ENGINEERING CHANGE NOTICE	1. ECN 186772
Page 1 of 2	Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.		4. Date
Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	R.G. Bauer/81340/H6-05/6-2167		11/30/92
	5. Project Title/No./Work Order No. Large-Scale Remediation/P161E	6. Bldg./Sys./Fac. No. NA	7. Impact Level 4
	8. Document Numbers Changed by this ECN (includes sheet no. and rev.) WHC-SD-EN-FDC-003, Rev. 0	9. Related ECN No(s). NA	10. Related PO No. NA

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

12. Description of Change

The words "Functional Design Criteria" were added to the title. The new title is, "Material Handling and Analytical system Functional Design Criteria for the 100-B/C Area Macroengineering Prototype Project."

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

13b. Justification Details

Previous title omitted descriptive words that are necessary to identify the document.

14. Distribution (include name, MSIN, and no. of copies)	RELEASE STAMP
See attached distribution list.	OFFICIAL RELEASE BY WHC (11) DATE DEC 17 1992 Station #12

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Engineering Change Notice

A-7900-013-1 (11/88)

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

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

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

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

Document Number/Revision	Document Number/Revision	Document Number Revision

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20. Approvals

Signature	Date	Signature	Date
OPERATIONS AND ENGINEERING		ARCHITECT-ENGINEER	
Cog Engineer R.G. Bauer R.G. Bauer	12/17/92	PE	
Cog. Mgr. M.J. Lauterbach [signature] for MJL	12/17/92	QA	
QA		Safety	
Safety		Design	
Security		Environ.	
Environ.		Other	
Projects/Programs			
Tank Waste Remediation System			
Facilities Operations		DEPARTMENT OF ENERGY	
Restoration & Remediation		Signature or Letter No.	
Operations & Support Services			
IRM		ADDITIONAL	
Other			

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SUPPORTING DOCUMENT

1. Total Pages 49

2. Title	3. Number	4. Rev No.
Material Handling and Analytical System Functional Design Criteria for the 100-B/C Area Macroengineering Prototype Project	WHC-SD-EN-FDC-003	0-A

5. Key Words	6. Author
cleanup, restoration, contaminants, decontamination, decommissioning APPROVED FOR PUBLIC RELEASE 12/16/92 N. Dolis	Name: R.G. Bauer R.G. Bauer Signature Organization/Charge Code 81340/P161E

7. Abstract

WHC-1992, *Material Handling and Analytical System Functional Design Criteria for the 100-B/C Area Macroengineering Prototype Project*, prepared by IT Corporation, Richland, Washington, for Westinghouse Hanford Company, Richland, Washington.

9. Impact Level 4

10. RELEASE STAMP

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DATE DEC 17 1992
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RECORD OF REVISION

(1) Document Number: WHC-SD-EN-FDC-003, Rev. 0-A

Page 1

(2) Title
Material Handling and Analytical System Functional Design Criteria for the 100-B/C Area Macroengineering Prototype Project

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release	
		(5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) Initial release per EDT 160277		
0-A RS	Title changed per ECN 186772	R. S. [signature]	[signature] for MJL 12/17/92

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Complete for all Types of Release

Purpose		ID Number (include revision, volume, etc.)
[] Speech or Presentation [] Full Paper (Check only one suffix) [] Summary [] Abstract [] Visual Aid [] Speakers Bureau [] Poster Session [] Videotape	[] Reference [X] Technical Report [] Thesis or Dissertation [] Manual [] Brochure/Flier [] Software/Database [] Controlled Document [] Other	WHC-SD-EN-FDC-003, Rev. 0 List attachments. Date Release Required 9/18/92

Title Functional Design Criteria Material Handling and Analytical System for the 100-B/C Area Macroengineering Prototype Project	Unclassified Category UC-NA	Impact Level 4

New or novel (patentable) subject matter? [X] No [] Yes If "Yes", has disclosure been submitted by WHC or other company? [] No [] Yes Disclosure No(s).	Information received from others in confidence, such as proprietary data, trade secrets, and/or inventions? [X] No [] Yes (Identify)
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Patent - General Counsel	[X]	[]	S W BERGLIN	[signature]	9/16/92
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	Yes	No	INFORMATION RELEASE ADMINISTRATION APPROVAL STAMP
References Available to Intended Audience	[X]	[]	Stamp is required before release. Release is contingent upon resolution of mandatory comments.
Transmit to DOE-HQ/Office of Scientific and Technical Information	[]	[X]	APPROVED FOR RELEASE — OFFICIAL DOCUMENT — Date 9/23/92

Author/Requestor (Printed/Signature) Date
R.G. Bauer [signature] 9/14/92

Intended Audience
[] Internal [] Sponsor [X] External

Responsible Manager (Printed/Signature) Date 9/14/92
J.G. Woolard RaCarlson for JGW

Date Cancelled	Date Disapproved

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ENGINEERING DATA TRANSMITTAL

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1	WHC-SD-EN-FDC-003		0	Material Handling and Analytical System for the 100-B/C Area Macroengineering Prototype Project	4	2	1	

