the training.

10.6 DECOMMISSIONING

Decommissioning for the LERF is discussed in Chapter 4.0. A detailed decommissioning plan is dependent upon the construction of a permanent effluent treatment facility and possible reuse of the basins for other waste management purposes.

10.6.1 Decontamination

The LERF basins have the potential for clean closure and reuse to support other projects or facilities. Decontamination and preparation for reuse will be accomplished in accordance with applicable requirements in the *Environmental Compliance Manual*, WHC-CM-7-5 (Ref. 26). The LERF has been shown to be a low level facility with respect to radiological and toxicological concerns. The construction of the basins is such that a majority of the radioactive substances which remain after pumping is completed will be contained within the layers of the basin liners and cover. An attempt will be made to clean and reuse the liners. If the liners cannot be reused, they will be disposed of as low level waste through either unit disposal or segmentation and containment. Associated piping and mechanical components which cannot be reused will be decontaminated for disposal in near-surface sites.

10.6.2 Decommissioning Program

The LERF will continue to receive effluent from the 242-A Evaporator until a permanent effluent treatment facility is constructed. Once the facility has been declared surplus, it will enter a decommissioning program which conforms with WHC-CM-7-5, Part Z, Surplus Facility Decontamination and Decommissioning. WHC-CM-7-5 endorses the requirements of the DOE manual *Defense Decontamination and Decommissioning Program Management Plan* (Ref. 27). This DOE manual identifies the activities required for the management, surveillance, maintenance, and decontamination and decommissioning of surplus facilities managed under the DOE Defense Program. After emptying the LERF basins, they could be available for other low level Waste Management Program uses. If the basins are suitable for such uses, the construction, contamination, and subsequent decommissioning of new facilities would be minimized. Such use would impact the date of decommissioning of the LERF.

10.6.3 Agreements With Outside Organizations

Cleanup of the Hanford Site is the subject of a Tri-Party Agreement between the DOE, the EPA, and the State of Washington (Ref. 108). One of the objectives of that agreement is to develop, demonstrate, and perform waste processing for remaining inventories of radionuclides. The LERF provides an acceptable interim storage of process effluents pending construction of a permanent treatment facility.

10.6.4 Arrangements for Funding

Funding for LERF decommissioning, as for all other Hanford Site DOE programs, is dependent on congressional appropriation. Funding will be requested as the overall Site program is developed and approved.

This page intentionally left blank.

11.0 OPERATIONAL SAFETY REQUIREMENTS

11.1 INTRODUCTION

The Operational Safety Requirements (OSRs) define acceptable conditions to ensure safe operation of the LERF during the interim retention of low hazard waste from the 242-A Evaporator stream effluent. The Operational Safety Limits (OSLs) define the conditions, safe boundaries, bases, and management controls required to ensure safe operation of a low hazard nuclear facility and to ensure that the operations remain within the definition of a low hazard nuclear facility.

11.2 PROPOSED OPERATIONAL SAFETY REQUIREMENTS

The safety requirements proposed for LERF are based on establishing an auditable set of requirements which ensure that the facility is operated within the radiological and toxicological bounds analyzed in Chapter 9.0 and in *242-A Evaporator Interim Retention Basin Hazard Classification Analysis* (Ref. 24).

The results of the accident analyses performed in Chapter 9.0 determined that the design and operation of LERF does not represent an unacceptable risk to the onsite individual or to the public.

An OSR will be required to ensure that the facility remains within the safety envelope as analyzed in Chapter 9.0 and the hazards analysis. The purpose of this OSR will be to ensure that the LERF facility will remain within the radiological and toxicological bounds established in the LERF Hazards Analysis (Ref. 24). The OSR called "LERF Operational Safety Requirement," is presented in the following subsection.

11.2.1 Operation Safety Requirement: LERF Inventory Control

This OSR is applicable to LERF exclusively; however, as the LERF represents an extension of the 242-A Evaporator, an additional OSR will be developed at the evaporator facility to ensure that the LERF inventory does not exceed the inventory limits established in the LERF Inventory Control OSR.

The OSR developed for LERF has been divided into six sections as defined in draft DOE Order N5480.ZZ (Ref. 109). The six sections are: Section 1.0 - Use and Application; Section 2.0 - Safety Limits and Limiting Control Settings; Section 3.0/4.0 - Limiting Condition for Operation and Surveillance Requirements; Section 5.0 - Bases; and Section 6.0 - Administrative Controls.

Table 11-1 presents the LERF OSR.

Table 11-1. Liquid Effluent Retention Facility Operational Safety Requirements. (sheet 1 of 5)

Section 1.0 Use and Application

1.1 DEFINITIONS

Note: Defined terms in this list appear in all-capitalized type throughout this operational safety requirement.

Term	Definition
DCG-water	Derived Concentration Guide - water; the concentration of a radionuclide in water that, under conditions of exposure for one year by one exposure mode, would result in an effective dose equivalent of 100 mrem.
LERF	Liquid Effluent Retention Facility
UNITY RULE	Applies when more than one radioactive or chemical constituent is present. It is defined by the sum of the fractional relationships of the concentration present to its respective DCG value. This result must be less than or equal to one.

Table 11-1. Liquid Effluent Retention Facility Operational Safety Requirements. (sheet 2 of 5)

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

1.2 OPERATIONAL MODES

1.2.1 Mode 1 - Operation -	LERF basin is receiving or is capable of receiving condensate discharge from the 242-A evaporator.
1.2.2 Mode 2 - Shutdown -	The affected LERF basin is not able to receive condensate discharges.

NOTE: It is possible to categorize each of the LERF basins individually into either of the modes above without affecting the other basins (i.e., basins 1 and 2 are in mode 1 while basin 3 is in mode 2).

1.3 FREQUENCY NOTATIONS

Notation	Frequency
Semi-annually	At least once per 180 d

1.4 SAFETY LIMIT

1.4.1 The SL establishes the upper bound for radioactive and chemical constituent concentrations in the LERF basins. Compliance with the SL criteria will ensure that concentrations in the LERF basins remain within the analyzed safety envelope. Compliance with the SL is required in both modes of operation.

Table 11-1. Liquid Effluent Retention Facility Operational Safety Requirements. (sheet 3 of 5)

Section 2.0 Safety Limit

2.1 Radioactive/Chemical Constituent Concentration

Radioactive constituent concentrations in the LERF basins shall not exceed 5,000 x DCG (water) for the following radionuclides: ^{3}H, ^{90}Sr, ^{106}Ru, ^{113}Sn, ^{137}Cs, ^{155}Es, ^{147}Pm, ^{239}Pu, and U (GROSS), (UNITY RULE applies to these calculations).

Note: For this application, the UNITY RULE has been modified such that the sum of the fractional relationships of the concentration present to its respective DCG value is less than or equal to 5,000.

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

Additionally, ammonia concentrations in the basins shall not exceed 3.0 E+04 ppm.

Surveillance: LERF Basin Sampling:

Basin samples shall be collected and analyzed semi-annually. The validated results of these samples shall be compared against the limits established in the SL, formally documented, and entered into a data base which will be used for trend analysis.

Applicability: Both Modes

Actions:

I. If the SL is exceeded take the following actions.

1. Notify 242-A operations to divert effluent streams from the LERF basins and place LERF in mode 2 within 4 h of detection.

2. Take a second sample to verify initial sample results.

Table 11-1. Liquid Effluent Retention Facility Operational Safety Requirements. (sheet 4 of 5)

3. Notify management that the SL has been exceeded and form a team to develop a corrective action plan which will bring the facility back into compliance with its SL.

Section 3.0 Bases

3.1 LERF BASIN RADIOACTIVE AND CHEMICAL CONSTITUENT CONCENTRATION LIMITS

Bases	
Background Summary	The purpose of establishing the LERF basin OSR is to assure that concentrations in the facility stay within the bounds established for the design based accidents in Chapter 9.0.
Application to Safety Analysis	The design base accidents for LERF use 5,000 X DCG as the source term for the maximum credible accidents (UNITY RULE applied). The OSR has been developed to assure these limits are not exceeded.
SL	The SL is established at 5,000 x DCG in the LERF basins (UNITY RULE applied). This is the upper bound of operation for the facility. The control features of the SL are intended to alert plant management to abnormal concentrations in the basins and to conservatively protect the SL.
Mode Applicability	The OSR applies to all modes of operation. The concentration limits in the basins must remain below the SL at all times to remain within the safety envelope defined in Chapter 9.0.
Action Statements	
SL	The actions required in the event of a SL violation are necessary because the facility is operating outside the analyzed safety envelope. A 4 h period is provided to allow for orderly shut down or diversion of evaporator effluents from the LERF.

Table 11-1. Liquid Effluent Retention Facility Operational Safety Requirements. (sheet 5 of 5)

Section 4 Administrative Controls

4.1 ORGANIZATION

4.1.1

The facility manager or designee is ultimately responsible to assure that concentration limits are not violated. This includes administering policy, procedures, and surveillance requirements to assure limits are not approached. It is also this individuals responsibility to review feed concentration data provided from Evaporator operations, and verify that this information is representative of basin sample results.

Training of operators and communication between LERF and 242-A Operations are the responsibility of facility management. Specific requirements and procedures shall be developed to implement these programs.

4.2 Incidents

4.2.1 SL Violation

A violation of the SL concentration limit is classified as an OSR violation. In the event of an OSR violation, DOE-RL will be promptly notified and operations will not recommence until DOE-RL has approved the corrective action plan.

4.2.2 SL Nonconformance

Failure to perform basin sampling at least semi-annually is an OSR nonconformance. Upon discovery of a nonconformance, the appropriate samples will be taken within 7 d or the LERF shall be placed in mode 2.

4.2.3 Incident Reporting

All violations and nonconformances shall be reported as required by WHC-CM-1-3, MRP 5.14 (Ref. 40).

12.0 QUALITY ASSURANCE

Chapter 12.0 describes the Quality Assurance (QA) program established by Westinghouse Hanford Company (Westinghouse Hanford) for the operation of the Liquid Effluent Retention Facility (LERF). The QA program described in this chapter applies to all activities which affect the safety and reliability of the LERF.

12.1 QUALITY ASSURANCE PROGRAM FOR PLANT OPERATION

This section provides a description of the Quality Assurance program which is established for the modification and operation of the LERF. The QA program consists of all planned and systematic actions which are necessary to provide adequate confidence that the LERF will perform satisfactorily. The QA program applies to all activities which could affect safety and reliability at the LERF. The QA program includes Quality Control (QC). The QC is the QA activities related to the physical characteristics of the material, structure, component, or system. The QC verification provides a means by which to control the quality of the material, structure, component, or system to predetermined requirements. Quality assurance provides a multidisciplinary system of QC backed by verification activities which demonstrate the completeness and appropriateness of achieved quality.

The assurance of quality is recognized as a multidisciplinary activity involving many organizational components and is not the sole domain of one organization. All project staff are responsible to plan, perform, and document activities affecting quality according to written procedures.

The Westinghouse Hanford QA Program is described in *Quality Assurance Manual*, WHC-CM-4-2 (Ref. 100) and specifically implemented for the operation of the LERF via the *Tank Farms, Grout, and Solid Waste Management Administration Manual*, WHC-CM-5-7, Section 1.14 (Ref. 70).

12.1.1 Organization

The Westinghouse Hanford organizational structure is described in WHC-CM-1-2, *Organizational Charts and Charters* (Ref. 45). Organizational charts and charters for Westinghouse Hanford divisional organizations denote the areas of responsibility and authority for each major department or division. Charts and charters are also provided to define responsibilities and authorities for some functions.

All Westinghouse Hanford organizations are responsible for implementation of a systematic and adequate approach for the performance of work affecting quality. The QA department has the responsibility for development of the Westinghouse Hanford QA program and has been given independent authority to assess the systematic implementation by all Westinghouse Hanford organizations of the requirements specified in the QA program. Tank Farm Project of the Waste Tank Safety, Operations and Remediation Division will operate the LERF and has responsibility for implementation of the Hanford QA plan to this facility.

The QA Department is responsible for and has the authority to: identify quality problems; initiate, recommend, or provide solutions through designated channels; and verify the implementation of solutions. Quality Assurance has responsibility and authority to order work suspended when continuation could result in violation of approved work requirements, product damage, or personnel injury per WHC-CM-1-3, MRP 5.2, Quality Assurance (Ref. 40), and *Quality Assurance Manual*, WHC-CM-4-2 (Ref. 100).

12.1.2 Design Control

Westinghouse Hanford is responsible for the design of modifications and major repairs for the LERF. Engineering departmental policies, standards, design guides, procedures, and instructions are employed for control of engineering design work to meet technical requirements. The design functions of Westinghouse Hanford are controlled by the management control systems described in *Quality Assurance Manual*, WHC-CM-4-2 (Ref. 100) and *Standard Engineering Practices*, WHC-CM-6-1 (Ref. 67).

Westinghouse Hanford Tank Farm Project Engineering and Projects organization provides controlled documented design definition in accordance with WHC-CM-5-5, GA-1.5, Defense Waste Engineering Charter (Ref. 95) and WHC-CM-6-1, EP-1.7, Engineering Document Approval and Release Requirements (Ref. 67).

The requirements and procedures governing design verification are defined in WHC-CM-6-1, EP-4.1, "Design Verification Requirements" (Ref. 67). The procedures identify the positions responsible for verification and require that design errors are identified and corrected. Documents cannot be released without verification. Verification of design documents is accomplished by individual or interdisciplinary design reviews, alternate calculations to verify the correctness of the original design calculations, or qualification testing to demonstrate adequacy of performance under conditions which simulate the most adverse design conditions. Design verification is accomplished by an individual other than the originator or the immediate supervisor of the originator who has adequate qualifications to have originated the work.

Design changes, including field changes, are subject to design control measures commensurate to those applied to the original design, as described in WHC-CM-6-1, EP-2.2, "Engineering Document Change Control" (Ref. 67). Verification and review of design changes are performed by engineering to the same level as that of the original design.

12.1.3 Procurement Document Control

Procurement procedures ensure that regulatory requirements, design and site investigation bases, and other necessary quality requirements are included or referenced in the documents for procurement of materials, equipment, and services for the LERF.

Procedures for preparation, review, approval, issue, control, and retention of Impact Level 1, Impact Level 2, and selected Impact Level 3 procurement documents are contained in *Procurement Manual and Procedures*, WHC-CM-2-1 (Ref. 111), *Materials Management Manual*, WHC-CM-2-2 (Ref. 112), and the *Quality Assurance Manual*, WHC-CM-4-2 (Ref. 100). The impact level system is described in WHC-CM-1-3, *Management Requirements and Procedures*, MRP 5.43, Impact Levels (Ref. 40).

These procedures identify the requirements to be met by each supplier's QA system, and the instructions for submitting documents to Westinghouse Hanford for information or approval. The procedures also establish Westinghouse Hanford 's right of access to supplier facilities for source inspection and audits, including requirements for advance notification of inspection or tests to be witnessed by a Westinghouse Hanford QA engineer.

