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4. Change/Revision Date: 07/97

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R. H. Engelmann 7-25-97
(Signature) (Date)

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A-6001-401.2 (07/94)

Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

97-EAP-577

JUL 25 1997

Mr. Moses N. Jaraysi
Program Manager
Nuclear Waste Program
State of Washington
Department of Ecology
1315 West Fourth Avenue
Kennewick, Washington 99336-6018

Dear Mr. Jaraysi:

CERTIFICATION OF HANFORD FACILITY DANGEROUS WASTE PART A AND PART B PERMIT APPLICATION DOCUMENTATION, LOW-LEVEL BURIAL GROUNDS (WA7890008967) (TSD: D-2-9)

Enclosed is the Hanford Facility Dangerous Waste Permit Application documentation (Part A, Form 3, Revision 10, and Part B, Revision 1), for the Low-Level Burial Grounds (LLBG). The LLBG Part A, Form 3, and Part B have been revised for incorporation into the Hanford Facility Resource Conservation and Recovery Act Permit during Modification C. Also enclosed is a list of changes that have been made to the LLBG permit application documentation since the last draft was given to the State of Washington Department of Ecology on June 17, 1997.

If you have any questions, please contact Tony McKarns, U.S. Department of Energy, Richland Operations Office, on 376-9333.

Sincerely,

James E. Rasmussen

James E. Rasmussen, Director
Environmental Assurance, Permits,
and Policy Division
DOE Richland Operations Office

EAP:ACM

S. M. Price for

William D. Adair, Director
Environmental Protection
Responsible Party for
Fluor Daniel Hanford, Inc.

Enclosures:
1. LLBG Part A, Form 3, Revision 10
2. LLBG Part B, Revision 1

cc w/encls:
R. Jim, YIN
D. Powaukee, NPT
J. Wilkinson, CTUIR

cc w/o encls:
W. Adair, FDH
D. Saueressig, WMH

14.0 PART B CERTIFICATION [K]

The following certification, required by WAC 173-303-810(13), for all applications and reports submitted to Ecology is hereby included:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Owner/Operator
John D. Wagoner, Manager
U.S. Department of Energy,
Richland Operations Office

Date 7/25/97

Co-operator*
H. J. Hatch,
President and Chief Executive Officer
Fluor Daniel Hanford, Inc.

Date 7/24/97

* Fluor Daniel Hanford, Inc. is responsible for information presented in Chapters 1.0 through 4.0 and 6.0 through 15.0, including the associated appendices.

14.0 PART B CERTIFICATION [K]

The following certification, required by WAC 173-303-810(13), for all applications and reports submitted to Ecology is hereby included:

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Owner/Operator — Date 7/25/97
John D. Wagoner, Manager
U.S. Department of Energy,
Richland Operations Office

Co-operator* — Date 24 July 1997
W. J. Madia, Director
Pacific Northwest National Laboratory

* Pacific Northwest National Laboratory is responsible for information presented in Chapter 5.0, including any associated appendices.

DOE/RL-88-20
Revision 1

UC-630

Hanford Facility Dangerous Waste Permit Application, Low-Level Burial Grounds

Date Published
July 1997

United States
Department of Energy

P.O. Box 550
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HANFORD FACILITY DANGEROUS WASTE PERMIT APPLICATION, LOW-LEVEL BURIAL GROUNDS

FOREWORD

The *Hanford Facility Dangerous Waste Permit Application* is considered to be a single application organized into a General Information Portion (document number DOE/RL-91-28) and a Unit-Specific Portion. The scope of the Unit-Specific Portion is limited to Part B permit application documentation submitted for individual, 'operating' treatment, storage, and/or disposal units, such as the Low-Level Burial Grounds (this document, DOE/RL-88-20).

Both the General Information and Unit-Specific portions of the *Hanford Facility Dangerous Waste Permit Application* address the content of the Part B permit application guidance prepared by the Washington State Department of Ecology (Ecology 1987 and 1996) and the U.S. Environmental Protection Agency (40 Code of Federal Regulations 270), with additional information needs defined by the *Hazardous and Solid Waste Amendments* and revisions of Washington Administrative Code 173-303. For ease of reference, the Washington State Department of Ecology alpha-numeric section identifiers from the permit application guidance documentation (Ecology 1996) follow, in brackets, the chapter headings and subheadings. A checklist indicating where information is contained in the Low-Level Burial Grounds permit application documentation, in relation to the Washington State Department of Ecology guidance, is located in the Contents Section.

Documentation contained in the General Information Portion is broader in nature and could be used by multiple treatment, storage, and/or disposal units (e.g., the glossary provided in the General Information Portion). Wherever appropriate, the Low-Level Burial Grounds permit application documentation makes cross-reference to the General Information Portion, rather than duplicating text.

Information provided in this Low-Level Burial Grounds permit application documentation is current as of June 1997.

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DOCUMENT CONTENTS

APPENDICES

CONTENTS (cont)

METRIC CONVERSION CHART

Into metric units			Out of metric units		
If you know	Multiply by	To get	If you know	Multiply by	To get
Length			**Length**		
inches	25.40	millimeters	millimeters	0.0393	inches
inches	2.54	centimeters	centimeters	0.393	inches
feet	0.3048	meters	meters	3.2808	feet
yards	0.914	meters	meters	1.09	yards
miles	1.609	kilometers	kilometers	0.62	miles
Area			**Area**		
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.092	square meters	square meters	10.7639	square feet
square yards	0.836	square meters	square meters	1.20	square yards
square miles	2.59	square kilometers	square kilometers	0.39	square miles
acres	0.404	hectares	hectares	2.471	acres
Mass (weight)			**Mass (weight)**		
ounces	28.35	grams	grams	0.0352	ounces
pounds	0.453	kilograms	kilograms	2.2046	pounds
short ton	0.907	metric ton	metric ton	1.10	short ton
Volume			**Volume**		
fluid ounces	29.57	milliliters	milliliters	0.03	fluid ounces
quarts	0.95	liters	liters	1.057	quarts
gallons	3.79	liters	liters	0.26	gallons
cubic feet	0.03	cubic meters	cubic meters	35.3147	cubic feet
cubic yards	0.76456	cubic meters	cubic meters	1.308	cubic yards
Temperature			**Temperature**		
Fahrenheit	subtract 32 then multiply by 5/9ths	Celsius	Celsius	multiply by 9/5ths, then add 32	Fahrenheit
Force			**Force**		
pounds per square inch	6.895	kilopascals	kilopascals	1.4504×10^{-4}	pounds per square inch

Source: *Engineering Unit Conversions*, M. R. Lindeburg, PE., Second Ed., 1990, Professional Publications, Inc., Belmont, California.

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Application Checklist

Complete this checklist by providing the facility name and indicating where the listed material has been placed in the application. This is particularly important when the application does not closely follow the outline of the checklist and guidance.

Include the completed checklist with the Dangerous Waste Permit application.

Facility name Low-Level Burial Grounds

Date Application Received ______________________

State of Washington Part B Permit Application Review Checklist for Treatment, Storage, and Disposal Facilities			
		Technically Adequate?	Location in Application
A.	**Part A Form**		Chapter 1.0
B.	**Facility Description and General Provisions**		Chapter 2.0
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B-1(a)	Facility Description		2.1
B-1(b)	Construction Schedule		2.1.2
B-2	Topographic Map		2.2
B-2a	General Requirements		2.2
B-2b	Additional Requirements for Land Disposal Facilities		2.2
B-3	Seismic Consideration	Not Applicable	Not Applicable
B-4	Traffic Information		2.4
C.	**Waste Analysis**		Chapter 3.0
C-1	Chemical, Biological and Physical Analyses		3.1
C-1a	Waste In Piles	Not Applicable	Not Applicable
C-1b	Landfilled Wastes		3.2
C-1c	Wastes Incinerated and Wastes Used in Performance Tests	Not Applicable	Not Applicable

	Technically Adequate?	Location in Application
C-2 Waste Analysis Plan		3.3 and Appendix 3A
C-2a Detailed Chemical, Physical, and/or Biological Analysis		Appendix 3A
C-2a(1) Parameters and Rationale		↓
C-2a(2) Analytical Methods		↓
C-2a(3) Generator-Supplied Analyses		↓
C-2b Additional Requirements for Wastes Generated Off-site		↓
C-2b(1) Parameters and Rationale to Confirm Identity of Off-site Waste		↓
C-2b(2) Analytical Methods to Confirm Identity of Off-site Waste		↓
C-2b(3) Representative Sampling of Incoming Off-site Wastes		↓
C-2c Methods for Collecting Samples for Detailed and Confirming Analyses		↓
C-2d Frequency of Analyses		↓
C-3 Manifest System		↓
C-3a Procedures for Receiving Shipments		↓
C-3b Response to Significant Discrepancies		↓
C-3c Provisions for Non-acceptance of Shipment		↓
C-3c(1) Non-acceptance of Undamaged Shipment		↓
C-3c(2) Activation of Contingency Plan for Damaged Shipment		↓

	Technically Adequate?	Location in Application
C-4 Tracking System		Appendix 3A
D. Process Information		Chapter 4.0
D-1 Containers		4.1
D-1a Description of Containers		4.1.1
D-1b Container Management Practices		4.1.1
D-1c Container Labelling		4.1.1
D-1d Containment Requirements for Storing Containers		4.1.2
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D-1d(1)(a) System Design		4.1.2.1
D-1d(1)(b) Structural Integrity of Base		4.1.2.1
D-1d(1)(c) Containment System Capacity		4.1.2.2
D-1d(1)(d) Control of Run-on		4.1.2.3
D-1d(2) Removal of Liquids from Containment System		4.1.3
D-1e Demonstration that Containment Is Not Required Because Containers Do Not Contain Free Liquids, Wastes That Exhibit Ignitability or Reactivity, or Wastes Designated F020 - 023, F026, or F027		4.2
D-1f Prevention of Reaction of Ignitable, Reactive, and Incompatible Wastes in Containers		4.3
D-1f(1) Management of Certain Reactive Wastes in Containers	Not Applicable	Not Applicable

	Technically Adequate?	Location in Application
D-1f(2) Management of Ignitable and Certain Other Reactive Wastes in Containers	Not Applicable	Not Applicable
D-1f(3) Design of Areas to Manage Incompatible Wastes	Not Applicable	Not Applicable
D-2 Tank Systems	Not Applicable	Not Applicable
D-2a Design, Installation and Assessment of Tanks Systems	Not Applicable	Not Applicable
D-2a(1) Design Requirements	Not Applicable	Not Applicable
D-2a(2) Integrity Assessments	Not Applicable	Not Applicable
D-2a(3) Additional Requirements for Existing Tanks	Not Applicable	Not Applicable
D-2a(4) Additional Requirements for New Tanks	Not Applicable	Not Applicable
D-2a(5) Additional Requirements for New On-ground or Underground Tanks	Not Applicable	Not Applicable
D-2b Secondary Containment and Release Detection for Tank Systems	Not Applicable	Not Applicable
D-2b(1) Requirements for All Tank Systems	Not Applicable	Not Applicable
D-2b(2) Additional Requirements for Specific Types of Systems	Not Applicable	Not Applicable
D-2b(2)(a) Vault Systems	Not Applicable	Not Applicable
D-2b(2)(b) Double-walled Tanks	Not Applicable	Not Applicable
D-2b(2)(c) Ancillary Equipment	Not Applicable	Not Applicable
D-2c Variances from Secondary Containment Requirements	Not Applicable	Not Applicable
D-2d Tank Management Practices	Not Applicable	Not Applicable

	Technically Adequate?	Location in Application
D-2e Labels or Signs	Not Applicable	Not Applicable
D-2f Air Emissions	Not Applicable	Not Applicable
D-2g Management of Ignitable or Reactive Wastes in Tank Systems	Not Applicable	Not Applicable
D-2h Management of Incompatible Wastes in Tank Systems	Not Applicable	Not Applicable
D-3 Waste Piles	Not Applicable	Not Applicable
D-4 Surface Impoundments	Not Applicable	Not Applicable
D-5 Incinerators	Not Applicable	Not Applicable
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D-6b(2) Exemption Based on Alternative Design and Location		4.5.2
D-6b(3) Exemption From Groundwater Protection Requirements Based on Design and Operation	Not Applicable	Not Applicable
D-6b(3)(a) Double-lined Landfill	Not Applicable	Not Applicable
D-6b(3)(b) Response to Liquids in Leak Detection System	Not Applicable	Not Applicable
D-6c Liner System, General Items		4.5.3
D-6c(1) Liner System Description		4.5.3.1
D-6c(2) Liner System Location Relative to High Water Table		4.5.3.2
D-6c(3) Loads on Liner System		4.5.3.3
D-6c(4) Liner System Coverage		4.5.3.4

		Technically Adequate?	Location in Application
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D-6d	Liner System, Foundation		4.5.4
D-6d(1)	Foundation Description		4.5.4.1
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D-6d(3)	Laboratory Testing Data		4.5.4.3
D-6d(4)	Engineering Analyses		4.5.4.4
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D-6d(4)(b)	Bearing Capacity		4.5.4.4.2
D-6d(4)(c)	Stability of Landfill Slopes		4.5.4.4.3
D-6d(4)(d)	Potential for Excess Hydrostatic or Gas Pressure		4.5.4.4.4
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D-6f(2)	Equivalent Capacity		4.5.6.2
D-6f(3)	Grading and Drainage		4.5.6.3
D-6f(4)	Maximum Leachate Head		4.5.6.4
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		Technically Adequate?	Location in Application
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D-6f(6)(b)	Strength of Piping		4.5.6.6.2
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D-6g(1)(b)	Soil Liners		4.5.7.1.2
D-6g(1)(c)	Leachate Collection and Removal Systems		4.5.7.1.3
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	Technically Adequate?	Location in Application
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D-6h(5) Maintenance		4.5.8.4
D-6i Control of Wind Dispersal		4.5.9
D-6j Liquids in Landfills		4.5.10
D-6j(1) Bulk or Noncontainerized Free Liquids	Not Applicable	Not Applicable
D-6j(2) Containers Holding Free Liquids	Not Applicable	Not Applicable
D-6j(3) Restriction to Small Containers	Not Applicable	Not Applicable
D-6j(4) Labpacks	Not Applicable	Not Applicable
D-6j(4)(a) Inside Containers	Not Applicable	Not Applicable
D-6j(4)(b) Overpack	Not Applicable	Not Applicable
D-6j(4)(c) Absorbent Material	Not Applicable	Not Applicable
D-6j(4)(d) Incompatible Wastes	Not Applicable	Not Applicable
D-6j(4)(e) Reactive Wastes	Not Applicable	Not Applicable
D-6k Containerized Wastes		4.5.11
D-61 Special Waste Management Plan for Landfills Containing Wastes FO20, F021, F022, F023, F026, and F027	Not Applicable	Not Applicable
D-61(1) Wastes Description	Not Applicable	Not Applicable
D-61(2) Soil Description	Not Applicable	Not Applicable
D-61(3) Mobilizing Properties	Not Applicable	Not Applicable
D-61(4) Additional Management Techniques	Not Applicable	Not Applicable

	Technically Adequate?	Location in Application
D-6m Prevention of Reaction of Ignitable, Reactive, and Incompatible Wastes in Landfills	Not Applicable	Not Applicable
D-6m(1) Management of Ignitable or Reactive Wastes Placed in Landfills	Not Applicable	Not Applicable
D-6m(2) Management of Incompatible Wastes Placed in Landfills	Not Applicable	Not Applicable
D-7 Land Treatment	Not Applicable	Not Applicable
D-8 Air Emissions Control		4.6
D-8a Process Vents	Not Applicable	Not Applicable
D-8a(1) Applicability of Subpart AA Standards	Not Applicable	Not Applicable
D-8a(1)(a) Process Vents Subject to Subpart AA Standards	Not Applicable	Not Applicable
D-8a(1)(b) Process Vents Not Subject to Subpart AA Standards	Not Applicable	Not Applicable
D-8a(1)(c) Re-evaluating Applicability of Subpart AA Standards	Not Applicable	Not Applicable
D-8a(2) Process Vents - Demonstrating Compliance	Not Applicable	Not Applicable
D-8a(2)(a) The Basis for Meeting Limits/Reductions	Not Applicable	Not Applicable
D-8a(2)(b) Demonstrating Compliance via Selected Method	Not Applicable	Not Applicable
D-8a(2)(c) Design Information and Operating Parameters for Closed Vent Systems and Control Devices	Not Applicable	Not Applicable
D-8a(2)(d) Re-evaluating Compliance with Subpart AA Standards	Not Applicable	Not Applicable
D-8b Equipment Leaks	Not Applicable	Not Applicable

		Technically Adequate?	Location in Application
D-8b(1)	Applicability of Subpart BB Standards	Not Applicable	Not Applicable
D-8b(1)(a)	Equipment Subject to Subpart BB	Not Applicable	Not Applicable
D-8b(1)(b)	Re-evaluating Applicability of Subpart BB Standards	Not Applicable	Not Applicable
D-8b(2)	Equipment Leaks - Demonstrating Compliance	Not Applicable	Not Applicable
D-8b(2)(a)	Procedures for Identifying Equipment Location and Method of Compliance, Marking Equipment, and Ensuring Records are Up-to-date	Not Applicable	Not Applicable
D-8b(2)(b)	Demonstrating Compliance with D-8b(1)(a) and (2)(a) Procedures	Not Applicable	Not Applicable
D-8b(2)(c)	Closed Vent Systems or Control Devices: Showing Compliance with Emission Reduction Standards	Not Applicable	Not Applicable
D-8c	Tanks and Containers	Not Applicable	Not Applicable
D-8c(1)	Applicability of Subpart CC Standards	Not Applicable	Not Applicable
D-8c(2)	Tank Systems and Container Areas - Demonstrating Compliance	Not Applicable	Not Applicable
D-9	Waste Minimization		Chapter 10.0
D-10	Groundwater Monitoring for Land-based Units		Chapter 5.0
E.	**Releases from Solid Waste Management Units**		Chapter 2.0
E-1	Solid Waste Management Units and Known and Suspected Releases of Dangerous Wastes or Constituents		2.4
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	Technically Adequate?	Location in Application
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E-2 Corrective Actions Implemented		2.4
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F-1 Security		6.1
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F-2b Inspection Log		6.2.1
F-2c Schedule for Remedial Action for Problems Revealed		6.2.2
F-2d Specific Process or Waste Type Inspection Requirements		6.2.3
F-2d(1) Container Inspections		6.2.3.1
F-2d(2) Tank System Inspections and Corrective Actions	Not Applicable	Not Applicable
F-2d(2)(a) Tank System Inspections	Not Applicable	Not Applicable
F-2d(2)(b) Tank Systems - Corrective Actions	Not Applicable	Not Applicable
F-2d(3) Storage of Ignitable or Reactive Wastes	Not Applicable	Not Applicable
F-2d(4) Air Emissions Control and Detection - Inspections, Monitoring, and Corrective Actions	Not Applicable	Not Applicable

	Technically Adequate?	Location in Application
F-2d(4)(a) Process Vents	Not Applicable	Not Applicable
F-2d(4)(b) Equipment Leaks	Not Applicable	Not Applicable
F-2d(4)(c) Tanks and Containers	Not Applicable	Not Applicable
F-2d(5) Waste Pile Inspection	Not Applicable	Not Applicable
F-2d(6) Surface Impoundment Inspection	Not Applicable	Not Applicable
F-2d(7) Incinerator Inspection	Not Applicable	Not Applicable
F-2d(8) Landfill Inspection		6.2.3.2
F-2d(8)(a) Run-on and Run-off Control System		6.2.3.2.1
F-2d(8)(b) +Leak Detection Systems		6.2.3.2.2
F-2d(8)(c) Wind Dispersal Control System		6.2.3.2.3
F-2d(8)(d) Leachate Collection and Removal System		6.2.3.2.4
F-2d(9) Land Treatment Facility Inspection	Not Applicable	Not Applicable
F-3 Preparedness and Prevention Requirements		6.3
F-3a Equipment Requirements		6.3
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F-4 Preventive Procedures, Structures, and Equipment		6.4
F-5 Prevention of Reaction of Ignitable, Reactive, and/or Incompatible Wastes		6.5
F-5a Precautions to Prevent Ignition or Reaction of Ignitable or Reactive Waste		6.5.1
F-5b Precautions for Handling Ignitable or Reactive Waste and Mixing Incompatible Wastes		6.5.2

	Technically Adequate?	Location in Application
F-5b(1) Ignitable or Reactive Wastes In Tanks	Not Applicable	Not Applicable
F-5b(2) Incompatible Wastes In Containers or Tanks	Not Applicable	Not Applicable
G. Contingency Plan		Chapter 7.0
G-1 General Information		Appendix 7A
G-2 Emergency Coordinators		Appendix 7A
G-3 Circumstances Prompting Implementation		Appendix 7A
G-4 Emergency Response Procedures		Appendix 7A
G-4a Notification		Appendix 7A
G-4b Identification of Dangerous Materials		Appendix 7A
G-4c Hazard Assessment and Report		Appendix 7A
G-4d Prevention of Recurrence or Spread of Fires, Explosions, or Releases		Appendix 7A
G-4e Additional Requirements for Surface Impoundments		Appendix 7A
G-4f Post-Emergency Actions		Appendix 7A
G-5 Emergency Equipment		Appendix 7A
G-6 Coordination Agreements		Appendix 7A
G-7 Evacuation Plan		Appendix 7A
G-8 Required Reports, Recordkeeping, and Certifications		Appendix 7A
G-8(1) General Requirements		Appendix 7A
G-8(2) Requirements for Tank Systems	Not Applicable	Not Applicable

		Technically Adequate?	Location in Application
H.	**Personnel Training**		Chapter 8.0
H-1	Job Title/Job Description		Appendix 8A
H-2	Outline of Training Program		Appendix 8A
H-3	Implementation of Training Program		Appendix 8A
I.	**Closure and Financial Assurance**		Chapter 11.0
I-1	Closure Plan/Financial Assurance for Closure		11.1
I-1a	Closure Performance Standard		11.2
I-1b	Closure Activities		11.3
I-1b(1)	Maximum Extent of Operation		11.4
I-1b(2)	Removing Dangerous Wastes		11.5
I-1b(3)	Decontaminating Structures, Equipment, and Soil		11.6
I-1b(4)	Sampling and Analysis to Identify Extent of Decontamination/ Removal and to Verify Achievement of Closure Standard	Not Applicable	Not Applicable
I-1b(4)(a)	Sampling to Determine Extent of Contamination	Not Applicable	Not Applicable
I-1b(4)(b)	Sampling to Confirm Decontamination of Structures and Soils	Not Applicable	Not Applicable
I-1b(5)	Other Activities	Not Applicable	Not Applicable
I-1c	Maximum Waste Inventory	Not Applicable	Not Applicable
I-1d	Closure of Waste Piles, Surface Impoundments, Incinerators, Land Treatment, and Miscellaneous Units	Not Applicable	Not Applicable
I-1e	Closure of Landfill Units		11.7

	Technically Adequate?	Location in Application
I-1e(1) Disposal Impoundments	Not Applicable	Not Applicable
I-1e(1)(a) Elimination of Liquids	Not Applicable	Not Applicable
I-1e(1)(b) Waste Stabilization	Not Applicable	Not Applicable
I-1e(2) Cover Design		11.7.1
I-1e(3) Minimization of Liquid Migration	Not Applicable	Not Applicable
I-1e(4) Maintenance Needs		11.7.1
I-1e(5) Drainage and Erosion		11.7.1
I-1e(6) Settlement and Subsidence		11.7.1
I-1e(7) Cover permeability		11.7.1
I-1e(8) Freeze/Thaw Effects		11.7.1
I-1f Schedule for Closure		11.8
I-1g Extension for Closure Time		11.9
I-1h Closure Cost Estimate	Not Applicable	Not Applicable
I-1i Financial Assurance Mechanism for Closure	Not Applicable	Not Applicable
I-2 Notice in Deed of Already Closed Disposal Units	Not Applicable	Not Applicable
I-3 Post-Closure Plan		11.10
I-4 Liability Requirements	Not Applicable	Not Applicable
I-4a Coverage for Sudden Accidental Occurrences	Not Applicable	Not Applicable
I-4b Coverage for Nonsudden Accidental Occurrences	Not Applicable	Not Applicable
I-4c Request for Variance	Not Applicable	Not Applicable

		Technically Adequate?	Location in Application
J.	**Other Federal and State Laws**		Chapter 13.0
K.	**Part B Certification**		Chapter 14.0

CONTENTS

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1.0 PART A [A]

The following is a chronology of the regulatory history of the Low-Level Burial Grounds (LLBG).

- The *RCRA Part B Permit Application Low-Level Burial Grounds and Retrievable Storage*, submitted November 6, 1985 included a Part A, Form 3, that identified the LLBG and the retrievable storage units.

- The LLBG, operating under interim status, were classified as landfills (D81) and the retrievable storage units were classified as container storage (S01). Reserved areas were included for future disposal. The following locations were included in the 1985 submittal:

  - LLBG: 218-W-2A, 218-W-3AE, 218-E-10, 218-W-5, 218-W-4C, 218-W-3A, 218-E-12B, 218-C-9.
  - Reserved: 218-W-6, 218-E-10B.
  - Retrievable Storage Units: 218-W-4C, 218-W-3A.

  Individual trench locations within these burial grounds were not identified.

- On August 15, 1987, Revision 1 of the Part A, Form 3, was issued to incorporate comments received from the Washington State Department of Ecology (Ecology). The 1985 Part A was divided into two Part A, Form 3's, that consisted of the 'LLBG' and the 'retrievable storage units,' without designating specific locations for the burial grounds.

- In November 1987, the two Part A, Form 3's, were revised (Revision 2) to incorporate the required signature process in which the U.S. Department of Energy, Richland Operations Office signed as owner/operator and Westinghouse Hanford Company signed as co-operator. The retrievable storage units also were reclassified as landfills (D81) at the request of the U.S. Environmental Protection Agency. Specific burial grounds were named only for the retrievable storage units.

- On May 19, 1988, the two Part A, Form 3's, were combined into one and issued as Revision 3. Revision 3 of the Part A consisted of LLBG, retrievable storage units, and a future radioactive mixed waste disposal facility. Revision 3 included graphic representations of the trenches and identified the following LLBG:

200 West Area	200 East Area
218-W-3A	218-E-10
218-W-3AE	218-E-12B.
218-W-4B	
218-W-4C	
218-W-5	
218-W-6	

The LLBG Part A, Form 3, (Revision 3) had the following changes:

Deleted: 218-W-2A, 218-E-10B, and 218-C-9
Added: 218-W-4B.

The 218-W-2A and 218-C-9 Burial Grounds were deleted, as it was determined that mixed waste was not disposed in these sites [*Consent Agreement and Compliance Order* between Ecology and the U.S. Department of Energy, October 1, 1986 (Ecology 1986)]. The 218-E-10B Burial Ground was deleted because the area was designated for another use before any waste disposal occurred. The 218-W-4B Burial Ground was added because dangerous waste is contained in caisson alpha 4.

- Revision 4 of the Part A, Form 3, was submitted to Ecology on October 18, 1989, and had the following changes.

  - The 'date operation began' was changed from 1944 to 1960 to reflect the earliest date that the oldest burial ground (216-E-10) began receiving waste.

  - Waste numbers F020, F021, F022, F023, F026, and F027 were deleted as these waste types are not put into the LLBG.

  - Following the addition of the decommissioned Shippingport reactor pressure vessel and the U.S. Navy defueled reactor compartments, the estimated annual quantity of waste for waste code D008 was increased from 100,000 pounds to 18,000,000 pounds and for waste code WT01 from 800,000 to 18,800,000 pounds.

  - The burial ground number within the caption of a photograph of a "Typical Radioactive Retrievable Storage Facility--Liquid Organics" was changed from the "218-W-46/200 W Area" to the "218-W-4C/200 W Area."

  - The President of Westinghouse Hanford Company was changed from William M. Jacobi to John E. Nolan.

- Revision 5 of the Part A, Form 3, submitted to Ecology on October 20, 1989, had the following change.

  - The estimated annual quantity of waste for waste code D008 was reduced from 18,000,000 pounds to 2,000,000 pounds. Based on discussions and correspondence among the U.S. Navy, the U.S. Environmental Protection Agency, and Ecology, the quantity of lead (16,000,000 pounds) in defueled reactor compartments was considered shielding and was designated as WT01, a state-only waste. In addition, no extraction procedure toxicity testing had been performed on reactor compartments; therefore, the defueled reactor compartments were manifested by the U.S. Navy as WT01 only.

- Revision 6 of the Part A, Form 3, submitted to Ecology on August 16, 1990, had the following changes.

  - Estimated annual quantity of waste for dangerous waste number D008 (lead) was increased from "2,000,000" pounds to "18,000,000" pounds. This increase accounted for lead shielding contained in defueled reactor compartments.

  - The description of dangerous wastes (Section IV.E.) was changed to include a description of the metallic lead shielding contained in defueled reactor compartments disposed in trench 94.

- Revision 7 of the Part A, Form 3, submitted to Ecology on November 4, 1994, had the following changes.

  - Dangerous waste number F039 (multi-source leachate) was added to reflect leachate generation from the startup of trench 31.

  - Dangerous waste number P035, P079, U231, U241, U242, and WC01 were removed per the revised Washington Administrative Code (WAC) 173-303.

  - Section III.C. "Processes" was changed to reflect current operations at the LLBG.

  - The President of WHC was changed from Roger C. Nichols to A. LaMar Trego.

- Revision 8 of the Part A, Form 3, was submitted to Ecology on September 30, 1996, in support of the Project Hanford Management Contract change to Fluor Daniel Hanford, Inc. In addition, the Part A, Form 3, was revised to reflect the date that Ecology was given authorization to regulate the dangerous waste portion of mixed waste as identified in 52 Federal Register 35556. A new design capacity was identified based on waste forecasts with no lateral expansion of the various burial ground boundaries. Dangerous waste numbers WC02, U175, and P025 were removed per WAC 173-303. The estimated annual quantity of waste was consolidated into one number, "160,000,000" kilograms for all dangerous waste numbers. Sections III.C, IV.E., photographs and graphics were updated to reflect current operations.

- Revision 9 of the Part A, Form 3, submitted to Ecology on March 4, 1997, had the following changes.

  - Comments from Ecology on Revision 8, of the Part A, Form 3, were incorporated.

  - The Part A, Form 3, was revised to reflect the date of regulation of the dangerous waste component of mixed waste as August 19, 1987.

  - Process code S01 (storage container) was added with a total process design capacity of 10,000,000 liters. The greater-than-90-day container storage is within the lined mixed waste disposal trenches 31 and 34 of the 218-W-5 Burial Ground.

- Dangerous waste numbers D004 through D043, all "U" and "P," and F001 through F005, and F028 were added under process code S01.

- Sections III.C and IV.E of the Part A, Form 3, were revised to include a discussion on process code S01.

- Graphics were updated to reflect current operations and the August 19, 1987 date of regulation of the dangerous waste component of mixed waste.

• Revision 10 of the Part A, Form 3, included in this permit application documentation, had the following changes.

  - Updated text in Section IV.E. to account for dangerous waste numbers D001 through D003 being listed for disposal (D81) in Section IV.A.

  - Hanford Site Coordinate System points corrected on 218-E-12B Burial Ground Site Plan.

  - Call out for mixed fission product caissons corrected on 218-W-4B Burial Ground Site Plan.

  - Updated trenches filled with low-level waste on 218-W-4C Burial Ground Site Plan. Following a record search on post-August 19, 1987 mixed waste, the eastern portion of trench 58 was determined not to contain regulated mixed waste.

Please print or type in the unshaded areas only
(fill-in areas are spaced for elite type, i.e., 12 character/inch).

FORM 3

DANGEROUS WASTE PERMIT APPLICATION

1. EPA/STATE I.D. NUMBER

W	A	7	8	9	0	0	0	8	9	6	7

FOR OFFICIAL USE ONLY

APPLICATION APPROVED	DATE RECEIVED *(mo., day, & yr.)*	COMMENTS

II. FIRST OR REVISED APPLICATION

Place an "X" in the appropriate box in A or B below (mark one box only) to indicate whether this is the first application you are submitting for your facility or a revised application. If this is your first application and you already know your facility's EPA/STATE I.D. Number, or if this is a revised application, enter your facility's EPA/STATE I.D. Number in Section I above.

A. FIRST APPLICATION *(place an "X" below and provide the appropriate date)*

☐ 1. EXISTING FACILITY *(See instructions for definition of "existing" facility. Complete item below.)*

MO.	DAY	YR.*
0 3	2 2	4 3

FOR EXISTING FACILITIES, PROVIDE THE DATE *(mo., day, & yr.)* OPERATION BEGAN OR THE DATE CONSTRUCTION COMMENCED *(use the boxes to the left)*

* The date construction of the Hanford Facility commenced.

☐ 2. NEW FACILITY *(Complete item below)*

MO.	DAY	YR.

FOR NEW FACILITIES, PROVIDE THE DATE, *(mo., day, & yr)* OPERATION BEGAN OR IS EXPECTED TO BEGIN

B. REVISED APPLICATION *(place an "X" below and complete Section I above)*

[X] 1. FACILITY HAS AN INTERIM STATUS PERMIT

[X] 2. FACILITY HAS A FINAL PERMIT

III. PROCESSES - CODES AND CAPACITIES

A. PROCESS CODE - Enter the code from the list of process codes below that best describes each process to be used at the facility. Ten lines are provided for entering codes. If more lines are needed, enter the code(s) in the space provided. If a process will be used that is not included in the list of codes below, then describe the process *(including its design capacity)* in the space provided on the *(Section III-C)*.

B. PROCESS DESIGN CAPACITY - For each code entered in column A enter the capacity of the process.

1. AMOUNT - Enter the amount.
2. UNIT OF MEASURE - For each amount entered in column B(1), enter the code from the list of unit measure codes below that describes the unit of measure used. Only the units of measure that are listed below should be used.

PROCESS	PROCESS CODE	APPROPRIATE UNITS OF MEASURE FOR PROCESS DESIGN CAPACITY
Storage:		
CONTAINER (barrel, drum, etc)	S01	GALLONS OR LITERS
TANK	S02	GALLONS OR LITERS
WASTE PILE	S03	CUBIC YARDS OR CUBIC METERS
SURFACE IMPOUNDMENT	S04	GALLONS OR LITERS
Disposal:		
INJECTION WELL	D80	GALLONS OR LITERS
LANDFILL	D81	ACRE-FEET *(the volume that would cover one acre to a depth of one foot)* OR HECTARE-METER
LAND APPLICATION	D82	*ACRES OR HECTARES*
OCEAN DISPOSAL	D83	GALLONS PER DAY OR LITERS PER DAY
SURFACE IMPOUNDMENT	D84	GALLONS OR LITERS
Treatment:		
TANK	T01	GALLONS PER DAY OR LITERS PER DAY
SURFACE IMPOUNDMENT	T02	GALLONS PER DAY OR LITERS PER DAY
INCINERATOR	T03	TONS PER HOUR OR METRIC TONS PER HOUR; GALLONS PER HOUR OR LITERS PER HOUR
OTHER (Use for physical, chemical, thermal or biological treatment processes not occurring in tanks, surface impoundments or incinerators. Describe the processes in the space provided; Section III-C.)	T04	GALLONS PER DAY OR LITERS PER DAY

UNIT OF MEASURE	UNIT OF MEASURE CODE
GALLONS	G
LITERS	L
CUBIC YARDS	Y
CUBIC METERS	C
GALLONS PER DAY	U
LITERS PER DAY	V
TONS PER HOUR	D
METRIC TONS PER HOUR	W
GALLONS PER HOUR	E
LITERS PER HOUR	H
ACRE-FEET	A
HECTARE-METER	F
ACRES	B
HECTARES	Q

EXAMPLE FOR COMPLETING SECTION III *(shown in line numbers X-1 and X-2 below)*: *A facility has two storage tanks, one tank can hold 200 gallons and the other can hold 400 gallons.* The facility also has an incinerator that can burn up to 20 gallons per hour.

LINE NUMBER	A. PROCESS CODE *(from list above)*	B. PROCESS DESIGN CAPACITY 1. AMOUNT *(specify)*	2. UNIT OF MEASURE *(enter code)*	FOR OFFICIAL USE ONLY
X-1	*S 0 2*	*600*	*G*	
X-2	*T 0 3*	*20*	*E*	
1	D 8 1	174	F	
2	S 0 1	10,000,000	L	
3				
4				
5				
6				
7				
8				
9				
10				

Continued from the front.

III. PROCESSES (continued)

C. SPACE FOR ADDITIONAL PROCESS CODES OR FOR DESCRIBING OTHER PROCESS (code "T04"). FOR EACH PROCESS ENTERED HERE INCLUDE DESIGN CAPACITY.

Refer to the following page.

IV. DESCRIPTION OF DANGEROUS WASTES

A. DANGEROUS WASTE NUMBER - Enter the four digit number from Chapter 173-303 WAC for each listed dangerous waste you will handle. If you handle dangerous wastes which are not listed in Chapter 173-303 WAC, enter the four digit number(s) that describes the characteristics and/or the toxic contaminants of those dangerous wastes.

B. ESTIMATED ANNUAL QUANTITY - For each listed waste entered in column A estimate the quantity of that waste that will be handled on an annual basis. For each characteristic or toxic contaminant entered in column A estimate the total annual quantity of all the non-listed waste(s) that will be handled which possess that characteristic or contaminant.

C. UNIT OF MEASURE - For each quantity entered in column B enter the unit of measure code. Units of measure which must be used and the appropriate codes are:

ENGLISH UNIT OF MEASURE	CODE	METRIC UNIT OF MEASURE	CODE
POUNDS	P	KILOGRAMS	K
TONS	T	METRIC TONS	M

If facility records use any other unit of measure for quantity, the units of measure must be converted into one of the required units of measure taking into account the appropriate density or specific gravity of the waste.

D. PROCESSES

1. PROCESS CODES:

For listed dangerous waste: For each listed dangerous waste entered in column A select the code(s) from the list of process codes contained in Section III to indicate how the waste will be stored, treated, and/or disposed of at the facility.

For non-listed dangerous wastes: For each characteristic or toxic contaminant entered in Column A, select the code(s) from the list of process codes contained in Section III to indicate all the processes that will be used to store, treat, and/or dispose of all the non-listed dangerous wastes that possess that characteristic or toxic contaminant.

Note: Four spaces are provided for entering process codes. If more are needed: (1) Enter the first three as described above; (2) Enter "000" in the extreme right box of Item IV-D(1); and (3) Enter in the space provided on page 4, the line number and the additional code(s).

2. PROCESS DESCRIPTION: If a code is not listed for a process that will be used, describe the process in the space provided on the form.

NOTE: DANGEROUS WASTES DESCRIBED BY MORE THAN ONE DANGEROUS WASTE NUMBER - Dangerous wastes that can be described by more than one Waste Number shall be described on the form as follows:

1. Select one of the Dangerous Waste Numbers and enter it in column A. On the same line complete columns B, C, and D by estimating the total annual quantity of the waste and describing all the processes to be used to treat, store, and/or dispose of the waste.
2. In column A of the next line enter the other Dangerous Waste Number that can be used to describe the waste. In column D(2) on that line enter "included with above" and make no other entries on that line.
3. Repeat step 2 for each other Dangerous Waste Number that can be used to describe the dangerous waste.

EXAMPLE FOR COMPLETING SECTION IV *(shown in line numbers X-1, X-2, X-3, and X-4 below)* - A facility will treat and dispose of an estimated 900 pounds per year of chrome shavings from leather tanning and finishing operation. In addition, the facility will treat and dispose of three non-listed wastes. Two wastes are corrosive only and there will be an estimated 200 pounds per year of each waste. The other waste is corrosive and ignitable and there will be an estimated 100 pounds per year of that waste. Treatment will be in an incinerator and disposal will be in a landfill.

LINE NO.	A. DANGEROUS WASTE NO. *(enter code)*	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE *(enter code)*	D. PROCESSES 1. PROCESS CODES *(enter)*	D. PROCESSES 2. PROCESS DESCRIPTION *(if a code is not entered in D(1))*
X-1	K 0 5 4	900	P	T 0 3 D 8 0	
X-2	D 0 0 2	400	P	T 0 3 D 8 0	
X-3	D 0 0 1	100	P	T 0 3 D 8 0	
X-4	D 0 0 2			T 0 3 D 8 0	*included with above*

FORM 3 DANGEROUS WASTE PERMIT APPLICATION
U.S. ENVIRONMENTAL PROTECTION AGENCY/STATE IDENTIFICATION NUMBER WA7890008967

Section III.C., Description of Process Codes listed in Section III.a.

D81

The Low-Level Burial Grounds (LLBG) began waste management operations in January of 1960. The LLBG comprise a landfill disposal unit (D81) and cover a total area of approximately 225 hectares (556 acres). The landfill is divided into eight burial grounds. Six burial grounds are located in the 200 West Area and two in the 200 East Area, as depicted on the attached drawings. The LLBG consist of lined and unlined trenches of various sizes and depths. All mixed waste destined for disposal in lined trenches will meet land disposal restriction requirements. The lined trenches consist of a double-liner leachate collection and removal system.

The process design capacity for mixed waste in the LLBG is 174 hectare-meters (2,275,819 cubic yards) of which 150 hectare-meters (1,961,913 cubic yards) is dedicated solely for the disposal of reactor compartment disposal packages.

S01

The greater-than-90-day container storage capability in mixed waste Trenches 31 and 34 of Burial Ground 218-W-5 provides a location to store various size containers of treated mixed waste in a Resource Conservation and Recovery Act (RCRA) compliant manner other than the Central Waste Complex. The placement of these containers in Trenches 31 and 34 eliminates the need to construct a mixed waste storage pad. This capability also reduces the need to transfer this waste prior to disposal. The process design capacity for storage of containers is estimated to be 10,000,000 liters (2,641,700 gallons).

Continued from page 2.
NOTE: Photocopy this page before completing if you have more than 26 wastes to list.

NUMBER *(entered from page 1)*

W A 7 8 9 0 0 0 8 9 6 7

IV. DESCRIPTION OF DANGEROUS WASTES (continued)

LINE NO.	A. DANGEROUS WASTE NO. *(enter code)*	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE *(enter code)*	D. PROCESSES 1. PROCESS CODES *(enter)*	D. PROCESSES 2. PROCESS DESCRIPTION *(if a code is not entered in D(1))*
1	D001	160,000,000	K	D81	Disposal
2	through				
3	D043				
4	WT01				
5	WT02				
6	WP01				
7	WP02				
8	WP03				
9	F001				
10	through				
11	F005				
12	F028				
13	F039				
14	W001				
15	U001				
16	through				
17	U012				
18	U014				
19	through				
20	U039				
21	U041				
22	through				
23	U053				
24	U055				
25	through				
26	U064				

Continued from page 2.
NOTE: Photocopy this page before completing if you have more than 26 wastes to list.

NUMBER *(entered from page 1)*

[illegible] A 7 8 9 0 0 0 8 9 6 7

IV. DESCRIPTION OF DANGEROUS WASTES (continued)

LINE NO.	A. DANGEROUS WASTE NO. (enter code)	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE (enter code)	D. PROCESSES 1. PROCESS CODES (enter)	2. PROCESS DESCRIPTION (if a code is not entered in D(1))
1	U066		K	D81	Disposal (Continued)
2	through				
3	U099				
4	U101				
5	through				
6	U103				
7	U105				
8	through				
9	U174				
[illegible]	U176				
11	through				
12	U194				
13	U196				
14	U197				
15	U200				
16	through				
17	U223				
18	U225				
19	through				
20	U228				
21	U232				
22	through				
23	U240				
[illegible]	[illegible]243				
25	through				
26	U249				

Continued from page 2.
NOTE: Photocopy this page before completing if you have more than 26 wastes to list.

I.D. NUMBER *(entered from page 1)*: [illegible]A7890008967

IV. DESCRIPTION OF DANGEROUS WASTES (continued)

LINE NO.	A. DANGEROUS WASTE NO. *(enter code)*	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE *(enter code)*	D. PROCESSES 1. PROCESS CODES *(enter)*	D. PROCESSES 2. PROCESS DESCRIPTION *(if a code is not entered in D(1))*
1	U328		K	D81	Disposal (Continued)
2	U353				
3	U359				
4	P001				
5	through				
6	P018				
7	P020				
8	through				
9	P024				
10	P026				
11	through				
12	P031				
13	P033				
14	P034				
15	P036				
16	through				
17	P051				
18	P054				
19	P056				
20	through				
21	P060				
22	P062				
23	through				
24	[illegible]078				
25	P081				
26	P082				

Continued from page 2.
NOTE: Photocopy this page before completing if you have more than 26 wastes to list.

I.D. NUMBER *(entered from page 1)*: A 7 8 9 0 0 0 8 9 6 7

IV. DESCRIPTION OF DANGEROUS WASTES (continued)

LINE NO.	A. DANGEROUS WASTE NO. *(enter code)*	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE *(enter code)*	D. PROCESSES 1. PROCESS CODES *(enter)*	D. PROCESSES 2. PROCESS DESCRIPTION *(if a code is not entered in D(1))*
1	P084		K	D81	Disposal (Continued)
2	P085				
3	P087				
4	through				
5	P089				
6	P092				
7	through				
8	P099				
9	P101				
[illegible]	through				
11	P116				
12	P118				
13	through				
14	P123				Included With Above
15	D004	10,000,000	K	S01	Storage-Container
16	through				
17	D043				
18	WT01				
19	WT02				
20	WP01				
21	WP02				
22	WP03				
23	W001				
[illegible]	F001				
25	through				
26	F005				

Continued from page 2.
NOTE: Photocopy this page before completing if you have more than 26 wastes to list.

I.D. NUMBER *(entered from page 1)*: W A 7 8 9 0 0 0 8 9 6 7

IV. DESCRIPTION OF DANGEROUS WASTES (continued)

LINE NO.	A. DANGEROUS WASTE NO. *(enter code)*	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE *(enter code)*	D. PROCESSES 1. PROCESS CODES *(enter)*	D. PROCESSES 2. PROCESS DESCRIPTION *(if a code is not entered in D(1))*
1	F028		K	S01	Storage-Container (Continued)
2	U001				
3	through				
4	U012				
5	U014				
6	through				
7	U039				
8	U041				
9	through				
10	U053				
11	U055				
12	through				
13	U064				
14	U066				
15	through				
16	U099				
17	U101				
18	through				
19	U103				
20	U105				
21	through				
22	U174				
23	U176				
24	through				
25	U194				
26	U196				

Continued from page 2.
NOTE: Photocopy this page before completing if you have more than 26 wastes to list.

I.D. NUMBER *(entered from page 1)*

W A 7 8 9 0 0 0 8 9 6 7

IV. DESCRIPTION OF DANGEROUS WASTES (continued)

LINE NO.	A. DANGEROUS WASTE NO. *(enter code)*	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE *(enter code)*	D. PROCESSES 1. PROCESS CODES *(enter)*	D. PROCESSES 2. PROCESS DESCRIPTION *(if a code is not entered in D(1))*
1	U197		K	S01	Storage-Container (Continued)
2	U200				
3	through				
4	U223				
5	U225				
6	through				
7	U228				
8	U232				
9	through				
10	U240				
11	U243				
12	through				
13	U249				
14	U328				
15	U353				
16	U359				
17	P001				
18	through				
19	P018				
20	P020				
21	through				
22	P024				
23	P026				
24	through				
25	P031				
26	P033				

Continued from page 2.
NOTE: Photocopy this page before completing if you have more than 26 wastes to list.

NUMBER *(entered from page 1)*

A 7 8 9 0 0 0 8 9 6 7

IV. DESCRIPTION OF DANGEROUS WASTES (continued)

LINE NO.	A. DANGEROUS WASTE NO. *(enter code)*	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE *(enter code)*	D. PROCESSES 1. PROCESS CODES *(enter)*	D. PROCESSES 2. PROCESS DESCRIPTION *(if a code is not entered in D(1))*
1	P034		K	S01	Storage-Container (Continued)
2	P036				
3	through				
4	P051				
5	P054				
6	P056				
7	through				
8	P060				
9	P062				
10	through				
11	P078				
12	P081				
13	P082				
14	P084				
15	P085				
16	P087				
17	through				
18	P089				
19	P092				
20	through				
21	P099				
22	P101				
23	through				
24	[illegible]116				
25					
26					

Continued from page 2.
NOTE: Photocopy this page before completing if you have more than 26 wastes to list.

NUMBER *(entered from page 1)*

A	7	8	9	0	0	0	8	9	6	7

IV. DESCRIPTION OF DANGEROUS WASTES (continued)

LINE NO.	A. DANGEROUS WASTE NO. *(enter code)*	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE *(enter code)*	D. PROCESSES 1. PROCESS CODES *(enter)*				D. PROCESSES 2. PROCESS DESCRIPTION *(if a code is not entered in D(1))*
1	P118		K	S01				Storage-Container (Continued)
2	through							↓
3	P123		↓	↓				Included With Above
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
[illegible]								
25								
26								

Continued from the front.

IV. DESCRIPTION OF DANGEROUS WASTES (continued)

E. USE THIS SPACE TO LIST ADDITIONAL PROCESS CODES FROM SECTION D(1) ON PAGE 3.

The mixed waste disposed in the LLBG will consist of toxicity characteristic waste (D001 through D043), state-only waste (WT01, WT02, WP01, WP02, WP03, and W001), and listed waste from nonspecific sources (F001 through F005 and F039). Current LLBG operations do not allow for storage or disposal of ignitable, reactive, and incompatible waste in trenches 31 and 34 of the 218-W-5 Burial Ground. Currently there is no mechanism in place to treat collected leachate with listed waste numbers other than F001 through F005. However, regulatorily acceptable alternatives for leachate management will allow for the disposal of other listed waste that include all "U," "P," and other "F" dangerous waste numbers. The reactor compartments in the 218-E-12B Burial Ground contain shielding constructed of metallic lead (state-only D008). Mixed waste could consist of up to 25 percent debris; however, this estimate could fluctuate as waste management needs dictate.

The mixed waste stored in the LLBG will consist of toxicity characteristic waste (D004 through D043), state-only waste (WT01, WT02, WP01, WP02, WP03, and W001), and listed waste from nonspecific sources (F001 through F005 and F028). Other waste that may be stored at the LLBG include all "U" and "P" dangerous waste numbers.

V. FACILITY DRAWING Refer to attached drawing(s).

All existing facilities must include in the space provided on page 5 a scale drawing of the facility *(see instructions for more detail)*.

VI. PHOTOGRAPHS Refer to attached photograph(s).

All existing facilities must include photographs *(aerial or ground-level)* that clearly delineate all existing structures; existing storage, treatment and disposal areas; and sites of future storage, treatment or disposal areas *(see instructions for more detail)*.

VII. FACILITY GEOGRAPHIC LOCATION This information is provided on the attached drawing(s) and photograph(s).

LATITUDE *(degrees, minutes, & seconds)*	LONGITUDE *(degrees, minutes, & seconds)*

VIII. FACILITY OWNER

[X] A. If the facility owner is also the facility operator as listed in Section VII on Form 1, "General Information", place an "X" in the box to the left and skip to Section IX below.

B. If the facility owner is not the facility operator as listed in Section VII on Form 1, complete the following items:

1. NAME OF FACILITY'S LEGAL OWNER	2. PHONE NO. *(area code & no.)*

3. STREET OR P.O. BOX	4. CITY OR TOWN	5. ST.	6. ZIP CODE

IX. OWNER CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

NAME *(print or type)*	SIGNATURE	DATE SIGNED
John D. Wagoner, Manager U.S. Department of Energy Richland Operations Office	[signature] for	7/25/97

X. OPERATOR CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

NAME *(print or type)*	SIGNATURE	DATE SIGNED
SEE ATTACHMENT		

 CONTINUE ON PAGE 5

X. OPERATOR CERTIFICATION

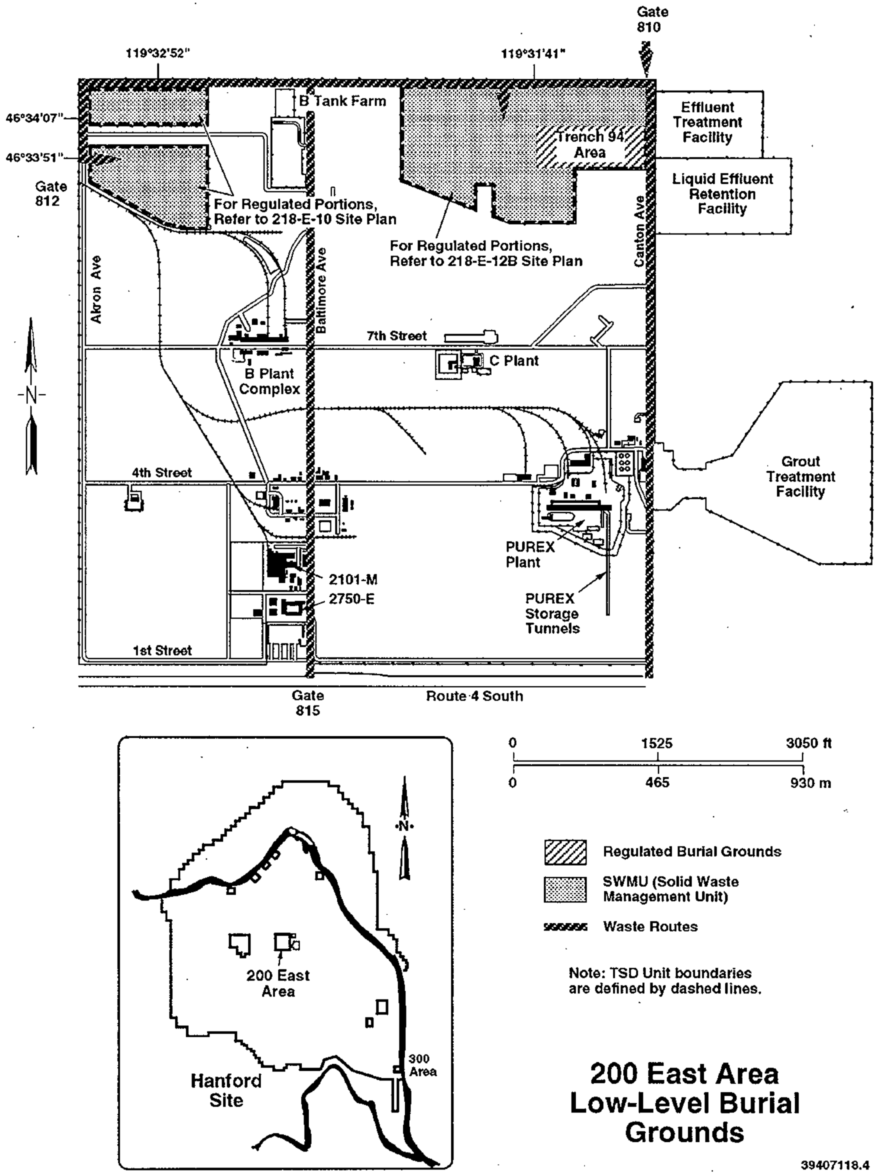
I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Owner/Operator
John D. Wagoner, Manager
U.S. Department of Energy
Richland Operations Office

Date 7/25/97

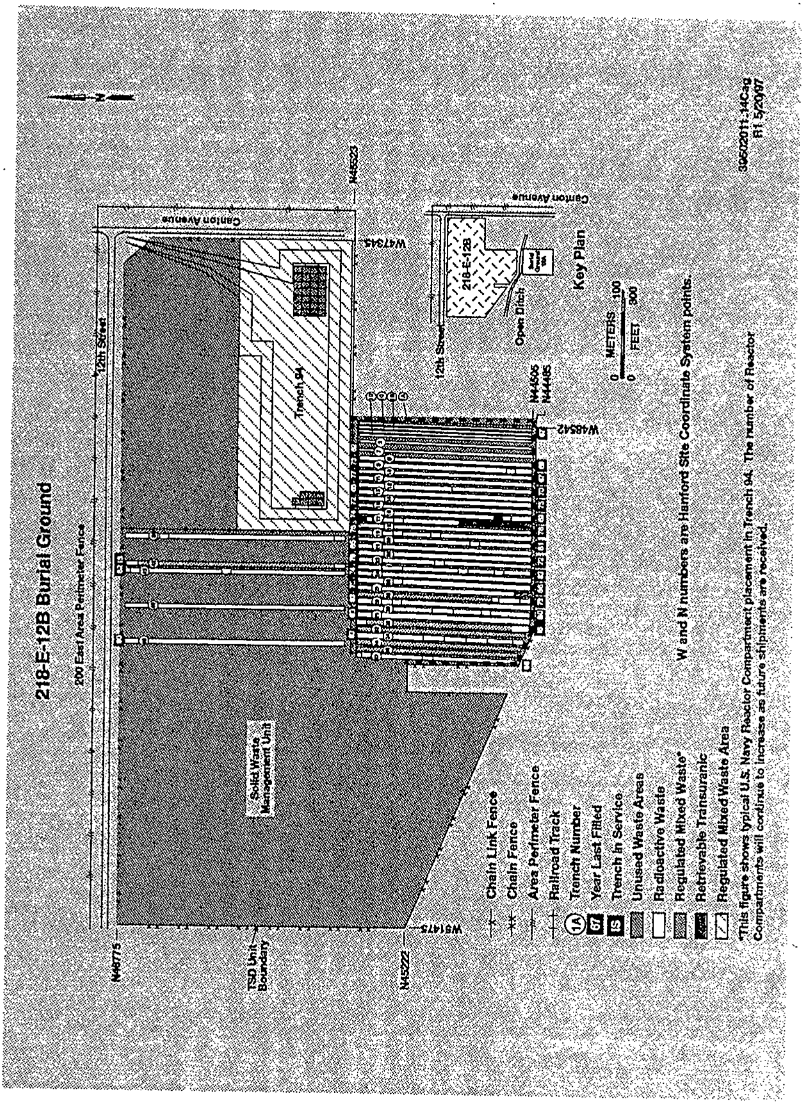
Co-operator
H. J. Hatch,
President and Chief Executive Officer
Fluor Daniel Hanford, Inc.

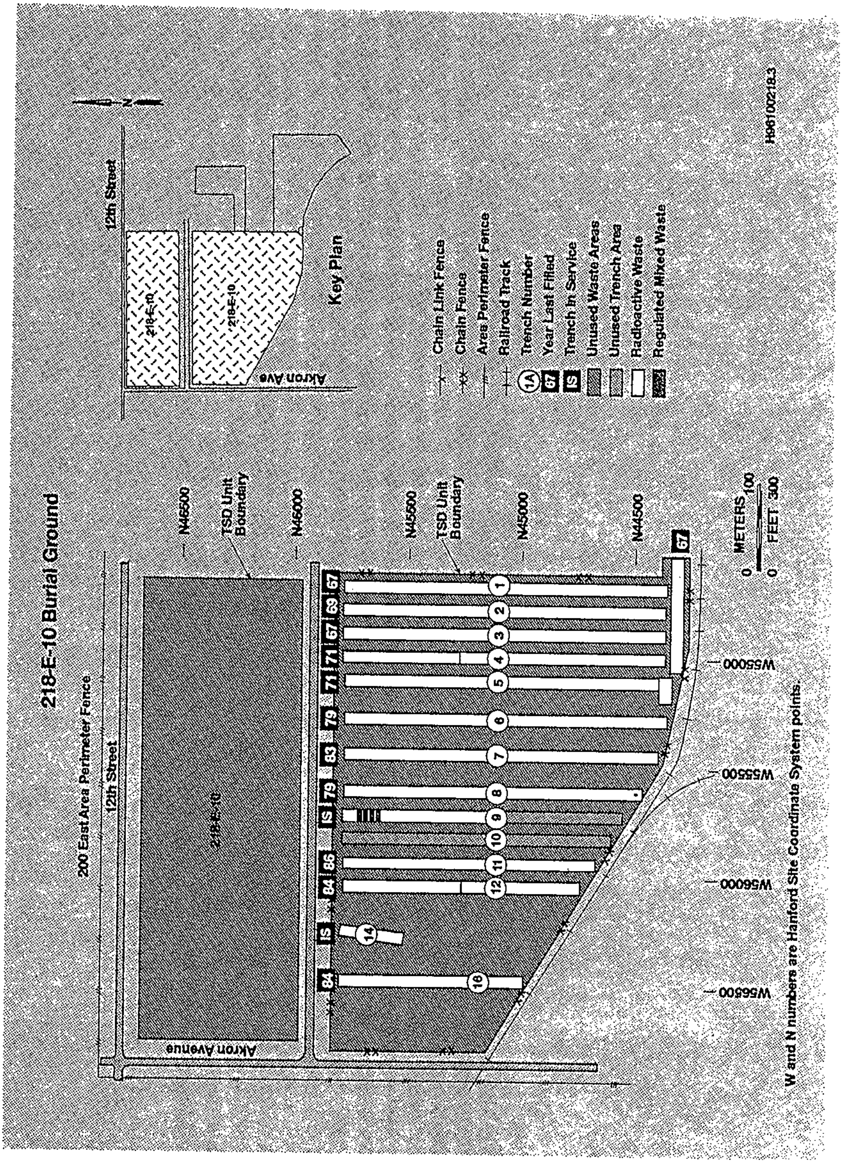
Date Jul 11, 1997

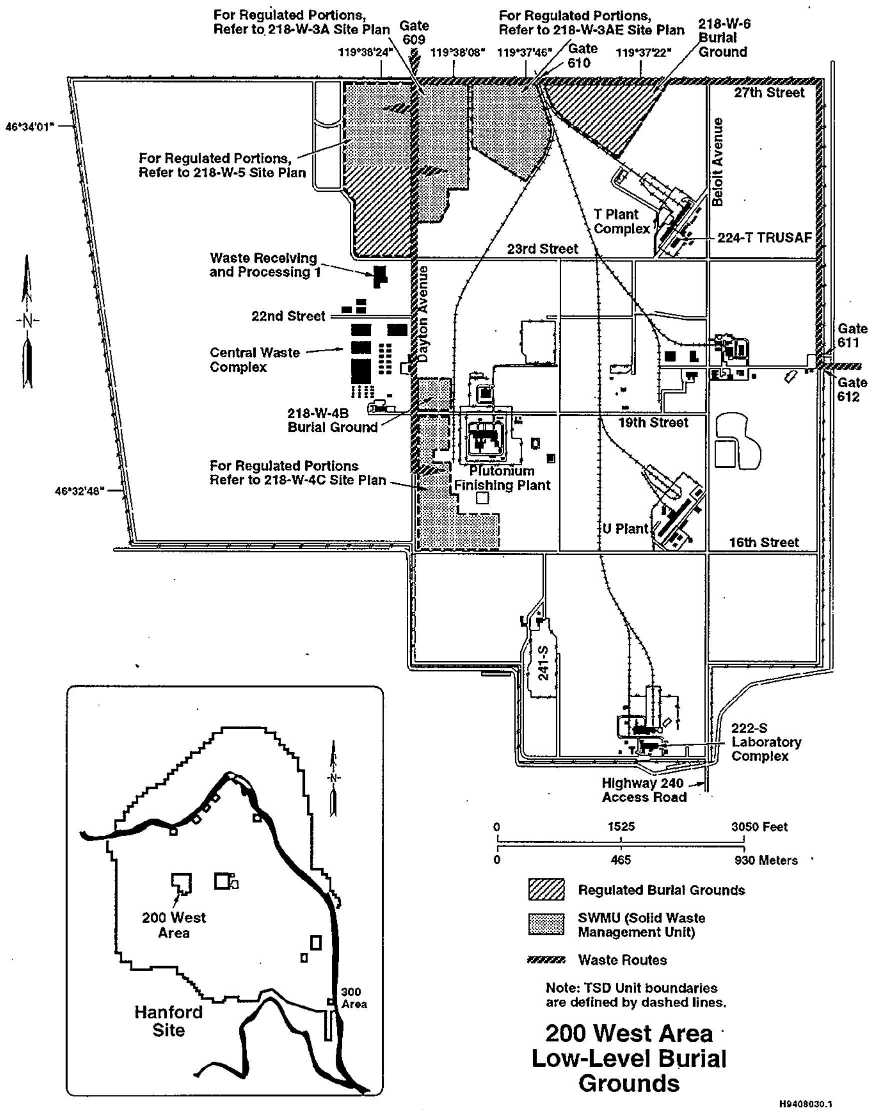


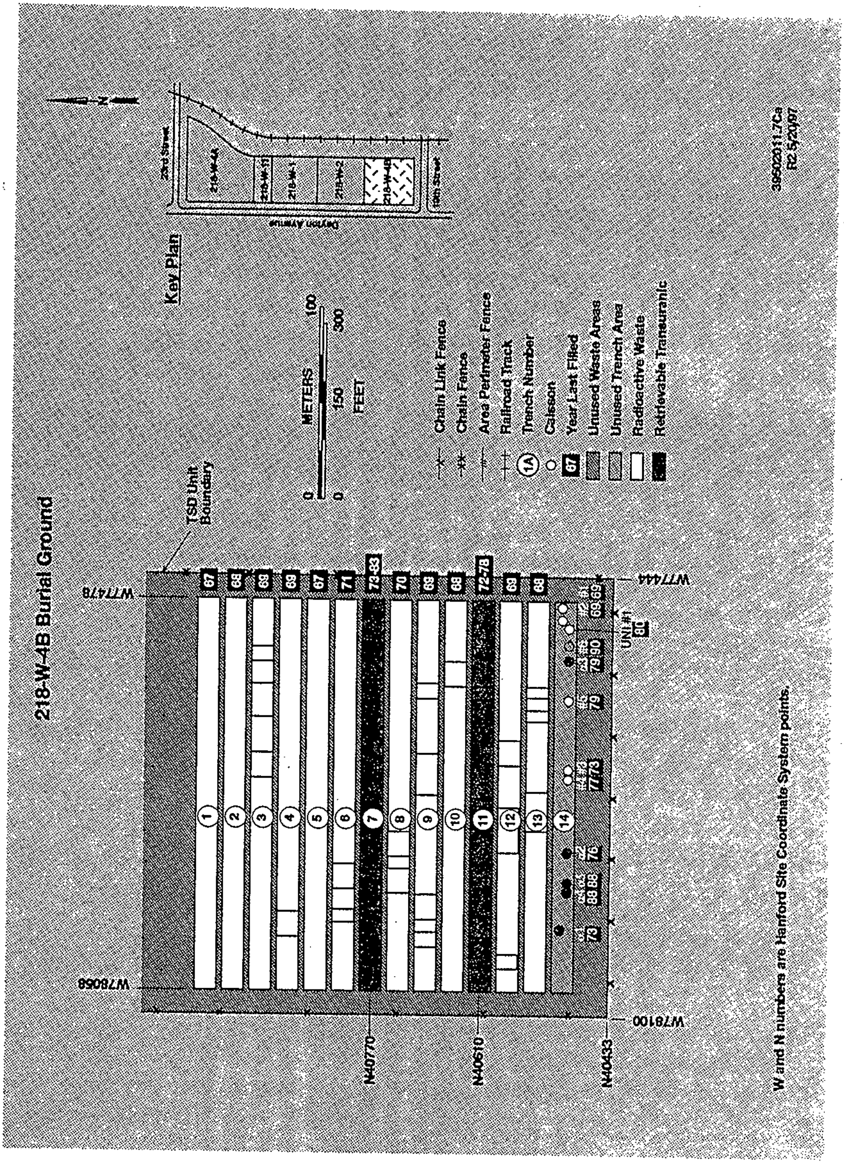
200 East Area Low-Level Burial Grounds

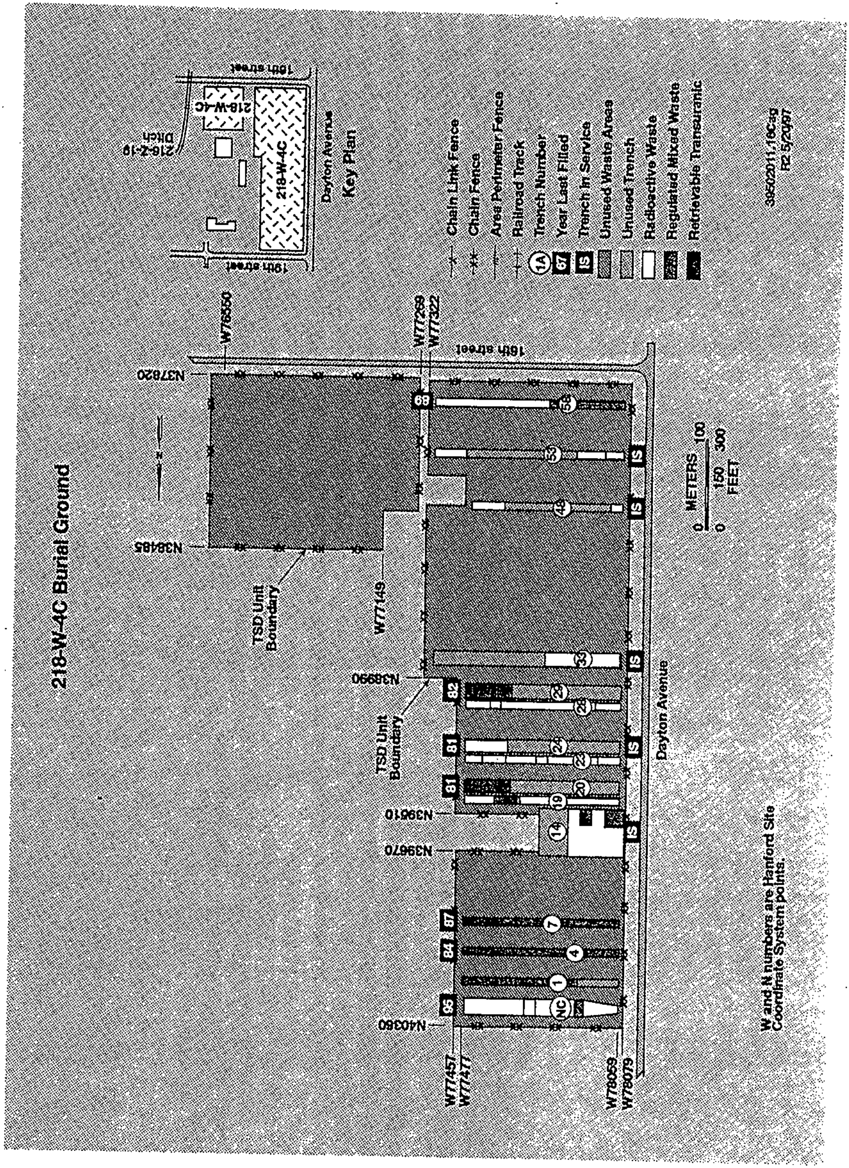
39407118.4

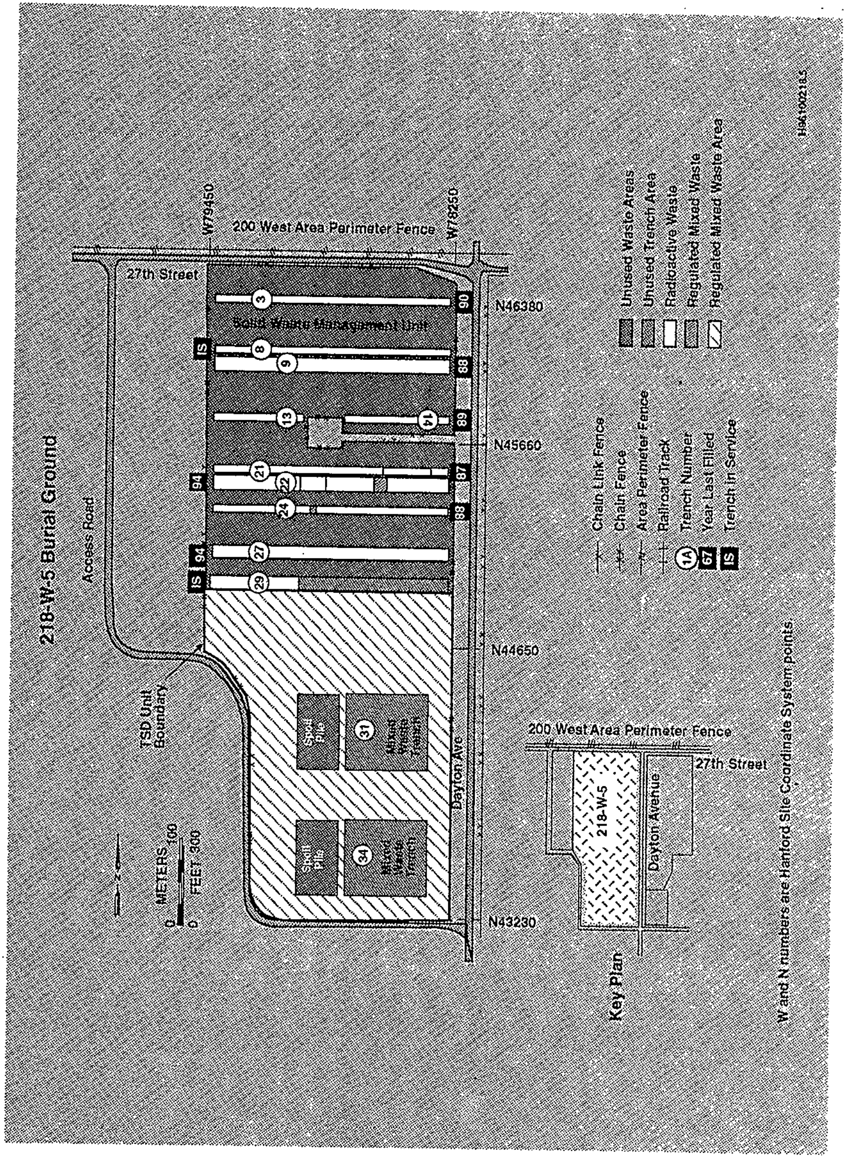

218-E-12B Burial Ground
200 East Area Perimeter Fence
12th Street
Canton Avenue
Trench 94
Solid Waste Management Unit
N46775
TSD Unit Boundary
N45222
W51475
W47345
N46523
W48542
N44505
N44465
Key Plan
218-E-12B
Open Ditch
12th Street
Canton Avenue
0 METERS 100
0 FEET 300
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
Trench Number
Year Last Filled
Trench in Service
Unused Waste Areas
Radioactive Waste
Regulated Mixed Waste*
Retrievable Transuranic
Regulated Mixed Waste Area
W and N numbers are Hanford Site Coordinate System points.
*This figure shows typical U.S. Navy Reactor Compartment placement in Trench 94. The number of Reactor Compartments will continue to increase as future shipments are received.
39602011.14Cag
R1 5/20/97

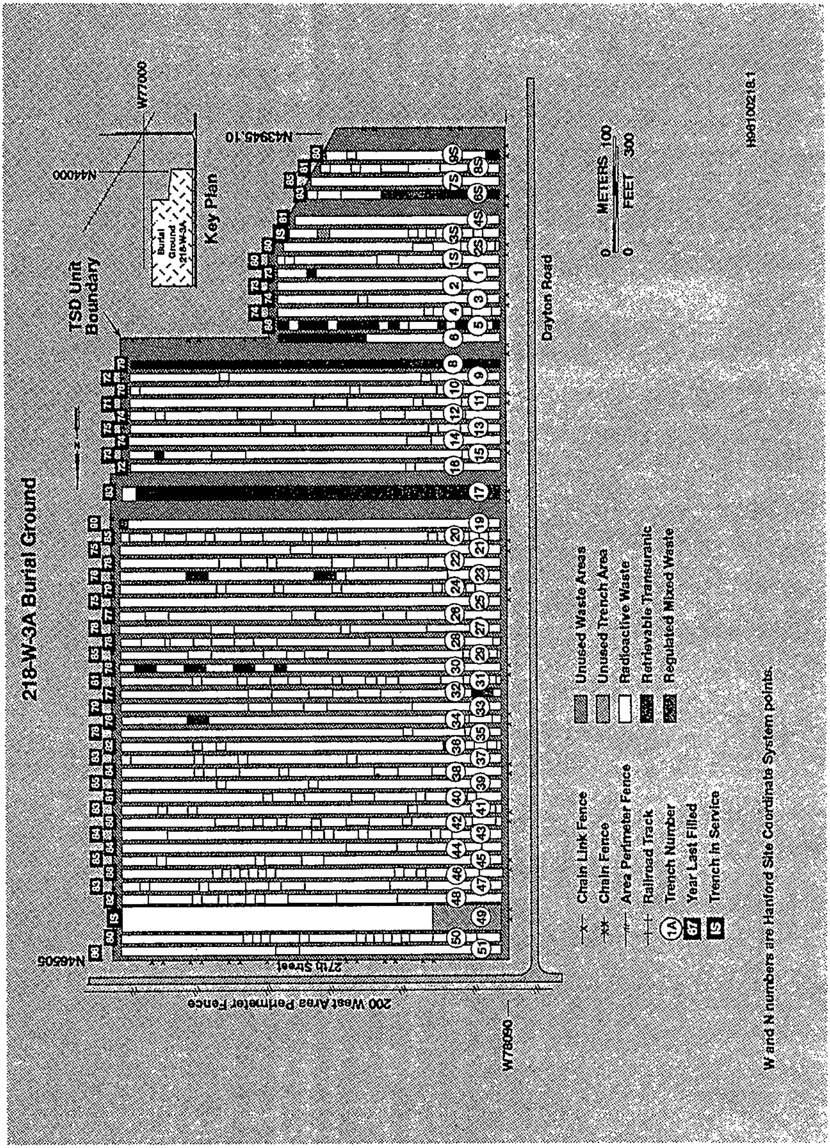

218-E-10 Burial Ground
200 East Area Perimeter Fence
12th Street
218-E-10
Akron Avenue
N46500
TSD Unit Boundary
N46000
N45500
TSD Unit Boundary
N45000
N44500
W55000
W55500
W56000
W56500
0 METERS 100
0 FEET 300
Key Plan
12th Street
218-E-10
218-E-10
Akron Ave
N
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
Trench Number
Year Last Filled
Trench In Service
Unused Waste Areas
Unused Trench Area
Radioactive Waste
Regulated Mixed Waste
W and N numbers are Hanford Site Coordinate System points.
H96100218.3

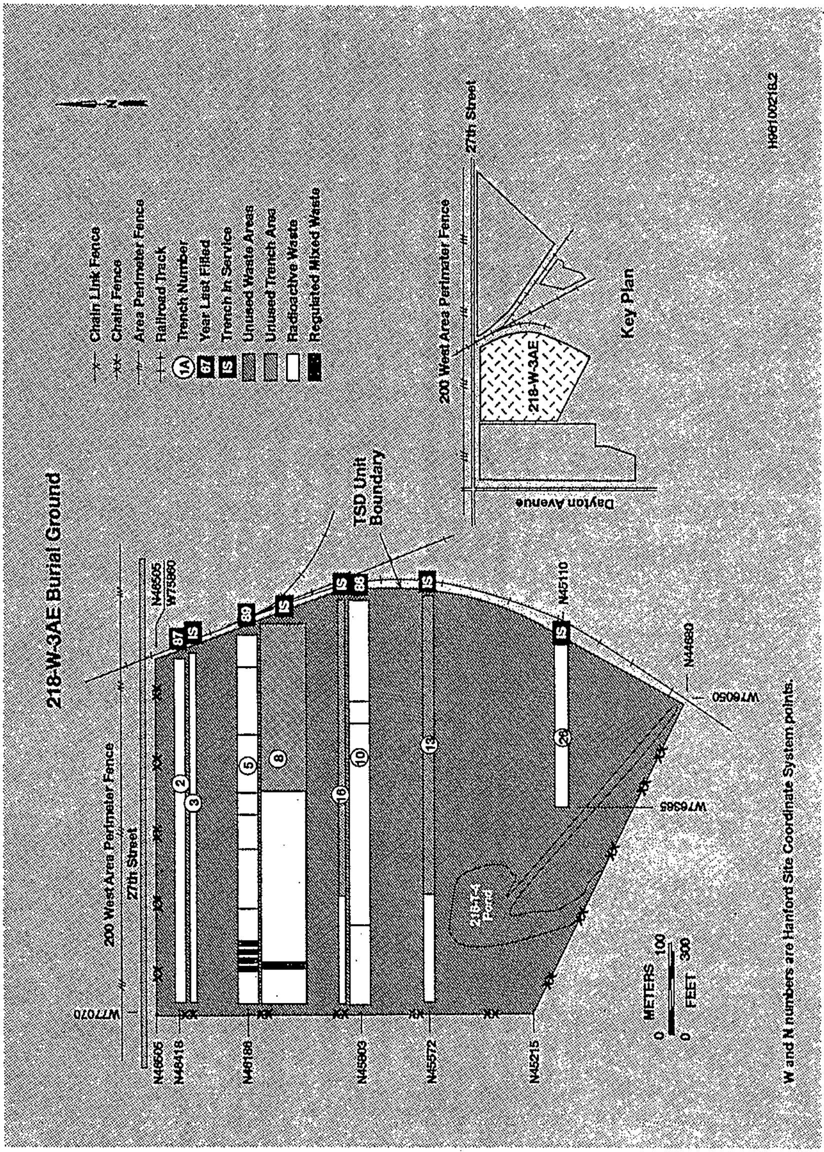

For Regulated Portions,
Refer to 218-W-3A Site Plan
Gate
609
For Regulated Portions,
Refer to 218-W-3AE Site Plan
218-W-6
Burial
Ground
119°38'24"
119°38'08"
119°37'46"
Gate
610
119°37'22"
27th Street
46°34'01"
For Regulated Portions,
Refer to 218-W-5 Site Plan
Beloit Avenue
T Plant
Complex
224-T TRUSAF
23rd Street
Waste Receiving
and Processing 1
22nd Street
Dayton Avenue
Gate
611
Central Waste
Complex
Gate
612
218-W-4B
Burial Ground
19th Street
For Regulated Portions
Refer to 218-W-4C Site Plan
Plutonium
Finishing Plant
46°32'48"
U Plant
16th Street
241-S
200 West
Area
300
Area
Hanford
Site
222-S
Laboratory
Complex
Highway 240
Access Road
0
1525
3050 Feet
0
465
930 Meters
Regulated Burial Grounds
SWMU (Solid Waste
Management Unit)
Waste Routes
Note: TSD Unit boundaries
are defined by dashed lines.
200 West Area
Low-Level Burial
Grounds
H9408030.1

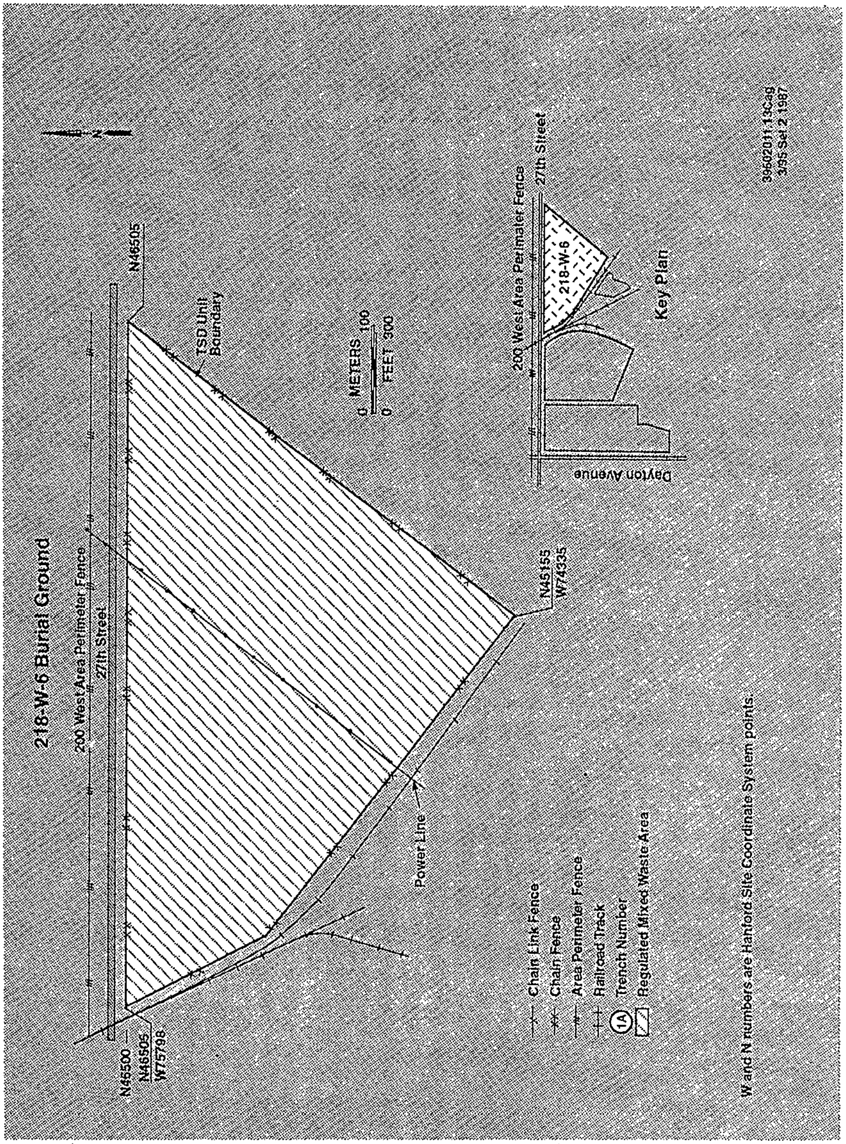

218-W-4B Burial Ground
TSD Unit Boundary
Key Plan
METERS
FEET
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
Trench Number
Caisson
Year Last Filled
Unused Waste Areas
Unused Trench Area
Radioactive Waste
Retrievable Transuranic
W77478
W78068
W77444
W78100
N40770
N40610
N40433
23rd Street
19th Street
Dayton Avenue
W and N numbers are Hanford Site Coordinate System points.
39502011.7Ca
R2 5/20/97


218-W-4C Burial Ground
19th street
218-W-4C
218-Z-19 Ditch
Dayton Avenue
Key Plan
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
Trench Number
Year Last Filled
Trench In Service
Unused Waste Areas
Unused Trench
Radioactive Waste
Regulated Mixed Waste
Retrievable Transuranic
39502011.16Csg
R2 5/20/97
W76550
W77269
W77322
N37820
N38485
16th street
TSD Unit Boundary
W77149
N38990
N39610
N39670
N40360
W77457
W77477
W78059
W78079
Dayton Avenue
METERS
FEET
W and N numbers are Hanford Site Coordinate System points.