16. KEY

Impact Level (F)	Reason for Transmittal (G)	Disposition (H) & (I)
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4	1	Cog.Eng. R.G. Bauer	[signature] for	9-23-92	H4-55						
4	1	Cog. Mgr. M.J. Lauterbach	[signature]	9/23/92	H4-55						
		QA									
		Safety									
		Env.									
		Central Files			L8-04						
		EDMC (2)			H4-22						

18.	19.	20.	21. DOE APPROVAL (if required)
R.G. Bauer [signature] for 9-23-92 Signature of EDT Originator / Date	Authorized Representative for Receiving Organization / Date	[signature] M.J. Lauterbach 9/23/92 Cognizant/Project Engineer's Manager / Date	Ltr. No. [] Approved [] Approved w/comments [] Disapproved w/comments

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SUPPORTING DOCUMENT

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3. Number

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6. Author

Name: R.G. Bauer

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7. Abstract

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CONTENTS

CONTENTS (cont)

FIGURE

TABLES

1.0 INTRODUCTION

1.1 BACKGROUND

From 1943 until 1990, the primary mission of the Hanford Site was to produce nuclear materials for the nation's defense. Waste disposal activities associated with this mission resulted in the creation of more than 1,000 past practice waste sites. The remediation of these sites forms the Hanford Environmental Restoration Project, a major systems acquisition funded by the U.S. Department of Energy (DOE). Remediation of these sites, which have been grouped into operable units, is governed by the Comprehensive Environmental Compensation and Liability Act of 1980 (CERCLA) or the Resource Conservation and Recovery Act of 1976 (RCRA). The waste sites are contaminated with radioactive constituents, chemical constituents, or combinations of both. Contamination from some of these sites has migrated into the groundwater.

Investigation and remediation of the past practice waste sites is governed by the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989), initially signed in 1989 by DOE, the U.S. Environmental Protection Agency (EPA), and Washington State Department of Ecology (Ecology). This agreement grouped the waste sites into 78 operable units, each of which was to be investigated and remediated separately under the CERCLA program or RCRA program, depending on the designation of the operable unit. A major milestone of the Tri-Party Agreement calls for completion of remediation at all past practice operable units by the year 2018.

Since the Tri-Party Agreement was signed, studies have been performed that indicate the costs of completing investigations and remediation as planned are very large and the time required for implementation could possibly exceed the deadline. For this reason, additional studies were undertaken to identify a faster and less costly approach to achieving Tri-Party Agreement objectives. These studies resulted in an alternate approach to Hanford Site remediation, referred to as "macroengineering." In this approach, the remediation would be conducted on a large scale (i.e., by aggregate area rather than by operable unit) using conventional earthmoving and demolition techniques and systems commonly employed in the mining and construction industries, but adapted to meet Hanford-specific objectives and conditions. A principal advantage of the macroengineering approach is the use of concurrent site and waste characterization (i.e., characterization applied as the waste removal proceeds), which avoids the need for much of the time-consuming and costly pre-characterization investigations. The conceptual studies defining the macroengineering approach for source unit and groundwater remediation as well as waste disposal are documented by WHC (1991a). The results of the studies clearly indicated that the macroengineering approach offered very significant cost and schedule advantages to the overall cleanup program and should be pursued as a preferred approach.

Following completion of the macroengineering conceptual studies, further evaluation identified a need for a full-scale demonstration of the technical and economic feasibility of the large scale remediation and disposal concepts. This evaluation further concluded that an objective of the prototype program should include actual and substantial site remediation, as opposed to simply conducting a pilot test project. The 100-B/C Area (Figure 1) was selected as the location for the prototype source unit remediation. The 100-B/C Area is designated under the Tri-Party Agreement as a CERCLA past practice area. The EPA is the lead regulatory agency for oversight of this area. Soil and solid wastes removed from this area will be transported and disposed in a new engineered disposal site to be constructed in the 200 Area. The scope of this functional design criteria (FDC) includes all waste handling and analytical systems and activities associated with waste removal at the 100-B/C Area, including waste transportation to the 200 Area. The 200 Area waste handling and disposal systems and activities are covered by a separate FDC.

1.2 PROJECT DESCRIPTION

The DOE has divided the Hanford Environmental Restoration Project into five subproject levels. They are:

- Treatment, Storage, and/or Disposal
- Surveillance and Maintenance
- Decontamination and Decommissioning
- Remedial Action
- Project Management and Support.

The 100-B/C Macroengineering Prototype Project is a proof-of-principle activity to support the large scale application of macroengineering to the 100 Areas and eventually the entire Hanford Site. Because the prototype project is scheduled to begin in the near-term, the technologies selected must be currently available or functional within the specified time-frame. Based on the conceptual studies (WHC 1991a), a technology baseline was developed and documented in WHC (1992). This technology baseline is referenced for design guidance but is not intended to constrain the design to the technologies identified in the baseline document.