Procurement documents issued by Westinghouse Hanford require that the supplier have a documented QA program that implements the applicable portions of the *Quality Assurance Manual*, WHC-CM-4-2 (Ref. 100). The extent of the program required depends on the type and use of the item or service being procured.

Westinghouse Hanford QA reviews procurement documents applicable to Impact Level 1, 2, or 3 items. This is done to ensure that the appropriate procurement clauses in the *Quality Assurance Manual*, WHC-CM-4-2, QI 4.1, "Procurement Document Control," Appendix 2 (Ref. 100), related to quality are referenced or included in procurement documents.

The QA personnel review the procurement documents to verify that the supplier provides appropriate documentation to verify that items or services meet the specified requirements. Any changes to procurement documents are reviewed/approved by the same level of personnel as the initial procurement document. This review is performed by the assigned QA engineer with assistance from the requisitioner/cognizant engineer and documented in accordance with WHC-CM-4-2, QI 4.1 (Ref. 100) before a contract is awarded.

The Procurement and Materials Management department ensures that approved procedures are followed in the procurement process, the required supplier documents are submitted for appropriate action, and records affecting quality are maintained in accordance with *Quality Assurance Manual*, WHC-CM-4-2, QR 17.0, "Quality Assurance Records," (Ref. 100).

12.1.4 Instructions and Procedures

Impact Level 1, 2, and 3 documentation affecting quality are prescribed by and performed in accordance with instructions, procedures, or drawings appropriate to the circumstances described in *Quality Assurance Manual*, WHC-CM-4-2, QR 5.0, "Instructions, Procedures, and Drawings," (Ref. 100). The policies and procedures controlling activities affecting the quality of the LERF are controlled, provide for the preparation, review, approval, distribution, and change control of work-defining documents and include or reference appropriate quantitative or qualitative acceptance criteria for determining that prescribed activities have been satisfactorily accomplished.

Westinghouse Hanford Engineering Standards Board is responsible for the development and approval of standard engineering practices which provide the control for the content and use of design documents per *Management*

Requirements and Procedures, WHC-CM-1-3, MRP 6.1, "Standard Engineering Practices," (Ref. 40). Westinghouse Hanford Manual WHC-CM-6-1, *Standard Engineering Practices* (Ref. 67), identifies the requirements and organizational responsibilities for the preparation, review, and approval of engineering instructions, procedures, and drawings under Westinghouse Hanford control.

Additional procedures which control operations of the LERF include WHC-CM-8-2, *200 Area Support Services*, Section 200, "Calibration Procedures;" Section 300, "Operating Procedures;" and Section 500, "Preventive Maintenance Procedures" (Ref. 113). These procedures control calibration maintenance, operations, and preventive maintenance activities. In addition, all facilities under the control of the Waste Tank Safety, Operations and Remediation Division, including the LERF, are operated in accordance with the formalized, approved procedures in WHC-CM-5-5, *Operations-General Administration*, GA-2.4, Procedure Compliance (Ref. 95).

12.1.5 Control and Identification of Purchased Material, Equipment, and Services

Westinghouse Hanford QA ensures that purchased materials, equipment, and services conform to the procurement documents. Established measures include provisions for source evaluation and selection, objective evidence of inspection at the contractor or subcontractor source, examination of products upon delivery, and audits. Documentary evidence that materials and equipment conform to code, regulation, or contract procurement requirements is made available before installation or use of such materials or equipment. The identification and control of items is according to WHC-CM-4-2, Section 8, Identification and Control of Items (Ref. 100). Specific requirements for the control of purchased materials, equipment, and services are contained in WHC-CM-2-1, *Procurement Manual and Procedures* (Ref. 111), and WHC-CM-2-2, *Materials Management Manual* (Ref. 112).

Procurement activities are planned and requirements documented to ensure a systematic approach to the procurement process. Procurement planning results in the documented identification of procurement methods and organizational responsibilities. The QA participation is provided for evaluation and selection of suppliers, verification of suppliers' activities, and receiving inspections.

Supplier capability to provide items or services is evaluated by Westinghouse Hanford before selection. The results of the supplier evaluation are documented. Suppliers providing commercial-grade items used for Impact Level 1, 2, and 3 applications do not require a source evaluation unless an evaluation is determined necessary based on the complexity of the item and its importance to safety. After receipt of a commercial-grade item, the Westinghouse Hanford purchaser will determine that the item meets the procurement requirements and specifications.

Methods used to accept an Impact Level 1, 2, or 3 item or service from suppliers may include: supplier certification and release (Certificate of Conformance); source verification; receiving inspection; or post-installation testing. In certain cases involving procurement of services only, such as third party inspection, engineering and consulting services, or installation, repair, overhaul, or maintenance work, Westinghouse Hanford will use one or more of the following methods to accept the service:

- Technical verification of the data produced
- Surveillance and audit of the activity
- Review of objective evidence for conformance to the procurement document requirements.

Supplier nonconformances are controlled by established procedures. Items found defective at receiving inspections are tagged and placed in segregated storage for dispositioning by the cognizant engineer. Requirements for nonconformance control are found in *Quality Assurance Manual*, WHC-CM-4-2, QI 4.1, "Nonconformance Documentation and Reporting," and QR 15.0, "Control of Nonconforming Items" (Ref. 100).

The installation of system or subsystem equipment items at the LERF is controlled by Equipment Installation Instructions (EIIs). The EIIs describe the requirements for installation of equipment and contain QA requirements. The preparation, review, approval, release and revision of EIIs are controlled by WHC-CM-6-1, EP-5.6, Equipment Installation Instructions (Ref. 67).

12.1.6 Inspection, Surveillance, and Testing

The "Quality Assurance Manual," WHC-CM-4-2 (Ref. 100) provides for inspection, surveillance, and testing of items and activities affecting quality during procurement, repair, modification, maintenance, installation, and operation.

12.1.6.1 Inspection. Inspection and acceptance criteria are derived from engineering design documents, supplier information, construction procedures, and maintenance procedures. The Quality Engineering organization is responsible for conducting specified inspections in the suppliers' shops during fabrication of material or equipment to ensure that all procurement requirements are being met. The frequency and scope of these inspections will vary with the complexity of work.

The QC organization inspects materials and equipment received at the LERF to ensure that it meets procurement requirements, was not damaged during shipment, has necessary documentation in order, and that all materials and equipment are adequately identified. In addition, Engineering may inspect certain procured items to determine if the necessary technical requirements were met.

The QC supervisor and inspection staff conduct site inspections as required by inspection documents. Inspection personnel will meet the approved training, experience, and qualification procedures established in *Quality Assurance Manual*, WHC-CM-4-2 (Ref. 100). Qualification procedures for inspection personnel include a provision to maintain and periodically review records of inspector qualifications to ensure that they are kept current.

12.1.6.2 Surveillance. The Westinghouse Hanford QA organization has implemented a surveillance program to monitor or observe items or activities for verification of conformance to specified requirements. These surveillances are conducted by a QA organization which is independent of the work being performed and are scheduled or implemented on a random basis. Surveillances are scheduled and conducted based on the activity's relative impact and/or importance to the LERF. All deficiencies, nonconformances, and potential quality problems identified during surveillances are documented and monitored until verification of effective corrective action is made.

The Waste Tank Safety, Operations and Remediation Division also performs its own internal surveillances. These surveillances are conducted in accordance with WHC-CM-5-5, GA-2.7, Internal Surveillance Program Requirements (Ref. 95). The requirements and procedures for the internal surveillance system applicable to the LERF are described in WHC-CM-5-7, *Tank Farms, Grout, and Solid Waste Management Administration Manual*, TFPC 2.1, Internal Surveillance of Tank Farm Operations (Ref. 70). This surveillance system is used to ensure that LERF activities are in compliance with applicable directives, documents and procedures. Surveillances are performed by personnel who are familiar with the area of surveillance but not directly responsible for records, compliance or reporting.

12.1.6.3 Testing. The *Quality Assurance Manual*, WHC-CM-4-2 (Ref. 100), requires that appropriate tests be performed and documented to ensure satisfactory performance of structures, systems, and components.

When testing is required to demonstrate that a system or component will perform satisfactorily in service, the requirements of *Standard Engineering Practices*, WHC-CM-6-1, EP 4.2, Testing Practices (Ref. 67) are implemented.

Functional, operability, and acceptance testing is performed to ensure that equipment maintenance work is performed correctly. This testing is controlled by WHC-CM-5-5, *Operations - General Administration*, EI-015, Functional Tests (Ref. 95). Work completion and retest requirements are also defined and controlled using WHC-CM-8-8, *Job Control System*, Section 5.8, "Work Completion and Retest" (Ref. 97).

12.1.7 Nonconforming Materials, Components, Fabrication, and Construction Features

The Westinghouse Hanford system for the control of nonconforming items requires that spare parts, materials, equipment, and components which do not conform to procurement requirements, lack required documentation, or fail in performance are controlled to prevent their inadvertent installation or use in the LERF. The control of nonconformances are implemented by *Quality Assurance Manual*, WHC-CM-4-2, Control of Nonconforming Items, QR 15.0 and Nonconformance Report Processing, QR 15.2 procedures (Ref. 100). Nonconformances are reported to the respective cognizant engineer through NCRs as specified by the procedure. All personnel are required to report nonconformances to their supervisors.

The nonconforming items are identified by marking, tagging, or other methods that will not adversely affect the use of the item. When possible, nonconforming items are placed in segregated storage until such time that a disposition is determined. Nonconformances are reported to Engineering for disposition. Engineering will decide whether the nonconforming item will be rejected, repaired to an acceptable condition, accepted as is, or other disposition. The disposition must have QA concurrence. The final disposition will be documented on the NCR form as required by procedure.

12.1.8 Corrective Action

The corrective action system provides procedures for prompt identification and correction of conditions adverse to quality which may require corrective action.

Within the Westinghouse Hanford QA program, situations which need corrective action are identified through review and trending of NCRs, supplier surveillance activities, QA surveillance and monitoring programs, QA audits, event fact sheets, trend analyses, and unusual occurrence reports. Corrective action is controlled and documented by means of corrective action reports as implemented by *Quality Assurance Manual*, WHC-CM-4-2, Corrective Action, QR 16.0 and Corrective Action Reporting, QI 16.2 (Ref. 100). When corrective action reports have been initiated, QA will schedule surveillances to monitor the efforts associated with the work to be accomplished.

12.1.9 Quality Assurance Records

Engineering Configuration Management (ECM) ensures that: controlled operating documents are available at work locations when released; that affected personnel are made aware of controlled document changes; and that no obsolete, void, or outdated controlled operating documents exist at work locations. In addition, ECM maintains a centralized accounting of controlled documents and their locations; assigns document numbers; reproduces, releases, tracks and removes controlled copies; and is responsible for record keeping, surveying, and other activities associated with controlling operating documents as detailed in WHC-CM-5-5, *Operations - General Administration*, GA-3.1, Operating Document Control System (Ref. 95).

12.1.10 Audits

This section describes the QA audit program as applied to the LERF. This program is in effect for all design, procurement, fabrication, construction, operation, and maintenance activities. The program applies both externally, to audits of LERF suppliers and contractors, and internally, to audits of Westinghouse Hanford organizational activities.

The QA organization is responsible for the establishment and implementation of the audit program as implemented by the procedures identified in *Quality Assurance Manual*, WHC-CM-4-2 (Ref. 100). Other departments within Westinghouse Hanford furnish engineers and specialists as audit team members.

Westinghouse Hanford policies provide QA full authority to identify and perform audits with full access to records and personnel. Contractual documents require suppliers and contractors to make their facilities, records, and personnel available for audit. Suppliers and contractors are obligated to define and implement corrective actions to resolve deficiencies discovered by the Westinghouse Hanford conducted audits.

Audit frequencies vary, depending upon the nature and importance of the activity being performed and results achieved. For each audit, checklists are prepared which cover the scope of the audit. The checklists identify the procedural requirements to be verified, observations to be made, items or characteristics to be reinspected, and any process or operating parameter to be verified.

Findings and observations are reviewed with responsible management at the conclusion of each audit. These findings and observations are subsequently incorporated into an audit report which is formally transmitted to the audited organization. Management of the audited organization is required to determine the appropriate corrective actions, schedule the corrective actions for completion, and periodically report in writing on such actions until complete. Westinghouse Hanford QA reviews these actions for adequacy and implementation.

13.0 REFERENCES

1. Chapter 173-303, Washington Administrative Code, "Dangerous Waste Regulations," Washington State Department of Ecology, October 1989.

2. WHC-SD-W105-FDC-001 Rev. 0, "242-A Evaporator and PUREX Interim Retention Basin, Project W-105 Functional Design Criteria," Westinghouse Hanford Company, Richland, Washington.

3. Regulatory Guide 3.26, "Standard Format and Content of Safety Analysis Reports for Fuel Processing Plants," U.S. Nuclear Regulatory Commission, February 1975.

4. DOE Order 6430.1A, "General Design Criteria," U.S. Department of Energy, Washington, D.C.

5. DOE/RL-90-43, Rev. 0, Draft "Liquid Effluent Retention Facility Dangerous Waste Permit Application," Department of Energy-Richland Operation Office, Richland, Washington, February, 1991.

6. WHC-SD-WM-PSAD-001, "Preliminary Safety Assessment Document, Evaporator and PUREX Interim Retention Basins," Project W-105, Westinghouse Hanford Company, Richland, Washington, March 28, 1990.

7. PNL-3509, "Standardized Input for Hanford Environmental Impact Statements," Part 1, May 1981 and Part 2, July 1982, Pacific Northwest Laboratory, Richland, Washington.

8. PNL-6415 Rev. 2, "Hanford Site National Environmental Policy Act (NEPA) Characterization," Cushing, C.E. (ed), December 1989.

9. "Yakima Firing Center Proposed Land Acquisition," Department of the Army, I Corps and Fort Lewis, Fort Lewis, Washington, 1989.

10. PNL-6684, "The Data Collection Component of the Hanford Meteorological Monitoring Program," Glantz, C. S. and M. M. Islam, Pacific Northwest Laboratory, Richland, Washington, September 1988.

11. PNL-4622, "Climatological Summary for the Hanford Area," Stone, W. A., J. M. Thorp, O. P. Gifford, and D. J. Hoitink, Pacific Northwest Laboratory, Richland, Washington, 1983.

12. PNL-7471, "Climatological Summary of Wind and Temperature Data for the Hanford Meteorological Monitoring Network," Glantz, C.S., et al., Pacific Northwest Laboratory, Richland, Washington.

13. PNL-6584, "GENII-The Hanford Environmental Radiation Dosimetry Software System, Version 1.485," B.P. Napier, R.A. Peloquin, D. L. Strenge, and J. V. Ramsdell, Pacific Northwest Laboratory, Richland, Washington, December 1988.

14. RLO-76-4, "Evaluation of Impact of Potential Flooding Criteria on the Hanford Project," Energy Research and Development Administration, 1976.