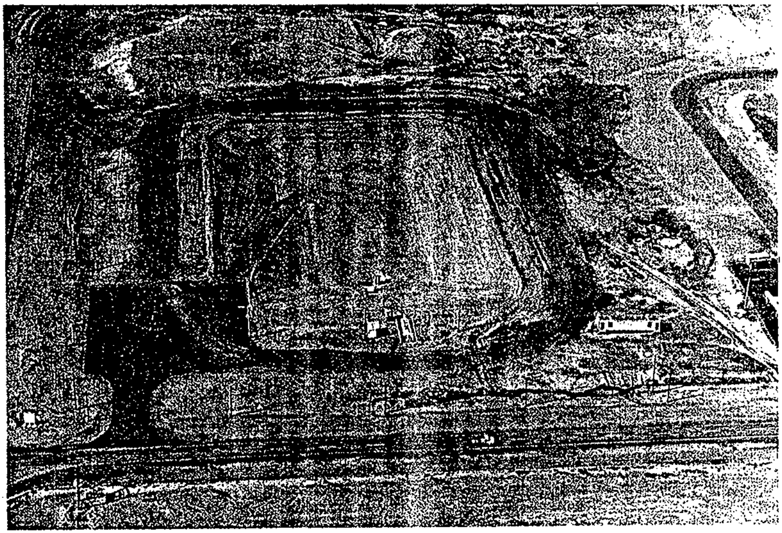

218-W-5 Burial Ground
Access Road
TSD Unit Boundary
200 West Area Perimeter Fence
W79450
W78250
27th Street
Solid Waste Management Unit
N46380
N45660
N44650
N43230
Dayton Ave
Spoil Pile
Mixed Waste Trench
METERS 0 100
FEET 0 300
N
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
Trench Number
Year Last Filled
Trench in Service
Unused Waste Areas
Unused Trench Area
Radioactive Waste
Regulated Mixed Waste
Regulated Mixed Waste Area
Key Plan
218-W-5
Dayton Avenue
W and N numbers are Hanford Site Coordinate System points


218-W-3A Burial Ground
TSD Unit Boundary
Key Plan
Burial Ground 218-W-3A
N44000
W77000
N43945.10
N46505
W78090
Dayton Road
27th Street
200 West Area Perimeter Fence
METERS 0 100
FEET 0 300
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
Trench Number
Year Last Filled
Trench in Service
Unused Waste Areas
Unused Trench Area
Radioactive Waste
Retrievable Transuranic
Regulated Mixed Waste
W and N numbers are Hanford Site Coordinate System points.
H9610021 8.1


218-W-3AE Burial Ground
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
Trench Number
Year Last Filled
Trench In Service
Unused Waste Areas
Unused Trench Area
Radioactive Waste
Regulated Mixed Waste
200 West Area Perimeter Fence
27th Street
TSD Unit Boundary
Key Plan
218-W-3AE
Dayton Avenue
218-T-4 Pond
W77070
W75960
W76050
W76365
N46605
N46418
N46188
N45803
N45572
N45215
N45110
N44690
METERS 0 100
FEET 0 300
H9610021B.2
W and N numbers are Hanford Site Coordinate System points.


218-W-6 Burial Ground
N
200 West Area Perimeter Fence
27th Street
N46505
TSD Unit Boundary
METERS 0 100
FEET 0 300
N45155
W74335
Power Line
N46500
N46505
W75798
200 West Area Perimeter Fence
27th Street
218-W-6
Key Plan
Dayton Avenue
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
1A Trench Number
Regulated Mixed Waste Area
W and N numbers are Hanford Site Coordinate System points.

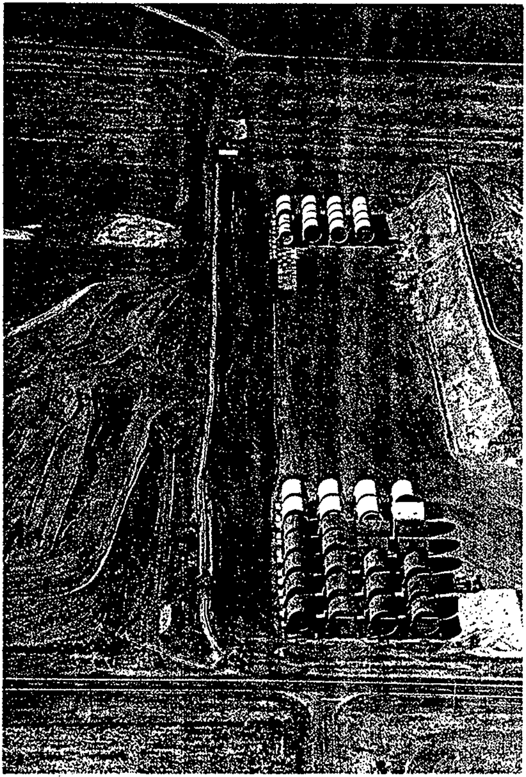
TYPICAL LINED MIXED WASTE TRENCH (TRENCH 34) 218-W-5/200 WEST AREA



46°33'36"
119°38'24"

95030469-44CN
(PHOTO TAKEN 1995)

REACTOR COMPARTMENT TRENCH 94



46°33'58"
119°31'06"

95030469-5CN
(PHOTO TAKEN 1995)

CONTENTS

APPENDIX

FIGURES

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2.0 FACILITY DESCRIPTION AND GENERAL PROVISIONS [B AND E]

Revision 0 of the LLBG dangerous waste permit application documentation described a land-based unit consisting of eight burial grounds located in the 200 East Area and 200 West Area. Seven of the original eight burial grounds (218-E-10, 218-E-12B, 218-W-3A, 218-W-3AE, 218-W-4C, 218-W-5, and 218-W-6) contain or will contain mixed waste that is subject to Washington Administrative Code (WAC) 173-303. In addition, portions of the 218-E-10, 218-E-12B, 218-W-3A, 218-W-3AE, 218-W-4C, and 218-W-5 Burial Grounds are designated as solid waste management units (SWMUs). One other burial ground (218-W-4B) within the LLBG, discussed in Revision 0, is now designated completely as SWMU (*Hanford Facility Dangerous Waste Permit Application, General Information Portion*, Chapter 2.0, DOE/RL-91-28).

Mixed waste is and has been received from onsite generating units and from offsite generators and is and will be disposed in mixed waste trenches. Leachate collected from lined trenches is transferred to leachate collection tanks that are located in proximity to the lined trenches.

A more detailed discussion of waste types and manifesting, and the identification of the processes and equipment, are provided in Chapters 3.0 and 4.0, respectively. Although the treatment, storage, and/or disposal of radioactive waste (i.e., source, special nuclear, and by-product materials as defined by the *Atomic Energy Act of 1954*) are not within the scope of *Resource Conservation and Recovery Act* (RCRA) *of 1976* or WAC 173-303, information is provided for general knowledge.

Low-level radioactive waste and transuranic waste continues to be placed in the SWMU portions of the LLBG. Transuranic mixed waste has not been placed in the LLBG since August 19, 1987. Soil is placed over some of the waste containers to provide radiological protection. Transuranic waste was placed in a manner that allows for retrieval and/or removal in the future if necessary. Any waste retrieved and/or removed will be processed and disposed in accordance with current federal and state requirements.

2.1 LOW-LEVEL BURIAL GROUNDS DESCRIPTION [B-1]

The LLBG are a land-based unit consisting of eight burial grounds located in the 200 East Area and 200 West Area. Seven of the eight burial grounds (218-E-10, 218-E-12B, 218-W-3A, 218-W-3AE, 218-W-4C, 218-W-5, and 218-W-6) are, or will be, used for the disposal of mixed waste and are subject to WAC 173-303. One burial ground (218-W-4B) is designated as SWMU (Figure 2-2 and Appendix 2A).

The 218-E-10, 218-E-12B, 218-W-3A, 218-W-3AE, 218-W-4C, and 218-W-6 Burial Grounds are classified as a landfill (D81) and the 218-W-5 Burial Ground is classified as a landfill (D81) and for greater-than-90-day container storage (S01). The regulated portions of the LLBG cover a total area of approximately 49 hectares.

The 218-E-10 and 218-E-12B Burial Grounds are located in the 200 East Area. The 218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-5, and 218-W-6 Burial Grounds are located in the 200 West Area. The LLBG consist of various sizes and depths of lined and unlined disposal trenches. All mixed waste destined for disposal will meet land disposal restriction (LDR) requirements [WAC 173-303-140 and 40 Code of Federal Regulations (CFR) 268] or other regulatory alternatives. The lined trenches have leachate collection and removal systems. The less-than-90-day leachate collection tanks are operated in accordance with the generator provisions of WAC 173-303-200. The less-than-90-day leachate collection tanks have a current design capacity of 37,850 liters; however, future leachate collection tank capacity might change to accommodate various sized lined trenches. The precise dimensions of leachate collection tanks for trenches 31 and 34 are provided in the construction quality assurance reports identified in Chapter 4.0.

Future mixed waste trench development and configuration within a burial ground are subject to change as disposal techniques improve or as waste management needs dictate and will be subject to an approved permit modification in accordance with the Hanford Facility (HF) RCRA Permit (Ecology 1994). Mixed waste is disposed in lined or in unlined trenches. Disposal of mixed waste in unlined trenches requires an exemption from the liner/leachate collection system requirements. This permit application documentation includes an exemption request for trench 94 for the disposal of U.S. Navy defueled reactor compartments (refer to Chapter 4.0, Section 4.3.2).

The following provides a brief description and identifies the generic types of waste disposed in the LLBG. An electronic database is maintained that documents each waste receipt, type of waste, and disposal location.

- The 218-E-10 Burial Ground is approximately 36.1 hectares in size (Chapter 1.0) and began receiving waste in 1960. Examples of waste placed in this burial ground include failed equipment, rags, paper, rubber gloves, disposable supplies, broken tools, and post-August 19, 1987 RCRA and state-only designated mixed waste.

- The 218-E-12B Burial Ground is approximately 68 hectares in size (Chapter 1.0) and began receiving waste in 1967. Examples of waste placed in this burial ground include defueled reactor compartments (trench 94), low-level waste, and retrievable transuranic waste.

- The 218-W-3A Burial Ground is approximately 20.4 hectares in size (Chapter 1.0) and began receiving waste in 1970. Examples of waste placed in this burial ground include ion exchange resins, failed equipment, tanks, pumps, ovens, agitators, heaters, hoods, jumpers, vehicles, accessories, retrievable transuranic waste, and post-August 19, 1987 RCRA and state-only designated mixed waste.

- The 218-W-3AE Burial Ground is approximately 20 hectares in size (Chapter 1.0) and began receiving waste in 1981. Examples of waste placed in this burial ground include rags, paper, rubber gloves, disposable supplies, broken tools, and post-August 19, 1987 RCRA and state-only designated mixed waste.

- The 218-W-4B Burial Ground is approximately 3.5 hectares in size (Chapter 1.0) and began receiving waste in 1968. Examples of waste placed in this burial ground include rags, paper, rubber gloves, disposable supplies, broken tools, alpha caissons, and retrievable transuranic waste.

- The 218-W-4C Burial Ground is approximately 20 hectares in size (Chapter 1.0) and began receiving waste in 1978. Examples of waste placed in this burial ground include contaminated soil, decommissioned pumps, pressure vessels, post-August 19, 1987 RCRA and state-only designated mixed waste, and retrievable transuranic waste.

- The 218-W-5 Burial Ground is approximately 37.2 hectares in size (Chapter 1.0) and began receiving waste in 1986. Examples of waste placed in this burial ground include rags, paper, rubber gloves, disposable supplies, broken tools, and post-August 19, 1987 RCRA and state-only designated mixed waste. This burial ground currently contains double-lined mixed waste trenches (trenches 31 and 34). Trenches 31 and 34 also are designated as a greater-than-90-day container storage. Waste to be placed in trenches 31 and 34 for storage purposes predominately will be macro-encapsulated long-length contaminated equipment and other containerized waste that has been treated to meet LDR requirements. Adjacent to the double-lined mixed waste trenches are leachate collection tanks. Examples of waste to be placed in the double-lined mixed waste trenches include mixed waste that has been treated to meet LDR requirements (including bulk waste), macro-encapsulated long-length contaminated equipment, etc.

- The 218-W-6 Burial Ground is approximately 16 hectares in size (Chapter 1.0), has not received any waste, and is reserved for future mixed waste disposal.

2.1.1 Other Environmental Permits

All environmental permits that are required to support operation of the LLBG are identified in the *Annual Hanford Site Environmental Permitting Status Report* (e.g., DOE/RL-96-63).

2.1.2 Construction Schedule

Any proposed new construction for mixed waste trenches will be managed as described in the HF RCRA Permit.

2.2 TOPOGRAPHIC MAP [B-2]

In addition to the topographic maps, several maps at various scales have been included in this permit application documentation. Small-scale maps generally are included with the text. Appendix 2A contains topographic maps of 200 East and 200 West Areas.

2.3 ROADWAY TRAFFIC INTO THE LOW-LEVEL BURIAL GROUNDS [B-4]

General traffic information for the Hanford Facility is presented in the General Information Portion (DOE/RL-91-28). Public access to the LLBG is restricted. Figure 2-1 depicts the normal transportation routes within the 200 East Area. Waste transported to the 200 West Area LLBG is routed through Gates 609 or 611 (Figure 2-2). Trucks typically are used to transport waste to the LLBG and range in size from heavy duty pickup trucks to tractor-trailer rigs, depending on the size and weight of the load. In some cases, special equipment such as transporters are used for unusual or unique loads. When special equipment is used, an evaluation ensures that the equipment does not damage the roadways.

2.4 RELEASE FROM SOLID WASTE MANAGEMENT UNITS [E]

Information concerning releases from SWMUs is discussed in the General Information Portion (DOE/RL-91-28). However, no known releases have been detected from the LLBG since the installation of the groundwater monitoring network (refer to Chapter 5.0).

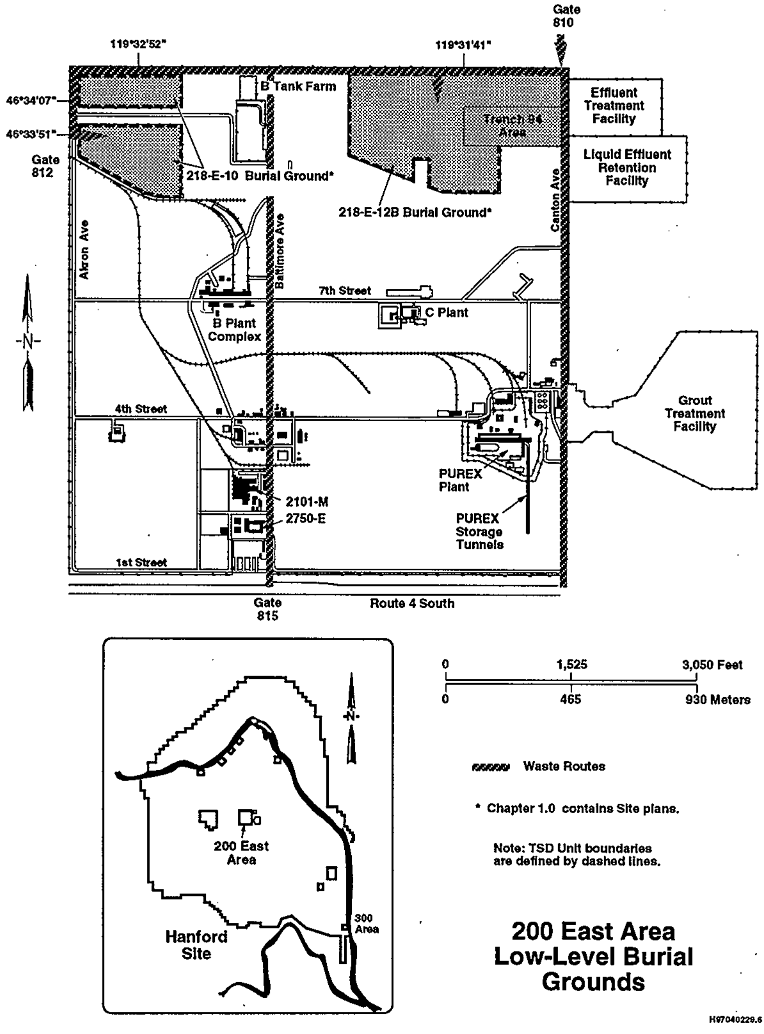

Figure 2-1. Low-Level Burial Grounds in the 200 East Area.

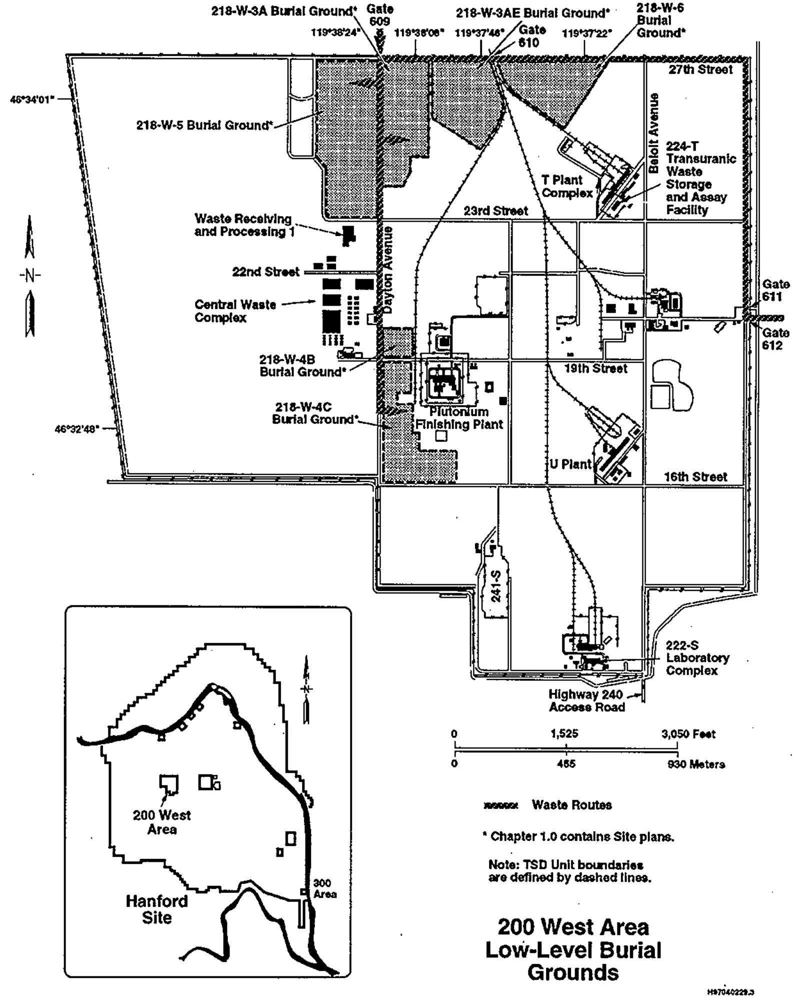

Figure 2-2. Low-Level Burial Grounds in the 200 West Area.

CONTENTS

APPENDIX

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3.0 WASTE CHARACTERISTICS [C]

This chapter provides information on the chemical, biological, and physical characteristics of the waste placed in the LLBG. A waste analysis plan (Appendix 3A) describes the methodology for determining waste types.

3.1 CHEMICAL, BIOLOGICAL, AND PHYSICAL ANALYSIS [C-1]

Records are available for waste placed in the LLBG since the burial grounds began operating in 1960. The detail associated with these records increases through time, particularly beginning in 1968. An account of waste placed in the LLBG since 1968 is maintained in an electronic database, on a continuing basis. This computer database lists the location of the waste container (using Hanford coordinates), the waste type, the record number of the original shipping documents, a container code, the volume of the waste container in cubic feet, and the weight of the container plus the waste in pounds. This database also tracks unpackaged or bulk waste placed in the LLBG. The last two categories include a list of dangerous constituents and the weight of each dangerous constituent in pounds. Complete records for radioactive waste with dangerous components have been maintained since 1986.

Only a relatively small fraction of the waste placed in the LLBG is classified as mixed waste. Dangerous constituents of this waste are co-contaminants of the radioactive waste. Mixed waste placed in the LLBG includes waste designated as dangerous and extremely hazardous per WAC 173-303.

Mixed waste placed in the LLBG could be packaged in a system of multiple barriers selected and specifically engineered to isolate the waste content from humans and the environment. The waste is confined in package systems that could include several plastic, metal, and glass containers as well as additional barriers to protect the environment or to make the waste more compatible with other barrier materials. Specific package barrier information is provided in Chapter 4.0.

3.2 LANDFILLED WASTES [C-1b]

Free liquids will not be accepted if the liquid is in excess of 1 percent of the volume of the waste or if the sorbent to potential liquid waste ratio is less than 2 to 1.

3.3 WASTE ANALYSIS PLAN [C-2]

The waste analysis plan (Appendix 3A) provides a description of how waste destined for the LLBG is identified to ensure proper handling and disposal.

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CONTENTS

CONTENTS (cont)

APPENDICES

FIGURE

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4.0 PROCESS INFORMATION [D]

This chapter discusses the processes used to dispose of mixed waste in the LLBG and includes a discussion of the design and function of the following.

- Containers
- Disposal trenches
- Leak detection system
- Leachate collection and removal system.

4.1 CONTAINERS [D-1]

All newly generated mixed waste accepted for storage at the LLBG is packaged in approved containers (U.S. Department of Transportation and/or U.S. Department of Energy), unless alternate packages are dictated by the size, shape, or form of waste (49 CFR 173) (e.g., metal boxes).

Mixed waste frequently is disposed in the container in which the waste was received. The only regulatory concerns with respect to the disposal of containerized waste in the LLBG are the potential for free liquids (free liquids will not be accepted if the liquid is in excess of 1 percent of the volume of the waste or if the sorbent to potential liquid waste ratio is less than 2 to 1) and subsidence due to void spaces in the containers. Both issues are addressed in the following sections.

4.1.1 Description of Containers [D-1a, D-1b, and D-1c]

Containers vary in shape, size, and strength depending on the form and weight of the waste. The most common containers are galvanized or aluminized 208-liter containers. Nominal 1.2-meter by 1.2-meter by 2.4-meter steel boxes are used frequently. Usually waste containers are lined to further contain the mixed waste. Liners consist of coatings to the interior of the containers, e.g., minimum 4 mil plastic liners or 90 mil polyethylene liners. Selection of the liner is driven by the chemical characteristics of the waste.

If the void space in containers of mixed waste exceeds 10 percent of the container volume, the containers must be crushed or repacked before storage.

Mixed waste containers are labeled and marked to indicate the dangerous and radioactive characteristics of the waste. The hazard labels are affixed, as required, to the sides of the containers, and each mixed waste container has a hazardous waste identification sticker attached in accordance with Ecology requirements. Marking and labeling requirements on the waste records are discussed in Chapter 3.0, Appendix 3A. In addition to the marking and labeling requirements, all waste containers are marked as follows:

- 'PERSISTENT' - If a WP01, WP02, or WP03 waste number is applicable
- 'TOXIC' - If a WT01 or WT02 waste number is applicable.

Before receipt for storage at trench 34 (and trench 31, if needed to support waste management needs), all containers are closed by the onsite generating unit or offsite generator by means of a neoprene gasket, steel lid, locking ring, locking ring bolt, and a lock nut torqued tight or by other available methods to meet requirements. On receipt, each container is inspected by LLBG operations personnel before acceptance for damage, proper closure, marking, and proper accompanying documentation.

The container packaging and container handling for trench 34 (and trench 31, if needed to support waste management needs), are designed to maintain containment of the waste, limit storage intrusion, and limit human exposure to mixed waste. The containers are placed on pallets or other support devices. Heavier containers are rotated to the bottom of the stack to ensure a stable center of gravity for each stack. Aisle space requirements are provided in Chapter 6.0, Section 6.3.5. Other unusual sized containers such as macro-encapsulated long-length contaminated equipment are handled by using cranes or other appropriate equipment.

For container disposal operations, container management practices are not applicable. However, if a container is disposed in the LLBG, the container must be 90 percent full. Alternatively, the container can be crushed, repacked, shredded, or similarly reduced in volume to the maximum practical extent before the container is buried (40 CFR 264.315).

On receipt, each container is inspected by operations personnel to confirm appropriate documentation and compliance with the waste acceptance criteria before the container is placed in the LLBG (refer to Chapter 3.0, Appendix 3A).

If containerized mixed waste must be opened (i.e., for confirmation sampling, repackaging, etc.), the container typically would be removed to an onsite treatment and/or storage unit or other approved location before being opened. The container would be sealed before being returned to the LLBG.

4.1.2 Containment Requirements for Storing Containers [D-1d]

The following sections describe secondary containment systems.

4.1.2.1 Secondary Containment System Design and Operation [D-1d(a) and (b)]. Refer to Section 4.5.3 for discussion on secondary containment system design and construction for trenches 31 and 34.

4.1.2.2 Containment System Capacity [D-1d(1)(c)]. Refer to Section 4.5.6 for discussion on containment system capacity for trenches 31 and 34.

4.1.2.3 Control of Run-On [D-1d(1)(d)]. Refer to Section 4.5.8 for discussion on control of run-on for trenches 31 and 34.

4.1.3 Removal of Liquids from Containment System [D-1d(2)]

Refer to Section 4.5.6 for discussion on containment system capacity for trenches 31 and 34.

In the event of a spill or release within trench 34 (and trench 31, if needed to support waste management needs), the following is performed.

1. Containers affected by the spill are inspected for signs of leakage. Leaking containers are repackaged and identified in the LLBG operating logbook.

2. Inspection reports and LLBG operating logbook are reviewed to identify any waste releases in trench 34 (and trench 31, if needed to support waste management needs) for which remedial actions have not been completed.

3. The containerized waste is handled as follows.

    - If the waste has been altered during stabilization and cleanup actions (absorbed, mixed, diluted, etc.), the containerized waste is managed in accordance with the provisions of the waste analysis plan (Chapter 3.0, Appendix 3A).

    - The LLBG inventory is updated to reflect the changes in waste description, volume, and storage location.

    - If the waste was not altered during stabilization and cleanup activities, the containerized waste is placed in trench 34 (and trench 31, if needed to support waste management needs) or at another onsite TSD unit. The LLBG inventory is altered to reflect any changes.

4. Cleanup soil (operations layer) will be removed and containerized; operations layer will be replaced.

5. Soil samples are taken from the operations layer (Section 4.5.3.1) and analyzed to verify cleanup adequacy.

6. When soil sampling techniques have verified cleanup, the LLBG supervisor signs the operating logbook, indicating that the waste was removed from the containment system and cleanup activities are completed.

Specific actions to be taken in response to a spill or discharge are detailed in the building emergency plan (Chapter 7.0, Appendix 7A).

4.2 CONTAINERS WITHOUT FREE LIQUIDS [D-1e]

Containers without free liquids that do not exhibit ignitability or reactivity are discussed in the following sections.

4.2.1 Test For Free Liquids

A test for free liquids is not performed unless specific instructions are received because testing would increase the radiation exposure of personnel. However, all mixed waste accepted for storage and/or disposal must comply with land disposal restriction requirements. For additional information on the waste acceptance criteria for the LLBG refer to Chapter 3.0, Appendix 3A.

4.2.2 Description of Containers

The description of containers is the same as is described in Section 4.1.1.

4.2.3 Container Management Practices

Container management practices are the same as are described in Section 4.1.1.

4.2.4 Container Storage Area Drainage

The description of the storage area drainage is the same as is described in Section 4.5.3.1.2.

4.3 PREVENTION OF REACTION OF IGNITABLE, REACTIVE, AND INCOMPATIBLE WASTE IN CONTAINERS [D-1f]

Current LLBG operations do not allow for storage or disposal of ignitable, reactive, and incompatible waste in trenches 31 and 34 of the 218-W-5 Burial Ground.

4.4 LEACHATE COLLECTION TANKS

Each lined LLBG mixed waste disposal trench is supported by an aboveground less-than-90-day leachate collection tank. The information contained in Appendix 4A, construction quality assurance report, and Appendix 4B, definitive design report, provide specific details for the leachate collection tank installation for trenches 31 and 34 of the 218-W-5 Burial Ground. The less-than-90-day leachate collection tanks are operated in accordance with the generator provisions of WAC 173-303-200.

4.5 LANDFILLS [D-6]

This permit application documentation addresses the following types of trenches located in the LLBG:

- Regulated mixed waste trench (trench 94) for which a waiver to the liner/leachate collection system requirements has been requested (Appendix 4D)
- Unlined trenches (Section 4.5.2.2)
- Lined trenches.

4.5.1 List of Wastes [D-6a]

Mixed waste disposed in the LLBG consists of listed waste, characteristic waste, state-only waste, and waste from nonspecific sources (Chapter 1.0). Examples of waste disposed in the LLBG include containerized or bulk waste such as contaminated soil, decommissioned pumps, pressure vessels, macro-encapsulated debris and macro-encapsulated long-length contaminated equipment, defueled reactor compartments, and mixed waste that has been treated to meet LDR.

4.5.2 Liner System Exemption Requests [D-6b and D-6b(2)]

This permit application documentation seeks an exemption to liner system requirements for the reactor compartment disposal trench (trench 94).

4.5.2.1 218-E-12B Burial Ground (Trench 94). Appendix 4D, "*Request for Exemption from Lined Trench Requirements at 218-E-12B Burial Ground Trench 94*", updates the exemption request submitted to Ecology on October 9, 1992 (DOE/RL-88-20, Supplement 1, Revision 1). The defueled reactor compartments are managed as a state-only dangerous waste due to the presence of lead shielding. The following is a summation of the content of the exemption request.

Defueled reactor compartment disposal packages are a unique integrated waste form that is both containment and waste. The welded steel structure of the package forms a sealed containment barrier for the materials contained within the waste matrix. This steel structure includes a combination of existing ship hull and structure, and installed bulkhead structure and/or exterior plating. The minimum thickness of this structure is typically 1.9 centimeters but is 1.3-centimeters thick over small penetrations through the hull of older reactor compartments. The packages are designed to be water tight at higher hydraulic pressures than would be experienced after disposal. The first potential generation of contaminated leachate would occur when general corrosion, in combination with soil pressure, causes the containment structure to rupture allowing lead in the packages to be exposed. This is not expected to occur for about 2,000 years and should not occur for about 600 years at the minimum. These times are based on conservative estimates of the general corrosion rate of carbon steel in trench 94 of 0.0015 centimeters per year for the maximum rate.

Each defueled reactor compartment contains elemental lead used as shielding, chromium and nickel in corrosion-resistant steel alloys, and small amounts of cadmium and asbestos for thermal insulation. The reactor compartments comply with WAC 173-303 requirements for removal of free liquids from waste. Before a defueled reactor compartment is sealed, liquids are removed to the maximum extent practical while keeping worker radiation exposure as low as reasonably achievable (ALARA). Therefore, some residual liquids remain in the defueled reactor compartments because removing all the residual liquids would entail significant worker radiation exposure. Where practical, absorbent is added to the reactor compartments to absorb residual liquids.

Lead is the only dangerous constituent present in quantities requiring regulation under WAC 173-303. Lead is not expected to migrate to an aquifer below the burial site for at least 240,000 years (conservative bounding case) and more likely over 2 million years (best estimate).

The exemption request (Appendix 4D) concludes that the reactor compartment waste form will prevent the generation of any contaminated leachate beyond the expected lifetime of the minimum technological liner/leachate system design. A liner/leachate collection system should not be required for the reactor compartment disposal trench because the thickness of the package structure prevents intrusion of precipitation into the compartment where waste is located. In addition, with an average annual rainfall of 15.2 to 17.8 centimeters, it is doubtful liquids will penetrate the 3.1 meters of soil covering the reactor compartments. Most of the precipitation will be lost to evapotranspiration. The potential for liquids reaching the reactor compartments will be reduced further when the 218-E-12B Burial Ground is covered (Chapter 11.0).

4.5.2.2 Unlined Trenches. The EPA published the "Final Authorization of State Hazardous Waste Management Program; Washington" (52 FR 35556). Although this authorization became effective on November 23, 1987, and included the authorization to regulate mixed waste, an agreement was reached with Ecology that the actual date for regulating mixed waste is August 19, 1987. An exemption from the liner system requirements for mixed waste is requested for all mixed waste that has been received for disposal in various unlined trenches since August 19, 1987.

4.5.3 Liner System, General Items [D-6c]

This section provides a general description of the liner systems used for mixed waste lined trenches.

The liner system is designed to prevent migration of leachate out of the lined trench during its active life. The active life consists of the operational period and the closure period. The liner system is designed to meet the EPA requirements, as identified in RCRA Subtitle C requirements for hazardous waste disposal facilities (40 CFR 264), technical guidance documents (e.g., EPA 1985), and WAC-173-303. In addition, the liner system incorporates the following general functional requirements:

- Range of Operating Conditions--year-round operation, withstand construction and long-term stresses

- Degree of Reliability--function safely and effectively throughout operating and postclosure period with minimum maintenance

- Intended Life--operational phase plus 30 years postclosure monitoring phase.

4.5.3.1 Liner System Description [D-6c(1)]. The trench liner systems comply with RCRA requirements for hazardous waste landfills. Refer to Appendix 4A and 4B for specific design information on liner systems. Figure 4-1 shows a typical design and includes the following components (from top to bottom).

- Operations layer: nominal amount (0.9-meter thick) of native soil. This layer provides a working surface for equipment, protects the liner from mechanical damage, and prevents freezing of the underlying low-permeability soil layer.

- Primary leachate collection system that contains at least one of the following:

  - a geotextile/geonet composite, with a minimum transmissivity value of 3×10^{-5} square meters per second

  - a minimum 0.3-meter-thick drainage gravel layer with a hydraulic conductivity of at least 1×10^{-2} centimeters per second (sometimes including drainage pipes)

  - a geonet, with a minimum transmissivity value of 3×10^{-5} square meters per second.

The primary leachate collection system collects and conveys leachate to the primary sump for removal and includes the following components.

- Primary geomembrane liner: generally consisting of high-density polyethylene because of its excellent resistance to chemicals. Minimum 60-mil thickness; can be textured (to improve stability against sliding) or smooth. The geomembrane acts as a moisture barrier. The primary leachate collection system includes perforated pipe that helps collect and guide water into the primary sump.

- Primary admix liner (optional; not required by regulations): a minimum 0.46-meter-thick layer of compacted soil/bentonite admixture with a permeability of 1×10^{-7} centimeter per second or less. This layer acts as an additional primary moisture barrier directly under the primary geomembrane.

- Secondary leachate collection system: same as primary system, except that pipes are not needed because very high flow capacities are not required. The purpose of this system is to collect any leachate that leaks through the primary liner system and convey the leachate to the secondary sump for removal. The secondary leachate collection system also serves as the leak detection system.

- Secondary geomembrane liner: same as primary geomembrane liner.

- Secondary admix liner: a minimum 0.9-meter-thick layer of compacted soil/bentonite admixture with a permeability of 1×10^{-7} centimeter per second or less. This layer acts as an additional moisture barrier directly under the secondary geomembrane.

4.5.3.1.1 Rain Cover. The rain covers for mixed waste disposal trenches (e.g., trenches 31 and 34 and potential future lined trenches) would intercept the majority of precipitation before encountering the disposed mixed waste. Removing this precipitation as clean rainwater versus managing the precipitation as multi-source leachate (F039) would implement waste minimization to the extent practical. The rain covers would include a geosynthetic membrane, flexible piping, and pumps necessary to ensure a complete system to collect and remove precipitation. Because the rain cover would be installed over the slopes of the trench, significant quantities of precipitation would be collected and removed.

4.5.3.1.2 Operations Layer. The purpose of the operations layer is to protect the underlying liner components from damage by equipment during lined trench construction and operation. On the sideslopes, this layer also protects the admix layer from freezing and desiccation cracking.

Previous research and experience has shown that desiccation cracks can occur under geomembrane liners when either the liner is not in close contact with the compacted admix or when the liner is subjected to wide temperature fluctuations (Corser and Cranston 1991). The operations layer acts as a weight to keep the geomembrane in contact with the admix, thereby reducing the potential for water vapor to form in an underlying airspace. The operations layer also acts as an insulating layer, together with the dead air space trapped in the geocomposite drainage layers.

The operations-layer material typically consists of onsite granular soil that is reasonably well graded and conforms to one of the following Unified Soil Classification System designations, ASTM D2487: GM, GC, SW, SM, SP, or SC. Material has a maximum particle size limit of 10.2 centimeters or less, depending on the strength of the underlying layers.

4.5.3.1.3 Primary Leachate Collection System. The primary leachate collection system is located below the operations layer and provides a flow path for the leachate flowing into the primary sump. Although any of the options presented in Section 4.5.3.1 are acceptable in the LLBG, the following is a description of the system used in the existing mixed waste disposal trenches.

Between the operations layer and the underlying drainage gravel, a geotextile layer functions as a filter separation barrier. The geotextile prevents migration of fine soil and clogging of the drainage gravel. The gravel is a minimum 0.3-meter-thick layer of washed, rounded to subrounded stone, with a permeability of at least 1 x 10^{-2} centimeter per second, as required by RCRA regulations. In addition, perforated high-density polyethylene drainage pipe is placed within the drainage gravel to accelerate leachate transport into the primary sump during high precipitation events. The gravel layer is underlain by a geotextile/geonet drainage layer resting on the primary high-density polyethylene geomembrane. The geonet provides additional drainage capacity for high-precipitation events and acts as a redundant drainage system.

On the lined trench sideslopes, the primary leachate collection system has a geocomposite drainage layer composed of a geonet, with a layer of geotextile thermally bonded to each side. This geocomposite drainage layer has a transmissivity at least as high as a 0.3-meter-thick gravel layer with a permeability of 1 x 10^{-2} centimeters per second. Geocomposite is used on the sideslopes to avoid problems associated with placement of clean granular material on slopes, and thereby minimizing the potential for damaging the underlying liner system.

4.5.3.1.4 Primary Geomembrane Liner. The primary geomembrane liner acts both as an impermeable leachate barrier and as a flow surface, routing leachate to the primary sump. High-density polyethylene is used because of its high resistance to chemical deterioration. However, other materials are acceptable provided these materials can achieve or exceed the performance specifications established for high-density polyethylene. Generally, textured (roughened) geomembrane is used to maximize shear strength along adjacent interfaces and to reduce the potential for sliding of the liner system.

4.5.3.1.5 Primary Admix Liner. A primary admix liner, consisting of a minimum 0.46-meter-thick compacted soil/bentonite admixture, could be installed immediately beneath the primary high-density polyethylene liner on the floor of the lined trench only. The purpose of this liner is to provide extra protection in the case of deterioration (such as stress cracking) of the primary geomembrane in those lined trenches that might be open for several years. In lined trenches that are closed after only a few years, this layer might not be necessary. The need for this layer is evaluated on a case-by-case basis during detailed design of the particular lined trench.

When used, the admix liner typically consists of silty sand from local borrow sources mixed with a nominal 12-percent sodium bentonite, by dry weight. The in-place permeability of the admix liner is 1 x 10^{-7} centimeter per second or less, consistent with RCRA requirements for secondary soil liners. The upper surface of the admix liner is trimmed to the design grades and tolerances as shown on the construction drawings (Appendices 4A and 4B). To prepare a smooth uniform surface on which to place the overlying geomembrane liner, the surface is rolled with a smooth steel-drum roller to remove all ridges and irregularities.

4.5.3.1.6 Secondary Leachate Collection System. The secondary leachate collection system provides the flow path for the leachate flowing into the secondary sump. Although any of the options presented in Section 4.5.3.1 are acceptable in the LLBG, the following is a description of the system used in the existing mixed waste disposal trenches.

The secondary leachate collection system has drainage gravel on the floor, with an additional geotextile/geonet layer and a geocomposite layer on the sideslopes. These materials and their configuration are similar to the primary leachate collection system described in Section 4.5.3.1.2, except for the absence of a perforated drainage pipe system on the floor of the lined trench. The secondary leachate collection system channels leachate that penetrates the primary liner system into the secondary sump.

The secondary leachate collection system also serves as the leak detection system. Leachate collected in the secondary sump is measured to determine the leakage rate through the primary liner. Appendix 4C contains the response action plan(s) for the mixed waste disposal trenches.

4.5.3.1.7 Secondary Geomembrane Liner. The secondary high-density polyethylene liner, located underneath the secondary leachate collection system, is placed directly against the secondary compacted admix liner. The secondary liner is similar to the primary geomembrane described in Section 4.5.3.1.3.

4.5.3.1.8 Secondary Admix Liner. The secondary admix liner has a minimum 0.9-meter-thick compacted soil/bentonite admixture located immediately beneath the secondary high-density polyethylene liner, as required by RCRA regulations. The secondary admix liner typically consists of silty sand from local borrow sources mixed with a nominal 12 percent sodium bentonite, by dry weight. The in-place permeability of the admix liner is 1×10^{-7} centimeter per second or less, consistent with RCRA requirements for secondary soil liners. The upper surface of the admix liner is trimmed to the design grades and tolerances as shown on construction drawings (Appendix 4A and 4B). The surface is rolled with a smooth, steel-drum roller to remove all ridges and irregularities. The result is a smooth uniform surface on which to place the overlying geomembrane liner.

4.5.3.1.9 Subgrade/Liner System Foundation. The lined trenches in the LLBG are founded in undisturbed native soils, generally ranging from silty sands to well-graded gravels. The liner system foundation is discussed in further detail in Section 4.5.4.

4.5.3.1.10 Access Ramp. Each lined trench has an access ramp. The access ramp also includes the liner system components previously described. However, some of the components are thickened and a top-course layer is installed to support traffic. These enhancements prevent damage to the liner system from vehicle traffic into the lined trench. Access ramp design can vary depending on the location of a trench and the type and frequency of traffic into the trench.

4.5.3.1.11 Truck Unloading Area Liner System. A truck unloading area is located at the top of the access ramp to provide an area for transfer of containerized waste from over-the-road trucks to forklifts or other vehicles/equipment that place the waste in the lined trench. The truck unloading area is lined with a high-density polyethylene geomembrane. Typically, a geotextile cushion and top-course aggregate is placed over the geomembrane. The high-density polyethylene drainage pipe can be included at the base of the aggregate to enhance drainage. The truck unloading area is paved with asphaltic concrete to facilitate cleanup of any accidental spills. Both the asphaltic concrete surface and the underlying drainage system of the unloading area direct all surface run-off into the primary leachate collection system of the lined trench.

4.5.3.2 Liner System Location Relative to High Water Table [D-6c(2)]. The groundwater level (seasonal high water table) is located 61.0 to 91.4 meters below the ground surface in the LLBG (refer to Chapter 5.0). It is anticipated that the deepest point of the liner system will be no greater than 21.3 meters below ground surface. Consequently, the liner systems are at least 39.7 meters above groundwater. The liner systems are not affected by the water table because of this large elevation difference.

4.5.3.3 Loads on Liner System [D-6c(3)]. The liner system experiences several types of stresses during construction, operation, and postclosure periods. These stresses are analyzed during the detailed design of each lined trench (Appendices 4A and 4B). The following sections discuss the types of stresses and potential analytical methods.

4.5.3.3.1 Stresses From Installation or Construction Operations. The sideslope geosynthetic liner components experience some stress during installation and before placing waste in the lined trench. A high-density polyethylene liner is temperature sensitive, expanding and contracting as liner temperatures increase and decrease. Thermally induced stresses can develop in the liner if deployment and anchoring occur just before a significant decrease in the liner temperature. The maximum potential liner thermal stress typically occurs during construction before placement of the operations layer. The high-density polyethylene liner is sufficiently thick so that this stress remains well below the yield strain and stress.

The drainage gravel has the potential to produce localized stress on the geomembrane liner during gravel placement with construction equipment. A geotextile cushion (and possibly a geonet) is placed at the base of the drainage gravel to the underlying geomembrane. A puncture analysis is performed to select a sufficiently thick geotextile. This analysis incorporates expected construction vehicle ground pressures and assumed drainage gravel gradation listed in the construction specifications. A safety factor of three is used when evaluating puncture stress.

Tension induced by liner-component load transfer is not anticipated to occur, because the liner interface coefficients of friction are higher than the sideslope angles. The liner component interface strengths are determined by laboratory direct shear tests. Both static and dynamic stability analyses are performed, using standard methods, design accelerations, and factors of safety.

Stresses on the geomembrane in the anchor trench also are evaluated during detailed design. Wind uplift and thermal expansion and contraction can cause stress in the geomembrane during construction. However, these stresses are not a problem, because these stresses are relatively low as compared to the tensile strength of the liner. The stresses are not present after construction, because of the weight and insulating properties of the operations layer.

4.5.3.3.2 Stresses Resulting From Operating Equipment. Loads on the liner system due to operating equipment are expected to be less severe than those generated by construction equipment for two reasons. One, operations equipment typically is lighter than construction equipment, and two, the 0.9-meter-thick operations layer dissipates stresses produced by the operating equipment.

The lined trenches are filled in a way that maintains adequate factors of safety against sliding. Stability analyses are performed during detailed design, once the lined trench geometry and liner system properties have been determined. The analyses establish operational parameters such as waste lift thickness and temporary operating slope angles.

Stability of the liner system components under the access ramp is analyzed separately. The analysis considers both static and dynamic (moving vehicle) conditions.

4.5.3.3.3 Stresses From Maximum Quantity of Waste, Cover, and Proposed Postclosure Land Use. When the lined trench is full and the cover system is in place, the liner system experiences a static load from the overlying waste, backfill, and cover materials. No significant increase in stresses on the liner system is anticipated from postclosure land use. The maximum design load of material overlying the liner system includes an allowance for the cover system (Chapter 11.0). Analyses include puncture resistance of the geomembranes and decrease in transmissivity of geocomposite drainage layers. Materials are specified based on the ability of the materials to perform adequately under postclosure loading conditions.

Dynamic stresses on the liner system result primarily from ground accelerations during seismic events. Both static and dynamic analyses are performed on the subgrade and liner components based on the finished configuration of the empty trench. Under postclosure conditions, the waste, backfill, and cover materials will tend to buttress the liner system, resulting in greater stability relative to the operational phase.

4.5.3.3.4 Stresses Resulting From Settlement, Subsidence, or Uplift. The subgrade settlement produced by waste loading is essentially elastic because of the coarse-grained, noncohesive, and drained nature of the soil. The subgrade rebounds during the excavation phase of construction and settles as the trench is filled. The compacted admix liner consolidates under waste loads. The total settlement is a combination of the subgrade elastic and the admix consolidation settlements. These settlements are analyzed with standard methods during detailed design of each lined trench. In general, differential settlements are expected to occur primarily across the lined trench sideslopes as the thickness of waste decreases from maximum to zero. Because geosynthetic liner components are highly elastic, the anticipated strains are not likely to produce any appreciable stresses in the liner system.

The potential for subsidence-induced stress is believed to be negligible based on the following information.

- The soils underlying the LLBG tend to be coarse-grained sands and gravels that are not subject to piping effects that can transport soil resulting in subsidence.

- The groundwater level is deep, at least 39.7 meters below the base of the deepest lined trenches, and does not affect bearing soils.

- No mining or tunneling has been noted. If the groundwater level was lowered substantially and consolidation occurred in the aquifer, local site-specific subsidence would be negligible because of the depth of the groundwater below the lined trenches.

- The native soils are well graded and relatively dense.

The potential for stresses resulting from uplift on the liner system also is expected to be negligible. The seasonal groundwater level is very deep, and higher-elevation perched groundwater is unlikely to develop because of the absence of aquitards in the coarse-grained Hanford formation underlying the LLBG. The coarse-grained nature of the Hanford formation also promotes rapid, primarily vertical, infiltration, which means it is unlikely that infiltration from outside the lined trench boundary will be transported laterally underneath the trench liner. Gas pressures are similarly unlikely to develop because of the absence of any noted subsurface gas generation (from organic material decomposition) and the coarse-grained, highly permeable sands and gravels underlying the landfill.

4.5.3.3.5 Internal and External Pressure Gradients. Pressure gradients across the liner caused by liquids or gases are expected to be negligible. Internal pressures due to liquids are controlled by the leachate collection and removal systems. Because leachate is removed from the sump in a timely manner, there is minimal liquid head on the liner (less than 30.5 centimeters) according to RCRA regulations). Any gas that is generated internally before closure is vented either through the waste or the leachate collection system. The closure cover design will consider gas venting.

External pressures on the liner system are expected to be minimal. Gas pressures are negligible because the subgrade soil contains no gas producing materials and is highly permeable, readily venting any potential gas to the atmosphere. External pressure from liquids is not anticipated because of the deep groundwater table and the highly permeable foundation soils.

4.5.3.4 Liner System Coverage [D-6c(4)]. The liner system covers all soils underlying the lined trench and extends over the crest of the sideslopes into the anchor trenches. In addition, the truck unloading areas at the top of the access ramps are lined with 90-mil high-density polyethylene geomembranes.

All surface water run-off from the truck unloading areas drains into the primary leachate collection systems.

4.5.3.5 Liner System Exposure Prevention [D-6c(5)]. No geosynthetic or admix components of the liner system are exposed to the atmosphere. The minimum 0.9-meter-thick operations layer covers the entire lined trench surface. This layer serves both as a physical protective barrier and as thermal insulation, protecting the admix layer from desiccation and frost damage.

The operations layer is inspected weekly for erosion. Excessive erosion, such as gullying, is repaired by replacing the eroded soil. Dust suppression agents are used to prevent excessive wind erosion. The dust suppression agents bind the surface of the operations layer and minimize wind entrainment of soil.

4.5.4 Liner System, Foundation [D-6d]

The following sections discuss the foundations beneath the liner systems.

4.5.4.1 Foundation Description [D-6d(1)]. Surficial deposits within the LLBG generally consist either of Recent eolian sands or the coarse-grained glaciofluvial flood sequence of the Hanford formation, which has an interstratified deposit of coarse sand, gravelly sand, and/or sandy gravel. Where eolian sands are present, these sands are underlain by the Hanford formation. Subsequent units underlying the Hanford formation are the early-Palouse soil, the Plio-Pleistocene unit, the middle Ringold unit, and the Elephant Mountain Member of the Columbia River Basalt Group (DOE/RL-91-28, Chapter 5.0).

The two geologic units pertinent to the LLBG lined trenches are summarized as follows.

Recent eolian sand: The sand is light olive gray in color and has a density that is loose at the surface but becomes compact with depth. The sand has a fine to medium grain size and includes little to some nonplastic silt-sized fines. The deposit is homogeneous except for a distinguishable layer of volcanic ash in some locations.

Glaciofluvial flood deposit: This deposit has well graded mixtures of sands and gravels with trace to little nonplastic silt-sized particles. The density of the deposit ranges from compact to very dense. The gravel content can vary with depth, and the deposit predominantly can become gravel. This coarse-grained deposit is part of the Cold Creek Bar, which was formed during the Pleistocene Epoch by glacial outburst flooding.

Liner system elevations are shown on the design documents for each lined trench (Appendix 4A and 4B).

4.5.4.2 Subsurface Exploration Data [D-6d(2)]. Geotechnical site investigations are used to support the detailed design of each lined trench. The investigations consist of a review of historical data, including well logs

(Chapter 5.0), and test pit data (Appendix 4E). Because the foundation soils are relatively consistent over broad areas, the need for borings and geophysical investigations are determined on a case-by-case basis. If boreholes are drilled, penetration test data are collected to determine the strength of the foundation materials in situ.

4.5.4.3 Laboratory Testing Data [D-6d(3)]. Laboratory testing is performed on soil samples from test pits and borings, both from the lined trench site and from potential borrow source locations. Testing is performed to classify soils, provide input parameters for engineering analyses, and for preparing material and construction specifications. The following tests are performed on the soil samples:

- Visual classification (ASTM D2487)--to classify soils
- Natural moisture content (ASTM D22/6)--for input to engineering analyses and preparing construction specifications
- Particle size analysis (ASTM D422 or D1140/C136)--for classification and input to engineering analyses
- Moisture-density relationships (ASTM D698 or D1557)--for preparing compaction specifications
- Triaxial strength (ASTM D4767)--for input to engineering analyses.

Laboratory testing is performed according to the most recent versions of ASTM procedures or other recognized standards. Additional tests are performed as needed.

Chemical analyses also are performed to screen for organic materials (both volatile and semivolatile) and hazardous metals. This is done to prevent incorporating contaminated material into the trench liner. Standard EPA methods are used for this screening.

4.5.4.4 Engineering Analyses [D-6d(4)]. The subgrade is required to support the liner system and overlying materials (waste, fill, and cover) without excessive settlement, compression, or uplift that could damage the liner system. This section describes the design approach used to satisfy these criteria.

4.5.4.4.1 Settlement Potential [D-6d(4)(a)]. The subgrade settlement produced by waste loading is essentially elastic because of the coarse-grained, noncohesive, and drained nature of the soil. The subgrade rebounds during the excavation phase of construction and settles as the trench is filled. An elastic settlement analysis using standard methods is performed to determine the magnitude of the total and differential settlement.

4.5.4.4.2 Bearing Capacity [D-6d(4)(b)]. The bearing capacity of the subgrade soil needs to support structures such as leachate collection tanks. The construction specifications typically require that the upper portion of the subgrade soil and all structural fill be moisture conditioned and compacted to at least 95 percent of the maximum modified Proctor dry density (ASTM D1557). Maximum allowable bearing capacities for foundations are established using standard geotechnical methods. Bearing capacities for the types of soils expected in the LLBG are typically greater than the maximum expected loads from the support structures.

4.5.4.4.3 Stability of Lined Trench Slopes [D-6d(4)(c)]. The lined trenches are constructed in eolian sand and the underlying coarse-grained Hanford formation. In granular, cohesionless, and drained soils such as these, the stability of the slope is related primarily to the maximum slope angle. Therefore, an infinite slope or other suitable analysis method is used to determine both static and dynamic sideslope stability. A more detailed discussion on lined trench slope stability is provided in Appendix 4B.

4.5.4.4.4 Potential for Excess Hydrostatic or Gas Pressures [D-6d(4)(d)]. Because the seasonal high-water level is at least 39 meters below the base of the deepest lined trench, no external hydrostatic pressure is expected from this source. Because of the coarse-grained nature of the foundation soils, any infiltration of surface water around the perimeter of the lined trench is expected to travel primarily downward. Therefore, infiltration should not cause substantial pressure on the exterior of the liner system. Internal hydrostatic pressure from leachate is negligible because the leachate is removed from the lined trench to limit head on the liner.

Gas pressure exerted externally on the liner system is expected to be negligible, because no gas generating material (i.e., organic material) is expected in the foundation soils. If any gas were generated below the liner system, little pressure buildup would occur because of the unsaturated coarse-grained nature of the foundation soils, which would vent the gas to the atmosphere. Internal gas pressure buildup is not anticipated, because the leachate collection system is vented to the atmosphere and dissipates any gas.

4.5.4.4.5 Seismic Conditions. Potential hazards from seismic events include faulting, slope failure, and liquefaction. Disruption of the lined trench by faulting is not considered a significant risk because (1) no major faults have been identified in the LLBG (DOE 1988) and (2) only one central fault at Gable Mountain on the Hanford Site shows evidence of movement within the last 13,000 years (WHC 1991a). The potential for slope failure is considered low, because granular materials typically have high strengths relative to the maximum sideslope angles expected for the lined trenches. Liquefaction occurs in loose, poorly graded granular materials that are subjected to shaking from seismic events. Saturated soils are most susceptible because of high dynamic pore pressures that temporarily lower the effective stress. During this process, the soil particles are rearranged into a more dense configuration, with a resulting decrease in volume. The foundation materials at the LLBG are not considered susceptible to liquefaction because the materials are well graded, unsaturated, and relatively dense.

4.5.4.4.6 Subsidence Potential. Subsidence of undisturbed foundation materials is generally the result of dissolution, fluid extraction (water or petroleum), or mining. The potential for subsidence is negligible based on the following.

- The soils underlying the LLBG are coarse-grained sands and gravels, which are not subject to piping that can cause transport of soil and resulting subsidence.

- The groundwater level is deep, at least 39.7 meters below the base of the lined trenches, and does not affect bearing soils.

- The soil and rock types below the LLBG are not soluble.

- No mining or tunneling has been noted. If the groundwater level were lowered substantially and consolidation occurred in the aquifer, local site-specific subsidence would be negligible because of the depth of the groundwater table below the lined trenches.

- The soils are well graded and relatively dense.

4.5.4.4.7 Sinkhole Potential. Extensive borings in and around the LLBG (Chapter 5.0) have not identified any soluble materials in the foundation soils or underlying sediments. Consequently, the potential for any sinkhole development is negligible.

4.5.5 Liner System, Liners [D-6e]

The following sections discuss the individual components of the LLBG liner systems.

4.5.5.1 Synthetic Liners [D-6e(1)]. As described in Section 4.5.3, the synthetic liners act as an impermeable barrier for leachate migration (Figure 4-1). The synthetic liners consist of high-density polyethylene material, which makes the liners resistant to chemical deterioration. Section 4.5.3 describes the synthetic liner system in greater detail. Additional detail is contained in Appendices 4A and 4B for each lined trench.

4.5.5.2 Synthetic Liner Compatibility Data [D-6e(1)(a)]. During detailed design of a lined trench, the composition of the expected leachate is estimated. Expected leachate composition is based on known waste composition, process information, leachate from operating lined trenches, and similar sources of data. Leachate constituents are compared to manufacturers' chemical compatibility data for synthetic liner components. In addition, the results of previous chemical compatibility testing and studies are evaluated against leachate composition. Information gained from this evaluation is used to select a liner that will be compatible with the expected leachate.

During landfill operation, the compatibility of waste receipts with the liner is ensured by the waste analysis plan (Chapter 3.0, Appendix 3A). The compatibility of the waste constituents with the liner material is established by laboratory testing. Such tests follow the procedures of EPA Method 9090A or other appropriate methods. Test results are evaluated using statistical methods and industry-accepted criteria for liner/leachate compatibility.

A waste constituent not listed in the waste acceptance criteria can be accepted into the LLBG, provided the 9090A test results or other analytical data are provided that demonstrates the waste constituent is compatible with the liner. Appendix 4F contains 9090A test results for suitability of synthetic liners.

4.5.5.3 Synthetic Liner Strength [D-6e(1)(b)]. As discussed in Section 4.5.3.3, the liner system experiences loads from several sources. During the detailed design process for each lined trench, the strength of liner system materials is evaluated against these loads. If an analysis shows an inadequate factor of safety, a stronger material is specified or the design is modified. These strength analyses are included as part of the design document package (Appendices 4A and 4B).

Seams in geomembranes are a critical area. However, with correct installation methods the seams are stronger than the surrounding material. Detailed installation requirements are included in the construction specifications to ensure that the most appropriate methods are used. In addition, procedures are established to demonstrate adequate seam strength is achieved during installation (Appendix 4A).

Seaming requirements for the geotextiles, geonet, and geocomposite drainage materials are not as critical. These materials are overlapped sufficiently to provide complete areal coverage, and relatively light seams are used to hold the panels in position during construction. After the lining system has been completed, seam strength requirements for these materials are negligible.

4.5.5.4 Synthetic Liner Bedding [D-6e(1)(c)]. The synthetic liner system is in contact with the compacted admix, drainage gravel, and operations layers.

The secondary flexible membrane liner is in direct contact with the compacted admix layer. This type of fine-grained material typically is used for clay liners overlain by flexible membrane liners. No problems related to the mechanical integrity of the flexible membrane liner are expected in this application.

With respect to the drainage gravel and operations layers, the geomembranes are protected by overlying geotextile/geonet or geocomposite layers. These geotextiles are designed to provide adequate protection during construction and operation to withstand the loads discussed in Section 4.5.3.3.

4.5.5.5 Soil Liners [D-6e(2)]. The LLBG mixed waste lined trenches are lined with a minimum (0.9-meter thick) layer of compacted soil/bentonite mixture (admix) under the secondary flexible membrane liner. This layer has an in-place permeability of less than 1 x 10^{-7} centimeter per second. The soil component of the admix is silty fine eolian sand or similar material from areas near the LLBG. Approximately 12 percent bentonite by dry weight added to the fine soil to achieve sufficiently low permeability; however, the percent might vary depending upon design. Construction of the liner is discussed in Section 4.5.7.

4.5.5.5.1 Material Testing Data [D-6e(2)(a)]. Laboratory testing is performed on soil liner materials to provide input parameters for engineering analyses and for preparing material and construction specifications. The following tests are performed:

- Particle size distribution (ASTM D422)
- Atterberg limits (ASTM D4318)
- Permeability (ASTM D5084)
- Moisture-density relationships (ASTM D698 or D1557)
- Strength (ASTM D4767)
- Consolidation (ASTM D2435).

Other types of tests might be performed if determined necessary for design or specification purposes.

Before constructing the lined trench, a full-scale test fill of the admix material is constructed (Appendix 4A). The primary purpose of the test fill is to verify that the specified soil density, moisture content, and permeability values can be consistently achieved using proposed compaction equipment and procedures. In-place density is measured using both the nuclear gauge (ASTM D2922) and rubber balloon (ASTM D2167) or sand cone (ASTM D1556) methods. In-place permeability is determined from a sealed double-ring infiltrometer test (ASTM D5093), which measures infiltration over a 27.6 square meter area. Admix permeability is estimated from thin-wall tube samples (ASTM D1587) obtained from the test fill and tested in the laboratory (ASTM D5084). Details of the test fill are developed during detailed design. During construction, field density (e.g., ASTM D2922, D2/67, and/or D1556) and moisture content (ASTM D2216) periodically are measured. Thin-wall tube samples (ASTM D1587) are taken at regular intervals and tested for permeability (ASTM D5084). Additional details of field testing during construction are developed during the design process.

Dispersion and piping in the admix are not considered likely, because the permeability, and thus the flow velocity, is very low, making it difficult to move the soil particles or otherwise disrupt the soil fabric. In addition, the admix is well graded, so the component particles tend to hold each other in place. Therefore, testing for these characteristics is not necessary.

4.5.5.5.2 Soil Liner Compatibility Data [D-6e(2)(b)]. As discussed in Section 4.5.5.2, expected leachate composition is determined as part of detailed trench design (Appendix 4A). The results of previous chemical compatibility testing and studies are evaluated against leachate composition to determine the effect of leachate on soil liner composition or permeability. If potential problems are indicated, the need for leachate specific compatibility tests is evaluated. The tests follow the procedures of (ASTM D5084) (flexible wall parameter) and California State guidelines (CSWRCB 1984), and consider the effects of radiation on the soil liner materials. If necessary, the composition of the soil liner admix is modified until satisfactory performance is achieved.

4.5.5.5.3 Soil Liner Thickness [D-6e(2)(c)]. Calculations have been performed to evaluate the effectiveness of the soil liner as a barrier to leachate. The following assumptions were used in the analysis.

- The soil liner is 0.9-meter thick and has a permeability of 1×10^{-7} centimeter per second.
- The average annual precipitation entering the lined trench is the difference between the total precipitation and the moisture lost by evapotranspiration. These values were derived from HELP modeling (WHC 1992a; EPA 1989) and are considered conservative because no run-off is allowed and no vegetation is assumed (i.e., bare ground conditions). On this basis, the net infiltration to the lined trench is 4.11 centimeters per year.
- The net infiltration acts immediately on the soil liner. This is a very conservative assumption, as travel time through and storage within the cover soil and waste are ignored.
- There is no flexible membrane liner (this is a very conservative assumption).
- The primary and secondary leachate collection and removal systems stop functioning after the lined trenches have been filled (this is also a very conservative assumption).
- The lined trench is exposed to infiltration for 10 years before a cover is constructed.
- Darcian flow occurs within the soil liner. Diffusion and adsorption mechanisms are not considered.

The analysis shows that leachate penetrates about 7.62 centimeters into the soil liner over the 10 year period. This is less than 10 percent of the total thickness of the secondary liner and suggests that the liner has a significant margin of excess performance, particularly given the conservative assumptions, noted previously. Supporting calculations are presented in Appendix 4G.

4.5.5.5.4 Soil Liner Strength [D-6e(2)(d)]. The expected loads on the liner system are discussed in Section 4.5.3.3. Significant stresses in the soil liner that must be considered are (1) internal stresses from the weight of the liner system, (2) stresses on the interface with the overlying materials, and (3) stresses during construction.

Internal stresses are present on the sideslopes from the weight of the operations layer and soil liner itself. Using material properties determined from laboratory testing, the stability of the soil liner is evaluated under both static and dynamic loading conditions. Standard methods of slope stability analysis are used. Interface strength is evaluated using laboratory test data and slope stability methods.

The primary concern during construction is bearing failure caused by the weight of overlying soil components of the liner system (e.g., drainage gravel on the floor) and the construction equipment used to spread these materials. Strength parameters developed from laboratory testing and standard analytical methods are used to determine bearing capacity.

If any of these analyses indicate unacceptable performance, the soil liner or geosynthetic design is changed to increase factors of safety to acceptable levels.

4.5.5.5.5 Engineering Report [D-6e(2)(e)]. An engineering report is prepared for each lined trench as part of the definitive design document package (Appendix 4B). The report describes the design of the liner system and includes supporting calculations. The engineering report is prepared and signed by a professional civil engineer registered in Washington State. Lined trench construction and material properties are provided in Appendix 4A.

4.5.6 Liner System, Leachate Collection and Removal System [D-6f]

The purpose of the leachate collection and removal system is to provide sufficient permeability and storage volume to collect, retain, and dispose of, in a timely manner, fluids falling on or moving through the waste. The primary leachate collection and removal system provides the preferential path along which the leachate flows into the primary sump. The secondary leachate collection and removal system (also called the leak detection system) is located between the primary and secondary geomembranes. The secondary leachate collection and removal system provides the preferential path along which any fluids leaking through the primary liner system flow to the secondary sump.

The collected leachate is pumped to a leachate collection tank, screened and/or sampled, and transferred to tanker trucks using methods and equipment developed to avoid accidental spills. The tanker truck is parked on an epoxy coated tanker loadout pad designed to capture and contain any possible spill of leachate. During loading operations, the leachate level in the leachate collection tank is monitored with level indicating equipment. The tanker trucks subsequently transport the leachate to a TSD unit.

4.5.6.1 System Operation and Design [D-6f(1)]. The lined trenches are operated in a way that ensures the bottom liner is maintained as dry as possible, and the head on the top liner is less than 30.5 centimeters. In extreme conditions (i.e., a 25-year storm event), the head on the top liner could exceed 30.5 centimeters for short durations. However, even in extreme conditions, the head on the bottom liner will not exceed 30.5 centimeters. The operating methodology, described in the following paragraphs, ensures that liquids on the bottom liner are removed continuously before the liquids can accumulate.

Both leachate collection systems can be operated either manually or automatically. When operated automatically, liquid level sensors cycle the pumps on and off, in response to rising and falling leachate levels. At least once a week, the leakage rate through the top liner is calculated to demonstrate that the leakage rate is less than the 'action leakage rate' (Appendix 4C). Data to support the leakage rate calculations can be obtained either from the flow totalizer in the secondary leachate collection pump discharge line or from the liquid level gauges. Collected leachate from the secondary leachate collection system can be either pumped back to the primary leachate collection system or to the leachate collection tank.

The design of the primary and secondary leachate collection systems is described in Section 4.5.3.1. System geometry is completed and material specifications are developed during the detailed design process. The leachate collection and removal system design complies with RCRA Subtitle C requirements and guidance.

Each sump has a thick layer of gravel designed to provide high permeability and storage capacity. Leachate is removed from the sumps by a pump installed in either vertical or sideslope riser pipes. Pressure transducers and/or floats are used to monitor leachate level in the sumps and provide appropriate signals to the pump control system. All pumps, transducers, and/or floats are removable for maintenance, calibration, and related activities.

4.5.6.1.1 Primary System. The base of the primary leachate collection and removal system is defined by the primary geomembrane. On the floor of the lined trench, the primary geomembrane is overlain by geonet, geocomposite, and/or granular drainage layers. A granular drainage layer is used and pipes are located at regular intervals to increase flow capacity. Geotextile layers at the top of the leachate collection and removal system prevent migration of fine soil particles into the gravel or geonet, thus prevent clogging. On the sideslopes, a geocomposite layer is used over the geomembrane. The geocomposite includes bonded geotextiles on both sides that increase the interface shear strength, and allow this material to be used on the sideslopes. Because of construction difficulties, no drainage gravel is placed on the sideslopes.

The primary leachate collection and removal system is covered by the operations layer. The layer is a minimum 0.9-meter thick, and provides protection for the underlying liner and drainage materials. The operations layer covers both the trench floor and the sideslopes.

The primary leachate collection and removal system is designed to accommodate the 25-year, 24-hour storm, as required by RCRA regulations. However, the EPA recognizes the need to temporarily store leachate from such rare events (EPA 1985). Should a greater than 25-year, 24-hour storm event occur, the primary leachate collection and removal system sump is designed to temporarily store leachate at a depth greater than 30.5 centimeters, as opposed to the alternative of constructing an excessively large leachate collection tank.

The primary leachate collection and removal system sump is equipped with two sump pumps. One pump is a high capacity pump capable of rapid removal of large volumes of leachate and is suitable for the transfer of batch quantities of leachate and can handle the larger volumes of leachate anticipated from the 25-year, 24-hour storm event. The other pump is a low capacity submersible pump located in the base of the primary sump. The pumps are fabricated from stainless steel or other corrosion resistant material.

4.5.6.1.2 **Secondary System.** The base of the secondary leachate collection and removal system is formed by the secondary geomembrane. The secondary leachate collection and removal system is similar to the primary leachate collection and removal system except that pipes are not included. The pipes are not needed because high flow capacity is not required for the low leachate volumes.

The secondary leachate collection and removal system drains to the secondary sump, which is located immediately below the primary sump. Because of the low volumes, the secondary leachate collection and removal system is equipped with only one low-capacity submersible pump.

4.5.6.1.3 **Response Action Plan.** In compliance with regulatory requirements, a response action plan is prepared for each lined trench. As part of this plan, the 'action leakage rate' is developed (Appendix 4C). In accordance with EPA guidance, the action leakage rate is calculated as "the maximum design flow rate that the leak detection system can remove without the fluid head on the bottom liner exceeding 30.5 centimeters" (EPA 1992). If the action leakage rate is exceeded, the DOE-RL does the following:

- Notifies the appropriate regulatory authority in writing of the exceedence within 7 days of the determination

- Submits a preliminary written assessment to the appropriate regulatory authority within 14 days of the determination, on the amount of liquids, likely sources of liquids, possible location, size, and cause of any leaks, and short-term actions taken and planned

- Determines to the extent practicable the location, size, and cause of any leak

- Determines whether waste receipt should cease or be curtailed, whether any waste should be removed from the unit for inspection, repairs, or controls, and whether the unit should be closed

- Determines any other short-term and/or long-term actions to be taken to mitigate or stop any leaks

- Within 30 days after the notification that the action leakage rate has been exceeded, submits to the appropriate regulatory authority the results of the analyses specified in the following paragraphs, the results of actions taken, and actions planned. Monthly thereafter, as long as the flow rate in the leak detection system exceeds the action leakage rate, the DOE-RL submits to the appropriate regulatory authority, a report summarizing the results of any remedial actions taken and actions planned.