The objectives of this project are to:

- Develop and demonstrate all systems, equipment, technologies and procedures on a full scale for characterization, removal, conveyance, and transport of contaminated soil and solid wastes within the past practice waste sites

- Complete the remediation of all 100-B/C Area past practice sites included in the defined project scope, within the specified time-frame.

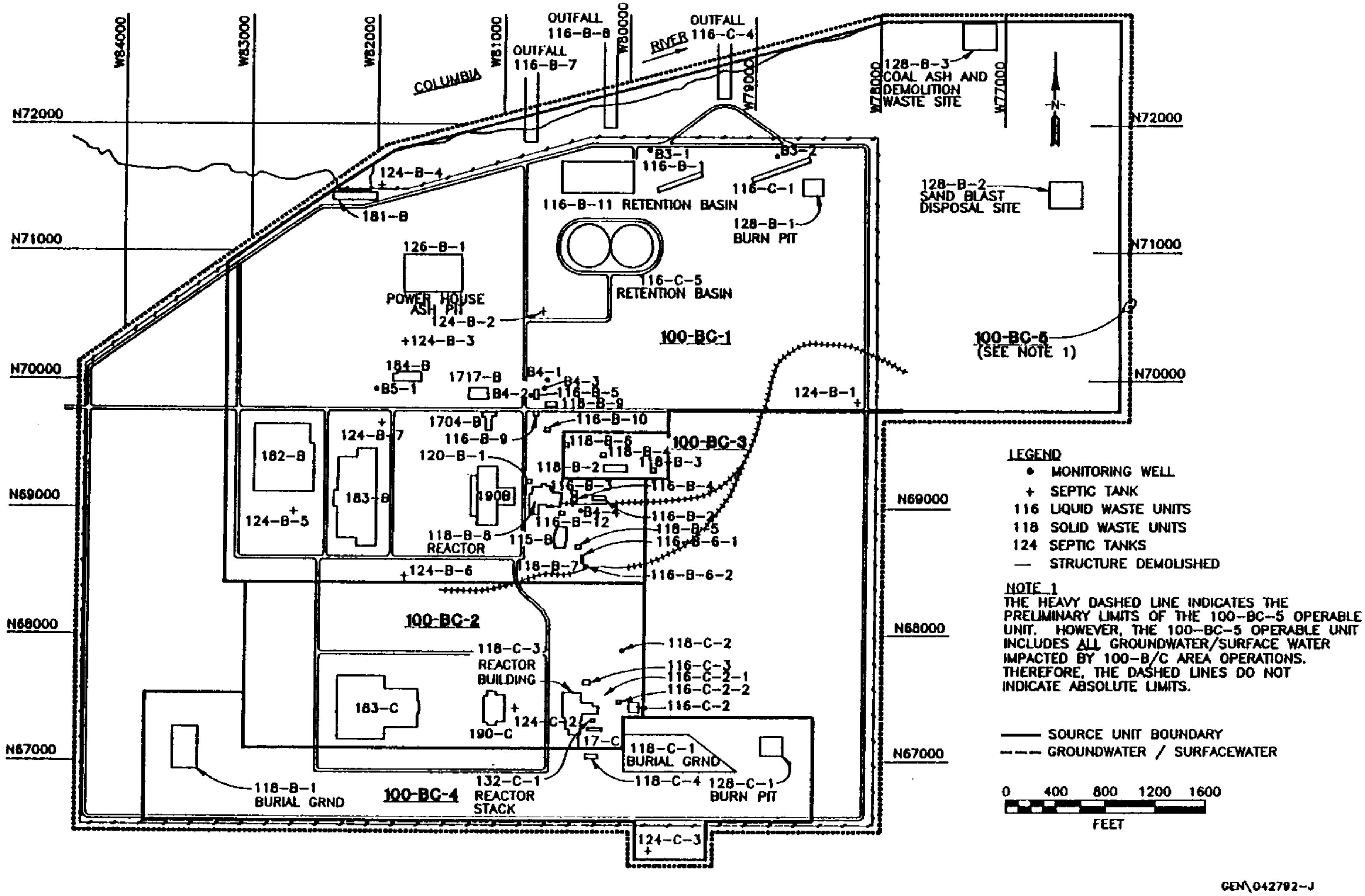

Figure 1. 100-B/C Area Site Map.

All contaminated soils associated with past practice waste sites, including soils contaminated from leaks of the on-shore portions of the reactor effluent pipelines, will be removed to the extent that such contamination exceeds the cleanup criteria. The cleanup criteria will consist of negotiated numerical limits based on federal and state Applicable or Relevant and Appropriate Requirements (ARAR) and DOE guidelines (such as radiation release limits of DOE Order 5480.11).

All solid waste including buried waste, land pipelines, river pipelines, and minor abovegrade and belowgrade structures will be remediated.

During excavation, waste materials will be size reduced as necessary to accommodate conveyance and transport systems. Waste materials will be segregated according to type of contamination and contamination levels into low-activity, high-activity, transuranic (TRU), radioactive/hazardous mixed waste, solely hazardous waste, and nonregulated (i.e., nondangerous and nonradioactive) waste to facilitate handling and disposal requirements. All waste, except TRU waste, containing concentrations of RCRA Land Disposal Restricted (LDR) constituents will be further segregated for separate handling and/or processing.