15. SDC 4.1 Rev. 11, Hanford Plant Standards, "Standard Arch-Civil Design Criteria, Design Loads for Facilities," U.S. Department of Energy-Richland Operation Office, Richland, Washington.

16. S-51-1, "Artificial Flood Possibilities on the Columbia River," Corps of Engineers, November 1951.

17. Title 10, Code of Federal Regulations Part 50, "Domestic Licensing of Production and Utilization Facilities," Nuclear Regulatory Commission, 1990.

18. "Seismic Exposure and Criteria for Seismic Analysis of Grand Coulee Dam, Columbia River, Grand Coulee, Washington," Blume, J. A. and Associates, Engineers, prepared for Washington Power Supply System, Richland, Washington, November 1972.

19. Title 40, Code of Federal Regulations Part 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities."

20. Standard Design Criteria 5.1, Hanford Plant Standards, "Standard Design Criteria for Heating, Ventilation, and Air Conditioning," U.S. Department of Energy, Richland, Washington.

21. ANSI A58.1, "Minimum Design Loads for Buildings and Other Structures," American National Standards Institute.

22. WHC-SD-W105-DR-001, Rev. 0, "Liquid Effluent Retention Facility - W105 General Design Criteria - Special Facilities," Westinghouse Hanford Company, Richland, Washington, March 1990.

23. WHC-CM-4-29, "Nuclear Criticality Safety Manual," Westinghouse Hanford Company, Richland, Washington.

24. WHC-SD-WM-PSE-004, "242-A Evaporator Interim Retention Basin Hazard Classification Analysis," Clapp, D. A., Westinghouse Hanford Company, Richland, Washington, 1989.

25. WHC-SD-WM-PSE-006 Rev. 0, "Preliminary Safety Evaluation, Evaporator and PUREX Interim Retention Basin," Project W-105, Johnson, L. E., Westinghouse Hanford Company, Richland, Washington, December 1989.

26. WHC-CM-7-5, "Environmental Compliance Manual," Westinghouse Hanford Company, Richland, Washington.

27. DOE manual (unnumbered), "Defense Decontamination and Decommissioning Program Management Plan," Department of Energy, Washington D.C.

28. WHC-SD-W049-SE-001 Rev. 0, "Liquid Effluent Retention Facility Site Evaluation Report," Westinghouse Hanford Company, Richland, Washington.

29. WHC-SD-W105-CDR-001 Rev. 0, Conceptual Design Report 242-A Evaporator and PUREX Interim Retention Basin Project W-105, Westinghouse Hanford, Richland, Washington.

30. EPA/530-SW-85-014, "Minimum Technology Guidance on Double Liner Systems for Landfills and Surface Impoundments - Design, Construction, and Operation," U.S. Environmental Protection Agency, Washington D.C., Draft, Version 2, May 1985.

31. Title 40, Code of Federal Regulations, Part 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities."

32. WHC-SD-EN-AP-024, Rev. 0, "Interim Status Groundwater Monitoring Plan for the 200 East Area Liquid Effluent Retention Facility," Westinghouse Hanford Company, Richland, Washington.

33. ASME/ANSI B31.3, "Chemical Plant and Petroleum Refinery Piping," The American Society of Mechanical Engineers.

34. DOE Order 5820.2A, "Radioactive Waste Management," U.S. Department of Energy, Washington, D.C.

35. DOE Order 5400.5, "Radiation Protection of the Public and the Environment," U.S. Department of Energy, Washington, D.C.

36. WHC-CM-4-9, "Radiological Design Criteria Manual," Westinghouse Hanford Company, Richland, Washington.

37. WHC-CM-4-10, "Radiation Protection Manual," Westinghouse Hanford Company, Richland, Washington.

38. WHC-CM-4-11, "ALARA Program Manual," Westinghouse Hanford Company, Richland, Washington.

39. WHC-EP-0063-2, "Hanford Radioactive Solid Waste Packaging, Storage, and Disposal Requirements," Westinghouse Hanford Company, Richland, Washington, September 1990.

40. WHC-CM-1-3, "Management Requirements and Procedures," Westinghouse Hanford Company, Richland, Washington.

41. WHC-CM-4-30, "Nuclear Safety Manual," Westinghouse Hanford Company, Richland, Washington.

42. DOE Order 5480.11, "Radiation Protection for Occupational Workers," U.S. Department of Energy, Washington, D.C.

43. WHC-CM-4-3, "Industrial Safety Manual," Westinghouse Hanford Company, Richland, Washington.

44. WHC-CM-4-15, "Radiation Work Requirements and Permits Manual," Westinghouse Hanford Company, Richland, Washington.

45. WHC-CM-1-2, "Organization Charts and Charters," Westinghouse Hanford Company, Richland, Washington.

46. DOE Order 5480.5, "Safety of Nuclear Facilities," U.S. Department of Energy, Washington, D.C.

47. DOE-RL Order 5480.5, "Safety of Nuclear Facilities," U.S. Department of Energy-Richland Operation Office, Richland, Washington.

48. WHC-IP-0692, "Health Physics Procedures Manual," Westinghouse Hanford Company, Richland, Washington.

49. PNL-MA-562, "Radiation Protection Instrument Manual," Pacific Northwest Laboratories, May 1988.

50. ANSI N13.5-1972, "Performance Specifications for Direct Reading and Indirect Reading Pocket Dosimeters for X and Gamma Radiation," (Reaffirmed 1989), American National Standards Institute, Washington, D.C.

51. ANSI N319-1976, "Personnel Neutron Dosimeters (Neutron Energies Less Than 20 MeV)," (Reaffirmed 1984), American National Standards Institute, Washington, D.C.

52. ANSI N322-1977, "Inspection and Test Specifications for Direct and Indirect Reading Quartz Fibre Pocket Dosimeters", (Reaffirmed 1983), American National Standards Institute, Washington, D.C.

53. ANSI N323-1978, "Radiation Protection Instrumentation Test and Calibration," (Reaffirmed 1983), American National Standards Institute, Washington, D.C.

54. WHC-CM-4-12, "Operational Health Physics Practices Manual," Westinghouse Hanford Company, Richland, Washington.

55. WHC-CM-4-16, "Dosimetry Manual," Westinghouse Hanford Company, Richland, Washington.

56. WHC-CM-8-6, "Site Support Manual," Westinghouse Hanford Company, Richland, Washington.

57. DOE Order 5484.1, "Environmental Protection, Safety, and Health Protection Information Reporting Requirements," U.S. Department of Energy, Washington, D.C.

58. PNL-6464, "Environmental Monitoring at Hanford for 1987", R. E. Jaquish and P. J. Mitchell, Pacific Northwest Laboratory, Richland, Washington, 1988.

59. WHC-CM-4-46, "Nonreactor Facilities Safety Analysis Manual," Westinghouse Hanford Company, Richland, Washington.

60. "Threshold Limit Values and Biological Exposure Indices for 1989 - 1990," American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio, 1989.

61. NUREG 1320, "Nuclear Fuel Cycle Facility Accident Analysis Handbook," U.S. Nuclear Regulatory Commission, Washington D.C., May 1988.

62. Regulatory Guide 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington D.C, November 1982.

63. PNL-2844, "Source Term and Radiation Dose Estimates for Postulated Damage to the 102 Building at the General Electric Vallecitos Nuclear Center," J. Mishima, et al., Pacific Northwest Laboratory, Richland, Washington, 1979.

64. SD-WM-DA-033 Rev. 0, "Grout Treatment Facility Review and Authorization Level Classification and Designation," Westinghouse Hanford Company, Richland, Washington.

65. SD-WM-SAR-023 Rev. 0, "242-A Evaporator/Crystallizer Safety Analysis Report," Carro, C. A., Westinghouse Hanford Company, Richland, Washington.

66. WHC-SD-EN-ES-001, Rev. 0, "Engineering Study for Purgewater Treatment," Westinghouse Hanford Company, Richland, Washington.

67. WHC-CM-6-1, "Standard Engineering Practices," Westinghouse Hanford Company, Richland, Washington.

68. ANSI/ASME NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities," American National Standards Institute, Washington, D.C.

69. WHC-CM-6-2, "Projects Department Management Manual," Westinghouse Hanford Company, Richland, Washington.

70. WHC-CM-5-7, "Tank Farms, Grout, and Solid Waste Management Administration Manual," Westinghouse Hanford Company, Richland, Washington.

71. WHC-CM-2-5, "Management Control System," Westinghouse Hanford Company, Richland, Washington.

72. WHC-CM-1-1, "Management Policies," Westinghouse Hanford Company, Richland, Washington.

73. DOE Order 5480.1B, "Environment, Safety, and Health Program for Department of Energy Operations," U.S. Department of Energy, Washington, D.C.

74. DOE Order 5481.1B, "Safety Analysis and Review System," U.S. Department of Energy, Washington, D.C.

75. WHC-CM-4-1, "Emergency Plan Manual," Westinghouse Hanford Company, Richland, Washington.

76. WHC-IP-0263-ETF, "Westinghouse Hanford Company Building Emergency Plan for 200 East Area Tank Farms," Westinghouse Hanford Company, Richland, Washington.

77. WHC-SD-WM-RD-008, "Westinghouse Hanford Company Building Emergency Plan for 200 East Area Tank Farms," Westinghouse Hanford Company, Richland, Washington.

78. DOE Order 4700.1, "Project Management System," U.S. Department of Energy, Washington, D.C.

79. DOE-RL Order 5700.2A, "Project Management System," U.S. Department of Energy-Richland Operations Office, Richland, Washington.

80. WHC-CM-6-12, "Projects Department Procedures," Westinghouse Hanford Company, Richland, Washington.

81. DOE-RL Order 5481.1, "Safety Analysis and Review System," U.S. Department of Energy, Washington D.C.

82. DOE 76-45 SSDC-1, "Occupancy - Use Readiness Manual," U.S. Department of Energy, Washington D.C.

83. DOE 76-45 SSDC-4, "Management Oversight and Risk Tree Users Manual," U.S. Department of Energy, Washington D.C.

84. WHC-SD-W105H-ATP-001, "ATP 4788, Evaporator/LERF Instrument and Electrical Systems Acceptance Test Procedure," Westinghouse Hanford Company, Richland, Washington.

85. WHC-SD-C018H-ATP-001 Rev. 0, "Acceptance Test Procedure for Composite Samplers at 242-A Evaporator, PUREX, and Liquid Effluent Retention Facility, Project C-018," Westinghouse Hanford Company, Richland, Washington.

86. WHC-SD-W105-TP-001, "Liquid Effluent Retention Facility Test Fill Plan," Westinghouse Hanford Company, Richland, Washington.

87. WHC-SD-W105-OTP-001, "Operability Test Procedure for the Liquid Effluent Retention Facility," Westinghouse Hanford Company, Richland, Washington.

88. W-105-C4, "Construction Specification for Soil/Bentonite Liner System for 242-A Evaporator and PUREX Interim Retention Basin," Kaiser Engineers Hanford, Richland, Washington.

89. WHC-WD-56110-001, "200 Areas Nuclear Operator Training Program Description," Westinghouse Hanford Company, Richland, Washington.

90. WHC-WD-56110-002, "200 Areas Operations Supervisors/Managers Training Program Description," Westinghouse Hanford Company, Richland, Washington.

91. SD-RE-TR-013 Rev. 3, "Tank Farm and Evaporator Process Control PCET and C Phase II, Plant Specific," Westinghouse Hanford Company, Richland, Washington.

92. SD-WM-TR-002, "Process Engineer Certification Training Phase II and III. Number 18-1837 Phase III LERF- Process Specific," Westinghouse Hanford Company, Richland, Washington.

93. WHC-CM-8-7, "Operations Support Services," Westinghouse Hanford Company, Richland, Washington.

94. OSD-T-151-00029, "Operating Specification Document for the Liquid Effluent Retention Facility (LERF)," Westinghouse Hanford Company, Richland, Washington.

95. WHC-CM-5-5, "Operations - General Administration," Westinghouse Hanford Company, Richland, Washington.

96. TO-670-030, "Perform Liquid Effluent Retention Facility Inspections," Westinghouse Hanford Company, Richland, Washington.

97. WHC-CM-8-8, "Job Control System," Westinghouse Hanford Company, Richland, Washington.

98. WHC-CM-3-5, "Document Control and Records Management Manual," Westinghouse Hanford Company, Richland, Washington.

99. DOE Order 1324 Series, U.S. Department of Energy, Washington, D.C.

100. WHC-CM-4-2, "Quality Assurance Manual," Westinghouse Hanford Company, Richland, Washington.

101. DOE Order 5500.1A, "Emergency Management System," U.S. Department of Energy, Washington, D.C.

102. DOE Order 5500.2A, "Emergency Notification, Reporting and Response Levels," U.S. Department of Energy, Washington, D.C.

103. DOE Order 5500.3, "Reactor and Nonreactor Nuclear Facility Emergency Planning, Preparedness, and Response Program for DOE Operations," U.S. Department of Energy, Washington, D.C.

104. DOE Order 5500.4, "Public Affairs Policy and Planning Requirements for Emergencies," U.S. Department of Energy, Washington, D.C.

105. DOE Order 5500.7A, "Vital Records Protection Program," U.S. Department of Energy, Washington, D.C.

106. DOE-RL, "Emergency Response Plan," U.S. Department of Energy Richland Office, Richland, Washington, March 1990.

107. DOE-RL, "Emergency Procedures," U.S. Department of Energy Richland Office, Richland, Washington, March 1990.

108. "Hanford Federal Facility Agreement and Consent Order," Washington State Department of Ecology, United States Environmental Protection Agency, U.S. Department of Energy, May 1989.

109. Draft DOE Order N5480.ZZ, "Technical Specifications and Operational Safety Requirements," U.S. Department of Energy, Washington, D.C., May 1989.

110. SD-MP-PMP-001 Rev. 1, "Generic Project Management Plan," Westinghouse Hanford Company, Richland, Washington.

111. WHC-CM-2-1, "Procurement Manual and Procedures," Westinghouse Hanford Company, Richland, Washington.

112. WHC-CM-2-2, "Materials Management Manual," Westinghouse Hanford Company, Richland, Washington.

113. WHC-CM-8-2, "200 Area Support Services," Westinghouse Hanford Company, Richland, Washington.

APPENDIX A

FACILITY DIAGRAMS

This page intentionally left blank.

APPENDIX A FACILITY DIAGRAMS

This section contains facility diagrams for the Liquid Effluent Retention Facility.

Figure A-1.