The leachate will be analyzed for chemical compounds and radionuclides. If the analytical results indicate that these constituents are present, and if the constituents can be traced to a particular type of waste placed in a known area of the lined trench, it might be possible to estimate the location of the leak. In addition, waste packages might not undergo enough deterioration during the active life of the trench to permit escape of the contents, it is possible that the leachate might be clean or the composition too general to show a specific source location.

If the source location cannot be identified, large-scale removal of the waste and operations layer to find and repair the leaking area of the liner would be one option for remediation. However, this procedure risks damaging the liner. In addition, waste would have to be handled, stored, and replaced in the trench. Backfill would need to be removed from around any waste packages to accomplish this. If the waste packages are damaged during this process, the risk of accidental release might be high. For these reasons, large-scale removal of waste and liner system materials is not a desirable option and will not be implemented except as a last resort.

The preferred alternative depends on factors such as the amount of waste already in the trench, the rate of waste receipt, the chemistry of the leachate (i.e., is it clean?), the availability of other disposal units, and similar considerations. Therefore, no single approach can be selected at this time. If necessary, an interim solution could be implemented while the evaluation and permanent remediation is performed. Examples of potential approaches include the following.

- The surface of the waste could be graded to direct run-off into a shallow pond. The surface would be covered with the low-hydraulic conductivity layer (geomembrane). Precipitation would be pumped or evaporated from the pond and would not infiltrate the waste already in the lined trench. Waste would be placed only during periods of dry weather, and stored at other onsite TSD units at other times. This type of approach also could be used to reduce leakage immediately after the action leakage rate is exceeded, while other remediation options are evaluated.

- Partial construction of the final closure cover could begin earlier than planned. This would reduce infiltration into the lined trench, and possibly reduce the leakage rate if the cover is constructed over the failed area.

- A layer of low-permeability soil could be placed over the existing waste, perhaps in conjunction with a geomembrane, to create a second 'primary' liner higher in the lined trench. This new liner would intercept precipitation and allow its removal.

- A rigid-frame or air-supported structure could be constructed over the trench to ensure that no infiltration occurs. Although costly, this approach could be less expensive than constructing a new trench.

In general, the selected remediation efforts will be progressive. Those remediation methods that are judged to be the least difficult and the most cost effective will be used first. If these efforts are not effective, more difficult or expensive options would be used.

4.5.6.2 Equivalent Capacity [D-6f(2)]. The geocomposite drainage layers used are commercially available that have equivalent flow capacity to a 30.5-centimeters layer of granular drainage material with a permeability of 1×10^{-2} centimeter per second. The construction quality assurance report (Appendix 4A) contains material specifications developed during detailed design and considers loads imposed by waste and cover materials.

4.5.6.3 Grading and Drainage [D-6f(3)]. In accordance with EPA guidance, all areas of the lined trench floor (except possibly sump bottoms) are graded at a slope of at least 1 percent to facilitate drainage and avoid ponding on the liners. In practice, floor slopes are designed with minimum slopes of 1.5 percent to accommodate slight variations associated with construction techniques. Grading tolerances are established so that the actual slope is at least 1 percent at all locations. For specific details of piping systems, sumps, pumps, etc., used to collect, hold, and transport leachate, refer to Appendices 4A and 4B.

4.5.6.4 Maximum Leachate Head [D-6f(4)]. The maximum head on the primary liner is less than 30.5 centimeters, except for rare storm events as discussed in Section 4.5.6.1. The sump is sized and designed to provide adequate surge storage to prevent leachate build up on the primary liner.

4.5.6.5 System Compatibility [D-6f(5)]. The primary and secondary leachate collection and removal systems are composed of inert geologic materials (sand and gravel), high-density polyethylene, and other geosynthetic materials such as polypropylene. As described in Section 4.5.5.2, the geosynthetics are evaluated for compatibility with the expected leachate. To ensure that the geosynthetics used in the lined trenches are chemically similar to those evaluated, manufacturers are required to submit quality control certificates and other manufacturing information and conformance tests performed on all materials. The results of these tests are presented in Appendix 4A.

Before a waste constituent is allowed in the lined trench, the waste constituent is evaluated for compatibility with the liner (e.g., identified in 9090A test results, testing, etc.). Other materials could contact the leachate, for example:

- Stainless steel, used for piping and wetted parts of pumps
- Rubber coatings for pump impellers and cases
- Polyvinyl chloride and other plastics in miscellaneous uses
- Epoxy or other materials used as tank coatings.

Compatibility of these materials with the expected leachate is considered in the trench liner system design. Compatibility of these materials is of lesser concern, because items that are comprised of these materials are entirely located within the containment area. Failure of these items would not result in a dangerous waste release, and the materials would be replaced or repaired.

4.5.6.6 System Strength [D-6f(6)]. Stability of drainage layer, strength of piping, and prevention of clogging are discussed in the following sections.

4.5.6.6.1 Stability of Drainage Layers [D-6f(6)(a)]. As described in Sections 4.5.3.3 and 4.5.5.3, the stability of the liners and leachate collection and removal system on the sideslopes is evaluated as part of detailed design. To provide sufficiently high shear strengths at the interfaces between geosynthetic components, textured geomembranes and thermally bonded geocomposites can be used.

Bearing capacity of the drainage and sump gravels is expected to be adequate, based on typical strength values for granular materials. Standard bearing capacity analyses are performed during detailed design to verify this assumption.

The transmissivity of the drainage layers under the combined load of the waste and cover was addressed in the design and is adequate to support leachate removal.

4.5.6.6.2 Strength of Piping [D-6f(6)(b)]. The drain pipes in the primary drainage and sump gravel and sideslope riser pipes are high-density polyethylene pipe, or equal. During detailed design, the required wall thickness of the pipe is determined according to the manufacturer's recommendations and standard analytical methods used by the piping industry. In these analyses, the ultimate load (derived from the estimated weight of the waste cover) is used, the allowable deflections are limited to 5 percent, and conservative values for soil modulus and lateral confinement are assumed. The calculations evaluating the pipe loads, required thickness, and strengths are presented in the definitive design report for each lined trench (Appendix 4B).

4.5.6.7 Prevention of Clogging [D-6f(7)]. The geotextiles that separate the drainage layers from adjacent soil layers are selected based on the ability of the geotextiles to retain the soil and prevent the soil from entering the leachate collection and removal system. Standard methods are used to determine the allowable range of opening sizes in the textiles. In addition, the amount of fine material in the drainage and sump gravels is limited by specification to less than a few percent, and is not expected to cause clogging problems. Because the waste disposed in the lined trench is required to satisfy LDR (40 CFR 268), the amount of organic material is minimal, and consequently biologic clogging is not a problem.

4.5.7 Liner System, Construction and Maintenance [D-6g]

Details relating to the liner system construction and maintenance are discussed in the following sections.

4.5.7.1 Material Specifications [D-6g(1)]. Material specifications are provided in the following sections for each of the materials used in the liner system.

4.5.7.1.1 Synthetic Liners [D-6g(1)(a)]. As described in Section 4.5.3.1, both the primary and secondary geomembrane liners are comprised of high-density polyethylene, or equal. Detailed specifications are prepared for each lined trench as part of the design process (Appendices 4A and 4B).

4.5.7.1.2 Soil Liners [D-6g(1)(b)]. As described in Section 4.5.3.1, the soil liner consists of imported bentonite (expansive clay) blended with fine soil deposits on or next to the LLBG. The fine soil is free of roots, woody vegetation, rocks greater than 2.54 centimeter in diameter, and other deleterious material. The bentonite content depends on the characteristics of fine soil. Mixing is performed under carefully controlled conditions in a pugmill or other approved alternatives. The admix is placed at a saturation of 85 percent or higher, to achieve an in-place permeability of 1×10^{-7} centimeter per second or less. The surfaces of the soil liners are rolled smooth before placing the overlying geomembranes. Additional specifications are prepared for each lined trench as part of the design process.

4.5.7.1.3 Leachate Collection and Removal System [D-6g(1)(c)]. Drainage and sump gravel consists of hard, durable, rounded to subrounded material. The gravel is washed and the amount of fine material (i.e., passing the number 200 sieve) is limited to a few percent. The permeability of the gravel is 1×10^{-2} centimeter per second or greater. Additional specifications are prepared as part of the design process.

For geotextiles and geonets, the composition, thickness, transmissivity, unit weight, apparent opening size, strength, and other properties are determined during detailed design based on results of engineering analyses, experience, and industry standard approaches.

4.5.7.2 Construction Specifications [D-6g(2)]. Construction requirements for major components of the lined trench are summarized in the following sections. Additional detail regarding methods, materials, inspection procedures, etc., are presented in Appendix 4A for each lined trench.

4.5.7.2.1 Liner System Foundation [D-6g(2)(a)]. The excavated subgrade surfaces are moisture conditioned and compacted to a depth of at least 20.3 centimeters before placing the admix layer.

4.5.7.2.2 Soil Liners [D-6g(2)(b)]. The soil and bentonite are blended thoroughly and moisture conditioned so that the admix is uniform and homogeneous throughout. The admix layer is placed in 20.3- to

25.4-centimeter-thick loose lifts and compacted so that the compacted lift thickness is 15.24 centimeter or less, except that the first lift could be up to 30.5-centimeter thick (loose). In the secondary liner, additional thickness might be necessary to prevent incorporation of the sandy subgrade soil into the liner. An admix layer is used in the primary liner system, the additional thickness prevents damage to underlying layers. Each new lift of admix is kneaded into the previously placed lift. The methods for admix preparation, type of compaction equipment, number of passes, and other details of the placement process are determined by constructing a test fill section before placing admix in the lined trench.

4.5.7.2.3 Synthetic Liners [D-6g(2)(c)]. To protect the overlying geomembranes, the admix surface is smooth and free of rocks, stones, sticks, roots, sharp objects, and debris of any kind. In all cases, the high-density polyethylene liners are deployed with the length of the roll parallel to the slope; no horizontal seams are allowed on slopes. Adjacent panels are overlapped 7.6 to 15.2 centimeters and thermally seamed using fusion or extrusion methods. Seams are inspected continuously using a vacuum box and air pressure tests. Destructive seam tests (peel and adhesion) are performed on samples taken at regular intervals. The geomembranes are protected by placing the overlying geosynthetic layers when practicable.

4.5.7.2.4 Leachate Collection and Removal Systems [D-6g(2)(d)]. Drainage and sump gravel are placed and spread carefully over the underlying geosynthetics using suitable equipment to prevent damage. Hauling and placing equipment operate on a minimum thickness of soil above any geosynthetic layer to avoid damage. Geosynthetic layers in the leachate collection and removal system are deployed, overlapped, and joined (e.g., tying for geonets, sewing for geotextiles) according to standard industry practice and the manufacturers' recommendations. Drainage and riser pipes are installed in the trenches. Pipes carefully are bedded and the trenches backfilled to provide adequate lateral support. Pumps and other mechanical components are installed according to manufacturers' recommendations. Appendix 4A contains the construction specifications for placement of all components of leachate collection and removal systems.

4.5.7.3 Construction Quality Control Program [D-6g(3)]. A construction quality assurance plan is prepared for use during lined trench construction and establishes in detail the following:

- The duties, responsibilities, and authority of all individuals and organizations involved in the work, including the engineer, contractors, and third-party construction quality assurance personnel

- Required qualifications and certifications for various technical personnel

- Inspection and sampling activities, both during manufacturing and construction, including sampling frequency and procedures

- Description of test methods, either directly or by reference to standard test methods such as ASTM, etc.

- Documentation requirements, including standard forms and inspection data sheets.

4.5.7.4 Maintenance Procedures for Leachate Collection and Removal Systems [D-6g(4)]. The accessible components of the leachate collection and removal systems are maintained according to preventive maintenance methods. These methods require periodic testing to prove that the equipment, controls, and instrumentation are functional and are properly calibrated. Testing intervals are derived from applicable regulations and manufacturer's recommendations. All pumps and motors are started or bumped monthly; first, to demonstrate that the pumps and motors are functional, and second, to move the bearing(s) so that the bearing surfaces do not seize or become distorted. Instruments are calibrated annually or at intervals suggested by the manufacturer. When applicable, the preventive maintenance methods include calibration instructions. Instruments that require annual calibration are as follows:

- Primary sump level indicator
- Secondary sump level indicator
- Primary sump level transducer.

Trenches 31 and 34 are equipped with leachate transport tanker loading areas. These tanker loading areas are approximately 6.4 meters wide by 19.5 meters long. Future tanker unloading areas could vary in size, as waste management needs dictate. The tanker loading areas are designed to collect any leachate that might spill during the loading operation. These loading areas contain curbs, sloping floors, and sump areas to channel any spilled liquid to an accumulation area where the liquid is collected and sent to an appropriate treatment and storage unit.

4.5.7.5 Liner Repairs During Operations [D-6g(5)]. Because of the 0.9-meter-thick operations layer, damage to the liner system is not expected. If damage does occur, the operations layer could be removed laterally as far as required. Underlying geosynthetic and gravel layers will be removed until an undamaged layer is encountered. The damaged layers will be repaired and replaced from the lowest layer upwards using similar procedures to those employed during construction. Most repairs to the geomembranes will be performed using a patch, which will be placed, welded, and tested by construction quality assurance personnel. Details of liner construction and inspection procedures in Appendix 4A.

4.5.8 Run-On and Run-Off Control Systems [D-6h]

Because of the sandy soils, small drainage area, and arid climate at the LLBG, storm water run-on and run-off are not expected to require major engineered structures. Interceptor and drainage ditches are adequate for run-on and run-off control. The 25-year, 24-hour precipitation event is the design storm used to size the lined trench systems. Beyond this, surface water evaluation is highly site-specific, and appropriate analyses are performed as part of detailed design for each lined trench.

4.5.8.1 Run-On Control System [D-6h(1)]. Run-on is controlled by drainage ditches or berms around the perimeter of the lined trench. Any overland flow approaching the trench is intercepted by the ditches or berms and conveyed to existing drainage systems or suitable discharge points. All the drainage ditches or berms are designed to handle the peak 25-year flow from the potential drainage area. By using low channel slopes, design flow velocities in the ditches are maintained below established limits for sand channels. Erosion protection (such as riprap) is not required because of the very low velocities.

The drainage for trenches 31 and 34 are designed and constructed such that the paved truck unloading area drains into the trenches and all other areas beyond the crest of the trenches drain outward, away from the trenches. The pavement in the truck staging area drains away from the trenches. Between the trench crest and the perimeter road, the area was graded to provide drainage toward the perimeter road. The perimeter road is sloped outward, at a grade of approximately 1 percent, to provide drainage away from the trenches. On the outside of the perimeter road, on the north and west sides of the trenches, drainage ditches were excavated to provide drainage away from the trenches.

4.5.8.1.1 Design and Performance [D-6h(1)(a)]. Design and performance details are determined for each lined trench as part of the detailed design process (Appendix 4B).

4.5.8.1.2 Calculation of Peak Flow [D-6h(1)(b)]. Computation of design discharge for the drainage ditches or berms is performed using standard analytical methods, such as the Rational Method or the computer program HEC-1 (USACE 1981). The 25-year, 24-hour precipitation depth is 4.0 centimeters, based on precipitation data recorded from 1947 to 1969 (PNL 1983). The tributary area for each section of ditch or berm depends on local topography.

4.5.8.2 Run-Off Control System [D-6h(2)(a and b) and (3)]. There is no run-off from the lined trenches because the trenches are constructed below grade. Any precipitation falling on the trenches is removed by either evapotranspiration or the leachate collection and removal systems. Therefore, a run-off control system is not needed.

4.5.8.3 Construction [D-6h(4)]. The drainage ditches or berms around the lined trenches are constructed with conventional earthmoving equipment such as graders and small dozers.

4.5.8.4 Maintenance [D-6h(5)]. The drainage ditches or berms require periodic maintenance to ensure proper performance. The most frequent maintenance activity, beyond periodic inspection, is cleaning the ditches or berms to remove obstructions caused by windblown soil and vegetation, (e.g., tumbleweeds). After rare storm events, regrading of the ditch bottom or repair of the berm might be required to repair erosion damage. This is expected to occur infrequently, however inspections will be conducted after 25-year storm events or at least annually.

4.5.9 Control of Wind Dispersal [D-6i]

The LLBG use varied methods to prevent wind dispersal of mixed waste, depending on the waste form. Methods to prevent wind dispersal include containerizing, stabilizing, grouting, spray fixitants, and backfill. Sometimes the natural form of the waste precludes the need for wind dispersal protection, (i.e., scrap piping and other solid debris). In other instances, the operating contractor implements a wind speed restriction during handling, and immediately backfills the waste to prevent wind dispersal.

4.5.10 Liquids in Landfills [D-6j]

Free liquids will not be accepted if the liquid is in excess of 1 percent of the volume of the waste or if the sorbent to potential liquid waste is less than 2 to 1. Waste received at the LLBG must comply with waste acceptance requirements as identified in Chapter 3.0, Appendix 3A.

4.5.11 Containerized Waste [D-6k]

Containerized waste received in the LLBG lined trenches is limited to a maximum of 10 percent void space. Several inert materials (diatomaceous earth, sand, lava rock) are used as acceptable void space fillers for waste that does not fill the container. Compliance with the void space restrictions is provided by the representative sampling performed (Chapter 3.0), and the assessments performed (Chapter 3.0, Appendix 3A).

4.6 AIR EMISSIONS CONTROL [D-8]

The LLBG also are required to adhere to applicable air regulations. The LLBG were 'air sampled' for constituents of concern during the last quarter of calendar year 1996. The results indicated that no constituents of regulatory concern were identified.

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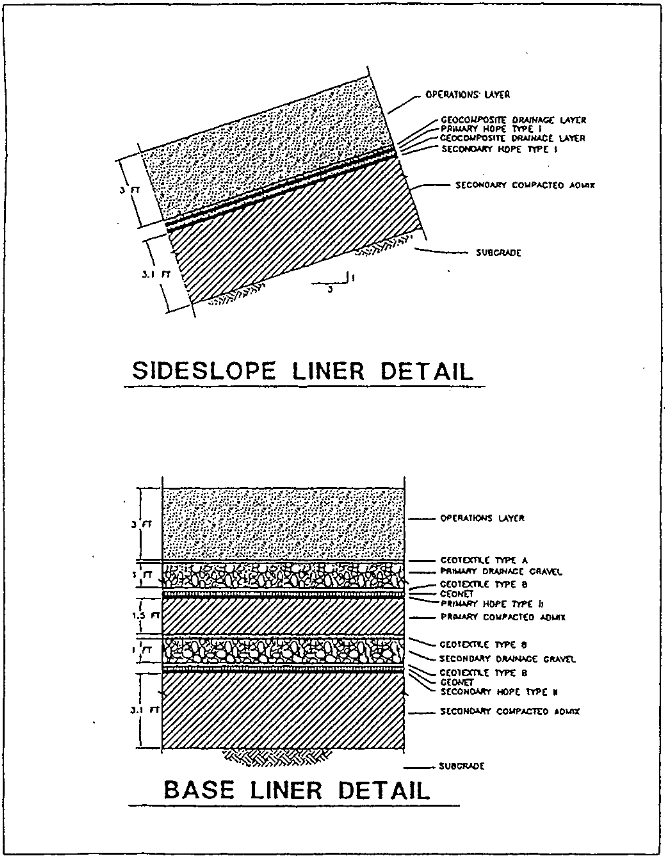

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Figure 4-1. Example Liner System.

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APPENDICES

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5.0 GROUNDWATER MONITORING [D-10]

5.1 EXEMPTION FROM GROUNDWATER PROTECTION REQUIREMENTS [D-10a]

A waiver from the groundwater monitoring requirements as allowed under WAC 173-303-645 is not requested. Therefore, the requirements of the Washington Administrate Code for groundwater monitoring are applicable to the LLBG.

5.2 INTERIM STATUS PERIOD GROUNDWATER MONITORING DATA [D-10b]

Information on interim status groundwater monitoring activities is provided in Appendix 5A, in *Hanford Site Groundwater Monitoring for Fiscal Year 1996* (PNNL 1997), and in the Hanford Environmental Information System. There have been no significant detections of the indicator parameters that could be attributed to the LLBG.

5.3 AQUIFER IDENTIFICATION [D-10c]

The characteristics of the uppermost aquifer beneath the LLBG and the regional physiographic, geologic, and hydrogeologic setting of the LLBG are summarized in Chapter 5.0 of the General Information Portion (DOE/RL-91-28).

5.4 CONTAMINANT PLUME DESCRIPTION [D-10d]

A description of the contaminant plumes existing beneath the LLBG and the 200 East Area and 200 West Area is provided in Chapter 5.0 of the General Information Portion (DOE/RL-91-28). However, there is no evidence the contamination described entered the groundwater from the LLBG.

5.5 DETECTION MONITORING PROGRAM [D-10e]

Interim status groundwater monitoring will be continued until a final status groundwater monitoring plan is submitted by DOE and approved by Ecology. The approved final status groundwater monitoring plan will be implemented immediately on approval and will be submitted for incorporation as a modification to the LLBG permit before the end of calendar year 1998. The ultimate goal is to develop a consolidated groundwater monitoring plan for the Hanford Site, which will supersede the LLBG specific final status groundwater monitoring plan.

Groundwater monitoring activities have been suspended for Low-Level Waste Management Area 5, which includes the 218-W-6 Burial Ground (Appendix 5B).

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CONTENTS

TABLES

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6.0 PROCEDURES TO PREVENT HAZARDS [F]

This chapter discusses security, inspection schedules, preparedness and prevention requirements, preventive procedures, structures, equipment, and prevention of reaction of ignitable, reactive and incompatible waste disposed and stored in the LLBG.

The LLBG is designed and operated to minimize exposure of the general public and operating personnel to mixed waste. Shielding, contamination control, control of toxic or dangerous material, and safety and security procedures are used to keep exposure ALARA.

6.1 SECURITY [F-1]

The following sections describe the security measures, equipment, and warning signs used to control entry to the LLBG. A discussion of Hanford Facility security is provided in the General Information Portion (DOE/RL-91-28).

6.1.1 Security Procedures and Equipment [F-1a]

The following sections describe the 24-hour surveillance system, barrier, and warning signs used to provide security and control access to the LLBG.

6.1.1.1 24-Hour Surveillance System [F-1a(a)]. The entire Hanford Facility is a controlled access area [refer to General Information Portion (DOE/RL-91-28)].

6.1.1.2 Barrier and Means to Control Entry [F-1a(b)]. Within the LLBG, access to the waste is minimized by the operational policy of burying the waste as soon as practical or if left uncovered, administrative procedures are used to control access. However, wherever waste is placed or exposure hazards are identified, barriers (e.g., chains, flagging, etc.) and warning signs are erected that surround the waste. In addition, the access ramps to trenches 31, 34, and 94 are provided with gates to control vehicle entry. Onsite training programs ensure that personnel are cognizant of the meaning of barriers and warning signs.

6.1.1.3 Warning Signs [F-1a(2)]. The active portions of the LLBG are within chained radiation zones with radiation signs every 30 meters along the chain. The signs are visible from all angles of approach, and are legible from a distance of at least 7.6 meters. Each active area used for mixed waste disposal is posted with a sign, in English, reading, "DANGER-UNAUTHORIZED PERSONNEL KEEP OUT". In addition to these signs, the fences around the 200 East Area and 200 West Area burial grounds are posted with signs warning against unauthorized entry. The signs are visible from all angles of approach.

6.1.2 Waiver [F-1b]

Waiver of the security procedures and equipment requirements for the LLBG are not requested. Therefore, WAC 173-303-310(1)(a) and (b) are not applicable.

6.2 INSPECTION PLAN [F-2]

This section describes the method and schedule for inspection of the LLBG. These inspections help to ensure that situations do not exist that might cause or lead to the release of mixed waste to the environment or that might pose a threat to human health. In addition, containers stored in trench 34 (and trench 31, if needed to support future waste management needs) are inspected to identify leaking containers, improperly stored containers, and degradation of safety equipment and/or systems. Abnormal conditions identified by inspections must be corrected on a schedule that helps prevent hazards to workers, the public, and the environment.

6.2.1 General Inspection Requirements [F-2a, F-2b]

The content and frequency of inspections are described in this section. The inspections are documented on inspection checklists and log sheets. The schedule and inspection records are kept in the inspection logbooks and retained by the LLBG operations personnel. Inspection records are retained for a minimum of 5 years, and contain the following information:

- Date and time of inspection
- Printed name and the hand written signature of the inspector
- Notation of the observations made
- An account of spills or discharges in accordance with WAC 173-303-145
- Date and nature of any repairs or remedial actions taken.

The inspection checklists consist of a listing of items that are to be assessed during each inspection. A yes/no response is made for each listed item. A 'yes' response means that the item is in compliance with the conditions stated on the checklist. Any problems identified during the inspection, as indicated by a 'no' response on the checklist, are reported immediately to the LLBG operations supervisor.

6.2.1.1 Types of Problems [F-2a(1), (2), (4), and (5)]. Each day the LLBG are used for the purposes of waste handling, an operator performs a daily inspection of areas subject to spills (e.g., loading and unloading areas and waste handling areas). The LLBG weekly inspections are performed to ensure operation and management of the LLBG is in accordance with WAC 173-303-630. Discrepancies are noted on the checklist. If the LLBG has no containerized waste in storage, weekly inspections will not be conducted. When completed, the inspector prints, signs, and dates the inspection checklist. The inspection checklist is placed in the LLBG inspection logbook and kept on file for a minimum of 5 years.

Backfilled trenches are inspected for signs of erosion of the trench cover. Evidence of settling or unevenness at a backfilled trench that would indicate subsidence is recorded to initiate corrective action.

Truck unloading areas at trenches 31 and 34 are inspected for signs of deterioration that would impact the ease of a chemical spill cleanup should a spill occur. Any spills will be managed as identified in the building emergency plan/contingency plan (Chapter 7.0). Cracks and wear are recorded to initiate corrective action.

6.2.1.2 Frequency of Inspections [F-2a(3)]. The inspection schedule for the LLBG is weekly for all regulated trenches. All regulated trenches are inspected for run-on, run-off, and erosion problems after a significant precipitation event. Only deficiencies are documented.

The LLBG operations organization performs a weekly inspection of trench 34 (and trench 31, if needed to support waste management needs) and the waste inventory (Section 6.2.3.1) (regardless of occupation) to ensure compliance with applicable federal and state regulations. Inspections cover condition of trench floor and sides, container structural integrity, corrosion of containers, aisle space, and evidence of leaks or spills. Inspection frequencies are indicated on the respective inspection checksheets. Trench 34 (and trench 31, if needed to support waste management needs) only stores mixed waste that meets LDR requirements. No ignitable, reactive, or corrosive waste will be stored in trench 34 (and trench 31, if needed to support waste management needs).

6.2.2 Schedule for Remedial Action for Problems Revealed [F-2c]

If leachate collection tank system inspections identify corrosion, leaks, spills, and/or precipitation in the secondary containment, the resultant liquid will be removed within 24 hours of detection. Further corrective actions are discussed in the building emergency plan (Chapter 7.0). If significant corrosion is observed, corrective actions will be pursued. Depending on the severity of the corrosion, corrective action could range from correcting upon discovery or longer if procurement of needed materials and personnel are required. Any problems revealed by the inspection must be remedied on a schedule that prevents hazards to human health and the environment.

Other conditions that are not a threat to human health and the environment (e.g., torn tank insulation) will be dispositioned in a timeframe established by the operations supervisor.

6.2.3 Specific Process or Waste Type Inspection Requirements [F-2d]

The following sections detail the inspections to be performed at the LLBG.

6.2.3.1 Container Inspection [F-2d(1)]. On receipt, each container for disposal is inspected by operations personnel to confirm appropriate documentation and compliance with the waste acceptance criteria (Chapter 3.0, Appendix 3A) before the container is placed in the LLBG.

While in the greater-than-90-day container storage configuration, specific items and/or problems to be noted during weekly container inspection include the following:

- Condition trench floor and sides
- Container structural integrity
- Containers closed
- Appropriate aisle spacing
- Corrosion of containers
- Evidence of spills or leaks
- Container labels and markings in place, legible, and unobscured
- Areas in and around waste stored in trench 34 (and trench 31, if needed to support waste management needs) are free of combustibles (e.g., tumbleweeds)
- Access ramp is intact (e.g., free of erosion)
- Chain barricades and postings are intact.

Records of inspection are maintained as detailed in Section 6.2.1.

6.2.3.2 Landfill Inspection [F-2d(8)]. All regulated trenches subject to WAC 173-303-665 requirements are inspected weekly and after a significant precipitation event.

6.2.3.2.1 Run-On and Run-Off Control System [F-2d(8)(a)]. A run-on control system is installed around the perimeter of each lined trench (Chapter 4.0, Section 4.5.8.1). The system consists of a berm along the outer margin of each lined trench and prevents run-on from entering the trench. All run-on control system berms will be inspected weekly and after significant storms for signs of deterioration, malfunction, or improper operation. Any precipitation that falls between the run-on control berm and the edge of the trench excavation eventually might flow into the primary leachate control and removal system sump and will be treated as leachate.

6.2.3.2.2 Leak Detection System [F-2d(8)(b)]. Leak detection for the lined trenches is accomplished by the following:

- Monitoring liquid level above the secondary liner
- High- and low-level alarms tested periodically
- Monitoring liquid levels above primary liner
- Inspections for the presence of liquids after significant precipitation events
- Verification of certain gauges and instruments to ensure these are in current calibration; calibration is performed annually (refer to Chapter 4.0, Section 4.5.7.4)
- Test leak detection system to ensure system is functioning properly:
  - Testing includes checking the indicator levels in the sumps
  - Levels are recorded on a daily action leakage rate calculation sheet (Table 6-1).

If the action leakage rate (Chapter 4.0, Appendix 4C) has not been exceeded, the liner system is functioning properly.

6.2.3.2.3 Wind Dispersal Control System [F-2d(8)(c)]. Waste packages placed in the LLBG that are containerized or have the characteristics of a container are in a form that eliminates the concern of wind dispersal. Waste packages are inspected upon receipt for evidence of damage, corrosion, or deterioration that might lead to dispersal of the contents. This inspection is repeated daily if waste management operations are being conducted and weekly to ensure that dispersal of contained material is not a concern.

Trench 94 is inspected weekly to verify the integrity of the defueled reactor compartments and to perform corrective action if needed.

Unpackaged or bulk waste with any potential for wind dispersal is covered or sprayed with fixative after being placed in a trench.

In addition, waste handling operations are suspended in winds exceeding 24 kilometers per hour unless specifically approved by operations supervisors. The supervisor only would grant approval to operate in winds over 24 kilometers per hour after determining that the risk to human health or the environment would be diminished by completing the work activity, or that the nature and form of the waste handling activity (work in progress with unstable physical form of waste package where wind may cause waste container to fail and disperse contamination) was such that the wind speed would have no significant impact.

6.2.3.2.4 Leachate Collection and Removal System [F-2d(8)(d)]. The following areas of the leachate collection and removal system are inspected weekly to identify the presence of leachate and to ensure proper functioning:

- Leachate collection tank(s), tank piping, transfer pump piping, sump piping and valve gallery area, and tank level gauge scale and tank area for leaks and/or damage

- Secondary containment for accumulation of liquids

- Aboveground portions of the leachate collection tank(s), tank piping, transfer pump, tank level gauge, and tank area and associated structural supports for corrosion

- Leachate collection tank(s), tank piping, transfer pump, tank level gauge, tank area, associated structural supports construction materials, and area immediately surrounding the externally accessible portion, including the secondary containment, for detection of erosion

- Trench general area for evidence of deterioration, malfunctions, or improper operation of run-on and run-off control systems.

In addition, verification will be performed when pumping occurs to check if the amount of actual leachate pumped from the leachate collection and removal system corresponds to the amount that is accumulated in the leachate collection tank (Table 6-2). This periodic check will verify the proper function of the leachate collection and removal sump pumps. Periodic evaluations (October through March) on the leachate transfer lines for freeze and thaw damage also is conducted.

6.3 PREPAREDNESS AND PREVENTION REQUIREMENTS [F-3, F-3a]

The following sections describe the preparedness and prevention measures taken at the LLBG and the internal and external communications and emergency equipment required. Further discussions on the possibility of a fire, explosion, or any unplanned sudden or nonsudden release of dangerous or dangerous waste constituents to air, soil, or surface water that could threaten human health or the environment are contained in the building emergency plan (Chapter 7.0).

6.3.1 Internal Communication [F-3a(1)]

There is one building, MO223, that is equipped to support communications. Immediate emergency instruction to personnel working at the LLBG is provided by two-way radios and cellular telephones.

6.3.2 External Communications [F-3a(2)]

Personnel at the LLBG have voice communication or equivalent (e.g., hand signals) during work assignments to maintain external communications with shift supervisors. Supervision contacts the Hanford Facility emergency telephone number (911) (811 for cellular telephones) if assistance is needed in the field.

6.3.3 Emergency Equipment [F-3a(3)]

Emergency equipment is available for use at the LLBG. The Hanford Facility maintains a sufficient inventory of heavy equipment (Attachment 4 of the Hanford Facility RCRA Permit). The Hanford Facility relies primarily on the Hanford Fire Department to control fires. Emergency equipment is not located at burial ground trenches. Portable fire extinguishers are carried on LLBG operations vehicles. Fire Station #2 (Attachment 4 of the HF RCRA Permit) is equipped with trained firefighting and emergency medical personnel and equipment, and is located within 5 minutes of any location within the LLBG. Spill cleanup materials are readily available from the Central Waste Complex, and other locations (overpack containers, protective clothing, handling and cleanup equipment). The building emergency plan (Chapter 7.0) references the emergency equipment.

The concrete pad used for staging the loading and unloading of leachate from the leachate collection tank(s) to a tanker truck contains a collection sump should any spills occur during transfer operations. Only collected liquids resulting from a spill will be pumped back into the leachate collection tank(s). A portable sump pump is used to transfer collected spills/liquids from the concrete pad sump. Tanker trucks are equipped with overflow shutoff switches or visual verification could be used to prevent the accidental spill of leachate during transfer operations.

6.3.4 Water for Fire Control [F-3a(4)]

Water for fire control at the LLBG is supplied by Hanford Fire Department trucks for fires requiring high water volume and pressure. Water is supplied by the following equipment:

- Each fire station normally has a truck equipped with a hydraulically operated aerial ladder, and one pumper (backup fire engine, without a boom, that is used if the aerial ladder is inoperable). Fire engines have a pumping capacity of at least 5,700 liters of water per minute.

- Other fire protection equipment uses chemicals rather than water as an extinguishing media.

6.3.5 Aisle Space Requirement [F-3b]

Aisle spacing for trench 34 (and trench 31, if needed to support waste management needs) is sufficient to allow the movement of personnel and fire protection equipment in and around the containers. This aisle spacing meets the requirements of the National Fire Protection Association and the Life Safety Code (NFPA 1996) for the protection of personnel and the environment. Inspection aisle space must be at least 76.2 centimeters.

Rows of containers are placed no more than two containers wide in accordance with WAC 173-303-630(5)(c). The containers are loaded and unloaded via the access ramp on the south side of each trench.

6.4 PREVENTIVE PROCEDURES, STRUCTURES, AND EQUIPMENT [F-4]

The following sections describe preventive procedures, structures, and equipment.

6.4.1 Unloading Operations [F-4a]

Methods used to prevent releases during unloading operations depend on waste form (e.g., containerized or bulk). The methods employed are as follows.

- Containers are inspected for damage before being unloaded from the transport vehicle.
- Containerized waste is handled by appropriate equipment (e.g., forklift or crane) during unloading.
- Path from loading area to storage area is clear of obstructions.
- Bulk waste is not unloaded with winds in excess of 24 kilometers per hour.
- Bulk waste is handled in a manner to ensure that dispersal does not occur (e.g., use of fixatives while placing bulk waste in trenches and air monitoring).

Any spills will be managed as identified in the building emergency plan (Chapter 7.0). Cracks and wear are recorded to initiate corrective action. In the LLBG, container pallets, burial containers, and other approved waste packages are placed individually in the trenches for burial.

Waste will be staged at the waste unloading area no longer than necessary for placement into the trench; however, waste might be left in place overnight should the daily operational shift end before waste is placed into the trench.

6.4.2 Run-Off [F-4b]

The waste in the LLBG is buried below the land surface; thus, the LLBG are designed to prevent run-off of precipitation that might have come in contact with waste. The average precipitation is 16 centimeters per year, so minimal run-off occurs. The land surface is relatively level, so trenches have only internal drainage. The minimal amounts of precipitation that accumulate are contained within the trenches.

The lined mixed waste trenches are designed to channel run-on liquid away from the burial trench. Run-off liquid is captured within the trench. Surface liquid evaporates. The liquid that leaches through the waste is captured in the leachate collection system and is managed as mixed waste.

6.4.3 Water Supplies [F-4c]

The design and operation of the LLBG are intended to minimize the generation of potentially contaminated leachate and to prevent its migration into groundwater resources in the local area. Operations (Chapter 4.0) are designed to protect local water supplies while site conditions (Chapter 5.0) also mitigate contaminant migration through surface water and groundwater.

A description of activities that prevent contamination of water supplies or groundwater include the following:

- Placement of mixed waste in lined trenches
  - Waste is containerized or stabilized to control migration of mixed waste
  - Run-on and run-off are controlled
  - Leak detection systems are used
  - Leachate is collected and managed as mixed waste
  - Inspections are performed
- Placement of backfill on completed portions of trenches
- Revegetation to control erosion of protective cover (Chapter 11.0).

6.4.4 Equipment and Power Failure [F-4d]

Electrical power for MO223 is provided. Loss of electricity at MO223 will not impair functions or constitute an emergency. Backup equipment is available for failed mechanized equipment.

Electrical power is required for trenches 31 and 34 of the 218-W-5 Burial Ground; however, loss of electricity does not constitute an emergency, but should be restored as soon as possible. Electricity supplies power to the sump pumps used to remove accumulated leachate from the primary and secondary liners.

6.4.5 Personal Protection Equipment [F-4e]

Personnel are trained in the use of applicable personal protection equipment. Examples of personal protection equipment frequently used include clothing (i.e., cloth coveralls, cloth and rubber shoe cover, cloth and rubber gloves and cloth caps); hard hats; safety shoes; safety glasses; and respiratory protection devices. The protective clothing required in the LLBG varies depending on the form and content of the waste.

Available respiratory protection equipment includes the following:

- Airpacks
- Filter masks with a graphite filter. This type of mask is for removing particulates from the respiratory stream
- Face masks with cartridges that react with various chemical fumes. These masks are used in special circumstances
- Full-face masks, with hoses attached to an air compressor some distance away, also are available when needed.

Personnel are required to be trained in using the various respiratory devices and must be checked routinely for mask fit (Chapter 8.0).

6.5 PREVENTION OF REACTION OF IGNITABLE, REACTIVE, AND INCOMPATIBLE WASTE [F-5]

The following sections describe prevention of reaction of ignitable, reactive, and incompatible waste.

6.5.1 Precautions to Prevent Ignition or Reaction of Ignitable or Reactive Waste [F-5a]

Waste preparation requirements prohibit the disposal of ignitable or reactive waste at the LLBG. Reactive and ignitable waste must be treated and/or neutralized before receipt and disposal (Appendix 3A). No ignitable or reactive waste will be stored in trench 34 (and trench 31, if needed to support waste management needs).

6.5.2 Precautions for Handling Ignitable or Reactive Waste and Mixing of Incompatible Waste [F-5b]

The waste analysis plan (Appendix 3A) requires that ignitable or reactive waste be treated in accordance with RCRA-specified treatment standards. In addition, measures are taken to ensure that the commingling of incompatible waste does not occur. Waste acceptance criteria ensure that the generating unit has performed the required treatment before the waste is disposed or stored in the LLBG.

Table 6-1. Typical Average Daily Action Leakage Rate Calculation.

AVERAGE DAILY ACTION LEAKAGE RATE CALCULATION

Operating Day __/__/__ ____.____ Gallons

Operating Day __/__/__ ____.____ Gallons

Operating Day __/__/__ ____.____ Gallons

Operating Day __/__/__ ____.____ Gallons

Operating Day __/__/__ ____.____ Gallons

Operating Day __/__/__ ____.____ Gallons

Operating Day __/__/__ ____.____ Gallons

Secondary Sump Total Volume **TOTAL** ____.____ Gallons
(DIVIDE TOTAL VOLUME BY 7)

AVERAGE DAILY ACTION LEAKAGE RATE: ____.____ Gallons

NOTIFY LLBG Operations Supervisor if Average Daily Action Leakage Rate is GREATER than 670 Gallons

____

Repairs or remedial action taken: ____________________________

____

Operator's Printed Name: ____________________ Date __/__/__

Operator's Signature: ____________________ Time ___.___ hrs

Operations Supervisor Printed Name: ____________________ Date __/__/__

Operations Supervisor Signature: ____________________ Time ___.___ hrs

Table 6-2. Conversion Chart.

Trench 31, primary sump conversion chart, from sump level indication, TR31-SP-LI-1, in inches to sump volume in gallons					
Primary sump level indication TR31-SP-LI-1 (inches)	Sump volume (gallons) per inch	Sump volume running total (gallons)	Primary sump level indication TR31-SP-LI-1 (inches)	Sump volume (gallons) per inch	Sump volume running total (gallons)
06.00	51	51	23.00	250	2,696
07.00	83	134	24.00	280	2,976
08.00	90	224	25.00	285	3,261
09.00	100	324	26.00	305	3,566
10.00	102	426	27.00	350	3,916
11.00	105	531	28.00	375	4,291
12.00	110	641	29.00	385	4,676
13.00	133	774	30.00	405	5,081
14.00	145	919	31.00	445	5,526
15.00	152	1,071	32.00	533	6,059
16.00	155	1,226	33.00	545	6,604
17.00	180	1,406	34.00	560	7,164
18.00	188	1,594	35.00	565	7,729
19.00	202	1,796	36.00	575	8,304
20.00	210	2,006	37.00	640	8,944
21.00	215	2,221	38.00	800	9,744
22.00	225	2,446	39.00	860	10,604

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APPENDIX

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7.0 CONTINGENCY PLAN [G]

The WAC 173-303 requirements for contingency plans are satisfied in the following documents: the *Building Emergency Plan for Low-Level Burial Grounds* (Appendix 7A) and the *Hanford Facility Contingency Plan*, Attachment 4 of the Hanford Facility RCRA Permit).

The unit-specific contingency plan document also serves to satisfy a broad range of other requirements [e.g., Occupational Safety and Health Administration standards (29 CFR 1910) and U.S. Department of Energy Orders]. Therefore, revisions made to portions of the contingency plan documents that are not governed by the requirements of WAC 173-303 will not be considered as a modification subject to review or approval by Ecology.

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APPENDIX

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8.0 PERSONNEL TRAINING [H]

The training plan provided in Appendix 8A discusses training requirements pertaining to the LLBG.

The training program is designed to be compliant with all applicable federal, state, and DOE-RL training requirements. The training program complies with requirements contained within WAC 173-303-330 for the development of a written dangerous waste training program. The training program is designed to prepare personnel to manage and maintain TSD units in a safe, effective, efficient, and environmentally sound manner. In addition to preparing employees to manage and maintain TSD units under normal conditions, the training program ensures that employees are prepared to respond in a prompt and effective manner should offnormal or emergency conditions occur.

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9.0 EXPOSURE INFORMATION REPORT

Exposure information for the LLBG is discussed in the General Information Portion (DOE/RL-91-28).

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10.0 WASTE MINIMIZATION [D-9]

To fulfill the requirements of 40 CFR 264.73(b)(9), a certification form that the LLBG have a waste minimization/pollution prevention program in place will be entered, annually, into the LLBG operating record.

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FIGURES

TABLES

11.0 CLOSURE AND FINANCIAL ASSURANCE [I]

This chapter discusses closure and postclosure activities for the LLBG. This closure plan complies with WAC 173-303-610 and represents the baseline for closure of the LLBG.

Closure and postclosure of the LLBG will be a complex activity. In an effort to understand how the LLBG eventually will be closed, a brief description of the current operational and regulatory status of the various burial grounds must be understood. The following discusses the current status of each burial ground.

- The 218-E-10 Burial Ground, with the exception of a few small areas that contain post-August 19, 1987 RCRA/WAC 173-303 regulated waste, is a SWMU and continues to receive only low-level waste.

- The 218-E-12B Burial Ground with the exception of trench 94, contains no RCRA/WAC 173-303 regulated waste. The majority of this burial ground, with the exception of trench 94, is a SWMU and continues to receive only low-level waste. This burial ground also contains retrievable transuranic waste. This transuranic waste eventually will be removed and the trenches will be used only for low-level waste disposal.

- The 218-W-3A Burial Ground, with the exception of a few small areas that contain post-August 19, 1987 RCRA/WAC 173-303 regulated waste, is a SWMU and continues to receive only low-level waste. This burial ground also contains retrievable transuranic waste. This transuranic waste eventually will be removed and the trenches will be used only for low-level waste disposal.

- The 218-W-3AE Burial Ground, with the exception of a few small areas that contain post-August 19, 1987 RCRA/WAC 173-303 regulated waste, is a SWMU and continues to receive only low-level waste. This burial ground also contains retrievable transuranic waste. This transuranic waste eventually will be removed and the trenches will be used only for low-level waste disposal.

- The 218-W-4B Burial Ground contains no RCRA/WAC 173-303 regulated waste. This burial ground is full and no longer receives waste. However, this burial ground also contains retrievable transuranic waste. This transuranic waste eventually will be removed and the trenches will be used only for low-level waste disposal.

- The 218-W-4C Burial Ground, with the exception of a few small areas that contain post-August 19, 1987 RCRA/WAC 173-303 regulated waste, is a SWMU and continues to receive only low-level waste. This burial ground also contains retrievable transuranic waste. This transuranic waste eventually will be removed and the trenches will be used only for low-level waste disposal.

- The 218-W-5 Burial Ground contains RCRA double-lined leachate collection and removal system trenches (trenches 31 and 34). Trenches 31 and 34 are located in the southern one-third portion of this burial ground. There are two small areas in the northern two-thirds portion of this burial ground that contains post-August 19, 1987 RCRA/WAC 173-303 regulated waste. The majority of this burial ground is a SWMU and continues to receive only low-level waste.

- The 218-W-6 Burial Ground has yet to be used. This burial ground, in its entirety, is identified for future disposal of RCRA/WAC 173-303 regulated mixed waste.

11.1 CLOSURE PLAN [I-1]

This closure plan addresses the pre-closure activities for the LLBG. Mixed waste that meets LDRs is, and will be, disposed in lined trenches that comply fully with RCRA Subtitle C standards (Chapter 4.0). Also, the use of unlined trenches for the disposal of mixed waste is, and will be, performed in accordance with applicable dangerous and hazardous waste regulations (defueled reactor compartments placed in trench 94 meet LDR in their as-built condition). Future mixed waste trenches will be located in the currently unused portions of the LLBG. Refer to Section 11.5 for discussion on removal of transuranic waste from the LLBG.

The LLBG RCRA-regulated areas will be closed according to the applicable dangerous waste regulations, U.S. Department of Energy requirements, and the best management practices available at the time of closure.

The cover(s) will be designed and located so that the cover(s) passively isolate the recognized hazard and properly protect human health and the environment. The cover(s) will conform to the requirements of WAC 173-303-610. The specification and/or variation for other cover designs will be provided at the time of closure once the hazard(s) have been defined. Although a final detailed cover design cannot be provided for all applications at this time, at closure, all covers will be designed to adequately protect human health and the environment.

11.2 CLOSURE PERFORMANCE STANDARDS [I-1a]

Refer to General Information Portion (DOE/RL-91-28, Chapter 11.0) for discussion regarding landfill closures.

11.3 PRE-CLOSURE ACTIVITIES

A complete list of partial closure activities has not been defined. It is assumed that pre-closure activities could include, at a minimum, placing interim or final covers over the lined mixed waste trenches once these trenches are no longer receiving waste. Placement of covers over individual trenches might be deferred until closure of the entire LLBG. Once a decision is made to construct final covers over the various burial grounds, a cover will be designed based on the hazard to be isolated. A closure cover design that satisfies the dangerous waste disposal requirements as defined in WAC 173-303 will be placed over the lined mixed waste trenches at the time of closure.

This closure plan does not address the closure of adjacent waste management areas (e.g., CERCLA operable units, other TSD units, etc.). However, this closure plan does address some of the parameters that will have to be evaluated when a burial ground is filled and ready for closure (Figure 11-1). In addition, this closure plan does not address activities outside the present scope and operation of the LLBG that might impact future disposal activities across the Hanford Facility.

Current waste management operations require that when a trench is filled with only low-level waste, the trench is backfilled with approximately 2.44 meters of soil to match the surrounding topography, which is predominately flat. These operations could change as waste management needs dictate. This cover is compacted by track-walking (e.g., weight of dozer) to stabilize and minimize subsidence. A maintenance and inspection program is implemented during this interim period to control erosion (e.g., the planting of shallow-rooted plants; an ongoing ocular monitoring program to remove any deep rooted plants, filling in areas of subsidence, and correcting any wind or water erosion if observed, and burrowing animals and insect intrusion) and other natural deterioration that could compromise human health or the environment. A chain-link fence might be erected around the perimeter of a backfilled burial ground for safety. On filling an entire burial ground, a detailed analysis might be necessary to determine the best method for final closure.

As stated previously, the majority of the LLBG are used only for low-level waste disposal (SWMU) and this disposal is outside the regulatory scope of RCRA and WAC 173-303. However, the low-level portions do impact the ability to perform final closure of the RCRA portions of the LLBG. Another significant impact affecting closure of the LLBG is integration with nearby CERCLA operable units, operating TSD units (e.g., Double-Shell Tank System and active burial grounds), roads, rails, and utility lines. Depending on how the LLBG are closed, closure caps for the low-level portions and the RCRA portions could cover, partially cover, or impact these structures in an adverse manner. A combined approach to address the radioactive and RCRA/WAC 173-303 portions might be necessary (Table 11-1).

The LLBG are located in an arid climate. To date, no known releases (radioactive and/or mixed waste) have been detected from the LLBG (Chapter 5.0). As stated previously, as a trench is filled, soil is added to make the trench match the surrounding topography and a program of erosion prevention is initiated. An exception is trench 94 of the 218-E-12B Burial Ground. To maximize the disposal capacity of this trench, the best operating method is to delay backfilling until the trench is filled with defueled reactor compartments. Other exceptions for delay would depend on best waste management practices.

The selection of a cover design has not been identified for all applications. The specification and/or variation for other designs will be provided at the time of closure once the hazard(s) have been defined. Although a final detailed cover design cannot be provided for all applications at this time, at closure, all covers will be designed to adequately protect human health and the environment. Furthermore, it is assumed that the cover design(s) could include features that satisfy or exceed the minimum requirements found in 40 CFR 260 through 270 to protect human health and the environment.

11.4 MAXIMUM EXTENT OF OPERATION [I-1b(1)]

The design capacity of the LLBG for mixed waste conservatively is calculated to be 174 hectare meters (Chapter 1.0).

11.5 REMOVING DANGEROUS WASTE [I-1b(2)]

Transuranic waste has been placed in various trenches of the LLBG since May 1970. Transuranic waste containers were placed on asphalt pads on the bottom of the trenches or placed in plywood-lined trenches. An earthen cover, where appropriate, was placed over the trenches to provide radiological protection. This waste was placed in a manner that allows for retrieval and/or removal in the future if necessary. No transuranic mixed waste has been placed into the LLBG since August 19, 1987. This waste eventually will be retrieved, processed, and disposed in accordance with current federal and state requirements. The low-level portion of the transuranic waste will be disposed of as low-level waste. This disposal could take place in the trenches in which the transuranic waste was removed. The pre-August 19, 1987 mixed waste portion of the transuranic waste will be disposed in lined trenches. The transuranic portion will be processed and prepared for offsite disposal. It is assumed that the retrieval of transuranic waste will be conducted and completed during the operational phase of the LLBG.

11.5.1 Retrievable Transuranic Waste

Transuranic waste has been placed in several different configurations (WHC 1989a, WHC 1989b, WHC 1989c, and WHC 1989d). All transuranic waste packages placed in the LLBG were free of external contamination at the time of emplacement and were designed to maintain integrity for a minimum of 20 years. It is assumed that retrieval of this waste can be accomplished without generating an airborne release of radioactivity.

Where retrievable transuranic waste has been covered with soil, conventional excavating equipment could be used to remove the bulk of the fill soil, taking care not to damage the waste containers. If necessary, manual removal of soil could be required from around the waste containers. If the structural integrity of a container is questionable, additional precautions will be exercised that could include, but are not limited to, wrapping with polyethylene sheets, overpacking the container to prevent airborne release during subsequent handling operations, or retrieval would be conducted inside a full-containment structure to minimize the risk of an environmental release and to protect personnel.

It is assumed that the retrieval of transuranic waste would be completed during the operational phase of the LLBG. As such, this activity would not be subject to requirements contained in WAC 173-303-610.

11.5.2 Gas Sampling

In most transuranic waste areas, polyvinylchloride tubes were installed downward through the temporary waste area cover and operational cover into the waste zone for ambient air sampling. The tubes were installed and samples were taken periodically from the early 1970s through the mid-1980s. The primary objective of this testing program was to determine if the concentration of hydrogen gas generated by radioactive decay was sufficient to be of concern during retrieval operations and to determine moisture content. Although the results indicated that generation of hydrogen gas would not be of concern, additional confirmatory sampling will be conducted before retrieval.

The gas sampling system will be removed during retrieval of transuranic waste. Because these systems will be removed before closure, removal of these systems will not be subject to WAC 173-303-610.

11.6 DECONTAMINATING STRUCTURES, EQUIPMENT, AND SOIL [I-1b(3)]

All equipment used during waste sampling or retrieval will be decontaminated as required to ensure the safety of personnel. Decontamination also will be performed before the use of such equipment in a subsequent retrieval operation to prevent cross-contamination. If required, radiological decontamination will be performed before nonradiological decontamination. Although certain types of materials will require special chemical or other decontamination procedures, routine decontamination generally will be accomplished by one of the following:

- Washing the items in nonphosphate detergent and tap water
- Rinsing or washing down three times with tap water
- Wiping with nonflammable, nontoxic cleaning solution.

If, after decontamination activities, waste retrieval equipment or structures are shown to have contamination above the established decontamination standards, the use of such items will be restricted or discontinued. The overburden soil once removed will be carefully managed and stockpiled for future use. This soil could be used to cover waste that is disposed in the LLBG.

Equipment and structures that cannot be decontaminated to operational standards and contaminated soils, pavements, and waste residuals will be disposed in accordance with WAC 173-303-610(5).

11.7 CLOSURE OF LANDFILL UNITS [I-1e and I-1e(2)]

Closure of the LLBG will be consistent with the closure requirements specified in WAC 173-303-610 where appropriate.

The cover design(s) that will be used at the time of closure will satisfy the requirements for dangerous waste disposal as defined by WAC 173-303 and 40 CFR 264.

11.7.1 Cover Design [I-1e(2), I-1e(4), I-1e(5), I-1e(6), I-1e(7), and I-1e(8)]

The cover could consist of several layers that could be constructed on top of native soil base. A generalized cross-section of an example cover is shown on Figure 11-2. The cover could be constructed on a soil grade layer (graded fill) shown as layer 9 in Figure 11-2. It is assumed that before construction of the final cover, the waste form would be appropriately stabilized.

11.7.1.1 Grade Layer. The surface of the burial ground would be graded and/or shaped, if necessary, to match the slope of the desired low-permeability layer. Additional soil would be placed over the burial ground to achieve the required cover grade. This grade layer could taper from zero thickness near the edge of the outermost burial ground (the cover boundary) to perhaps several meters at the center of the cover; the thickness would depend on the lateral dimensions of the particular cover and the grade of the cover. As discussed, the grade layer also would provide a firm (nonsettling) foundation for the overlying layers.

The grade layer would consist of native soils. This material would be sufficiently well-graded to allow effective compaction. Field studies would be performed to identify suitable borrow sites. These studies would consist of evaluating existing geologic data pertaining to surficial deposits, surface mapping and sampling, test pits, laboratory testing, and possibly surface geophysics and/or limited drilling. This information is available for most cover material located on the Hanford Site. During construction of the prototype barrier at the 200-BP-1 operable unit (DOE/RL-94-76), design requirements specified that the subgrade fill be constructed from sandy soil (containing cobbles less than 75 millimeters at their greatest dimension with a constitution not more than 20 percent of the fill), obtained from a local borrow site. The material was found within a kilometer of the location.

The grade layer generally would be placed in uniform horizontal lifts, or tapered for sloped or crowned covers, to meet grade specifications after compaction. The optimum lift thickness would depend on the soil and equipment characteristics and would be determined using laboratory test data. Field verification could be provided by constructing a test pad before cover construction. To minimize settlement, the grade layer would be compacted to 95 percent of maximum density as determined by ASTM D 1557 [modified proctor (ASTM 1993)] or other approved method. Compaction will be accomplished with a large, smooth, drum vibratory roller or similar piece of equipment, sized to prevent damage to underlying liner system components if present.

During construction of the cover, measurements on density of the placed grade layer would be taken periodically by bulk sampling and volume measurement techniques (e.g., ASTM D 4914). This testing would be used to determine the need for moisture conditioning, time constraints for placement, the optimum lift thickness, the required number of passes to achieve compaction, and similar information necessary to establish quality control specifications.

11.7.1.2 Low-Permeability Layer. The low-permeability layer could consist of either a 0.61 meter layer of soil mixed with bentonite, a geosynthetic clay liner (GCL), or a composite asphalt layer. The permeability of this layer would be greater than the permeability of the liner, if a liner is present. The selection of an appropriate material for this layer would be based on the hazard that is to be isolated. The low-permeability layer is the primary barrier in preventing soil and/or water from migrating into the waste zone.

The GCLs would be placed as panels on top of the grade layer. All GCLs are manufactured as panels approximately 4 to 5 meters in width and approximately 25 to 60 meters in length. The panels are placed on rolls at the factory and unrolled at or near the burial ground. The weight of the roll varies but ranges from 600 to 2,000 kilograms. The panels typically are overlapped 75 to 300 millimeters and tend to be self-sealing. Slight differences in the recommended installation exists between the various manufactures.

A 60-centimeter thick layer of soil mixed with bentonite could be used as the low-permeability layer. The soil component would consist of well-graded silt or silty sand from a suitable borrow source or else screened from native soils. The maximum particle size generally would be 4.75 millimeters (No. 4 sieve) to exclude larger particles that might reduce the overall permeability of the mixture or puncture the overlying geomembrane. This soil would be mixed with enough bentonite to lower the hydraulic conductivity of the mixture to 1×10^{-7} centimeters per second per day or less at a readily achievable degree of compaction. The optimum percentage of bentonite would depend on the properties of both the soil and the bentonite itself and would be determined by laboratory testing of candidate mixtures. However, previous studies (Daniels 1988) indicate that approximately 10 percent bentonite should provide satisfactory performance.

The soil/bentonite material would be mixed (e.g., by disking or in a pugmill) at a location close to the cover and would be stockpiled to minimize moisture changes. If necessary, the surface of the grade layer would be moistened and proof rolled immediately before placing this admixture. To meet permeability specifications, the soil/bentonite layer would be placed in 15-centimeter thick lifts and compacted with a self-propelled sheepsfoot compactor. The first lift could be somewhat thicker depending on compactor and grade layer characteristics, to prevent the soil/bentonite from being driven into the underlying layer. In-place densities would be measured with a sand cone or other direct method or a nuclear density gage calibrated to the specific mixture used for the cover. Permeability would be measured on thin-walled tube samples in the laboratory. The sample holes in the cover would be carefully backfilled and compacted by hand. Material that does not have an in-place hydraulic conductivity of 1×10^{-7} centimeters per second or less would be recompacted or replaced as appropriate, and the permeability test repeated. The top surface of the soil/bentonite layer would be rolled with a smooth drum roller to provide a flat, even surface for the overlying geomembrane. The moisture content of the admix surface would be maintained by sprinkling, covering, or other means to prevent drying and desiccation. Potential concerns about desiccation also would be mitigated by installing the other layers of the cover as soon as possible after the admix layer has been placed.

Placement of the composite asphalt layer would follow the procedure used to construct the prototype barrier (DOE/RL-94-76). The layer would be placed using conventional paving practices. Material either would be batched in the 200 Areas or hauled from the nearest batch plant. A conventional paving machine would be used to place the asphalt. The asphalt would be placed in two lifts. Each lift would be approximately 7.5-centimeters thick. An overlap of approximately 1.5 meters is specified. A material specification that at least 6 percent of the material would be less than 0.074 millimeter was used during construction of the prototype. The asphalt would be covered with either a coat of polymer-modified asphalt or gilsonite, a naturally occurring derivative of tar sand. It is recommended that the protective coat be at least 250 millimeters in thickness.

It has been reported that GCLs are much better able to resist damage from freeze-thaw considerations, desiccation, and differential settlement than are compacted soil liners (Daniels 1994). The GCLs are thin blankets of bentonite clay attached to one or more geosynthetic materials (geotextile or geomembrane). These are commercially available and are particularly well suited for arid or dry conditions. The liners typically contain approximately 5 kilograms per square meter of bentonite that has an effective hydraulic conductivity of 1×10^{-9} centimeters per second.

It has been shown that desiccation-induced cracking can occur after several freeze-thaw cycles or dry-wetting cycles for the composite clay soil layers. Furthermore, the data published by Lagatta (1992) indicates that most compacted soil layers cannot withstand tensile strains greater than 0.1 to 1.0 percent. The GCLs can withstand tensile strains from 5 to 20 percent (Daniels 1994). Therefore, if freeze-thaw or wetting drying cycles are anticipated and/or differential settlement, which could result in significant distortion is anticipated, it is recommended that a GCL be used instead of compacted soil/bentonite layer. If biological intrusion, freeze-thaw or wetting-drying, and differential settlement are not anticipated, a 60-centimeter two component [flexible membrane liner (FML) and compacted soil/bentonite layer] might prove to be the most economical low-permeability layer.

It is recommended that GCLs and/or composite soil/bentonite layers be used to isolate mixed waste where the radiological component of risk is very low. As opposed to the asphaltic concrete composite layer, the GCL would not provide a barrier to biological intrusion. Although the design life of the GCL is unknown, it is assumed to be several hundred years (Daniels 1994). By comparison, the design life of the composite asphalt layer is estimated to be several thousand years.

11.7.1.3 Flexible Membrane Liner (optional). If the soil/bentonite layer is used, a low-permeability layer FML (or geomembrane) could be placed over the soil/bentonite layer. Using a FML is consistent with the two component EPA guidance for RCRA cover design (EPA 1989).

The geomembrane would consist of a 40-mil sheet of high-density polyethylene (HDPE), very-low-density polyethylene (VLDPE), or other suitable material. The 40-mil thickness is twice that recommended by the EPA (EPA 1989), but is considered appropriate to reduce the risk of damage during construction and subsequently during the postclosure period from such potential hazards as settlement, roots, and burrowing animals. The composition of the geomembrane would be selected for high resistance to normal weathering and chemical deterioration, including any fertilizers and herbicides that might be used to establish the vegetative cover. Physical and mechanical properties of the geomembrane, such as thickness, strength, and density, would be verified by conformance testing (to ASTM and other standard tests as appropriate) on samples of material received at the site. A FML that does not meet manufacturer's or design specifications would be rejected.

The geomembrane would be placed on the prepared soil/bentonite surface with several centimeters of overlap between adjacent sheets. In most cases, the panels would be placed so that the seams run down gradient. Sheets would be joined by fusion or extrusion welding. Samples for destructive seam-strength tests would be taken every few hundred meters to ensure adequacy of the welding process, and the sample locations would be patched. Nondestructive tests such as vacuum box or pressure testing (the type of test would depend on the welding method) would be performed along the entire length of all seams to ensure total seam integrity. Any part of a seam that fails these tests would be repaired or removed and patched as appropriate. A FML installation would be performed by specialists experienced in this technology and would be conducted under detailed quality assurance/quality control procedures to be developed as part of the final cover design.

Depending on construction staging, sandbags would be placed on the FML at approximately regular intervals to prevent damage from wind uplift before the overlying layers are placed. Design methods, such as those described by Wayne and Koerner (1988), would be used to estimate more precisely the sandbag requirements. The sandbags will be removed before placing the drainage layer.

As stated, this is an optional layer that would only be used if the 60 centimeter thickness of soil mixed with bentonite is used as the low-permeability layer.

11.7.1.4 Drainage Layer. The drainage layer would conduct any water that percolates through the overlying layers laterally to the drainage ditch. Thus, the drainage layer would prevent hydraulic pressure from building up directly on the low-permeability liner, and thereby eliminate one set of forces that would drive moisture through the primary moisture control barrier.

The design criteria for the drainage layer would be that the layer convey water at a rate no less than $1x10^{-2}$ centimeters per second per day. The drainage layer would consist of a geonet or layers of sand and gravel. If asphalt is used as the primary low-permeability layer, a 15-centimeter layer of gravel would be placed directly on the asphalt. If either the GCL or two component FML composite soil and bentonite layer is selected for use, then either a geocomposite (geotextile combined with a geonet), if a capillary break is not included in the design, or a 30 centimeter layer of sand (15 centimeters) overlaid by gravel (15 centimeters) would be used. For this case, the drainage layer would be constructed by first placing the 15 centimeter thickness of sand on the FML and placing the 15-centimeter thickness of gravel on the layer of sand. If the surface grade of the FML is 3 percent or greater, a geosynthetic bedding material might need to be placed on the FML before placement of the sand to prevent the slippage of sand off the surface of the FML. This is a characteristic that would need further review before construction of the cover.

The gravel or sand followed by gravel layer would be placed using conventional construction practice. Placement of the material would be in two 15 centimeter lifts. Each lift would be consolidated using a vibratory roller. During the construction of the prototype barrier, two passes of the vibratory roller were found to be sufficient. If a FML or GCL is used, it is recommended that rounded (not crushed) material be used as the drainage medium to avoid damaging the FML. The maximum grain size should be no greater than 0.95 centimeter. If a composite asphalt layer is used, crushed material can be used. However, if crushed material is used, the material as applied (specifications) would need to satisfy the minimum drainage criteria of $1x10^{-2}$ centimeters per second.

11.7.1.5 Plant, Animal, and Human Intrusion Layer (optional). The performance objectives for the permanent isolation surface barrier are summarized as follows:

- Function in a semiarid to sub-humid environment
- Limit the recharge of water through the waste to near zero amounts [0.05 centimeter per year ($1.6x10^{-9}$ centimeters per second)]
- Be maintenance free
- Minimize the likelihood of plant, animal, and human intrusion
- Limit the exhalation of noxious gases
- Minimize erosion-related problems
- Meet or exceed RCRA Subtitle C cover performance requirements
- Isolate waste for 1,000 years.

To satisfy the intrusion performance objective, a layer of fractured basalt riprap 1.5-meter thick has been incorporated into the design of the prototype permanent isolation surface barrier. This is an optional layer that would only be included in the design of barriers that require the additional human and/or bio-intrusion protection to reduce either the environmental or human health risk.

11.7.1.6 Graded Filter Layer. A graded filter consisting of crushed rock overlaid by sand is the next layer. This layer would be placed on either the plant, animal and human intrusion layer (Section 1.5) if incorporated into the design, directly over the drainage layer (Section 1.4) if the bio-barrier is not included in the design and a geosynthetic drainage layer (geonet) is used. The graded filter layer would function as a capillary break and will increase the effectiveness of the surface layer by imposing the use of the "Richards" principal. The graded filter serves to separate the surface soil layer from the drainage layer. A geotextile would be placed on the top of the graded filter to decrease the potential for fine material to enter the filter and drainage zone. The geotextile would be permeable to drainage and would not support a standing head of water.

The thickness of the graded filter could vary. For the prototype barrier, 30 centimeters of crushed rock was placed on the railroad or highway ballast. The crushed rock was placed in two lifts of 15 centimeters graded, and rolled to 95 percent maximum density using a steel drum vibratory roller. The crushed material was screened through a 16-millimeters mesh before being placed.

During the construction of the prototype barrier, a 15-centimeter layer of sand was placed directly over the crushed rock. The sand was obtained onsite and placed in accordance with WSDOT M41-10, 2-03.3(14) (WSDOT 1991). Standard dump trucks were used to haul the sand from Pit 30 located in the 200 Areas to the construction site. A grader was used to level and finish grade the sand layer. A geotextile was placed on top of the graded filter before construction of the surface soil layer.

It is important to note that the creation of the 'capillary break' allows the surface soil layer to both store and recycle water. This will reduce and might eliminate the need to build a surface slope into the final grade of the surface soil layer under semiarid conditions.

11.7.1.7 Surface Soil Layer. A surface soil would be placed over the geotextile to intercept, store and recycle water, and prevent damage to the underlying structure from natural and synthetic processes. Factors assimilated into the design of the surface soil layer include the following:

- Aspects of soil physics including the characterization and quantification of soil physical properties

- The collection, interpretation, and use of meteorological and long-term climatology data

- The collection and use of wind and water erosion

- The collection and use of information on vegetation, bio-intrusion, and human intrusion

- The use of physical models (lysimeters) and numerical models (computer codes) to simulate performance and help optimize design.

Analytical methods (simulation modeling) have been used to size the surface soil layer. Using field data collected from the Field Lysimeter Test Facility, both the UNSAT-H and HELP numerical models have been calibrated to simulate onsite conditions. For several years, these calibrated models have been used to compute the performance of barrier designs thereby, defining the appropriate surface soil thickness for the barrier. The two most important factors in engineering the surface soil thickness are the assignment of the water retention characteristics for soil and climate information.

The selection of soil to be used for the surface soil layer started in the mid-1980's. By the time the Hanford Defense Waste Environmental Impact Statement was issued (DOE 1989), it had been decided that the Warden Silt Loam Soil available at several locations on the Central Plateau was the desired material for constructing surface barriers that would recycle water. Most design studies have assumed the use of this material. The physical and hydraulic properties of this soil have been quantified.

The surface soil layer could consist of two layers. The top layer consists of the selected silt loam to which 15 percent (by weight) pea gravel is added. The addition of this pea gravel serves to armor this layer thereby reducing the rate of soil deflation to less than 5 percent of the nominal unprotected rate. The bottom layer consists of silt rich material. The silt rich material is found naturally occurring at several locations on the Central Plateau and is characterized with more than 30 percent passing the No. 230 sieve. The silt layers are placed using conventional construction techniques in a single lift. Once the material is placed, it is groomed to a compaction of 88 percent maximum dry density.

As discussed in Section 11.1.7.6, the actual thickness of the two layers would vary depending on the desired water storage of the soil. The minimum thickness guideline recommended by EPA is 60 centimeters (EPA 1989).

11.7.1.8 Vegetative Cover. The vegetative cover performs three functions. First, the plants return water stored in the surface soil back to the atmosphere, significantly decreasing net infiltration and reducing the amount of moisture available to penetrate the cover. Second, the vegetation stabilizes the surface soil component of the cover against wind and water erosion. Finally, the vegetative cover restores the appearance of the land to a more natural condition and appearance.

The importance of vegetation on the recycling of water has been recognized and measured for years onsite and at other locations in the semiarid west. A number of lysimeters have been constructed onsite to measure recharge and the effectiveness of plants and grasses in reducing recharge. The most controlled studies on this phenomenon have been performed at the Field Lysimeter Test Facility. In these studies, it has been observed that a

2.0-meter thickness of soil supporting no vegetation and isolated through the use of a capillary break has sufficient storage capacity to recycle twice the annual amount of seasonable precipitation on the Hanford Site. If vegetation is introduced, the storage capacity of the soil column is increased to three times the annual average (Gee et al. 1992).

A mixture of seeds will be used to establish vegetation. The selection of the seed mix would be based on past vegetation activities onsite and work performed in support of the engineered barrier (Link et al. 1994). The seed types would be selected based on resistance to drought, rooting density, and ability to extract water. In particular, attention would be given towards those factors that prevent deep root penetration into the buried waste. It has been observed that the best way to control root penetration is to construct a layer of rocks that creates a void space. Both the graded filter and the optional bio-barrier serve this purpose. During final design, suitable plant and grass species, such as wheatgrasses, would be identified.

11.7.1.9 Wind Erosion. The principal hazard associated with wind erosion is the thinning of the cover surface soil layer. This in turn potentially could lead to breaching of the moisture barriers, gradually allowing larger quantities of water to reach the waste. The engineering approaches to mitigating wind erosion of the cover are (1) designing the surface soil layer with an appropriate total thickness to compensate for future soil loss that might result from wind erosion, (2) establishing a vegetative cover on the surface to reduce wind erosion, and (3) include an appropriate coarse material (admix) in the upper layer of the surface soil to form an armor layer.

The use of coarse soil on the cover surface is expected to reduce wind erosion to negligible levels. The use of gravel admixtures for protecting silt-loam Hanford soils exposed to environmental conditions has been studied for several years by PNNL (PNL 1994). As a result of this work, a pea gravel admix of 15 percent has been added to the surface layer. Use of the pea gravel admix would serve as an armor layer thereby minimizing the rate of soil deflation.

Although soil deflation has been minimized (estimated to be less than 5 percent of an unarmored surface), some erosion of the native surface soils in the vicinity of the cover would certainly occur. The rate of deflation will be governed by wind speed and saltating sand. The result of wind erosion could effect the operation of the drainage ditches. Periodic maintenance of these ditches might be required.

11.7.1.10 Water Erosion. The potential hazard associated with water erosion is the same as that for wind erosion, namely the loss of soil from the top or surface layer. The effect of water erosion on cover designs on the Hanford Site has been studied for several years by PNNL. The results indicate that vegetation cover has the most dominant effect on reducing water erosion. The rock mulch or pea gravel admix also has a positive effect in reducing water erosion but is less effective than vegetation. The effects of potential water erosion have been measured and quantified in terms of the universal soil loss equation (PNL 1992).

Several engineering approaches have been adopted to minimize the potential for water erosion:

- Limiting the surface slopes
- Providing run-on control with the sideslope drainage ditches
- Compacting the surface soil in a way that promotes significant infiltration rather than excessive run-off
- Properly designing the sideslopes to prevent gullying
- Establishing a vegetative cover to slow surface run-off
- Incorporating coarse material (pea gravel admix) in the upper portion of the surface soil layer to help form an erosion-resistant armor
- Limiting flow path lengths through the use of vegetation and admix.

The cover design was evaluated for potential erosion damage from overall soil erodibility, sheet flow, and gullying. The results indicate that expected erosion under worst-case conditions is within acceptable limits (refer to Chapter 11.0, Section 11.1.5).

11.7.1.11 Settlement and Subsidence. A discussion on settlement and subsidence is provided in Section 11.3.

11.7.1.12 Deep-Rooted Plants. The potential hazard from deep-rooted plants are roots penetrating the GCL and compacted soil/bentonite layers. The asphalt layer is assumed to resist this hazard. Penetration of this layer could provide a pathway for surface water to infiltrate the waste. Dangerous materials could be absorbed by the roots and brought to the ground surface where it could be released into the environment. Plants common to the 200 Areas are reported to have roots up to approximately 2.4-meters deep (PNL 1985), and might be sufficient to penetrate the thickness of the cover.

The following are design features that would minimize the potential for problems with deep-rooted plants.

- The surface soil (top two layers) will retain most of the precipitation, because the underlying drainage layer has significantly higher permeability and much less water retention capacity. Therefore, it is expected that vegetation preferentially will occupy the surface soil layer and not have an affinity for growing into the drier underlying layers.
- The thickness of the surface soils will be sized to promote the development of semiarid deep-rooted perennial grasses and to discourage the development of deep-rooting intrusive species.

The use of plants to recycle water has been studied for several years. This work was initiated at the Field Lysimeter Test Facility in the 200 Areas and continues at the prototype barrier test site located on the 200 Areas Plateau. Results of this work have been documented by Link (1994). Results from the ongoing work at the prototype barrier test site could be used during final design of the cover.

11.7.1.13 Burrowing Animals. Small animals indigenous to the Hanford Site have been reported to burrow to depths of more than approximately 2 meters (PNL 1986b). This is sufficient to penetrate the thickness of the top two layers. The sand and gravel filter layers and the gravel drainage layer should prevent the animals from burrowing any deeper. Of primary concern is the effect of borrowing on either reducing the storage capacity of the cover or providing a burrow that would in effect short circuit the effectiveness of the soil layers to store water.

This possible condition has been studied by Landeen (1994). An animal intrusion lysimeter test facility consisting of six lysimeters (150 centimeters by 150 centimeters by 180 centimeters deep) was constructed. Small burrowing animals common to the Hanford Site (Great Basin pocket mice, Townsend ground squirrels, and pocket gophers) were introduced over a 3 to 4 month test period. The animals were allowed to habitat the lysimeters. The soil wetting and drainage were forced using a rainulator. Tests were performed from April 1988 through August 1990.

Information collected from five tests indicated that water was lost from all the lysimeters including the control lysimeter (no animals) during the summer months. During the winter months, all lysimeters gained water. The data collected from the lysimeters also indicated that there was little difference in the total water content between the control and animal held lysimeters during the test periods. This suggest that burrow systems will not significantly increase the amount of water at depth or in storage. In fact the burrowing activity may enhance the removal of water from the soil (Landeen 1994).

11.7.2 Meteorology and Climatology

Meteorological records have been collected for over 75 years in eastern Washington. Meteorological records have been collected for approximately 50 years as part of the Hanford onsite operations. On the Hanford Site, the 79-year average annual precipitation is 16.2 centimeters per year. This annual precipitation record has been extended to over 75,000 years using a pollen analog developed on the Hanford Site (Petersen 1994). Based on this record, the long-term range of annual precipitation has ranged from 50 percent below the present day mean annual precipitation to more than 25 percent greater than the present day mean annual precipitation.

Based on extreme-value analysis, the 100-year and 1,000-year storm events have been predicted for the Hanford Site. The 24-hour maximum accumulation for the 100-year return period is 5.05 centimeters and for the 1,000-year return is 6.81 centimeters. Using 35 years of extreme event precipitation records (1946-1980), there were two 24-hour precipitation events where the accumulated precipitation exceeded 5.0 centimeters (Peterson 1994). The 100-year and 1,000-year recurrence events were based on this record.

About 38 percent of all precipitation is in the form of snow. This form of precipitation usually occurs during December through February. One out of every four winters is expected to produce an accumulation of snow that exceeds 16.2 centimeters (Peterson 1994). The water content of the snow varies greatly.