All radioactive waste is low-level per DOE-RL Order 5820.2A. Low-activity waste is equivalent to contact-handled low-level waste as defined by WHC (1988b), i.e., surface radiation dose rate less than 200 mrem/h. High activity waste is equivalent to remote handled low-level waste per WHC (1988b), i.e., surface radiation dose rate exceeding 200 mrem/h.

All free liquids will be destroyed, removed, or solidified as no free liquids will be transported to the disposal site. Compactible waste (e.g., pipe, plate, structural metals, wood, cardboard, and paper) will be volume reduced by compaction. Intact drums will be individually opened and the contents handled in the same manner as the bulk wastes. Compressed gas cylinders will be depressurized and the contents treated.

All waste materials will be transported in bulk to the 200 Area for disposal to the extent practical.

As waste is excavated, it will be characterized using field instruments, and sampling and analysis to determine content and levels of radiological and chemical contaminants. On-line characterization will be conducted to indicate that target cleanup levels have been reached as the excavation proceeds. A mobile laboratory will provide rapid-turnaround of sample analyses to support excavation, waste segregation, and waste transport operations.

Sampling and analysis will be performed following excavation to certify that the site meets the cleanup criteria (Section 3.2). These samples will be analyzed in normal-turnaround laboratories using Contract Laboratory Program (CLP) procedures.

Following certification that a site meets the cleanup criteria, the site will be restored to a condition that is consistent with the intended future land use and to protect the site from damage by natural erosion.

1.3 PURPOSE AND SCOPE

The purpose of this document is to develop the FDC for the Materials Handling/Analytical Systems portion of the 100-B/C Area Prototype Project. Waste disposal is covered by a separate FDC document.

Project scope includes:

- Twenty-nine past practice waste sites in the 100-B/C Area as identified in the Waste Information Data System (WIDS) database (WHC 1991d)
- Buried reactor effluent pipelines including all junction boxes, valve pits, and associated components
- Soil, associated with effluent pipeline leaks on land, which is contaminated above cleanup criteria limits
- The portion of the reactor effluent pipelines extending into the Columbia River
- Other structures or waste sites that are not listed in the WIDS database and are not addressed by other programs such as, but not limited to, the Decontamination and Decommissioning (D&D) Program
- Other contaminated soil that exceeds cleanup criteria limits that may be discovered during 100-B/C remediation, e.g., contamination resulting from unplanned or unreported releases.

Project scope excludes:

- All facilities, buildings, structures, or other systems that are or will be addressed by other programs such as D&D
- Groundwater remediation including the associated aquifer sediments
- River sediments.

Key design assumptions are listed as follows:

- The 100-B/C Area implementation schedule includes a 30-month design phase, a 15-month procurement phase, and a 6-year demonstration/ remediation phase.
- Waste remediation will stop at the edge of existing buildings that are outside the scope of remediation; the edge of the building is defined as the limit beyond which further excavation would compromise the structural integrity of the building foundation.
- Design analysis will be based on existing site data; principal sources of information include the draft 100 Area Operable Unit Remedial Investigation/Feasibility Study (RI/FS) work plans for the 100-BC Operable Units (DOE-RL 1990a,b,c), and data obtained from other sources including interviews from past 100 Area operating personnel.

This report is prepared in accordance with DOE-RL Order 4700.1, Attachment V-1, and WHC (1991c), EP-5.8, Functional Design Criteria.

1.4 SITE DESCRIPTIONS

The 100-B/C CERCLA past practice waste sites are listed in Tables 1 through 6. These waste sites can generally be grouped into four types:

- Solid waste disposal sites
- Liquid waste disposal sites
- Contaminated structures and pipelines
- Contaminated soils resulting from leaks or unplanned releases.

Each of these waste site types is discussed in the following sections. More detailed summaries are provided in Appendix A.1.0 of WHC (1991a).

The information presented in the tables is a compilation of data from three sources: WHC (1991d), Dorian and Richards (1978), and Miller and Wahlen (1987).

The site descriptions were obtained from WIDS, which is accepted as the most current data available on Hanford waste sites. The radionuclide concentrations for liquid waste units were obtained from Dorian and Richards, (1978). No radionuclide concentration data are available for the burial grounds (with exception of 118-B-1). The estimated solid waste volumes for burial grounds were obtained from Miller and Wahlen (1987).

1.4.1 Solid Waste Disposal

From 1944 through 1973, direct land burial was used to dispose solid, low-level radioactive wastes associated with reactor operations. Eight locations have been identified as burial grounds and one location has been identified as a demolition/landfill site. Pertinent data for all nine solid waste disposal sites are given in Tables 1 and 2.

The majority of waste generated from routine reactor operations was placed in two primary burial grounds, one for B reactor (118-B-1) and one for C reactor (118-C-1). These are the largest burial grounds in the 100-B/C Area. The other burial grounds were associated with special programs such as retention basin repair, effluent line modifications, thimble removal, and materials from special reactor irradiations.