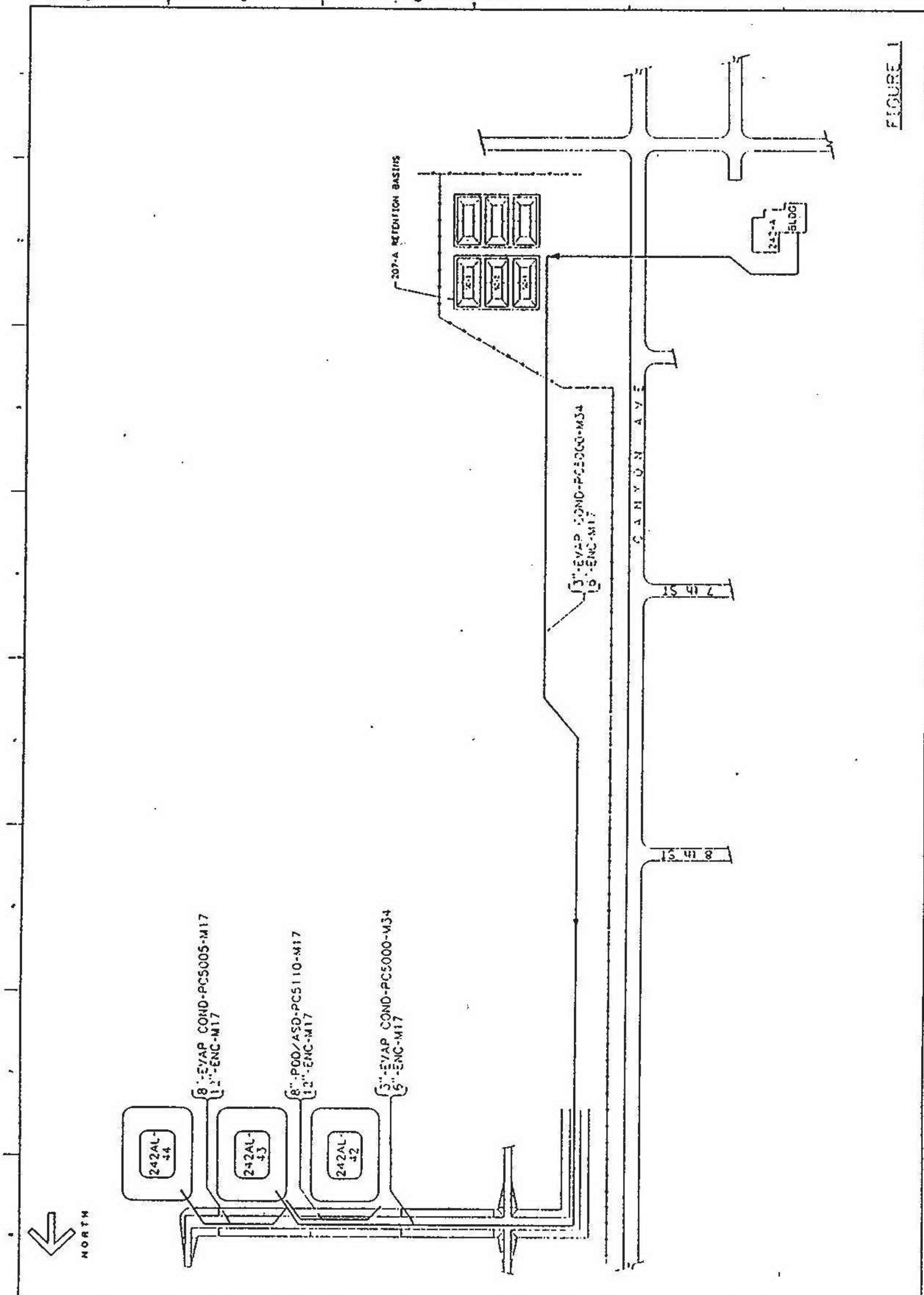


FIGURE 1
207-A RETENTION BASINS
242-A BLDG
CANYON AVE
3" EVAP COND-PC5000-M34
6" ENC-M17
8" EVAP COND-PC5005-M17
12" ENC-M17
8" POD/ASD-PC5110-M17
12" ENC-M17
3" EVAP COND-PC5000-M34
6" ENC-M17
242AL-44
242AL-43
242AL-42
NORTH

Figure A-2.

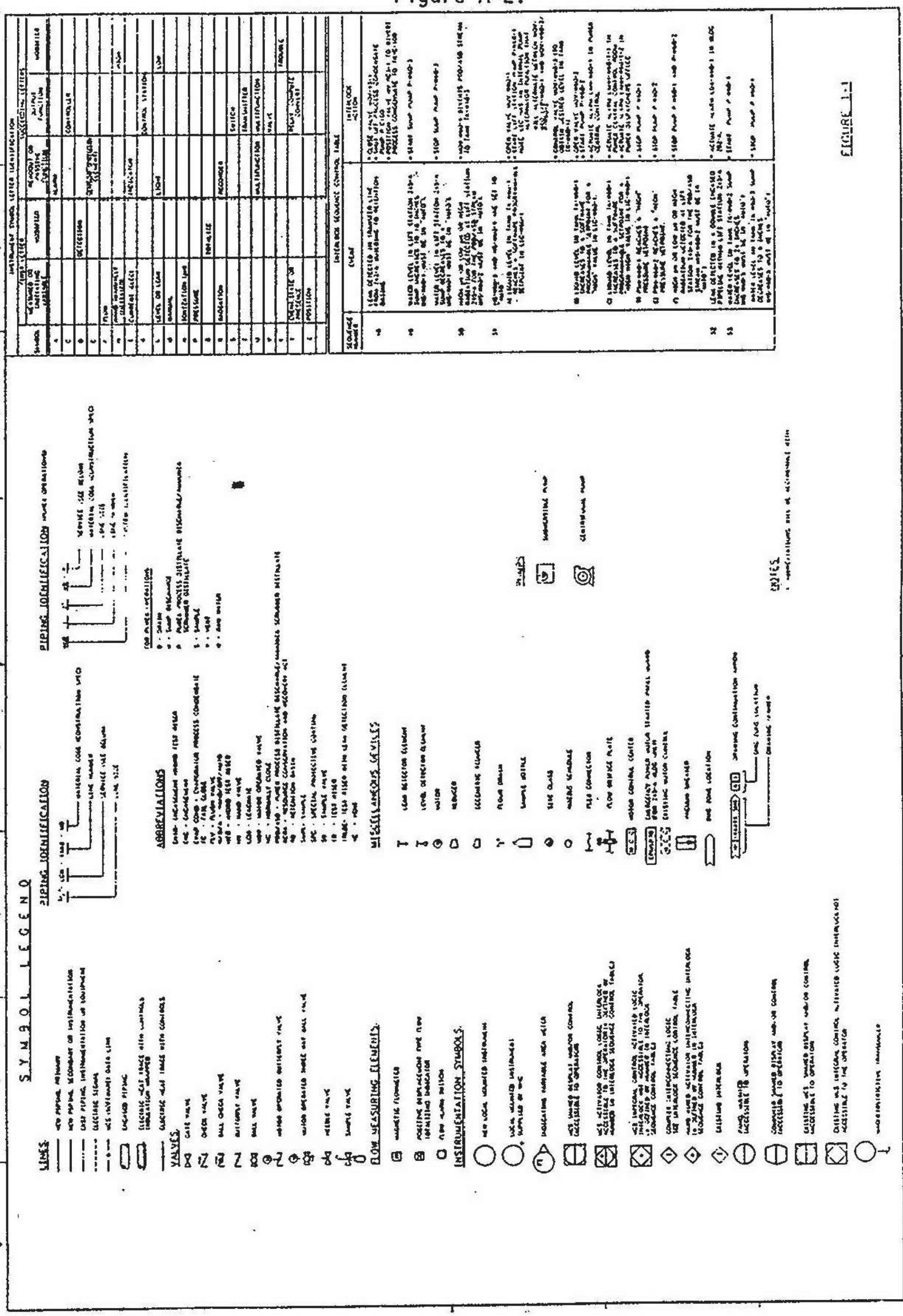


Figure A-3.

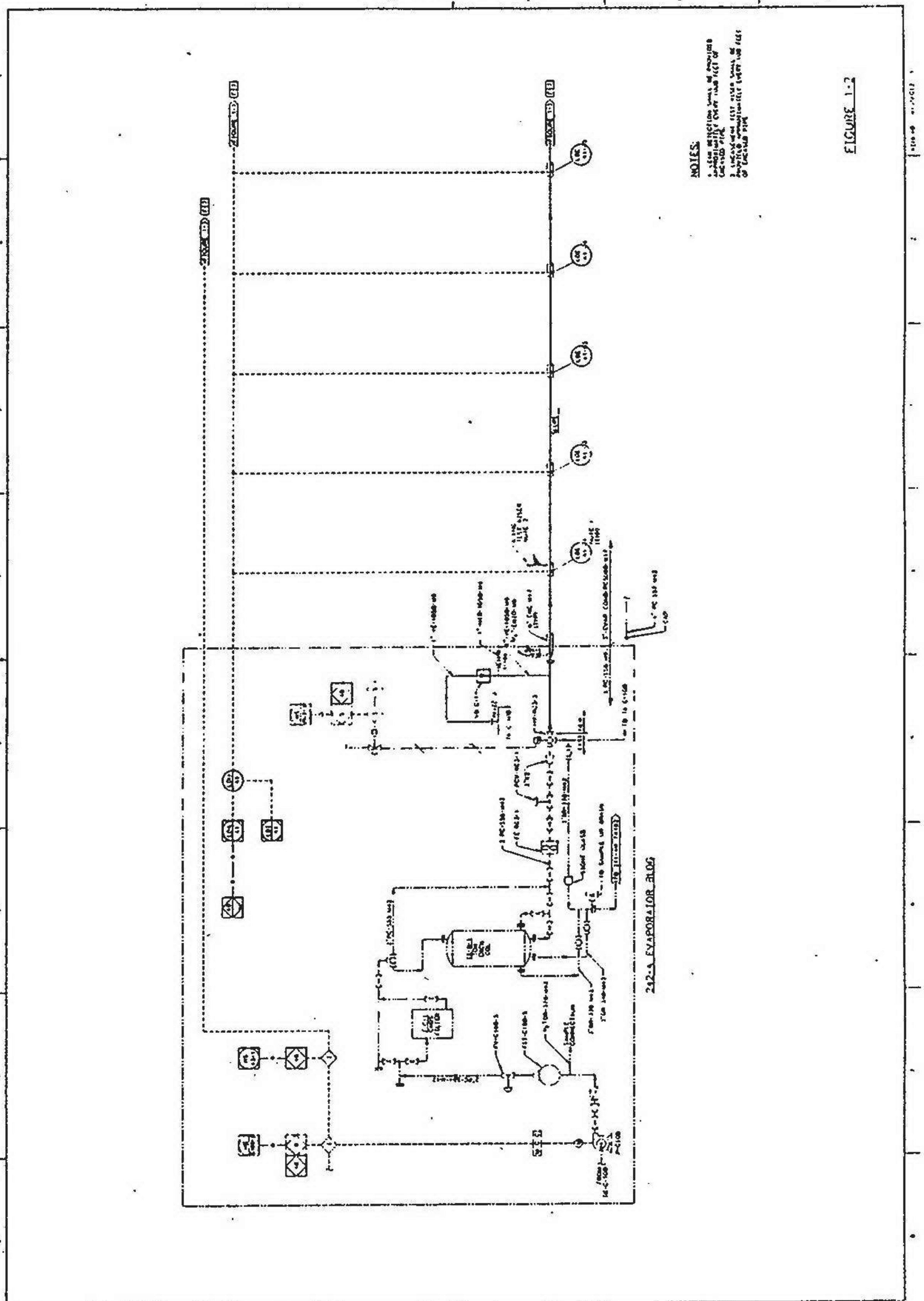
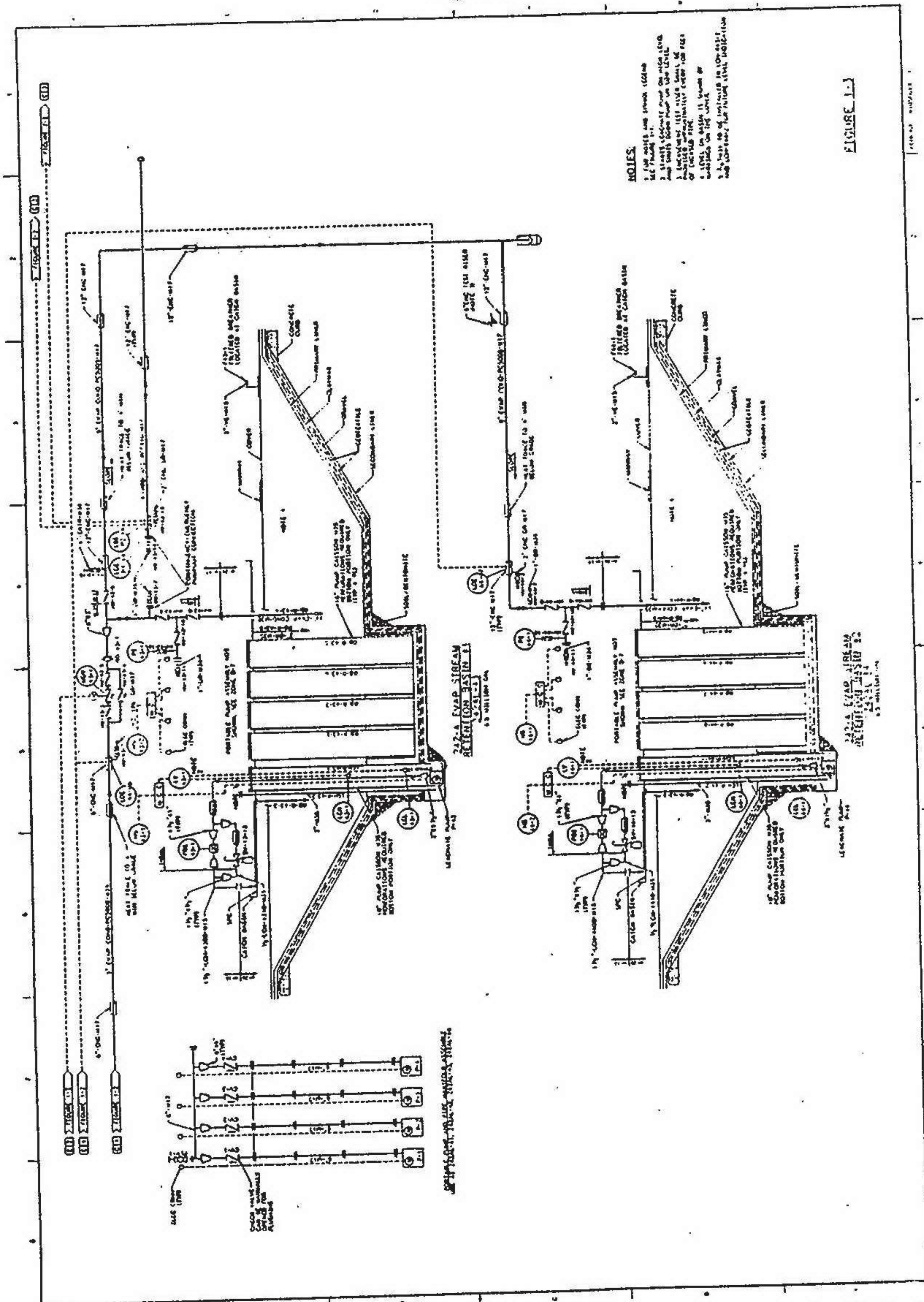


Figure A-4.