11.7.3 Numerical Simulation Models

Both the HELP model and UNSAT-H numerical simulation models have been used to predict the performance of various cover designs for possible use onsite. The two models have been compared and have been found to provide consistent results. The HELP model usually overpredicts drainage.

Both models were used by Martian (1994) to compare the performance of three designs with a surface soil thickness ranging from 1 to 2 meters. The results from this analysis tends to bound the design considerations that are of interest for use onsite. The soil layering consisted of a Warden Silt layer containing the pea gravel admix overlaying a Warden silt layer. The thickness of the layers is provided in Table 11-2.

Water balance simulations were conducted for each design for three different precipitation treatments: (a) ambient conditions, (b) 2X ambient precipitation conditions, and (c) design storm condition. The ambient precipitation scenarios used daily precipitation information from the Hanford Meteorological Station for the 10-year period 1979 through 1988. The 2X ambient precipitation scenario was realized by simply doubling the daily precipitation. The design storm event varied for each design and was superimposed on the ambient and 2X precipitation condition when the soil was at its maximum moisture content following the maximum precipitation event. For all three designs, this event was simulated to occur on December 31, 1983. The results from these calculations, using both the UNSAT-H and HELP simulation models, are provided in Table 11-3.

The design storm events are summarized as follows; (a) a 1,000-year, 24-hour event for design 1, (b) a 500-year, 24-hour event for design 2, and (c) a 100 year, 24-hour event for design 3. Superimposing these events on the simulated precipitation treatments had no effect on the calculated drainage.

11.8 SCHEDULE FOR CLOSURE [I-1f]

As stated previously, closure of the LLBG will be a complex process. Closure of the various burial grounds that comprise the LLBG is not expected to occur within the next 30 or more years. A disposal strategy document (WHC 1996) addresses the filling sequence of various trenches and provides an estimate as to when a burial ground will be filled. This document, addressing both mixed and low-level waste, is based on waste forecasts and is designed to be modified to account for the constantly changing waste forecasts. The majority of waste identified in this document is low-level only. This document projects to the year 2023.

This closure plan will be updated accordingly to reflect the current closure plan schedule per WAC 173-303-830, Appendix I. In addition, at a time when a closure date is established, a revised closure plan and closure schedule will be submitted to Ecology that contains detailed information regarding specific activities and implementation timeframes.

11.9 EXTENSION FOR CLOSURE [I-1(g)]

An extension for closure of post-August 19, 1987, regulated mixed waste that has been disposed in the various burial grounds (refer to Chapter 1.0) until permit expiration is requested. At that time it is likely that another extension will be requested consistent with the schedule for closure as identified in Section 11.8.

11.10 POSTCLOSURE PLAN [I-3]

Because of the long active life of the LLBG, a comprehensive postclosure plan will be developed when closure becomes imminent.

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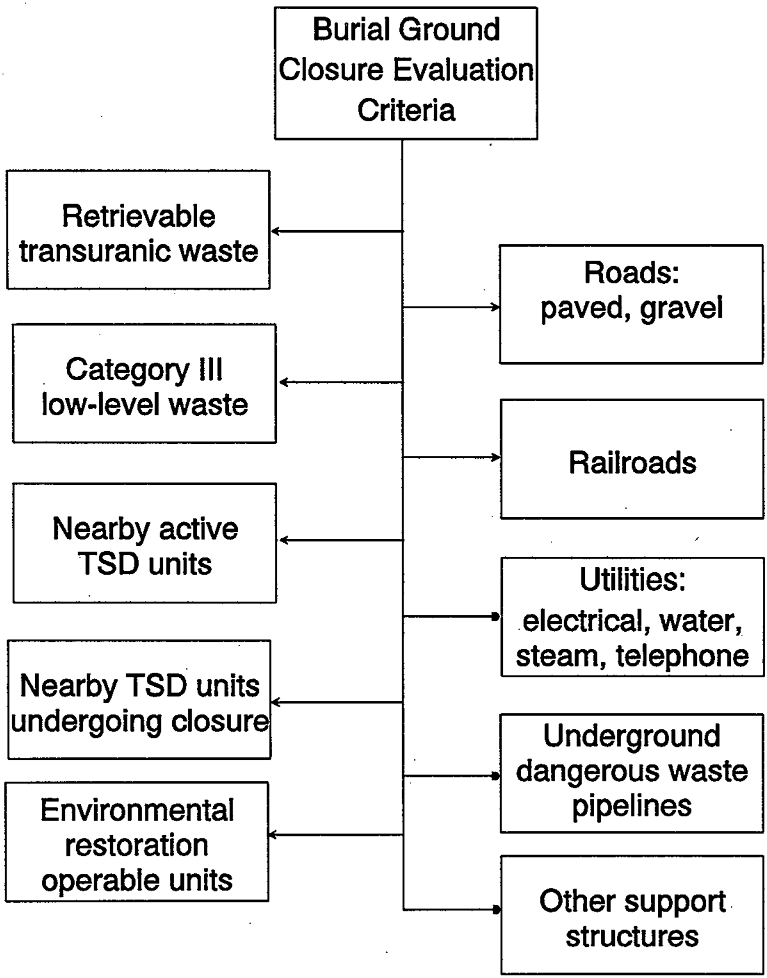


Figure 11-1. Low-Level Burial Grounds Closure Evaluation Process.

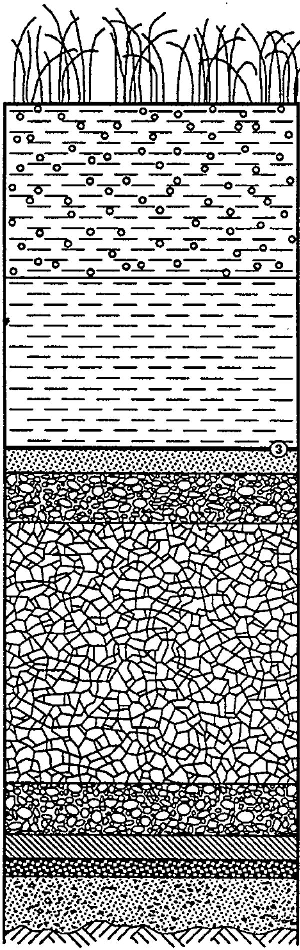
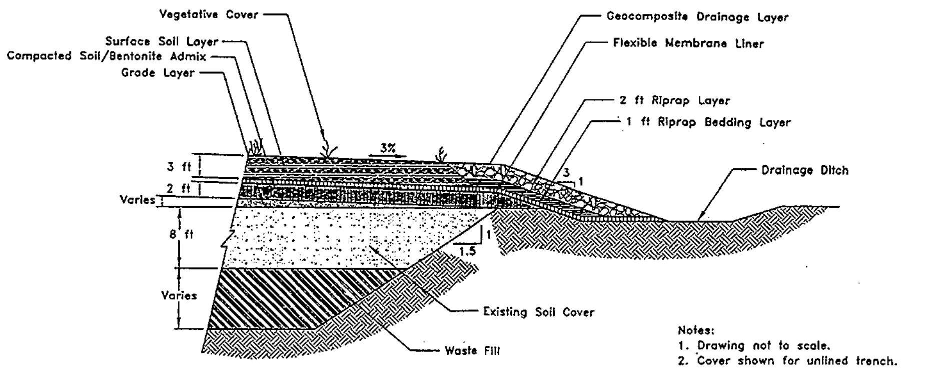


Figure 11-2. Generalized Cross-Section of Landfill Cover.



Note: To convert feet (ft) to meters, multiply by 0.3048.

Figure 11-3. Typical Cross-Section Showing Proposed Sideslope Treatment and Drainage Ditch.

Table 11-1. Potential Interferences/Integration Opportunities With Closure Cap.

Burial ground	Predominant waste received	Land area used as of 01/97 (percent)	Contains retrievable transuranic waste	Contains Category III low-level waste	Active TSD units in vicinity	Operable unit	Roads	Railroads	Utilities	Environmental impacts (affected flora/fauna)
218-E-10	Low-level	60	No	Yes	No	200-BP-10	Akron Avenue 12th Street	Yes	Electrical	TBD
218-E-12B	Low-level, defueled reactor compartments (mixed waste)	20	Yes	Yes	No	200-PO-6	Canton Avenue 12th Street	No	Electrical Telephone	TBD
218-W-3A	Low-level	99	Yes	Yes	218-W-3AE 218-W-5	200-ZP-3	Dayton Avenue 27th Street	No	No	TBD
218-W-3AE	Low-level	30	No	Yes	218-W-3A 218-W-6	200-ZP-3 200-TP-3	27th Street	Yes	No	TBD
218-W-4B	Low-level	100	Yes	No	218-W-4C	200-ZP-3	Dayton Avenue 19th Street	Yes	Electrical	TBD
218-W-4C	Low-level	26	Yes	Yes	218-W-4B	200-ZP-3 200-ZP-1 200-UP-1	Dayton Avenue 16th Street 19th Street	Yes	Pump and treat Electrical	TBD
218-W-5	Low-level, mixed waste	20	No	Yes	218-W-3A WRAP 1	200-ZP-3	Dayton Avenue 23rd Street	No	Electrical Telephone	TBD
218-W-6	Future mixed waste	0	No	No	218-W-3AE	200-ZP-3	27th Street	Yes	Electrical	TBD

Table 11-2. Comparison of Three Surface Soil Geometries.

Design 1	Design 2	Design 3
Layer 1: 101.6 centimeters (Silt/15 % Pea Gravel by volume)	Layer 1: 50.8 centimeters (Silt/15 % Pea Gravel)	Layer 1: 20.32 centimeters (Silt/15 % Pea Gravel)
Layer 2: 101.6 centimeters (Silt)	Layer 2: 101.6 centimeters (Silt)	Layer 2: 71.12 centimeters (Silt)

Table 11-3. Comparison of Calculated Drainage for Three Surface Soil Geometries.

Numerical Model	Design	Treatment	Drainage (centimeters)
UNSAT-H	Design 1	Ambient	0.0
UNSAT-H	Design 1	2X	0.0
UNSAT-H	Design 2	Ambient	0.0
UNSAT-H	Design 2	2X	0.0
UNSAT-H	Design 3	Ambient	0.005
UNSAT-H	Design 3	2X	0.683
HELP	Design 1	Ambient	0.0001
HELP	Design 1	2X	0.0011
HELP	Design 2	Ambient	0.00025
HELP	Design 2	2X	0.299
HELP	Design 3	Ambient	0.0022
HELP	Design 3	2X	0.2872

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12.0 REPORTING AND RECORDKEEPING

Reporting and recordkeeping requirements that could be applicable to the Hanford Facility are described in Chapter 12.0 of the General Information Portion (DOE/RL-91-28). Not all of these requirements and associated reports and records identified in Chapter 12.0 of the General Information Portion are applicable to the LLBG. Those reporting and recordkeeping requirements determined to be applicable to the LLBG are summarized as follows:

- Hanford Facility Contingency Plan and incident records (as identified in the General Information Portion):
  - Immediate reporting
  - Written reporting
  - Shipping paper discrepancy reports.

- Unit-specific Part B permit application documentation and associated plans

- Personnel training records

- Groundwater monitoring records

- Inspection records (unit)

- Onsite transportation documentation

- Land disposal restriction records

- Waste minimization and pollution prevention.

In addition, the following reports prepared for the Hanford Facility will contain input, when appropriate, from the LLBG:

- Quarterly Hanford Facility RCRA Permit modification report
- Anticipated noncompliance
- Required annual reports.

Annual reports updating projections of anticipated costs for closure and postclosure are described in the General Information Portion (DOE/RL-91-28).

The LLBG Operating Record 'records contact' is kept on file in the General Information file of the Hanford Facility Operating Record (refer to DOE/RL-91-28, Chapter 12.0).

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13.0 OTHER FEDERAL AND STATE LAWS [J]

Applicable federal, state, and local laws applicable to the LLBG are discussed in Chapter 13.0 of the General Information Portion (DOE/RL-91-28). Generally, the laws applicable to the LLBG include, but might not be limited to, the following:

Atomic Energy Act of 1954
Federal Facility Compliance Act of 1992
Clean Air Act of 1977
Safe Drinking Water Act of 1974
Emergency Planning and Community Right-to-Know Act of 1986
Toxic Substances Control Act of 1976
National Historic Preservation Act of 1966
Endangered Species Act of 1973
Fish and Wildlife Coordination Act of 1934
Federal Insecticide, Fungicide, and Rodenticide Act of 1975
Hazardous Materials Transportation Act of 1975
National Environmental Policy Act of 1969
Washington Clean Air Act of 1967
Washington Water Pollution Control Act of 1945
Washington Pesticide Control Act of 1971
Model Toxics Control Act
Benton Clean Air Authority Regulation 1
State Environmental Policy Act of 1971.

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14.0 PART B CERTIFICATION [K]

The following certification, required by WAC 173-303-810(13), for all applications and reports submitted to Ecology is hereby included:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Owner/Operator — Date 7/25/97
John D. Wagoner, Manager
U.S. Department of Energy,
Richland Operations Office

Co-operator* — Date 7/24/97
H. J. Hatch,
President and Chief Executive Officer
Fluor Daniel Hanford, Inc.

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* Fluor Daniel Hanford, Inc. is responsible for information presented in Chapters 1.0 through 4.0 and 6.0 through 15.0, including the associated appendices.

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14.0 PART B CERTIFICATION [K]

The following certification, required by WAC 173-303-810(13), for all applications and reports submitted to Ecology is hereby included:

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Owner/Operator
John D. Wagoner, Manager
U.S. Department of Energy,
Richland Operations Office

Date 7/25/97

Co-operator*
W. J. Madia, Director
Pacific Northwest National Laboratory

Date 24 July 1997

* Pacific Northwest National Laboratory is responsible for information presented in Chapter 5.0, including any associated appendices.

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APPENDICES

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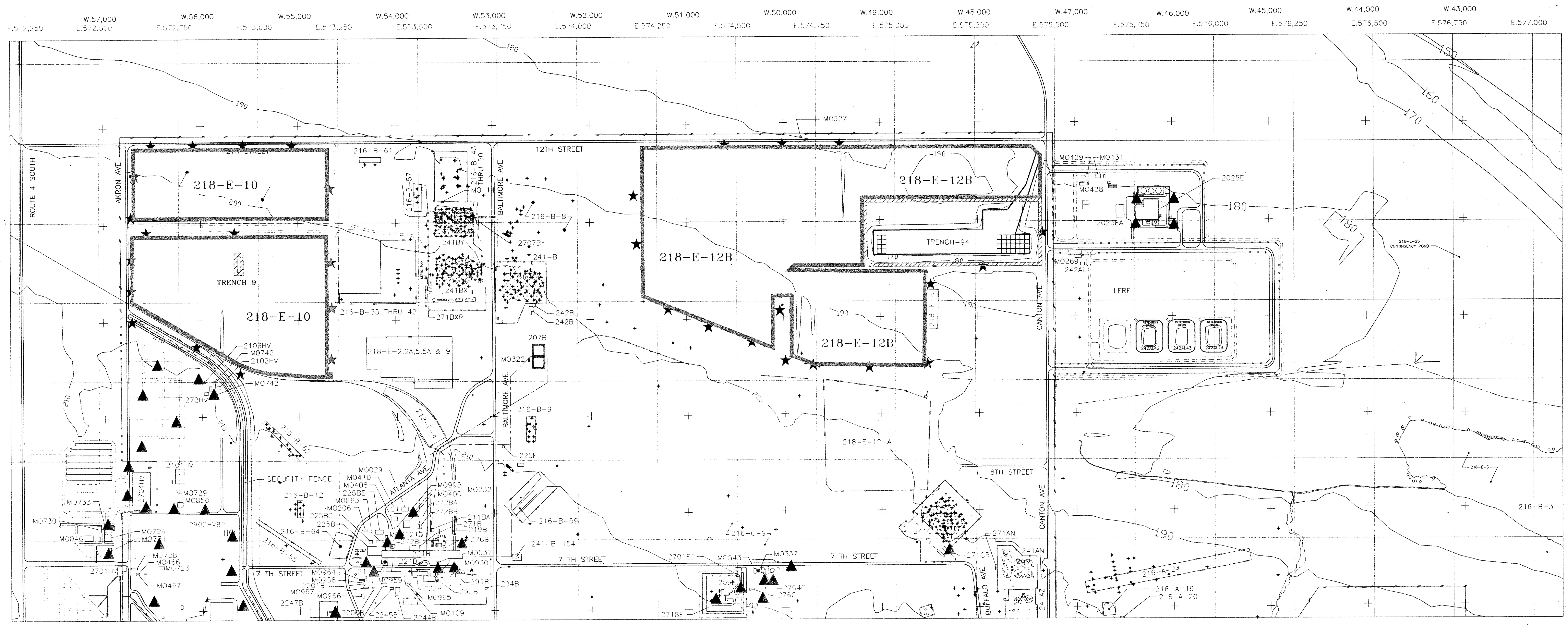
APPENDIX 2A

TOPOGRAPHIC MAPS

APPENDIX 2A

H-13-000259, Rev. 0	200 East Area Low-Level Burial Grounds.
H-13-000260, Rev. 0	200 West Area Low-Level Burial Grounds.



LEGEND

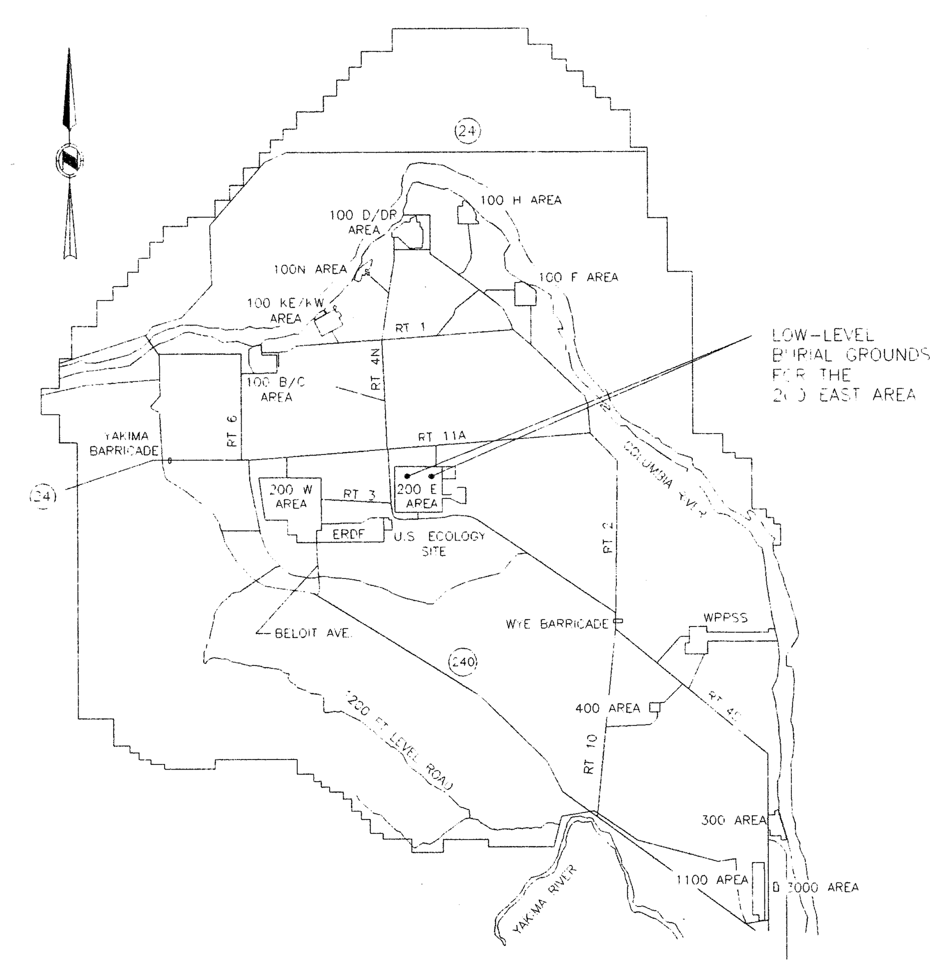
W.47,000 N.43,000	HANFORD PLANT COORDINATES (FEET)
E.576,250 N.136,000	WASHINGTON STATE COORDINATES (METERS)
200	MAJOR CONTOUR (METERS)
	MINOR CONTOUR (METERS)
	IMPROVED ROAD
	UNIMPROVED ROAD
	DIRT ROAD
	SIDEWALKS\PARKING LOTS
	RAILROADS
	RETAINING WALL
	BUILDINGS/STRUCTURES & TOWERS
242A	BUILDING NUMBER
	MOBILE OFFICES
	SECURITY,WARNING,MISC FENCES
	POST & CHAIN (CRIB,BURIAL GROUND FENCES)
	PERIMETER FENCES
	WELL
	TANKS
	PROCESS SEWER
	SANITARY SEWER
216-A-42	CRIB
218-E-10	BURIAL GROUND
	SOLID WASTE MANAGEMENT UNIT (SWMU), TREATMENT, STORAGE, AND/OR DISPOSAL (TSD) UNIT BOUNDARY SEE NOTE 4.
	POST-AUGUST 19, 1987 TSD UNIT BOUNDARY SEE NOTE 4.
	WITHDRAWAL WELL
	INJECTION WELL
	RCRA MONITORING WELLS FOR LLBG
	FIRE HYDRANTS

GENERAL NOTES

1. THIS MAP IS BASED ON AERIAL PHOTOGRAPHY FLOWN ON 6-24-89. THE ORIGINAL TOPOGRAPHIC MAP WAS PREPARED BY MERRICK & COMPANY AND CERTIFIED TO MEET NATIONAL MAP ACCURACY STANDARDS. OFFICIAL COPIES OF THE MERRICK MAPS THAT SHOW THE CERTIFICATE ARE LOCATED IN THE LOCKHEED MARTIN ENGINEERING FILES AS DRAWING NUMBERS H-2-79476 SHEET 1 AND H-2-79477 SHEET 1 THRU 37. NAMES OF ADDITIONAL FEATURES AND THE TITLE BLOCK WERE ADDED BY WESTINGHOUSE HANFORD COMPANY.
2. WASHINGTON STATE PLANE COORDINATE SYSTEM: THE OFFICIAL COORDINATE SYSTEM AS DEFINED BY THE REVISED CODE OF WASHINGTON (RCW). THE HANFORD SITE LIES WITHIN THE WASHINGTON COORDINATE SYSTEM, SOUTH ZONE. THIS GRID COVERS THE ENTIRE SITE AND USES X (EASTINGS) AND Y (NORTHINGS) COORDINATES.

   HORIZONTAL DATUM: NAD-83 LAMBERT PROJECTION. WASHINGTON STATE PLANE COORDINATES ARE SHOWN IN METERS.

   CONTOUR INTERVAL: 2.5 METERS.
3. HANFORD PLANT GRID: A LOCAL GRID SYSTEM WITH ITS INITIAL POINT NORTHEAST OF THE 400 AREA. IT COVERS 200 EAST AND 200 WEST AREA AS WELL AS GENERAL SITE WORK SUCH AS WELLS AND BURIAL GROUNDS. HANFORD COORDINATES ARE SHOWN IN FEET.
4. THE SWMU AND THE POST-AUGUST 19,1987 (TSD) UNIT BOUNDARY COMPRISE THE TSD UNIT BOUNDARY AS IDENTIFIED IN THE HANFORD FACILITY DANGEROUS WASTE PERMIT APPLICATION, LOW-LEVEL BURIAL GROUNDS (DOE/RL-88-20).



KEY PLAN

SCALE: NONE

SITE PLAN

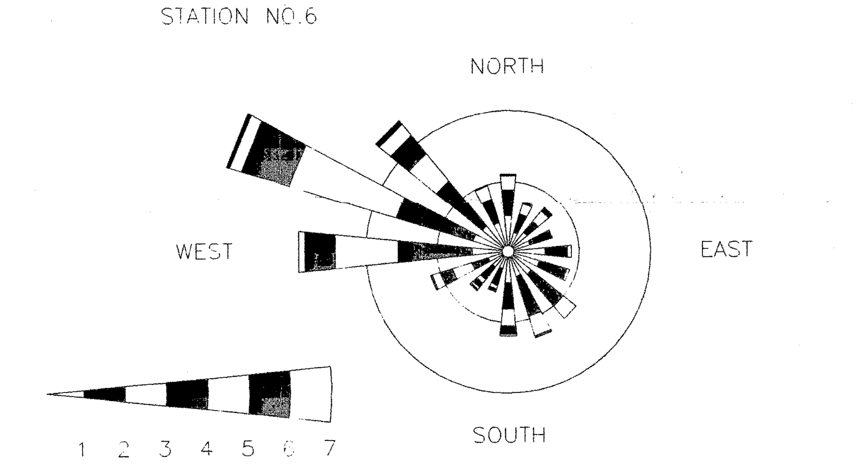
SCALE 1:6000

0 60 120 240 360 480

1 cm = 60 meters

WIND ROSE FOR: 200E AREA
% CALM WINDS = .7
STATION NO.6

PERIOD COVERED
1/1/93 - 12/31/93



PADDLES INDICATE DIRECTION WIND IS COMING FROM.
RADIAL GRIDS REPRESENT 5.0% AND 10.0% OCCURRENCE.

WIND CLASS	MILES/HOUR
1	>1.0 - 3.0
2	4.0 - 7.0
3	8.0 - 12.0
4	13.0 - 18.0
5	19.0 - 24.0
6	25.0 - 31.0
7	32.0 +

WIND ROSE

THIS MAP IS TO BE USED FOR REFERENCE PURPOSES ONLY.
DO NOT USE THIS MAP FOR CONSTRUCTION PURPOSES.

REF NUMBER	TITLE
H-13-000205 THRU H-13-000207	200 AREA TOPOGRAPHIC MAP
H-13-000213 THRU H-13-000216	200 AREA TOPOGRAPHIC MAP
H-13-000221 THRU H-13-000224	200 AREA TOPOGRAPHIC MAP
H-13-000228 THRU H-13-000231	200 AREA TOPOGRAPHIC MAP

REFERENCES

NEXT USED ON H-13-000200

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DRAWN RAFAEL TORRES 4-30-97
DFTG APVD 5/1/97
COG ENGR 5/14/97
APVD 5/13/97

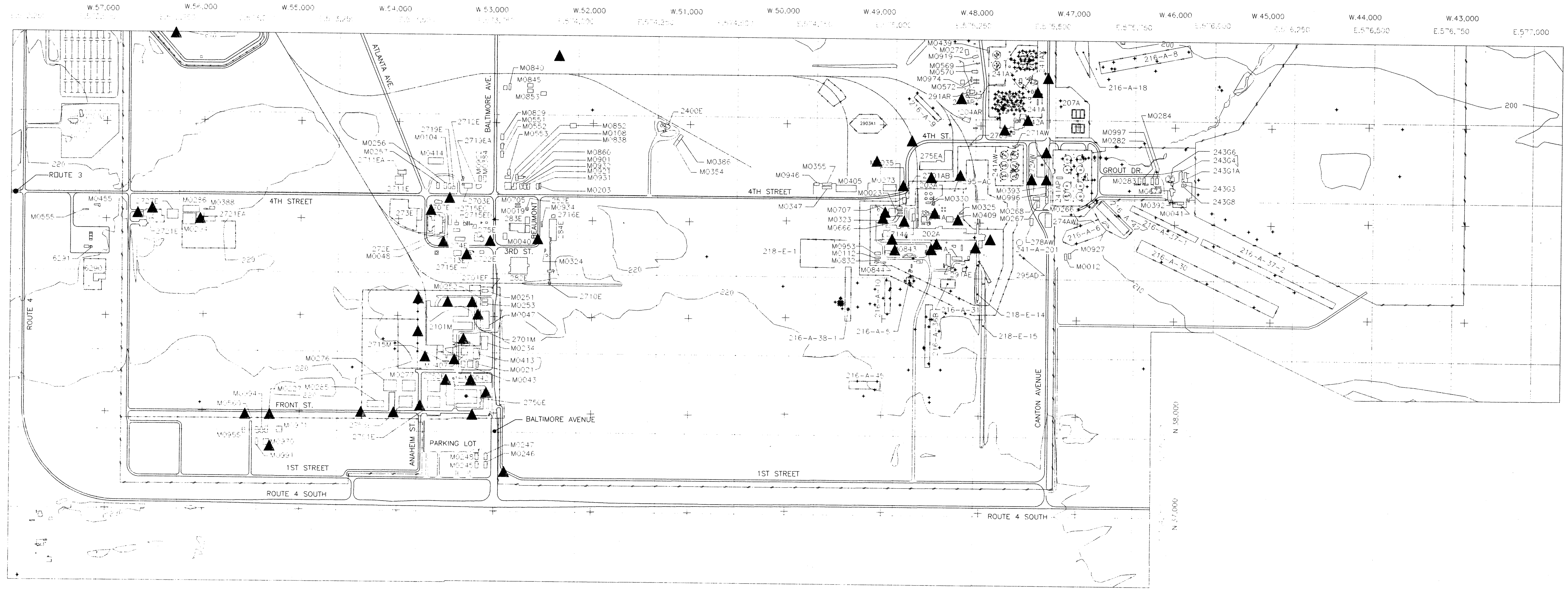
U.S. DEPARTMENT OF ENERGY
Richland Operations Office
Fluor Daniel North West

200 EAST AREA LOW-LEVEL BURIAL GROUND TOPOGRAPHIC MAP

SIZE F | BLDG NO 200E | INDEX NO 0103 | DWG NO H-13-000259 | REV 0
SCALE SHOWN | EDT 614848 | SHEET 1 OF 2

H-13-000259 SHEET 1 OF 2 REV 0

54-6000-027(5/89)



SITE PLAN

SCALE 1:600

1 inch = 50 meters

WIND ROSE

1. FOR WIND ROSE SEE SHEET 1.

GENERAL NOTES

1. FOR GENERAL NOTES AND LEGEND SEE SHEET 1.

THIS MAP IS TO BE USED FOR REFERENCE PURPOSES ONLY. DO NOT USE THIS MAP FOR CONSTRUCTION PURPOSES.

DRAWN	RAFAEL TORRES 4-30-97
CHECKED	
DFTG APVD	
COG ENGR	5/1/97
APVD	5/1/97
APVD	5/13/97
APVD	5/13/97

U.S. DEPARTMENT OF ENERGY
Richland Operations Office
Fluor Daniel North West

200 EAST AREA LOW-LEVEL BURIAL GROUND TOPOGRAPHIC MAP

SIZE	BLDG NO	INDEX NO	DWG NO	REV
F	200E	0103	H-13-000259	0

SCALE SHOWN — EDT 614848 — SHEET 2 OF 2

DWG NO	TITLE
DRAWING TRACEABILITY LIST	

REF NUMBER	TITLE
REFERENCES	
NEXT USED ON	H-13-000200

REV	DESCRIPTION	REV BY DATE	CHK BY DATE	DFTG APVD DATE	COG ENGR	OTHER	OTHER

REVISIONS — APPROVALS BY/DATE

CADFILE N000259B — CADCODE DOS:6.0:ACD2:12.0:SS

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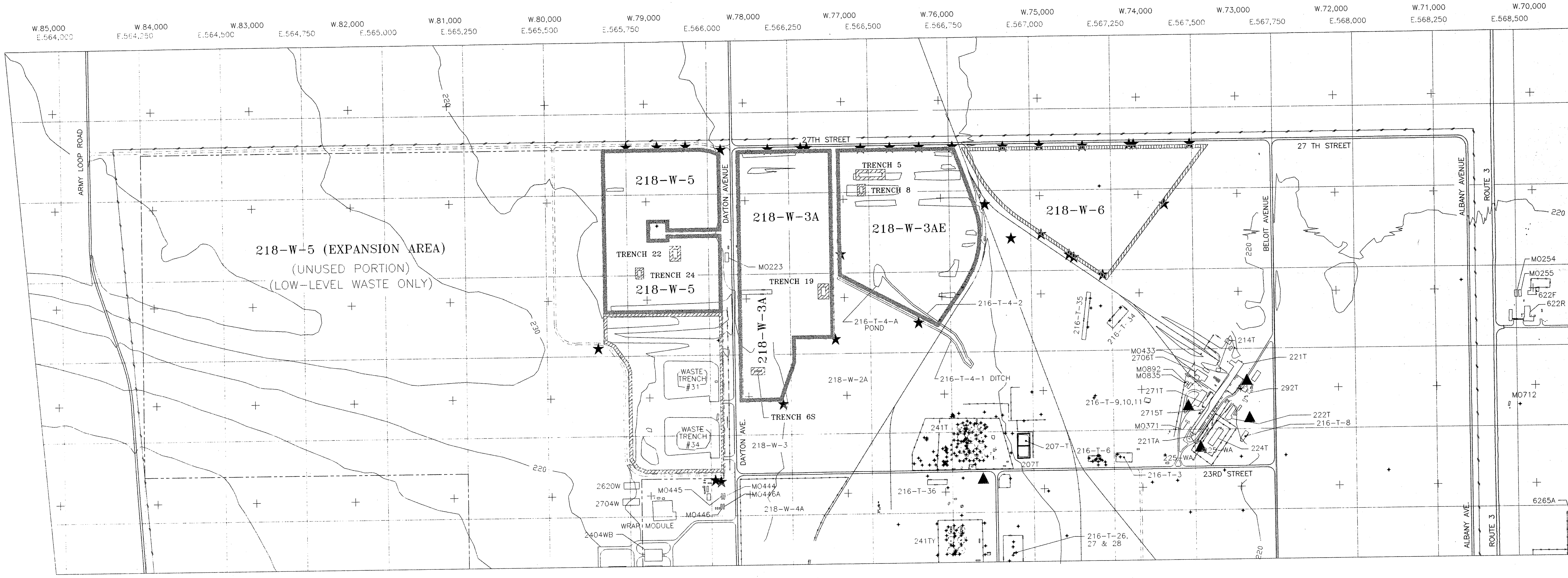


SITE PLAN

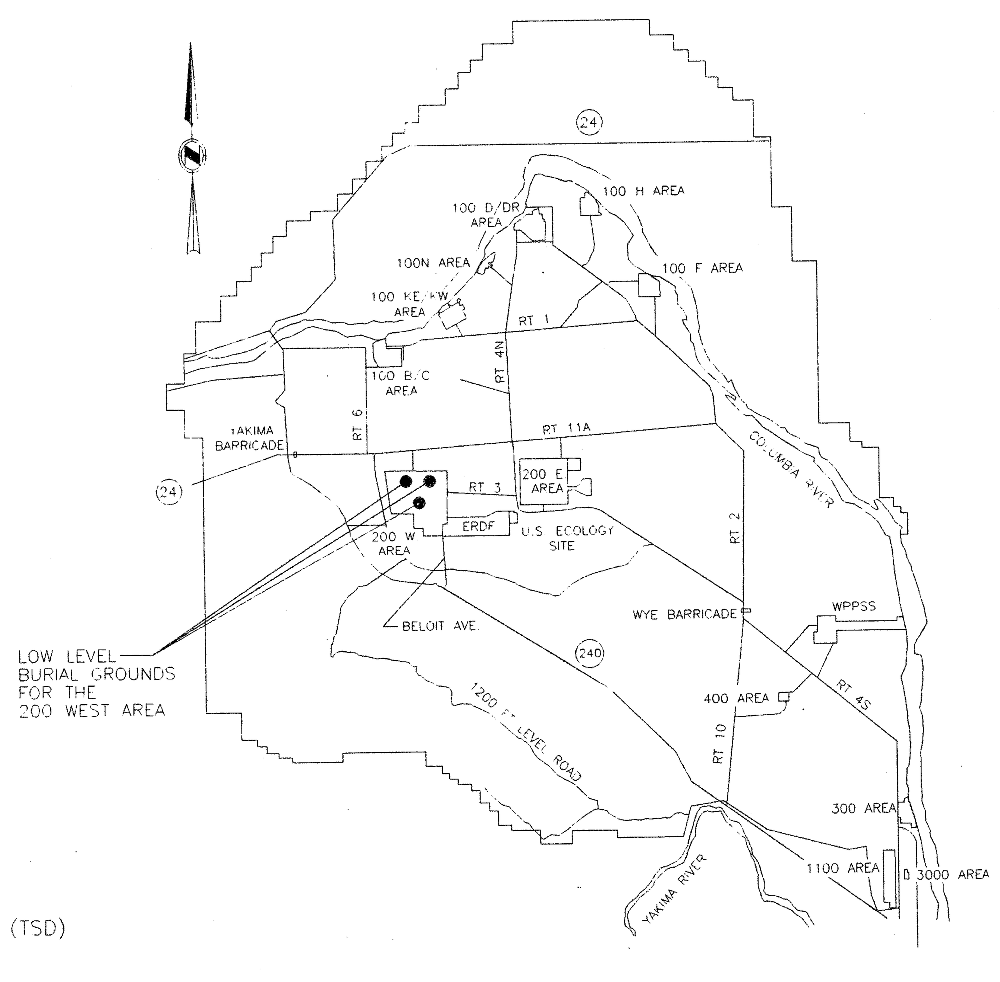
SCALE 1:6000

0 60 120 240 360 480

1 cm = 60 meters

LEGEND

- W.47,000 / N.43,000 — HANFORD PLANT COORDINATES (FEET)
- E.576,250 / N.136,000 — WASHINGTON STATE COORDINATES (METERS)
- INDEX CONTOUR (METERS)
- INDEX CONTOUR (METERS)
- IMPROVED ROAD
- UNIMPROVED ROAD
- DIRT ROAD
- SIDEWALKS\PARKING LOTS
- RAILROADS
- RETAINING WALL
- BUILDINGS/STRUCTURES & TOWERS
- 224-T — BUILDING NUMBER
- MOBILE OFFICES
- SECURITY,WARNING,MISC FENCES
- POST & CHAIN (CRIB,BURIAL GROUND FENCES)
- PERIMETER FENCES
- WELL
- TANKS
- 216-A-42 — CRIB
- 218-W-5 — BURIAL GROUND
- SOLID WASTE MANAGEMENT UNIT (SWMU), TREATMENT, STORAGE, AND/OR DISPOSAL (TSD) UNIT BOUNDARY. SEE NOTE 5.
- POST-AUGUST 19, 1987 TSD UNIT BOUNDARY SEE NOTE 5.
- BURIAL GROUND BOUNDARY
- WITHDRAWAL WELL
- INJECTION WELL
- RCRA MONITORING WELLS FOR LLBG
- FIRE HYDRANTS



KEY PLAN

SCALE: NONE

GENERAL NOTES

1. THIS MAP IS BASED ON AERIAL PHOTOGRAPHY FLOWN ON 6-24-89. THE ORIGINAL TOPOGRAPHIC MAP WAS PREPARED BY MERRICK & COMPANY AND CERTIFIED TO MEET NATIONAL MAP ACCURACY STANDARDS. OFFICIAL COPIES OF THE MERRICK MAPS THAT SHOW THE CERTIFICATE ARE LOCATED IN THE LOCKHEED MARTIN ENGINEERING FILES AS DRAWING NUMBERS H-2-79476 SHEET 1 AND H-2-79477 SHEET 1 THRU 37. NAMES OF ADDITIONAL FEATURES AND THE TITLE BLOCK WERE ADDED BY WESTINGHOUSE HANFORD COMPANY.

2. WASHINGTON STATE PLANE COORDINATE SYSTEM: THE OFFICIAL COORDINATE SYSTEM AS DEFINED BY THE REVISED CODE OF WASHINGTON (RCW). THE HANFORD SITE LIES WITHIN THE WASHINGTON COORDINATE SYSTEM, SOUTH ZONE. THIS GRID COVERS THE ENTIRE SITE AND USES X (EASTINGS) AND Y (NORTHINGS) COORDINATES.

   HORIZONTAL DATUM: NAD-83 LAMBERT PROJECTION. WASHINGTON STATE PLANE COORDINATES ARE SHOWN IN METERS.

   CONTOUR INTERVAL: 2.5 METERS.

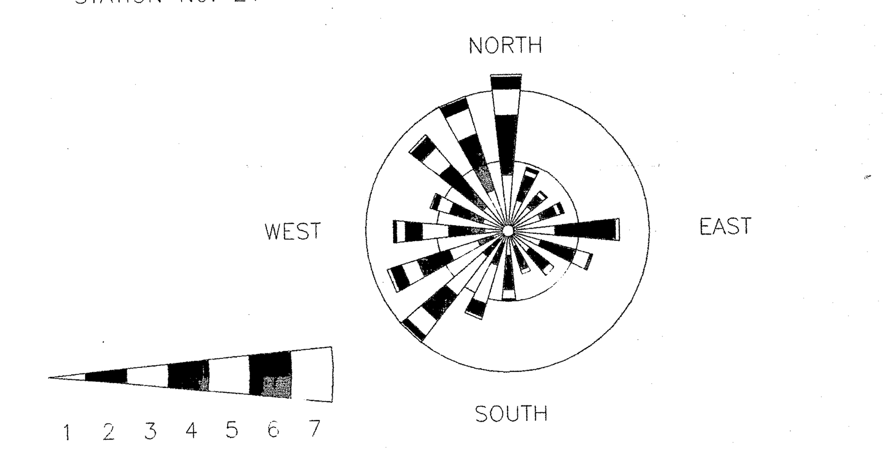
3. HANFORD PLANT GRID: A LOCAL GRID SYSTEM WITH ITS INITIAL POINT NORTHEAST OF THE 400 AREA. IT COVERS 200 EAST AND 200 WEST AREA AS WELL AS GENERAL SITE WORK SUCH AS WELLS AND BURIAL GROUNDS. HANFORD COORDINATES ARE SHOWN IN FEET.

4. 218-W-5 EXPANSION AREA IS IDENTIFIED IN THE ENGINEERING SUPPORT DATA UPDATE FOR THE HANFORD DEFENSE WASTE ENVIRONMENTAL IMPACT STATEMENT, RHD-RE-ST-30 ADD P, 1980, RICHLAND, WASHINGTON.

5. THE SWMU AND THE POST-AUGUST 19,1987 TSD UNIT BOUNDARY COMPRISE THE TSD UNIT BOUNDARY AS IDENTIFIED IN THE HANFORD FACILITY DANGEROUS WASTE PERMIT APPLICATION, LOW-LEVEL BURIAL GROUNDS (DOE/RL-88-20).

WIND ROSE FOR: HANFORD MET STATION
% CALM WINDS = .5
STATION NO. 21

PERIOD COVERED
1/1/93 - 12/31/93



PADDLES INDICATE DIRECTION WIND IS COMING FROM.
RADIAL GRIDS REPRESENT 5.0% AND 10.0% OCCURRENCE.

WIND CLASS	MILES/HOUR
1	>1.0 - 3.0
2	4.0 - 7.0
3	8.0 - 12.0
4	13.0 - 18.0
5	19.0 - 24.0
6	25.0 - 31.0
7	32.0 +

WIND ROSE

MAY 20 1997 ... 37 ... (20)

THIS MAP IS TO BE USED FOR REFERENCE PURPOSES ONLY.
DO NOT USE THIS MAP FOR CONSTRUCTION PURPOSES.

REF NUMBER	TITLE
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H-13-000209 THRU H-13-000211	200 AREA TOPOGRAPHIC MAP
H-13-000217 THRU H-13-000219	200 AREA TOPOGRAPHIC MAP
H-13-000225 THRU H-13-000227	200 AREA TOPOGRAPHIC MAP
H-13-000233 H-13-000234	200 AREA TOPOGRAPHIC MAP
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REVISIONS — REV NO / DESCRIPTION / REV BY DATE / CHK BY DATE / DFTG APVD DATE / COG ENGR / OTHER / OTHER — APPROVALS BY/DATE

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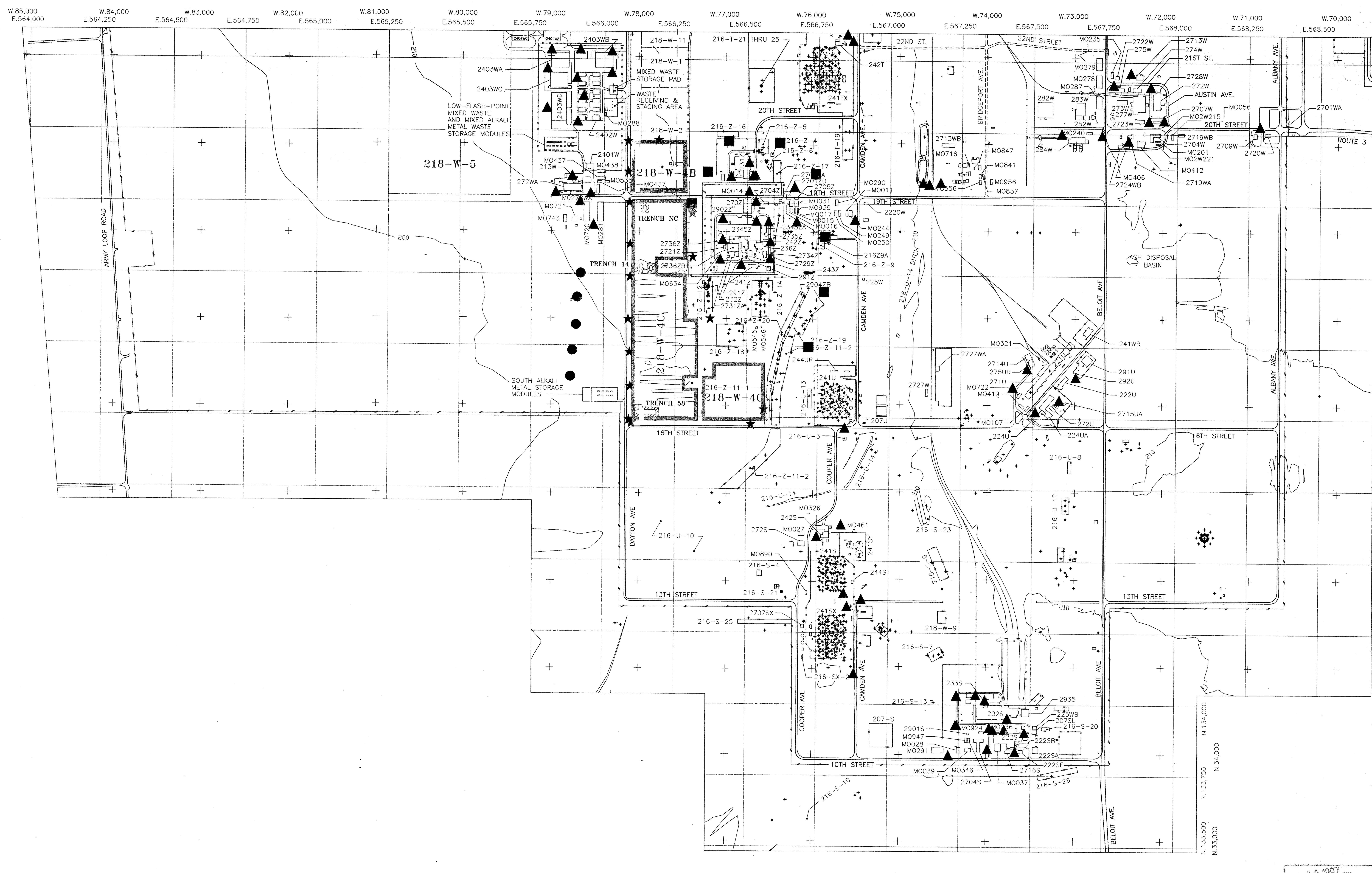
CHECKED 4/5/97
DFTG APVD 4/5/97
COG ENGR 5/14/97
APVD 5/13/97
APVD 5/13/97
APVD 5/13/97

U.S. DEPARTMENT OF ENERGY
Richland Operations Office
Fluor Daniel North West

200 WEST AREA LOW-LEVEL BURIAL GROUND TOPOGRAPHICAL MAP

SIZE F — BLDG NO 200W — INDEX NO 0103 — DWG NO H-13-000260 — REV 0
SCALE SHOWN — EDT 614849 — SHEET 1 OF 2

DWG NO H-13-000260 SH 1 of 2 REV 0



SITE PLAN

SCALE: 1:6000

0 60 120 240 360 480

1 cm = 60 meters

GENERAL NOTES

1. FOR GENERAL NOTES SEE SHEET 1.

THIS MAP IS TO BE USED FOR REFERENCE PURPOSES ONLY. DO NOT USE THIS MAP FOR CONSTRUCTION PURPOSES.

U.S. DEPARTMENT OF ENERGY
Richland Operations Office
Fluor Daniel North West

200 WEST AREA
LOW-LEVEL BURIAL GROUND
TOPOGRAPHICAL MAP

DRAWN RAFAEL TORRES 5-7-97

DWG NO	TITLE
DRAWING TRACEABILITY LIST	

REF NUMBER	TITLE
REFERENCES	
NEXT USED ON	H-13-000200

REVISIONS

CADFILE N000260B CADCODE DOS:6.0:AC02:12.0:SS

SIZE F BLDG NO 200W INDEX NO 0103 DWG NO H-13-000260 REV 0

SCALE: SHOWN ECN 614849 SHEET 2 OF 2

54-6000-027(5/89)

APPENDIX 3A

WASTE ANALYSIS PLAN FOR LOW-LEVEL BURIAL GROUNDS

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CONTENTS

CONTENTS (cont)

FIGURES

TABLES

GLOSSARY

ALARA	as low as reasonably achievable
AWMP	alternative waste management plan
CAP	corrective action plan
COLIWASA	composite liquid waste sampler
CFR	Code of Federal Regulations
CWC	Central Waste Complex
DOE-RL	U.S. Department of Energy, Richland Operations Office
Ecology	Washington State Department of Ecology
HF	Hanford Facility
LDR	land disposal restriction
LLBG	Low-Level Burial Grounds
MSDS	material safety data sheet
PCB	polychlorinated biphenyl
PES	performance evaluation system
pH	negative concentration logarithm of the hydrogen-ion concentration
QA/QC	quality assurance and quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
RCW	Revised Code of Washington
RTR	real-time radiography
SWITS	solid waste information tracking system
SWMU	solid waste management unit
TRU	transuranic
WAC	Washington Administrative Code
WAP	waste analysis plan
WRAP 1	Waste Receiving and Processing 1
WSRd	waste specification record
°C	degrees Celsius

METRIC CONVERSION CHART

The following conversion chart is provided to the reader as a tool to aid in conversion.

Into metric units | Out of metric units

If you know	Multiply by	To get	If you know	Multiply by	To get
Length			**Length**		
inches	25.40	millimeters	millimeters	0.0393	inches
inches	2.54	centimeters	centimeters	0.393	inches
feet	0.3048	meters	meters	3.2808	feet
yards	0.914	meters	meters	1.09	yards
miles	1.609	kilometers	kilometers	0.62	miles
Area			**Area**		
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.092	square meters	square meters	10.7639	square feet
square yards	0.836	square meters	square meters	1.20	square yards
square miles	2.59	square kilometers	square kilometers	0.39	square miles
acres	0.404	hectares	hectares	2.471	acres
Mass (weight)			**Mass (weight)**		
ounces	28.35	grams	grams	0.0352	ounces
pounds	0.453	kilograms	kilograms	2.2046	pounds
short ton	0.907	metric ton	metric ton	1.10	short ton
Volume			**Volume**		
fluid ounces	29.57	milliliters	milliliters	0.03	fluid ounces
quarts	0.95	liters	liters	1.057	quarts
gallons	3.79	liters	liters	0.26	gallons
cubic feet	0.03	cubic meters	cubic meters	35.3147	cubic feet
cubic yards	0.76	cubic meters	cubic meters	1.308	cubic yards
Temperature			**Temperature**		
Fahrenheit	subtract 32 then multiply by 5/9ths	Celsius	Celsius	multiply by 9/5ths, then add 32	Fahrenheit

Source: *Engineering Unit Conversions*, M. R. Lindeburg, PE., Second Ed., 1990, Professional Publications, Inc., Belmont, California.

1.0 UNIT DESCRIPTION

The purpose of this waste analysis plan (WAP) is to document the waste acceptance process, sampling methodologies, analytical techniques, and overall processes that are undertaken for waste accepted for disposal at the Low-Level Burial Grounds (LLBG), which are located in the 200 East and 200 West Areas of the Hanford Facility, Richland, Washington. Because dangerous waste does not include the source, special nuclear, and by-product material components of mixed waste, radionuclides are not within the scope of this documentation. The information on radionuclides is provided only for general knowledge. The LLBG also receive low-level radioactive waste for disposal. The requirements of this WAP are not applicable to this low-level waste.

1.1 DESCRIPTION OF PROCESSES AND ACTIVITIES

The LLBG are a land-based unit consisting of eight burial grounds located in the 200 East Area and 200 West Area. Seven of the eight burial grounds (218-E-10, 218-E-12B, 218-W-3A, 218-W-3AE, 218-W-4C, 218-W-5, and 218-W-6) are, or will be, used for the disposal of mixed waste and are subject to *Dangerous Waste Regulations*, Washington Administrative Code (WAC) 173-303. One burial ground (218-W-4B) is designated as a solid waste management unit (SWMU) (Figures 1-1 and 1-2).

The 218-E-10, 218-E-12B, 218-W-3A, 218-W-3AE, 218-W-4C, and 218-W-6 Burial Grounds are classified as landfills and the 218-W-5 Burial Ground is classified as a landfill and for greater-than-90-day container storage. The regulated portions of the LLBG cover a total area of approximately 49 hectares.

The 218-E-10 and 218-E-12B Burial Grounds are located in the 200 East Area. The 218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-5, and 218-W-6 Burial Grounds are located in the 200 West Area. The LLBG consist of various sizes and depths of lined and unlined disposal trenches. All mixed waste destined for disposal will meet land disposal restriction (LDR) requirements [WAC 173-303-140 and 40 Code of Federal Regulations (CFR) 268] or other regulatory alternatives. The lined trenches have leachate collection and removal systems. The less-than-90-day leachate collection tanks are operated in accordance with the generator provisions of WAC 173-303-200 and are not subject to this WAP.

Future trench development and configuration within a burial ground are subject to change as disposal techniques improve or as waste management needs dictate and will be subject to an approved permit modification in accordance with the Hanford Facility (HF) *Resource Conservation and Recovery Act* (RCRA) *of 1976* Permit (Ecology 1994). Mixed waste is disposed in lined or in unlined trenches in accordance with applicable LDR requirements.

The following provides a brief description and identifies the generic types of waste disposed in the LLBG. An electronic database, which can be found within the LLBG operating organization, is maintained that documents each waste receipt, type of waste, and disposal location.

- The 218-E-10 Burial Ground (Figure 1-3) is approximately 36.1 hectares in size and began receiving waste in 1960. Examples of waste placed in this burial ground include failed equipment, rags, paper, rubber gloves, disposable supplies, broken tools, and post-August 19, 1987 RCRA and state-only designated mixed waste.

- The 218-E-12B Burial Ground (Figure 1-4) is approximately 68 hectares in size and began receiving waste in 1967. Examples of waste placed in this burial ground include defueled reactor compartments (trench 94), low-level waste, and retrievable transuranic waste.

- The 218-W-3A Burial Ground (Figure 1-5) is approximately 20.4 hectares in size and began receiving waste in 1970. Examples of waste placed in this burial ground include ion exchange resins, failed equipment, tanks, pumps, ovens, agitators, heaters, hoods, jumpers, vehicles, accessories and post-August 19, 1987 RCRA and state-only designated mixed waste, and retrievable transuranic waste.

- The 218-W-3AE Burial Ground (Figure 1-6) is approximately 20 hectares in size and began receiving waste in 1981. Examples of waste placed in this burial ground include rags, paper, rubber gloves, disposable supplies, broken tools, and post-August 19, 1987 RCRA and state-only designated mixed waste.

- The 218-W-4B Burial Ground (Figure 1-7) is approximately 3.5 hectares in size and began receiving waste in 1968. Examples of waste placed in this burial ground include rags, paper, rubber gloves, disposable supplies, broken tools, alpha caissons, and retrievable transuranic waste.

- The 218-W-4C Burial Ground (Figure 1-8) is approximately 20 hectares in size and began receiving waste in 1978. Examples of waste placed in this burial ground include contaminated soil, decommissioned pumps, pressure vessels, and post-August 19, 1987 RCRA and state-only designated mixed waste, and retrievable transuranic waste.

- The 218-W-5 Burial Ground (Figure 1-9) is approximately 37.2 hectares in size and began receiving waste in 1986. Examples of waste placed in this burial ground include rags, paper, rubber gloves, disposable supplies, broken tools, and post-August 19, 1987 RCRA and state-only designated mixed waste. This burial ground currently contains double-lined mixed waste trenches (trenches 31 and 34) (Figure 1-10). Trenches 31 and 34 also are designated as greater-than-90-day container storage. Waste placed in trenches 31 and 34 for storage purposes and eventual disposal predominately is macro-encapsulated long-length contaminated equipment and other containerized waste treated to meet LDR requirements. Adjacent to the double-lined mixed waste trenches are leachate collection tanks operated in accordance with the generator provisions of WAC 173-303-200. Examples of waste to be placed in the double-lined mixed waste trenches include mixed waste that has been treated to meet LDR requirements (including containerized bulk waste), macro-encapsulated long-length contaminated equipment, etc.

- The 218-W-6 Burial Ground (Figure 1-11) is approximately 16 hectares in size, has not received any waste, and is reserved for future mixed waste disposal.

1.1.1 How Waste is Accepted, Moved, Processed, and Managed

The following sections describe the different types of information and knowledge for waste acceptance. The movement, processing, and management of waste at the LLBG is described in Chapter 4.0 of the *Hanford Facility Dangerous Waste Permit Application, Low-Level Burial Grounds* (DOE/RL-88-20).

1.1.1.1 Narrative Process Descriptions. The LLBG currently accepts mixed waste. All mixed waste is disposed in lined mixed waste trenches or other approved alternatives. Waste accepted either can be containerized or bulk solids. Typical onsite generating units include research laboratories, and chemical and nuclear reprocessing units. Waste also is accepted from decommissioning of structures, waste retrieval and cleanup, waste sampling, etc. Typical offsite generators include research laboratories, chemical and nuclear processing plants, test sites, etc. The onsite generating unit, offsite generator, treatment, storage, and/or disposal unit transferring waste to the LLBG will be hereafter referred to as the 'generator'.

Mixed waste that meets LDR requirements, as specified in 40 CFR 268 and WAC 173-303-140, is disposed in lined trenches with leachate collection and removal systems. The Hanford Facility is required to test certain mixed waste depending on the type of treatment standard to ensure that the waste or treatment residuals are in compliance with applicable LDR. Such testing is performed according to the frequency specified in this WAP.

Two types of mixed waste are disposed in the LLBG under exemption allowed by WAC 173-303-806: remote-handled mixed waste and other waste (e.g., defueled reactor compartments; refer to DOE/RL-88-20, Appendix 4D).

1.1.1.2 Types of Acceptable Knowledge. When collecting documentation on a waste stream or container, the LLBG operating organization must determine if the information provided by the generator is acceptable knowledge. Acceptable knowledge requirements could be met using the following types of information:

- Mass balance from a controlled process
- Material safety data sheet (MSDS) on unused chemical products
- Test data from a surrogate sample
- Analytical data on the waste or a waste from a similar process

- A combination of two or more of the following:
  - Interview information
  - Logbooks
  - Procurement records
  - Validated analytical data
  - Radiation dose rate profiles
  - Procedures and/or methods
  - Process flow charts
  - Inventory sheets
  - Vendor information
  - Mass balance from an uncontrolled process (e.g., spill cleanup)
  - Mass balance from a process with variable inputs and outputs (e.g., washing/cleaning methods).

If the information is sufficient to quantify constituents and/or characteristics as required by the regulations and unit specific acceptance criteria, the information is acceptable knowledge.

1.1.1.3 Description of Waste Profile System. The performance evaluation system (PES) is used to determine initial physical screening frequency of the generator. The PES provides a periodic status of an individual generator's performance for waste received. Also, the PES provides a mechanism for determining corrective actions and physical screening frequency adjustments when a problem has been discovered after waste has arrived at the LLBG.

1.1.1.3.1 Initial Physical Screening Frequency Determination. The initial physical screening frequency determination is based on the following general process.

- The LLBG operating organization reviews the waste profile information to determine if there is any misdesignated or inappropriately segregated waste. Based on this review, the LLBG operating organization identifies any concerns associated with the following:
  - documented waste management program
  - waste stream characterization information
  - potential for inappropriate segregation.

- Based on the identification of concerns during the review, the LLBG operating organization establishes an initial physical screening frequency for the new waste stream(s).

1.1.1.3.2 Monthly Performance Evaluation. The monthly performance evaluation is used to trend generator performance on a programmatic basis and is used to adjust the overall physical screening frequency. However, only a portion of the general waste streams could be affected by the monthly performance evaluation if substantial documentation can be provided to demonstrate that one or more general waste streams will not exhibit similar problems.

Conformance issues are documented during the pre-shipment review and/or verification. These conformance issues are tracked on a conformance report. The conformance report is used to complete the generator evaluation worksheet

(Figure 1-12). A generator receiving a score of 10 or greater has demonstrated less than satisfactory performance, and must be evaluated for corrective action determination.

1.1.1.3.3 Conformance Issue Resolution. Conformance issues identified during verification might result in a waste container that does not meet the LLBG waste acceptance criteria. If a possible conformance issue is identified, the following steps are taken to resolve the issue.

- LLBG operating organization personnel compile all information concerning the possible conformance issue(s).
- The generator is notified and requested to supply additional information to assist in the resolution of the issue(s). If the generator-supplied information resolves the issue(s), no further action is required.
- On resolution of the initial conformance issue, the generator provides a corrective action plan (CAP) that clearly states the reason for the failure and describes the actions to be completed to prevent a reoccurrence.
- The LLBG operating organization reviews the CAP and waste stream justification for adequacy.
- If a CAP is determined to be inadequate, the generator remains at a physical screening rate set by the LLBG operating organization.

1.1.2 Process for Reducing the Physical Screening Frequency

After a generator's frequency has been adjusted (e.g., poor performance or following initial frequency) the physical screening frequency can be reduced in accordance with the following criteria:

- The physical screening frequency is stepped down in a minimum of two steps based on the ability of the generator to quickly implement their CAP or demonstrate their ability to appropriately manage waste (as applicable)
- The reduction is determined during the monthly evaluation process; however, the following minimum criteria must be met before the reduction of the frequency:
  - Five containers from the streams in question must pass verification
  - The LLBG operating organization believes that there is adequate evidence that the CAP or new generator's waste management program has been implemented and is effective.

  NOTE: The LLBG operating organization could perform a generator visit to obtain documentation that the CAP has been fully implemented.

If the frequency was adjusted based on conformance issues, the CAP must be fully implemented before the generator is allowed to return to the minimum physical screening frequency.

1.1.3 Process Flow Diagram

Refer to Figure 1-13 for LLBG waste analysis plan flowchart.

1.1.4 Operating Conditions and Process Constraints

The following sections discuss the operating conditions and process constraints for the LLBG.

1.1.4.1 Operating Conditions. For information determined to be 'acceptable knowledge', the LLBG operating organization must determine if the information is adequate for management of the waste at the LLBG. Adequate acceptable knowledge is based on (1) general waste knowledge requirements, (2) LDR waste knowledge requirements, and (3) waste knowledge exceptions.

1.1.4.1.1 General Waste Knowledge Requirements. At a minimum, the generator must supply enough information for the waste to be managed at the LLBG. The minimum level of acceptable knowledge consists of designation data where the toxic constituents causing a waste number to be assigned are quantified and data are provided to address any operational parameters necessary for proper management of the waste in the LLBG.

1.1.4.1.2 Land Disposal Restriction Information Requirements. Waste can be placed in the LLBG only if the waste meets all applicable treatment standards. The LLBG operating record contains all information required to document that the appropriate treatment standards have been met. For waste that does not meet all applicable treatment standards, the waste is transferred to another TSD unit for proper disposition.

For the purposes of this WAP, only one representative sample is required to demonstrate compliance with a concentration-based treatment standard and the corroborative testing for the sample could be accomplished in the following manner.

- Generators could use onsite laboratories or offsite contract laboratories and must certify that the waste meets LDR requirements. The LLBG operating organization will use these analytical data to meet the requirements found in 40 CFR 268.7 and WAC 173-303-140(4).

- Generators could use an independent laboratory (independent meaning not part of the generator's management structure; contract laboratories are acceptable), or send a sample to the Hanford Site for laboratory testing. The generator must certify the waste meets LDR requirements.

1.1.4.1.3 **Waste Knowledge Exceptions.** The following waste knowledge exceptions have been developed to account for those instances when the generator cannot meet the general waste knowledge and LDR waste knowledge requirements of this WAP.

- Hazardous debris, as defined in WAC 173-303-040, that is managed in accordance with 40 CFR 268.45 (Debris Rule) is not required to be sampled. Management of debris in this manner does not depend on the quantification of constituents to meet federal and state-only LDR regulations. Hazardous debris meeting treatment standards in accordance with 40 CFR 268.45 also meets any state-only LDR in WAC 173-303-140(4).

- Waste that is retrieved from the LLBG could be transferred to an onsite TSD storage unit with only the necessary information to properly manage the waste at the unit.

Other exceptions should be brought to the attention of the LLBG operating organization for appropriate disposition.

1.1.4.2 **Process Constraints.** The process constraints for the LLBG consist of the following:

- Defining whether there is acceptable knowledge
- Acceptable knowledge is adequate for disposal
- Waste meets LLBG safety criteria [e.g., as low as reasonably achievable (ALARA) concerns, etc.].

1.2 IDENTIFICATION AND CLASSIFICATION OF WASTE

Mixed waste is acceptable for disposal in the LLBG except for the following waste types.

- Waste is not accepted for disposal when the waste contains free-standing liquid unless all free-standing liquid:

  - Has been removed by decanting, or other methods
  - Has been mixed with sorbent or stabilized (solidified) so that free-standing liquid is no longer observed
  - Has been otherwise eliminated
  - Container is very small, such as an ampule
  - Container is a labpack and is disposed in accordance with WAC 173-303-161 or 40 CFR 264.316
  - Is less than 1 percent of the volume of the waste or if the sorbent to potential liquid waste ratio is greater than 2 to 1.

  Free liquid is determined by SW-846, Method 9095 (Paint Filter Liquids Test) [WAC 173-303-140(4)(b) and 40 CFR 264.314(d)] only for waste that has the potential for free liquid formation.

- Gaseous waste is not accepted for disposal if the waste is packaged at a pressure in excess of 1.5 atmospheres at 20°C.

- Pyrophoric waste is not accepted for disposal. Waste containing less than 1 weight percent pyrophoric material partially or completely dispersed in each package is not considered pyrophoric for the purposes of this requirement.

- Solid acid waste is not accepted for disposal (WAC 173-303-140(4)(c)).

- Untreated mixed waste with greater than 10 percent dangerous organic/carbonaceous constituents is not accepted for disposal [WAC 173-303-140(4)(d)]. Paper, sawdust, wood, and other similar carbon-to-carbon bonded debris matrix items are not considered organic/carbonaceous constituents.

- Waste not meeting the applicable treatment standards is not accepted for disposal [40 CFR 268 and WAC 173-303-140(4)].

Untreated extremely hazardous waste is not accepted for disposal. Extremely hazardous waste that has been treated could be disposed in accordance with the Revised Code of Washington (RCW) 70.105.050(2). Mixed waste with constituents that could result in loss of liner integrity is not accepted in the LLBG. Table 1-1 provides a list of chemicals that have been shown to be incompatible with the liner (DOE/RL-88-20). Mixed waste with chemical constituents other than heavy metals, heavy metal salts, or those listed in Table 1-1 are evaluated on a case-by-case basis.

1.2.1 Dangerous Waste Numbers, Quantities, and Design Capacity

The Part A, Form 3, permit application for the LLBG identifies dangerous waste numbers, quantities, and the design capacity and is located in Chapter 1.0 of the LLBG dangerous waste permit application documentation (DOE/RL-88-20).

For waste that cannot be managed in accordance with the requirements set forth in this WAP, an alternative waste management plan (AWMP) could be submitted to the Washington State Department of Ecology (Ecology) for review. Because many activities associated with or necessary to support waste management projects readily would not be predictable, some flexibility in timeframes for submitting, reviewing, and completing waste management plans would be necessary. In general, the following schedules could be observed.

- Submit the AWMP to the Ecology Project Manager at least 120 days before the project is expected to begin. The cover letter must state that "no reply within 45 days constitutes approval".

- Ecology reviews and provides comments (if any) within 45 days after receiving the AWMP.

- If comments are received, comments will be resolved through project manager meetings or other workshops as agreed to by the U.S. Department of Energy, Richland Operations Office (DOE-RL) and Ecology. When the plan is resubmitted on resolution of Ecology's comments, the same review timeframes are applicable.

- If no comments are received from Ecology within 45 days after the AWMP is submitted, the plan is denoted as being approved.

These timeframes could be adjusted by mutual agreement to account for project-specific needs and priorities. The AWMP is reviewed to ensure the following.

- The project does not endanger human health and the environment.

- The course of action chosen is well justified.

On gaining written or automatic approval, the DOE-RL proceeds as described in the AWMP. Should the plan require revision due to unforseen circumstances, the DOE-RL will resubmit the plan before continuing. On conclusion of the project, the DOE-RL will supply Ecology with a report outlining the activities performed and the results of these activities. A determination also will be made if the WAP requires revision. Under most circumstances, it is expected that the AWMP will not result in the need to amend the WAP.

1.2.2 Unit-Specific Information

For a detailed description on processes, operations, and physical dimensions, refer to Chapter 4.0 of the Hanford Facility dangerous waste permit application LLBG documentation (DOE/RL-88-20).

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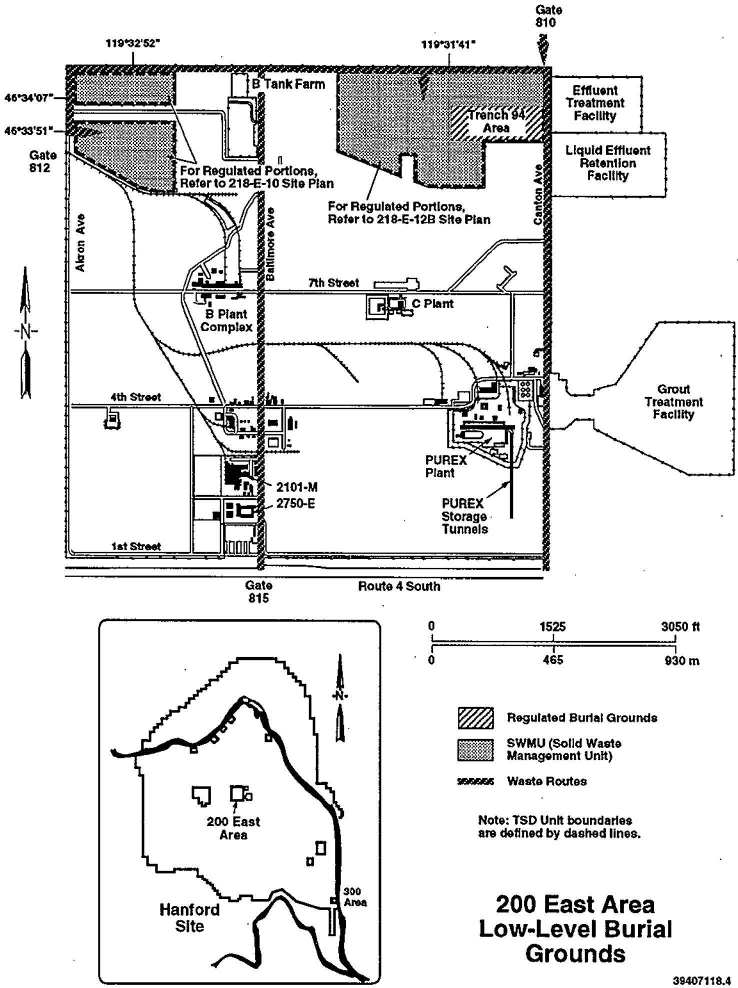

Figure 1-1. Locations of Low-Level Burial Grounds in the 200 East Area.

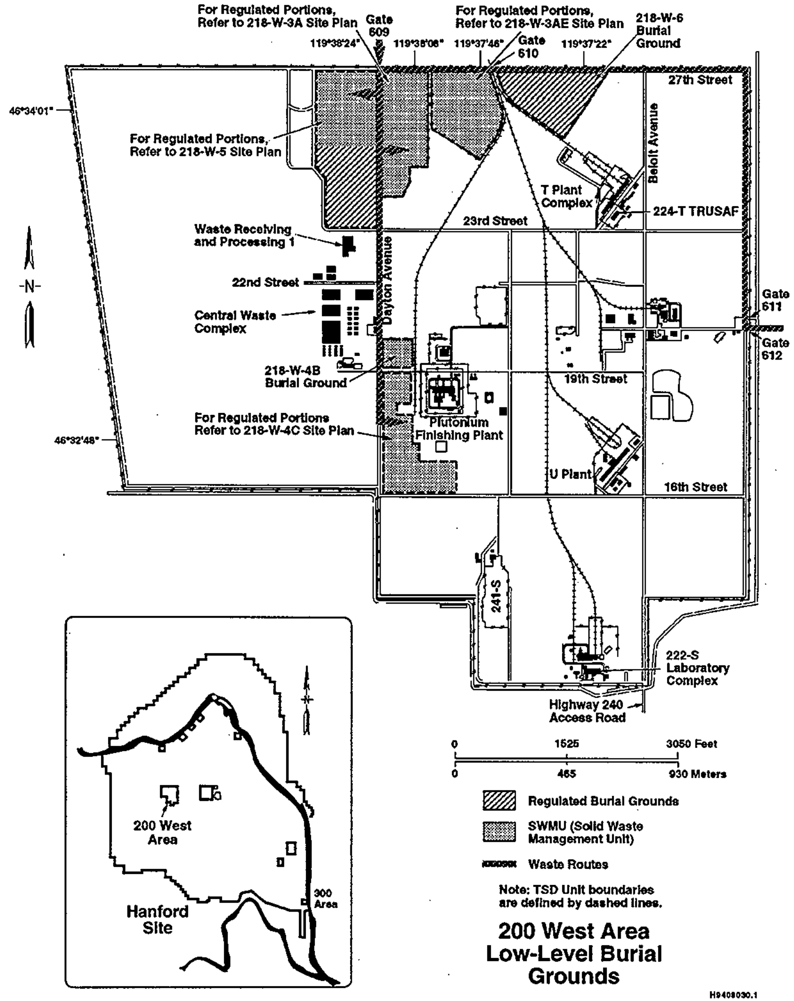

Figure 1-2. Locations of Low-Level Burial Grounds in the 200 West Area.

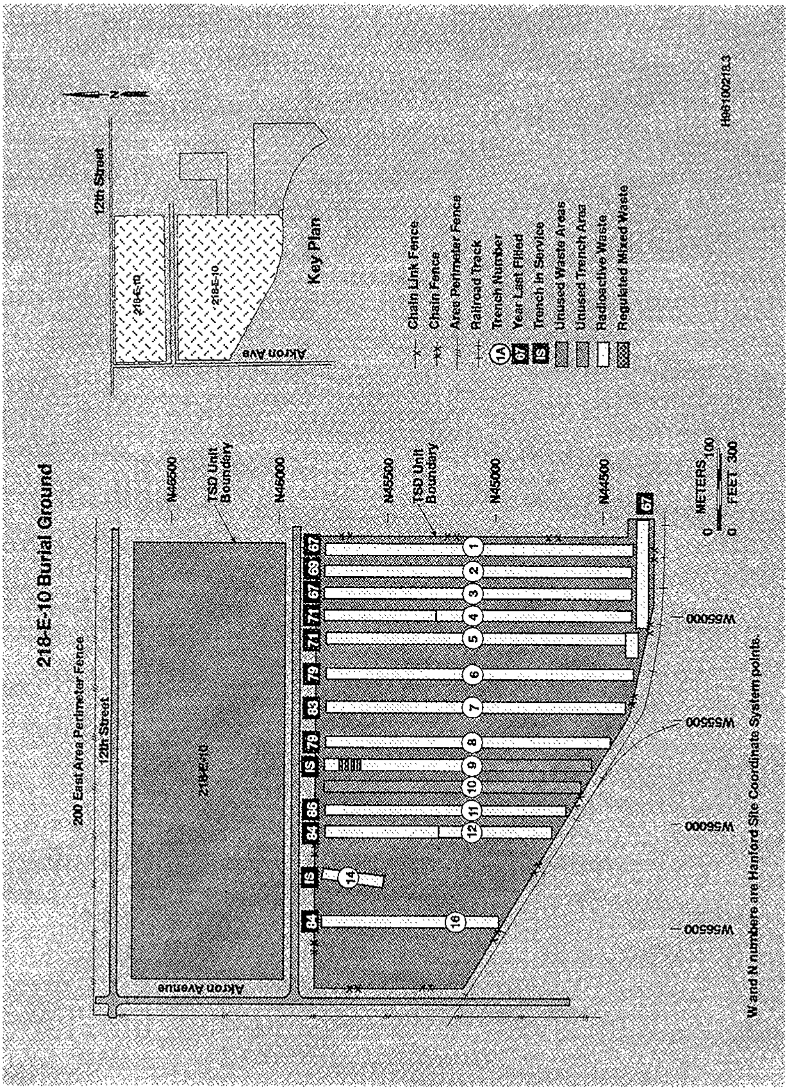

Figure 1-3. 218-E-10 Burial Ground.