The solid waste burial grounds differ in their physical characteristics: some consist of a series of parallel trenches or pits and some are constructed of vertically set, metal or concrete culvert pipe. The deep, narrow trenches contained high-radiation dose, large-size equipment; the pits and pipes were used for small, high-radiation dose reactor hardware.

Table 1. Solid Waste Disposal Sites in the 100-B/C Area.

WIDS Number	Site name	Site description (LxWxD)	Waste description
118-B-1	105-B Burial Ground	Size: 1,000 x 321 x 20 ft - 21 trenches running east-west, 3 trenches running north-south; perforated burials and spline silos. - Perforated burials were generally in excavations shored with railroad ties. - Spline silos were metal culverts with a 5 to 6 ft radius. - Typically, the trenches are 300 ft long by 20 ft wide by 20 ft deep with a 20-ft space between them.	The spline silos received metallic wastes. The trenches received general reactor waste from 100-B and 100-N reactors that included the following: aluminum tubes, irradiated facilities, thermocouples, vertical and horizontal aluminum thimbles, stainless steel gunbarrels and expendables, plastic wood, cardboard, etc. See Table 2.
118-B-2	Construction Burial Ground No. 1	Size: 60 x 30 x 10 ft	Dry waste from 107-B Basin repair work and 115-B alterations by minor construction.
118-B-3	Construction Burial Ground No. 2	Size: 350 x 275 x 20 ft	Solid waste from effluent line modification and reactor generated solid waste during modification programs.
118-B-4	105-B Spacer Burial Ground	Size: 50 x 30 x 15 ft - Six dummy storage pits installed belowground; the pits are constructed of metal culverts 15 ft deep and 6 ft in diameter.	The unit was used for disposal of fuel spacers.
118-B-5	Ball 3X Burial Ground	Size: 50 x 50 x 20 ft - Consists of one trench.	Used for highly contaminated wastes, such as old thimbles and step plugs, that were removed from the 105-B Building for the Ball 3X work in 1953.
118-B-6	108-B Solid Waste Burial Ground	Size: 40 x 40 x 20 ft - Two concrete pipes, 18 ft long and 6-ft diameter; buried vertically in the ground. - A light metal cap was placed over pipes in the concrete pad.	Used for disposal of tritium wastes and tritium recovery process waste, primarily aluminum target cans and lead target melting pots.
118-B-7	111-B Solid Waste Burial Ground	Size: 8 x 8 x 8 ft - A concrete marker identifies the site.	Received miscellaneous solid waste (decontamination materials and associated equipment).
118-C-1	105-C Burial Ground	Size: 510 x 400 x 15 ft - Contains many trenches running north and south and six pits (10x 10 ft)	Used for miscellaneous solid waste from 105-C Building including pressure tubes, aluminum spacers, control rods, soft waste, and reactor hardware.
126-B-2	183-B Clearwells - Demolition and Inert Landfill	Size: 751 x 135 ft - Consists of two clearwells separated in the center by a pump room; the clearwells are covered, reinforced concrete and have a capacity of about 10 million gal. - The pump room is constructed of reinforced concrete and is about 22 ft deep. - The clearwells are intact, and the aboveground portion of the pump room has been demolished.	The pump room is the only portion of this unit currently containing waste. The waste consists of demolition waste from the aboveground portion of the pump room.

Data from WHC (1991d)

Table 2. Estimated Solid Waste Disposal Site Contents.

WIDS number	Site Name	Metallic and Other Waste (tons)						
		Lead	Aluminum[1]	Pb/Cd	Boron[2]	Mercury	Graphite	Other[3]
118-B-1	105-B Burial Ground	30.0	135.2	201.2/8.4	1.4	1.0	0.08	527
118-B-2	Construction Burial Ground No. 1	†	†	†	†	†	†	†
118-B-3	Construction Burial Ground No. 2	†	†	†	†	†	†	†
118-B-4	105-B Spacer and Dummy Storage Burial Ground	†	†	†	†	†	†	†
118-B-5	Ball 3X Burial Ground	†	†	†	†	†	†	†
118-B-6	108-B Solid Waste Burial Ground	18.0	25.0	-	-	0.05	-	23
118-B-7	111-B Solid Waste Burial Ground	†	†	†	†	†	†	†
118-C-1	105-C Burial Ground	23.8	94.8	105.9/4.4	1.2	-	0.56	211
126-B-2	183-B Clearwells - Demolition and Inert Landfill	‡	‡	‡	‡	‡	‡	‡

1 Includes aluminum cladding on lead/cadmium pieces, spacers, and aluminum contained in splines.
2 Includes boron from splines, vertical and horizontal safety rods at 1.5% x total weight buried.
3 Includes soft waste, desiccant, and miscellaneous materials.
† Included in the 118-B-1 totals
‡ No Data
Data from: Miller and Wahlen, "Estimates of Solid Waste Buried in 100 Area Burial Grounds," WHC-EP-0087, October 1987.