This page intentionally left blank.

APPENDIX B

DOE ORDER 6430.1A GENERAL DESIGN REQUIREMENT JUSTIFICATIONS FOR NON-COMPLIANCE

This page intentionally left blank.

APPENDIX B

DOE ORDER 6430.1A GENERAL DESIGN REQUIREMENT JUSTIFICATIONS FOR NON-COMPLIANCE

The following discusses each of the nine non-compliant criteria and provides justification for non-compliance.

I. Section 1300-1.4.4 Monitoring of Releases

I.a. **Requirement**--Requires that all releases from the facility be monitored in accordance with the directive on Radiological Effluent Monitoring and Environmental Surveillance in DOE 5400 series. Chapter II.1a. of DOE 5400.5 requires that annual doses to the Public, for all exposure pathways and radioactive sources, be lower than 100 mrem. Chapter II.3. of DOE 5400.5 addresses routine releases of liquid effluents for disposal, to the soil column. Chapter II.3a. establishes that at the point of discharge no greater than one (1) DCG (or a sum of the fractions totalling 1 DCG) be released to the soil column for disposal. Chapter II.7 requires that annual doses, either factual or anticipated, in excess of 10 mrem be reported.

I.b. **Deviation/Justification**--

- With respect to Chapter DOE Order 5400.5 II.1a. the routine dose assessment performed in Chapter 8.0 and the accident analysis performed in Chapter 9.0 of the Liquid Effluent Retention Facility (LERF) Safety Analysis Report (SAR) have determined that the annual doses to the Public for all exposure pathways will be less than 100 mrem. In addition, with respect to Chapter II.7, the analyses performed in Chapters 8.0 and 9.0 have determined that the annual dose to the Public will not exceed 10 mrem in any year. Therefore, routine airborne effluent monitoring is not required at LERF.

- With respect to Chapter DOE Order 5400.5 II.3a. the LERF is designed to meet the applicable environmental codes and standards to protect the environment. The facility has been designed to contain liquids, i.e., pipe-in-pipe construction and double-walled basins with a leachate collection system, and is not designed to discharge liquids to the soil column for disposal. In addition, a ground water monitoring system consisting of wells has been provided to detect accidental liquid releases to the soil column. Therefore, no liquid effluent monitoring systems, in addition to the wells, are required at LERF.

II. Section 1300-3.2 Safety Class Items

II.a Requirement--

- Defines a safety class item as a system, component, structure, or process whose failure could adversely affect the environment or the health and safety of the public. The LERF does not comply with a requirement within this criteria regarding to provide monitoring during and after a DBA.

II.b. Deviation/Justification--

- With respect to monitoring releases during and after a DBA, the accident analyses performed in Chapter 9.0 of the LERF SAR have determined that the annual doses to the Public for all exposure pathways will be less than 100 mrem during and after a DBA. In addition, with respect to DOE Order 5400.5 Chapter II.7, the analyses performed in Chapter 9.0 have determined that the annual dose to the Public will not exceed 10 mrem in any one year should a DBA occur.

- LERF is also designed to meet the applicable environmental codes and standards required to protect the environment. The facility has been designed to contain liquids, i.e., pipe-in-pipe construction and double-walled basins with a leachate collection system, and is not designed to discharge liquids to the soil column for disposal. In addition, a ground water monitoring system consisting of wells is provided to detect accidental liquid releases to the soil column. The accident analyses performed in Chapter 9.0 of the LERF SAR that liquid releases will not exceed the limits established in DOE Order 5400.5 II.3a during or after a DBA.

III. 1300-6.5.2 Air Monitoring and Warning Systems

III.a. **Requirement**--Requires air monitoring and warning systems be provided in areas where hazardous materials are stored or handled and where hazardous airborne particles or vapors may be present. Air samplers must be located to provide a representative sample of the airborne materials and must comply with ANSI N13.1.

III.b. **Deviation/Justification**--LERF is an unmanned facility and based on the analyses presented in Chapters 8.0 and 9.0 in the LERF SAR does not represent a risk to workers. That is, exposures to workers are below the limits established in DOE Order 5400.5. In addition, workers involved in routine sampling and maintenance activities will be accompanied by Health Physics Technicians with portable instruments to detect airborne radiation.

IV. 1300-6.5.3 Personnel Monitoring and Warning Devices

IV.a. **Requirement**--Requires devices to warn personnel of possible contamination or other hazardous materials if appropriate. Provisions shall be made for personnel monitoring devices in the vicinity of the work station. Continuous Air Monitors (CAMs) shall be provided to detect and alarm at prescribed airborne radioactivity levels. Portable instruments will be available to survey work stations and workers before, during or after routine activities.

IV.b. **Deviation/Justification**--CAMs will not be provided based on the discussion provided in 1300-6.5.2.

V. 1300-6.5.4 Ionizing Radiation Monitoring System

V.a. **Requirement**--Requires an Area Radiation Monitoring (ARM) and alarm system be provide to alert personnel of unexpected increases in ionizing radiation levels.

V.b. **Deviation/Justification**--LERF will not provide ARMs based on the discussion provided in 1300-6.5.2.

VI. 1300-6.8 Change Rooms

VI.a. **Requirement**--Requires men's and women's change rooms for changing into and from protective clothing adjacent to shower facilities. Change rooms shall be designed to segregate contaminated clothing from clean clothing and to ensure that contamination on the contaminated clothing is contained in a storage container. A HEPA filtered exhaust system is also required if dispersible radionuclides are handled in the process area it serves. The LERF is in compliance with all requirements of this criteria with the exception of; the change rooms are not located adjacent to shower facilities, and the change room exhaust system is unfiltered.

VI.b. **Deviation/Justification**--Based on the operations performed at LERF and the low levels of contamination present, it is not justified to provide a decontamination facility at LERF. Decontamination showers, if necessary, are provided in the Tank Farms Decontamination Facility in Building 272-AW. In addition to the Tank Farms Decontamination Facility, emergency eye wash stations and clean water will be provided at LERF for minor emergencies and skin contaminations.

- The LERF is a liquid storage facility and as such no dispersible radionuclides are handled in LERF; therefore, it is not necessary to provide a HEPA filtered exhaust system for the change room facility. Clothing, potentially contaminated from radioactive liquids will be stored in containers, thus eliminating the potential for resuspension of radionuclides in the change room.

VII. 1300-9 Effluent Control and Monitoring

VII.a. **Requirement**--This criteria addresses routine liquid, solid and gaseous waste streams. This criteria requires facilities or equipment be provided to handle these wastes in a safe, efficient and environmentally responsible manner. The LERF does not generate any liquid waste streams during routine operations; however, gaseous and solid wastes are generated during normal operations. Routine gaseous and solid waste streams are discussed in the following:

VII.b. **Deviation/Justification**--

- **Gaseous Wastes**--LERF does not directly generate gaseous wastes. Gasses are released through the filtered breather vents, sample ports and migration through the cover. Based on the dose analyses performed in Chapter 8.0, the consequences associated with these releases are below the dose guidelines presented in DOE Order 5400.5.

- **Solid Wastes**--LERF does not directly generate solid wastes. Solid wastes are generated as a result of routine surveillance, sampling and maintenance activities, consisting primarily of contaminated cloth, paper and failed equipment. The wastes will not be stored at LERF and will be disposed of in accordance with current Westinghouse Hanford policies and procedures. Therefore, the solid waste dose contribution will be negligible.

VIII, 1300-12.4 General Human Factors Implementation Criteria and Considerations

VIII.a. **Requirement**--This section addresses general criteria for incorporating human factors engineering into the design of the facility. This section also addresses the design of human-machine interfaces, i.e., alarms, monitors, displays, etc.

VIII.b. **Deviation/Justification--**

- The LERF is an unmanned facility and the hazard presented by the operation of LERF and the simple system design, control interfaces and operational and maintenance requirements do not require a human factors assessment.

- The use of engineering judgement based on past experiences of operators, design engineers, and maintenance personnel has been utilized in the design of LERF. The design has been reviewed by the appropriate personnel and the concerns of these individuals have been addressed and incorporated in all LERF documentation in accordance with the standard procedures.

IX. 1323-6.3 Effluents

IX.a. **Requirement**--Requires that all exhaust outlets that may contain radioisotopes other than ambient levels of those naturally occurring in the environment be provided with two monitoring systems. The waste sources which shall be considered shall include radioactive liquid waste process vessel vents, and high level liquid radioactive waste collection and storage tank vents.

IX.b. **Deviation/Justification**--LERF is designed to contain only low-level liquid radioactive wastes and does not represent an undue risk to the environment or the Public (see Chapters 8.0 and 9.0).

- The facility has been designed to contain liquids, i.e., pipe-in-pipe construction and double-walled basins with a leachate collection system. Therefore, no liquid effluent monitoring systems, in addition to the wells, are required at LERF.

- The LERF can potentially release airborne effluents via the basin ventilation filters, diffusion through the cover and through the sample ports when opened. As shown in Chapters 8.0 and 9.0, the doses to facility workers and onsite and offsite individuals are insignificant and do not require additional monitoring.

This page intentionally left blank.

APPENDIX C

DOSE MODELS UTILIZED TO ESTIMATE DOSES TO FACILITY WORKERS, AND ONSITE AND OFFSITE INDIVIDUALS

This page intentionally left blank.

APPENDIX C

DOSE MODELS UTILIZED TO ESTIMATE DOSES TO FACILITY WORKERS, AND ONSITE AND OFFSITE INDIVIDUALS

C.1 METHODOLOGY USED TO CALCULATE DIRECT RADIATION DOSE ESTIMATES FOR TRANSFER PIPING AND LERF BASINS

Direct radiation dose estimates have been calculated for the transfer piping and the LERF basin. These calculations were performed using an accepted computer code and the source term presented in the FDC. Section C.1.1 briefly describes the computer code used to calculate the direct radiation dose and Section C.1.2 presents the input and output files generated by the computer code.

C.1.1 Computer Code Used to Generate Dose Estimates

A computer code was used to calculate the direct radiation dose to facility workers near the LERF transfer pipe during a transfer from the 242-A Evaporator to LERF. The computer code used to generate the dose estimates is called ISOSHLD (Ref. C-1). This computer code is the accepted Hanford Site code for calculating direct radiation doses.

The ISOSHLD is a computer code developed by Battelle Northwest Laboratories to perform gama ray shielding calculations for isotopic sources. This code can model the source and the shielding for a variety of applications. Point kernel integration is used to calculate attenuation for most geometries using Simpson's rule for numerical integration. Linked fission product inventory codes are provided to model source strengths in uniform or exponential distributions. Buildup factors are calculated by the code based on the number of mean free paths of material between the source and the target, the effective atomic number of a particular shield, and the point isotropic NDA buildup data available as Taylor coefficients. Other libraries are linked to ISOSHLD available to solve most isotope shielding problems of interest.

The code can calculate solutions for any combination of the following:

<u>Shield and Source Geometry</u>

1. Point
2. Line
3. Sphere
4. Sphere with slab shields
5. Truncated cone
6. Disc
7. Cylinder
8. Cylinder with slab shields
9. Cylinder end

10. Rectangular solid
11. Infinite slab and plane
12. Exponential source distribution where applicable.

Isotope Selection from Calculated Fission Products

1. Noble gases
2. Halogens
3. Volatile solids
4. All except the above 3
5. All fission products
6. Individual isotopes by individual specification.

Source Type

1. Calculated source strength from known fuel irradiation exposure
2. Specify curies of isotopes in library, both fission and activation products
3. Source strength in photons of specific energies for source volume.

Shield Region Geometry and Materials

1. Up to 5 regions
2. Material in each region
3. Material density in each region
4. Region and material for which buildup is most important.

C.1.2 Input and Output Files

The following presents, by case, the input data used to model direct doses to facility workers. In all cases an effective biological factor of 1 was used to convert from Rad to rem.

Case 1: Transfer pipe - Receptor located 1 cm from pipe

Source Term: 5,000 times the DCG for ^{137}Cs and 137MBa (equilibrium ratio of Cs to Ba of 1 to 0.946)

Source Geometry: Cylinder with a diameter equal to 10.16 cm and length equal to 1.83 E+02 cm

Case 2: Transfer pipe - Receptor located 1 m from pipe

Source Term: 5,000 times the DCG for ^{137}Cs and -137MBa (equilibrium ratio of Cs to Ba of 1 to 0.946)

Source Geometry: Cylinder with a diameter equal to 10.16 cm and length equal to 1.83 E+02 cm

Case 3: LERF Basin - Receptor located 1 m above cover and in center of basin

Source Term: 5,000 times the DCG for ^{137}Cs and -137MBa (equilibrium ratio of Cs to Ba of 1 to 0.946)

Source Geometry: Slab with a length equal to 8.23 E+03, width equal to 1.00 E+04, and thickness equal to 6.40 E+02 cm.

The following presents the output files generated by ISOSHLD.