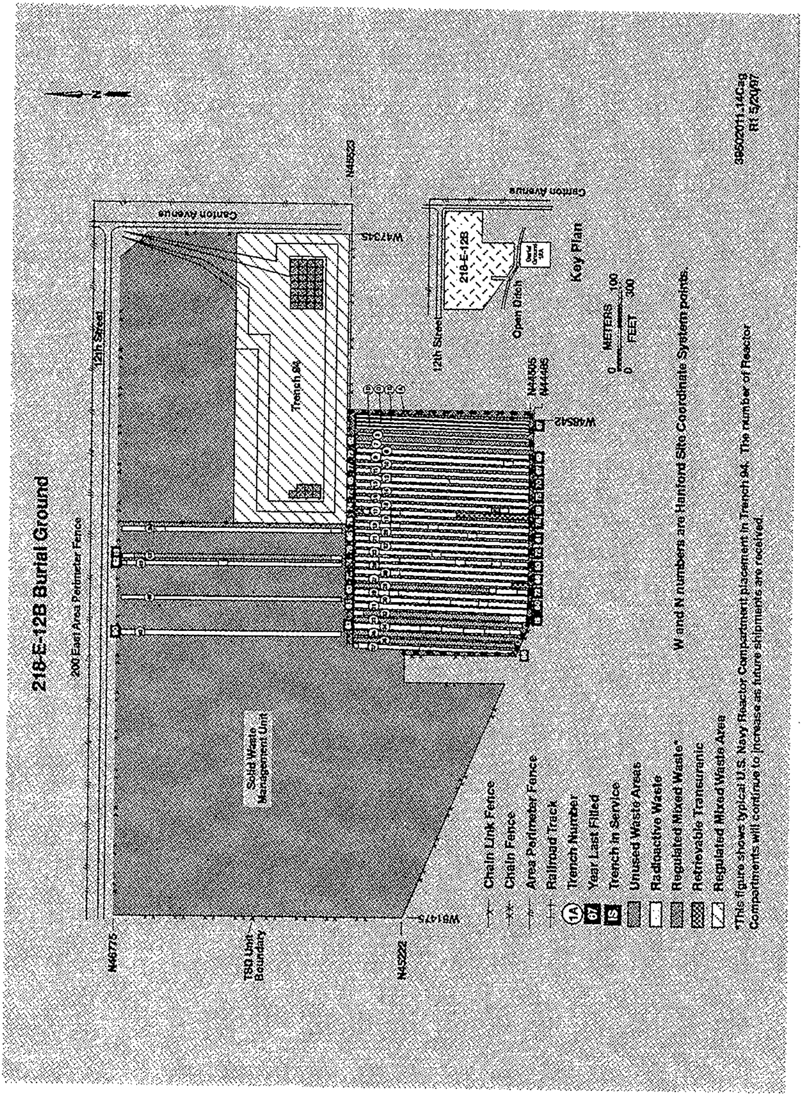

Figure 1-4. 218-E-12B Burial Ground.

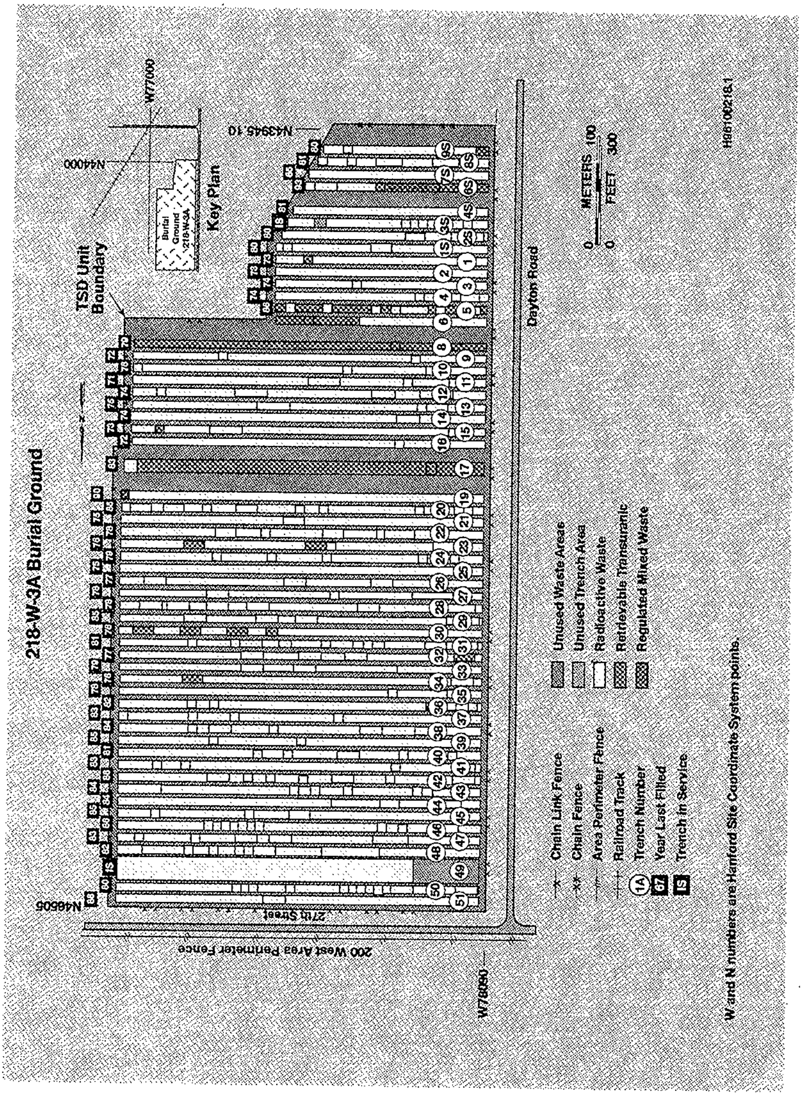

Figure 1-5. 218-W-3A Burial Ground.

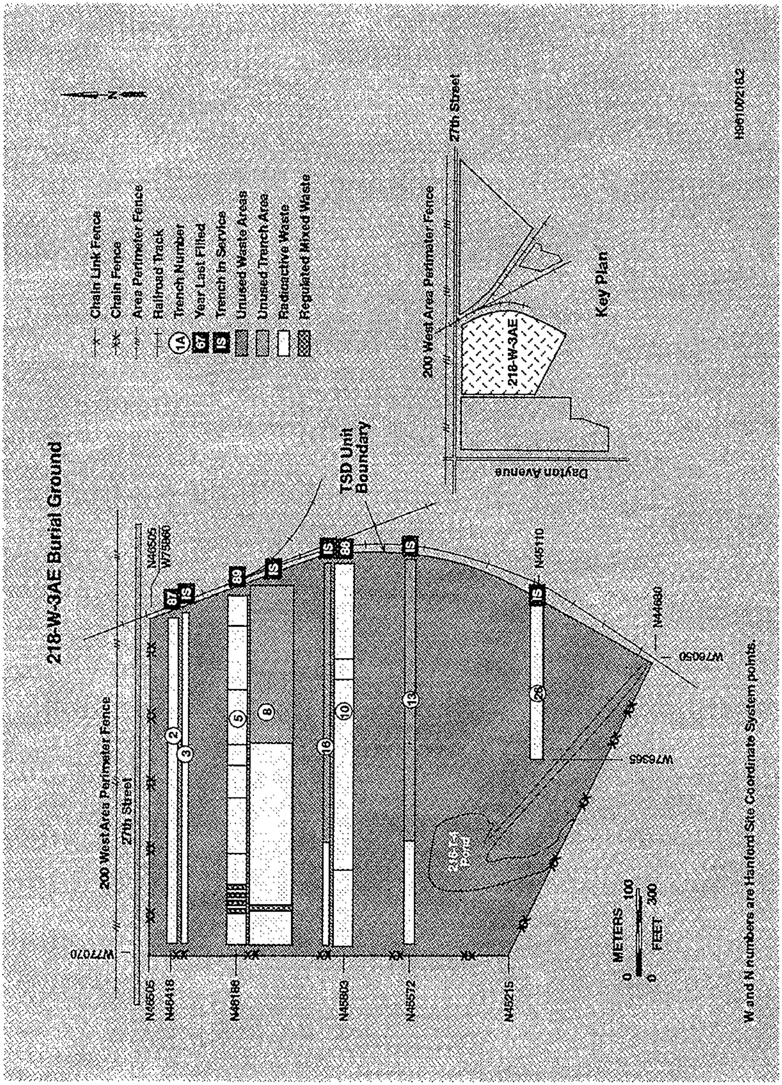

Figure 1-6. 218-W-3AE Burial Ground.

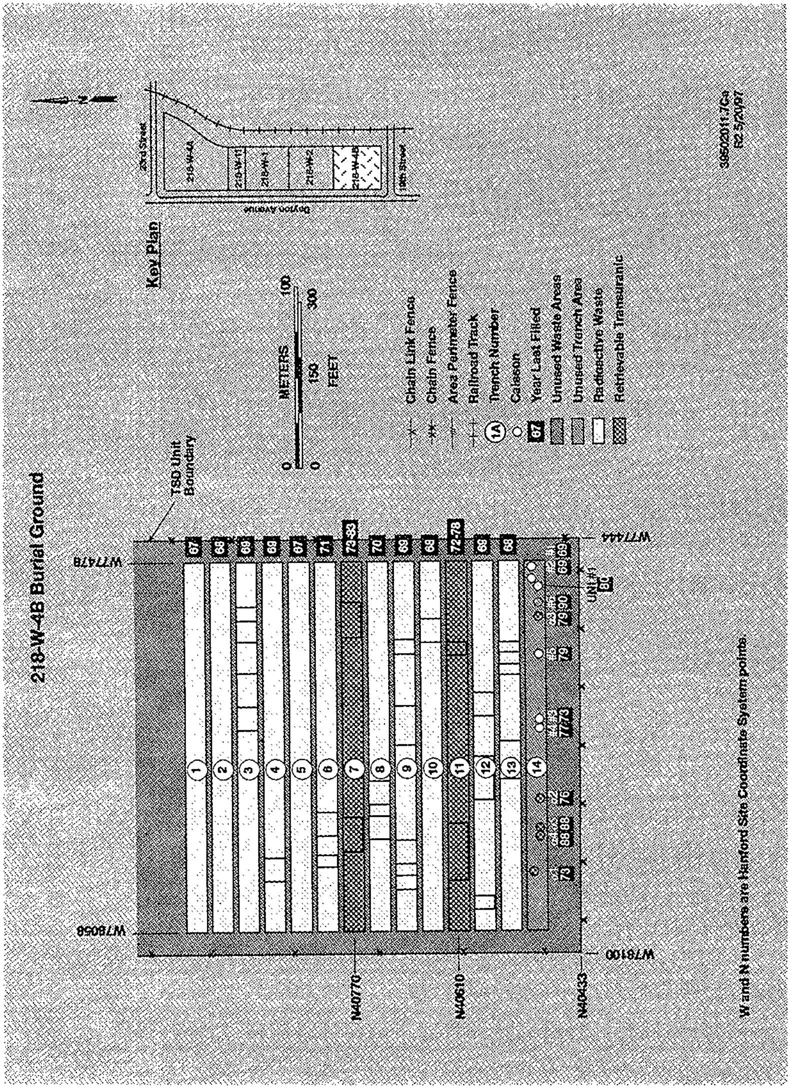

Figure 1-7. 218-W-4B Burial Ground.

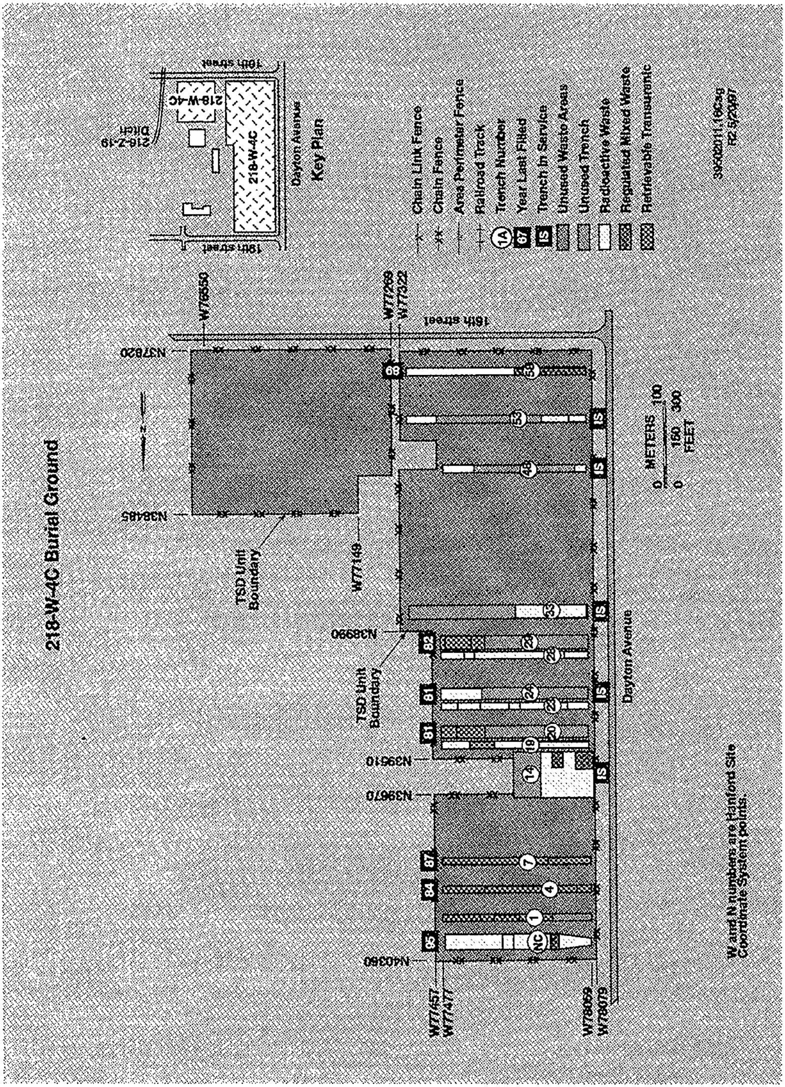

Figure 1-8. 218-W-4C Burial Ground.

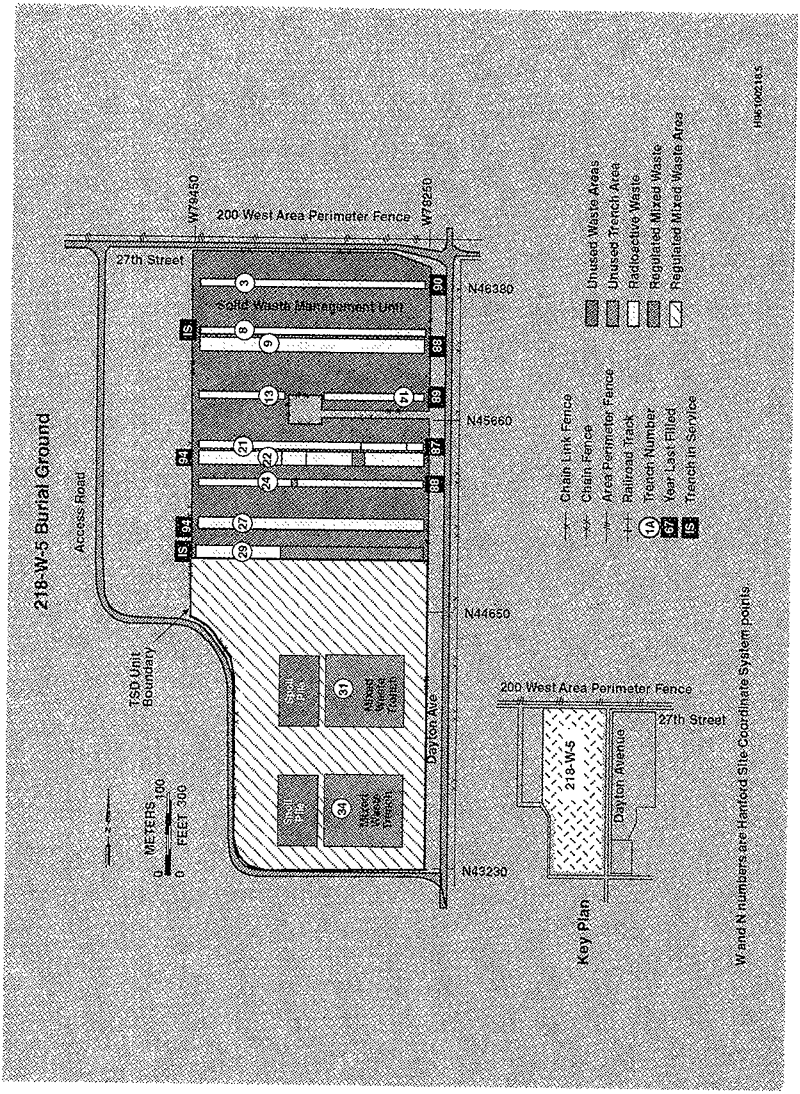

Figure 1-9. 218-W-5 Burial Ground.

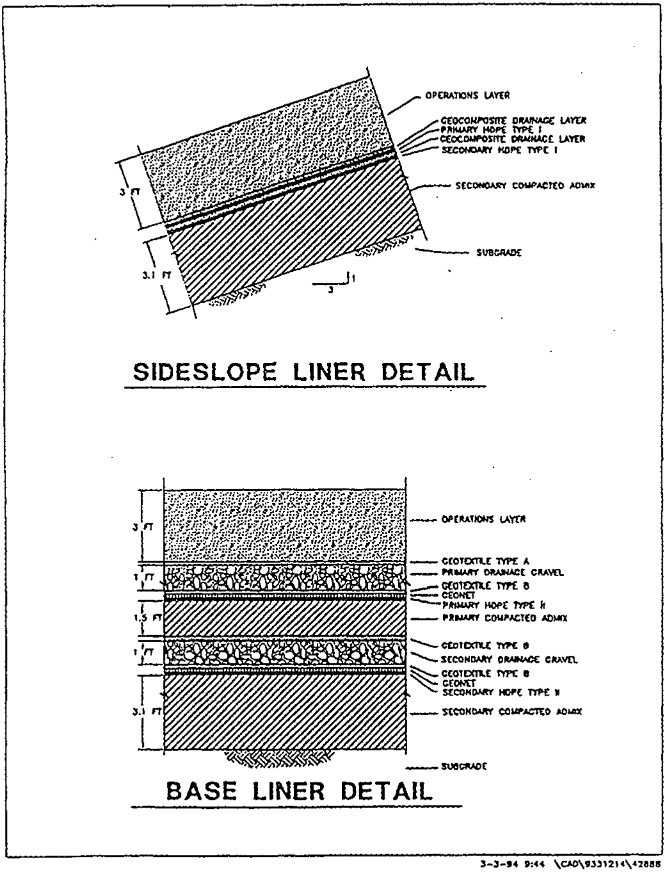

Figure 1-10. Typical Resource Conservation and Recovery Act-Compliant Liner System.

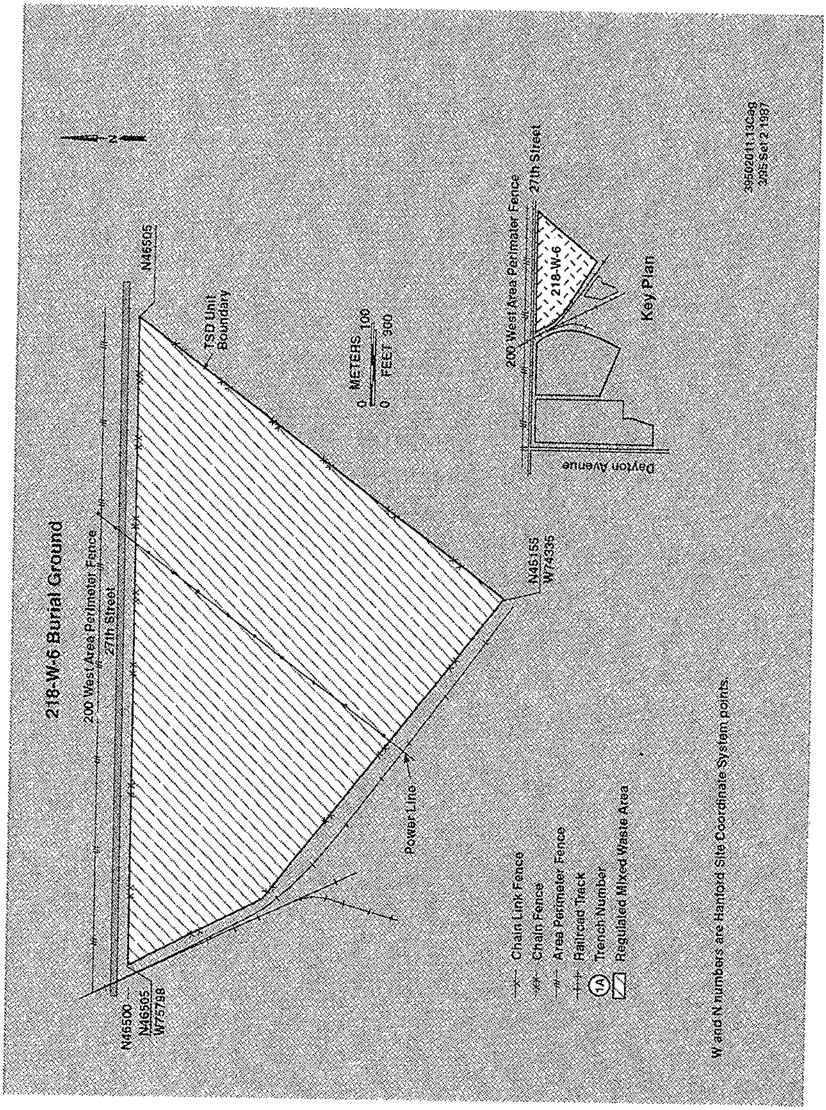

Figure 1-11. 218-W-6 Burial Ground.

Generator : ____

Month ______ Year ______

Generator:	Range	Score -include justification
Designation Conformance Issue(s)		
regulatory violation	7-10	
mismanagement of waste	4-6	
no mismanagement of waste	1-3	
Characterization Conformance Issue(s)		
safety issue	7-10	
mismanagement of waste	4-6	
no mismanagement of waste	1-3	
Paperwork Inconsistencies		
LDR form	1-3	
shipping papers or waste tracking forms	1-3	
profile discrepancies	1-3	
incomplete shipment/transfer information	1-3	
Screening Conformance Issue(s)		
regulatory violation and/or a safety issue	7-10	
mismanagement of waste	4-6	
no mismanagement of waste	1-3	
Receipt Conformance Issue(s)		
regulatory violation and/or a safety issue	7-10	
mismanagement of waste	4-6	
no mismanagement of waste	1-3	
		SCORE:

Number of containers received: ________

Number of containers screened (including date of activity): ________

Additional Comments:

____

____

____________________. Initial Evaluation completed by: ______________________

Note - a score of 10 or more requires input from the performance evaluation system team.

Figure 1-12. Example Generator Evaluation Worksheet.

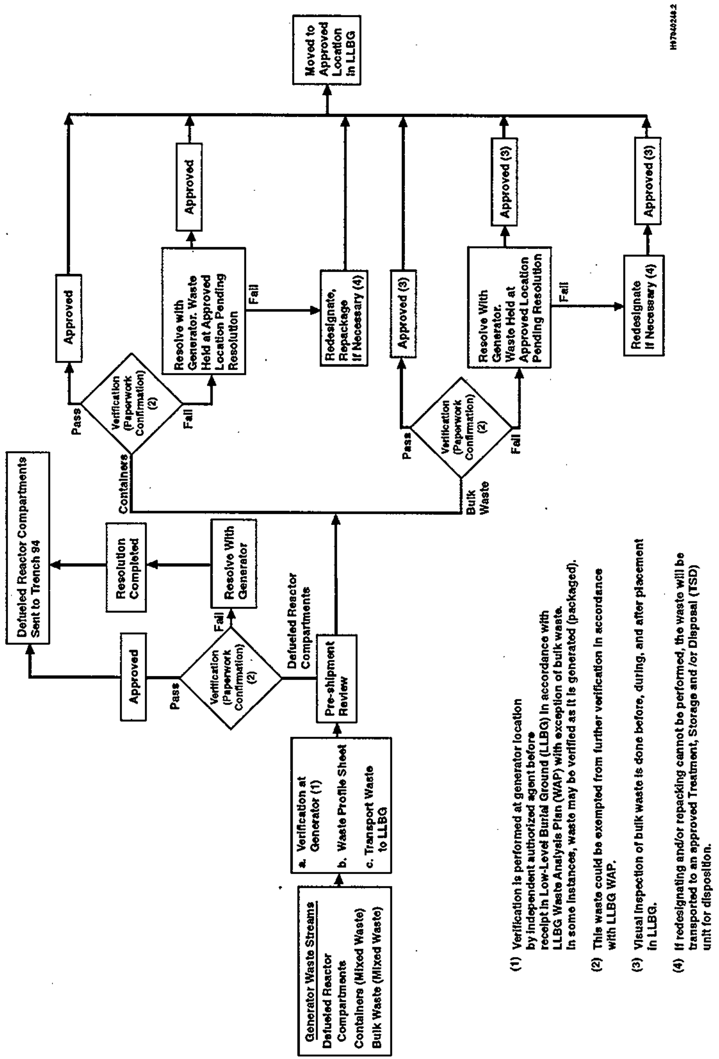

Figure 1-13. Low-Level Burial Grounds Waste Analysis Plan Flowchart.

Table 1-1. Incompatible Chemicals.

Amyl chloride	Diethyl benzene	Nitrobenzene
Aqua regia	Diethyl ether	Perchlorobenzene
Bromic acid	Elemental bromine	Propylene dichloride
Bromobenzene	Elemental chlorine	Sulfur trioxide
Bromoform	Elemental fluorine	Sulfuric acid (fuming)
Calcium bisulfite	Ethyl chloride	Thionyl chloride
Calcium sulfide	Ethylene trichloride	Vinylidene chloride.

2.0 DESCRIPTION OF CONFIRMATION PROCESS

This section covers the confirmation process and includes the appropriate pre-shipment review and/or verification steps and/or parameters. Confirmation process requirements appear twice in WAC 173-303-300 and apply to two different scenarios [refer to process flowchart (Section 1.0, Figure 1-13) for confirmation process].

Scenario 1: The process that an owner or operator uses to confirm knowledge supplied by the generator is acceptable knowledge to ensure that the waste is managed properly. [WAC 173-303-300(1)].

Scenario 2: The process that the LLBG operating organization uses to determine, by analysis if necessary, that each offsite waste received at the LLBG matches the identity of the waste specified on the accompanying manifest or shipping paper. [WAC 173-303-300(3)].

2.1 PRE-SHIPMENT REVIEW

Pre-shipment review takes place before waste can be scheduled for transfer or shipment to the LLBG. The review focuses on whether the waste stream is defined accurately and the LDR status determined correctly. Only waste determined to be acceptable for disposal is scheduled. This determination is based on the information that the generator provides. The following sections discuss the pre-shipment review process.

2.1.1 Pre-Shipment Review Process

The pre-shipment review ensures the waste has been characterized and the data provided qualify as 'acceptable knowledge' (Section 1.1.4.1). The information obtained from the generator during the pre-shipment review, at a minimum, includes all information detailed in Section 1.1.4.2.

Waste could be characterized on a waste stream basis. Individual container data must be compared to the waste profile data to ensure the information is accurate. Every transfer or shipment must be reviewed to ensure the waste meets the acceptance criteria for the LLBG. The repeat and review frequency for generators to review profile information will be yearly or as the waste generation process changes.

For each waste transfer or shipment that is a candidate for disposal, the generator provides (1) all pertinent chemical, radiological, and physical data requested on the waste tracking form/shipping paper; (2) other supporting documentation such as MSDS, analytical data, etc.; (3) a description of the waste contents on the container inventory record; and (4) LDR notification/certification information or equivalent documentation (e.g., national capacity variance, contained-in determination variance, etc.,) as applicable. The pertinent information is entered into a solid waste information tracking system (SWITS).

Based on waste identification information provided, the waste designation is reviewed to ensure consistency with waste designations per WAC 173-303-070, as well as for technical accuracy to ensure the waste meets the waste acceptance criteria. If the transfer or shipment information is found to be acceptable, a final operations review is completed and the transfer or shipment is scheduled. For bulk waste, every truck load is inspected visually; any waste showing visible variations in color, texture, or wetness is subject to sampling per this WAP.

Where potential nonconformances exist in the information provided, waste characteristics do not match the waste certification summary, or additional constituents are expected to be present that do not appear on the documentation, the generator is contacted by the LLBG operating organization or an approved designated organization for resolution.

2.1.2 Methodology to Ensure Compliance with Land Disposal Restrictions Requirements

Only mixed waste that meets the treatment standards of 40 CFR 268 and WAC 173-303-140 is considered for disposal. Because waste treatment to meet LDR criteria does not occur at the LLBG, all generators are subject to LDR or any LDR-related variances and are required to submit all the notifications and certifications described in 40 CFR 268.7. The following are general requirements for notifications and supporting documentation.

- The waste is subject to LDR and the generator has treated the waste.
  - The generator supplies the appropriate LDR certification information (40 CFR 268 and WAC 173-303-140).
- The waste is subject to LDR and the generator has determined that the waste naturally meets the LDR treatment standard for disposal.
  - The generator develops the certification based on process knowledge, analytical data, and supplies the appropriate LDR certification information necessary to demonstrate compliance with the LDR treatment standards of 40 CFR 268 and WAC 173-303-140.
- The waste is subject to an exemption from a prohibition on landfill disposal.
  - The generator submits a notice stating the waste is not prohibited from land disposal as required by 40 CFR 268.7(a)(3) and WAC 173-303-140(6).

A representative sample of the waste could be required to be submitted for analysis to ensure that contamination-based LDR requirements are met. The frequency of corroborative testing for the purpose of confirming compliance with LDR standards (concentration based and underlying hazardous constituents) is (1) a minimum of one test for the case where the variability of the waste constituents of concern(s) is determined and (2) a minimum of three tests for the case where the variability of the waste constituents of concern(s) is not determined. In both cases, if the test results are less than the standard or underlying hazardous constituent threshold or if above the threshold but not statistically different than the data on which the certification of LDR compliance was made, the waste is corroborated as being compliant with LDR standards.

2.2 WASTE VERIFICATION

Verification consists of container receipt inspection, physical screening, and chemical screening as required by the criteria set forth in this WAP. Waste verification consists of testing key physical and chemical properties. Waste verification parameters are selected based on the following criteria:

- The need to identify restricted waste
- Parameters important to the proper management of waste at the LLBG
- Parameters that can be used to corroborate that waste received matches the identity of waste specified on accompanying transfer or shipping papers
- The need to protect human health and the environment.

Incoming waste verification is accomplished by reviewing applicable documentation and waste tracking forms or shipping papers against the waste. The physical/chemical screening frequencies are applied for verification purposes only. A waste stream is defined as having similar physical and chemical characteristics and dangerous waste numbers and the same LDR treatment requirements and waste management requirements.

For containers disposed in the lined trenches, the following verification rates apply:

- Offsite--the minimum physical verification rate is 10 percent of each waste stream applied per generator, per shipment
- Onsite--for verification purposes only, waste streams generated by each Hanford Site contractor and each of their subcontractors is verified at 5 percent per year.

Verification is performed using a combination of container receipt inspection, physical screening, and/or chemical screening. Verification is performed at an approved location [e.g., Central Waste Complex (CWC), Waste Receiving and Processing 1 (WRAP 1), etc.] as determined by the LLBG operating organization.

A bulk waste stream could be verified by screening the allowable rate of the total number of loads throughout the waste stream*.

2.2.1 Container Receipt Inspection

The container receipt inspection is a mandatory element of the confirmation process. Therefore, 100 percent of the containers/shipments are inspected for damage and to ensure the waste containers shipped are those denoted in the documentation. This activity is a mechanism for identifying containers that have not been subject to a pre-shipment review, identifying any paperwork issues, or identifying damaged containers before receipt of the container.

2.2.2 Physical Screening Process Guidance

Physical screening is considered an additional verification element. This section provides guidance on the methods and frequency concerning the use of physical screening as a verification activity.

Waste received before the establishment of a verification program must be verified when initially transferred to the LLBG. However, waste stored in the CWC, WRAP 1, etc., that has been processed through a physical screening program does not require additional physical screening [e.g., transuranic (TRU) certification program, current waste specification program, and backlog confirmation program, 183-H Solar Evaporation Basins sampling program].

2.2.2.1 Physical Screening Methods. Each of the following physical screening methods identified complies with the requirement to verify a waste and are listed in order of preference. The verifier must document the reasoning behind the method chosen when using a method other than #1 or #2.

1. Visual inspection (opening the container)
2. Nondestructive examination [real-time radiography (RTR)]
3. Nondestructive assay
4. Dose rate profile.

2.2.2.2 Physical Screening Frequency. The minimum physical screening frequency is in accordance with Section 2.2. The LLBG operating organization adjusts the physical screening frequency for generators based on objective performance criteria (refer to Section 1.1.2).

Containers that comprise the verification sample set are chosen using the following bias sampling methodology:

- Choose any and all containers for which concerns were identified during pre-shipment review

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* Note: A bulk waste stream is defined as large volumes of waste from a single generating event (e.g., soil remediation from a single location).

- Choose containers from separate locations and containing waste from different waste specification records (WSRds) to ensure that the verification program accurately tests for variability within programs and waste types

- If one and two are not applicable, randomly choose containers from the 'General Waste Stream'* as required to meet the applicable physical screening frequency.

If one container out of a verification sample set fails, another sample set or 3 additional containers (whichever is larger) must be chosen for physical screening (i.e., if the initial verification sample set equals three containers and one fails, then three more containers must be chosen). If two containers fail, the entire shipment fails.

If RTR is used to meet the physical screening requirements, 5 percent per year of the containers that have been nondestructively examined must be opened to ensure the equipment is functioning appropriately. Containers opened for other reasons, such as chemical screening or to investigate inconsistencies, could be used to meet this requirement. This requirement is based on the total number of containers reviewed not on a shipment or general waste stream basis. The generator is required, at a minimum, to meet this requirement over a 3 month average with a minimum of one container being opened every month the RTR is used for physical screening.

2.2.2.3 Physical Screening Exceptions. There are cases in which physical screening is not required. Therefore, the following exceptions have been developed to account for these instances.

- Shielded, classified, and remote-handled mixed waste is not required to be physically screened; however, the generator must perform a more rigorous documentation review and obtain the raw data used to characterize the waste. Ecology will be notified and have the opportunity to review information on this waste type before shipment. For classified waste, it is necessary to have an appropriate DOE security clearance and a need-to-know the information as defined by the classifying organization or agency.

- Mixed waste that cannot be physically screened at the LLBG or associated verification facility by acceptable physical screening methods must be physically screened at the generator location (e.g., large components, containers that cannot be opened, greater than 20 millirem per hour at 30 centimeters, contain greater than 10 nanocuries per gram of transuranic radionuclides, or will not fit into the nondestructive examination unit). Physical screening at the generator location consists of observing the packaging of the waste.

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* Note: 'General Waste Stream' is defined as a waste from a single generator in the same waste management group.

If no location can be found to perform the physical screening, no screening is required.

- Mixed waste that is packaged by an independent authorized agent for the LLBG operating organization is considered to have met the physical screening requirements denoted in this WAP.

- A bulk mixed waste stream could be verified by an applicable screening frequency identified in Section 2.2.

2.2.3 Chemical Screening Process Methods

Chemical screening is considered an additional verification element. This section provides guidance on the methods and frequency concerning the use of chemical screening as a verification activity.

The LLBG operating organization must describe the appropriate parameters for the waste accepted into the LLBG. At a minimum, at least three of the following methods must be used to complete the chemical screening process for mixed waste subject to physical screening. However, if only three methods are used, the generator must document the reasoning used to determine the chemical screening methods chosen (at a minimum, pH will be one of the three methods chosen):

- pH
- HH (Chlor-n-oil/water/soil)
- Ignitability and/or headspace testing (e.g., lower explosive limit, portable gas chromatograph, flame ionization detector, photoionization detector, high-voltage adapter. Instrument must be appropriate for conditions)
- Peroxide
- Oxidizer
- Sulfide
- Cyanide
- Paint Filter
- Water Reactivity.

2.2.3.1 Chemical Screening Frequency. At a minimum, 10 percent of the mixed waste verified by physical screening (Section 2.2.2.2) must be screened chemically. Chemical screening is not required to use SW-846 methodology. Although grab samples are acceptable, the LLBG operating organization must obtain a representative sample.

Laboratory hood waste packaged in accordance with 40 CFR 264.316/ 40 CFR 265.316, and WAC 173-303-161 must be screened chemically. Inner containers are segregated by physical appearance. At least one container from each group (or three containers if all similar) will be screened chemically. Solids require no chemical screening.

2.2.3.2 Chemical Screening Exceptions. There are cases in which chemical screening is not required. Therefore, the following exceptions have been developed to account for these instances:

- Waste that is exempted from the physical screening requirements (Section 2.2.2.3) is exempted from chemical screening

- Commercial chemical products (mixed waste) in the original product container(s) (i.e., off-specification, outdated, or unused products)

- Chemical containing equipment (mixed waste) removed from service, (i.e., ballasts, batteries, etc.)

- Hazardous debris (mixed waste) as defined in WAC 173-303-040

- Mixed waste containing asbestos

- Mixed waste, environmental media, and/or debris from the cleanup of spills or release of single substance or commercial product or otherwise known material (i.e., material for which an MSDS can be provided)

- Confirmed noninfectious mixed waste (i.e., xylene, acetone, ethyl alcohol, isopropyl alcohol) generated from laboratory tissue preparation, slide staining, or fixing processes

- Containers with an external dose rate of >20 millirem per hour at 30 centimeter and/or contain >10 nanocuries per gram of transuranic radionuclides

- Other special-case situations handled on a case-by-case basis.

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3.0 SELECTING WASTE ANALYSIS PARAMETERS

The following discusses selecting waste analysis parameters, associated rationale, and methods for these analyses. The analytical screening parameters that could be used for waste received at the LLBG are as follows.

- Physical description--used to determine the general characteristics of the waste. This facilitates subjective comparison of the sampled waste with previous waste descriptions or samples. Also, a physical description is used to verify the observational presence or absence of free liquids.

  Methods--samples are inspected and the physical appearance of the waste is recorded. RTR and/or visual examination is used.

- Radioactivity screen--used to quantify radionuclides for verification of transuranic radionuclide content, nontransuranic radionuclide content, and the waste classification (i.e., low-level waste or transuranic).

  Methods--a sample of the waste is passed by a geiger counter, survey meter, or a waste container is assayed using passive-active neutron or segmented gamma scanning techniques.

- Ignitability and/or headspace volatile organic compound analysis--performed to determine the ignitability and the presence or absence of solvents or other volatile organic compounds in waste. The headspace volatile organic compound analysis is one of the few methods available to evaluate the presence of volatile organic compounds that could be associated with heterogeneous materials.

  Methods--for headspace volatile organic compounds, a sample of the headspace gases in a container is analyzed by one or more of the following: Fourier transform infrared spectroscopy, gas chromatography/mass spectroscopy, HNU, organic vapor analyzer, and colorimetric tubes.

- Paint filter liquids test--used to verify the presence or absence of free liquid in solid or semisolid material to be landfilled.

  Method--to a standard paint filter, 100 centimeters or 100 grams of waste are added and allowed to settle for 5 minutes. Any liquid passing through the filter signifies failure of the test (SW-846 Method 9095).

- pH screen--used to identify the pH and corrosive nature of an aqueous or solid waste, to aid in establishing compatibility strategies, and to indicate if the waste is acceptable for disposal in the LLBG.

  Methods--full range pH paper is used for the initial screening. If the initial screen indicates a pH below 4 or above 10, a pH meter is used. Procedures for preparing and extracting the solution and liquid are described in the test procedures of WAC 173-303-110(3)(a).

- Oxidizer potential screen--used to determine the fire-producing potential of the waste. This test can be applied to waste liquids, solids, and semisolids.

  Methods--all waste forms are tested using oxidizer tests.

- Water reactivity screen--used to determine if the waste has the potential to react vigorously with water to form gases or other reaction products.

  Method--for liquid waste, water is added to the waste. The solution is observed for evidence or fuming, bubbling, or spattering. These reactions are considered to be positive evidence that the waste is water reactive.

- Cyanide screen--used to indicate whether the waste produces hydrogen cyanide upon acidification below pH 2.

  Method--to a test tube or beaker containing approximately 5 milliliters of sample, an equal amount of freshly prepared ferrous ammonium citrate is added. 3 Normal hydrochloric acid is used to reduce the pH of the solution to about 2.0. A deep blue color indicates the presence of cyanide. The test can detect free cyanide and complex cyanides in concentrations above 200 parts per million.

- Sulfide screen--used to indicate if the waste produces hydrogen sulfide upon acidification below pH 2.

  Methods--sample is added to beaker or test tube and enough 3 Normal hydrochloric acid is added to bring the pH down to 2.0. A sulfide test strip is placed in the solution. If the paper turns brown or silvery black, the presence of sulfides in the sample is indicated. If there is no color change, the total sulfides are reported as nondetectable.

- HH screen--used to indicate whether polychlorinated biphenyls (PCBs) are present in oil-bearing waste and to determine if the waste needs to be managed in accordance with the regulations prescribed in the *Toxic Substance Control Act of 1976*.

  Method--the tests to be conducted include the HAZCAT* beilstein test, and/or the appropriate organic chlorine test.

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* HAZCAT is a registered trademark of Haztech Systems Incorporated, San Francisco, California.

4.0 SELECTING SAMPLING PROCEDURES

Specific sampling processes depend on both the nature of the material and the type of packaging. This section describes the sampling methodology.

4.1 SAMPLING STRATEGIES

Chemical screening is done in accordance with Table 4-1. Refer to Section 2.0 for discussion on sampling limitations, criteria for frequency, numbers and types of samples, and exceptions of waste categories and/or waste streams that cannot be sampled. Chemical screening might be performed in the trench, at the generator, or at another location approved for the waste to be sampled.

4.2 SELECTING SAMPLING EQUIPMENT

Sampling equipment selection is detailed in Table 4-1. Sampling equipment needed to sample waste is maintained and decontaminated by the LLBG operating organization.

4.3 SAMPLE PRESERVATION

Chemical screening methods referenced or described in Section 3.0 do not require any preservation methods.

4.4 ESTABLISHING QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES FOR SAMPLING

The following quality assurance/quality control (QA/QC) elements are used by LLBG operating organization, before transferring or shipping waste to the LLBG, to ensure sampling activities result in acceptable laboratory data:

- Using representative sampling methods as defined by WAC 173-303-110(2), 40 CFR 261 Appendix I, and/or SW-846 Chapter 9, whenever possible

- Using appropriate sample containers and equipment

- Numbering samples properly

- Using a standard labeling procedure

- Using field QA/QC samples
  - 1 in 20 to laboratory
  - 1 duplicate per event
  - 1 in 20 blank.

- Expiration date not expired
- Equipment calibration current.

Table 4-1. Low-Level Burial Ground Chemical Screening Sampling Results.

Waste type	Reference in SW-846 (EPA 1986)	
	Waste type	Equipment
Liquids	Free-flowing liquids and slurries	COLIWASA, SW-846, Chapter 9, glass thief or pipet
Solidified liquids	Sludges	Trier, SW-846, Chapter 9, scoops and shovels
Sludges	Sludges	Trier, SW-846, Chapter 9, scoops and shovels
Soils	Sand or packed powders and granules	Auger, SW-846, Chapter 9, scoops and shovels
Absorbents	Large-grained solids	Large trier, SW-846, Chapter 9, scoops and shovels
Wet absorbents	Moist powders or granules	Trier, SW-846, Chapter 9, scoops and shovels
Process solids and salts	Moist powders or granules	Trier, SW-846, Chapter 9, scoops and shovels
	Dry powders or granules	Thief, SW-846, Chapter 9, scoops and shovels
	Sand or packed powders and granules	Auger, SW-846, Chapter 9, scoops and shovels
	Large-grained solids	Large trier, SW-846, Chapter 9, scoops and shovels
Ion exchange resins	Moist powders or granules	Trier, SW-846, Chapter 9, scoops and shovels
	Dry powders or granules	Thief, SW-846, Chapter 9, scoops and shovels
	Sand or packed powders and granules	Auger, SW-846, Chapter 9, scoops and shovels

COLIWASA = composite liquid waste sampler.
NA = not applicable.

5.0 SELECTING A LABORATORY, LABORATORY TESTING, AND ANALYTICAL METHODS

The following sections discuss selecting a laboratory for analyzing samples for QA/QC elements.

5.1 SELECTING A LABORATORY

The following laboratory QA/QC requirements apply to laboratory analyses of generator waste.

- The daily quality of analytical data generated in the contracted analytical laboratories is controlled by the implementation of an analytical laboratory QA plan.

- Before commencement of the contract for analytical work, the laboratory submits their QA plan for approval. At a minimum, the plan documents the following:

  - Sample custody and management practices
  - Sample preparation and analytical procedures
  - Instrument maintenance and calibration procedures
  - Internal QA/QC measures, including the use of method blanks
  - Sample preservatives used
  - Analyses requested.

When required, replicate testing usually is accomplished by analyzing two samples, one by the generator and another by the LLBG operating organization.

5.2 SELECTING TESTING AND ANALYTICAL METHODS

The generator describes and identifies the analytical methods to be used to analyze for the physical and chemical screening parameters identified in Section 3.0 for the mixed waste categories. If more than one testing and/or analytical method is used for a given physical and chemical screening parameter, the LLBG operating organization identifies all methods and applications.

The generator identifies the type of testing and analytical method to be used at the laboratory (e.g., for metals analysis state which type of determination procedure will be used such as inductively coupled plasma metals by atomic absorption).

The generator identifies the decision level necessary for each analytical parameter. If the decision level is found in a regulation, the generator references the regulation. Section 3.0 identifies the applicable decision levels, operational parameter(s), and analytical methods necessary to ensure that the waste is within the LLBG acceptance criteria.

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6.0 SELECTING WASTE RE-EVALUATION FREQUENCIES

This section is not applicable to the LLBG for waste that is placed in a disposal configuration. Newly generated waste is re-evaluated annually as necessary to ensure the waste stream has not changed.

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7.0 SPECIAL PROCEDURAL REQUIREMENTS

This section discusses any special process requirements for receiving mixed waste at the LLBG.

7.1 PROCEDURES FOR RECEIVING WASTE GENERATED ONSITE

Mixed waste received from onsite generators is detailed in Sections 2.2 and 3.0 and a flowchart is provided (Figure 1-13).

7.2 PROCEDURES FOR RECEIVING WASTE GENERATED OFFSITE

Mixed waste received from offsite is handled in the same manner as mixed waste received from onsite, with the exception of defueled reactor compartments disposed in trench 94 of the 218-E-12B Burial Ground, which are transported directly from the generator to trench 94.

7.3 PROCEDURES FOR IGNITABLE, REACTIVE, AND INCOMPATIBLE WASTE

The LLBG does not accept ignitable, reactive, or incompatible waste (refer to Section 1.2). The following is how the LLBG operating organization ensures that ignitable, reactive, or incompatible waste is not accepted at the LLBG.

- Pre-shipment review and chemical screening ensures ignitable and reactive waste are not accepted.

- Pre-shipment review alone ensures waste incompatible with the liner in the lined trenches are not accepted.

7.4 PROVISIONS FOR COMPLYING WITH FEDERAL AND STATE LAND DISPOSAL RESTRICTION REQUIREMENTS

Sections 1.1.4.1.2 and 2.1.2 describe compliance with federal and state LDR requirements.

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8.0 RECORDKEEPING

Recordkeeping requirements that are applicable to this WAP are described in Chapter 12.0, Table 12-1, of the General Information Portion (DOE/RL-91-28).

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9.0 REFERENCES

DOE/RL-88-20, *Hanford Facility Dangerous Waste Permit Application, Low-Level Burial Grounds*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-91-28, *Hanford Facility Dangerous Waste Permit Application, General Information Portion*, U.S. Department of Energy, Richland Operations Office, Richland, Washington, revised periodically.

EPA, 1986, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846*, Third Edition, as amended, U.S. Environmental Protection Agency, Washington, D.C.

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APPENDIX 4A

CONSTRUCTION QUALITY ASSURANCE REPORT

Transmitted from DOE-RL to Ecology.

Reference: Transmittal of the Hanford Facility Low-Level Burial Grounds Construction Quality Assurance Report and W-025 As-Built Drawings

Document Number: WHC-SD-W025-RPT-002, Revision 0.

Correspondence Number: 95-PCA-238, March 28, 1995.

Document Number: WHC-SD-W025-RPT-001, Revision 0.

Correspondence Number: 95-SWT-568, September 19, 1995.

APPENDIX 4B

DEFINITIVE DESIGN

Transmitted from DOE-RL to Ecology.

Reference: Low-Level Burial Grounds Dangerous Waste Permit Application Supplement 2: Design Documentation for Mixed Waste Nondragoff Land Disposal Facility (DOE/RL-88-20, Supplement 2, Revision 0).

Definitive Design Report, WHC-SD-W025-FDR-001, Revision 0.

Correspondence Number: 90-PPB-186, September 20, 1990.

APPENDIX 4C

RESPONSE ACTION PLAN

Transmitted from DOE-RL to Ecology.

Reference: Revision to Response Action Plan.

Document Number: WHC-SD-W025-AP-001, Revision 1.

Correspondence Number: 95-SWT-427, July 19, 1995.

APPENDIX 4D

REQUEST FOR EXEMPTION FROM LINED TRENCH REQUIREMENTS AT 218-E-12B BURIAL GROUND TRENCH 94

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CONTENTS

ATTACHMENTS

FIGURES

TABLES

1.0 INTRODUCTION

This request for exemption applies only to the decommissioned, defueled reactor compartments disposed in trench 94 of the 218-E-12B Burial Ground (Figure 1-1: refer to regulated mixed waste area). This exemption request* does not apply to any other waste at the 218-E-12B Burial Ground or to any other burial ground on the Hanford Facility, and is limited to regulatory requirements addressing liner/leachate collection systems.

Decommissioned, defueled reactor compartments contain radioactivity caused by exposure of structural components to neutrons during normal operation of the ships and submarines. In addition to radioactivity, the reactor compartments disposed in trench 94 contain lead used as shielding and polychlorinated biphenyls (PCBs). The lead used as shielding is regulated as a state-only dangerous waste in accordance with WAC 173-303. The PCBs are regulated in accordance with TSCA.

In May of 1984, the Navy issued an environmental impact statement (EIS) that evaluated alternatives for disposal of reactor compartments from submarines preceding the LOS ANGELES (SSN 688) class (USN 1984). Land disposal was the alternative selected. Shipment of reactor compartments from pre-LOS ANGELES submarines to trench 94 of the 218-E-12B Burial Ground began in April of 1986 (referred to hereafter as reactor compartments being disposed of under the current program).

In 1996, the Navy issued an EIS that considered the disposal of reactor plants from cruisers, and from LOS ANGELES and OHIO Class submarines (USN 1996) (hereafter referred to as reactor compartments considered for disposal under the 1996 EIS). The record of decision for this EIS selected disposal by land burial of the entire reactor compartment at the LLBG. Land disposal of these reactor compartments may require additional capacity beyond the existing size of trench 94. It might be necessary to expand trench 94 to accommodate the additional reactor compartments.

The DOE-RL's objectives in preparing and submitting this exemption request is as follows.

1. **Request an exemption from dangerous waste landfill liner and leachate collection and removal system (hereinafter referred to as liner/leachate collection system) requirements for trench 94 of the 218-E-12B Burial Ground.**

   Revision 0 of the LLBG Part B dangerous waste permit application was submitted in December 1989 to Ecology and the U.S. Environmental Protection Agency (EPA), Region 10. The Part B dangerous waste permit application indicated that a request for exemption from

* For practical purposes, the terms 'exemption' and 'waiver' are used interchangeably. The term 'exemption' is used in WAC 173-303 whereas 'waiver' is used in 40 CFR 761.

liner/leachate collection system requirements for disposal of the reactor compartments would be submitted to Ecology and the EPA. The *Low-Level Burial Grounds Dangerous Waste Permit Application Request for Exemption from Lined Trench Requirements for Submarine Reactor Compartments* (Revision 0) was submitted in July 1990 (DOE/RL-90-12).

2. **Obtain EPA Region 10 review and comment on the request to Ecology for exemption from liner/leachate collection system requirements.**

   In accordance with the Compliance Agreement between DOE-RL and the EPA, Region 10 (DOE/RL-90-12, Appendix H), the EPA (Region 10) would grant final approval of a TSCA chemical waste landfill permit for trench 94 based, in part, on documentation of compliance with state requirements for dangerous waste landfills. Therefore, obtaining EPA Region 10 review and comment would ensure that the EPA regulations for waiving liner/leachate collection system requirements are addressed in this exemption request.

1.1 SCOPE

This exemption request applies only to the decommissioned, defueled reactor compartments that are being disposed in trench 94 of the 218-E-12B Burial Ground. This exemption request does not apply to any other waste at the 218-E-12B Burial Ground or to any other burial ground on the Hanford Facility, and is limited to regulatory requirements addressing liner/leachate collection systems.

1.2 BACKGROUND

The 218-E-12B Burial Ground began receiving waste in 1967. Waste contained in the 218-E-12B Burial Ground includes mixed waste, low-level waste, and transuranic waste. Trench 94 is used for the final disposal of decommissioned, defueled reactor compartments.

The first defueled reactor compartment was placed in trench 94 in April 1986. The reactor compartments are prepared for disposal by the Puget Sound Naval Shipyard (PSNS) in Bremerton, Washington, and are transported by barge to the Port of Benton adjacent to the Hanford Facility and then over land to the 218-E-12B Burial Ground.

Final disposal of the decommissioned, defueled reactor compartments has been addressed in the Navy's EISs (USN 1984, USN 1996). The EISs discuss the presence of potentially hazardous materials. Because of the large amount of lead shielding in the reactor compartments, the EISs specifically discussed the long-term potential hazard of the lead shielding.

Extraction procedure testing of elemental solid lead has determined that the leachate contains lead in concentrations that would require regulation of elemental lead as a RCRA hazardous waste. However, the EPA, in a June 1987 letter, stated that "lead whose primary use is shielding in low-level waste disposal operations is not subject to Federal hazardous waste regulations when placed on the land as part of its normal commercial use." This was reiterated by the EPA in a February 1991 letter (Attachment 1), which stated that "the lead shielding contained in the SRC disposal packages is not considered to be solid waste as defined by 40 CFR § 261.2," and the EPA believes that the reactor compartment disposal packages are not subject to regulation under RCRA. Regardless, the thick metal encapsulation of the shielding lead within the reactor compartments, as built, already meets the RCRA treatment standards of 40 CFR 268.42, Treatment Code MACRO, for disposal of radioactive lead solids.

The presence of the lead shielding within the reactor compartments has caused the reactor compartments to be regulated as 'state-only' dangerous waste for disposal under WAC 173-303. The PSNS has studied the feasibility of removing this lead from the reactor compartments (e.g., PSNS 1990a, USN 1996). These studies found that removal of the lead would be very difficult and would result in radiation exposure to shipyard workers ranging from about 184 to 1,065 roentgen equivalent man (rem) per reactor compartment depending on the ship class. This exposure is orders of magnitude higher than the exposure that results from preparing reactor compartments for disposal. Additionally, lead removal would cost about $14 to $108 million dollars per reactor compartment depending on the ship class. Thus, both the additional exposure and expense would be substantial. The studies concluded that the removal of lead from the reactor compartments is not a reasonable method to mitigate the hazards associated with the lead contained within the reactor compartments. As discussed in Section 4.2.2, lead is not expected to migrate from the reactor compartments to groundwater for over 2 million years (240,000 years at the minimum) (USN 1995).

The PCB impregnated wool felt sound damping material is removed from reactor compartments when present. The reactor compartments might contain several kilograms of PCBs (typically less than 5 kilograms) tightly bound in the composition of solid materials such as thermal insulation, electric cable coverings, and rubber items manufactured before PCBs were banned. Because the PCBs would be present in materials in concentrations over 50 parts per million, the reactor compartments would be regulated as a toxic waste by the EPA under 40 CFR 761. The PCB-containing materials are distributed widely throughout the reactor compartment, and their removal would be difficult and would result in significant exposure of personnel to radiation. These PCBs would be contained totally within the fully sealed, all-welded reactor compartment structures.

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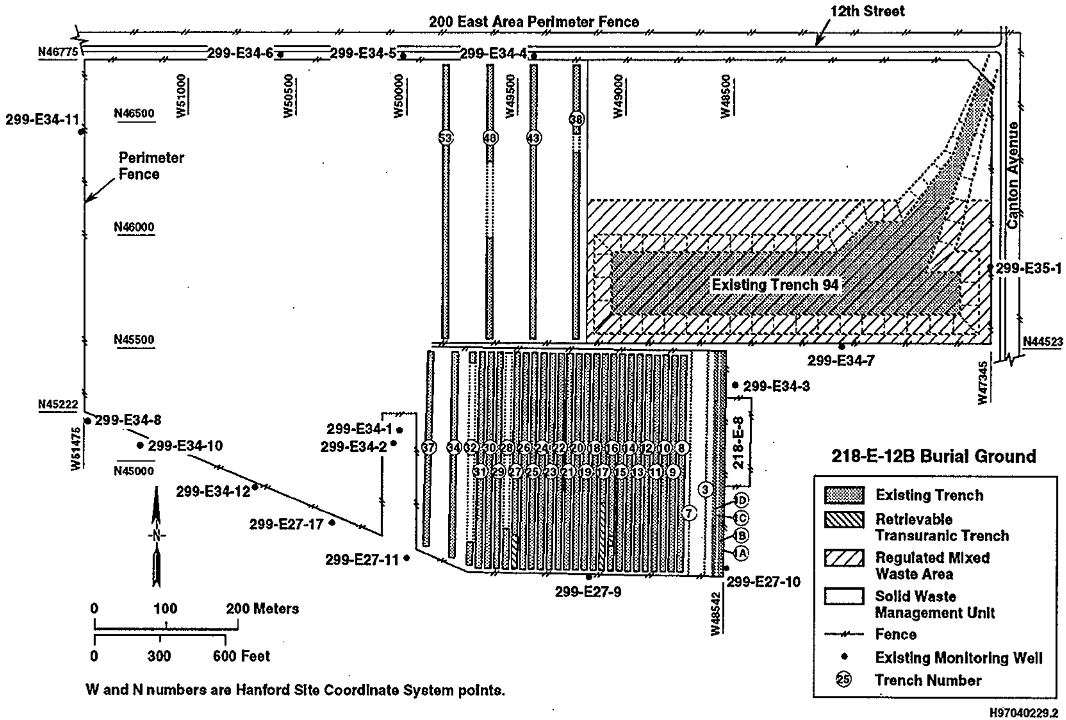

Figure 1-1. Location of Trench 94 within the 218-E-12B Burial Ground.

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2.0 BASIS FOR LINER/LEACHATE COLLECTION SYSTEM EXEMPTION REQUEST

Landfills used for the disposal of mixed waste, dangerous waste, and PCB waste must meet a number of regulatory requirements. For some of these requirements, the regulations allow exemptions provided that certain conditions are met (Table 2-1). One of the requirements for which an exemption may be granted is the requirement for liner/leachate collection systems. This section describes the specific regulatory requirements for mixed waste and PCB waste landfill liner/leachate collection systems applicable to reactor compartments in trench 94 and describes the conditions that must be met to obtain an exemption. The approach to be applied to satisfy these requirements also is described, including specific performance objectives and a criterion to be used to determine whether requirements have been met.

2.1 REGULATORY REQUIREMENTS

The following discusses the WAC 173-303-665(2) regulations determined to be applicable to liner/leachate collection systems and their exemption. The approach for the exemption request is to meet all the following applicable conditions for exemption:

- Condition given in WAC 173-303-665(2) to prevent the migration of any dangerous constituents into the groundwater or surface water at any future time

- Condition given in 40 CFR 761.75(c)(4) for no unreasonable risk.

2.1.1 Requirements of Washington Administrative Code Chapter 173-303

Requirements for mixed waste and dangerous waste landfill liner/leachate collection systems are given in WAC 173-303-665(2). Under WAC 173-303-665(2)(a)(i), dangerous waste landfills are required to have a liner "that is designed, constructed, and installed to prevent any migration of wastes out of the landfill to the adjacent subsurface soil or groundwater or surface water at anytime during the active life (including the closure period) of the landfill. The liner must be constructed of materials that prevent wastes from passing into the liner during the active life of the facility". Under WAC 173-303-665(2)(a)(ii), dangerous waste landfills are required to have "a leachate collection and removal system immediately above the liner that is designed, constructed, maintained, and operated to collect and remove leachate from the landfill". Under WAC 173-303-665(2)(h), a landfill unit that commences construction on a lateral expansion after July 29, 1992 must install two or more liners and a leachate collection and removal system above and between such liners.

Provisions for exemptions from liner/leachate collection system requirements are given in WAC 173-303-665(2)(b). Exemptions could be given if Ecology finds, based on a demonstration by the owner or operator, that alternative design and operating practices, together with location characteristics, would prevent migration of any dangerous constituents into the groundwater or surface water at any future time. Specific requirements for exemption requests in permit applications are given in WAC 173-303-806(4)(h)(ii)(A). These requirements include detailed plans and engineering and hydrogeologic reports, as appropriate, describing alternate design and operating practices that will, in conjunction with location aspects, prevent the migration of any dangerous constituent into the groundwater or surface water at any future time.

Conditions for waiver of the minimum technological design requirements are contained in WAC 173-303-665(2)(j). Waivers may be granted if the owner/operator demonstrates that alternative design and operating practices, together with location characteristics: "Will prevent the migration of any dangerous constituent into the groundwater or surface water at least as effectively as the liners and leachate collection and removal systems" and "will allow detection of leaks of dangerous constituents through the top liner as least at effectively".

2.1.2 Requirements of Title 40 Code of Federal Regulations Part 761

Requirements for liner/leachate collection systems for chemical waste landfills used to dispose of PCBs are given in 40 CFR 761.75(b). Under 40 CFR 761.75(b)(1), chemical waste landfills are required to be located in thick, relatively impermeable formations such as large-area clay pans. Where this is not possible, the soil will have a high clay and silt content with the following parameters:

(i) In-place soil thickness, 1.2 meters or compacted soil liner thickness, 0.9 meter;

(ii) Permeability (cm/sec), equal to or less than 1×10^{-7};

(iii) Percent soil passing No. 200 sieve, <30;

(iv) Liquid limit, <30; and

(v) Plasticity index <15.

Alternately, under 40 CFR 761.75(b)(2) "synthetic membrane liners shall be used when, in the judgment of the Regional Administrator, the hydrologic or geologic conditions at the landfill require such a liner in order to provide at least a permeability equivalent to the soils in paragraph (b)(1) of this section." Under 40 CFR 761.75(b)(7), a leachate collection system is required consisting of: (1) a gravity flow drain field installed above the liner, (2) a gravity flow drain field installed above the liner and above a secondary liner, or (3) a network of suction lysimeters installed along the sides and under the bottom of the liner.

Conditions for the waiver of liner/leachate collection system requirements are contained in 40 CFR 761.75(c)(4). A waiver for chemical waste landfill requirements may be granted by the EPA Administrator, Region 10, if the owner/operator submits evidence that "operation of the landfill will not present an unreasonable risk of injury to health or the environment from PCBs when one or more of the requirements of paragraph (b) of this section are not met."

2.2 APPROACH TO LINER/LEACHATE COLLECTION SYSTEM EXEMPTION REQUEST

The following sections discuss the regulatory approaches to a liner/leachate collection system exemption request.

2.2.1 Approach to Washington Administrative Code Chapter 173-303

Washington State requirements for landfills are contained in WAC 173-303-665(2). The basic design to which the alternate design (i.e., reactor compartment burial in an unlined trench) will be compared is the Ecology minimum technological design specified in WAC 173-303-665(2)(h), which requires liners and leachate collection systems.

The results of a detailed site-specific lead migration study show that the trench 94 location characteristics will prevent migration of lead from reactor compartments to the unconfined aquifer or to the Columbia River for very long periods of time [hundreds of thousands of years or greater (PNL 1992)]. Available data on the geology, geochemistry, and geohydrology of the disposal site were used to develop a conceptual model for release and transport of lead from the reactor compartments. Laboratory studies were performed to provide information needed for the model that was not available from existing databases.

The condition for waiver of minimum technological design requirements under WAC 173-303-665(2)(j) for each new landfill unit on which construction commences after January 29, 1992, and each lateral expansion of a landfill unit on which construction commences after July 29, 1992, is that alternative design and operating practices, together with location characteristics: (i) "Will prevent the migration of any dangerous constituent into the ground water or surface water at least as effectively as the liners and leachate collection and removal systems" and (ii) "Will allow detection of leaks of dangerous constituents through the top liner at least as effectively." The minimum technological design relies on the use of engineered features (i.e., liner/leachate collection system) to prevent the release of dangerous constituents to the environment. These features have a finite lifetime after which a release can occur and a finite lifetime during which the features can be operated to prevent release of contaminants. The effective lifetime of these features, therefore, is the reasonable time for which the minimum technological design should be expected to prevent the release of dangerous constituents to the environment.

It will be demonstrated that the design and operating practice of the reactor compartment package buried in an unlined trench will contain the dangerous constituents within the reactor compartments for a much longer period than the expected design life of the geosynthetic liner components.

2.2.2 Approach to Title 40 Code of Federal Regulations Part 761

The condition for a waiver from liner/leachate collection system requirements under 40 CFR 761.75(c)(4) requires prevention of unreasonable risk of injury to health or the environment due to PCBs. The design required under 40 CFR 761.75(b) consists of only a single liner with a leachate collection system. The minimum technological design requires double liners and leachate collection systems and, therefore, is more protective of the environment and will result in less risk than the design required under 40 CFR 761.75(b). The resultant risk from the minimum technological design, therefore, is judged to be 'reasonable'. An alternate design, which is demonstrated to have better performance than the minimum technological design, also will result in 'reasonable' risk.

2.3 PERFORMANCE OBJECTIVES AND CRITERION

In the preceding section, conditions were established that, if met, will allow exemption from liner/leachate collection system requirements. In this section, specific, measurable performance objectives and criterion of the alternate landfill design are defined to determine whether these conditions have been met.

Performance is evaluated for both the active life of the unit and the period after the active life. The active life is defined as the period from initial receipt of dangerous waste until certification of final closure, which is effectively the period preceding installation of a cover. The period after the active life will include a postclosure care period for the 218-E-12B Burial Ground. For the purpose of the performance evaluations, the postclosure care period is defined as the period 30 years after final closure of the 218-E-12B Burial Ground*. This definition is consistent with postclosure care requirements given in WAC 173-303-610(7).

The following sections establish the specific performance objectives and criterion.

2.3.1 Performance Objectives and Criterion to Demonstrate Better Performance than the Minimum Technological Design Requirements for Liner/Leachate Collection Systems

As the WAC 173-303-665(2) liner/leachate system minimum technological design requirements are more stringent than the TSCA requirements, the

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*The period 30 years after final closure of the 218-E-12B Burial Ground extends more than 30 years beyond final closure of trench 94 because the burial ground could be closed in phases (Chapter 11.0).

WAC 173-303-665(2) requirements will be the basis for comparison of the performance objective.

The preamble to the final minimum technological requirement rules states that "The goal of liners and leachate collection systems is to prevent migration by collecting and removing leachate before it can migrate during the unit's active life and post-closure care period" (51 FR 60, p. 10708). This was reiterated in the preamble to the rules as amended in response to the requirements of the 1984 HSWA to RCRA (57 FR 3462). This objective recognizes that at many landfills leachate will be generated during the active life and will continue to be generated during the postclosure care period. An impermeable cover is installed at closure to promote drainage and to provide long-term minimization of liquid migration through the landfill. Thus, the minimum technological performance objective will be the basis for comparison. The minimum technological design performance objective is to prevent leachate migration from the landfill unit by collecting and removing leachate before the leachate can migrate during the active life of the unit and the postclosure care period.

Trench 94 has been in operation since 1986 without burial of the reactor compartments placed there. This mode of operation allows flexibility in the disposal of this unique waste and this practice could continue until installation of the final RCRA cover. The following operating practices are employed to monitor the condition of the reactor compartments until they are buried. Each week a nuclear operator performs an inspection of trench 94. The reactor compartments are visually inspected to verify their integrity. In addition, trench 94 is inspected for run-on, run-off, and erosion problems after a significant precipitation or windstorm event. Further corrective actions are discussed in the building emergency plan (Chapter 7.0).

The performance of the alternate design must be at least as effective as the liners and leachate collection and removal system of the minimum technological design and must allow detection of leaks of hazardous constituents through the top liner at least as effectively. It can be concluded that the performance of the minimum technological design will be exceeded if generation of contaminated leachate is prevented beyond the expected lifetime of the minimum technological design. Therefore, the performance criterion selected for evaluating the alternate design is as follows:

> Demonstrate that the alternate design and operating practice, together with location characteristics, prevent generation of any contaminated leachate beyond the expected design lifetime of the minimum technological liner/leachate collection system design.

Section 4.0 demonstrates that the containment provided by the reactor compartment package outlasts the expected design life of a liner/leachate collection system, and that no contaminated leachate will be generated during the active life and postclosure period of the unit.

2.3.2 Performance of Designs After Expected Lifetime of a Liner/Leachate Collection System

This section addresses performance of the disposal system design after the expected lifetime of a liner/leachate collection system.

As discussed in Sections 2.3.1 and 2.3.2, the liner/leachate collection systems are intended to prevent migration of contaminants during the active life and postclosure care period of the unit. Liner/leachate collection systems are not designed specifically to provide long-term control over migration of contaminants; the cover provides that function by preventing the infiltration of water. In the preamble to the final minimum technological requirement rules, the EPA (51 FR 60, p. 10711) stated the following:

"Based on presently available information, the Agency does not view liner systems as the primary means of controlling the migration of hazardous constituents in the long term. The Agency continues to believe that liners are best used to facilitate the collection and removal of leachate (47 FR 32284, July 26, 1982). Because the function of liner systems then, is relatively short-term in nature, as opposed to providing protection for many decades or even hundreds of years, the effectiveness of liners is overshadowed by other factors that include: (1) the nature of the location of the unit with respect to climate, hydrogeology, and population, (2) the nature of the waste in the unit, and (3) the long-term performance of the final cover that is placed over the unit at closure."

For many hundreds of years, the reactor compartment package will prevent migration of contaminants. Over the very long periods of interest with respect to preventing contaminant migration, however, neither the liner/leachate collection system nor the reactor compartment (which will outlast the liner/leachate collection system) will prevent contaminant migration. Over the very long timeframes under consideration, even the cover cannot be expected to withstand the elements and remain fully functional. Thus, the factors that most influence the potential for long-term contaminant migration are the hydrogeologic and geochemical characteristics of the disposal site. Therefore, Section 4.0 also addresses the performance of the disposal system over these very long timeframes.

Table 2-1. Comparison of Regulatory Requirements for Liners, Leachate Collection, and Exemptions.

Requirement	Dangerous waste regulations	PCB regulations
Liner(s)	WAC 173-303-665(2) requires liners that will prevent migration out of the landfill during the active life.	40 CFR 761.75(b) requires landfill to be located in thick relatively impermeable formations or to have 0.9 to 1.2 meters of compacted soil liner or in place soil having a permeability less than or equal to $1x10^{-7}$ cm/sec, etc.
Leachate collection	WAC 173-303-665(2) requires a leachate collection and removal system above and between liners. WAC 173-303-665(2)(h) requires a leachate collection and removal system above and between the liners (refer to note).	40 CFR 761.75(b) requires leachate collection system above the liner.
Exemption conditions	WAC 173-303-665(2)(b) allows for exemptions from liner and leachate collection requirements upon demonstrating no migration of dangerous constituents to surface water or groundwater at any future time.	40 CFR 761.75(c)(4) allows for waiver of liner and leachate collection system requirements of 40 CFR 264.301(c) upon demonstrating no unreasonable risk from PCBs.
	WAC 173-303-665(2)(j) allows for approval of alternative design or operating practices upon demonstration that design will prevent migration of dangerous constituents into the groundwater and will allow detection of leaks of dangerous constituents through the top liner.	

CFR = Code of Federal Regulations.
PCB = polychlorinated biphenyl.
WAC = Washington Administrative Code.
cm/sec = centimeter per second.

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3.0 NATURE AND QUANTITY OF WASTE

This section describes the reactor compartment waste that will be disposed of in trench 94.

3.1 WASTE CHARACTERISTICS

Each reactor compartment package is that section of the ship containing the nuclear reactor plant. The nuclear reactor plant consists of the reactor vessel, steam generators, pumps, valves, and piping. Figure 3-1 provides typical dimensions and weights of reactor compartment packages. The reactor compartments are completely sealed by welding to prevent release of the radioactive and dangerous materials contained within the reactor compartments. All nuclear fuel has been removed from the reactor compartments; therefore, the radioactive materials remaining in the reactor compartments consist only of activation products from operation of the nuclear reactors. Figures 3-2 and 3-3 provide general cross-sections of typical submarine and cruiser reactor compartment packages. Before shipment to the Hanford Facility, the reactor compartment is removed from the decommissioned/defueled ship. Removal of the reactor compartment from the ship includes the following:

- Removing spent nuclear fuel from the reactor
- Removing liquids that can be pumped or drained
- Removing wool felt sound damping material that contains PCB (when present)
- Cutting and sealing radioactive system piping at the reactor compartment boundary
- Cutting the reactor compartment from the rest of the ship
- Sealing the reactor compartment with welded steel plates
- Testing the reactor compartment package to verify that all penetrations and openings have been closed and sealed to meet U.S. Department of Transportation and Nuclear Regulatory Commission standards. Once prepared for shipment, the reactor compartment is a completely sealed unit.

The reactor compartments each contain more than 90.7 metric tons of permanently installed lead shielding in the form of panels or poured-in-place lead contained within thick metal sheathing plates. The thick metal encapsulation of this lead, as originally constructed, meets the treatment standards of 40 CFR 268.42, Treatment Code MACRO, for disposal of radioactive lead solids, including lead shielding. Work during the reactor compartment preparation process maintains this encapsulation with no treatment of the lead shielding occurring. The PSNS has studied the feasibility of removing this lead from the reactor compartments (Section 1.0).

The presence of the large quantity of lead as a dangerous waste constituent within the reactor compartments causes the reactor compartments to be regulated as 'state-only' dangerous waste for disposal under WAC 173-303.

The reactor compartments also could contain several kilograms of PCBs (typically less than 5 kilograms) tightly bound in the composition of solid materials such as thermal insulation, electric cable coverings, and rubber items manufactured before PCBs were banned. Because the PCBs currently are present in materials in concentrations over 50 parts per million, the reactor compartments in trench 94 are regulated under 40 CFR 761. The PCB containing materials are distributed widely throughout the reactor compartment, and their removal is difficult and would result in significant exposure of personnel to radiation. These PCBs are contained totally within the fully sealed, all-welded reactor compartment packages. Some reactor compartments considered for disposal under the 1996 EIS might not contain solid PCBs in regulated concentration due to their later date of construction. These reactor compartments also would be placed at trench 94 under the preferred alternative.

A variety of other hazardous materials could be present in small amounts in reactor compartments, including silver plating on electrical contacts; silver brazing alloys; cadmium plating or fasteners and components; chromates; amines, and ethylene glycol in small pockets of residual liquid; arsenic trioxide in glass; cyanoacrylate adhesive; and paints containing cyanide, red lead, lead napthenate, coal tar, and chromium trioxide. Preliminary investigations indicate these materials at below regulated levels for the reactor compartments considered for disposal under the 1996 EIS. This is consistent with the conclusions of earlier work conducted in support of the current reactor compartment disposal program (PSNS 1990b). Reactor compartments constructed before the mid-1970s also contain thousands of kilograms of asbestos in the insulation on pipes and other components. The asbestos would be fully contained within the reactor compartment package, complying with 40 CFR 61. The reactor compartments are a unique, integrated waste form that is both containment and waste. Thus, the entire reactor compartment disposal package is the waste under evaluation. For cruiser reactor compartments, the reactor compartment forms part of the containment that would be supplemented by exterior structure built around the reactor compartment, enclosing the reactor compartment to form the disposal package. For these packages, the supplemental structure would not be considered part of the waste when evaluated.

Residual liquid is removed from the reactor compartments to the maximum extent practical, while keeping radiation exposure to workers ALARA. Federal radiation exposure guidelines require that nuclear work be accomplished in a manner that keeps radiation exposure to workers and the public ALARA (10 CFR 20). Proven liquid removal methodologies used for the current reactor compartment disposal program would be adapted for the reactor compartments considered for disposal under the 1996 EIS. Residual liquid in reactor compartments is trapped in pockets within valves, pumps, tanks, vessels, and other inaccessible piping system components of the reactor plant and associated ship support systems (widely distributed in over 300 discrete locations for current reactor compartments). The piping and components of the reactor plant and associated ship support systems are designed and intended to hold water for a use other than storage (e.g., the transfer of heat energy from the reactor to produce steam for propulsion). The reactor plant and associated ship support systems are a part of the reactor compartment disposal package, a unique integrated waste form that also contains a number of other structures designed to perform other functions not related to liquid containment. However, the reactor compartment package provides multiple barriers to liquids within the structures. Absorbent also is added to a shield tank and the reactor vessel, when component configuration allows, in quantities calculated to absorb two times the maximum residual liquid volume that could be present. Ecology has determined that the reactor compartment packages are protective of the environment and in compliance with WAC 173-303 (Attachment 2).

3.2 WASTE PACKAGE STRUCTURAL DESCRIPTION

Figures 3-2 and 3-3 provide cross-sections of typical reactor compartment packages. Major structural components are shown. The ship's hull and inner bulkheads provide barriers for containment of materials within the reactor compartment packages and provide strength to the packages. External structures installed by PSNS provide additional strength and containment to seal the packages.

The containment lifetime of the reactor compartment package is discussed in Section 4.0 and is based on these figures.

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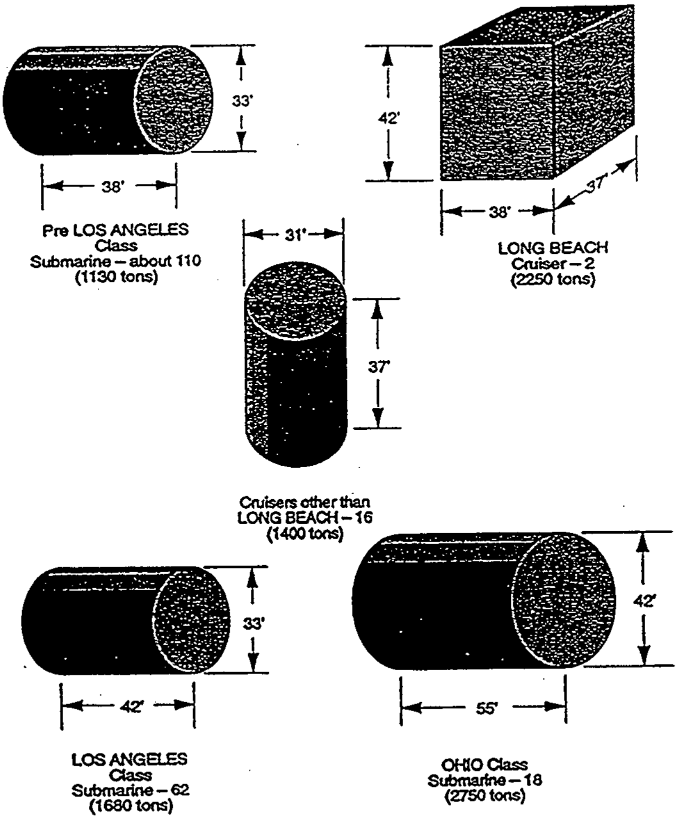
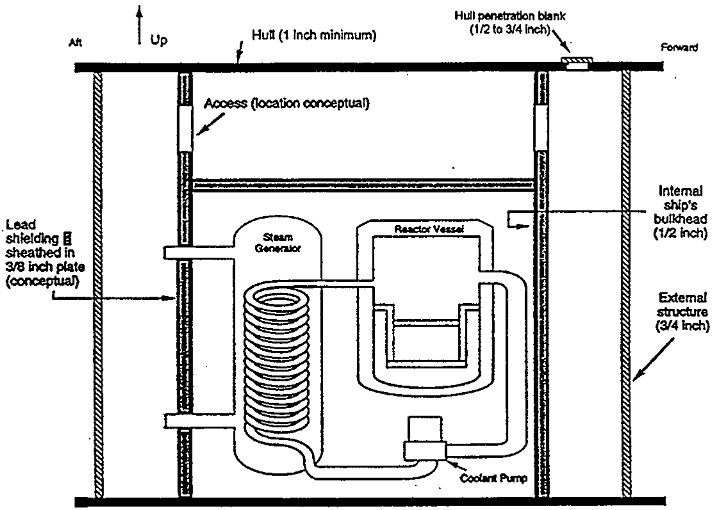


Note: Dimensions and weights are approximate. Quantities are current projections.