Table 3. Liquid Waste Disposal Sites in the 100-B/C Area. (sheet 1 of 2)

WIDS number	Site name	Site description (LxWxD)	Waste description
116-B-1	107-B Liquid Waste Disposal Trench	Size: 200 x 30 x 15 ft	Received effluent from the 107-B Retention Basin at times of high activity due to fuel element failure.
116-B-2	105-B Storage Basin Trench	Size: 75 x 10 x 15 ft	Dug after a fuel element was accidently cut in half in the 105-B Storage Basin. Basin water was discharged to this unit in an attempt to remove radionuclides from the fuel storage basin cooling water for contamination control.
116-B-3	105-B Pluto Crib	Size: 10 x 10 x 11 ft An excavation, possibly shored with railroad ties and filled with gravel.	Received effluent from reactor tubes containing ruptured fuel elements.
116-B-4	105-B Dummy Decontamination French Drain and Disposal Crib	Size: 4 ft diameter, 20 ft deep. Has a graded rock and sand bottom.	Received spent acid rinse water from the 105-B dummy decontamination facility (fuel element spacers and reactor hardware).
116-B-5	108-B Crib	Size: 84 x 16 x 10 ft	Received liquid tritium wastes from the 108 Building. Only wastes less than 1 micro-Ci/cc were discharged to this unit.
116-B-6A	111-B Crib No. 1 (116-B-6-1)	Size: 12 x 8 x 15 ft	Received radioactive wastes from equipment decontamination, the 111-B Building, and liquid wastes from fuel element spacer decontamination (performed at 111-B Building decontamination station).
116-B-6B	111-B Crib No. 2 (116-B-6-2)	Size: 4 x 8 x 8 ft	Received radioactive wastes from equipment decontamination in the 111-B Building and liquid wastes from fuel element spacer decontamination.
116-B-9	104-B-2 French Drain	Size: 4 ft diameter, 3 ft deep.	Received waste water from the P-10 storage Building drain.
116-B-10	108-B Dry Well (French drain)	Size: 3 ft diameter, 7 ft deep. - Has a metal manhole cover. - A 1.5-in. drain line was added in the mid-50's that came from the second floor of the experimental tube decontamination facility.	Received liquid decontamination wastes from the 108-B Tube Examination and Experimental Facility.
116-B-12	117-B Crib	Size: 10 x 10 x 10 ft Filled with gravel and covered to grade with clean soil.	Received drainage from the confinement system in the 117-B Building seal pits.
116-B-13	107-B South Sludge Trench	Size: 50 x 50 x 10 ft	Received sludge waste from the 107-B Retention Basin.
116-B-14	107-B North Sludge Trench	Size: 120 x 10 x 10 ft	Received low-level sludge waste from the 107-B Retention Basins.
116-C-1	107-C Liquid Waste Disposal Trench	Size: 500 x 50 x 25 ft	Received effluent overflow from the 107-C Retention Basin during reactor outages due to ruptured fuel elements.

Table 3. Liquid Waste Disposal Sites in the 100-B/C Area. (sheet 1 of 2)

WIDS number	Site name	Site description (LxWxD)	Waste description
116-C-2A	105-C Pluto Crib (116-C-2)	Size: 140 x 100 x 20 ft Contains gravel and sand fill; unlike other pluto cribs, effluent passed through a sand filter prior to being discharged.	Received an unknown volume of contaminated wastes from the decontamination of dummy fuel elements on the wash pad, contaminated water from 105-C Irradiated Fuel Examining facilities, and 105-C Reactor rear face liquid wastes.
116-C-2C	105-C Pluto Crib Sand Filter (116-C-2-2)	Size: 23 x 16 x 6 ft - An open bottom concrete box placed in a sand and gravel pit. - Contaminated water was spread over the surface of sand filter by distribution trays; it is covered with concrete shielding slabs.	Received contaminated wastes from the decontamination of dummy fuel elements on the wash pad and effluents from 105-C Irradiated Fuel Examination facilities.

Data from WHC (1991d).

Table 4. Estimated Radionuclide Contamination in Liquid Waste Disposal Sites.

WIDS number	Site name	Average concentration (pCi/g)			
		β/γ	$^{239/40}Pu$	^{238}Pu	Notes
116-B-1	107-B Liquid Waste Disposal Trench	64	0.17	0.0021	β/γ_{max} = 360
116-B-2	105-B Storage Basin Trench	90	0.64	-	β/γ_{max} = 160
116-B-3	105-B Pluto Crib	1,700	5.6	0.11	β/γ_{max} = 4,000
116-B-4	105-B Dummy Decontamination French Drain and Disposal Crib	‡	‡	‡	
116-B-5	108-B Crib	16,000	-	-	β/γ_{max} = 73,000 (tritium)
116-B-6A	111-B Crib No. 1 (116-B-6-1)	1400	2.3	-	β/γ_{max} = 2,600
116-B-6B	111-B Crib No. 2 (116-B-6-2)	16	-	-	β/γ_{max} = 16
116-B-9	104-B-2 French Drain	‡	‡	‡	
116-B-10	108-B Dry Well (French Drain)	‡	‡	‡	
116-B-12	117-B Crib	‡	‡	‡	
116-B-13	107-B South Sludge Trench	‡	‡	‡	
116-B-14	107-B North Sludge Trench	‡	‡	‡	
116-C-1	107-C Liquid Waste Disposal Trench	440	-	0.74	β/γ_{max} = 3,200
116-C-2A	105-C Pluto Crib (116-C-2)	190	-	-	β/γ_{max} = 280
116-C-2C	105 Pluto Crib Sand Filter (116-C-2-2)	42,000	19	19	β/γ_{max} = 7,300,000 $^{239/40}Pu_{max}$ = 1,500 $^{238}Pu_{max}$ = 1,600