Start run at 11:11:40 02/01/91

ISOSHLD-PC (RIBD removed)
Version 1.6, December 1989
for IBM & Compatible Personal Computers
PROCESS TECHNOLOGY GROUP
KAISER ENGINEERS - HANFORD
Richland, WA 99352

PROJECT W-105 LERF, Rev. 1

Table of Source Activity:

Scale Factor = 1.000E+00

Isotope Name	Initial Values	Final uCi/cc
CS-137	1.50E-02	1.500E-02
BA-137M	1.42E-02	1.420E-02

Shield Composition, g/cc

	Shield 1	Shield 2	Shield 3	Shield 4	Shield 5
H2O	1.200E+00	0.000E+00	0.000E+00		
TISSUE	0.000E+00	2.123E+00	0.000E+00		
AIR	0.000E+00	0.000E+00	1.210E-03		

CASE 1 :4" FRP PIPE, 1 CM FROM THE SURFACE

Source Shields Distance to Detector, X = 6.720E+00 cm
Cylindrical Cyl. & Slab Volume = 1.719E+04 cc
Source Length = 1.829E+02 cm Distance Along Cylinder, Y = 9.144E+01 cm
Integration Specs: NTHETA = 15 NPSI = 15 DELR = 6.837E-01 cm
Total Intervals: 1.800E+03

Shield Thickness, cm 5.470E+00 2.400E-01 1.000E+00
Taylor Buildup Data for Shield 2 with Effective Atomic Number 4.0

Source activity is interpreted as uCi/cc

Exposure Rate at Detection Point = 2.708E-03 R/hr
= 1.941E-10 amp/kg

```
CASE 2  : 100 CM FROM THE SURFACE

Source              Shields         Distance to Detector, X = 1.057E+02 cm
 Cylindrical          Cyl. & Slab       Volume = 1.719E+04 cc
 Source Length = 1.829E+02 cm       Distance Along Cylinder, Y = 9.144E+01 cm
 Integration Specs:    NTHETA = 15    NPSI = 15     DELR = 6.837E-01 cm
   Total Intervals:  1.800E+03

 Shield Thickness, cm    5.470E+00  2.400E-01  1.000E+02
 Taylor Buildup Data for Shield 2 with Effective Atomic Number  4.0

 Source activity is interpreted as uCi/cc

 Exposure Rate at Detection Point = 8.253E-05 R/hr
                                  = 5.915E-12 amp/kg


***>   CASE 000


 Finish run at  11:13:07  02/01/91

 Contents of Input file, b:w-105.00

1         2   PROJECT W-105 LERF, Rev. 1
 CASE  1  :4" FRP PIPE, 1 CM FROM THE SURFACE
 &INPUT NEXT=1,  IGEOM=11, SLTH=182.88, Y=91.44 ,
 T(1)=5.47   ,  T(2)=.24   ,  T(3)=1.0    ,
 X=6.72    ,    NTHETA=15,  NPSI=15,
 NSHLD=3, JBUF=2,  SFACT=1     , DELR=0.672  , ICONC=1,
 WEIGHT(335)=1.5E-02   ,WEIGHT(336)=1.42E-02   &
          1  1.2
          2            2.123
1         3                         0.00121
 CASE 2   : 100 CM FROM THE SURFACE
 &INPUT NEXT=4, T(3)=100, X=105.72   &
 CASE 000
 &INPUT NEXT=6 &
```

Start run at 09:02:01 02/01/91

```
ISOSHLD-PC     (RIBD removed)
Version 1.6,   December 1989
for IBM & Compatible Personal Computers
PROCESS TECHNOLOGY GROUP
KAISER ENGINGEERS - HANFORD
Richland, WA  99352
```

PROJECT W-105 LERF, Rev. 1

Table of Source Activity:

Scale Factor = 1.000E+00

Isotope Name	Initial Values	Final uCi/cc
CS-137	1.50E-02	1.500E-02
BA-137M	1.42E-02	1.420E-02

Shield Composition, g/cc

	Shield 1	Shield 2	Shield 3	Shield 4	Shield 5
H2O	1.200E+00	0.000E+00			
AIR	0.000E+00	1.210E-03			

CASE 1 : DOSE RATE 1 METER ABOVE THE CENTER OF THE POOL

```
Source              Shields          Distance to Detector, X = 7.401E+02 cm
 Slab                 Slab                   Volume = 5.298E+10 cc
 Thickness = 6.401E+02 cm    Height = 8.230E+03 cm    Width = 1.006E+04 cm
 Integration Specs:    NTHETA = 25     NPSI = 25    DELR = 3.048E+01 cm
   Total Intervals:  1.312E+04

 Shield Thickness, cm   6.401E+02  1.000E+02
 Taylor Buildup Data for Shield 1 with Effective Atomic Number  4.0

 Source activity is interpreted as uCi/cc

 Exposure Rate at Detection Point = 1.614E-02 R/hr
                                  = 1.157E-09 amp/kg
```

C.2 METHODOLOGY USED TO CALCULATE DIRECT RADIATION DOSE ESTIMATES FOR TRANSFER PIPING AND LERF BASINS

Radiation exposures to onsite and offsite individuals have been calculated based on postulated airborne releases from LERF. These calculations were performed using an accepted computer code and the source term presented in the FDC. Section C.2.1 briefly describes the computer code used to calculate the direct radiation dose and Section C.2.2 presents the input and output files generated by the computer code.

C.2.1 Computer Code Used to Generate Dose Estimates

A computer code was used to calculate the radiation doses to onsite and offsite from the LERF basins. The computer code used to generate the dose estimates is called GENII (Ref. C-2). This computer code is the accepted Hanford Site code for calculating direct radiation doses.

The GENII is designed to calculate radiation doses for acute and chronic releases, with options for annual, committed and actual dose; for evaluating exposure pathways including direct exposure via water, soil, air, inhalation and ingestion. The scenarios available include acute releases to the air or water, from either elevated or ground level sources; chronic releases to the air or water, from either elevated or ground level sources; and initial contamination of soil or surfaces. Target populations are identified by distance and direction for individuals, populations and for intruders into contained sources. A wide variety of potential exposure scenarios can be used to calculate doses to the target populations.

C.2.2 Input and Output Files

The following presents, by case, the input data and the output files for the GENII runs to calculate doses to the maximum onsite and offsite individual.

C.3 REFERENCES

C-1. Engel, R. L., J. Greenborg, and M. M. Hendrickson. 1966. ISOSHLD - A Computer Code for General purpose Isotope Shielding Analysis, BNWL-236, Pacific Northwest Laboratory, Richland, Washington.

C-2. 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 and 2., Pacific Northwest Laboratory, Richland, Washington.

```
########################## Program GENII Input File ############  8 Jul 88 ####
Title: LERF FSAR - no cover, July dose - 2.43E+6 L, SB 15.4 km E
     \GENII\lerf3sb.in                          Created on 01-17-1991 at 13:04
OPTIONS========================= Default ========================================
F    Near-field scenario?        (Far-field)     NEAR-FIELD: narrowly-focused
F    Population dose?           (Individual)                 release, single site
T    Acute release?               (Chronic)      FAR-FIELD:  wide-scale release,
     Maximum Individual data set used                        multiple sites
                                    Complete                               Complete
TRANSPORT OPTIONS============       Section   EXPOSURE PATHWAY OPTIONS=====  Section
T  Air Transport                    1         T  Finite plume, external      5
F  Surface Water Transport          2         F  Infinite plume, external    5
F  Biotic Transport (near-field)    3,4       F  Ground, external            5
F  Waste Form Degradation (near)    3,4       F  Recreation, external        5
                                              T  Inhalation uptake           5,6
REPORT OPTIONS=======================         F  Drinking water ingestion    7,8
T  Report AEDE only                           F  Aquatic foods ingestion     7,8
T  Report by radionuclide                     F  Terrestrial foods ingestion 7,9
T  Report by exposure pathway                 F  Animal product ingestion    7,10
F  Debug report on screen                     F  Inadvertent soil ingestion

INVENTORY ######################################################################

 4    Inventory input activity units: (1-pCi  2-uCi  3-mCi  4-Ci  5-Bq)
 0    Surface soil source units (1- m2  2- m3  3- kg)
      Equilibrium question goes here

   --------|----Release Terms------|----------Basic Concentrations---------|
   Use when|  transport selected   |  near-field scenario, optionally      |
   --------|-----------------------|---------------------------------------|
   Release |        Surface Buried |        Surface Deep    Ground  Surface|
   Radio-  |Air     Water   Waste  |Air     Soil    Soil    Water   Water  |
   nuclide |/yr     /yr     /m3    |/m3     /unit   /m3     /L      /L     |
   --------|------- ------- -------|------- ------- ------- ------- -------|
   H 3      2.4E+04

   --------|----Derived Concentrations-----|
   Use when|  measured values are known    |
   --------|-------------------------------|
   Release |Terres. Animal  Drink   Aquatic|
   Radio-  |Plant   Product Water   Food   |
   nuclide |/kg     /kg     /L      /kg    |
   --------|------- ------- ------- -------|

TIME ###########################################################################

1     Intake ends after (yr)
50    Dose calc. ends after (yr)
0     Release ends after (yr)
0     No. of years of air deposition prior to the intake period
0     No. of years of irrigation water deposition prior to the intake period

FAR-FIELD SCENARIOS (IF POPULATION DOSE) #######################################

0           Definition option: 1-Use population grid in file POP.IN
0                              2-Use total entered on this line

NEAR-FIELD SCENARIOS ###########################################################

            Prior to the beginning of the intake period: (yr)
```

```
0            When was the inventory disposed?  (Package degradation starts)
0            When was LOIC?  (Biotic transport starts)
0          Fraction of roots in upper soil (top 15 cm)
0          Fraction of roots in deep soil
0          Manual redistribution: deep soil/surface soil dilution factor
0          Source area for external dose modification factor (m2)
TRANSPORT ###################################################################
           ====AIR TRANSPORT=================================SECTION 1=====
                   0-Calculate PM             |0          Release type (0-3)
3          Option: 1-Use chi/Q or PM value    |F          Stack release (T/F)
                   2-Select MI dist & dir     |0          Stack height (m)
                   3-Specify MI dist & dir    |0          Stack flow (m3/sec)
0          Chi/Q or PM value                  |0          Stack radius (m)
13         MI sector index (1=S)              |0          Effluent temp. (C)
15400.0    MI distance from release point (m)|0          Building x-section (m2)
T          Use jf data, (T/F) else chi/Q grid|0          Building height (m)

           ====SURFACE WATER TRANSPORT===========================SECTION 2=====
0          Mixing ratio model: 0-use value, 1-river, 2-lake
0          Mixing ratio, dimensionless
0          Average river flow rate for: MIXFLG=0 (m3/s), MIXFLG=1,2 (m/s),
0          Transit time to irrigation withdrawl location (hr)
           If mixing ratio model > 0:
0            Rate of effluent discharge to receiving water body (m3/s)
0            Longshore distance from release point to usage location (m)
0            Offshore distance to the water intake (m)
0            Average water depth in surface water body (m)
0            Average river width (m), MIXFLG=1 only
0            Depth of effluent discharge point to surface water (m), lake only

           ====WASTE FORM AVAILABILITY===========================SECTION 3=====
0          Waste form/package half life, (yr)
0          Waste thickness, (m)
0          Depth of soil overburden, m

           ====BIOTIC TRANSPORT OF BURIED SOURCE=================SECTION 4=====
T          Consider during inventory decay/buildup period (T/F)?
T          Consider during intake period (T/F)?    | 1-Arid non agricultural
0          Pre-Intake site condition.............. | 2-Humid non agricultural
                                                   | 3-Agricultural

EXPOSURE ####################################################################

           ====EXTERNAL EXPOSURE=================================SECTION 5=====
           Exposure time:                |   Residential irrigation:
0            Plume (hr)                  | T        Consider: (T/F)
0            Soil contamination (hr)     | 0        Source: 1-ground water
0            Swimming (hr)               |                  2-surface water
0            Boating (hr)                | 0        Application rate (in/yr)
0            Shoreline activities (hr)   | 0        Duration (mo/yr)
0          Shoreline type: (1-river, 2-lake, 3-ocean, 4-tidal basin)
0          Transit time for release to reach aquatic recreation (hr)
1.0        Average fraction of time submersed in acute cloud (hr/person hr)

           ====INHALATION========================================SECTION 6=====
8766.0     Hours of exposure to contamination per year
0          0-No resus-  1-Use Mass Loading          2-Use Anspaugh model
0            pension      Mass loading factor (g/m3)   Top soil available (cm)

           ====INGESTION POPULATION==============================SECTION 7=====
```

0	Atmospheric production definition (select option):
0	0-Use food-weighted chi/Q, (food-sec/m3), enter value on this line
	1-Use population-weighted chi/Q
	2-Use uniform production
	3-Use chi/Q and production grids (PRODUCTION will be overridden)
0	Population ingesting aquatic foods, 0 defaults to total (person)
0	Population ingesting drinking water, 0 defaults to total (person)
F	Consider dose from food exported out of region (default=F)

Note below: S* or Source: 0-none, 1-ground water, 2-surface water
3-Derived concentration entered above

==== AQUATIC FOODS / DRINKING WATER INGESTION=========SECTION 8====

F Salt water? (default is fresh)

USE ? T/F	FOOD TYPE	TRAN-SIT hr	PROD-UCTION kg/yr	-CONSUMPTION- HOLDUP da	RATE kg/yr	DRINKING WATER	
F	FISH	0.00	0.0E+00	0.00	0.0	0	Source (see above)
F	MOLLUS	0.00	0.0E+00	0.00	0.0	T	Treatment? T/F
F	CRUSTA	0.00	0.0E+00	0.00	0.0	0	Holdup/transit(da)
F	PLANTS	0.00	0.0E+00	0.00	0.0	0	Consumption (L/yr)

====TERRESTRIAL FOOD INGESTION======================SECTION 9=====

USE ? T/F	FOOD TYPE	GROW TIME da	--IRRIGATION-- S *	RATE in/yr	TIME mo/yr	YIELD kg/m2	PROD-UCTION kg/yr	--CONSUMPTION-- HOLDUP da	RATE kg/yr
F	LEAF V	0.00	0	0.0	0.0	0.0	0.0E+00	0.0	0.0
F	ROOT V	0.00	0	0.0	0.0	0.0	0.0E+00	0.0	0.0
F	FRUIT	0.00	0	0.0	0.0	0.0	0.0E+00	0.0	0.0
F	GRAIN	0.00	0	0.0	0.0	0.0	0.0E+00	0.0	0.0

====ANIMAL PRODUCTION CONSUMPTION===================SECTION 10====

USE ? T/F	FOOD TYPE	---HUMAN---- CONSUMPTION RATE kg/yr	HOLDUP da	TOTAL PROD-UCTION kg/yr	DRINK WATER CONTAM FRACT.	-----STORED FEED----- DIET FRAC-TION	GROW TIME da	-IRRIGATION-- S *	RATE in/yr	TIME mo/yr	YIELD kg/m3	STOR-AGE da
F	BEEF	0.0	0.0	0.00	0.00	0.00	0.0	0	0.0	0.00	0.00	0.0
F	POULTR	0.0	0.0	0.00	0.00	0.00	0.0	0	0.0	0.00	0.00	0.0
F	MILK	0.0	0.0	0.00	0.00	0.00	0.0	0	0.0	0.00	0.00	0.0
F	EGG	0.0	0.0	0.00	0.00	0.00	0.0	0	0.0	0.00	0.00	0.0
						-------------FRESH FORAGE------------						
	BEEF					0.00	0.0	0	0.0	0.00	0.00	0.0
	MILK					0.00	0.0	0	0.0	0.00	0.00	0.0

###

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: LERF FSAR - no cover, July dose - 2.43E+6 L, SB 15.4 km E

Executed on: 03/20/91 at 14:16:41 Page A. 1

This is a far-field (wide-scale release, multiple site) scenario.
Release is acute
Individual dose

THE FOLLOWING TRANSPORT MODES ARE CONSIDERED
Air

THE FOLLOWING EXPOSURE PATHS ARE CONSIDERED:
Finite plume, external
Inhalation uptake

THE FOLLOWING TIMES ARE USED:
Intake ends after (yr): 1.0
Dose calculations ends after (yr): 50.0

========== FILENAMES AND TITLES OF FILES/LIBRARIES USED ====================

Input file name: \GENII\lerf3sb.in	3-20-91
GENII Default Parameter Values (28-Mar-90 RAP)	4-03-90
Radionuclide Master Library (11/28/90 RAP)	11-29-90
External Dose Factors for GENII in person Sv/yr per Bq/n (8-May-90 R	5-08-90
Internal Dose Increments, PNL Solubility Choices Rerun 12/3/90 PDR	12-03-90
EXTGAM - Gamma Energies by Group for Finite Plume (13-May-90 RAP)	5-14-90
200 AREA - 10 M - Pasquill A - F (1983 - 1987 Average)	

Release Radio- nuclide	Air Ci/yr	Surface Water Ci/yr	Buried Source Ci/m3
H 3	2.4E+04	0.0E+00	0.0E+00

(Release Terms)

========== AIR TRANSPORT ==========

Joint frequency data input.
1.5E+04 Maximum individual distance from release point (m)
1.3E+01 Maximum individual sector index (Wind Toward E)
Ground level release.