Figure 3-1. Comparison of Reactor Compartment Packages.



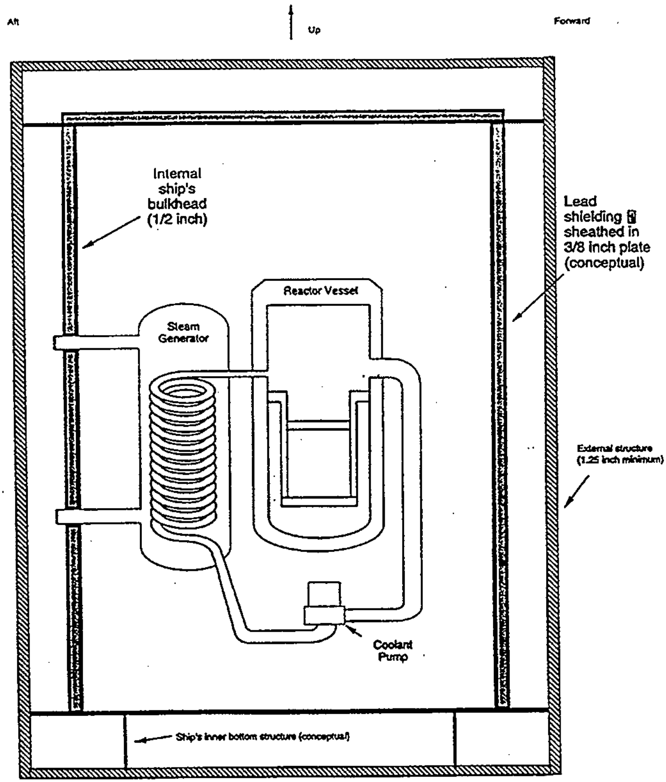
General Notes:

(1) PSNS installed structure is cross hatched:

(2) There are a limited number of small diameter penetrations through the hull (e.g., about 10 with maximum 6 inch diameter is typical for pre-LOS ANGELES Class ships). These are sealed with 1/2 to 3/4 inch blanks (typical location shown).

(3) On some submarines, the aft end of the hull tapers inwards with an external shelf (at least 3/8-inch thick) forming a ballast tank external to the hull.

Figure 3-2. General Cross-Section of Typical Submarine Reactor Compartment Package.



General Note:
PSNS installed structure is cross hatched:

Figure 3-3. General Cross-Section of Typical Cruiser Reactor Compartment Package.

4.0 PERFORMANCE EVALUATION

The purpose of this section is to demonstrate that the following performance criterion is satisfied. The criterion was established in Section 2.3.1, as meeting the regulatory requirements for obtaining an exemption from the lined trench and leachate collection system requirements for dangerous waste landfills. The performance criterion is as follows:

Demonstrate that the alternate design (i.e., burial without a liner/leachate collection system) and operating practices, together with location characteristics, prevent generation of any contaminated leachate beyond the expected lifetime of the minimum technological liner/leachate collection system design.

Sections 2.1.1 and 2.2.1 discuss the minimum technological requirements that hazardous waste landfills have two or more liners and a leachate collection system above and between the liners. The liner/leachate collection design life is discussed in Chapter 4.0. Studies on estimated lifetimes of geosynthetics have been performed (WHC 1991b, WHC 1992a). It has been noted that "buried HDPE is expected to have a lifetime of about 50 years, while more optimistic studies cite evidence that indicates polypropylene geotextiles could survive as long as 200 years" (WHC 1992a).

The performance of the cover (Chapter 11.0) will affect the overall performance of the 218-E-12B Burial Ground. The cover will limit further the amount of moisture available to corrode the reactor compartments. The amount of lead or PCBs that could be reached from the waste in trench 94, after ultimate breach of the reactor compartment containment, will be controlled by the amount of moisture that can migrate through the cover to contact the waste and the chemistry of this moisture.

This section demonstrates that the criterion is met and that no benefit would result from using liner/leachate collection systems.

4.1 INTEGRITY OF THE REACTOR COMPARTMENT PACKAGE

For the following reactor compartment integrity corrosion studies, credit was not taken for the presence of the cover.

The thick structure of reactor compartment packages inherently provides a very high-integrity waste package. The packages have substantial ability to contain waste for a long time.

Waste containers are required to be at least 90 percent full when placed in a landfill to minimize subsidence. Although this rule is not directly applicable to the reactor compartments, which are a unique, integrated waste form that is both containment and waste, the capacity of the reactor compartment package structure to withstand soil loading at trench 94 was evaluated. For submarine reactor compartments (Figure 3-2), the hull and external structure on each end make up the outer containment boundary. These structures easily can withstand the soil pressure of burial. Cruiser reactor compartments (Figure 3-3) would perform comparably given their thick external structure. All of the radioactivity, lead, and PCBs in the reactor compartments are contained within these boundaries. Burial of the reactor compartment packages will not compromise their containment integrity. There will not be subsidence in the landfill cover due to package containment failure over the cover's engineered design life as a moisture barrier.

The integrity of the reactor compartment is its ability to provide a containment barrier to prevent the lead shielding and PCB containing materials from contacting the environment. The time required for corrosion of the reactor compartment to allow exposure of lead and PCBs to the environment depends on the corrosion rate of steel in trench 94, the thickness of the steel barriers, and the ability of the reactor compartment to withstand soil pressure after its structure is weakened by corrosion.

4.1.1 Reactor Compartment Corrosion Studies

The Naval Civil Engineering Laboratory (NCEL) study (Attachment 3) quantified corrosion of reactor compartments in trench 94 using two approaches. First, corrosion information from the National Institute of Standards and Technology (NIST) (formerly National Bureau of Standards) test sites was researched to obtain data from test sites with soil conditions similar to the Hanford Facility (Attachment 4). Second, the NCEL reviewed the *Underground Fuel Storage Tank Corrosion Study* (WHC 1992b), which reported the results of the inspection of recently unearthed fuel storage tanks on the Hanford Facility to determine their rate of corrosion. The following discussion is derived from these studies.

Steel buried in soil experiences both general and pitting* corrosion. General corrosion is the type of corrosion that is uniformly distributed over a metal surface. Conversely, pitting corrosion is a localized corrosion that results in small pits or cavities randomly distributed over a surface. The pits result from variations in the environment in contact with the surface of the steel that cause local variations in the corrosion rate. It is important to note that for carbon steel, the pitting rate decreases with time because of corrosion products that accumulate on the surface of the metal and that retard the pitting process. Thus, in the early years of burial, steel will exhibit a higher pitting rate. As the corrosion products accumulate on the steel surface, the pitting process slows down. The pit will continue to get deeper, but at a progressively decreasing rate.

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*The term 'pitting' used in this report refers to the type of local corrosion that forms pits when carbon steels corrode in soil and where the rate of pit propagation decreases with time. This is not the same as pitting corrosion associated with passive metals such as stainless steels when these steels are exposed to solutions containing halide ions, where the rate of pit propagation increases with time.

Factors that affect the rate of corrosion of steel in soil include soil resistivity, soil chloride content, soil sulfate content, and soil acidity (pH). Site-specific data were collected at trench 94 to determine the corrosion potential of the soils in which the reactor compartments will be buried.

The soil resistivity was measured at depths of 3, 6, 9, 12, and 15 meters at each of six locations around the perimeter of and adjacent to trench 94 using the Wenner Four Electrode Method [Standard Method G-57-78 (ASTM 1989)], identified in Attachment 5. The results of this investigation indicate that the soils at and near trench 94 are generally of high resistivity and present a low corrosion potential. Soil resistivity values ranged from 10,140 ohm-centimeter to 166,305 ohm-centimeters, with an average of 31,000 ohm-centimeter. For comparison, values above 10,000 ohm-centimeters are considered by the National Association of Corrosion Engineers (NACE) to indicate low relative corrosion rates. Although resistivity is a good indicator of soil corrosivity, the resistivity data used alone do not allow calculation of site-specific corrosion rates for the reactor compartments in trench 94.

Soil samples were taken from representative locations in trench 94 and tested for moisture content and soil chemistry, including pH, and chloride and sulfate concentrations.

Information from NIST corrosion test sites with soil characteristics comparable to those at trench 94 was evaluated. These sites (Springfield, Ohio; Los Angeles, California; and Salt Lake City, Utah) provided a good indication of expected corrosion rates for trench 94. Corrosion data from these NIST test sites showed a pitting corrosion rate that ranged between 0.0058 and 0.0091 centimeter per year for bare uncoated steel. These comparisons are shown in Attachment 3, Table 1. The NCEL predicts the pitting corrosion rate for trench 94 actually to be lower than the values from the comparison sites because the soil resistivity at the 218-E-12B Burial Ground is significantly higher than at the comparison sites.

Based on these comparisons, the maximum pitting rate is predicted to be no more than 0.0089 centimeter per year. A linear projection predicts a maximum pit depth of 0.89 centimeters in 100 years. However, a pit depth of 0.254 centimeter in 100 years is more likely (averages to an expected pitting rate of 0.0025 centimeter per year) because of the benign conditions that are established in the controlled burial of reactor compartments in trench 94, and the fact that the pitting rate for steel buried in soil will not follow a linear rate, but actually will decrease with time.

These predicted values were supported by the data obtained from inspection of fuel storage tanks unearthed at the Hanford Facility (WHC 1992b). Sixteen underground fuel storage tanks were exhumed from soil between 1989 and 1990. These tanks were constructed of carbon steel somewhat similar to the steel of the reactor compartments. The tanks had been buried for as long as 46 years and provided good evidence of the expected performance of steel buried at the Hanford Facility over long periods (WHC 1992b).

An independent review of the NCEL study was performed by NIST, who combined the NCEL data from comparison sites and performed a linear regression analysis to evaluate the validity of the linear model used by NCEL to predict pitting at 100 years (Attachment 4). Based on analysis of these data, the expected maximum pit depth in samples buried at the NIST sites for 100 years is 0.553 ± 0.262 centimeter) with a 99 percent confidence interval (dashed lines Figure 1, Attachment 4). This averages to a pitting rate of 0.005 ± 0.0014 centimeter) per year (solid line of Figure 1, Attachment 4). Considering that trench 94 has higher resistivity than the NIST sites used for comparison, and considering that a linear projection to estimate maximum pit penetration provides a conservative estimate, the NIST review indicated that the estimated maximum pit depth in steel buried in the trench 94 environment will be less than 0.89 centimeter after 100 years with an expected pit depth of 0.25 centimeter in 100 years being reasonable. These 100-year pit depths, when converted to linear pitting rates, result in a maximum pitting rate of 0.0089 centimeter per year and an expected pitting rate of 0.0025 centimeter per year.

4.1.2 Reactor Compartment Package Expected Lifetime

Based on the containment thicknesses presented in Section 3.2, and the predicted corrosion rates, the containment lifetime of the reactor compartments can be calculated. For submarine reactor compartments, the earliest time to penetration of the 1.27-centimeter-thick plates (covering small diameter hull penetrations on older reactor compartments at trench 94) is 143 years, using the maximum pitting corrosion rate of 0.0089 centimeter per year. Using the expected pitting corrosion rate of 0.0025 centimeter per year, the covers would not be penetrated for 500 years. It would take 1.5 times as long to penetrate the 1.9-centimeter-thick hull penetration covers currently installed on submarine reactor compartments and the 1.9-centimeter-thick plate forming the ends of submarine reactor compartment packages. It would take even longer to penetrate the minimum 3.18-centimeter-thick exterior structure of cruiser reactor compartment packages.

Pitting corrosion of the 1.27-centimeter-thick cover plates is, however, unlikely to be the controlling factor in exposing contaminants to the soil. Pitting corrosion initially would result in only very small pits (0.159 centimeter diameter) randomly distributed over the surface of the reactor compartment. Because of the arid climate, and dry nature of in situ soil at trench 94, the soil above the reactor compartments (when buried) is not expected to become saturated with water, and thus moisture should not separate from the soil and enter pits at the reactor compartment surface. In addition, these pits will not allow soil to enter the reactor compartment in any significant quantity. Because of the geometry of the reactor compartment, small amounts of soil entering through pits in the 1.27-centimeter covers will not contact contaminants. Oxygen depletion will inhibit corrosion in the sealed reactor compartments until the time the containment is penetrated by external corrosion. An analysis of corrosion failure of the reactor compartments indicates that the first significant contact of soil with lead probably will occur when general corrosion weakens external containment structures to the degree where soil loading causes the structures to rupture.

Pitting corrosion rates are based essentially on the depth of the deepest pit measured on a test surface. Figure 4-1 depicts a typical corrosion profile on a corroded steel surface. Pit depth and volume, shown by the solid line, vary across the surface. This variation can be normalized across the corroded surface to a uniform reduction in metal thickness (shown by the dashed line). This is accomplished by measuring the weight loss of the corrosion specimen, converting to a metal volume loss by use of a material density, and applying this volume loss across the entire surface. Dividing this uniform thickness reduction over a time period produces a general (uniform) corrosion rate. General corrosion rates in soils are significantly lower than pitting rates. Table 4-1 is a list of 'maximum penetrations' (pitting rates) and 'average penetrations' (general corrosion rates) derived from NIST corrosion test sites. The ratio of pitting rate to general corrosion rate is called the pitting factor. To estimate the general corrosion rate from a predicted pitting rate, the pitting rate is divided by the pitting factor. As shown, the general corrosion rates in soils considered to be similar to those in trench 94 are approximately 10 times less than the pitting rates (pitting factor of 10). To be conservative, general corrosion rates for trench 94 were estimated using a pitting factor of 6, thus set at 1/6th the pitting rates predicted by NCEL vice 1/10th as the data would suggest. Using this ratio, the maximum long-term general corrosion rate for trench 94 would be 0.0015 centimeter per year based on the maximum 0.0089 centimeter per year pitting rate predicted by NCEL. Similarly, an expected long-term general corrosion rate of 0.0005 centimeter per year would be calculated from the expected pitting rate of 0.0025 centimeter per year.

General corrosion eventually will cause reactor compartment package containment structures to be unable to resist the pressure exerted by the soil, causing the structures to rupture. The capacity of these structures to withstand soil loading is evaluated. The 1.9-centimeter-thick containment structure forming the ends of submarine reactor compartment packages (spanning most of the hull diameter) is expected to be the limiting case in this regard, rupturing before the small cover plates. The earliest time at which rupture occurs is approximately 600 years, using the maximum general corrosion rate of 0.0015 centimeter per year. Using the expected general corrosion rate of 0.0005 centimeter per year, rupture would not occur for approximately 2,100 years. Even then, only a small amount of lead would be exposed because there is typically 0.95-centimeter-thick steel plate covering the lead shielding panels inside the reactor compartment packages. Cruiser reactor compartments are expected to be as durable as submarine reactor compartments due in part to the minimum 3.18-centimeter-thick external structure of these reactor compartment packages.

It is important to note that the structures being discussed are separated from the internal shielded bulkheads of the reactor compartment. Even after the external containment structures begin to fail, structural support would be provided by the internal shielded bulkheads and, for submarines, also internal hull stiffeners, which have not been exposed to soil.

It is concluded that pitting corrosion will not penetrate the thinnest containment plating (the small 1.27-centimeter-thick hull penetration covers on submarine reactor compartments) for at least 143 years and more likely about 500 years; however, this penetration would not result in generation of contaminated leachate. Using a conservative approach, the first potential generation of contaminated leachate would not occur for about 600 years at the minimum and more likely about 2,000 years, as a result of general corrosion and soil pressure causing the rupture of external containment structures allowing soil to enter areas containing lead shielding.

4.2 LEAD MIGRATION

Leachate can be generated when waste is contacted by moisture that infiltrates down through the soil. The characteristics of the leachate, combined with the geochemical and geohydraulic properties of the soil, determine how quickly and at what concentration contaminants will reach groundwater. This section discusses the potential of the lead shielding in the reactor compartments to dissolve and migrate to groundwater (the unconfined aquifer) and to surface water (the Columbia River). Section 4.5 discusses the migration potential of the PCBs contained within the reactor compartments.

Lead is relatively stable and insoluble in the environment and does not readily form leachate through dissolution or by soil chemical reactions. Additionally, soil has a strong tendency to adsorb lead and lead compounds. Thus lead will not migrate readily from the reactor compartments to groundwater. However, the detrimental health effects of lead cause lead to be of concern in drinking water, even at very low concentrations. Therefore, the DOE-RL considers that there would be an inherent responsibility to evaluate the potential for the lead in the reactor compartment to migrate to groundwater and to potential future downstream users, even if this were not required to support a request for exemption from lined trench requirements.

4.2.1 Lead Migration Analysis

A lead migration analysis was conducted by PNL using the site-specific information of trench 94 (PNL 1992). The following discussion summarizes the results of the report.

Over the future millennia, the reactor compartments will be subject to degradation by the natural environment, primarily through corrosion caused by chemical weathering, and dissolution by vertically infiltrating water. The resulting leachate (infiltrating water containing solute) will drain downward through the unsaturated vadose zone under the influence of gravity until the leachate enters the unconfined aquifer, where the leachate would disperse and would be transported to the Columbia River. Some materials are transported at the same velocity as the water in which the materials are dissolved. Others are retarded by soil adsorption mechanisms. These mechanisms are represented by a retardation factor (R), which is the ratio of the velocity of the water to the velocity of the solute. These transport processes occur very slowly in the dry, slightly alkaline Hanford Facility soils.

The potential for lead within the reactor compartments to enter groundwater under the 218-E-12B Burial Ground was investigated by examining available data on the geology, geochemistry, and geohydrology of the 218-E-12B Burial Ground. The data were used to develop a conceptual model for release and transport of lead from the reactor compartments. This model assumes that the geology of the site will remain constant over the future millennia. The characteristics of the Hanford formation beneath the burial ground were investigated using existing data and by sampling soil from the excavated faces of trench 94. Strata in the faces of trench 94 were mapped, and drilling logs from boreholes and wells adjacent to the 218-E-12B Burial Ground were used to map sediment in the strata between the floor of trench 94 and the basalt formation. Sediment samples collected at trench 94 and a limited number of samples from borehole cuttings were tested to determine their physical and hydraulic properties, including grain size distribution, moisture content, porosity, permeability, and bulk density.

The solubility of lead in Hanford Facility soils and groundwater was predicted using the MINTEQ computer code (PNL 1987a) along with groundwater chemistry data from laboratory analysis of samples from an onsite monitoring well. Laboratory batch adsorption studies and flow through soil column studies were conducted to determine the distribution coefficient (Rd) for lead adsorbed on Hanford formation sediments. These studies also included experiments to determine the effect of other major materials in the reactor compartments, such as nickel, to compete with lead for adsorption by the soil. The retardation factor (R) was calculated using the distribution coefficient (Rd), soil bulk density, and soil porosity.

Computer modeling was employed to quantify the rate of groundwater movement through the vadose zone and the unconfined aquifer, and to predict the rate of lead migration from trench 94 to downgradient locations. The CFEST code was used to produce a two-dimensional model of the regional aquifer to obtain parameters necessary for the lead transport analysis. The TRANSS code (PNL 1986a) was employed to simulate mass flow and transport through the vadose zone and the unconfined aquifer using a one-dimensional stream tube approach. This approach is similar to that used in previously published documents for the Hanford Site (DOE 1987; DOE 1989). The TRANSS code used for the modeling is a less sophisticated code than the VAM3D or PORFLO-3 codes. The TRANSS code was selected because it had been used in previous onsite studies (e.g., DOE 1987; DOE 1989). The TRANSS code provided a relatively uncomplicated approach to generate a conservative model of lead migration. A conservative code uses weighted input parameters to generate the shortest likely migration times and the largest likely groundwater concentrations. Extensive conservatism was built into the one-dimensional TRANSS code analysis.

Results were obtained for a single reactor compartment and for 120 reactor compartments in trench 94, using both current climactic conditions and a potential future wetter condition. The 'recharge' volume of water moving down through the soil was established as 0.5 centimeter per year for the current climate case and 6.0 centimeters per year for the wetter condition, which generally is consistent with values used in other Hanford Site environmental impact studies (DOE 1987; DOE 1989). Neither scenario takes credit for the cover. The models were used to calculate the travel times and potential lead concentrations in the aquifer 100 meters from the reactor compartment burial site, and at a well location 5 kilometers downstream. The travel times and potential concentration of lead in the Columbia River also were calculated.

The results from the PNL lead migration study (PNL 1992) were extrapolated (USN 1995) to consider the cumulative effects of the disposal at trench 94 of all of the reactor compartment types shown in Figure 3-1. A total of 220 reactor compartments were considered in the extrapolation for a conservative estimate of impact. The extrapolation incorporated refinements in the migration modeling developed by PNL after the original lead migration study, namely a more accurate estimate of the amount of recharge water contacting reactor compartments and a more accurate aquifer streamtube dimension. These refinements tended to reduce predicted lead concentrations in the aquifer. The very long times predicted by PNL for lead to migrate to groundwaters were unchanged.

4.2.2 Lead Migration Results

The results of the lead migration studies indicate the following (as extrapolated for 220 reactor compartments at trench 94) (USN 1995; PNL 1992).

- For an arid climate similar to present conditions at a recharge rate of 0.5 centimeter per year:
  - Lead would not reach the unconfined aquifer for 2.2 million years
  - The maximum predicted concentration of lead after 2.2 million years is 4 parts per billion at 100 meters and at 5 kilometers from the reactor compartment burial site
  - Lead would not reach the Columbia River for 2.8 million years
  - The quantity of lead entering the Columbia River would not exceed 94 grams per year (not presented in USN 1995).
- For the wetter condition at a recharge rate of 6 centimeters per year:
  - Lead would not reach the unconfined aquifer for 240,000 years
  - The maximum predicted concentration of lead after 240,000 years is 26 parts per billion at 100 meters and at 5 kilometers from the reactor compartment burial site
  - Lead would not reach the Columbia River for 740,000 years

- The quantity of lead entering the Columbia River would not exceed 1,110 grams per year (not presented in USN 1995).

It is important to note that these studies are very conservative.

- The modeling does not account for the presence of a (moisture barrier) cover.

- The studies conservatively assume that all moisture contacting lead dissolves lead to the maximum concentration of lead that the moisture can hold (i.e., the lead solubility limit). Conservative lead solubilities are assumed at about twice the value obtained through laboratory testing.

- The adsorption of lead in soil is characterized with a Rd that effectively shows the ratio of lead adsorbed in soil to that remaining in solution. Conservative values for this coefficient are assumed at about one-half the values obtained through laboratory testing.

- The one-dimensional TRANSS code simulation of lead mass transport modeling assessed the magnitude of potential problems resulting from contaminant migration. The code was used as a conservative screening tool. In general, this less sophisticated code would be expected to overestimate groundwater concentrations when compared with the results of two- and three-dimensional groundwater flow and transport codes (PNL 1992). The calculations indicate that any lead migration will be tens to hundreds of thousands of years into the future, and the resulting groundwater concentrations will be low.

4.3 POLYCHLORINATED BIPHENYL MIGRATION

The reactor compartments also might contain several kilograms of PCBs (typically less than 5 kilograms) tightly bound in the composition of solid materials such as thermal insulation, electrical cable coverings, and rubber items manufactured before PCBs were banned in the mid-1970's. Because PCBs are present in materials in concentrations above 50 parts per million, disposal of the reactor compartments in trench 94 is regulated by the EPA under TSCA (40 CFR 761). To obtain a waiver from liner/leachate collection system requirements under 40 CFR 761.75(c)(4), it is necessary to demonstrate that this disposal will not present an unreasonable risk to human health or the environment.

The conclusion that these PCBs do not pose an unreasonable risk to human health or the environment is supported by the following.

- **The small amount of PCBs initially present**-- Several kilograms (typically less than 5 kilograms) typically represents only about 3 to 5 parts per million of a whole reactor compartment package. In addition, reactor compartments constructed after PCBs were banned might not contain solid PCBs. No liquid PCBs are present in the reactor compartments.

- **The difficulty of extracting the PCBs from the components or materials**--The initial concentrations of PCBs in leachate will be controlled by solubility of the PCBs present. The potential leachate is water. The PCBs present in the reactor compartments consist primarily of Aroclor* 1254 with lesser amounts of Aroclor 1260 (PSNS 1990b). The water solubilities of these PCB formulations are 0.012 milligrams per liter and 0.003 milligrams per liter, respectively (EPA 1985, p. 4-11). Therefore, even if the PCBs were not tightly bound in the solid materials of the reactor compartment, their solubility in water is extremely low and the potential concentration in leachate is very low. However, the PCBs in the reactor compartments are not free to dissolve in water. The PCBs are part of the formulation of solid materials within the reactor compartment and are tightly bound in the material's matrix. In this form, the PCBs are not measurably soluble and cannot be removed by wipe sampling methods. Thus, the release of the PCBs will be over long periods as the parent materials break down.

- **The small amount of water in the soil**--The arid conditions of the Hanford Facility environment strictly limit the amount of water available to support PCB extraction and transport. Trench 94 soils are a typical mix of Hanford formation sandy gravel and gravelly-sand. The water content in the vadose zone is less than 6 percent by weight.

- **Containment**--The reactor compartments are expected to contain the PCB materials for about 600 years at the minimum and more likely about 2,000 years, at least as long as for lead. The dry soil will inhibit breakdown of the PCB materials.

- **The dilution in the vadose zone and aquifer over very long periods**--The nature of the PCBs and the reactor compartment disposal site severely will restrict the release of PCBs from entering the food chain or being consumed by humans. Using the transport modeling from the lead migration study (PNL 1992), if 1/2 the moisture assumed to contact the reactor compartments (as a result of surface precipitation falling on soil directly above the reactor compartments) is very conservatively assumed to dissolve PCBs at the maximum cumulative solubility of 0.015 milligrams per liter, downstream PCB concentrations in the aquifer under the site should be less than 1/2 part per billion even under the conservative wetter condition case (USN 1995).

- **The attenuation on soil**--It is unlikely that soluble PCBs would travel at the same velocity as the downward percolating water in the vadose zone or in the stream tube in the aquifer. As PCB-contaminated leachate moves through the soil, the PCBs will be retarded by soil attenuation. The primary mechanism for attenuation of water-soluble PCBs is adsorption on organic carbon present in the soil.

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*Aroclor is a trademark of Monsanto Chemicals.

For soil attenuation of organics such as PCBs, a distribution coefficient, K_{oc}, describes the equilibrium ratio of the concentration of contaminant in solid organic carbon to the concentration in the liquid phase (i.e., milligram per kilogram-oc per milligram per liter). Values of K_{oc} for Aroclor 1254 and Aroclor 1260 are 530,000 liters per kilogram and 6,700,000 liters per kilogram, respectively (Mabey et al. 1982). For comparison, the K_{oc} values for typical organic contaminants were reported by Lyman et al. (1982, p. 4-1) to range from 1 liter per kilogram to 10,000,000 liters per kilogram, with the low value representing low adsorption and the high value representing very high adsorption. The values for Aroclor 1254 and Aroclor 1260 are near the upper end of this range, which indicates a high adsorption potential. Even though the organic carbon content in trench 94 soil is low, some adsorption on soil will occur, retarding the PCB migration and potentially further reducing the already low concentrations predicted.

In summary, the containment of the reactor compartment package and the tightly bound nature of the small amount of PCBs present will prevent any migration for many centuries or longer. Any subsequent release and migration of PCBs should occur so slowly, and the concentrations of PCBs that enter the environment will be so small, that it can be concluded that this disposal of PCBs will not present an unreasonable risk to human health or the environment.

4.4 DEMONSTRATION THAT PERFORMANCE EVALUATIONS SATISFY PERFORMANCE CRITERION

This section demonstrates that the results of the previous performance evaluations satisfy the performance criterion of Section 2.3, which was established to determine if the regulatory requirements of WAC 173-303 and 40 CFR 761 for exemption from liner/leachate collection system requirements are met.

4.4.1 Demonstration of Better Performance than Minimum Technological Design Requirements for Liner/Leachate Collection Systems

Section 4.1.2 contains an estimate of the containment lifetime of reactor compartment packages buried in trench 94 using site-specific corrosion studies. Without credit for the cover, and using the 'maximum' pitting corrosion rate of 0.0089 centimeter per year, the first pit would not penetrate the containment for at least 143 years. Using the more probable 'expected' pitting corrosion rate of 0.0025 centimeter per year, the first pit would not penetrate the containment for 500 years. These first small penetrations would occur in the minimum 1.27-centimeter-thick cover plates and would not result in the generation of contaminated leachate. It is estimated that the first potential for generation of contaminated leachate would not occur until general corrosion caused structural failure that allowed the surrounding soil to contact lead. This event would not occur for about 600 years at a minimum, and more likely for about 2,000 years after burial.

It is clear that the optimistic estimate of liner design life falls far short (by an estimated 500 years) of the conservative estimate of reactor compartment containment lifetime (i.e., based on 'maximum' corrosion rates). Thus, the performance criterion is satisfied.

Trench 94 has been in operation since 1986 without burial of the reactor compartments placed there. This mode of operation allows flexibility in the disposal of this unique waste and this practice could continue until installation of the final RCRA cover. The following operating practices are employed to monitor the condition of the reactor compartments until these are buried. Each week a nuclear operator performs an inspection of trench 94. The reactor compartments are visually inspected to verify their integrity. In addition, trench 94 is inspected for run-on, run-off, and erosion problems after a significant precipitation or windstorm event. Further corrective actions are discussed in the building emergency plan (Chapter 7.0).

4.4.2 Demonstration of Long-Term Performance of the Disposal System

Section 4.2.2 summarized the results of the site-specific lead migration studies. The PNL study (PNL 1992) showed that lead is strongly retained by soil adsorption. This result was not affected by the addition of reactor compartments to trench 94 (USN 1995). For the current arid climate condition, using conservative assumptions and the immediate availability of soluble lead, with conservative modeling, lead would not migrate to the aquifer at 100 meters from trench 94 for at least 2.2 million years or to the Columbia River for at least 2.8 million years.

For a potential future wetter condition, using the same conservative assumptions and modeling, lead would not migrate to the aquifer at 100 meters from trench 94 for at least 240,000 years or to the Columbia River for at least 740,000 years.

These timeframes are well beyond the time the Hanford Site geological and hydrological features could be transformed by glacial flooding and scouring (DOE 1987, p. 3.58). The predicted timeframe for return of an ice age is 40,000 to 50,000 years (DOE 1987, p. 5.25). Studies based on previous ice age events postulate that breakthrough of ice dams on upper tributaries of the Columbia River will produce glacial flooding in the Hanford Basin, which reasonably could be expected to scour out the waste sites to a depth of several meters. Then, as flood waters back up at Wallula Gap, the water velocity markedly would decrease and most of the sediments and waste probably would be reworked and redeposited within the Pasco Basin (PNL 1985). Waste in burial ground trenches could be scoured out and either would be carried to the ocean or redeposited along with other sediments in the Pasco Basin. The Hanford Site defense waste EIS indicated that "In any event, such floods would obliterate most evidence of civilization along the Columbia River" (DOE 1987, p. 5.25). Thus, it is generally accepted that events that reasonably cannot be expected to occur within a 100,000-year timeframe should not be considered in environmental evaluations. In fact, most studies are limited to 10,000 years, with a period of interest occasionally extending up to 100,000 years.

It is clear that even the most conservative estimate of the time for lead to reach groundwater or surface water significantly exceeds the timeframes of concern.

4.5 SUMMARY

The information presented in this section has demonstrated that the reactor compartments will outlast, by a considerable margin, the estimated design life of a liner/leachate collection system. This section also has demonstrated that the lead in the reactor compartments will not migrate to groundwater before a timeframe that is beyond the geologist's ability to predict future geologic conditions. Finally, the information presented has demonstrated that the small amount of PCBs in the reactor compartments does not present an unreasonable risk to the environment. These demonstrations satisfy the regulatory requirements for exempting trench 94 from liner/leachate collection system regulatory requirements.

The strong structure of the reactor compartments and the low corrosion rates identified for buried steel at trench 94 provide an excellent barrier to the generation of leachate from the waste. The dry climate and native soil together will further limit any potential movement of lead from the waste. Even when considering future wetter conditions, lead would not reach the groundwater aquifer for about 240,000 years. Over this time, impacts from human activities and geologic events (e.g., next ice age) would be far greater than any impacts from the lead.

Trench 94 has been in operation since 1986 without burial of the reactor compartments placed there. This mode of operation allows flexibility in the disposal of this unique waste and this practice could continue until installation of the final RCRA cover. Weekly inspections of the waste and trench are conducted and will continue until the reactor compartments are buried.

The beneficial site and waste characteristics combined with the operating practices for trench 94 ensure that human health and the environment are protected adequately by the proposed alternative of land disposal of the reactor compartments in an unlined trench with a cover.

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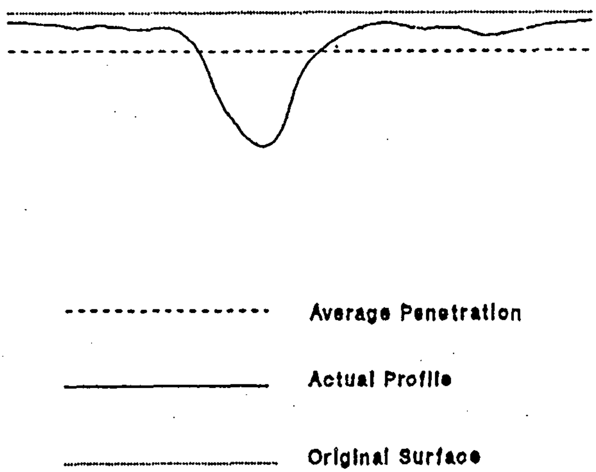

Figure 4-1. Typical Corrosion Profile.

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Table 4-1. National Institute of Standards and Technology Corrosion Test Site Data.

Test site	Maximum penetration rate (inches per year)	Average penetration rate (inches per year)	Pitting factor*
Springfield, Ohio	0.00355	0.00037	9.59
Los Angeles, California	0.00338	0.00028	12.07
Salt Lake City, Utah	0.00229	0.00023	9.96

*Pitting factor = maximum penetration/average penetration.
For conversion to centimeters, multiply inches by 2.54.

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5.0 REQUEST FOR EXEMPTION FROM LINED TRENCH REQUIREMENTS

Section 4.0 provides the following:

- Performance of the proposed alternate design in preventing migration of the only WAC 173-303 regulated dangerous waste constituent, the shielding lead; and performance results from the ability of the site characteristics to strongly attenuate migration of this constituent

- Demonstrates that this performance satisfies the previously stated conditions for waiving liner/leachate collection system requirements (i.e., there is no technical advantage to installing a liner/leachate collection system at trench 94)

- Concludes that not only are the regulatory criteria for waiving liner/leachate collection system requirements satisfied, but in addition, operating practices are employed that are protective of the environment.

Thus, the DOE-RL hereby applies for an exemption from the dangerous waste landfill liner/leachate collection system requirements specified in WAC 173-303-665(2)(a) and WAC 173-303-665(2)(h), under the provisions of WAC 173-303-665(2)(b) and WAC 173-303-665(2)(j), for disposal of reactor compartments in trench 94 of the 218-E-12B Burial Ground on the Hanford Facility.

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ATTACHMENT 1

LETTER 02/01/91 FROM M. GEARHEARD (U.S. ENVIRONMENTAL PROTECTION AGENCY) TO K.W. BRACKEN (U.S. DEPARTMENT OF ENERGY, RICHLAND OPERATIONS OFFICE) REGARDING "REGULATION OF SUBMARINE REACTOR COMPARTMENT DISPOSAL PACKAGES"

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United States Environmental Protection Agency | Region 10 1200 Sixth Avenue Seattle WA 98101 | Alaska Idaho Oregon Washington

EPA

February 1, 1991

Reply To
Attn Of: HW-074

Kenneth W. Bracken, Acting Director
Waste Management Division
Department of Energy
Richland Operations Office
P.O. Box 550 (A5-21)
Richland, Washington 99352

Re: Regulation of Submarine Reactor Compartment Disposal Packages

Dear Mr. Bracken:

The U.S. Environmental Protection Agency (EPA) Region 10 has recently reviewed the regulation of the Submarine Reactor Compartment (SRC) disposal packages under the Resource Conservation and Recovery Act (RCRA). The lead shielding in the SRC disposal packages is considered by EPA Region 10 to be an integral part of the container and still serving its intended primary purpose. Therefore, the lead shielding contained in the SRC disposal packages is not considered to be solid waste as defined by 40 CFR § 261.2. This position is consistent with the enclosed EPA-Headquarters policy and guidance regarding lead used as shielding. In addition, since the lead shielding is not a RCRA hazardous waste, it is not subject to the treatment requirements under RCRA for a D008 radioactive lead solid as defined in 40 CFR § 268.42, Table 3. The SRC lead shielding is, however, regulated as a "state only dangerous waste" by the Washington State Department of Ecology.

EPA Region 10, based on a review of the Puget Sound Naval Shipyard, March 12, 1990 "Reactor Compartment Disposal Package Hazardous Material Investigation" and December 12, 1990 "Engineering Report of Liquid Removal from Submarine Reactor Compartment Disposal Packages", believes that the SRC disposal packages are not subject to regulation by EPA Region 10 under RCRA. The EPA Region 10 will, however, continue to regulate the polychlorinated biphenyls (PCBs) contained in the SRC disposal packages in accordance with the Toxic Substances Control Act (TSCA). Until such time as the TSCA chemical waste landfill approval is granted, the Department of Energy (DOE) must continue to operate under the terms of the March 27, 1990 TSCA Compliance Agreement regarding PCB disposal for the SRC disposal packages. If any additional information pertinent to the regulation of the SRC disposal packages becomes available, the DOE must inform EPA Region 10 of any changes.

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DOE-RL/AMR

I91-TDS-031

If any additional information is required, please contact Daniel Duncan at (206) 553-6693/FTS 399-6693.

Sincerely,

Michael Gearheard, Chief
Waste Management Branch

cc:

Paul Day, EPA
Tom Eaton, Ecology
Toby Michelena, Ecology
Timothy Nord, Ecology
Roger Stanley, Ecology
Captain Arthur Clark, PSNS

ATTACHMENT 2

LETTER FROM WASHINGTON STATE DEPARTMENT OF ECOLOGY TO U.S. DEPARTMENT OF ENERGY, RICHLAND OPERATIONS OFFICE REGARDING REACTOR COMPARTMENT COMPLIANCE WITH LAND DISPOSAL RESTRICTIONS

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STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
1315 W. 4th Avenue • Kennewick, Washington 99336-6018 • (509) 735-7581

February 28, 1996

Mr. James E. Rasmussen
U.S. Department of Energy
Richland Operations Office
P.O. Box 550
Richland, WA 99352

Dear Mr. Rasmussen:

Re: Reactor Compartments Disposal Packages Meet Disposal Requirements

The Washington State Department of Ecology (Ecology) has reviewed your January 12, 1996, letter, Request for Concurrence that Reactor Compartment Disposal Packages Comply with Amended Disposal Regulations Regarding Residual Liquids.

Ecology understands the Reactor Compartment Disposal Packages are a unique waste form and agrees the proposed disposition of these packages is environmentally protective and in compliance with WAC 173-303, provided the following conditions are satisfied.

- Liquids in the Reactor Compartment Disposal Packages shall be removed to the maximum extent practical considering As Low As Reasonably Achievable principles for controlling worker radiation exposure.

- Liquids existing in piping systems external to the forward and aft bulkhead shall be removed by draining from existing valves at low points, dismantling of the piping systems, or equivalent method.

- Liquids existing in piping systems internal to the forward and aft bulkheads shall be removed by draining from existing valves at low points, pumping out, "blowing down," using compressed gas, or equivalent method.

- Liquids in the reactor vessel and primary shield water tanks shall be removed to the maximum extent practical by pumping or equivalent method. A non-biodegradable sorbent shall be added to reactor vessels and primary water shield tanks (as internal configuration permits) to absorb any liquids remaining.

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In the event a Reactor Compartment Disposal Package does not meet the criteria listed above, Ecology should be contacted prior to disposal to determine compliance with WAC 173-303. If you have any questions, please call me at 736-3048.

Sincerely,

Norman T. Hepner, P. E.
Nuclear Waste Program

NH:mf

cc: Mark French, USDOE
Jim Wrzeski, PSNS

ATTACHMENT 3

PREDICTION OF PITTING CORROSION PERFORMANCE OF SUBMARINE REACTOR COMPARTMENTS AFTER BURIAL AT TRENCH 94, HANFORD, WASHINGTON

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DEPARTMENT OF THE NAVY

NAVAL CIVIL ENGINEERING LABORATORY
PORT HUENEME, CA 93043-5003

IN REPLY REFER TO:
3900
Ser L43/0286

25 MAR 1992

From: Commanding Officer, Naval Civil Engineering Laboratory, Port Hueneme
To: Commander, Puget Sound Naval Shipyard, Bremerton, WA 98314-5000 (Code 2300.1)

Subj: CORROSION OF BURIED SUBMARINE REACTOR COMPARTMENTS

Encl: (1) NCEL Report "Prediction of Pitting Corrosion Performance of Submarine Reactor Compartments After Burial at Trench 94, Hanford, Washington" - March 1992

1. Enclosure (1) is a final report on an effort by the Naval Civil Engineering Laboratory (NCEL) to predict the corrosion behavior of decommissioned submarine reactor compartments that are to be buried at Hanford, Washington. The report was prepared at the request of the Nuclear Engineering Department, Code 2300.1, Puget Sound Naval Shipyard (PSNS) and is based upon both the evaluation of historical corrosion data from the literature and an NCEL inspection of steel structures exhumed from the vicinity of the burial site. This report completes the NCEL effort on this project.

2. Based upon a conservative evaluation of both the historical corrosion data from the literature and from the evaluation of structures exhumed from the vicinity of the burial site, a maximum penetration of 0.350 inches over a 100 year burial period was projected. A more realistic maximum penetration of 0.100 inches in 100 years can be achieved through the use of select backfill adjacent to the reactor compartments and the installation of a moisture barrier cover over the trench.

PAUL A. CHAPLA

RECEIVED MAR 31 1992

Prediction of Pitting Corrosion Performance of Submarine Reactor Compartments After Burial at Trench 94, Hanford, Washington

March 1992

NCEL
Naval Civil Engineering Laboratory
Port Hueneme, CA 93043-5003

Author: Jim Jenkins

Table of Contents

PREDICTION OF PITTING CORROSION PERFORMANCE OF SUBMARINE REACTOR COMPARTMENT AFTER BURIAL AT TRENCH 94, HANFORD, WASHINGTON

I. PURPOSE

The intent of this review is to provide a prediction of the maximum penetration which can be expected to occur due to pitting corrosion of Submarine Reactor Compartments during a 100 year period of burial in Trench 94 at Hanford, Washington. This information is needed to determine the need for controlling corrosion of the reactor compartments during the post burial period.

II. BACKGROUND

No site specific corrosion testing has been performed for reactor compartments buried in Trench 94. However, corrosion in Trench 94 soil can be related to experience with corrosion at other sites when comparisons are made based on chemical content, resistivity, aeration and method of burial. This relationship permits long range estimation of corrosion performance in Trench 94 using historical data from the other sites.

This method of predicting corrosion is supported by the results of a study on the conditions of underground fuel storage tanks exhumed at Hanford[1]. Thus, based on an investigation of testing conducted at various sites by the National Institute of Standards and Technology (NIST), formerly National Bureau of Standards, and correlating the results with the corrosion of fuel storage tanks at Hanford, it was possible to establish a conservative estimate of the corrosion of reactor compartments buried in Trench 94 over a 100 year period.

III. CONCLUSIONS

The predicted maximum pitting corrosion penetration for a 100 year period is 0.350 inches for the reactor compartments buried in Trench 94 at Hanford, Washington. The actual amount of pitting corrosion is likely to be considerably less than the estimated maximum penetration for the following reasons:

The HY80 steel used for the submarine hull and the MIL-S-22698 Grade DH-36, CL-U steel used for fabrication of the containment bulkheads on the ends of the compartments are more resistant to corrosion than the open hearth carbon steel used in the NIST corrosion tests.

The reactor compartments will be buried with native soil prepared to provide properties which will give corrosion rates lower than for unprepared native soils. The Hanford soil will be graded to remove stones greater than a half inch to create a uniform backfill that will prevent differential environments that can create galvanic cells that accelerate corrosion. The NIST test data and most of the data from the fuel storage tanks is for steel buried in native soil.

Moisture content of the soil in Trench 94 will be lower since a cover compliant with the requirements of the Resource Conservation and Recovery Act (RCRA) will be installed that reduces moisture incursion into the soil. The NIST test data and the fuel storage tank data are from sites that did not have such a cover. Even without a RCRA cover the moisture content would be lower in Trench 94 since the reactor compartments will be buried 10 to 40 feet underground as compared to NIST testing that was accomplished at 5 feet where the moisture content is higher.

Soil characteristics at Trench 94 are less corrosive than NIST test sites because of the comparable chloride and sulfate content and higher resistivity.

The estimation of the upper limit of corrosion is based on a linear projection of corrosion data which results in a conservative prediction of long term corrosion performance, since actual corrosion rates usually decrease over time.

IV. DISCUSSION

A review of historical corrosion data from studies previously accomplished at Hanford revealed that the conditions affecting corrosion and the materials investigated in most of these studies are not comparable to the reactor compartments buried in Trench 94, (as discussed in Appendix A). Thus, it was concluded that corrosion rates derived from these studies should not be used to predict corrosion rates for reactor compartments in Trench 94.

On the other hand, investigation of corrosion data from tests conducted by the NIST at various sites, and corrosion data from exhumed fuel storage tanks at Hanford, identified conditions more representative of the burial conditions for the reactor compartments in Trench 94 at Hanford, allowing the maximum depth of penetration to be confidently predicted for the 100 year post burial period.

Review of National Institute of Standards and Technology Corrosion Test Data

The use of historical data from other sites to predict corrosion rates at Hanford requires that the soil characteristics be comparable. The characteristics of soil which have the most significant effect on the corrosion performance of buried steel are the resistivity, chloride ion content, sulfate ion content, aeration, and pH.

Extensive soil analysis conducted in Trench 94 by Ebasco Services Incorporated[2][3] confirm that soil characteristics are very comparable with values normally used to describe Hanford[1][5]. Testing did identify an isolated area in Trench 94 with undesirable amounts of chloride and sulfate. However, as reported by Ebasco, these samples were obtained from a thin layer of clay in the trench side and are not representative of the soils in Trench 94.

NIST has conducted extensive corrosion studies on uncoated metals exposed to soil at many test sites[4]. While none of these tests were performed at the Hanford site, the data from several NIST test sites can be used to establish a *probable* corrosion rate for Trench 94 since the soil characteristics are similar. Soil characteristics and corrosion rates at several of the NIST test sites, and typical soil characteristics for Hanford are given in Table 1. All of the NIST sites have well aerated soils as does Hanford.

While soil characteristics of the NIST test sites are similar to those of Trench 94, the resistivity, which is the predominant factor in terms of corrosivity in these types of soils, is much higher at Trench 94. Therefore, higher corrosion rates are likely to result at the NIST test sites than will be experienced by the reactor compartments buried in prepared backfill in Trench 94. The data from the least corrosive NIST test site, Salt Lake City, indicates a penetration rate of 0.00229 inches per year based upon a test duration of 17.4 years. A projection of the data from the Salt Lake City data is shown in Figure 1. This projection gives a maximum penetration of 0.230 inches in 100 years and establishes a more realistic prediction of long term corrosion of the reactor compartments at Trench 94.

Prediction of long term corrosion performance from short term corrosion data, using a linear projection as discussed above, is imprecise because the corrosion rate varies with time. The corrosion rate for carbon steel generally decreases with time giving a curve which is concave downward as depicted in Figure 2. If the data is from a sufficiently long period, the corrosion data from intermediate periods of exposure can be used to project a realistic, but conservative estimate of long term corrosion performance. This is demonstrated by a linear projection, tangent to the curve for corrosion penetration versus time shown as the line to point A in Figure 2. Linear projection of long term performance from only one data point, a secant projection, will result in a very conservative estimate of long term corrosion performance shown as the line to point B in Figure 2. This secant projection results in a higher estimate of long term corrosion from the same corrosion data. Thus the linear projection used in this study to predict corrosion of reactor compartments is considered conservative

Data from Hanford Underground Storage Tanks

In the period between 1989 and 1991, 16 carbon steel fuel storage tanks, buried for as long as 46 years, were exhumed from the Hanford Site in the vicinity of Trench 94. An evaluation of the external corrosion of these tanks was performed[1] and established a maximum pitting corrosion rate of 0.0035 inches per year. The conclusions of this study are in agreement with results obtained using the NIST test data from other sites for predicting corrosion attributed to soil conditions at Hanford.

Of all the corrosion studies conducted at Hanford, the study of the buried fuel storage tanks most closely relates to the conditions under which the reactor compartments will be buried in Trench 94. The fuel storage tanks were buried in soils and backfill representative of the general characteristics of the Hanford Site[1] as described in Table 1. From inspections of the backfill adhering to the fuel storage tanks, it was apparent that some of the tanks were buried using select backfill (sand), while others had been buried using backfill which had not been prepared, containing both very fine material and large rocks. The tanks buried with unprepared backfill exhibited the worst cases of pitting corrosion due to large stones being in contact with the tank. This created galvanic cells that accelerated the corrosion rate at the point of contact. In comparison, the maximum pitting corrosion rate for the fuel storage tanks buried in prepared backfill was significantly less and ranged between 0.0013 and 0.0019 inches per year.

The corrosion data from the evaluation of the fuel storage tanks is considered to be applicable for establishing an upper limit on the pitting corrosion of the reactor compartments at Trench 94. A linear projection of the highest pitting corrosion rate gives a conservative estimate of 0.350 inches of pitting corrosion penetration over a 100 year period. For the reactor compartments, lower corrosion rates will be achieved by using prepared native soil, providing an environment which is free from stones or other debris which can cause differential cells that accelerate corrosion. In addition, a lower moisture content will be achieved by installation of a RCRA cover.

V. SUMMARY

In estimating an upper limit for the corrosion of reactor compartments buried in Trench 94 at Hanford, Washington, both historical test data from similar sites and data from excavated material buried in the vicinity of Trench 94 were assessed. In all cases assumptions made in assessing the data were conservative and result in a projection of corrosion penetration higher than that which is realistically anticipated. An estimate of 0.350 inches of penetration of the reactor compartments over a 100 year period is projected as a conservative upper limit considering the assumptions used in the evaluation of the corrosion data. However, a penetration of 0.100 inches in 100 years is expected due to the benign conditions which will be established in the controlled burial of reactor compartments in Trench 94.

Table 1
Soil Characteristics
and Pitting Corrosion Data for
the National Institute of Standards and Technology[4]
Corrosion Test Sites
Compared to Hanford[8][2]

Site	Resistivity (ohm-cm)	Chloride (mg-eq/100g)	Sulfate (mg-eq/100g)	pH	Maximum Penetration Rate (Inches/yr.)
Springfield Ohio	2,980	0.03	0.12	7.3	0.00355
Los Angeles California	2,600	0.06	0.35	7.3	0.00338
Salt Lake City, Utah	1,700	0.06	0.48	7.6	0.00229
Hanford Washington	5,000	0.01	0.10	8.2	——
Trench 94 Hanford Washington	31,000	0.08	0.21	8.2	——

PENETRATION VERSUS TIME
NIST DATA - SALT LAKE SITE

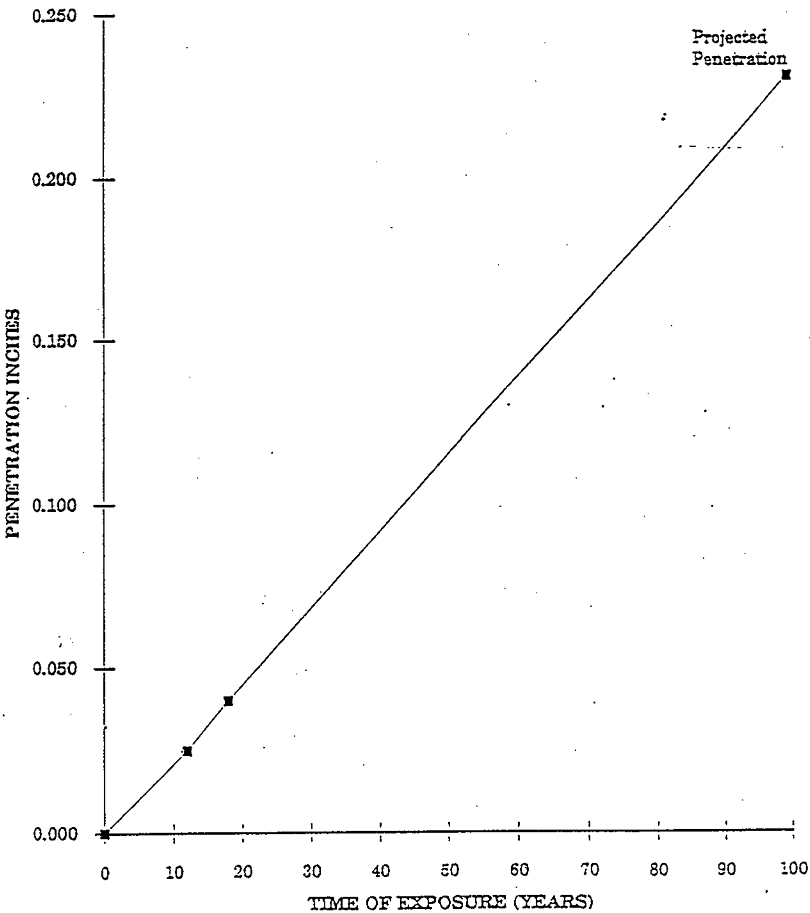

Figure 1. Projection of NIST Salt Lake City Pitting Corrosion

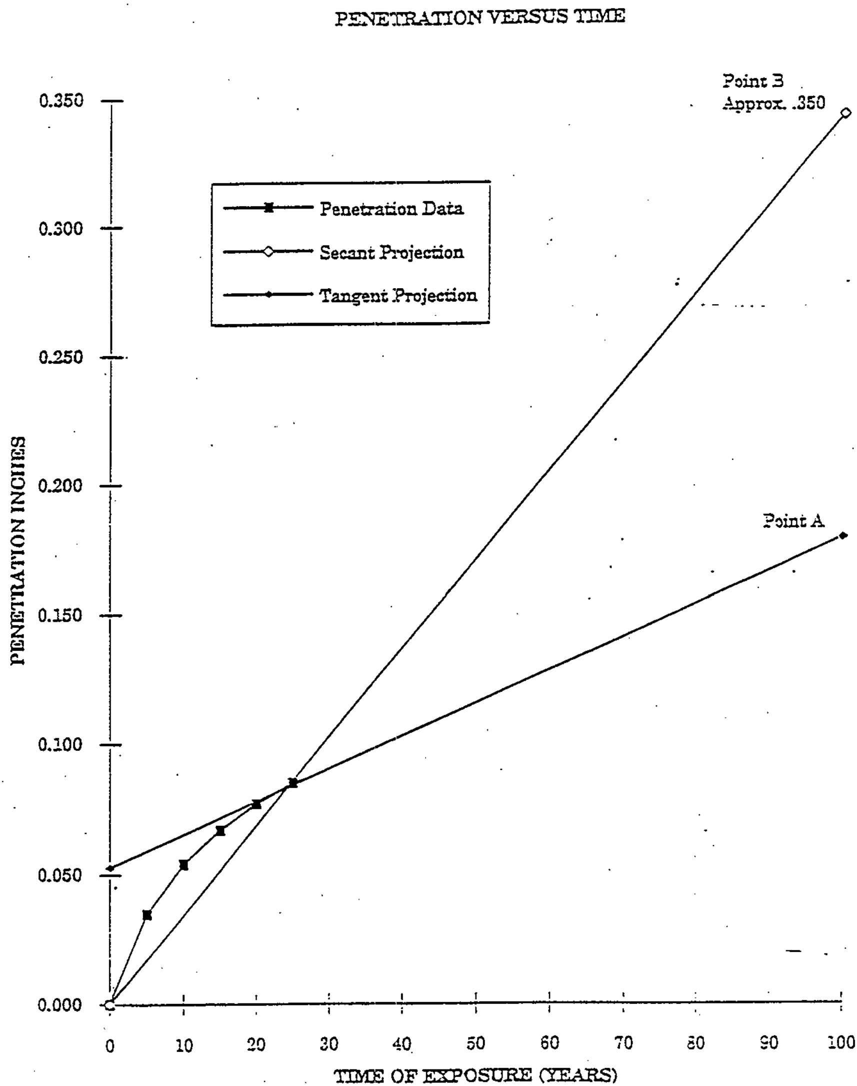

Figure 2. Comparison of Actual Pitting Corrosion Data to Single Point Data Projection (using simulated data)

References

1. "Underground Fuel Storage Tank Corrosion Study" by W.C. Carlos, WHC-EP-0507, Westinghouse Hanford Company, February 1992.

2. "Report on Soils in Naval Trench 94" by Ebasco Services Incorporated, September 4, 1991.

3. "Supplemental Report on Soils in Naval Trench 94" by Ebasco Services Incorporated, October 29, 1991.

4. "Underground Corrosion" by Melvin Romanoff, National Bureau of Standards Circular 579, April 1957.

5. "A Review of the Hanford Site Soil Corrosion Applicable to Solid Waste containers" by J. R. Divine, WHC-EP-0408, Pacific Northwest Laboratory, May 1991.

6. "Corrosion in Waste Drums from the 183H Solar Evaporation Basin Cleanout Project" by D. R. Duncan, WHC-IP-0716. Westinghouse Hanford Company, January 16, 1991.

7. "Inspection of Retrievably Stored Transuranic Waste Containers" by R. C. Morton, SD-WM-TRP-002. Rockwell Hanford Operations, July 15, 1982

8. "Evaluation of Soil Corrosion at Hanford Atomic Products Operation - Summary Report - Underground Pipeline and Structure Corrosion Study Program" by R. T. Jaske, General Electric, April 15, 1955.

9. "Corrosion Behavior of Selected Stainless Steels in Soil Environments" by E. Escalante, National Bureau of Standards Circular NBS-IR-81-2228 (NBS).

Appendix A

Summary of Previous Corrosion Studies as They Relate to Burial of Submarine Reactor Compartments in Trench 94

Prior to the underground fuel storage tank corrosion study [1], corrosion studies at the Hanford Site have been performed, mainly to determine the estimated service life of drum type waste containers and underground utilities. Previous Hanford Site data is based primarily on visual observation, as opposed to that obtained using more accurately measured data and well documented data gathering techniques[5]. Thus, existing data is considered only approximate and is limited in scope.

Many corrosion studies previously performed at Hanford have limited applicability since they document specific burial conditions that accelerated the rate of corrosion beyond that occurring in native Hanford soil. These conditions include elevated corrosivity of waste internal to the container[6], excessive humidity in the disposal environment[7] and elevated temperatures of soil with mineral or chemical content not representative of native Hanford soil[8]. Therefore, a close examination of the burial conditions is necessary before information from a specific study can be used to predict corrosion rates of materials at Hanford. In particular, none of the burial conditions discussed in these studies are representative of the conditions that will exist for the reactor compartments buried in Trench 94.

The corrosion data from NIST studies conducted at the Toppenish[9] site is commonly used in the projection of the corrosion behavior of steel at the Hanford site. However, as shown in Table A-1, the soil characteristics at the other three sites are considered more representative of Hanford than Toppenish. The chloride and sulfate levels at Toppenish are significantly higher than Hanford and the other NIST tests sites. The only soil characteristic at Toppenish that is comparable to the Hanford Site is pH.

Values for pH between 7 and 11 are normally considered mildly alkaline. Consequently, it is concluded that a higher corrosion rate at Toppenish results from the higher chloride and sulfate levels. It appears that the decision to use corrosion rates for Toppenish to predict corrosion at Hanford was very conservative because of the higher chloride and sulfate content of the Toppenish soil, as indicated by previous studies[5].

In summary, these earlier reports document corrosion rates which are higher and not solely a result of exposure to native Hanford soil as will be the condition for the reactor compartments in Trench 94 at Hanford. In fact, little existing Hanford corrosion data is considered useful in the accurate prediction of corrosion performance of reactor compartments in Trench 94 and studies with more comparable conditions and materials, such as the exhumed fuel storage tank study, should be utilized.

TABLE A-1

Soil Characteristics
and Pitting Corrosion Data for
the National Institute of Standards and Technology[4]
Corrosion Test Sites
Compared to
Toppenish[9] and Hanford[8][2]

Site	Resistivity (ohm-cm)	Chloride (mg-eq/100g)	Sulfate (mg-eq/100g)	pH	Maximum Penetration Rate (Inches/yr.)
Springfield Ohio	2,980	0.03	0.12	7.3	0.00355
Los Angeles California	2,600	0.06	0.35	7.3	0.00338
Salt Lake City, Utah	1,700	0.06	0.48	7.6	0.00229
Toppenish Washington	6,000	0.93	0.45	8.8	0.00890
Hanford Washington	5,000	0.01	0.10	8.2	—
Trench 94 Hanford Washington	31,000	0.08	0.21	8.7	—

ATTACHMENT 4

LETTER REPORT FROM E.N. PUGH (NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY) TO G.R. YOUNT (PUGET SOUND NAVAL SHIPYARD) REGARDING REVIEW OF "PREDICTION OF PITTING CORROSION PERFORMANCE OF SUBMARINE REACTOR COMPARTMENTS AFTER BURIAL AT TRENCH 94, HANFORD, WASHINGTON"

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NIST
UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899

April 16, 1992

Capt. G.R. Yount, U.S. Navy
Commander
Puget Sound Naval Shipyard
Code 100
Bremerton, WA 98814-5000

Dear Capt. Yount,

As requested in your Order For Work And Services number N00251-92-WR-20230, attached is our letter report on the review of the Naval Civil Engineering Laboratory document entitled "Prediction of Corrosion Performance of Submarine Reactor Compartments After Burial at Trench 94, Hanford, Washington".

Sincerely,

E.N. Pugh

Dr. E.N. Pugh, Chief
Metallurgy Division

NIST | UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899

April 16, 1992

Capt. G. R. Yount, U.S. Navy
Commander
Puget Sound Naval Shipyard
Code 100
Bremerton, WA 98814-5000

Dear Capt. Yount,

This is a letter report on our review of the document entitled "Prediction of Corrosion Performance of Submarine Reactor Compartments After Burial at Trench 94, Hanford, Washington" by Jim Jenkins [1]. Jenkins examined the results of NBS (now renamed NIST) underground corrosion tests with soils similar to Trench 94 at Hanford [2,3] and the results of examinations of tanks buried for up to 46 years at a site near Trench 94 at Hanford [4] and concluded that the expected pitting corrosion rate of steel in the trench would be approximately 0.001 inches per year and that the maximum corrosion penetration after 100 years would be less than 0.350 inches. After careful review of Jenkins' report, the report on tanks buried at Hanford and the original NIST data, we conclude that Jenkins utilized conservative procedures for developing these estimates and, in our opinion, the corrosion rates for the reactor compartments in Trench 94 will be within these figures.

This opinion is based on the following conditions. The first is that the corrosion behavior of the NIST samples at the NIST sites with soils identified as similar to Trench 94 will be representative of the behavior of the reactor components. The second is that the processes that determined that corrosion behavior during the exposure periods used for the NIST study (≈17 years) will continue to limit the corrosion rate in a similar manner in Trench 94 for 100 years. The third is that the soils in contact with all of the steel surfaces will be essentially the same as that given in the specification for Trench 94 soil. The fourth, is that in using the maximum penetration data from the tanks buried at Hanford, it is assumed that the corrosion behavior of these tanks was similar to that observed in the NIST studies.

To evaluate the condition that soils at the NIST sites are representative of the soil in Trench 94, we examined the original data on the characteristics of the soils at the NIST sites identified by Jenkins. In Table 1 of his report, Jenkins specifies three soils at NIST sites as similar to soils at Trench 94 in Hanford. These are site #26 in Springfield OH, site #35 in Los Angeles CA, and site #47 in Salt Lake City UT. In

Table A1, appendix A, he also lists NIST site A in Toppenish WA as of interest because of its proximity to Hanford, but not necessarily similar to the Hanford soils [2]. References in his document identify NIST sites #12 in Los Angeles, site #20 in Cleveland OH, and site #32 in Rochester NY as similar to soils in the Hanford complex, but not necessarily at Trench 94 [3]. We agree with Jenkins that, except for the Toppenish site, these soils are similar to that reported for Trench 94. To evaluate the validity of using the Toppenish site to estimate the behavior in Trench 94, we went back to the original measurements of the soil characteristics and found that the values given in reference [3] and cited by Jenkins are correct. This is important as the chloride content of the Toppenish soil is more than ten times that given for Trench 94 and, therefore, this site should not be considered representative of conditions expected for Trench 94. The other sites are reasonable choices, but underground corrosion is a complex issue and the use of corrosion data from one site to predict corrosion behavior at another site has not been thoroughly evaluated scientifically and, in some cases [6], has failed to provide accurate estimates.

To develop a corrosion penetration estimate from the NIST data for comparison to Jenkins' estimate, we combined all of the average maximum penetration data from the NIST sites identified by Jenkins as similar to Trench 94, excepting the Toppenish site, and performed a linear regression analysis, figure 1. This approach assumes that the variations in the soil characteristics and the corrosion rates at these NIST sites should encompass the variations at Trench 94. Linear regression analysis of this data estimates the expected maximum penetration in samples buried at the NIST sites for 100 years as 0.218±0.103 inches with a 99% confidence interval. While this corresponds to an estimated penetration rate of 0.00198±0.00054 inches which is greater than the 0.001 inches per year determined by Jenkins, the maximum penetration estimated by this technique with a 99.5% confidence is 0.321 inches which is below Jenkins' maximum penetration estimate of 0.350 inches.

To evaluate the validity of using a linear model for the maximum penetration (a constant corrosion rate), we examined the exponent, n, determined by Romanoff [3] by fitting the NIST data to the relationship

$$P=Kt^n$$

For a constant corrosion rate as required for linear behavior, the value determined for this exponent would be one and, if the corrosion rate decreases with time, the value of this exponent will be less than one. Romanoff's results are given in Table 1 and, by examining this table, it can be seen that for all of the sites identified by Jenkins as having soil characteristics similar to Trench 94, the exponent, n, was less than one and, in most cases, significantly less than one. Therefore, Romanoff's results demonstrate that using 1 as the exponent for estimating the maximum corrosion penetration is a conservative estimate.

In our discussion, we have used the term maximum penetration rate to represent the maximum wall thinning that occurs at the bottom of the corrosion pits that form when steel corrodes in soils. We avoided using the term "pitting corrosion" to describe this form of attack because we did not want to confuse this type of attack with the pitting corrosion that is observed on passive metals such as stainless steels when they are exposed to solutions containing halide ions. For pitting of steels in soils, the pits result from variations in the environment in contact with the surface of the samples which cause local variations in the corrosion rate and, as corrosion products accumulate on the surface, the rate of pit propagation decreases as shown by Romanoff.

Jenkins uses five additional arguments explain why the maximum penetration at Trench 94 would be less than that observed at the NIST test sites. Our comments on each of these is as follows:

1) Jenkins states that the HY 80 steel and the Grade DH-36, CL-U steel are more resistant to underground corrosion than steels used by NIST. Although 3.5 % Ni and 0.9% Cr are added to the HY80 alloy to enhance low temperature toughness and the low carbon improves weldability, these slight variations from a plain carbon steel would provide only minimal improvement of the underground corrosion performance of alloy HY 80 for the time frame of interest. Similarly, the Grade DH-36 CL-U Steel has a slightly elevated Mn and Si compared to a plain carbon steel, but again, these modifications will not significantly improve its corrosion performance in an underground environment.

2) Jenkins states that by using prepare backfill with no stones larger than 0.5 inches the soils will be less corrosive than similar NIST soils. We believe that removal of large stones from the Trench 94 backfill makes the Trench 94 backfill more similar to the NIST soils. None of the NIST test site soils contain the large (10 inch), oblong stones found at trench 94. The largest (2 inch) stones at any NIST site are found at Site B in Baltimore, and they are relatively few in number compared to Trench 94. Jenkins statement is more appropriate for the tanks buried at Hanford where the maximum penetrations were higher for the tanks buried with unprepared native soil than the tanks buried with prepared backfill.

3) We agree that a continuous, unperforated plastic cover at Trench 94 will reduce moisture intrusion from the soil surface. It is also true that the water table at most NIST sites is considerably higher than that found at Trench 94, because water tables are closer to the soil surface and in general, rainfall is greater. Since the deterioration rate of the plastic cover is unknown, it cannot be factored into the estimates.

4) We agree that the resistivity of soil at Trench 94 is generally higher than that found at any of the NIST underground test sites, and in this respect is expected to be less corrosive than the NIST soils. Chloride and sulfate content at Trench 94 and the NIST sites identified by Jenkins are very similar, and would not be expected to have a significant effect on relative corrosivity of these soils.

5) We agree that a linear projection of maximum pit penetration as performed by Carlos, provides a conservative estimate of the corrosion penetration. There is an uncertainty associated with any extrapolation beyond existing data and conservative approaches are required.

In summary, it is our opinion that Jenkins' conclusion, that the maximum penetration of steels buried in these environments will be less than 0.350 inches after 100 years and the expected or average pitting corrosion rate will be 0.001 inches per year, is reasonable given the conservative estimation procedures he employed, our existing knowledge of corrosion mechanisms, the environmental conditions expected at Trench 94, and the existing NIST data on corrosion behavior of similar steels at similar sites.

Sincerely,

Edward Escalante
Corrosion Group

Richard E. Ricker, Ph.D.
Group Leader
Corrosion Group

References

1) J. Jenkins, "Prediction of Corrosion Performance of Submarine Reactor Compartments After Burial at Trench 94, Hanford, Washington, (DRAFT), Naval Civil Engineering Laboratory, Port Hueneme, CA, January 1992.

2) W.F. Gerhold, "Corrosion Behavior of Ductile Cast-Iron Pipe in Soil Environments", J. American Water Works Assoc., v68, n12, December 1976.

3) M. Romanoff, "Underground Corrosion", National Bureau of Standards Circular 579, April 1957, reprinted by the National Association of Corrosion Engineers, Houston, TX, 1989.

4) W.C. Carlos, "Underground Fuel Starage Tank Corrosion Study", Westinghouse Hanford Co., WHC-EP-0507, February 1992.

5) R.E. Walpole, R.H. Myers, "Probability and Statistics for Engineers and Scientists", The Macmillan Co., New York, 1972.

6) W. J. Schwerdtfeger, "Soil Resistivity as Related to Underground Corrosion and Cathodic Protection," J. Res. of NBS, v69c, n1, January-March 1965.

Table 1 - Mean values of constants $k_{5.3}$ and n and their standard errors. [3]

Site No.	Soil Type	$k_{5.3}$	$\sigma_{k5.3}$	n	σ_n
12	Hanford fine sandy loam	51.2	14.0	0.13	0.73
20	Mahoning silt loam	34.4	2.7	0.42	0.09
26	Miami silt loam	45.7	7.1	0.41	0.22
32	Ontario loam	44.8	2.6	0.33	0.07
35	Ramona loam	26.5	1.3	0.25	0.08
47	Unidentified silt loam	20.1	1.2	0.32	0.08

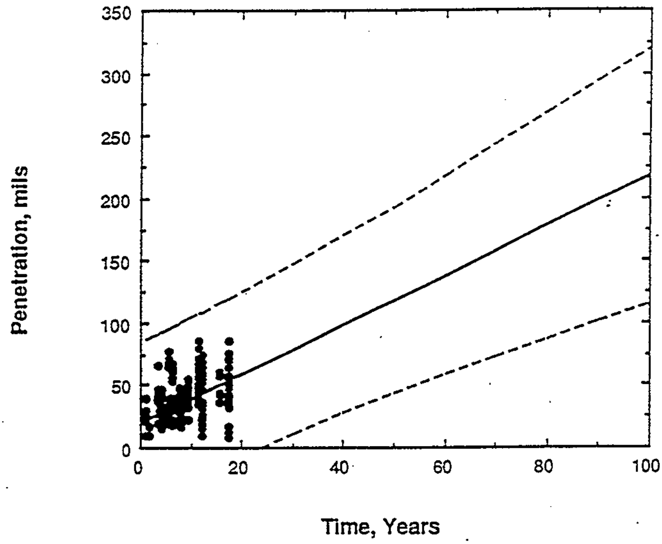

Figure 1 - Linear regression analysis of the average maximum penetration data obtained at all of the sites identified by Jenkins as having soils similar to Trench 94. The dashed lines represent the upper and lower limits of the expected values at the 99% confidence level based on the linear growth rate assumption.

ATTACHMENT 5

LETTER FROM D.R. HELGESON (CORROSION CONTROL SPECIALISTS) TO C.L. REAUME (PUGET SOUND NAVAL SHIPYARD) REGARDING SOIL RESISTIVITY TESTING, HANFORD, WASHINGTON

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CORROSION CONTROL SPECIALISTS

R & B Corporate Park, Suite P101
6617 South 193rd Place
Kent, Washington 98032
(206) 251-8075

June 29, 1990

Puget Sound Naval Shipyard
Officer In Charge of Construction
Public Works Dept. Code 460
Bremerton, Washington

Attn: Cheryl L. Reaume

Ref: Soil Resistivity Testing
Hanford, Washington
Contract No. N62474-90-M-6478

Dear Ms. Reaume,

On Wednesday June 27,1990 CCS completed the testing as directed by the referenced contract. The preliminary results were faxed to your office on June 28, 1990. The following is a summary of the procedures used and a brief analysis of the data.

Test Procedures

The test procedure followed was that described by The ASTM Standard Method G-57-78, " Field Measurements of Soil Resistivity Using The Wenner Four electrode Method ". The testing was completed using a Nilsson Model 400 soil resistivity meter Certified and Calibrated on June 26, 1990. A sketch is attached depicting the general arrangement of the meter, electrodes, and wiring.

Testing was witnessed by William Carlos (Westinghouse) and by G.L. Ecklund (U.S. Navy). Testing was done at six locations. One test was completed on each side of the existing excavation for Trench 94 and one test for each of two spoil piles. Testing was done at each location with pin spacings of 10, 20, 30, 40, and 50 feet.

Prior to leaving the site copies of the raw data collected was provided to William Carlos.

The Wenner four pin test procedure provides the average resistivity of the soil to a depth equal to the pin spacing. Therefore testing was completed at several depth in addition to the 50 foot spacing requested to better characterize the soil. Moreover the data may be enhanced by processing the data with formulations developed by H.E. Barnes. The Barnes formulations provides an approximation of soil resistivities for depth layers. The data collected for these test were processed in this manner. The data is tabulated on the attached data sheets.

The data is useful in both evaluating the potential for corrosion activity and for designing cathodic protection. However in evaluating the potential for corrosion activity of a site, it should not be done using soil resistivities alone. Soil resistivities should be combined with the other parameters, as you have scheduled for testing, including conductivity, sulfides, sulfates, chlorides, moisture content, and pH.

Results and Analysis

The soil resistivity data collected at this site is generally classified as high and not very corrosive but it does show some stratification. Further the Barnes layer calculations on the north side of the trench would indicate a more aggressive environment for buried steel. However in analyzing soil resistivities by themselves, caution should be used in drawing any firm conclusions regarding the potential for corrosion. The National Association of Corrosion Engineers (NACE) in their basic short courses provide a guideline for the relative amount of corrosion in the absence of mitigating measures. Those guidelines are as follows:

Soil Resistivity		Relative Corrosion Rate
Below 500	ohm-cm	Very Corrosive
500 to 1000	ohm-cm	Corrosive
1000 to 2000	ohm-cm	Moderately Corrosive
2000 to 10,000	ohm-cm	Mildly Corrosive
Above 10,000	ohm-cm	Progressively less Corrosive

NACE does not suggest that in high resistivity soils that there is no corrosion but only that the rates of corrosion in general decrease. The conceptual cathodic protection design package being evaluated by the Navy for the SRC site provides a reference in Attachment 3 to H.C. Van Nouhuys. Van Nouhuys classifies and evaluates soils in high ranges that extend up to a million ohm-cm. The majority of his conclusions were arrived at by collecting pipeline leak histories in high resistivity soils. His work is supported by many others working with underground pipelines and tanks.

Thus it is our recommendation that cathodic protection be applied to the SRC's even though the soil resistivities are classified as high with relativity low corrosion rates. The basis for this recommendation is based on the present plan to maintain the integrity of the SRC in excess of 100 years.

Also in reviewing the conceptual design being prepared..., it would appear the Navy is desirous of a galvanic system. This is the most desirable type of cathodic protection system in nearly all applications. However, to make the installation of a galvanic system effective in high resistivity soils economically feasible, the current requirement must be low. Based on my casual inspection of the SRC's while on site, it is my opinion the quality of coating may need to be upgraded to achieve that end. It would be my recommendation the a detailed coating inspection of each SRC be completed prior to formalizing the selection of a galvanic anode design.

CCS would be pleased to assist the Navy with this project as it proceeds. If we can clarify any of the above please contact our office.

Sincerely

Dennis R. Helgeson, P.E.