β/γ = Beta/Gamma ‡ = No Data Data from Dorian and Richards (1978)

Table 5. Contaminated Structures in the 100-B/C Area.

WIDS number	Site name	Site description (LxWxD)	Waste description
116-B-7	1904-B1 Outfall Structure	Size: 27 x 14 ft Consisted of an open concrete sump and effluent lines that ran from the sump to the middle of the river; it also included a concrete spillway that terminated at the river shore line.	Used for disposal of water plant treatment waste water.
116-B-8	1904-B2 Outfall Structure	Size: 27 x 14 ft Consisted of an open concrete sump and effluent lines that ran from the sump to the middle of the river. It also included a concrete spillway that terminated at the top of the riverbank. If the main line plugged, the effluent would overflow into the spillway that lead to a large riprap area at the top of the riverbank.	Reactor cooling water disposal.
116-B-11	107-B Retention Basin	Size: 450 x 230 x 24 ft Concrete lined with a vertical baffle down the middle, lengthwise. The floor of the unit consists of concrete slabs, their joints originally closed with neoprene water seals. To a height of almost 10 ft above the floor, the walls slope and are about 4 in. thick. The upper sections of the walls, about 10 ft, are vertical and range in thickness from about 5 ft 8 in. at the bottom, to 1 ft at the top. The unit has been backfilled with soil to a depth of almost 4 ft.	- Received cooling water effluent from the 105-B Reactor for radioactive decay and thermal cooling. - Total radionuclide inventories in the vicinity of the unit ranged from 5 to over 400 Ci. - 80% of the total radionuclide inventory is contained in the soil adjacent to the unit. - Approximately 10 Ci have leached into the concrete floor and walls. - In early 1952, gross leakage at the inlet for the 105-B effluent line was detected and steadily increased in volume. - In late 1952, there were two known leaks from the effluent line: 1) near #2 diversion box for the 30-in. line and 2) near the 8-in. riser for the temporary by-pass line northeast of the 105-B Building. - In February 1954, a break occurred in this unit.
116-C-5	107-C Retention Basin	Size: 330 ft diameter, 16 ft deep. Two carbon steel tanks, each with a series of steel baffle plates inside to prevent water from channeling across the tank into the discharge line.	- Received cooling water from the 105-C Reactor for radioactive decay and thermal cooling. - Total radionuclide inventories in the vicinity of the basin ranged from 5 to over 400 Ci. - 80% of the total radionuclide inventory is contained within the soil adjacent to the unit. - Approximately 10 Ci have leached into the sediment. - Developed leaks during its operating life; the leaks could have been as high as 5,000 to 10,000 gal/min.
132-C-2	1904-C Outfall Structure (116-C-4)	Contains a riprap overflow down to the river consisting of basalt boulders. Has been reduced to near-grade level and backfilled.	None

Data from WHC (1991d)

Table 6. Estimated Radiological Contamination in Contaminated Structures.

WIDS number	Site name	Average concentration (pCi/g)			
		β/γ	$^{239/40}Pu$	^{238}Pu	Notes
116-B-7	1904-B1 Outfall Structure	‡	‡	‡	
116-B-8	1904-B2 Outfall Structure	‡	‡	‡	
116-B-11	107-B Retention Basin Sludge	61,000	58	1.9	
	Fill less Sludge	590	0.71	0.0039	β/γ_{max} = 9,500
	Underneath 0 to 20 ft	1,800	5.0	0.1	
	Adjacent Surface	2,900	0.5	-	Avg = Max
	Adjacent Underground	0.74	0.22	-	β/γ_{max} = 560
	Concrete	1,400	0.031	1.8	All basins
116-C-5	107-C Steel Retention Basins - Sludge	18,000	65	2.4	
	Fill less Sludge	270	0.78	0.054	β/γ_{max} = 1,200 $^{239/40}Pu_{max}$ = 16
	Underneath 0 to 20 ft	875	1.24	-	Averaged from 0 to 8 ft and 8 to 20 ft
	Adjacent Surface	98	0.51	-	
	Adjacent Underground	12	0.014	-	
132-C-2	1904-C Outfall Structure (116-C-4)	‡	‡	‡	

β/γ = Beta/Gamma
‡ = No Data
Data from Dorian and Richards (1978)

Adams et al. (1984) describes a typical 100 Area burial trench as consisting of layers of hard waste and soft waste. The soft waste, consisting of boxes of clothing, paper, etc., was placed on top of the hard waste, which consisted primarily of contaminated reactor hardware. However, recent interviews with 100 Area operations personnel indicate that layering of waste was not practiced in the 100-B/C Area. Instead, soft waste may have been dumped into one end of the trench while hard waste was dumped into the opposite end. Adams et al. (1984) estimated that although soft waste made up more than 75% of the volume in the trenches, it contained less than 1% of the total inventory of radioactive materials.