========== EXTERNAL EXPOSURE ==========

1.0E+00 Fraction of time spent in cloud

========== INHALATION ==========

Resuspension not considered

Input prepared by: ____________________ Date: __________

Input checked by: ______________________________ Date: ____________

==

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: LERF FSAR - no cover, July dose - 2.43E+6 L, SB 15.4 km E

Executed on: 03/20/91 at 14:16:41 Page A. 2

Sector Index: 13
Probability: 5.0E-02

Distance (m)	Travel Time (sec)	Energy 0.15 (MeV)	Energy 0.4 (MeV)	Energy 0.75 (MeV)	Energy 1.25 (MeV)	Energy 1.75 (MeV)	Energy 2.25 (MeV)
15400.	17303.	1.8E-06	1.6E-06	1.5E-06	1.4E-06	1.4E-06	1.2E-06

```
--------------------------------------------------------------------------------
                      GENII  Dose Calculation Program
                        (Version 1.485 3-Dec-90)

Case title:    LERF FSAR - no cover, July dose - 2.43E+6 L, SB 15.4 km E

Executed on:   03/20/91 at 14:16:50                               Page B.   1
--------------------------------------------------------------------------------
9.9E-06    Individual E/Q
```

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: LERF FSAR - no cover, July dose - 2.43E+6 L, SB 15.4 km E

Executed on: 03/20/91 at 14:16:57 Page C. 1

Acute release
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

Organ	Committed Dose Equivalent	Weighting Factors	Weighted Dose Equivalent
Gonads	7.2E-03	2.5E-01	1.8E-03
Breast	7.2E-03	1.5E-01	1.1E-03
R Marrow	8.9E-03	1.2E-01	1.1E-03
Lung	7.2E-03	1.2E-01	8.7E-04
Thyroid	7.2E-03	3.0E-02	2.2E-04
Bone Sur	8.9E-03	3.0E-02	2.7E-04
Stomach	7.2E-03	6.0E-02	4.3E-04
S Int.	7.2E-03	6.0E-02	4.3E-04
UL Int.	7.2E-03	6.0E-02	4.3E-04
LL Int.	7.2E-03	6.0E-02	4.3E-04

Internal Effective Dose Equivalent	7.0E-03
External Dose	0.0E+00
Annual Effective Dose Equivalent	7.0E-03

Controlling Organ:	R Marrow
Controlling Pathway:	Inh
Controlling Radionuclide:	H 3
Total Inhalation EDE:	7.0E-03
Total Ingestion EDE:	0.0E+00

```
GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title:    LERF FSAR - no cover, July dose - 2.43E+6 L, SB 15.4 km E

Executed on:   03/20/91 at 14:16:57                              Page C.  2
-------------------------------------------------------------------------------

Acute release
Uptake/exposure period:                                          1.0
Dose commitment period:                                         50.0
Dose units:                                                  Rem


               Dose Commitment Year
                    1         2         3     ...
             ________________________________
Internal   : |
Intake     : |
Year:      3 |                       0.0E+00   ...
             |                          +
           2 |            0.0E+00    0.0E+00   ...               Internal
             |               +          +                        Effective
           1 |  7.0E-03 + 0.0E+00 + 0.0E+00 + ...  =  7.0E-03   Dose
                                                                 Equivalent
                  ||        ||         ||
Internal                                                         Cumulative
Annual          7.0E-03 + 0.0E+00 + 0.0E+00 + ...  =  7.0E-03   Internal
Dose                                                             Dose
                   +         +          +                 +
External
Annual          0.0E+00   0.0E+00   0.0E+00   ...     0.0E+00
Dose
                  ||        ||         ||                ||
Annual                                                           Cumulative
Dose            7.0E-03 + 0.0E+00 + 0.0E+00 + ...  =  7.0E-03   Dose

                                                                 Maximum
                                                      7.0E-03   Annual
                                                                 Dose Occurred
                                                                 In Year  1
```

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: LERF FSAR - no cover, July dose - 2.43E+6 L, SB 15.4 km E

Executed on: 03/20/91 at 14:16:57 Page C. 3

Acute release
Uptake/exposure period: 1.0
Dose commitment period: 50.0
Dose units: Rem

Committed Dose Equivalent by Exposure Pathway

Pathway	Lung	Stomach	S Int.	UL Int.	LL Int.	Bone Su	R Marro	Testes
Inhale	7.2E-03	7.2E-03	7.2E-03	7.2E-03	7.2E-03	8.9E-03	8.9E-03	7.2E-0
Total	7.2E-03	7.2E-03	7.2E-03	7.2E-03	7.2E-03	8.9E-03	8.9E-03	7.2E-0

Pathway	Ovaries	Muscle	Thyroid
Inhale	7.2E-03	7.2E-03	7.2E-03
Total	7.2E-03	7.2E-03	7.2E-03

External Dose by Exposure Pathway

Pathway	
Plume	0.0E+00
Total	0.0E+00

```
------------------------------------------------------------------------------
                      GENII  Dose Calculation Program
                        (Version 1.485 3-Dec-90)

 Case title:    LERF FSAR - no cover, July dose - 2.43E+6 L, IP 15.4 km E

 Executed on:  03/20/91 at 14:06:54                              Page A.  1
------------------------------------------------------------------------------

          This is a far-field (wide-scale release, multiple site) scenario.
          Release is acute
          Individual dose

          THE FOLLOWING TRANSPORT MODES ARE CONSIDERED
               Air

          THE FOLLOWING EXPOSURE PATHS ARE CONSIDERED:
               Ground, external
               Terrestrial foods ingestion
               Animal product ingestion
               Inadvertent soil ingestion

          THE FOLLOWING TIMES ARE USED:
               Intake ends after (yr):                  50.0
               Dose calculations ends after (yr):       50.0

========== FILENAMES AND TITLES OF FILES/LIBRARIES USED =====================

 Input file name: \GENII\lerf3ip.in                                  3-20-91
 GENII Default Parameter Values (28-Mar-90 RAP)                      4-03-90
 Radionuclide Master Library   (11/28/90 RAP)                       11-29-90
 Food Transfer Factor Library - (RAP  29-Aug-88) (UPDATED LEACHING FA  8-29-88
 External Dose Factors for GENII in person Sv/yr per Bq/n (8-May-90 R  5-08-90
 Internal Dose Increments, PNL Solubility Choices Rerun 12/3/90 PDR  12-03-90
 200 AREA - 10 M - Pasquill A - F (1983 - 1987 Average)

==============================================================================

          -------- ----Release Terms------
          Release           Surface Buried
          Radio-    Air     Water   Source
          nuclide   Ci/yr   Ci/yr   Ci/m3
          -------- ------- ------- -------
          H 3      2.4E+04 0.0E+00 0.0E+00

========== AIR TRANSPORT =====================================================
          Joint frequency data input.
1.5E+04   Maximum individual distance from release point (m)
1.3E+01   Maximum individual sector index (Wind Toward E   )
          Ground level release.

========== EXTERNAL EXPOSURE =================================================
 4.4E+03  Hours of exposure to ground contamination

========== INGESTION POPULATION ==============================================
       1  Atmospheric production definition: 1 - Use population-weighted chi/Q

========== TERRESTRIAL FOOD INGESTION ========================================

                  GROW    --IRRIGATION--          PROD-     --CONSUMPTION--
```

FOOD TYPE	TIME d	S *	RATE in/yr	TIME mo/yr	YIELD kg/m2	UCTION kg/yr	HOLDUP d	RATE kg/yr
Leaf Veg	90.0	0	0.0	0.0	1.5		1.0	3.0E+01
Oth. Veg	90.0	0	0.0	0.0	4.0		5.0	2.2E+02
Fruit	90.0	0	0.0	0.0	2.0		5.0	3.3E+02
Cereals	90.0	0	0.0	0.0	0.8		180.0	8.0E+01

========== ANIMAL FOOD INGESTION ==========

FOOD TYPE	---HUMAN---- CONSUMPTION RATE kg/yr	HOLDUP d	TOTAL PROD-UCTION kg/yr	DRINK WATER CONTAM FRACT.	----STORED FEED---- DIET FRAC-TION	GROW TIME d	S *	-IRRIGATION-- RATE in/yr	TIME mo/yr	YIELD kg/m3	STOR-AGE d
Meat	8.0E+01	15.0		0.00	0.3	90.00	0	0.0	0.0	0.80	0.0
Poultry	1.8E+01	1.0		0.00	1.0	90.00	0	0.0	0.0	0.80	0.0
Cow Milk	2.7E+02	1.0		0.00	0.3	45.00	0	0.0	0.0	2.00	0.0
Eggs	3.0E+01	1.0		0.00	1.0	90.00	0	0.0	0.0	0.80	0.0
					----FRESH FORAGE----						
Meat					0.75	45.0	0	0.0	0.0	2.00	0.0
Cow Milk					0.75	30.0	0	0.0	0.0	1.50	0.0

Note: Animal diet fraction for years 2 through 50.0000

==========

Input prepared by: ______________________ Date: __________

Input checked by: ______________________ Date: __________

==========

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: LERF FSAR - no cover, July dose - 2.43E+6 L, IP 15.4 km E

Executed on: 03/20/91 at 14:06:54 Page A. 2

	Probability	E/Q (sec/m3)	DOQ (m2)	Travel Time (sec)	Population-Weighted E/Q (person-sec/m3)
Sector index:13					
Distance: 15400.0					
	0.0234	1.5E-05	1.5E-07	17303.	
	0.0500	9.9E-06	9.9E-08	17303.	
	0.1000	5.8E-06	5.8E-08	5811.	
	0.2500	4.4E-06	4.4E-08	3277.	
	0.5000	2.0E-06	2.0E-08	2154.	

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: LERF FSAR - no cover, July dose - 2.43E+6 L, IP 15.4 km E

Executed on: 03/20/91 at 14:07:02 Page B. 1

9.9E-06 Individual E/Q

```
                    GENII  Dose Calculation Program
                      (Version 1.485 3-Dec-90)

Case title:    Winter: LERF FSAR - no cover, July dose - 2.43E+6 L, IP 15.4
                km E
Executed on:   03/20/91 at 14:07:17                              Page C.  1

Acute release
Uptake/exposure period:                                        50.0
Dose commitment period:                                        50.0
Dose units:                                                 Rem


            Dose Commitment Year
                  1         2         3      ...

Internal   :  ________________________________
Intake     : |
Year:      3 |                     0.0E+00   ...
             |                        +
           2 |          0.0E+00    0.0E+00   ...            Internal
             |             +          +                     Effective
           1 | 0.0E+00 + 0.0E+00 + 0.0E+00 + ...  =  0.0E+00 Dose
                                                            Equivalent
                  ||        ||         ||
Internal                                                    Cumulative
Annual         0.0E+00 + 0.0E+00 + 0.0E+00 + ...  =  0.0E+00 Internal
Dose                                                        Dose
                  +         +          +               +
External
Annual         0.0E+00   0.0E+00   0.0E+00   ...     0.0E+00
Dose
                  ||        ||         ||              ||
Annual                                                      Cumulative
Dose           0.0E+00 + 0.0E+00 + 0.0E+00 + ...  =  0.0E+00 Dose

                                                            Maximum
                                                     0.0E+00 Annual
                                                            Dose Occurred
                                                            In Year   0
```

External Dose by Exposure Pathway

Pathway	
Sur Soil	0.0E+00
Total	0.0E+00

External Dose by Exposure Pathway

Pathway	
Sur Soil	0.0E+00
Total	0.0E+00

```
------------------------------------------------------------------------------
                     GENII  Dose Calculation Program
                       (Version 1.485 3-Dec-90)

Case title:    Spring: LERF FSAR - no cover, July dose - 2.43E+6 L, IP 15.4
                km E
Executed on:   03/20/91 at 14:07:25                                Page C.  2
------------------------------------------------------------------------------

Acute release
Uptake/exposure period:                                   50.0
Dose commitment period:                                   50.0
Dose units:                                            Rem


            Dose Commitment Year
                   1         2         3      ...

Internal   :  _________________________________
Intake     : |
Year:      3 |                      0.0E+00   ...
             |                         +
           2 |            0.0E+00   0.0E+00   ...                  Internal
             |               +         +                           Effective
           1 | 0.0E+00 + 0.0E+00 + 0.0E+00 + ...  =  0.0E+00       Dose
                                                                   Equivalent
                  ||        ||        ||
Internal                                                           Cumulative
Annual         0.0E+00 + 0.0E+00 + 0.0E+00 + ...  =  0.0E+00       Internal
Dose                                                               Dose
                  +         +         +                 +
External
Annual         0.0E+00   0.0E+00   0.0E+00   ...     0.0E+00
Dose
                  ||        ||        ||                ||
Annual                                                             Cumulative
Dose           0.0E+00 + 0.0E+00 + 0.0E+00 + ...  =  0.0E+00       Dose

                                                                   Maximum
                                                     0.0E+00       Annual
                                                                   Dose Occurred
                                                                   In Year   0
______________________________________________________________________


                      External Dose by Exposure Pathway

Pathway
---------------    -------
Sur Soil           0.0E+00
---------------    -------
Total              0.0E+00
```

External Dose by Exposure Pathway

Pathway	
Sur Soil	0.0E+00
Total	0.0E+00

```
-------------------------------------------------------------------------------
                     GENII  Dose Calculation Program
                       (Version 1.485 3-Dec-90)

Case title:    Summer: LERF FSAR - no cover, July dose - 2.43E+6 L, IP 15.4
                km E
Executed on:   03/20/91 at 14:07:34                               Page C.  3
-------------------------------------------------------------------------------

Acute release
Uptake/exposure period:                                         50.0
Dose commitment period:                                         50.0
Dose units:                                                 Rem


              Dose Commitment Year
                    1          2          3      ...

Internal   :  ______________________________________
Intake     : |
Year:      3 |                        0.0E+00    ...
             |                           +
           2 |             0.0E+00    0.0E+00    ...                Internal
             |                +          +                          Effective
           1 | 0.0E+00 + 0.0E+00 + 0.0E+00 + ...  =  0.0E+00      Dose
                                                                     Equivalent
                 ||        ||         ||
Internal                                                             Cumulative
Annual         0.0E+00 + 0.0E+00 + 0.0E+00 + ...  =  0.0E+00      Internal
Dose                                                                 Dose
                  +         +          +                  +
External
Annual         0.0E+00   0.0E+00    0.0E+00    ...      0.0E+00
Dose
                 ||        ||         ||                  ||
Annual                                                               Cumulative
Dose           0.0E+00 + 0.0E+00 + 0.0E+00 + ...  =  0.0E+00      Dose

                                                                     Maximum
                                                         0.0E+00    Annual
                                                                     Dose Occurred
                                                                     In Year   0
______________________________________________________________________
```