RC Site (Trench 94)
anford, Washington
-84

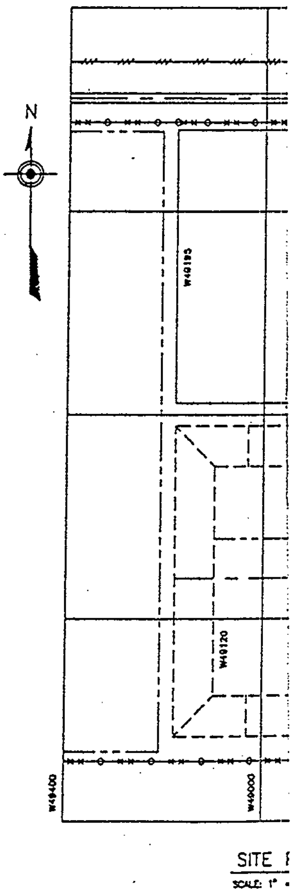
D. Helgeson
6/27/90
Nilsson (Model 400)
S/N 40-2291

Soil Resistivity Data
Wenner four Pin Method

Test Site	Location	Pin Spacing (ft)	Soil Resistivity (ohm-cm)	Barnes Layer Resistivity (ohm-cm)
1	East side of trench	10	36,385	--
		20	65,110	309,270
		30	22,980	10,017
		40	37,534	**
		50	41,173	67,247
2	South side of trench	10	70,855	--
		20	103,410	191,309
		30	166,305	**
		40	72,004	26,634
		50	41,173	15,177
3	Spoil pile to south of trench	10	23,938	--
		20	22,980	22,096
		30	34,470	**
		40	35,236	37,753
		50	54,578	**
4	West side of trench	10	107,240	--
		20	91,920	80,432
		30	97,665	111,616
		40	91,920	78,131
		50	85,218	65,975

Test Site	Location	Pin Spacing (ft)	Soil Resistivity (ohm-cm)	Barnes Layer Resistivity (ohm-cm)
5	North side of trench	10	21,065	--
		20	10,140	**
		30	25,283	114,182
		40	21,448	14,194
		50	14,363	6,187
6	Spoil pile to north of trench	10	36,385	--
		20	32,385	30,087
		30	41,939	92,481
		40	29,108	15,178
		50	53,620	**

* The Barnes layer calculation is not valid for these layers



NOTES:

1. S.R.C. STANDS FOR SUBMARINE REACTOR COMPARTMENT.
2. SOIL RESISTIVITY TESTS. WENNER FOUR-ELECTRODE METHOD ASTM-G 57-78 (1984).

RESISTIVITY TEST TABLE

TEST NO.	LOCATION
1.	EAST SIDE OF TRENCH, FIRST PIN LOCATED 65.5' FROM ℄ OF CANTON AVE., IN-LINE WITH SOUTH SIDE OF SRC NO. 1. [PIN ALIGNMENT N-S]
2.	SOUTH SIDE OF TRENCH, FIRST PIN LOCATED 55' DUE WEST OF POWER POLE. [PIN ALIGNMENT E-W]
3.	TOP OF SOUTH SPOIL AREA, FIRST PIN LOCATED 70' DUE SOUTH OF TEST 2. [PIN ALIGNMENT E-W]
4.	WEST SIDE OF TRENCH, FIRST PIN LOCATED 20' DUE WEST OF EDGE OF TRENCH, IN-LINE WITH SOUTH SIDE OF SRC NO. 1. [PIN ALIGNMENT N-S]
5.	NORTH SIDE OF TRENCH, FIRST PIN LOCATED AT EDGE OF PIT. [PIN ALIGNMENT E-W]
6.	TOP OF NORTH SPOIL AREA, FIRST PIN LOCATED AT EDGE OF PIT. [PIN ALIGNMENT E-W]

E.J. SEVERUD
R.C. CARLOS
C.C. EVANS

U.S. DEPARTMENT OF ENERGY
Richland Operations Office
Westinghouse Hanford Company

NAVAL SRC
TRENCH 94
SOIL RESISTIVITY TEST

F | E-128 | 7801 | SK-2-240

APPENDIX 4E

SITE INVESTIGATION REPORT

Transmitted from DOE-RL to Ecology.

Reference: Low-Level Burial Grounds Dangerous Waste Permit Application Supplement 2: Design Documentation for Mixed Waste Nondragoff Land Disposal Facility (DOE/RL-88-20, Supplement 2, Revision 0).

Site Investigation Report: WHC-SD-W025-SE-001, Revision 0.

Correspondence Number: 90-PPB-186, September 20, 1990.

APPENDIX 4F

9090A TEST RESULTS

Transmitted from DOE-RL to Ecology.

Reference: A Final Report: Laboratory Testing of Geomembrane for Waste containment Environmental Protection Agency Method 9090

Document Number: 9090 Test Results, WHC-SD-WM-TRP-237, Revision 0.

Correspondence Number: 96-SWT-333, November 7, 1996.

APPENDIX 4G

SOIL LINER PERFORMANCE CALCULATIONS

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APPENDIX 4G

SOIL LINER PERFORMANCE CALCULATIONS

Assume Net Infiltration = Total precip - evapotrans (no run-off)

[From WHC 1992 (Project W-025 Design Report), Appendix C.1, page 44]:

Precip	=	"7.08"
Evapotrans	=	5.46
Net Infiltration	=	1.62"

Assume landfill is open for 10 years.

Assume no flexible membrane liner, no holding time/storage for precipitation.

$\therefore$ Head on soil liner after 10 years = 10 x 1.62 = 16.2"

Average head = 16.2"/2 = 8.1"

Darcy's Law: $q = KiA$

and $q/A = V$

$\therefore V = Ki$ where K = hydraulic conductivity = 10^{-7} cm/sec
i = pressure gradient = 8.1"/36" = 0.225

$\therefore V = 0.225 \times 10^{-7}$ cm/sec

In 10 years, penetration = 0.225×10^{-7} cm/sec x 3600 sec/hr x 24 hr/day x 365 day/yr x 10 years
= 7.1 cm
= 2.8 in

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APPENDIX 5A

INTERIM STATUS GROUNDWATER MONITORING

APPENDIX 5A

CONTENTS

FIGURES

FIGURES (cont)

TABLES

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APPENDIX 5A

INTERIM STATUS GROUNDWATER MONITORING

Eight burial grounds were included in the interim status groundwater monitoring program. These are the 218-E-10 and 218-E-12B Burial Grounds in the 200 East Area (refer to Chapter 1.0) and the 218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-5, and 218-W-6 Burial Grounds in the 200 West Area (refer to Chapter 1.0).

In accordance with an agreement signed by Ecology and the DOE-RL (Ecology 1986), an initial groundwater monitoring system consisting of 35 wells was installed around the LLBG. This system was designed in accordance with WAC 173-303-400 and 40 CFR 265, Subpart F requirements. Based on information from the initial 35 wells, 46 additional wells have been installed completing the monitoring network for the LLBG.

The following sections provide a summary of the groundwater monitoring data obtained from wells installed during the interim status period.

1.0 INTERIM STATUS GROUNDWATER MONITORING APPROACH

A specific investigative approach was taken to support the design of the LLBG groundwater monitoring system. This approach consisted of the following elements.

- Define specific waste management areas for the LLBG. These low-level waste management areas (LLWMAs) consisted of one or more regulated units treated as a single monitored unit with respect to groundwater monitoring. The size and extent of a LLWMA were determined principally by the size and location of regulated units.

- Establish an initial groundwater monitoring well network from which stratigraphic, hydrogeologic, and background water quality information can be obtained. The data was used to determine the need for additional groundwater monitoring wells.

- Provide preliminary hydrogeologic properties of the uppermost aquifer system beneath the LLBG using data collected from the monitoring well network and from previously collected or published data.

Within the scope of the 1986 agreement (Ecology 1986), the DOE-RL agreed to install an initial network of 35 groundwater monitoring wells of no more than 305 total meters drilled to supplement the interim status program. The groundwater monitoring plan for installation contained specific details for these 35 wells (PNL 1987). These wells were to provide information regarding the hydrogeologic properties of the uppermost aquifer beneath the LLBG and also were to be used in collecting background water quality data at quarterly intervals for at least 1 year from the time of installation. The initial network of 35 wells was installed as planned, and the goals of the network in providing preliminary hydrogeologic information and background water quality data were met. Based on data from the initial well network, 46 additional groundwater monitoring wells were installed. The construction details for these wells are contained in the various borehole completion reports (WHC 1990a; WHC 1990b; WHC 1993a, WHC 1993b, and WHC 1994).

Preliminary hydrogeologic properties within the uppermost aquifer were documented by PNL (1989a) based on information from the initial network of 35 wells. Within the scope of the characterization plan, the following four specific objectives were achieved:

- Development of a preliminary conceptual model of the hydrogeologic system within the uppermost aquifer
- Determination of horizontal and vertical hydraulic gradients within the uppermost aquifer
- Determination of the range and distribution of horizontal hydraulic conductivity values within the uppermost aquifer
- Determination of the storativity of the sediments within the uppermost aquifer.

The methods applied to achieve the objectives are described in Section 2.2. Hydrogeologic properties for the 46 additional groundwater monitoring wells were reported in WHC 1989e; WHC 1990b; and WHC 1993a, WHC 1993b, and WHC 1994.

Compliance boundaries were established for five LLWMA that incorporate portions of one or more burial grounds. These boundaries, shown in Figure 1 and Figure 2, were defined by a line that connects the monitoring wells spaced around the perimeter of each LLWMA. Because of uncertainties and potential future changes in the direction of groundwater flow described later in this text, the compliance boundaries are shown in the figures to extend around the entire LLWMA. However, at any specified time, the regulatory compliance boundary will be considered to be present only along the existing downgradient limit of the LLWMA, in compliance with WAC 173-303-645(6)(a). The individual monitoring wells were located in accordance with WAC 173-303-645(9)(b), as close as possible to the hydraulically downgradient limit of the LLWMA taking into account rights-of-way and other physical obstructions. The following are the designated burial grounds incorporated in the LLWMA:

- LLWMA-1--218-E-10 Burial Ground
- LLWMA-2--218-E-12B Burial Ground
- LLWMA-3--218-W-3A, 218-W-3AE, and 218-W-5 Burial Grounds
- LLWMA-4--218-W-4B and 218-W-4C Burial Grounds
- LLWMA-5--218-W-6 Burial Ground.

2.0 INVESTIGATIVE METHODS

This section summarizes the techniques and methods used to assess the hydrogeologic properties of the uppermost aquifer beneath the LLBG.

2.1 EXISTING SITE HYDROGEOLOGIC INFORMATION

Hydrogeologic information has been collected since activities began in the mid-1940s. Much of the information on subsurface geology in the 200 Areas has resulted from the analysis and interpretation of more than 1,400 boreholes and wells completed in and around the 200 Areas. Raw data have been compiled into the following databases:

- Hanford Groundwater Database
  - Summarized borehole geologic logs
  - Water level data
  - Groundwater quality data
  - Well elevation data

- ROCSAN Database System
  - Particle size distribution from borehole sediment samples
  - Calcium carbonate content from borehole sediment samples.

Borehole samples were archived in the Hanford Geotechnical Sample Library and have been catalogued (Additon 1977). Geophysical logs from the boreholes are maintained by Pacific Northwest National Laboratory's (PNNL) Earth and Environmental Sciences Center.

Interpretations of the raw data were published and a well-documented list of published studies was provided by PNL (1989a). Many of the early reports, however, present relatively little detail because of the limited groundwater and subsurface geologic data available at the time.

2.2 GENERAL WELL DESIGN

As required by WAC 173-303-400(3)(a) and 40 CFR 265.91, the interim status groundwater monitoring system included monitoring wells completed to obtain representative groundwater samples from the uppermost saturated zone beneath each of the LLWMAs. This saturated zone is within the Ringold Formation and/or the Hanford formation, depending on the local geology [Chapter 5.0 of the General Information Portion (DOE/RL-91-28)]. The interim status groundwater monitoring wells were drilled and constructed consistent with Ecology and EPA guidance and with Ecology review, and are in compliance with WAC and RCRA regulations.

The initial interim status monitoring well network consisted of 35 wells located around four existing LLWMA. These wells were drilled and installed from July to October 1987, and are referred to hereafter as the '1987 wells'. Sixteen wells were installed in the 200 East Area and 19 wells were installed in the 200 West Area. Eleven of the wells in the 200 West Area and all

16 wells in the 200 East Area were drilled as single wells. The remaining eight wells were in the 200 West Area and were drilled as four pairs with wells of a given pair located 7.6 to 15.2 meters apart. For each pair, one is a deep well penetrating the uppermost aquifer system to a lower semiconfining unit (a depth of approximately 61 to 76 meters below the water table) and is screened over the lower 6.1 meters of the aquifer, while the second is a shallow well penetrating only the upper 6.1 to 9.1 meters of the aquifer. Dimensions and locations for each of these wells are presented in Figures 1 and 2, and Tables 1 through 5.

A larger number of wells monitor the upper part of the uppermost aquifer than have been installed to monitor the lower part of that aquifer. This is because there is considered to be virtually no likelihood of dense, nonaqueous phase liquids (DNAPL) from the waste in the LLBG reaching the groundwater and sinking to the bottom of the aquifer. This conclusion is based on the lack of large volumes of liquid waste disposed in the LLBG, and the disposal of small liquid volumes in sorbing materials. Such waste could migrate to the groundwater only as low density aqueous phase solutions dissolved in infiltrating precipitation. However, despite the very low likelihood of generating DNAPLs from the LLBG, four wells were completed in the lower part of the uppermost aquifer for verification.

Ten additional wells, referred to hereafter as the '1989 wells', were drilled and installed from June to November 1989. Six more wells were installed from October 1989 to February 1990, and are referred to hereafter as the '1990 wells'. All 1989 and 1990 wells are shallow wells screened over the upper 6.1 to 9.1 meters of the aquifer. Seven of these wells are located in the 200 East Area and nine wells are located in the 200 West Area. In 1991, 18 wells were installed between March and December. Two of these wells were designed to monitor the lower portion of the unconfined aquifer at LLWMA-5. All remaining 1991 wells were designed to monitor the upper part of the aquifer. However, problems encountered during drilling one well at LLWMA-4 resulted in the well being completed in a localized perched water zone associated with a nearby liquid disposal unit. Ten wells were installed in 1992 and two in 1993. These 12 shallow wells monitor the upper 6.1 meters of the aquifer and completed the monitoring network for the LLBG. Dimensions and locations for each of these wells are presented in Figures 1 and 2, and Tables 1 through 5.

The following summarizes the general design used in the construction of wells. The procedures employed in drilling the 1987 wells followed guidelines specified in Kasper and Myers (1987) and presented in PNL (1989a). Procedures for installation of the 1989 and 1990 interim status wells were provided in the revised groundwater monitoring plan (WHC 1989f). Procedures for installation of the 1991, 1992, and 1993 wells were documented in drilling specifications (WHC 1990c) and in subsequent revisions.

Figure 3 presents a schematic diagram for both the shallow and the deep groundwater monitoring wells. The majority of the wells were drilled with cable-tool rigs using either drive-barrel or hard-tool methods; however, two of the 1992 and both of the 1993 wells were drilled using the air rotary method. During cable-tool drilling, the hard-tool method normally was used when gravels consisted of very large particles or when the sediments were saturated. Using the drive-barrel method, a short length of heavy-walled pipe was driven into the sediments and withdrawn. The sediments removed from the barrel generally were representative of the formation. During hard-tool drilling, a solid metal bit was used to break up the sediments. Water was added to the sediments to form a mud that was bailed out of the borehole providing formation samples for geologic description.

Each well was drilled to its required depth using temporary carbon steel casing to support the walls of the borehole. The temporary casing was nested to facilitate its removal once the final stainless steel casing was in place. The temporary casings were removed from the borehole in 0.6-meter increments for every 0.6 meter of completion material emplaced (e.g., filter sand, bentonite grout). This prevented the completion materials from 'locking up' the casings and prevented sediments from collapsing into the borehole. For the 1987 wells, a 3.1-meter long, 20-centimeter outside diameter stainless steel screen (30-slot) was installed at the bottom of the temporary casing for aquifer testing. For the 1989 and 1990 wells, slug tests were performed after the monitoring well installation was completed.

Once the temporary outer casing was in place (and aquifer testing was completed in the 1987 wells), the permanent casing was set. Permanent casing consisted of factory-slotted, 4-inch Schedule-5 type 304 stainless steel screen, and threaded, flush-jointed Schedule-40 type 304 stainless steel casing. Screen lengths ranged from 3.1 to 9.1 meters. For all the 1987 wells and two of the 1989 wells (299-E34-7 and 299-E35-1), the screens were wire-wound with a slot size of 0.03 centimeter (10-slot) to 0.8 centimeter (30-slot). The remaining 1989 and all 1990 wells were completed using 10-slot screens. All subsequent wells were completed using screens. All well casings and screens were factory cleaned and wrapped in polyethylene for delivery to the site. Factory cleaning included a phosphoric acid bath, pressure washing using an alkaline degreaser/cleaner, a warm water rinse, and air drying. All casing and screen segments were inspected for integrity and cleanliness before installation.

Before setting the permanent casing, Colorado silica sand (20-40, 16-30, 10-20, 20-30, or 8-12 mesh) was used to backfill the hole to the desired depth. The bottom of the screen was set at approximately 15 centimeters above the base of the aquifer for the deep wells, while the top of the screen was placed no more than 0.9 meter above the water table for the shallow wells. Once the stainless steel permanent casing and screen were set in the hole, silica sand was used to fill the annulus between the outer and inner casing to 1.5 meters above the top of the screen. Above the sand pack, approximately 1.5 meters of bentonite pellets were emplaced. In 12 of the 1987 wells, grout was used to seal the well to the surface. The remaining wells were sealed to the surface with either bentonite granules or bentonite slurry. The type of seal used was determined by the drilling contractors.

After settlement of the bentonite seal, cement was used to permanently seal either the upper 0.9 to 1.5 meters of the annulus for the 1987 wells, or the upper 5.2 to 6.1 meters of the annulus for the 1989 and 1990 wells. A 1.2-meter by 1.2-meter concrete pad was placed around the well and marked by a brass plate stamped with the well number. Protective guard posts were installed around each well.

2.3 WELL LOCATIONS AND CONSTRUCTION DETAILS

The locations of the 81 interim status monitoring wells for the 200 East and 200 West Areas are shown in Figure 1 and Figure 2, respectively. The wells also are shown on the topographic maps in Appendix 2A. The location coordinates, surface elevations, drilled depths, and screened interval depths are summarized in Tables 1 through 5. The 1987 wells represent 2,893 total meters drilled. The general construction of all wells is described in Section 2.2.2. Construction logs for the monitoring wells are presented in the following documents: WHC 1989a; WHC 1990a; WHC 1990b; and WHC 1993a, WHC 1993b, and WHC 1994.

Of the 33 wells installed around LLWMA-1 and LLWMA-2 in the 200 East Area, 23 wells were drilled through the relatively thin uppermost aquifer to the top of the Elephant Mountain Member of the Saddle Mountains Basalt. The remaining wells were drilled to a maximum of 5.2 meters into the unconfined aquifer. All wells were completed in the top of the unconfined aquifer with 3.1 to 6.1 meters of screen.

In the 200 West Area, 48 wells were constructed around LLWMA-3, LLWMA-4, and LLWMA-5, of which one well (299-W7-3) was completed to the top of the basalt. Five other wells (299-W6-3, 299-W6-6, 299-W10-14, 299-W15-17, and 299-W18-22) were drilled to the top of the lower mud unit of the Ringold Formation. Approximately 7.6 to 15.2 meters from each deep well, a second well was completed in the top 5.2 to 8.2 meters of the aquifer. One well at LLWMA-4 (299-W18-29) was completed in an area of localized perched water because attempts to seal the annulus in the perched zone casing failed. This well has a 4.9-meter screen. Thirty-three of the shallow wells in the 200 West Area were completed with 6.1-meter screens. Seven were completed with 9.1-meter screens to account for projected water level declines in response to the 1984 decommissioning of the 216-U-10 Pond (U Pond). One well at LLWMA-5 (299-W6-12) was completed with a 4.9-meter screen because of a suspected localized confining layer of silt at the water table.

2.4 DOWNGRADIENT AND UPGRADIENT INTERIM STATUS WELLS

Based on water table elevations at the time of well installation, and consistent with recent water table elevations, the following wells are considered downgradient and upgradient wells for each LLWMA. The wells have been identified with a superscript indicating the year of installation:

<u>Downgradient Shallow Wells</u>

LLWMA-1 299-E32-2^{87}, 299-E32-3^{87}, 299-E32-5^{89}, 299-E32-6^{91}, 299-E32-7^{91}, 299-E32-8^{91}, 299-E32-9^{91}, 299-E32-10^{92}, 299-E33-30^{87}, 299-E33-34^{90}

LLWMA-2 299-E27-8[87], 299-E27-9[87], 299-E27-11[89], 299-E27-17[91], 299-E34-2[87], 299-E34-3[87], 299-E34-7[89], 299-E34-9[91], 299-E34-10[91], 299-E34-11[92], 299-E34-12[92]

LLWMA-3 299-W6-2[87], 299-W7-1[87], 299-W7-2[87], 299-W7-4[87], 299-W7-5[87], 299-W7-6[87], 299-W7-7[89], 299-W7-8[89], 299-W7-9[90], 299-W7-10[90], 299-W7-11[91], 299-W7-12[91], 299-W8-1[87]

LLWMA-4 299-W15-15[87], 299-W15-19[89], 299-W15-20[89], 299-W15-23[90], 299-W15-24[89], 299-W18-21[87], 299-W18-23[87], 299-W18-26[89], 299-W18-27[91], 299-W18-28[91] 299-W15-21 was drilled and abandoned in 1989 because of problems encountered in well completion.

LLWMA-5 299-W6-5[91], 299-W6-7[91], 299-W6-8[91], 299-W6-11[92], 299-W6-12[92]

<u>Upgradient Shallow Wells</u>

LLWMA-1 299-E28-26[87] 299-E28-27[87], 299-E28-28[90], 299-E32-4[87], 299-E33-28[87], 299-E33-29[87], 299-E33-35[90]

LLWMA-2 299-E27-10[87], 299-E34-4[87], 299-E34-5[87], 299-E34-6[87], 299-E35-1[89]

LLWMA-3 299-W9-1[87], 299-W10-13[87], 299-W10-19[92], 299-W10-20[93], 299-W10-21[93]

LLWMA-4 299-W15-16[87], 299-W15-18[87], 299-W18-24[87], 299-W18-32[92]

LLWMA-5 299-W6-2[87], 299-W6-4[91], 299-W6-9[92], 299-W6-10[92], 299-W7-10[90], 299-W11-31[92]

<u>Upgradient Perched Well</u>

LLWMA-4 299-W18-29[91]

<u>Downgradient Deep Wells</u>

LLWMA-3 299-W7-3[87]

LLWMA-4 299-W18-22[87]

LLWMA-5 299-W6-6[91]

<u>Upgradient Deep Wells</u>

LLWMA-3 299-W10-14[87]

LLWMA-4 299-W15-17[87].

LLWMA-5 299-W6-3[91]

The designation of monitoring wells as being upgradient or downgradient is complicated in certain instances because of low groundwater gradients and complex site geometries. Wells 299-E28-26 and 299-E32-4 at LLWMA-1 and wells

299-E34-4, 299-E34-5, and 299-E34-6 at LLWMA-2 were at one time considered to be downgradient wells, based on limited data from the immediately surrounding groundwater monitoring wells. However, a reevaluation of the water level data from an expanded network of wells and over a 6-year period from 1987 to 1993 indicates that these are upgradient wells. These data are presented in Section 2.3.2.1. Well 299-E34-3 at LLWMA-2 originally was listed as an upgradient well, but because of its location at an interior corner of the unit, it is more appropriately designated a downgradient well. Other wells are located in alcoves, corners, or between sections of burial grounds such that these are downgradient of one part of the burial ground and upgradient of another part. These wells include 299-E32-2 in LLWMA-1, 299-E34-2 in LLWMA-2, and 299-W7-4 in LLWMA-3. These wells have been tentatively designated as either downgradient or upgradient based on the presently filled portions of the burial grounds.

Well 299-E32-4 at LLWMA-2 was completed to the top of basalt without encountering the water table. In the years following installation of the well, the water level has declined as a result of diminishing liquid disposal activities in the 200 East Area. As a result, water sampling at three other wells at LLWMA-2 (299-E34-4, 299-E34-6, and 299-E35-1) has been discontinued because of the lack of water.

The upgradient wells were screened at approximately the same hydrostratigraphic horizon as the downgradient wells. The *RCRA Groundwater Monitoring Technical Enforcement Guidance Document* (EPA 1986) recommends that the upgradient wells be located beyond the upgradient extent of potential contaminants from the regulated LLWMA. In addition, 40 CFR 265.91(a)(1)(i) and (ii) requires that upgradient wells provide background water quality data that are 'representative' of the uppermost aquifer near the unit and not affected by the unit. The upgradient wells, with the exception of 299-W18-24 in LLWMA-4, are located at the upgradient edge of the respective LLWMA.

2.5 GENERAL HYDROGEOLOGIC INVESTIGATIVE TECHNIQUES

Characterization of the geohydrologic properties of the LLBG was based on information gained from borehole sediment samples, geophysical logging, aquifer testing, and water level measurements.

Borehole sediment samples were collected using four different sampling methods: split-barrel continuous core, drive-barrel grab samples, hard-tool and bailer grab samples, and grab samples from the rotary drillings. Split-barrel sampling was conducted on five wells: 299-W15-21, 299-W7-8, 299-E32-5, 299-E35-1, and 299-W7-9. Well 299-W15-21 subsequently was abandoned when a casing broke and was replaced with well 299-W15-24; no soil sampling was performed in the replacement well. Soil samples were collected from the remainder of the wells using either drive-barrel or hard-tool and bailer. Although drive-barrel sampling was preferred over hard-tool and bailer sampling, the noncohesive, gravelly nature of the sediments (particularly in the 200 East area) precluded the use of the drive-barrel for much of the drilling. Samples were collected at 1.5-meter intervals. Additional samples were collected at lithologic contacts, in moist zones, and in zones where organic substances were detected. The following testing was conducted on selected sediment samples:

- Field lithologic characterization
- Laboratory petrographic and mineralogic analyses (thin sections, x-ray diffraction, x-ray fluorescence)
- Grain size distribution
- Field moisture content
- Water retention capacity
- Calcium carbonate content
- Total and inorganic carbon analysis
- Cation exchange capacity
- Hydraulic conductivity.

Field moisture content, water retention capacity, and hydraulic conductivity analyses were not performed on bailed samples because of the high degree of physical disturbance.

The following types of geophysical borehole logging were conducted:

- Natural gamma (gross gamma ray)
- Porosity (neutron-epithermal neutron; 1987 wells only)
- Density (gamma-gamma; 1987 wells only).

Predevelopment groundwater sampling was conducted in the 1987 wells for volatile organics, gross alpha and beta radiation, gamma radiation, tritium, total strontium, plutonium, uranium, cyanide, and semivolatile organics (200 East Area only), and WAC 173-303-9905 constituents (three wells in 200 West Area, one well in 200 East Area). This sampling was conducted to determine the disposition of purgewater. No predevelopment groundwater sampling was conducted in the later wells because all purgewater was handled as if it were contaminated in 1989 and 1990. In 1990, a strategy for dealing with purgewater was developed [HF RCRA Permit, Attachment 5 (Ecology 1994)].

Constant discharge production and recovery aquifer testing was conducted in all 1987 wells except in 299-E28-26 (high uranium), 299-E34-4 (dry), and 299-E34-6 (low water). Slug tests were conducted in wells installed in later years and after 1991 drawdown and recovery data were collected during well development. Water level measurements were conducted before and after well installation and subsequently at least quarterly.

Detailed results for the 1987 wells are presented in PNL (1989a). Results for the remaining wells are reported in WHC 1989e; WHC 1990b; and WHC 1993a, WHC 1993b, and WHC 1994.

3.0 INTERIM STATUS DATA

This section summarizes groundwater monitoring activities during the interim status period. The sampling and analysis plan, water level measurements, and analytical chemistry results are presented.

3.1 SAMPLING AND ANALYSIS PLAN

This section summarizes aspects of the groundwater sampling and analysis plan (PNL 1989a, Appendix B) that have been and currently are being used for the interim status program at the LLBG groundwater monitoring wells. Groundwater samples representative of the uppermost aquifer beneath the LLBG have been obtained and analyzed for detecting potential contaminant releases.

All interim status sampling activities at the LLBG currently are performed under contract by PNNL. The interim status groundwater sampling program at the LLBG was designed to provide initial water quality information on the uppermost aquifer beneath active and proposed regulated units within the LLWMA. Dedicated sampling equipment is provided for most of the wells, thus minimizing the potential for cross-contamination between the wells. The dedicated components of the system consist of a pump, well cap, and access for a water-level measurement device. In all wells, a dedicated pump was installed.

3.1.1 Static Water-Level Measurements

Before purging or sampling the monitoring well, the static water level is measured, recorded, and remeasured until reproducible results are obtained. These measurements are taken as depth-to-water from the top of the well casing and are subtracted from the surveyed elevation of the casing to obtain the elevation of the water level. Graduated steel measuring tapes are used for official measurements. Measurements are reported to the nearest 0.3 centimeter and are repeated until two readings agree to within plus or minus 0.6 centimeter. Between wells, the wetted section of tape is rinsed with de-ionized water and dried with a paper towel to minimize the risk of cross-contamination.

3.1.2 Well Purging

Interim status monitoring wells are purged before sample collection to obtain groundwater samples that are representative of the formation water rather than of the stagnant water from the well casing. Groundwater that has occupied the well undergoes chemical changes and becomes dissimilar from true formation water. Monitoring wells are purged until a minimum of three casing volumes of water have been removed.

3.1.3 Sample Withdrawal

After the interim status monitoring well has been purged, water samples are withdrawn from the well using the dedicated pump. The pumping rate during purging is approximately 11.4 to 18.9 liters per minute. If a monitoring well is not capable of sustaining this extraction rate, the pumping rate is reduced. The pumping rate is reduced to about 3.8 liters per minute for collection of groundwater samples.

During the sampling event, multiple groundwater samples are obtained for the specific laboratory analyses. Samples are collected and bottled in the following order:

- Bottles with septum caps (volatiles)
- Unfiltered samples (major-ions, cyanide, semivolatiles, metals)
- Filtered samples (metals).

3.1.4 Field Analyses

During interim status well purging and sample withdrawal, field determinations of temperature, pH, and specific conductivity are measured and recorded. Groundwater samples for laboratory analysis are not collected until each of these parameters has stabilized (PNL 1989a).

3.1.5 Sample Preservation and Handling

Measurements of temperature, specific conductance, and pH are taken in the field on unpreserved samples. Samples submitted for dissolved metals analysis are filtered in the field using a 0.45-micrometer membrane filter and are acidified with nitric acid to a pH of less than 2.0. Samples analyzed for cyanide are not filtered and are preserved by adding sodium hydroxide to raise the pH to greater than 12.0. Samples for volatile and semivolatile organic compounds are unfiltered and unpreserved. Samples for total organic halogen (TOX) and total organic carbon (TOC) are acidified to a pH of less than 2.0 using sulfuric acid and phosphoric acid, respectively. Samples for radium, gross alpha, and gross beta radiation are acidified with nitric acid to a pH of less than 2.0.

Prelabeled sample bottles containing the appropriate preservative are used for each monitoring well. Bottles that contain samples to be analyzed for volatile compounds, TOX, and TOC are filled to slightly more than full to ensure that there is no free head space. Bottles containing samples for all remaining parameters are filled to approximately 95 percent of capacity. Recommended sample containers and sample volumes are presented in Table 6.

Immediately after collection, the sample bottles are placed in sealed, insulated coolers packed with ice to cool the bottles to approximately 4°C. The coolers are transported to the lead laboratory for analysis. Field parameter record forms are attached to the sealed containers. The temperatures of the samples are measured upon opening the cooler in the laboratory. If the temperature is approximately 4°C and some of the original unmelted ice is found to remain in the cooler, the samples are considered to have been maintained at the appropriate temperature during the time the samples were in the cooler.

3.1.6 Chain-of-Custody

Chain-of-custody procedures are followed in collecting interim status data to ensure the integrity of groundwater samples from the time of collection through laboratory analysis and data reporting. This program includes sample labels, sample seals, field record forms, chain-of-custody forms, sample analysis request forms, and laboratory acceptance procedures.

3.1.7 Quality Assurance and Quality Control Procedures

Quality assurance and quality control procedures are applied to both field and laboratory interim status data to ensure the reliability and validity of the data. One aspect of the quality assurance and quality control program is to monitor field and trip blanks and interlaboratory samples to evaluate the accuracy of results from the lead laboratory.

Interlaboratory comparisons are conducted to determine if the analytical results obtained from the lead laboratory are comparable to results from other laboratories. Comparisons are conducted for anions, volatile organics, and metals.

Spiked samples are submitted to the lead laboratory to estimate any bias in laboratory analytical procedures and to determine whether such bias exceeds control limits. Blind, spiked samples prepared by PNNL and spiked samples prepared under a multilaboratory comparison program are both used in this procedure. Field duplicates are obtained by retrieving a second sample from the same well using the same sampling equipment and sampling techniques. Field duplicates are taken on a frequency of one for every 20 wells.

Field and trip blanks are submitted to the lead laboratory to determine whether environmental conditions encountered during collection and transportation of samples have affected the results of sample analyses. Preparation of field blank samples consists of filling sample vials at the wellhead with Type 2-ASTM water (de-ionized, charcoal-filtered, and boiled). At least one field blank is submitted for each sample period per LLWMA, or at the rate of one blank for each 20 wells. Trip blanks, prepared in the laboratory by filling sample vials with Type 2-ASTM water, travel into the field with the empty field blank and sample containers. Both field and trip blank sample bottles are packed with ice and are transported to the laboratory for analysis along with the groundwater samples. Because wells are sampled using dedicated sampling pumps, no equipment blanks are obtained.

3.1.8 Disposal of Purgewater

Before May 1989, all purgewater generated from sampling of interim status wells was released to the ground surface in the vicinity of the well. Beginning in May 1989, purgewater has been contained initially in galvanized steel troughs located near the well head. Tanker trucks are used to collect and transport the purgewater from the troughs to a modular-tank area. The modular-tank area consists of multiple 3,785,400-liter storage tanks constructed of double layers of HDPE with a geotextile leak detection and containment system. Collected purgewater is stored in the modular-tank area until transferred to the 200 Area Effluent Treatment Facility.

3.2 ANALYTICAL DATA

The following sections present analytical data on interim status water quality.

3.2.1 Groundwater Elevations

Groundwater elevation data have been obtained for the interim status wells since well installation. Water levels were measured weekly from December 1987 to mid-March 1988 and then at least quarterly to the present time. Table 7 presents representative water-level data for selected wells between the time of well installation and the present. Data collected is reported in the RCRA quarterly groundwater monitoring reports.

Groundwater elevations for June 1991, 1992, 1993 are shown in Figures 4 through 9. These figures are based on data from various Hanford Facility groundwater monitoring wells located near the 200 Areas. These figures have been published in annual reports (e.g., DOE/RL-93-88).

Groundwater elevations beneath both LLWMA-1 and LLWMA-2 have exhibited minor fluctuations since 1987, probably in response to variations in discharge rates to the nearby 216-B-3 Pond (B Pond) and to the decommissioning of Gable Mountain Pond. Water levels near these two LLWMAs rose an average of 23 centimeters between December 1987 to January 1989, and dropped approximately 31 centimeters per year since that time. The water table has dropped below the top of the basalt at wells 299-E34-6 and 299-E35-1 on the north and east sides of LLWMA-2. Both of these wells are completed to the top of basalt; therefore sampling is precluded at these wells.

From December 1987 to January 1989, water levels in groundwater monitoring wells near LLWMA-3 decreased an average of more than 15 centimeters, while monitoring wells located adjacent to LLWMA-4 decreased about 21 centimeters. Since 1991, water levels have decreased approximately 31 centimeters a year in monitoring wells near LLWMA-3 and LLWMA-4. Indications from the first year of measurements at LLWMA-5 are consistent with this rate of decline. These decreases probably result from the continuing dissipation of the U Pond mound.

Measured groundwater elevations reflect both present and past disposal of waste water to surface ponds and trenches. The significant groundwater mounding in the vicinity of the B Pond (east of the 200 East Area) has caused the normal regional eastward flow gradient to reverse and develop a westward flow component beneath LLWMA-1 and LLWMA-2. The water table map of June 1993 for LLWMA-1 and LLWMA-2 shows the westward flow to have a hydraulic gradient of approximately 0.00025 beneath the 200 East Area. The magnitudes and directions of the hydraulic gradients in the 200 East Area are somewhat uncertain because of the relatively flat gradients in the area and the variable influence of the nearby disposal ponds.

Beneath the 200 West Area, the apex of the groundwater mound formed in response to disposal at the U Pond has moved to the northeast since use of the pond was discontinued in 1984 and has been reinforced by continued waste water disposal to the 216-U-14 Ditch. The continued existence of the mound (greater than 18.3 meters above pre-Hanford Site conditions) has forced the normal regional eastward groundwater flow to a more north-northeast direction beneath LLWMA-3 and LLWMA-5, and to a west-northwest direction beneath LLWMA-4. In June 1993, the hydraulic gradient was approximately 0.0015 beneath LLWMA-3 and LLWMA-5 and 0.0006 beneath LLWMA-4.

As the groundwater mound in the 200 West Area continues to decline, water levels in monitoring wells at LLWMA-3, LLWMA-4, and LLWMA-5 will continue to decline, and the regional groundwater flow direction will shift more toward the northeast and the east. Decreased disposal of waste water to the B Pond in the 200 East Area has lowered groundwater levels beneath the 200 East Area. Continued groundwater level decreases are expected in the 200 East Area following decommissioning of the B Pond in the 1990s.

3.2.2 Results of Water Quality Analyses--Predevelopment Samples

Predevelopment groundwater quality data were obtained for each of the 1987 wells at the completion of well construction and before aquifer testing. These samples were taken to determine if the groundwater geochemically was acceptable for discharge to the ground during aquifer testing and borehole development. Samples were analyzed for volatile organic compounds, gross alpha and beta radiation, gamma radiation, tritium, total strontium, plutonium, and uranium. Samples taken from wells in the 200 East Area also were analyzed for cyanide and semivolatile organics. Three wells in the 200 West Area (299-W7-3, 299-W15-17, and 299-W18-22) and one well in the 200 East Area (299-E34-2) were analyzed for the complete suite of WAC 173-303-9905 constituents. These analytical data are documented (PNL 1989a).

The predevelopment water was considered acceptable for direct ground discharge if the contaminant levels were below 10 percent of the designated WAC 173-303 dangerous waste guidelines and below 1/25 of the derived concentration guides for radionuclides (DOE 1988; PNL 1989a). The derived concentration guides are being developed to be in compliance with 40 CFR 61 Subpart H standard of 25 millirems per year for radiological exposure. Results of the water quality analyses show that water from only one well (299-E28-26) exceeded these criteria. The water obtained from that well was shown to have a mean concentration of 21.8 picocuries per liter of uranium-234, which is greater than 1/25 of the derived concentration guideline of 500 picocuries per liter that the DOE is considering establishing for this constituent. For this reason, well 299-E28-26 was not pump tested.

No other constituents analyzed during the predevelopment sampling events were shown to be in concentrations that would limit the water discharge to the ground. However, detectable concentrations of tritium, carbon tetrachloride, chloroform, total alpha radiation, total beta radiation, and methylene chloride were observed.

3.2.3 Results of Water Quality Analyses--Quarterly and Semi-annual Samples

The first sampling event for the interim status well network was completed in September/October 1988. Sampling was continued quarterly for the first six sampling rounds. As a result of elevated values of specific conductance and TOX at LLWMA-1 and LLWMA-3 respectively, groundwater quality assessment plans were prepared (WHC 1990d and 1990e). Sampling continued quarterly at LLWMA-1 and LLWMA-3 until January of 1994 when assessment reports (WHC 1993c and 1993d) concluded the groundwater contamination was not the result of disposal practices at the LLBG. Sampling is now conducted semi-annually at LLWMA-1 and LLWMA-3. Semi-annual sampling began at LLWMA-2 and LLWMA-4 in 1989 after initial background values for contamination indicator parameters were established. Quarterly sampling began at LLWMA-5 after the initial monitoring wells were installed in 1991. Semi-annual sampling began at LLWMA-5 in 1993 (Appendix 5B). Statistical comparisons are made on the semi-annual sampling results to determine the impact, if any, of the LLBG.

Samples were analyzed for WAC 173-303-645(5) (Table 1) drinking water parameters and WAC 173-303-9905 chemical parameters, pH, specific conductivity, TOX, and TOC. These four latter parameters are the interim status contamination indicator parameters, and four replicates are obtained and analyzed from each well in each sampling round; other parameters are analyzed less frequently and no replicates are obtained. All groundwater quality data from the LLBG monitoring well network are entered into a PNNL database for permanent storage and are published in quarterly groundwater monitoring reports.

Table 8 identifies those chemical constituents that exceeded established drinking water standards (40 CFR 141) during the initial interim status groundwater sampling event (September/October 1988). At LLWMA-1, groundwater obtained from wells 299-E28-26, 299-E28-27, 299-E32-2, and 299-E32-3 exceeded established drinking water standards for tritium (20,000 picocuries per liter), and groundwater from well 299-E28-26 exceeded limits for nitrate and gross alpha radiation (45 milligrams per liter and 15 picocuries per liter, respectively). This well also was shown to have a high level of dissolved uranium (53.2 micrograms per liter). The concentration of dissolved chromium approached the drinking water standard in well 299-E33-29 (50 micrograms per liter), but the concentration might be reflective of well construction practices rather than true groundwater contamination (PNL 1989b).

In wells installed around LLWMA-2, only the concentration of dissolved chromium approached the drinking water limits (wells 299-E34-2 and 299-E34-6). The source of the dissolved chromium might be from the well installation technique, because elevated concentrations of iron and manganese (unfiltered) also were observed. An investigation into the source of the chromium is ongoing, and the chromium concentrations are being carefully monitored and evaluated

The concentration of dissolved chromium exceeded the drinking water standard in three wells (299-W6-2, 299-W7-6, and 299-W10-14) adjacent to LLWMA-3, while nitrate exceeded 45 milligrams per liter in two wells (299-W6-2 and 299-W7-4) and approached the standard in two additional wells (299-W7-1 and 299-W7-5). Carbon tetrachloride was detected in five samples and exceeded the established drinking water standard (5 micrograms per liter) in four of the samples (299-W6-2, 299-W7-4, 299-W7-5, and 299-W10-13).

Samples obtained from wells at LLWMA-4 were shown to be above detection limit in gross alpha radiation (299-W18-21), chromium (299-W15-15, 299-W15-16, 299-W15-18, 299-W18-21, and 299-W18-23), nitrate (299-W15-16, and 299-W15-18), carbon tetrachloride (299-W15-15, 299-W15-16, 299-W15-18, 299-W18-21, 299-W18-23, and 299-W18-24), and trichloroethylene (299-W15-16). The high concentrations of carbon tetrachloride (0.13 to 8.1 milligrams per liter) observed in the samples might be reflective of constituents derived from past waste water disposal practices at the 216-Z cribs. The highest concentrations of carbon tetrachloride were observed in samples upgradient of LLWMA-4 and immediately downgradient of the waste water disposal areas and the Plutonium Finishing Plant in the 200 West Area.

3.2.4 Statistical Results

Background data were collected during the first year of sampling, from September 1988 to July 1989, and included four sampling events. These data have been published in quarterly groundwater monitoring reports (e.g., PNL 1989b). Statistical analysis of the September/October 1989 sampling results for contamination indicator parameters (pH, specific conductivity, TOC, and TOX) were calculated. Results of the statistical analysis indicated that LLWMA-1 and LLWMA-3 statistically had significant increased levels of contamination indicator parameters in a downgradient well compared to background values determined from upgradient wells. Assessment plans were delivered to Ecology for both LLWMAs (WHC 1990d; 1990e). Details of the statistical analyses are presented in the assessment plans and summarized in the following.

Interim status data from the fall 1989 sampling round were analyzed using the Average Replicate Test (EPA 1986). This methodology compares the average replicate mean for each indicator parameter at every downgradient well to a critical mean. The critical mean is a function of the mean and standard deviation of the background data, the confidence interval (0.99 in this case), the degrees of freedom in the background data, and the number of comparisons in each sampling event. The number of comparisons in each sampling event is the product of the number of indicator parameters (four in this case) and the number of downgradient wells in the LLWMA.

The assessment plan for LLWMA-1 was triggered by a statistically significant higher specific conductance in well 299-E28-26. The critical mean for specific conductance at LLWMA-1 was 492.9 micromhos per centimeter, while the average value in 299-E28-26 was 511 micromhos per centimeter. The primary objective of the assessment plan was to determine if the elevated value was due to disposal activities at LLWMA-1, or to activities at another location, such as the 216-B-62 Crib.

An assessment report (WHC 1993c) determined that well 299-E28-26 is upgradient rather than downgradient of LLWMA-1. The most likely source of the high specific conductance was elevated nitrate associated with past disposal practices at the 216-B-55 and 216-B-62 cribs located to the south of LLWMA-1. The observed contamination therefore appears to have originated at another location. Updated critical means for the contamination indicator parameters have been calculated and LLWMA-1 has returned to detection level monitoring.

The assessment plan for LLWMA-3 was triggered by a statistically significant higher TOX in well 299-W7-4. The critical mean for TOX at LLWMA-3 was 95.5 parts per billion, and the average concentration in 299-W7-4 was 171 parts per billion. The primary purpose of the assessment plan was to determine if the elevated value was due to disposal activities at LLWMA-3, or to activities at an upgradient location, such as the 216-Z-18 Crib.

Additional upgradient groundwater monitoring wells have been installed at LLWMA-3 and analysis of the groundwater chemistry data indicates that the original upgradient wells did not adequately characterize the groundwater beneath LLWMA-3. The assessment report (WHC 1993c) issued concluded that the elevated TOX in well 299-W7-4 was a result of the extensive carbon tetrachloride contamination beneath the 200 West Area. The source of this contamination is to the south of LLWMA-3. Background levels of the contamination indicator parameters are being re-established for LLWMA-3. Quarterly samples for the contamination indicator parameters were collected from the shallow upgradient monitoring wells for four quarters and upgradient/downgradient comparison values were reestablished in May 1995. Sampling for contamination indicator parameters, interim primary drinking water parameters, water quality parameters, and site-specific parameters currently is semi-annually.

Analysis of the data from LLWMA-2, LLWMA-4, and LLWMA-5 does not indicate statistically significant increases of contamination indicator parameters in downgradient wells.

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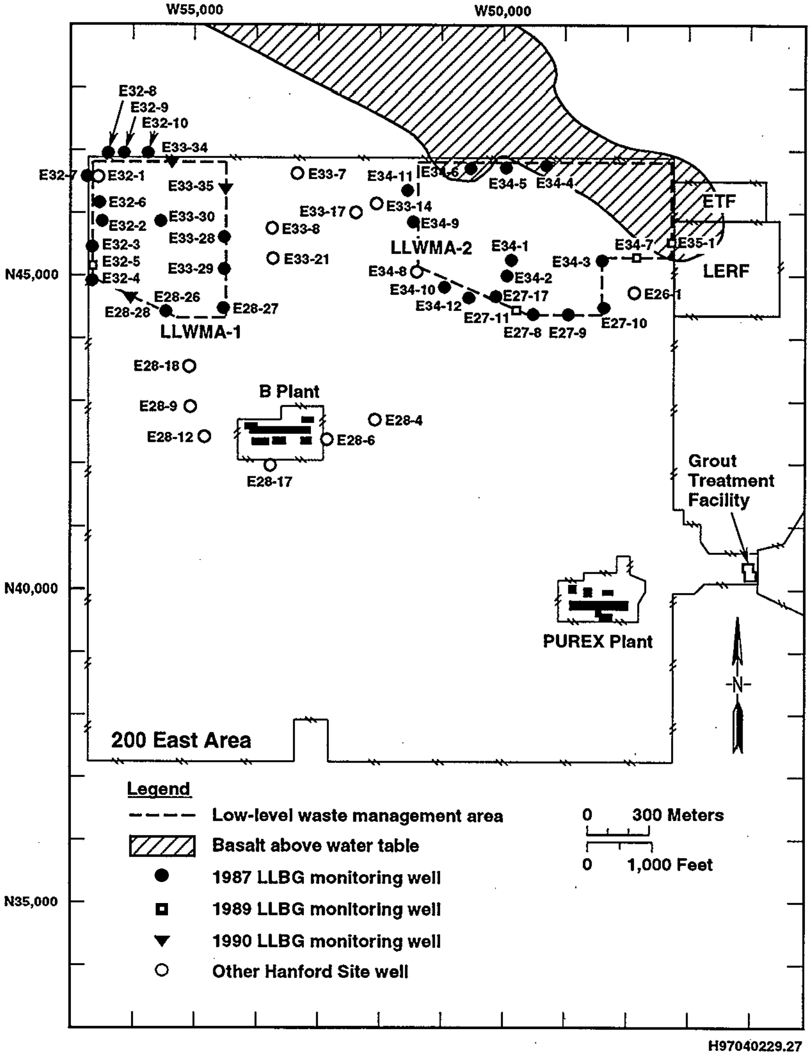

Figure 1. Locations of Interim Status Monitoring Wells in the 200 East Area.

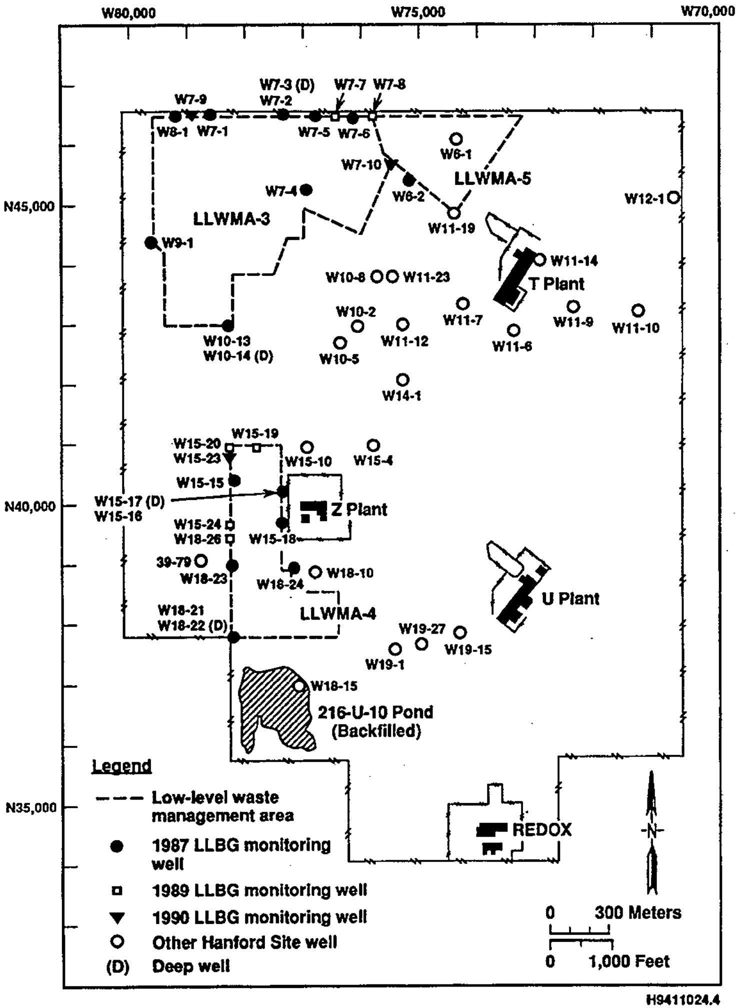

Figure 2. Locations of Interim Status Monitoring Wells in the 200 West Area.

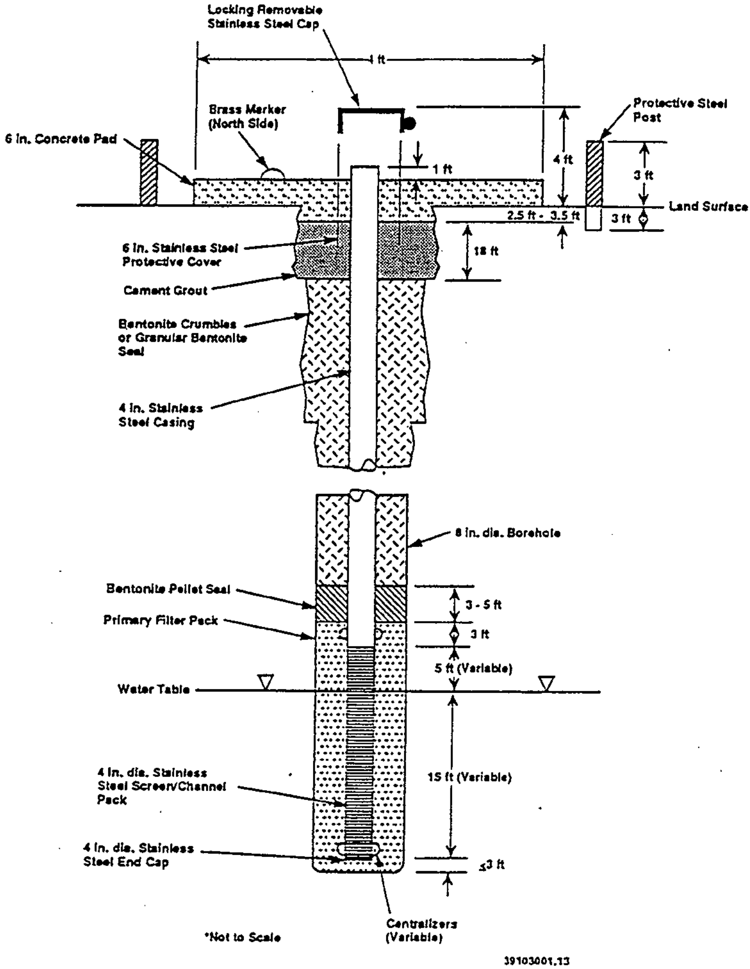

Figure 3. Schematic Design Used for Monitoring Wells Around the Low-Level Burial Grounds (stratigraphy representative of the 200 West Area) (After PNL 1989a).

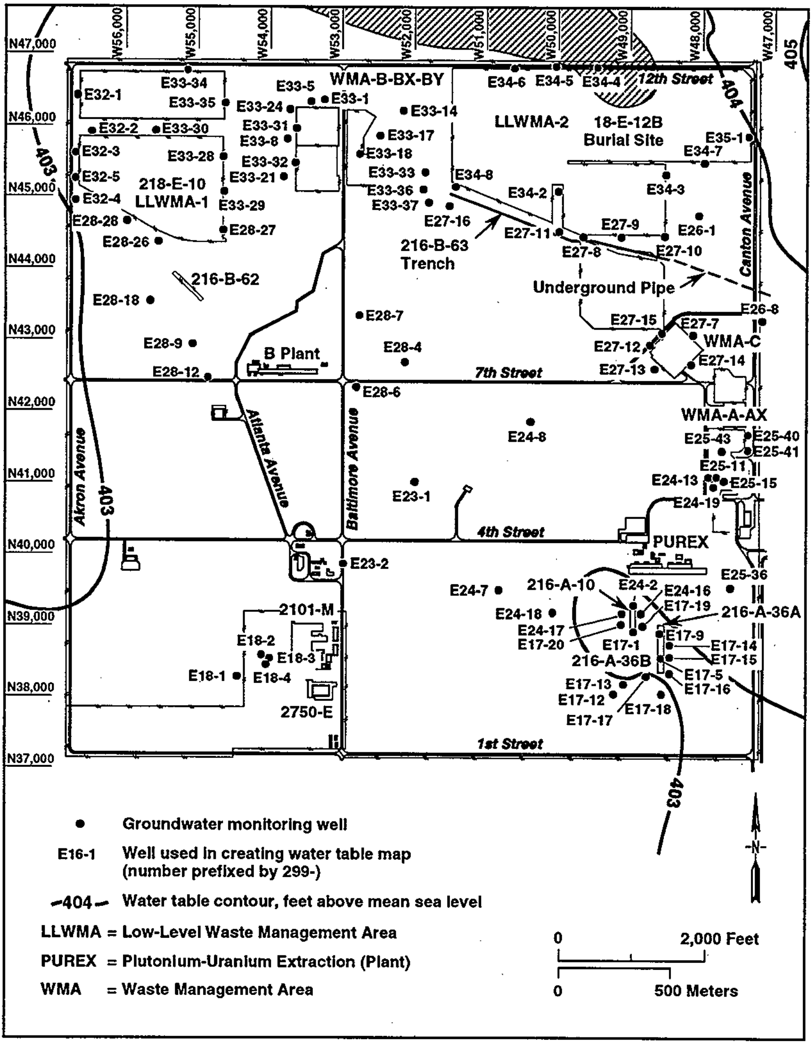

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Figure 4. Water Table Beneath Low-Level Waste Management Areas 1 and 2 in the 200 East Area, June 1991.

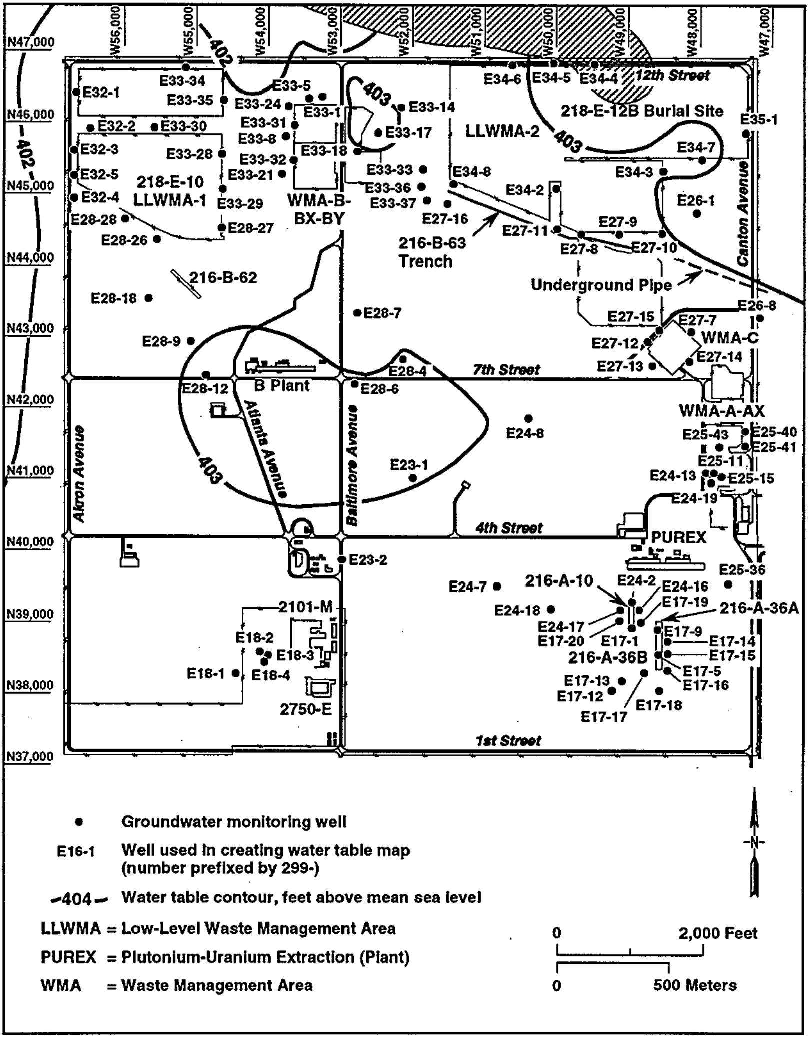

Figure 5. Water Table Beneath Low-Level Waste Management Areas 1 and 2 in the 200 East Area, June 1992.

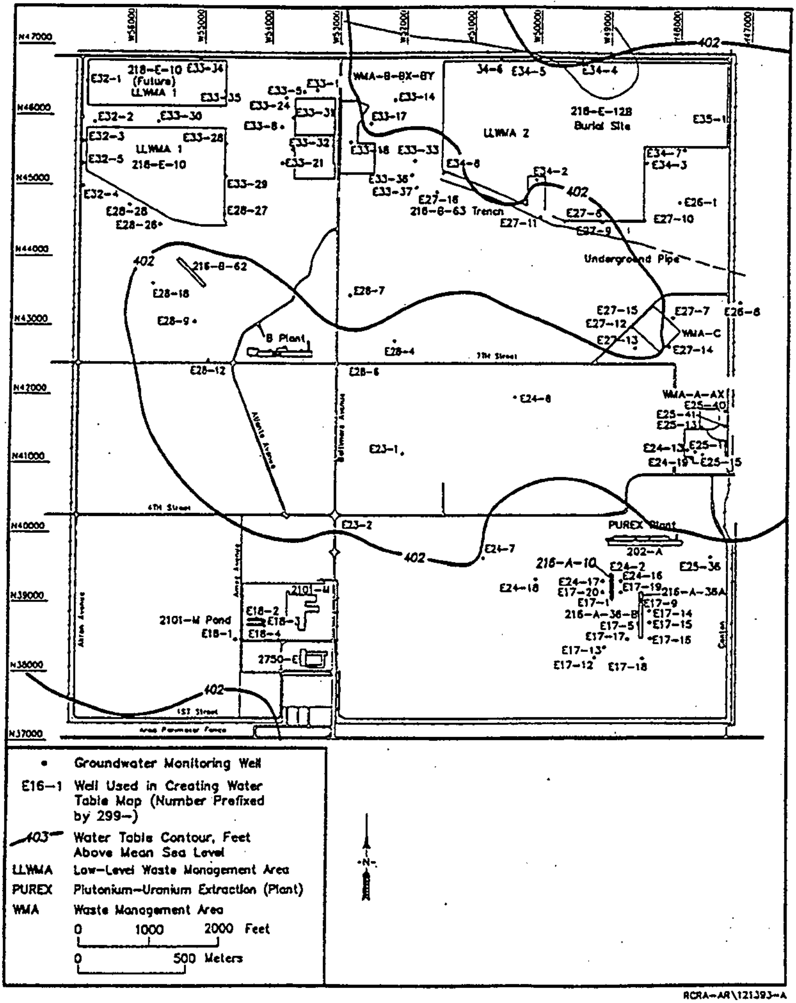

Figure 6. Water Table Beneath Low-Level Waste Management Areas 1 and 2 in the 200 East Area, June 1993.

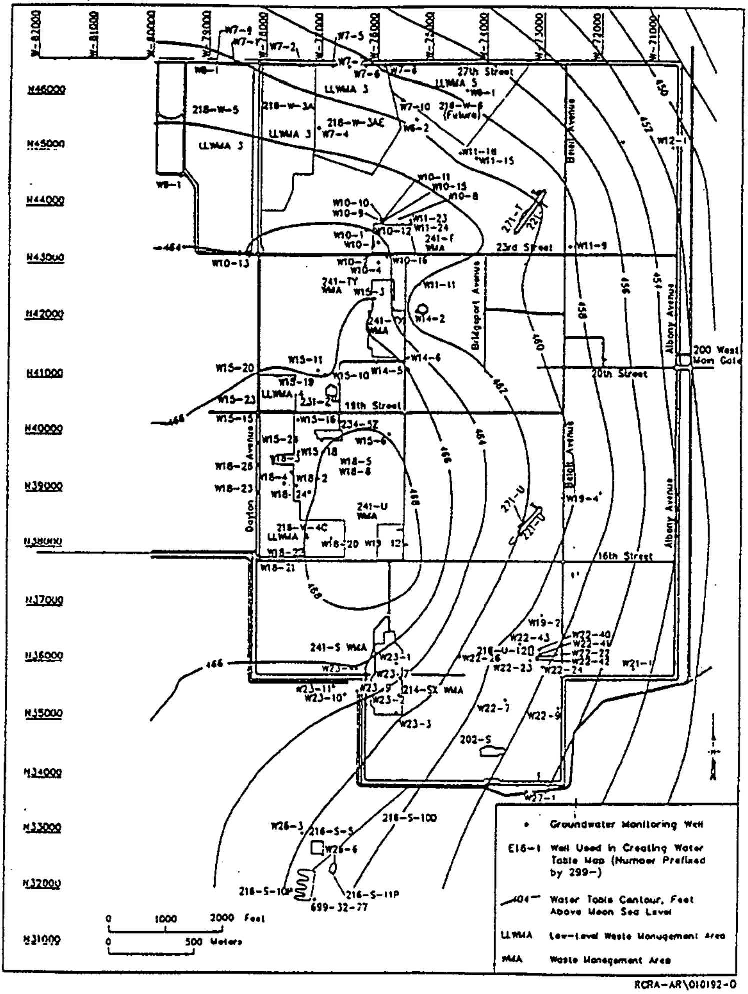

Figure 7. Water Table Beneath Low-Level Waste Management Areas 3, 4 and 5 in the 200 West Area, June 1991.

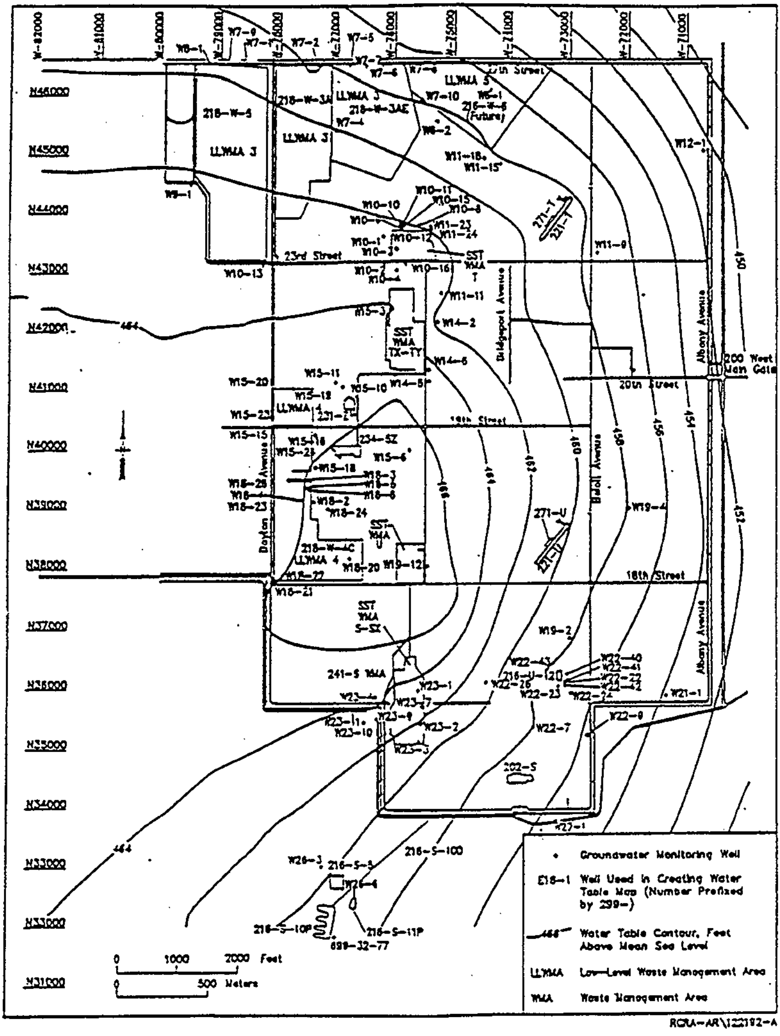

Figure 8. Water Table Beneath Low-Level Waste Management Areas 3, 4 and 5 in the 200 West Area, June 1992.

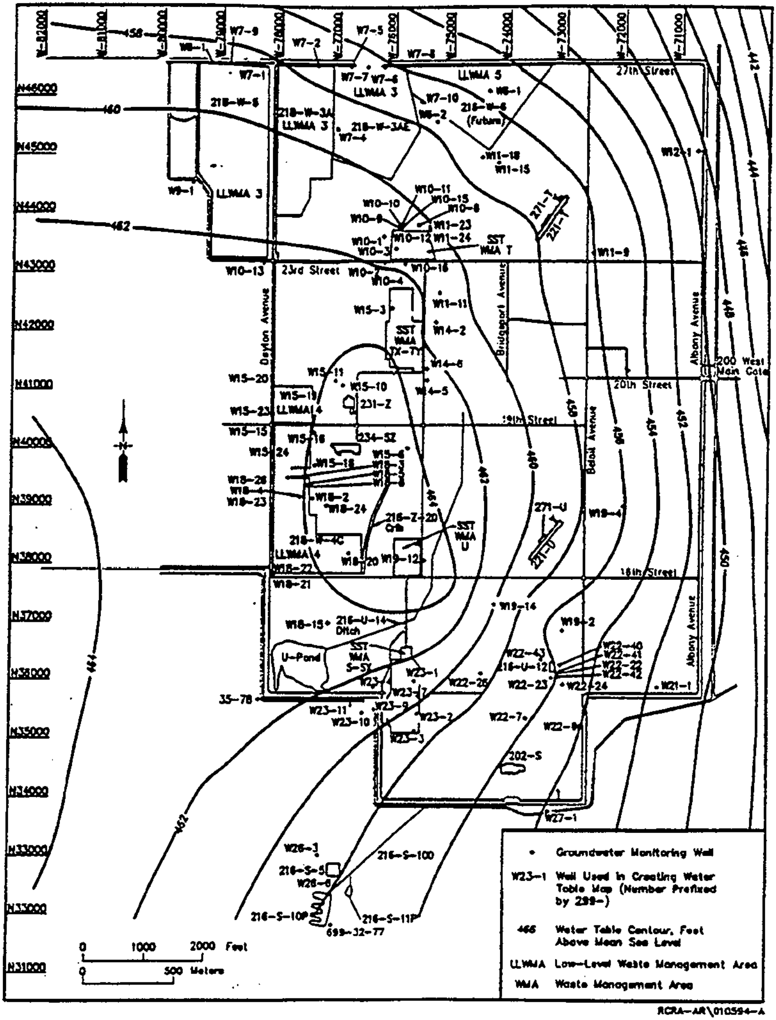

Figure 9. Water Table Beneath Low-Level Waste Management Areas 3, 4, and 5 in the 200 West Area, June 1993.

Table 1. Construction Details for Detection-Level Monitoring Wells; Low-Level Waste Management Area-1.
(sheet 1 of 2)

Well	Coordinates	Top of casing elevation (meters)	Drilled depth (meters)	Screened interval (meters)
299-E28-26	N 44,446 W 55,606	209.48	100	85-91
299-E28-27	N 44,595 W 54,670	207.38	92	82-88
299-E28-28	N 44,724 W 56,056	209.32	90	84-90
299-E32-2	N 45,904 W 56,565	204.23	88	79-85
299-E32-3	N 45,631 W 56,721	206.21	93	81-87
299-E32-4	N 44,985 W 56,713	209.06	95	85-91
299-E32-5	N 45,306 W 56,725	207.92	90	83-89
299-E32-6	N 46,060 W 56,722	203.44	85	78-84
299-E32-7	N 46,493 W 56,720	200.69	83	75-81
299-E32-8	N 46,802 W 56,513	196.77	78	72-78
299-E32-9	N 46,802 W 56,081	196.09	78	70-76
299-E32-10	N 46,800 W 55,569	194.44	75	68-74
299-E33-28	N 45,596 W 54,668	202.46	85	78-84
299-E33-29	N 45,124 W 54,665	205.36	88	80-86

Table 1. Construction Details for Detection-Level Monitoring Wells; Low-Level Waste Management Area-1.
(sheet 2 of 2)

Well	Coordinates	Top of casing elevation (meters)	Drilled depth (meters)	Screened interval (meters)
299-E33-30	N 45,903 W 55,660	202.29	85	78-84
299-E33-34	N 46,796 W 55,065	193.04	73	67-73
299-E33-35	N 46,351 W 54,685	195.99	76	69-76

Table 2. Construction Details for Detection-Level Monitoring Wells; Low-Level Waste Management Area-2.
(sheet 1 of 2)

Well	Coordinates	Top of casing elevation (meters)	Drilled depth (meters)	Screened interval (meters)
299-E27-8	N 44,496 W 49,642	194.41	78	69-75
299-E27-9	N 44,484 W 49,122	191.78	74	67-73
299-E27-10	N 44,520 W 48,522	190.34	73	65-71
299-E27-11	N 44,558 W 49,990	196.07	81	70-76
299-E27-17	N 44,752 W 50,337	193.46	75	68-74
299-E34-2	N 45,076 W 50,048	192.27	74	67-73
299-E34-3	N 45,337 W 48,488	186.39	65	59-65
299-E34-4	N 46,791 W 49,419	179.09	54	48-54
299-E34-5	N 46,791 W 50,014	180.07	58	52-58
299-E34-6	N 46,784 W 50,609	182.22	59	53-59
299-E34-7	N 45,520 W 47,949	184.17	63	59-62
299-E34-9	N 45,765 W 51,520	191.62	71	65-71
299-E34-10	N 45,091 W 51,199	195.00	76	69-75
299-E34-11	N 46,264 W 51,551	188.35	67	63-66

Table 2. Construction Details for Detection-Level Monitoring Wells; Low-Level Waste Management Area-2.
(sheet 2 of 2)

Well	Coordinates	Top of casing elevation (meters)	Drilled depth (meters)	Screened interval (meters)
299-E34-12	N 44,907 W 50,783	194.71	76	68-75
299-E35-1	N 45,870 W 47,339	182.36	59	55-58

Table 3. Construction Details for Detection-Level Monitoring Wells; Low-Level Waste Management Area-3.
(sheet 1 of 2)

Well	Coordinates	Top of casing elevation (meters)	Drilled depth (meters)	Screened interval (meters)
299-W6-2	N 45,571 W 75,302	211.06	76	68-75
299-W7-1	N 46,551 W 78,601	210.53	75	68-75
299-W7-2	N 46,519 W 77,385	205.92	72	62-68
299-W7-3	N 46,520 W 77,420	206.09	145	137-143
299-W7-4	N 45,435 W 77,040	204.73	72	62-71
299-W7-5	N 46,509 W 76,816	205.14	70	63-69
299-W7-6	N 46,509 W 76,219	206.85	74	64-70
299-W7-7	N 46,509 W 76,519	205.72	70	63-69
299-W7-8	N 46,510 W 75,880	209.50	75	67-73
299-W7-9	N 46,549 W 78,889	210.95	77	67-73
299-W7-10	N 45,921 W 75,564	210.21	74	67-73
299-W7-11	N 46,512 W 77,769	207.70	72	65-71
299-W7-12	N 46,514 W 78,246	209.68	75	67-73
299-W8-1	N 46,551 W 79,200	213.76	83	72-78
299-W9-1	N 44,508 W 79,507	224.86	90	81-87

Table 3. Construction Details for Detection-Level Monitoring Wells; Low-Level Waste Management Area-3.
(sheet 2 of 2)

Well	Coordinates	Top of casing elevation (meters)	Drilled depth (meters)	Screened interval (meters)
299-W10-13	N 43,137 W 78,297	213.07	76	69-75
299-W10-14	N 43,143 W 78,330	213.19	141	130-136
299-W10-19	N 44,545 W 77,249	208.17	72	65-72
299-W10-20	N 43,987 W 77,565	209.56	74	68-74
299-W10-21	N 44,930 W 76,466	205.45	72	64-70

Table 4. Construction Details for Detection-Level Monitoring Wells; Low-Level Waste Management Area-4.
(sheet 1 of 2)

Well	Coordinates	Top of casing elevation (meters)	Drilled depth (meters)	Screened interval (meters)
299-W15-15	N 40,330 W 78,103	212.74	78	68-77
299-W15-16	N 40,269 W 77,387	208.75	74	63-72
299-W15-17	N 40,221 W 77,387	208.68	137	129-132
299-W15-18	N 39,705 W 77,383	117.56	74	63-72
299-W15-19	N 41,041 W 77,772	210.80	75	65-72
299-W15-20	N 41,028 W 78,120	212.86	74	67-73
299-W15-23	N 40,680 W 78,119	213.20	74	67-73
299-W15-24	N 39,851 W 78,096	213.17	74	67-73
299-W18-21	N 37,794 W 78,080	203.80	69	60-69
299-W18-22	N 37,831 W 78,109	203.76	139	127-137
299-W18-23	N 38,987 W 78,120	212.39	78	67-76
299-W18-24	N 38,998 W 77,180	208.59	73	63-72
299-W18-26	N 39,477 W 78,097	213.07	76	68-74
299-W18-27	N 38,607 W 78,103	210.39	73	66-72
299-W18-28	N 38,214 W 78,096	207.26	70	63-70

Table 4. Construction Details for Detection-Level Monitoring Wells; Low-Level Waste Management Area-4.
(sheet 2 of 2)

Well	Coordinates	Top of casing elevation (meters)	Drilled depth (meters)	Screened interval (meters)
299-W18-29	N 37,952 W 76,560	205.48	46	36-41
299-W18-32	N 37,780 W 76,709	206.24	69	62-68

Table 5. Construction Details for Detection-Level Monitoring Wells; Low-Level Waste Management Area-5.

Well	Coordinates	Top of casing elevation (meters)	Drilled depth (meters)	Screened interval (meters)
299-W6-2	N 45,571 W 75,302	211.06	76	68-75
299-W6-3	N 45,399 W 74,713	213.31	134	125-128
299-W6-4	N 45,370 W 74,667	213.74	79	72-78
299-W6-5	N 46,510 W 73,477	217.64	87	80-87
299-W6-6	N 46,511 W 74,053	216.40	144	128-131
299-W6-7	N 46,512 W 74,077	216.49	84	75-81
299-W6-8	N 46,514 W 75,004	211.45	77	70-76
299-W6-9	N 45,609 W 74,997	212.78	77	70-77
299-W6-10	N 45,901 W 73,744	217.16	85	77-83
299-W6-11	N 46,500 W 74,564	214.23	85	83-85
299-W6-12	N 46,504 W 75,374	211.08	78	73-78
299-W7-10	N 45,921 W 75,564	210.21	74	67-73
299-W11-31	N 45,188 W 74,375	215.45	81	73-79

Table 6. Sample Volume and Container Type for Interim Status Groundwater Sampling Parameters.

Parameter	Recommended container[a]	Sample volume (milliliters)
pH	P, CG	25
Specific conductivity	P, CG	100
Organic compounds		
Volatile organic compounds	AG - Teflon[b] lined septum in cap	2-40 vials
Semi-volatile organic compounds	AG	2,000
Total organic halogen (TOX)	AG	250
Total organic carbon (TOC)	AG	250
Metals		
Beryllium	P	1,000
Chromium	P	1,000
Copper	P	1,000
Cadmium	P	1,000
Silver	P	1,000
Sodium	P	1,000
Mercury	G	1,000
Lead	P	1,000
Inorganic anions		
Chloride	P	1,000
Fluoride	P	1,000
Sulfate	P	1,000
Nitrate	P	1,000
Nonmetals		
Radium	P	500
Gross alpha	P	500
Gross beta	P	500
Cyanide	P	500

[a]Container types: P - plastic (PE), AG - amber glass, CG - clear glass.
[b]Teflon is a trademark of E.I. duPont de Nemours and Company, Incorporated.