External Dose by Exposure Pathway

Pathway	
Sur Soil	0.0E+00
Total	0.0E+00

External Dose by Exposure Pathway

Pathway	
Sur Soil	0.0E+00
Total	0.0E+00

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: Autumn: LERF FSAR - no cover, July dose - 2.43E+6 L, IP 15.4 km E
Executed on: 03/20/91 at 14:07:42 Page.C. 4

Acute release
Uptake/exposure period: 50.0
Dose commitment period: 50.0
Dose units: Rem

Organ	Committed Dose Equivalent	Weighting Factors	Weighted Dose Equivalent
Gonads	6.6E-01	2.5E-01	1.6E-01
Breast	6.6E-01	1.5E-01	9.8E-02
R Marrow	8.1E-01	1.2E-01	9.7E-02
Lung	6.6E-01	1.2E-01	7.9E-02
Thyroid	6.6E-01	3.0E-02	2.0E-02
Bone Sur	7.7E-01	3.0E-02	2.3E-02
Stomach	6.6E-01	6.0E-02	3.9E-02
S Int.	6.6E-01	6.0E-02	3.9E-02
UL Int.	6.6E-01	6.0E-02	3.9E-02
LL Int.	6.6E-01	6.0E-02	3.9E-02

Internal Effective Dose Equivalent	6.4E-01
External Dose	0.0E+00
Annual Effective Dose Equivalent	6.4E-01

Controlling Organ:	R Marrow
Controlling Pathway:	Ing
Controlling Radionuclide:	H 3
Total Inhalation EDE:	0.0E+00
Total Ingestion EDE:	6.4E-01

```
--------------------------------------------------------------------------------
                      GENII  Dose Calculation Program
                         (Version 1.485 3-Dec-90)

Case title:     Autumn: LERF FSAR - no cover, July dose - 2.43E+6 L, IP 15.4
                 km E
Executed on:    03/20/91 at 14:07:42                              Page C.  5
--------------------------------------------------------------------------------

Acute release
Uptake/exposure period:                                          50.0
Dose commitment period:                                          50.0
Dose units:                                                   Rem


             Dose Commitment Year
                  1        2        3      ...
            ___________________________________
Internal  : |
Intake    : |
Year:     3 |                       0.0E+00  ...
            |                          +
          2 |              0.0E+00  0.0E+00  ...                Internal
            |                 +        +                        Effective
          1 |   6.4E-01 + 0.0E+00 + 0.0E+00 + ... =   6.4E-01  Dose
                                                                Equivalent
                  ||          ||       ||
Internal                                                        Cumulative
Annual          6.4E-01 + 0.0E+00 + 0.0E+00 + ... =   6.4E-01  Internal
Dose                                                            Dose
                  +           +        +                 +
External
Annual          0.0E+00   0.0E+00   0.0E+00  ...       0.0E+00
Dose
                  ||          ||       ||               ||
Annual                                                          Cumulative
Dose            6.4E-01 + 0.0E+00 + 0.0E+00 + ... =   6.4E-01  Dose

                                                                Maximum
                                                      6.4E-01  Annual
                                                                Dose Occurred
                                                                In Year  1
________________________________________________________________
```

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: Autumn: LERF FSAR - no cover, July dose - 2.43E+6 L, IP 15.4 km E
Executed on: 03/20/91 at 14:07:42 Page C. 6

Acute release
Uptake/exposure period: 50.0
Dose commitment period: 50.0
Dose units: Rem

Committed Dose Equivalent by Exposure Pathway

Pathway	Lung	Stomach	S Int.	UL Int.	LL Int.	Bone Su	R Marro	Testes
Leaf Veg	1.9E-02	1.9E-02	1.9E-02	1.9E-02	1.9E-02	2.2E-02	2.3E-02	1.9E-0
Oth. Veg	1.4E-01	1.4E-01	1.4E-01	1.4E-01	1.4E-01	1.6E-01	1.7E-01	1.4E-0
Fruit	2.1E-01	2.1E-01	2.1E-01	2.1E-01	2.1E-01	2.4E-01	2.6E-01	2.1E-0
Cereals	3.3E-02	3.3E-02	3.3E-02	3.3E-02	3.3E-02	3.8E-02	4.0E-02	3.3E-0
Meat	5.1E-02	5.1E-02	5.1E-02	5.1E-02	5.1E-02	6.0E-02	6.3E-02	5.1E-0
Poultry	1.1E-02	1.1E-02	1.1E-02	1.1E-02	1.1E-02	1.3E-02	1.4E-02	1.1E-0
Cow Milk	1.8E-01	1.8E-01	1.8E-01	1.8E-01	1.8E-01	2.1E-01	2.2E-01	1.8E-0
Eggs	1.9E-02	1.9E-02	1.9E-02	1.9E-02	1.9E-02	2.3E-02	2.4E-02	1.9E-0
Soil Ing	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+0
Total	6.6E-01	6.6E-01	6.6E-01	6.6E-01	6.6E-01	7.7E-01	8.1E-01	6.6E-0

Pathway	Ovaries	Muscle	Thyroid
Leaf Veg	1.9E-02	1.9E-02	1.9E-02
Oth. Veg	1.4E-01	1.4E-01	1.4E-01
Fruit	2.1E-01	2.1E-01	2.1E-01
Cereals	3.3E-02	3.3E-02	3.3E-02
Meat	5.1E-02	5.1E-02	5.1E-02
Poultry	1.1E-02	1.1E-02	1.1E-02
Cow Milk	1.8E-01	1.8E-01	1.8E-01
Eggs	1.9E-02	1.9E-02	1.9E-02
Soil Ing	0.0E+00	0.0E+00	0.0E+00
Total	6.6E-01	6.6E-01	6.6E-01

External Dose by Exposure Pathway

Pathway	
Sur Soil	0.0E+00
Total	0.0E+00

GENII Dose Calculation Program
(Version 1.485 3-Dec-90)

Case title: Autumn: LERF FSAR - no cover, July dose - 2.43E+6 L, IP 15.4 km E
Executed on: 03/20/91 at 14:07:42 Page C. 7

Acute release
Uptake/exposure period: 50.0
Dose commitment period: 50.0
Dose units: Rem

Cumulative Internal Dose to Organs by Exposure Pathway

Pathway	Lung	Stomach	S Int.	UL Int.	LL Int.	Bone Su	R Marro	Testes
Leaf Veg	1.9E-02	1.9E-02	1.9E-02	1.9E-02	1.9E-02	2.2E-02	2.3E-02	1.9E-0
Oth. Veg	1.4E-01	1.4E-01	1.4E-01	1.4E-01	1.4E-01	1.6E-01	1.7E-01	1.4E-0
Fruit	2.1E-01	2.1E-01	2.1E-01	2.1E-01	2.1E-01	2.4E-01	2.6E-01	2.1E-0
Cereals	3.3E-02	3.3E-02	3.3E-02	3.3E-02	3.3E-02	3.8E-02	4.0E-02	3.3E-0
Meat	5.1E-02	5.1E-02	5.1E-02	5.1E-02	5.1E-02	6.0E-02	6.3E-02	5.1E-0
Poultry	1.1E-02	1.1E-02	1.1E-02	1.1E-02	1.1E-02	1.3E-02	1.4E-02	1.1E-0
Cow Milk	1.8E-01	1.8E-01	1.8E-01	1.8E-01	1.8E-01	2.1E-01	2.2E-01	1.8E-0
Eggs	1.9E-02	1.9E-02	1.9E-02	1.9E-02	1.9E-02	2.3E-02	2.4E-02	1.9E-0
Soil Ing	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+0
Total	6.6E-01	6.6E-01	6.6E-01	6.6E-01	6.6E-01	7.7E-01	8.1E-01	6.6E-0

Pathway	Ovaries	Muscle	Thyroid
Leaf Veg	1.9E-02	1.9E-02	1.9E-02
Oth. Veg	1.4E-01	1.4E-01	1.4E-01
Fruit	2.1E-01	2.1E-01	2.1E-01
Cereals	3.3E-02	3.3E-02	3.3E-02
Meat	5.1E-02	5.1E-02	5.1E-02
Poultry	1.1E-02	1.1E-02	1.1E-02
Cow Milk	1.8E-01	1.8E-01	1.8E-01
Eggs	1.9E-02	1.9E-02	1.9E-02
Soil Ing	0.0E+00	0.0E+00	0.0E+00
Total	6.6E-01	6.6E-01	6.6E-01

External Dose by Exposure Pathway

Pathway	
Sur Soil	0.0E+00
Total	0.0E+00

CHECKLIST FOR PEER REVIEWS

Document Reviewed: Chapter 9 of Final Safety Analysis Report 242-A Evaporator Liquid Effluent Retention Facility, WHC, Feb 26, 1991

Scope of Review:

Yes	No	N/A	
[ ]	[ ]	[X]	* Previous reviews complete and cover analysis, up to scope of this review, with no gaps.
[X]	[ ]	[ ]	Problem completely defined.
[X]	[ ]	[ ]	Accident scenarios developed in a clear and logical manner.
[X]	[ ]	[ ]	Necessary assumptions explicitly stated and supported.
[X]	[ ]	[ ]	Computer codes and data files documented.
[X]	[ ]	[ ]	Data used in calculations explicitly stated in document.
[X]	[ ]	[ ]	Data checked for consistency with original source information as applicable.
[X]	[ ]	[ ]	Mathematical derivations checked including dimensional consistency of results.
[X]	[ ]	[ ]	Models appropriate and used within range of validity or use outside range of established validity justified.
[X]	[ ]	[ ]	Hand calculations checked for errors. Spreadsheet results should be treated exactly the same as hand calculations.
[X]	[ ]	[ ]	Code runstreams correct and consistent with analysis documentation.
[X]	[ ]	[ ]	Code output consistent with input and with results reported in analysis documentation.
[X]	[ ]	[ ]	Acceptability limits on analytical results applicable and supported. Limits checked against sources.
[X]	[ ]	[ ]	Safety margins consistent with good engineering practices.
[X]	[ ]	[ ]	Conclusions consistent with analytical results and applicable limits.
[X]	[ ]	[ ]	Results and conclusions address all points required in the problem statement.
[X]	[ ]		Document presentation quality meet SA&R standards
[X]	[ ]	[ ]	Format consistent with appropriate NRC Regulatory Guide or other standards
[ ]		[X]	* Review calculations, comments, and/or notes are attached.

Rick J. Van Vleet [signature] 03/22/1991
Reviewer Approval (Printed Name and Signature) Date

* Any calculations, comments, or notes generated as part of this review should be signed, dated and attached to this checklist. Such material should be labeled and recorded in such a manner as to be intelligible to a technically qualified third party.

[X] [ ] [ ] Analysis entered into analysis database

Edward R. Sllo 3/25/91
Analyst (Printed Name and Signature) Date

CHECKLIST FOR PEER REVIEWS

Document Reviewed: Chapter 9 of Final Safety Analysis Report 242-A Evaporator Liquid Effluent Retention Facility, WHC, Feb 26, 1991

Scope of Review: Basic assumptions, modeling methods, compatability to actual facility, development of source terms.

Yes	No	N/A	
[ ]	[ ]	[✓]*	Previous reviews complete and cover analysis, up to scope of this review, with no gaps.
[✓]	[ ]	[ ]	Problem completely defined.
[✓]	[ ]	[ ]	Accident scenarios developed in a clear and logical manner.
[✓]	[ ]	[ ]	Necessary assumptions explicitly stated and supported.
[ ]	[ ]	[✓]	Computer codes and data files documented.
[✓]	[ ]	[ ]	Data used in calculations explicitly stated in document.
[✓]	[ ]	[ ]	Data checked for consistency with original source information as applicable.
[✓]	[ ]	[ ]	Mathematical derivations checked including dimensional consistency of results.
[✓]	[ ]	[ ]	Models appropriate and used within range of validity or use outside range of established validity justified.
[✓]	[ ]	[ ]	Hand calculations checked for errors. Spreadsheet results should be treated exactly the same as hand calculations.
[ ]	[ ]	[✓]	Code runstreams correct and consistent with analysis documentation.
[ ]	[ ]	[✓]	Code output consistent with input and with results reported in analysis documentation.
[✓]	[ ]	[ ]	Acceptability limits on analytical results applicable and supported. Limits checked against sources.
[✓]	[ ]	[ ]	Safety margins consistent with good engineering practices.
[✓]	[ ]	[ ]	Conclusions consistent with analytical results and applicable limits.
[✓]	[ ]	[ ]	Results and conclusions address all points required in the problem statement.
[✓]	[ ]		Document presentation quality meet SA&R standards
[✓]	[ ]	[ ]	Format consistent with appropriate NRC Regulatory Guide or other standards
[ ]		[✓]*	Review calculations, comments, and/or notes are attached.

J.P. Hinckley (signature) J.P. Hinckley 3-21-91

Reviewer Approval (Printed Name and Signature) Date

* Any calculations, comments, or notes generated as part of this review should be signed, dated and attached to this checklist. Such material should be labeled and recorded in such a manner as to be intelligible to a technically qualified third party.

CHECKLIST FOR HEDOP REVIEW

Document Reviewed: Chapter 9 of Final Safety Analysis Report 242-A Evaporator Liquid Effluent Retention Facility, WHC, Feb 26, 1991

Scope of Review:

Yes	No	N/A	
[X]	[ ]	[ ]	HEDOP-accepted code(s)/version(s) or other appropriate calculation methodology used.
[X]	[ ]	[ ]	Appropriate receptor locations evaluated.
[X]	[ ]	[ ]	Appropriate models (finite plume vs. semi-infinite cloud, building wake, etc.) used.
[X]	[ ]	[ ]	Appropriate pathways evaluated for each receptor.
[X]	[ ]	[ ]	Analysis consistent with HEDOP recommendations.
[X]		[ ] *	Review calculations, comments, and/or notes are attached.

Rick J. Van Vleet [signature] 03/22/1991
HEDOP Reviewer Approval (Printed Name and Signature) / Date

* Any calculations, comments, or notes generated as part of this review should be signed, dated and attached to this checklist. Such material should be labeled and recorded in such a manner as to be intelligible to a technically qualified third party.

THE TECHNICAL/HEDOP COMMENTS WERE GENERATED BY ANOTHER HEDOP REVIEWER (D. A. HIMES). I EVALUATED THE DISPOSITION AND INCORPORATION OF THOSE COMMENTS. [signature] 03/22/1991