Table 7. Water Level Information for Selected Low-Level Burial Grounds Groundwater Monitoring Wells.

	Well	December measurements (meters above mean sea level) 1987	1989	1991	1993
LLWMA-1					
	299-E28-26	123.40	123.28	122.86	122.31
	299-E32-2	123.32	123.21	122.79	122.29
	299-E33-28	123.40	123.28	122.84	122.36
LLWMA-2					
	299-E27-10	123.64	123.48	123.03	122.52
	299-E34-2	123.49*	123.39	122.86	122.42
	299-E34-5	123.78	123.63	123.20	122.77
LLWMA-3					
	299-W6-2	140.81	140.66	140.05	139.31
	299-W7-2	140.55	140.32	139.88	139.19
	299-W7-4	141.23	140.95	140.43	139.74
	299-W7-3d	140.17	139.90	139.55	138.87
	299-W10-14d	142.20	141.88	141.36	140.53
LLWMA-4					
	299-W15-15	143.15	142.86	142.14	141.23
	299-W15-16	143.37	143.12	142.28	141.36
	299-W18-21	143.28	142.91	142.22	141.22
	299-W15-17d	143.23	142.96	142.17	141.33
	299-W18-22d	143.05	142.63	142.00	141.09
LLWMA-5					
	299-W6-2	140.81	140.66	140.05	139.31
	299-W6-4	----	----	----	139.45
	299-W6-7	----	----	----	138.38
	299-W6-3d	----	----	----	139.27
	299-W6-6d	----	----	----	138.37

* - Measured 1/8/88.
d - Monitors bottom of unconfined aquifer.

Table 8. Chemical Constituents Exceeding Drinking Water Standards During Initial Interim Status Sampling Event (September/October 1988).

Constituent	Number of wells			
	LLWMA-1	LLWMA-2	LLWMA-3	LLWMA-4
Gross alpha (15 picocuries per liter)[a]	1	0	0	1
Carbon tetrachloride (5 parts per billion)[a]	0	0	4	6
Coliform bacteria (1 MPN)[a]	0	0	0	1
Chromium (50 parts per billion)[a]	0	0	3	5
Nitrate (45 milligrams per liter)[a]	1	0	2	2
Trichloroethylene (5 parts per billion)[a]	0	0	0	1
Tritium (20,000 picocuries per liter)[a]	5	0	0	0

[a]40 CFR 141; MPN = most probable number.

APPENDIX 5B

SUSPENSION OF GROUNDWATER SAMPLING AT LOW-LEVEL WASTE MANAGEMENT AREA 5

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Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

9601159

APR 3 1996

Mr. David L. Lundstrom
200 Area Section Manager
Nuclear Waste Program
State of Washington
Department of Ecology
1315 W. Fourth Avenue
Kennewick, Washington 99336-6018

Dear Mr. Lundstrom:

SUSPENSION OF GROUNDWATER SAMPLING AT LOW-LEVEL WASTE MANAGEMENT AREA 5 (LLWMA-5)

The LLWMA-5 in the 200 West Area is one of the Low-Level Burial Grounds monitored under the Resource Conservation and Recovery Act (RCRA) program on the Hanford Site. This LLWMA comprises all of the 216-W-6 burial ground in the north-central portion of 200 West. Waste has not been placed in this burial ground.

Groundwater has been monitored specifically for RCRA at this site since 1991. Background values and required statistics for the contamination indicator parameters (CIPs) were determined in 1993. Because it was not clear in 1993 when the first wastes were to be placed in LLWMA-5, semiannual sampling has continued.

A determination has now been made that the LLWMA-5 will not be needed for several years. As an economy measure, groundwater sampling for LLWMA-5 will be suspended beginning the first quarter of 1996. Sampling will be re-instituted prior to any wastes being disposed to LLWMA-5. At that time statistical evaluations will be done to determine whether the established background levels for the CIPs are still representative of groundwater conditions beneath the burial ground.

If you want to discuss this matter further or require additional information, please contact me at 373-9630.

Sincerely,

M. J. Furman

M. J. Furman, Project Manager
Groundwater Project

GWP:MJF

cc: A. Diliberto, WHC
S. Leja, Ecology
J. Schmid, WHC H6-06
D. Sherwood, EPA
J. Williams, WHC (H6-30)

APPENDIX 7A

BUILDING EMERGENCY PLAN FOR LOW-LEVEL BURIAL GROUNDS

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This plan covers the following: 200 West Area Burial Grounds, 200 East Area Burial Grounds, and the MO-223 (200 West Area Burial Ground Trailer).

Approved:

Building Emergency Director — Date 6-5-97

Environmental Compliance Officer — Date 6/6/97

Manager, Solid Waste Management — Date 6/6/97

Hanford Fire Department — Date 6/6/97

Emergency Preparedness — Date 6/6/97

This plan will be reviewed annually and updated as required by the Building Emergency Director and modified pursuant to Washington Administrative Code (WAC) 173-303-830 and in accordance with the Hanford Facility RCRA Permit. This document will be approved by the manager of Emergency Preparedness (or delegate) and the Hanford Fire Department.

CONTENTS

CONTENTS (cont)

CONTENTS (cont)

METRIC CONVERSION CHART

The following chart is provided as a tool to aid in conversion of units.

Into metric units			Out of metric units		
If you know	Multiply by	To get	If you know	Multiply by	To get
Length			**Length**		
inches	25.40	millimeters	millimeters	0.0393	inches
inches	2.54	centimeters	centimeters	0.393	inches
feet	0.3048	meters	meters	3.2808	feet
yards	0.914	meters	meters	1.09	yards
miles	1.609	kilometers	kilometers	0.62	miles
Area			**Area**		
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.092	square meters	square meters	10.7639	square feet
square yards	0.836	square meters	square meters	1.20	square yards
square miles	2.59	square kilometers	square kilometers	0.39	square miles
acres	0.404	hectares	hectares	2.471	acres
Mass (weight)			**Mass (weight)**		
ounces	28.35	grams	grams	0.0352	ounces
pounds	0.453	kilograms	kilograms	2.2046	pounds
short ton	0.907	metric ton	metric ton	1.10	short ton
Volume			**Volume**		
fluid ounces	29.57	milliliters	milliliters	0.03	fluid ounces
quarts	0.95	liters	liters	1.057	quarts
gallons	3.79	liters	liters	0.26	gallons
cubic feet	0.03	cubic meters	cubic meters	35.3147	cubic feet
cubic yards	0.76	cubic meters	cubic meters	1.308	cubic yards
Temperature			**Temperature**		
Fahrenheit	subtract 32 then multiply by 5/9ths	Celsius	Celsius	multiply by 9/5ths then add 32	Fahrenheit

Source: *Engineering Unit Conversions*, M. R. Lindeburg, PE., Second Ed., 1990, Professional Publications, Inc., Belmont, California.

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1.0 GENERAL INFORMATION

The Low-Level Burial Grounds (LLBG) are located on the Hanford Site, a 1,450-square kilometer U.S. Department of Energy (DOE) operational site in southeastern Washington State. The LLBG are located in both the 200 East and 200 West Areas near the center of the Hanford Site.

1.1 FACILITY NAME: U.S. Department of Energy Hanford Site Low-Level Burial Grounds.

1.2 FACILITY LOCATION: Benton County, Washington; within both the 200 East and 200 West Areas.

Structures covered by this plan are as follows:

- 200 East Area Burial Grounds (218-E-10 and 218-E-12B)
- 200 West Area Burial Grounds (218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-5, and 218-W-6)
- MO-223 Trailer.

1.3 OWNER: U.S. Department of Energy
Richland Operations Office
825 Jadwin Avenue
Richland, Washington 99352

FACILITY MANAGER: Rust Federal Services of Hanford Inc.
P.O. Box 700
Richland, Washington 99352

1.4 DESCRIPTION OF THE FACILITY AND OPERATIONS

The LLBG consist of eight burial grounds located in the 200 East Area and 200 West Area. Seven of the eight burial grounds (218-E-10, 218-E-12B, 218-W-3A, 218-W-3AE, 218-W-4C, 218-W-5, and 218-W-6) are, or will be, used for the disposal of mixed waste and are subject to WAC 173-303. One burial ground (218-W-4B) is designated as a solid waste management unit.

The 218-E-10, 218-E-12B, 218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, and 218-W-6 Burial Grounds are classified as a landfill (D81) and the 218-W-5 Burial Ground is classified as a landfill (D81) and for greater-than-90-day container storage (S01). The regulated portions of the LLBG cover a total area of approximately 49 hectares.

The 218-E-10 and 218-E-12B Burial Grounds are located in the 200 East Area. The 218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-5, and 218-W-6 Burial Grounds are located in the 200 West Area. The LLBG consist of various sizes and depths of lined and unlined disposal trenches. All mixed waste destined for disposal will meet land disposal restriction (LDR) requirements [WAC 173-303-140 and 40 Code of Federal Regulations (CFR) 268] or other regulatory alternatives. The lined trenches have leachate collection and removal systems. The less than-90-day leachate collection tanks are operated in accordance with the generator provisions of WAC 173-303-200.

Future trench development and configuration within a burial ground are subject to change as disposal techniques improve or as waste management needs dictate and will be subject to an approved permit modification in accordance with the Hanford Facility (HF) RCRA Permit (Ecology 1994). Mixed waste is disposed in lined or in unlined trenches. Disposal of mixed waste in unlined trenches requires an exemption from the liner/leachate collection system requirements.

The following provides a brief description and identifies the generic types of waste disposed in the LLBG. An electronic database is maintained that documents each waste receipt, type of waste, and disposal location.

- The 218-E-10 Burial Ground is approximately 36.1 hectares in size and began receiving waste in 1960. Examples of waste placed in this burial ground include failed equipment, rags, paper, rubber gloves, disposable supplies, broken tools, and post-August 19, 1987 RCRA and state-only designated mixed waste.

- The 218-E-12B Burial Ground is approximately 68 hectares in size and began receiving waste in 1967. Examples of waste placed in this burial ground include defueled reactor compartments (trench 94), low-level waste, and retrievable transuranic waste.

- The 218-W-3A Burial Ground is approximately 20.4 hectares in size and began receiving waste in 1970. Examples of waste placed in this burial ground include ion exchange resins, failed equipment, tanks, pumps, ovens, agitators, heaters, hoods, jumpers, vehicles, accessories, retrievable transuranic waste, and post-August 19, 1987 RCRA and state-only designated mixed waste.

- The 218-W-3AE Burial Ground is approximately 20 hectares in size and began receiving waste in 1981. Examples of waste placed in this burial ground include rags, paper, rubber gloves, disposable supplies, broken tools, and post-August 19, 1987 RCRA and state-only designated mixed waste.

- The 218-W-4B Burial Ground is approximately 3.5 hectares in size and began receiving waste in 1968. Examples of waste placed in this burial ground include rags, paper, rubber gloves, disposable supplies, broken tools, alpha caissons, and retrievable transuranic waste.

- The 218-W-4C Burial Ground is approximately 20 hectares in size and began receiving waste in 1978. Examples of waste placed in this burial ground include contaminated soil, decommissioned pumps, pressure vessels, post-August 19, 1987 RCRA and state-only designated mixed waste, and retrievable transuranic waste.

- The 218-W-5 Burial Ground is approximately 37.2 hectares in size and began receiving waste in 1986. Examples of waste placed in this burial ground include rags, paper, rubber gloves, disposable supplies, broken tools, and post-August 19, 1987 RCRA and state-only designated mixed waste. This burial ground currently contains double-lined mixed waste trenches (trenches 31 and 34). Trenches 31 and 34 also are designated as a greater-than-90-day container storage. Waste to be placed in trenches 31 and 34 for storage purposes predominately will be macro-encapsulated long-length contaminated equipment and other containerized waste that has been treated to meet LDR requirements. Adjacent to the double-lined mixed waste trenches are leachate collection tanks. Examples of waste to be disposed in the double-lined mixed waste trenches include mixed waste that has been treated to meet LDR requirements (including bulk waste), macro-encapsulated long-length contaminated equipment, etc.

- The 218-W-6 Burial Ground is approximately 16 hectares in size, has not received any waste, and is reserved for future mixed waste disposal.

Leachate Collection Tanks

The LLBG mixed waste disposal trenches are supported by leachate collection tanks. Typically, leachate collection tanks are aboveground, carbon steel tanks, internally coated with an amine-cured epoxy. The leachate collection tanks are located adjacent to the disposal trenches and are provided with secondary containment. Secondary containment exists for all feed piping. The leachate collection tanks are provided with a portable enclosure to protect the tank and secondary containment from the elements (i.e., rain, snow, etc.).

The leachate collection tanks have a current design capacity of 37,850 liters; however, future leachate collection tank capacity might change to accommodate various sized lined trenches.

1.5 EVACUATION ROUTING

Figures 1 and 2 provide identification of the staging areas within the LLBG.

During an evacuation, all personnel should move a safe distance upwind of the hazard or report to the nearest staging area for accountability, as the emergency situation dictates. Responses to alarms are discussed in Section 7.0.

The Primary staging area for 200 East LLBG (218-E-10 and 218-E-12B) is in the north east corner of trench #94 (218-E-12B Burial Ground) near the telephone. The secondary staging area is the northwest corner of the MO-720 parking lot in 200 West.

The primary staging area for 200 West LLBG (218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-5, and 218-W-6) is near MO-223. The secondary staging area is the northwest corner of the MO-720 parking lot.

If during the emergency it becomes necessary to evacuate the primary staging area, the staging area manager or Building Emergency Director (BED) will instruct personnel to proceed to the secondary staging area. Evacuation routes and transportation will be assigned as appropriate. Means of communicating this information include: by word of mouth, bullhorn, radios, etc.

At the staging area, personnel wearing special work permit (SWP) clothing will segregate themselves from those persons not wearing SWP clothing.

2.0 PURPOSE

This building emergency plan (plan) describes both the hazards and the basic responses to off-normal and/or emergency conditions at the LLBG. "Emergency" as used in this document includes events meeting the WAC 173-303 definition of Emergency, DOE Order 232.1, and categories of Unusual Occurrence and Emergency (DOE Orders 5500.2B and 5500.3A). These events include spills or releases as a result of waste management, fires and explosions, transportation activities, movement of materials, packaging, and natural and security contingencies. This plan, in conjunction with the "Hanford Facility Contingency Plan" (DOE/RL-93-75), is provided to the Washington State Department of Ecology (Ecology) to meet WAC 173-303 requirements.

3.0 BUILDING EMERGENCY ORGANIZATION

Building emergency organizations are discussed in the following sections.

3.1 BUILDING EMERGENCY DIRECTOR

The BED or designated alternate has overall responsibility for implementing this plan. The BED has the responsibilities of the Emergency Coordinator as discussed in WAC 173-303-360 and is responsible for LLBG related events. A listing of the primary and alternate BEDs by title, work location, and work telephone number is contained in Section 13 of the plan. The onsite emergency preparedness organization maintains a list of BED names work and home telephone numbers with Patrol Operations Center (POC) in accordance with Hanford Facility RCRA Permit Dangerous Waste Portion, General Condition II.A.4. The BEDs have the authority to commit all necessary resources (both equipment and personnel) to respond to any emergency. Additional responsibilities have been delegated to Hanford Fire Department personnel who, as the Incident Commander, are authorized to act for the BED when the BED is absent in accordance with Hanford Facility Contingency Plan (DOE/RL-93-75), Section 3.0. These Hanford Fire Department personnel have the authority to commit all necessary resources (both equipment and personnel) to respond to any emergency.

3.2 OTHER MEMBERS

As a minimum, the BED appoints and trains individuals to perform as Personnel Accountability Aides and Staging Area Managers. The accountability aides facilitate the implementation of protective actions (evacuation or take cover) and facilitate the accountability of personnel after protective actions have been implemented. Staging area managers coordinate and/or conduct activities at the staging area. In addition, the BED might identify additional support personnel [Radiological Control (RC), maintenance, engineering, hazardous material coordinators, etc.] to be part of the building emergency organization.

The building emergency organization for the LLBG is posted at MO-223 and MO-720 in the 200 West Area, and at the Emergency Operations Center in the Federal Building.

4.0 IMPLEMENTATION OF THE PLAN

To meet the requirements of WAC 173-303-360, this plan will be considered to be implemented when the BED has determined that a release, a fire, or an explosion involving dangerous waste or dangerous waste constituents that could threaten human health or the environment (WAC 173-303-360 Emergency) has occurred at the LLBG. An incident requiring evacuation of personnel or the summoning of emergency response units will not necessarily indicate that the plan has been implemented. The incident classification process is described in the Hanford Facility Contingency Plan (DOE/RL-93-75), Sections 4.0, 5.1.4, and 5.1.5.

This plan will be considered implemented whenever the BED determines that one of the incidents listed in Section 6.0 has or will occur and that the severity is or will be such that there is a potential to endanger human health or the environment. The BED will implement this plan through specific implementing procedures.

The BED must assess each incident to determine the response necessary to protect the personnel, LLBG, and the environment. If assistance from Hanford Patrol, Fire, or ambulance units is required, the Hanford Emergency Response Number 911; (373-3800 from cellular telephones) must be used to contact the Patrol Operations Center and request the desired assistance. To request other resources or assistance from outside the LLBG, the Patrol Operations Center business number is used (373-3800). The Emergency Duty Officer (EDO) is requested when making the initial 911 call.

5.0 FACILITY HAZARDS

Hazards at the LLBG potentially include industrial hazards, hazardous materials, radiological materials, radioactive and/or mixed waste, physical hazards, biological hazards, and criticality.

5.1 INDUSTRIAL HAZARDS

Industrial hazards could include incidents of transportation, accidents with moving equipment, subsidence (cave-ins), exposure to spilled waste or chemicals, or from radiological or chemical exposure from spills. Potential material handling mishaps are associated with forklift or crane operations. These include potential rupture of packages due to misalignment of the forklift tines or a load dropped during a crane operation.

5.2 HAZARDOUS MATERIALS

Hazardous materials might include (but might not be limited to) the following: spray adhesive, sorbent, diesel fuel, hydraulic oil, propane, road salt, industrial cleaner and degreaser, and unleaded gasoline.

5.3 RADIOACTIVE MATERIALS

Low-level radioactive materials are disposed or can be stored in both the 200 East and 200 West Area burial grounds. All mixed waste must meet LDR requirements for disposal.

5.4 RADIOACTIVE AND/OR MIXED WASTE

The LLBG are designed for disposal of bulk and containerized waste. Any mixed waste designated for the LLBG must meet LDR requirements.

5.5 PHYSICAL HAZARDS

Physical hazards might include (but might not be limited to) the following: tripping or falling, wind-blown sediment, falling objects (e.g., containers), etc.

5.6 BIOLOGICAL HAZARDS

Biological hazards might include (but might not be limited to) the following: snake, spider, scorpion, bees, and wasp bites or stings.

5.7 CRITICALITY

Criticality is prevented by the form or distribution of the fissionable material in the waste.

6.0 POTENTIAL EMERGENCY CONDITIONS

Potential emergency conditions could fall into one of three basic categories: operational (process upsets, fires and explosions, loss of utilities, spills, and releases), natural phenomena (earthquakes), and security contingencies (bomb threat, hostage situation, etc.).

6.1 OPERATIONAL

The following sections include a description of the 'worst-case' accident anticipated for each of the identified credible emergencies. This information typically is derived from safety analysis reports, hazards evaluations, or risk assessments.

6.1.1 Loss of Utilities

- Electrical power is required for trenches 31 and 34 of the 218-W-5 burial ground operations, however, loss of electricity does not constitute an emergency, but should be restored as soon as possible. Electricity supplies power to the sump pumps used to remove accumulated leachate from the primary and secondary liners.
- <u>Loss of Water</u> - N/A.
- <u>Loss of Ventilation</u> - N/A.

- Loss of Steam - N/A.
- Loss of Air - N/A.

6.1.2 Major Process Disruption/Loss of Plant Control

N/A.

6.1.3 Pressure Release

N/A.

6.1.4 Fire and/or Explosion

Potential fire hazards include smoke inhalation, burns, damage to equipment and/or structures, and release of hazardous materials, radioactive and/or mixed waste constituents.

6.1.5 Hazardous/Radioactive Material Spill

Low-level radioactive waste and mixed waste are placed in the LLBG. Material use, storage, disposal, and control information is available on the Solid Waste Information Tracking System (SWITS). Spills or releases could result in the following conditions.

- Spill of Hazardous Material. Hazards associated with a spill include potential exposure to radioactive and/or dangerous constituents as well as potential environmental damage. Because most waste in the LLBG is solid, spill procedures primarily are applicable to liquids that might have been improperly received.

  Any dangerous waste spills would involve accumulated leachate that would be contained within the leachate collection tank(s) and valve gallery secondary containment area, and spill procedures would be applicable (trenches 31 and 34 of the 218-W-5 Burial Ground). EXCEPTION: A pumping spray spill that could result in a release of leachate to the environment.

  During the transfer of leachate from the leachate collection tank(s) to a transport tanker, spills could result in a release of leachate to the environment.

- Toxic Fumes Hazards. Mixed waste disposed in the LLBG could produce airborne radioactive contamination. Volatilization of solids during a fire might generate toxic fumes. Plutonium, an alpha emitter, is known to generate hydrogen (H_2) gas when hydrogenous materials are present in the waste; however, catalytic recombiners are used to maintain H_2 gas concentrations below 1 percent.

  Waste acceptance criteria require that the offsite generators and onsite generating units document waste with gas-generating potential and that the requirement for gas recombiners be specified on the waste tracking forms.

- Fires or Explosions Involving Hazardous Material. A fire or chemical reaction in the LLBG could result in the release of dangerous and/or radioactive constituents to the air or soil.

- Reactive Chemical/Corrosive Material Hazards. N/A.

- Thermal Reactions/Hazards. N/A.

- Flammable Material/Liquids Hazards. Although the LLBG does not dispose of these types of materials, operating equipment requires these materials (e.g., gasoline, hydraulic fluids, oils, etc) for operation. These materials, if ignited could result in the release of dangerous and/or radioactive constituents to the air or soil.

- Asbestos Release. Asbestos might be released during tornadoes, high winds, fires, or other events that damage or destroy the packaging material.

6.1.6 Pressurized/bulging containers

The potential exists for pressurized or bulging containers to rupture resulting in a release to the air or soil.

6.1.7 Transportation and/or Packaging Incidents

Potential consequences of transportation and/or packaging incidents are spills or spread of radioactive contamination, chemical contamination, or personnel contamination. A forklift-damaged container could result in a release to the environment.

6.1.8 Unusual, Irritating, or Strong Odors

For an unusual, irritating, or strong odor, contact Industrial Hygiene (IH), who will evaluate the potential hazards through various IH methods and proceed as applicable. If necessary, the facility manager may request the Hanford Fire Department Hazardous Materials (HAZMAT) team to respond.

6.1.9 Radiological Material Release

- Gaseous Effluent Discharges (stack release) - N/A.

- Liquid Effluent Discharges - N/A.

- Significant Contamination Spread/Releases. Significant contamination spread or release might involve hazards resulting from exposure to radioactive and/or mixed waste. The major potential cause of spread or a release includes damaged containers, high winds, or a fire that might disperse contaminated airborne particles.

6.1.10 Criticality

Fissionable materials located in the LLBG exist in a form or distribution that ensures a critical mass cannot be attained.

6.1.11 Radioactive and/or Mixed Waste Not Acceptable (and cannot be transported)

Acceptable reasons for denying receipt of a radioactive and/or mixed waste transfer/shipment are as follows:

- The LLBG is not capable of managing the dangerous waste type.
- A significant discrepancy exists between the transfer/shipment and the waste listed on the manifest or tracking form.
- The waste arrives in a condition that presents an unreasonable hazard to operations or personnel.

6.2 NATURAL PHENOMENA

Natural phenomena are discussed in the following sections.

6.2.1 Seismic Event

Depending on the magnitude of the event, severe structural damage could occur resulting in serious injuries or fatalities and the release of radioactive and/or mixed waste. Damaged electrical circuits and wiring could result in the initiation of multiple fires.

6.2.2 Volcanic Eruption/Ashfall

Ashfall could cause shorts in electrical equipment powering sump pumps.

6.2.3 High Winds/Tornados

High winds or tornados might cause structural damage to systems (e.g., leachate collection tanks, trenches, etc.) containing radioactive and/or mixed waste resulting in a release to the environment. In addition, electrical power outages also could result from high winds or tornados.

6.2.4 Flood

N/A.

6.2.5 Range Fire

The hazards associated with a range fire include access restrictions and travel hazards such as poor visibility. Waste in the LLBG is either buried or packaged in materials that are fire retardant.

6.2.6 Aircraft Crash

An aircraft crash could result in the direct release of radioactive and/or mixed waste or cause a fire that could lead to the release of radioactive and/or mixed waste.

6.3 SECURITY CONTINGENCIES

Security contingencies are discussed in the following sections.

6.3.1 Bomb Threat

A bomb threat might be received by anyone who answers the telephone or receives mail. The major effect on the LLBG will be evacuation of personnel. If a bomb explodes, the effects are the same as those discussed under fire and explosion.

6.3.2 Hostage Situation

A hostage situation could pose an emergency situation if there is the potential to adversely impact the LLBG. This can be as a result of losing LLBG control (operators removed from their stations) or when the situation results in the coercion of an employee to take some malevolent action.

6.3.3 Suspicious Object

The major effect on the LLBG is that the effected burial ground would need to perform an emergency shutdown and evacuate.

7.0 INCIDENT RESPONSE

The initial response to any emergency is to immediately protect the health and safety of persons in the immediate area. Identification of released material is essential to determine appropriate protective actions. Containment, treatment, and disposal assessment will be the secondary responses.

The following sections describe the process for implementing basic protective actions as well as descriptions of response actions for the events listed in Section 6.0. The "Hanford Facility Contingency Plan" (DOE/RL-93-75) provides a description of generic incident responses, describes the process for assessing and identifying the hazardous materials and/or dangerous waste, and describes the process for categorizing and classifying an incident.

7.1 PROTECTIVE ACTIONS RESPONSES

Protective actions responses are discussed in the following sections.

7.1.1 Evacuation

If an evacuation is ordered or the evacuation siren sounds in the area of the LLBG, personnel should proceed, as follows:

Low-Level Burial Grounds Staging Areas	Area	Location
Primary staging area	200 East	Northeast corner of trench #94 (218-E-12B Burial Ground) near the pole-mounted telephone
Secondary Staging Area		NW corner of MO-720/721 parking lot
Primary staging area	200 West	Outside MO-223
Secondary staging area		NW corner of MO-720/721 parking lot

The BED or staging area manager directs evacuations; however, to ensure that evacuations can be conducted promptly and safely, all personnel should be familiar with the following:

- A Crash Alarm Telephone is located in MO-223. Personnel at MO-223 will notify personnel in the burial grounds by portable, hand-held radio, word of mouth or any other means available.
- Occupied structures on the Crash Alarm Telephone system must ensure that all nearby occupied units also are evacuating.

Area evacuations are rapid or controlled and the differences between them are pointed out in the actions listed in the following. When possible, these steps should be performed concurrently.

AREA EVACUATION PROCEDURE
Halt any operations or work and place equipment and structures in a safe condition. Use emergency shutdown procedures for rapid evacuation.
Use whatever means are available (portable radios, bullhorns, runners, etc.) to pass the evacuation information to personnel.
Evacuate personnel to the staging area; group personnel as follows: potentially contaminated protective clothing, keys immediately available for vehicles, those needing rides.
Conduct personnel accountability. Report personnel accountability results to the Emergency Operations Center (EOC) (373-3876, 373-1786, or 544-8085).
Load personnel in civilian clothes into private and government vehicles, load SWP clad persons into a separate government vehicle, if possible, and try to provide reserve transportation for people with late shutdown duties.
Relay pertinent evacuation information (routes, destination etc.) to drivers.
Dispatch vehicles as soon as the vehicles are loaded.
Report status to the EOC, request additional transportation if required, and report if any personnel remain who are performing late shutdown duties.

7.1.2 Take Cover

When the Take Cover Alarm is activated, personnel should take cover in the nearest building or trailer.

Normally, the LLBG will be alerted of an impending attack via the Area Crash Alarm Telephone System at MO-223. Portable, hand-held radios are used throughout the LLBG.

7.2 RESPONSE TO OPERATIONAL EMERGENCIES

The BED reviews the LLBG event recognition and classification procedure and, if required, classifies the event and initiates area protective actions and site emergency response organization activation.

7.2.1 Loss of Utilities

- Loss of Electricity. Electricity in the trailers is for lighting only. Loss of electricity will not impair functions or constitute an emergency.

  Electrical power is required for trenches 31 and 34 of the 218-W-5 Burial Ground operations; however, loss of electricity does not constitute an emergency, but should be restored as soon as possible. Electricity supplies power to the sump pumps used to remove accumulated leachate from the primary and secondary liners.
- Loss of Water - N/A.

- Loss of Ventilation - N/A.

- Loss of Steam - N/A.

- Loss of Air - N/A.

7.2.2 Utility Disconnect Plan

Use these steps to place the utilities in a safe and secure condition when an emergency has been declared, or when directed by the BED.

- Heating, Ventilation, and Air Conditioning (HVAC) - N/A.

- Electrical

  Trenches 31 and 34: To disconnect electricity to trench 31, open the cutout switches for the 480 VAC transformers on Panel "A" main breaker in the 218-W-5-252 Building. To disconnect electricity to trench 34, open the cutout switches for the 480 VAC transformers on Panel "A" main breaker in the 218-W-5-252A Building.

- Fire Sprinkler System - N/A.

- Sanitary Water/Sewer - N/A.

- Process Water - N/A.

- Steam - N/A.

- Telephone Service. Call 376-6322 or 376-1611 and ask the Telephone Service Contractor to disconnect service.

7.2.3 Major Process Disruption/Loss of Plant Control - N/A.

7.2.4 Pressure Release - N/A.

7.2.5 Fire and/or Explosion

Fire fighting in the LLBG is complicated by the presence of large amounts of radioactive material that might generate airborne contamination. It is extremely important to avoid breaching the containment of the containers or disturbing bulk waste in the LLBG.

In the event of a fire, the discoverer calls 911. Trained personnel could use portable fire extinguishers for small fires. Personnel should use their best judgment whether to fight a fire or to evacuate. Under no circumstances will personnel remain to fight a fire if unusual hazards exist. Because of the danger of violent container failure, fires in the vicinity of the exposed transuranic containers located in trenches 1, 20, and 29 of the 218-W-4C Burial Ground should not be extinguished by operations personnel. Rather, personnel should evacuate the trench immediately and call 911.

- On notification of a fire in the LLBG, personnel shut down equipment, secure waste ONLY if time permits.
- Personnel leave the area and proceed to the designated staging area for accountability.
- The BED proceeds directly to the MO-720 conference room, establishes an Incident Command Post and obtains all necessary information pertaining to the incident. The BED meets the Hanford Fire Department or sends a representative to meet them.
- The BED reviews the LLBG event recognition and classification procedure and, if required, classifies the event and initiates area protective actions and site emergency response organization activation.
- The BED informs the site emergency response organization as to the extent of the emergency (including estimates of mixed waste or radioactive material quantities released to the environment).
- If operations are stopped in response to a fire, the BED ensures that systems are monitored for leaks, pressure buildup, gas generation, and ruptures.
- Hanford Fire Department firefighters extinguish the fire.
- The BED ensures that all emergency equipment is cleaned and fit for its intended use following completion of cleanup procedures.

7.2.6 Hazardous Material, Radioactive and/or Mixed Waste Spill

Spills can result from many sources including the leachate collection tanks, container spills or leaks, damaged packages, or personnel error. Spills of mixed waste are complicated by the need to deal with the extra hazard induced by the presence of radioactive materials. The response to a spill is as follows:

The discoverer performs the following actions for a spill:

- Takes action to contain and/or to stop the spill or container leak if all of the following are true.
  - The identity of the substance(s) involved is known.
  - Appropriate protective equipment and control/cleanup supplies, e.g., absorbents, are readily available.
  - Discoverer safely can perform the action(s) without assistance, or assistance readily is available from other trained personnel.
- Notifies LLBG personnel (including BED) of discovery of spill or release.

- Initiates notifications to the Hanford Fire Department by calling 911, and provides all known information.

If any of the previous conditions are not met or if there is any doubt, evacuate the area and remain outside, upwind of the spill, pending the arrival of the BED. The discoverer remains available for consultation with the BED, Hanford Fire Department, or other emergency response personnel and restricts access to the area until the arrival of the BED.

The BED performs or arranges for the following:

- An Incident Command Post at the MO-720 conference room and coordinates further spill mitigation activities
- Obtains all available information pertaining to the incident and determines if the incident requires implementation of the contingency plan
- Reviews the LLBG event recognition and classification procedure and, if required, classifies the event and initiates area protective actions and site emergency response organization activation
- Arranges for care of any injured persons
- Maintains access control at the incident site by keeping unauthorized personnel and vehicles away from the area. Security personnel can be used to assist in site control if control of the boundary is difficult (e.g., repeated incursions). In determining controlled access areas, considers environmental factors such as wind velocity and direction
- Proper remediation of the incident after evaluation
- Remains available for fire, patrol, and other authorities on the scene, and provides all required information
- Enlists the assistance of alternate BED(s), if response activities are projected to be long term
- Ensures the use of proper protective equipment, remedial techniques, transfer procedures [including ignition source control (e.g., nonsparking tools, grounding containers, isolation of ignition sources, use of explosion-proof electrical equipment, etc.) for flammable or reactive spills], and decontamination procedures by all involved personnel, if remediation is performed by LLBG personnel
- Remains at the Incident Command Post (ICP) to oversee activities and to provide information, if remediation is performed by the Hanford Fire Department Hazardous Materials Response Team or other response teams
- Ensures proper containerization, packaging, and labeling of recovered spill materials and overpacked containers

NOTE - All containers of spill debris, recovered product, etc., are managed in the same manner as waste containers. Overpacks in use are marked with information pertaining to their contents and noted as to whether the container inside the overpack is leaking or is in good condition.

- If operations are stopped in response to the release, ensures that systems are monitored for leaks, pressure buildup, gas generation, and ruptures
- Ensures decontamination (or restocking) and restoration of emergency equipment used in the spill remediation before resuming operations
- Provides required reports after the incident, in accordance with the "Hanford Facility Contingency Plan" (DOE/RL 93-75)

7.2.6.1 Transportation Incidents. In accordance with WAC 173-303-145, the discoverer or BED could take the following actions for leaks or spills resulting from a hazardous materials transportation incident if the actions can be performed without jeopardizing personnel safety, as appropriate:

- Determines the nature of incident
  - Personnel injuries
  - Hazardous material spill with fire
  - Hazardous material spill without fire
- Assists injured personnel
- Initiates notifications to the appropriate personnel by any means available (telephone, radio, passing motorist, etc.) to request assistance from the Hanford Fire Department (Emergency Coordinator/Event Commander for these type of events), Hanford Patrol, and medical personnel.
- Remains in a safe location and attempts to isolate the area to prevent inadvertent personnel access.

7.2.6.2 Receipt of Damaged or Unacceptable Shipments. In accordance with WAC 173-303-370, when a damaged shipment or transfer of radioactive and/or mixed waste arrives at the LLBG and the shipment/transfer is unacceptable for receipt, the damaged shipment/transfer should not be moved.

If a damaged shipment or transfer results in a spill, the following actions are performed:

- Notify the BED, the Hanford Fire Department, and the appropriate personnel to advise of the situation. The BED responds and assists in the evaluation of, and response to, the incident
- Notify the offsite generator or onsite generating unit of the damaged shipment/transfer, and request any information necessary to assist in responding to the spill

- Proceed with remedial action, including overpacking damaged containers, cleanup of spilled material, or other necessary actions to contain the spill

7.2.7 Unusual, Irritating, or Strong Odors

If an unusual, irritating, or strong odor is detected and the discoverer believes that the odor might be from a toxic or dangerous material, the discoverer performs the following:

- Notifies nearby personnel and evacuates the effected burial ground
- Notifies the BED

If the discoverer knows of the source and scope of the odor, this information is reported to the BED. Containment measures are described in Section 7.2.6.

If the unusual odor is detected and the source of the odor is unknown, the BED evaluates additional protective actions and notifies Industrial Hygiene.

7.2.8 Radiological Material Release

- Radioactive Gaseous Effluent Discharge. Air sampling will be performed using the appropriate equipment any time a worker is likely to be exposed to 10 percent of the isotopes Derived Air Concentration (DAC). Tritium oxide (HTO) has a DAC value of 20 microcuries per cubic meter ($\mu Ci/m^3$). For better control of personnel exposures, the following table is included.

Airborne Concentration Equal to 5 mrem Dose Equivalent			
Concentration	**Time**	**Concentration**	**Time**
10 $\mu Ci/m^3$	4 hours	150 $\mu Ci/m^3$	15 minutes
15 $\mu Ci/m^3$	2.5 hours	200 $\mu Ci/m^3$	12 minutes
20 $\mu Ci/m^3$	2 hours	250 $\mu Ci/m^3$	10 minutes
30 $\mu Ci/m^3$	1 hour, 20 min	300 $\mu Ci/m^3$	8 minutes
50 $\mu Ci/m^3$	50 minutes	350 $\mu Ci/m^3$	7 minutes
80 $\mu Ci/m^3$	30 minutes	400 $\mu Ci/m^3$	6 minutes
100 $\mu Ci/m^3$	25 minutes	450 $\mu Ci/m^3$	5 minutes

All personnel possibly exposed to HTO should have a tritium bioassay performed as soon as possible (must be within 30 days of exposure).

- Radioactive Liquid Effluent Discharge. If collected leachate is released, the liquid will be contained by secondary containment.

- Significant Contamination Spread. There are no continuous air monitors in the LLBG. Monitoring is performed by Radiological Control personnel. If monitoring reveals a significant contamination spread, stop breathing until you move out of the affected area, and notify immediate manager and the BED.

7.2.9 Criticality

Transuranic waste is present in the LLBG. Methods are in place for handling this waste type.

7.2.10 Radioactive and/or Mixed Waste Not Acceptable (and cannot be transported)

- Solid waste operations isolates the area of unacceptable waste.
- Discoverer notifies the BED. The BED responds, evaluates, and notifies appropriate personnel.
- The solid waste management group assembles an investigation team.
- The investigation team determines the circumstances and the actions to be taken.
- The solid waste management group proceeds with the actions determined by the investigation team.
- The solid waste management group submits a written report to Ecology within 15 days of the incident.

7.3 PREVENTION OF RECURRENCE OR SPREAD OF FIRES, EXPLOSIONS, OR RELEASES

The BED, in coordination with emergency response organizations, takes the steps necessary to ensure that a secondary release, a fire, or an explosion does not occur. The following actions are taken:

- Isolates the area of the initial incident by shutting off power to sump pumps, etc., to minimize the spread of a release and/or the potential for a fire or explosion
- Inspects containment for leaks, tears, cracks, or other damage
- Inspects for toxic vapor generation
- Removes released material and waste remaining inside of containment structures (e.g., secondary containment for the leachate collection tanks) as soon as possible
- Contains and isolates residual waste material using dikes and adsorbents

- Covers or using other methods (e.g., fixatives for dust suppression), stabilizes areas where residual released materials remain to prevent migration or spread from wind or precipitation run-off

- Installs new structures, systems, or equipment to enable better management of hazardous materials or radioactive and/or mixed waste

- Reactivates operations in affected areas only after cleanup of residual waste materials is achieved.

7.4 RESPONSE TO NATURAL PHENOMENA

Response to natural phenomena are discussed in the following sections.

7.4.1 Seismic Event

The primary role of the emergency response organization in a seismic event is coordinating the initial response to injuries, fires, and fire hazards; and acting to contain or control hazardous materials and radioactive and/or mixed waste releases.

Individuals should remain calm and stay away from windows, nearby steam lines, trenches, and any nearby hazardous material, radioactive and/or mixed waste locations. Once the shaking has subsided, individuals should evacuate carefully and assist those needing help. The location of any trapped individuals is reported to the BED or is reported to 911.

The BED takes whatever actions are necessary to minimize damage and personnel injuries. The following actions include:

- Coordinating searches for personnel and potential hazardous conditions (fires, spills, etc.)

- Conducting accountability

- Securing utilities and LLBG operations

- Arranging rescue efforts, and notifying 911 for assistance

- Performing facility inspections in accordance with the post-natural phenomena hazards inspection plan and procedure

- Determining if hazardous materials, radioactive and/or mixed waste were released

- Determining current local meteorological conditions

- Warning other units and implement protective actions if the release poses a danger

- Providing personnel and resource assistance to other operations, if required and possible.

7.4.2 Volcanic Eruption/Ashfall

When notified of an impending ashfall, the BED will implement measures to minimize the impact of the ashfall, such as:

- Closing the covers over the ventilation intakes (e.g., structures covering leachate collection tanks)
- Installing filter media or protective coverings on outdoor equipment that could be adversely affected by the ash
- Shutting down some or all operations and processes
- Sealing secondary use exterior doors
- Releasing all but essential personnel to go home

If as a result of the ashfall other emergency conditions arise (e.g., fires due to electrical shorts or lightning), response is as described in other paragraphs in this section.

7.4.3 High Winds/Tornados

On notification of impending high winds, the BED takes steps necessary to secure all outdoor waste and hazardous material container locations.

7.4.4 Flood - N/A.

7.4.5 Range Fire

Responses to range fires are handled by preventive measures (i.e., keeping hazardous material and waste accumulation areas free of combustible materials such as weeds and brush). If a range fire breaches the LLBG boundaries, the response is as described in Section 7.2.5.

7.4.6 Aircraft Crash

The response to an aircraft crash is the same as that listed in Section 7.2.6.1 for responding to transportation incidents.

7.5 SECURITY CONTINGENCIES

Security contingencies are discussed in the following sections.

7.5.1 Bomb Threat

- Telephone Threat. Individuals receiving telephoned threats try to gain as much information as possible from the caller (using the bomb threat checklist if available). On conclusion of the call, notify the BED and Security via 911.

The BED evacuates the LLBG and queries personnel at the staging area regarding any suspicious objects. When Security personnel arrive, follow their instructions.

- Written Threat. Receivers of written threats handle the letter as little as possible. Notify the BED and Security. Depending on the content of the letter, the LLBG may or may not be evacuated. The letter is turned over to Security personnel, and their instructions are followed.

7.5.2 Hostage Situation/Armed Intruder

The discoverer of a hostage situation or of an armed intruder reports this to 911 and to the BED if possible. The BED, after conferring with Security personnel, could covertly evacuate areas of the LLBG not observable by the hostage taker(s)/intruder. No alarms will be sounded.

Security will determine the remaining response actions and will activate the Hostage Negotiating Team if necessary.

7.5.3 Suspicious Object

The discoverer of a suspicious object reports this to the BED and calls 911, if possible, and ensures that the object is not disturbed.

The BED will evacuate the LLBG and (based on the description provided by the discoverer) attempt to determine the identity or owner of the object. This could be done by questioning personnel at the staging area. If the identity/ownership of the object cannot be determined, Security will assume command of the incident. An Emergency Ordnance Team will be dispatched to properly dispose of the object.

8.0 TERMINATION OF EVENT, INCIDENT RECOVERY, RESTART OF OPERATIONS, AND POSTEMERGENCY EQUIPMENT MAINTENANCE AND DECONTAMINATION

Termination of event, incident recovery, restart of operations, and postemergency equipment maintenance and decontamination are discussed in the following sections.

8.1 TERMINATION OF EVENT

The BED declares the termination of an event. However, if additional emergency centers are activated, only the highest activated level of the emergency organization, in conjunction with the BED, will declare that an event has ended. If the DOE-RL Emergency Operations Center (EOC) is activated, only the DOE-RL director officially terminates the event. In all cases, however, the BED must be consulted before reentry is initiated.

8.2 INCIDENT RECOVERY AND RESTART OF OPERATIONS

A recovery plan is developed when necessary. A recovery plan is needed following an event when further risk could be introduced to personnel, the LLBG, or the environment through recovery action and/or to maximize the preservation of evidence. Depending on the magnitude of the event and the effort required to recover from the event, recovery planning might involve personnel from DOE-RL and other contractors. If a recovery plan is required, the plan is reviewed by appropriate personnel and approved by a Recovery Manager before restart. Restart of operations is performed in accordance with the approved plan.

If this plan were implemented for a WAC 173-303-360 emergency (Section 4.0), Ecology must be notified before operations can resume. Section 9.0 of the "Hanford Facility Contingency Plan" (DOE/RL-93-75) discusses different reports to outside agencies. This notification is in addition to those required reports and must include the following statements.

- There are no incompatibility issues with the waste and released materials from the incident.

- All the equipment has been clean, fit for its intended use, and placed back into service. The notification may be made via telephone conference. Additional information that Ecology requests regarding these restart conditions might be included in the required 15-day report (DOE/RL-93-75).

For emergencies not involving activation of the EOC, the BED ensures that conditions are restored to normal before operations are resumed. If the EOC was activated and the emergency phase is complete, a special recovery organization could be appointed at the discretion of EOC to restore conditions to normal. The makeup of this organization depends on the extent of the damage and its effects.

8.3 INCOMPATIBLE WASTE

After an event, the BED or the onsite recovery organization ensures that no waste that might be incompatible with the released material is treated, stored, and/or disposed of until cleanup is completed. Cleanup actions are taken by LLBG personnel or other assigned personnel. Actions to be taken might include, but are not limited to, any of the following:

- Neutralization of corrosive spills

- Chemical treatment of reactive materials to reduce hazards

- Overpacking or transfer of contents from leaking containers

- Use of sorbents to contain and/or absorb leaking liquids for containerization and storage and/or disposal

- Decontamination of solid surfaces impacted by released material, e.g., intact containers, equipment, floors, containment systems, etc.

- Disposal of contaminated porous materials that cannot be decontaminated and any contaminated soil

- Containerizing and sampling of recovered materials for classification and determination for proper management

- Followup sampling of decontaminated surfaces to determine adequacy of cleanup techniques as appropriate

Waste from cleanup activities is designated and managed as newly generated waste. A field check for compatibility is performed as necessary. Incompatible waste is not placed in the same container. Containers of waste are placed in approved storage areas appropriate for their compatibility class.

If incompatibility of waste was a factor in the incident, the BED or the onsite recovery organization ensures that the cause is corrected. Examples include modification of an incompatibility chart or increased scrutiny of waste from an offsite generator or onsite generating unit when incorrectly designated waste caused or contributed to an incident.

8.4 POSTEMERGENCY EQUIPMENT MAINTENANCE AND DECONTAMINATION

All equipment used during an incident is decontaminated (if practicable) or disposed of as spill debris. Decontaminated equipment is checked for proper operation before storage for subsequent use. Consumables and disposed materials are restocked. Fire extinguishers are recharged or replaced.

The BED ensures that all equipment is cleaned and fit for its intended use before operations are resumed. Depleted stocks of neutralizing and absorbing materials are replenished, self-contained breathing apparatus are cleaned and refilled, protective clothing is cleaned or disposed of and restocked, etc.

Factors to consider when establishing an equipment and personnel decontamination station are as follows:

- Water supplies
- Containment/catch basins and/or systems
- Personal necessary to accomplish proper decontamination
- Protective clothing
- Decontamination supplies (buckets, brushes, soap, chemicals as needed)
- Risk to personnel
- Weather conditions [i.e., severe heat, cold (current and forecasted)]
- Toxicity of material
- Porosity of equipment to be decontaminated
- Disposal requirements of decontamination rinse
- Use of controlled zones to maintain contamination control.

9.0 EMERGENCY EQUIPMENT

Hanford Site emergency resources and equipment are described and listed in the contingency plan (DOE/RL-93-75, Section 7.0).

9.1 FIXED EMERGENCY EQUIPMENT

None.

9.2 PORTABLE EMERGENCY EQUIPMENT

Low-Level Burial Ground Portable Emergency Equipment		
TYPE	**LOCATION**	**CAPABILITY**
Fire extinguishers	In motorized equipment (e.g., trucks, etc.,), nearby structures (e.g., change trailers, storage buildings, etc.,).	Use on any Class A, B, or C fires. (Note: Some are only B and C.) Do NOT use on sodium.
Eye wash and safety shower	None are located in the LLBG area. Use nearest equipment as directed by management.	Assists in flushing unwanted chemical and material from clothing and body.

9.3 COMMUNICATIONS EQUIPMENT/WARNING SYSTEMS

Communications Equipment		
TYPE	**LOCATION**	**CAPABILITY**
Hand-held radios	Portable	N/A

9.4 PERSONAL PROTECTIVE EQUIPMENT

Low-Level Burial Ground Protection Equipment		
TYPE	**LOCATION**	**CAPABILITY**
Anti-C	LLBG	Contamination protection
Supplied air	Available from Respiratory Protection	Protection from airborne hazards
Full-face respirator	MO-721 Mask Station	Protection from airborne particulates
Self-contained breathing apparatus	Available from Respiratory Protection	Breathing air supplied for work in hazardous atmospheres
SWP Clothing	MO-223 (200 West Area change trailer)	Personnel protection against exposure
Acid suit	N/A	Protection when working with caustics/acids

9.5 SPILL CONTROL AND CONTAINMENT SUPPLIES

If in the event of a nonradioactive hazardous materials spill (although highly unlikely), control equipment to be used for an emergency and/or recovery phase is identified as follows:

Burial Ground Spill Control Equipment		
TYPE	**LOCATION**	**CAPABILITY**
Absorbents	Central Waste Complex	Contain or clean up spills
Overpack containers	Central Waste Complex	Provide containment for leaking or damaged containers
Shovels	Conex by MO-223	Clean up hazardous material spills
Chemical transfer pumps	Central Waste Complex	Move hazardous materials
Spill kit	Central Waste Complex	Clean up hazardous material spills

9.6 EMERGENCY COMMAND CENTER

The Incident Command Post for the LLBG is the conference room in MO-720. The Incident Command Post could be moved at the direction of the BED.

10.0 COORDINATION AGREEMENTS

The DOE-RL has established a number of coordination agreements, or memoranda of understanding (MOU), with various agencies to ensure proper response resource availability for incidents involving the Hanford Site. A description of the agreements is contained in the contingency plan (DOE/RL-93-75, Section 8.0).

11.0 REQUIRED REPORTS

Three types of written post-incident reports are required for incidents on the Hanford Site. The reports are summarized in the contingency plan (DOE/RL-93-75).

12.0 PLAN LOCATION

Copies of this plan are maintained at the following locations:

- MO-223
- Hanford Fire Department

- Emergency Operations Center
- Hanford Local Area Network (HLAN)
- MO-720 Conference room

NOTE - In accordance with coordination agreements, the Hanford Fire Department provides direction during onsite event response and provides all needed information to support agencies that may be assisting the onsite responses. Therefore, only copies of plans for facilities where offsite agencies are the initial responders (e.g., 1163 Stores Building) will be provided to offsite support agencies.

13.0 BUILDING EMERGENCY ORGANIZATION

Building Emergency Director

	TITLE	LOCATION	PHONE
PRIMARY	Team Lead	MO-721	373-5187
ALTERNATE	Ops Engineer	MO-721	373-1737

The complete building emergency organization listing of positions, names, work locations and telephone numbers for the LLBG is maintained in a separate, internally controlled, facility document. Copies are distributed to appropriate facility locations and to Emergency Preparedness. In addition, names and work and home telephone numbers of the BEDs and alternates are available from the Patrol Operations Center (373-3800) in accordance with the Hanford Facility RCRA Permit, Dangerous Waste Portion, General Condition II.A.4.

14.0 REFERENCES

DOE Order 232.1, *"Occurrence Reporting and Processing of Operations Information"*.

DOE Order 5500.1B, *"Emergency Management Systems"*.

DOE/RL-93-75, *Hanford Facility Contingency Plan*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

NIOSH, 1996, *Pocket Guide to Chemical Hazards*, National Institute of Occupational Safety and Health, U.S. Department of Health and Human Resources, Public Health Service, Centers for Disease Control, Washington, D.C., updated periodically.

Figure 1. Burial Grounds, 200 East Area.

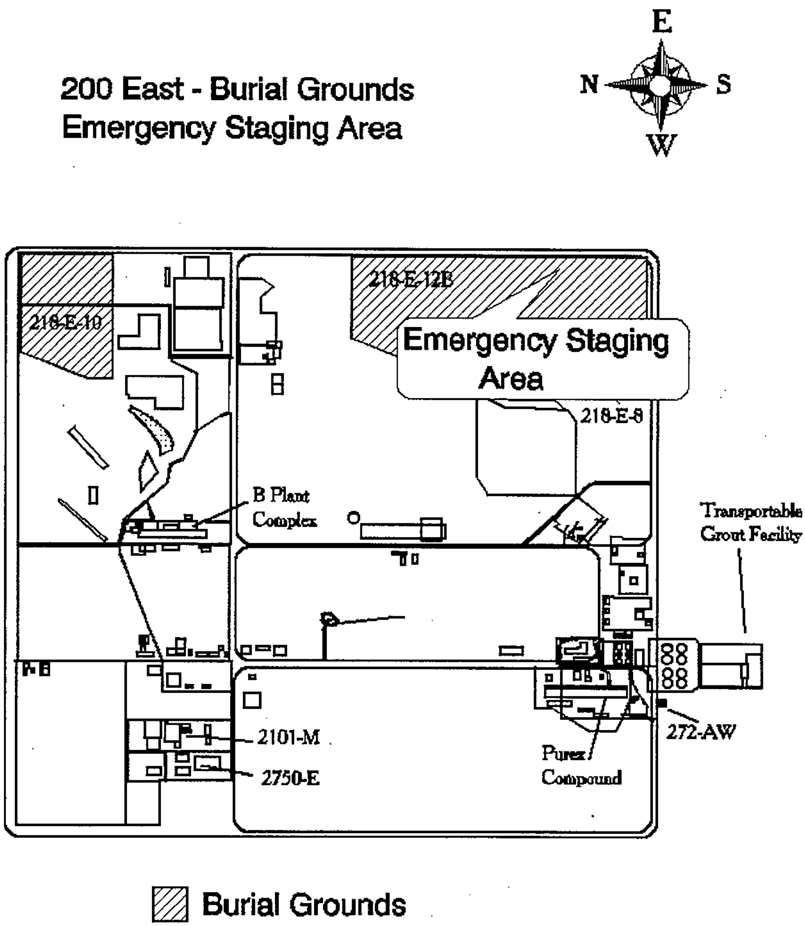
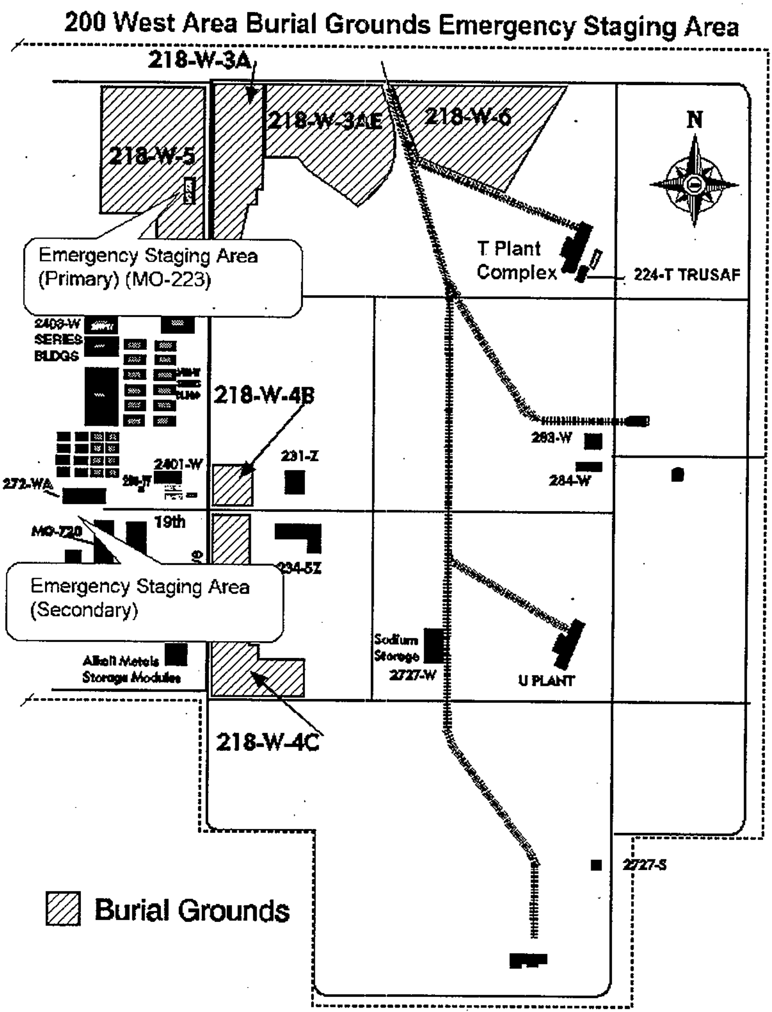


Figure 2. Burial Grounds, 200 West Area.



ATTACHMENT A

LISTING OF PROCEDURES AND GUIDES

The list is maintained by the LLBG organization and will be provided upon request.

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APPENDIX 8A

TRAINING

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R. W. Reddinger
R. W. Reddinger, Manager
Operations Support and Training

6/6/97
Date

BS Darling
B. S. Darling, Training Team Leader
Operations Support and Training

6/6/97
Date

R. J. Giroir
R. J. Giroir, Manager
Solid Waste Management

6/6/97
Date

K M McDonald
K. M. McDonald, Environmental Compliance Officer
Solid Waste Management

6/6/97
Date

CONTENTS

1.0 PURPOSE

This document outlines the Dangerous Waste Training Program (DWTP) for the Low-Level Burial Grounds (LLBG) organization. The LLBG are permitted as a treatment, storage, and/or disposal (TSD) unit on the Hanford Facility. The DWTP implements the requirements of Washington Administrative Code (WAC) 173-303-330 and Title 40 Code of Federal Regulations (CFR) 264.16 for the development of a written dangerous waste training plan.

2.0 SCOPE

This DWTP applies to personnel who perform work at, or in support of, the LLBG. The training requirements in this program are based on an assessment of employee duties and responsibilities. The LLBG DWTP ensures personnel responsible for dangerous waste management are trained to perform the job duties pertinent to the handling, treatment, storage, and/or disposal of dangerous waste. In addition, this training program ensures that personnel are familiarized with emergency equipment and/or systems and emergency procedures to safely operate and maintain the LLBG.

3.0 DEFINITIONS

NONE

4.0 RESPONSIBILITIES

4.1 Facility Manager

The LLBG Facility Manager has the overall responsibility to meet all training requirements of WAC 173-303-330 and Condition II.C of the Hanford Facility RCRA Permit (Ecology 1994). To meet the requirements in WAC 173-303-330(1)(a), the training director position is described in the *Hanford Facility Dangerous Waste Permit Application, General Information Portion* (DOE/RL-91-28, Chapter 8.0).

4.2 Training Manager

The training manager has overall responsibility for establishing, conducting, and administering the training program for the LLBG to ensure personnel are trained to meet their assigned jobs.

4.3 Facility Management

All managers are responsible for the following:

- Determining required training for all personnel assigned to the LLBG, as required by job assignment.

- Ensuring that personnel assigned to LLBG receive required initial training, continuing training, and retraining as needed to be qualified to perform their assigned duties in dangerous waste management.

- Maintaining up-to-date personnel training records for assigned personnel.

4.4 Training Personnel

All training personnel are responsible for the following:

- Reviewing training requirements whenever regulations change or annually at a minimum for adherence to regulations and to ensure the requirements reflect the current systems, procedures, and policies applicable to each position.

- Developing and conducting training on new and existing systems or equipment.

4.5 Personnel

All LLBG and support personnel are responsible for the following:

- Working with their managers to define applicable training
- Completing necessary training to gain/maintain qualifications.

5.0 TRAINING PROGRAM

The LLBG DWTP is implemented based on training requirements related to job responsibilities.

5.1 Training Requirements

Training requirements for individual personnel are tracked in the Training Matrix (TMX).

The responsible manager reviews training requirements when personnel change positions or assume new job responsibilities, when changes are identified to this training plan (other than editorial changes), or annually, as a minimum. Updates to the training requirements are made as necessary.

Personnel must meet the training requirements within 6 months of the date of hire, within 6 months of assignment to the LLBG, or within 6 months of assignment to a new position within the LLBG. Personnel in-training will not make decisions that could affect facility safety. Personnel independently can perform specific jobs or tasks for which they are qualified. Personnel performing work who do not meet all training requirements must be supervised by a qualified person.

As new requirements are identified and indicated in this training plan, LLBG personnel will comply with the new requirements within 6 months of the effective date of the requirement.

5.2 Job Titles and Descriptions

Personnel are assigned a job title and a job description. The job description includes requisite skills, work experience, education, and other qualifications, and a brief list of duties and/or responsibilities. This information is maintained by the human resources department.

5.3 Dangerous Waste Worker Position

Personnel are categorized into six worker positions: (1) All Employee, (2) General Worker, (3) Advanced General Worker, (4) General Manager, (5) General Shipper, and (6) Waste Designator.

Personnel are placed in a position based on duties and responsibilities as determined by a job analysis or management assessment. In the event personnel duties and responsibilities fall into more than one position, personnel will complete the training requirements for each position.

Duties and responsibilities of personnel associated with dangerous waste management at LLBG are listed in the following sections.

5.3.1 All Employee

Personnel included in this position are those who do not fall into one of the other five positions and have no duties or responsibilities directly associated with dangerous waste management. Typical job titles of personnel in this position include secretaries, clerks, and oversight personnel.

Most visitors, categorized as All Employee, generally tour, provide oversight, or are brought onsite for interviews. Other non-Hanford Facility personnel who gain access to the LLBG to complete work in controlled areas but do not become involved in the management of dangerous waste are categorized as All Employee.

5.3.2 General Worker

Personnel with limited dangerous waste management duties, such as activities associated with the generation of dangerous waste or facility maintenance or modification, are categorized as General Workers. Typical job titles of personnel in this position include maintenance personnel, health physics technicians, and transporters.

Personnel categorized as General Workers could be assigned duties and responsibilities for the following:

- Placing waste into pre-approved containers and filling out log sheets where applicable
- Completing radiological surveys of dangerous waste
- Moving containers or loading packaged containers onto trucks

- Responding to a spill or release of known contents where duties and responsibilities are limited to containing the spill/release, returning the container to an upright position, and/or placing the known spilled material or waste into a pre-approved container.

- Applying container markings or labels based on direction from an Advanced General Worker, General Manager, or General Shipper.

5.3.3 Advanced General Worker

Personnel whose duties exceed those of a General Worker for dangerous waste management are categorized as Advanced General Workers. The typical job title of personnel in this position is Nuclear Process Operator.

Responsibilities of an Advanced General Worker for management of dangerous waste in containers can include the following:

- Determining container markings and labels
- Preparing container log sheets
- Completing waste inventories
- Sampling of waste
- Packaging and transporting waste samples
- Responding to spills and releases of waste in accordance with approved procedures
- Performing inspections and surveillances
- Receiving transfers and/or shipments of waste.

Responsibilities of an Advanced General Worker for management of dangerous waste in a tank can include conducting daily inspections on tank systems and ancillary equipment, and transferring and/or shipping waste from the tank system.

Responsibilities of an Advanced General Worker for management of dangerous waste in a landfill can include managing leachate and precipitation run-off and receiving transfers and/or shipments of waste.

5.3.4 General Manager

Personnel identified as General Managers coordinate, direct, and oversee the work of General or Advanced General Workers in the management of dangerous waste or in the operation and control of the LLBG. Other duties could include responsibilities during emergency events requiring implementation of the building emergency plan. Typical job titles of personnel in this position include Operations Manager, Environmental Manager, Environmental Compliance Officer, Environmental Engineer/Scientist, Hazardous Material Specialist, and Building Emergency Director.

Responsibilities of a General Manager include the following:

- Directing, controlling, and coordinating the storage, transfer, and/or disposal of dangerous waste

- Maintaining operational records

- Reviewing and approving LLBG operating procedures
- Recognizing and responding to abnormal and/or emergency conditions
- Ensuring emergency and monitoring equipment, process equipment, procedures, designs, etc., comply with DOE Orders, federal and state regulations, national standards, and applicable engineering procedures and management standards
- Maintaining operating documentation, operating procedures, flowsheets, sample schedules, specifications, process test plans and procedures, operational safety requirements, etc.
- Reviewing and approving engineering design documents and drawings for compliance to applicable policies, procedures, and instructions per national standards and codes
- Providing technical assistance for hazardous material and dangerous waste spill response
- Supervising and coordinating dangerous waste transfer, storage, and/or disposal
- Providing approved storage containers and applicable markings
- Preparing and maintaining applicable waste handling documentation in accordance with DOE Orders and federal and state regulations
- Providing waste disposition instructions.

5.3.5 General Shipper

Personnel who prepare and sign waste movement documentation for both onsite or offsite shipments of dangerous waste are categorized as General Shipper.

5.3.6 Waste Designator

Personnel who perform and/or complete waste designations are categorized as a Waste Designator.

5.4 Required Training

Attachment 1 is a matrix of the classes, with brief descriptions, required for the worker positions. Training for emergency procedures, emergency equipment, and emergency systems to meet the requirements of WAC 173-330(1)(d) is included in these courses as specified in the course description. Attachment 2 provides a matrix of job titles and required training for each worker position.

Personnel who have completed training offsite are required to provide a certificate or other suitable evidence of training course(s) that meet the requirements of WAC 173-303 and this plan.

5.5 Non-Hanford Facility Personnel

Non-Hanford Facility personnel who will be performing work at the LLBG must complete the appropriate level of training determined by line management according to the tasks they will perform.

The LLBG management is responsible for ensuring that non-Hanford Facility personnel training requirements are met before granting access.

5.6 Conduct of Training

The training program uses a systematic approach to training. Training design, development, and implementation are based on learning objectives derived from the analysis of the specific job/task. Training is provided using classroom instruction, on-the-job training, required reading, computer-based training methods, and/or by providing drills. Training is developed and provided by personnel knowledgeable in dangerous waste management policies and/or procedures.

5.7 Documentation of Training

Classroom training is documented on course completion rosters, which are signed by personnel attending the course. The completion of the training is documented in an electronic data storage record.

Training record summaries are stored in the Training Records Information (TRI) system. Training records for former personnel are kept on the TRI system for 3 years from the date personnel last worked at LLBG. Original signed and dated training records are maintained by the Hanford Training Records organization. These records are transferred quarterly to the Records Holding Facility in Richland, Washington. After approximately 1 year at the Records Holding Center, the original training records are archived.

5.7.1 Training Records

When a training record is requested during an inspection, an electronic data storage record will be provided. If an electronic data storage record does not supply the requested information, a hard copy training record will be provided. Training records of former personnel might not be readily available and could require a representative from the Training Records organization to access this information.

5.7.2 Training Status

The electronic data storage training record and this training plan are used to determine the training status of personnel.

6.0 REFERENCES

DOE/RL, 1994, DOE-RL/U.S. Army Corps of Engineers to Ecology "State of Washington Department of Ecology Administrative Order No. DE94NM-063" dated April 14, 1994, items 3 and 4.

DOE/RL-91-28, *Hanford Facility Dangerous Waste Permit Application, General Information Portion*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, 1994, *Dangerous Waste Portion of the Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste*, Washington State Department of Ecology, Olympia, Washington.

7.0 ATTACHMENTS

ATTACHMENT 1. RCRA TRAINING PROGRAM COURSE DESCRIPTIONS

ATTACHMENT 2. REQUIRED TRAINING FOR LOW-LEVEL BURIAL GROUNDS PERSONNEL

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ATTACHMENT 1. RCRA TRAINING PROGRAM COURSE DESCRIPTIONS

The following constitute the RCRA training program courses as determined by (1) WAC 173-303, (2) the Hanford Facility RCRA Permit, and (3) correspondence between DOE-RL and Ecology on dangerous waste training.

Title	**000001 Hanford General Employee Training**
Description	Course covers DOE Orders and applicable policies pertaining to employer and employee rights and responsibilities, general radiation training, hazard communications, dangerous waste, fire prevention, personal protective equipment, safety requirements, emergency preparedness, accident reporting, and avenues for addressing safety concerns.
Mandating document(s)	Hanford Facility RCRA Permit, General Condition II.C.2 and II.C.4.
Target audience	All Hanford Facility personnel working on the Hanford Facility.
Frequency	Annual.

Title	**02006G Waste Management Awareness**
Description	Course introduces personnel to federal laws governing chemical safety in the work place. The course provides the hazardous material/waste worker with the basic fundamentals for safe use of hazardous materials and initial accumulation or storage of dangerous or mixed waste in containers. The concepts covered in this course instruct personnel on specific waste generation procedures and requirements, which include: (1) applicable waste management practices (i.e., waste stream identification, waste segregation practices, completing container logsheets, and housekeeping requirements), (2) proper responses to incidents pertaining to the waste in the accumulation containers, (3) proper responses to dealing with waste of unknown origins, and (4) proper responses to questions posed in the field concerning the above elements.
Mandating document(s)	WAC 173-303-330(1) Letter: DOE-RL/U.S. Army Corps of Engineers to Ecology "State of Washington Department of Ecology Administrative Order No. DE 94NM-063" dated April 14, 1994, items 3 and 4. Hanford Facility RCRA Permit, General Conditions II.C.1 and II.C.4.
Target audience	Hanford Facility personnel categorized as a General Worker, Advanced General Worker, and General Manager. Subcontractors categorized as General Workers. Other courses may provide equivalent training so that credit for this course is provided when the electronic data storage training record is generated.
Frequency	One-time only. (Annual refresher training is not required because training is adequately covered through 035110 and/or 03E044.)

Title	**020159 Advanced Course 2 - Hazardous Waste Shipper Certification**
Description	Course defines responsibilities and liabilities with regard to compliance to manifesting requirements and U.S. Department of Transportation regulations, including placarding, identifying proper shipping names, and loading requirements.
Mandating document(s)	WAC 173-303-330(1), -180, -190, and -370. Hanford Facility RCRA Permit, General Condition II.Q, as applicable
Target audience	General Shippers of dangerous or mixed waste on roadways anywhere on the Hanford Facility.
Frequency	Every 3 years.

Title	**02028B Building Emergency Director Training**
Description	Course provides an overview of the responsibilities of the Building Emergency Director, identifies the building emergency organizations and actions required during an event, discusses implementing the contingency plan, and discusses drill and exercise requirements.
Mandating document(s)	WAC 173-303-330(1), -340, -350, and -360.
Target audience	Hanford Facility personnel categorized as General Managers because they perform the responsibilities of a RCRA Emergency Coordinator through the title of Building Emergency Director or alternate (e.g., On-Call Manager).
Frequency	Initial (retrained annually by 037510 Building Emergency Director/Warden Requalification).

Title	**300025 Solid Waste Mixed Waste Land Disposal Facility Operations Certification**
Description	Qualifies nuclear process operators to operate the systems associated with the mixed waste trenches including management of waste in containers, tanks, and landfills.
Mandating document(s)	WAC 173-303-330, -630, -640, -650 Hanford Facility RCRA Permit, General Conditions.
Target audience	Operations personnel categorized as Advanced General Workers.
Frequency	Every 2 years.

Title	**300040 Solid Waste Low-Level Burial Ground Facility Operations Certification**
Description	Qualifies nuclear process operators to operate the systems associated with the mixed waste trenches including management of waste in containers, tanks, and landfills.
Mandating document(s)	WAC 173-303-330, -630, -650.
Target audience	Operations personnel categorized as Advanced General Workers.
Frequency	Every 2 years.

Title	**300590 Solid Waste Manager Certification**
Description	Course is a self-study course designed to cover management topics in order to safely operate the solid waste facilities.
Mandating document(s)	WAC 173-303-330, -630, -640, -650. Hanford Facility RCRA Permit, General Conditions.
Target audience	General Managers who are categorized because they are immediate managers of Advanced General Workers who manage dangerous or mixed waste in containers, tank systems, and/or surface impoundments.
Frequency	Every 2 years.

Title	**300700 Solid Waste Facility Orientation**
Description	Introduction to the LLBG, Central Waste Complex, 224-T Transuranic Waste Storage and Assay Facility, and 616 Nonradioactive Dangerous Waste Storage Facility including facility missions, hazards, and emergency response procedures.
Mandating document(s)	WAC 173-303-330 Hanford RCRA Permit, General Condition II.C.
Target audience	All personnel assigned to, or working at, LLBG.
Frequency	Annual.

Title	**035010 Waste Designation**
Description	Course teaches dangerous waste designation according to WAC 173-303. Class content includes section-by-section lecture on the regulations, with examples following each section. Students complete examples using a waste designation flow chart. Examples addressed include: listed waste, characteristic waste, and Washington State criteria of toxicity and persistent.
Mandating document(s)	WAC 173-303-330(1), -070, and -080 through -100.
Target audience	General Shippers and Waste Designators.
Frequency	One-time only. (Annual retrain is only required for those personnel who are required to complete 035012.)

Title	**035012 Waste Designation Qualification**
Description	Course provides qualification to be a Waste Designator.
Mandating document(s)	WAC 173-303-330(1), -070, and -080 through -100.
Target audience	Waste Designators.
Frequency	Annual.

Title	**035020 Facility Waste Sampling and Analysis**
Description	Course presents waste sampling methodologies according to U.S. Environmental Protection Agency Protocols SW-846, "Test Methods for Evaluating Solid Waste Physical/Chemical Methods". This course also covers documentation requirements in a sampling plan and/or waste analysis plan, field and laboratory quality control/assurance, the data quality objectives process, and use of actual sampling equipment as specified by WAC 173-303-110. Finally, topics on listed waste management pertaining to sample management and available onsite sampling services are covered.
Mandating document(s)	WAC 173-303-330(1), -070, -110, and -300.
Target audience	General Managers and/or General Shippers categorized because they perform responsibilities for sampling waste or effluent streams.
Frequency	One-time only.

Title	**035100 Container Waste Management - Initial**
Description	Course covers general training requirements pertaining to waste management of container in less-than-90-day accumulation areas and TSD units. The course incorporates WAC 173-303-200(1), -630, DOE Orders, and container management policy. Course includes practical exercises for hands-on experience with the packaging of dangerous or mixed waste, and preparation of packages for final destination. This course does not cover waste management aspects pertaining to other RCRA waste management units such as tank systems, surface impoundments, containment buildings, landfills, etc.
Mandating document(s)	WAC 173-303-330(1), -630, -200(1) and waste minimization.
Target audience	Advanced General Workers and General Managers categorized because they are immediate managers of or direct Advanced General Workers who manage containers of dangerous or mixed waste.
Frequency	Initial (refresher annually by 035110 Core Waste Management Training).

Title	**035110 Container Waste Management - Refresher**
Description	Refresher Course for Container Waste Management - Initial.
Mandating document	WAC 173-303-330(1), -630, -200(1), and waste minimization.
Target audience	Advanced General Workers and General Managers categorized because they are immediate managers of or direct Advanced General Workers who manage dangerous or mixed waste in containers.
Frequency	Annual.

Title	**035120 Waste Management Administration - Initial**
Description	Course is designed for personnel preparing to become shippers of dangerous and/or mixed waste. This course covers regulatory and onsite policies, forms, reports, forecasts, and plans. Topics also covered include: waste characterization, waste certification summaries, waste specification system, and solid waste storage/disposal records. In addition, students learn how these forms are used to complete shipping papers.
Mandating document(s)	WAC 173-303-330(1), -630, -200, -210, -220, -380, and -390.
Target audience	General Shippers categorized because they direct Advanced General Workers in the management of containers of dangerous and mixed waste.
Frequency	Initial (refresher annually by 035130 - Waste Management Administration).

Title	**035130 Waste Management Administration - Refresher**
Description	Refresher course for Waste Management Administration - Initial.
Mandating document(s)	WAC 173-303-330(1), -630, -200, -210, -220, -380, and -390.
Target audience	General Shippers categorized because they direct Advanced General Workers in the management of containers of dangerous and mixed waste.
Frequency	Annual.

Title	**037510 Building Emergency Director/Warden Requalification**
Description	Refresher for Building Emergency Director Training.
Mandating document(s)	WAC 173-303-330, -340, -350, and -360.
Target audience	General Managers categorized because they have the responsibilities of the RCRA Emergency Coordinator.
Frequency	Annual.

Title	**03E044 Low-Level Burial Grounds Facility Emergency and Hazard Information Checklist**
Description	Course consists of a review of specific chemical hazards associated with operating the LLBG, as covered by the LLBG Building Emergency Plan. The training is completed by the supervisor, manager, or a designated individual. Information reviewed includes hazards in the work area and emergency response requirements, including communication and alarm systems, response to groundwater contamination incidents, and response to fires.
Mandating document(s)	WAC 173-303-330(1)(d), -340, -350, and -630.
Target audience	LLBG personnel categorized as General Workers, Advanced General Workers, and General Managers.
Frequency	Annual.

ATTACHMENT 2. REQUIRED TRAINING FOR LOW-LEVEL BURIAL GROUNDS

Position	Job Title	Required Training
All Employee	All other Job Titles not specifically listed.	000001 300700
General Worker	Radiological Control Technician, Maintenance Personnel (Electrician, Instrument Technician, Insulator, Millwright, Painter, Pipefitter, Power Operator, Process Crane Operator, Rigger, Sign Painter, Truck Driver, Welder), Maintenance Manager, Radiological Control Manager.	000001 02006G 03E044 300700
Advanced General Worker	Nuclear Process Operator	000001, 02006G, 035100/035110, 03E044, 300025, 300040, 300700
General Manager	Operations Manager/Team Leader	000001, 02006G, 02028B/037510, 035100/035110, 03E044, 300590, 300700
	Environmental Manager/Team Leader	000001, 02006G, 035010, 035020, 035100/035110, 03E044, 300700
	Environmental Compliance Officer	000001, 02006G, 035010, 035020, 035100/035110, 03E044, 300700
	Environmental Engineer/Scientist Plant Engineer (Environmental)	000001, 02006G, 035010, 035020, 035100/035110, 03E044, 300700
	Hazardous Material Specialist	000001, 02006G, 035010, 035020, 035100/035110, 03E044, 300700
	Building Emergency Director	000001, 02006G, 02028B/037510, 035100/035110, 03E044, 300700

Position	Job Title	Required Training
General Shipper	Shipper	000001, 02006G, 020159, 035010, 035100/035110, 035120/035130, 03E044, 300700
Waste Designator	Waste Designator	000001, 035010, 035012, 03E044, 300700

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