The demolition/landfill site (126-B-2) consists of a pair of 10 million gal, reinforced concrete clearwells. The pump room is the only portion currently containing waste, consisting of demolition waste from the above-ground portion of the pump room.

1.4.2 Liquid Waste Disposal

Liquid waste was disposed to the soil column through cribs, trenches, and French drains. Pertinent data for this class of sites are summarized in Tables 3 and 4.

1.4.2.1 Cribs

Available Hanford documents (e.g. Adams et al 1984) describe 100 Area cribs as buried, generally rock-filled, structures; early cribs were typically open-bottomed, buried boxes, constructed from timbers, which ranged in area from 32 to 14,000 ft^2. Some of these timbered cribs had associated tile fields for overflow. Some were provided with a secondary cavity to handle overflow. However, recent interviews with 100 Area operations personnel suggest that the documents do not accurately portray 100-B/C cribs, i.e., the 100-B/C cribs may not have used timbers or rock but may have been merely excavated pits. Some of the cribs received waste through fire hoses rather than hard-pipe.

The largest crib, 116-C-2, included a sand filter. Existing characterization data indicate that the 116-C-2 crib and sand filter are the most contaminated of all the liquid waste disposal sites in the 100-B/C Area (Dorian and Richards, 1978).

Cribs can generally be categorized by the type of liquid disposal service provided. These are listed as follows:

- Pluto cribs received effluent from individual process tubes following fuel cladding failures and are generally the most contaminated of all cribs.

- Dummy/perforation decontamination cribs received radioactive liquid wastes from the decontamination of dummy fuel element spacers in the 105-B Building (DOE-RL 1991a).

- 108 Building cribs or underground drains received contaminated liquid effluents from the 108 Laboratory building operations (DOE-RL 1991a).

- 117 Building cribs received drainage from the ventilation system water seal pits in the 117 Building (DOE-RL 1991a).

1.4.2.2 French Drains

French drains were generally gravel-filled, concrete or vitreous clay pipe. These were generally 3 to 4 ft in diameter and ranged from 3 to 20 ft deep.

1.4.2.3 Trenches

Trenches were open excavations with sloped sides. The trenches ranged from 50 to 500 ft long, 10 to 50 ft wide, and from 10 to 25 ft deep.

Each reactor area used a trench as backup to the retention basin when the effluent was too highly contaminated to be released to the river. Types of trenches are described as follows:

- The liquid waste disposal trenches received effluent from the retention basins during fuel element cladding failures. The trenches were used in early reactor operations until increased flow and leakage forced parallel use of both sides of the 107-B retention basin and both 107-C basins.

- Storage basin trenches received water from the fuel storage basins. The basins presently contain highly radioactive sludge, therefore some of that material is probably contained in the trenches.

- The B Area contained two sludge trenches that were used to bury low-level sludge waste from the B Area retention basin (DOE-RL 1991a).

1.4.3 Contaminated Structures

Contaminated structures include retention basins, effluent pipelines and junction boxes, outfall structures, and miscellaneous constructed facilities. Pertinent data for structures are given in Tables 5 and 6.

1.4.3.1 Retention Basins

The retention basins were rectangular concrete or circular steel structures used to retain cooling water effluent from the reactor for radioactive decay and thermal cooling prior to discharge to the river. The basins ranged in capacity from 16 to 24-million gal (DOE-RL 1991a). Some of the basins were baffled to provide separate compartments.

The 107-B retention basin has been partially demolished and the rubble has been buried in-place in the basin via application of a soil cover. The basins have also been used as temporary disposal for contaminated piping and other demolition materials. Contaminated sludge was deposited on the basin floors.

1.4.3.2 Pipelines

Effluent pipelines provided a conduit for cooling water flow from the reactors to the retention basins, from the retention basins to the outfall structures, and from the outfall structures to the discharge point in the middle of the Columbia River. The 100-B/C Area contained approximately 22,500 ft of effluent pipeline ranging from 12- to 72-in-diameter (Adams et al. 1984). The original B Reactor pipelines were constructed of reinforced concrete pipe and vitreous tile. However, failed sections were later replaced with welded-steel lines. The pipelines included manholes, junction boxes, tie-lines between parallel legs, and valves. Junction boxes have been sealed or filled with gravel and the effluent lines are sealed to prevent entry. Some contaminated sludge was deposited on the bottoms of the effluent pipes.

1.4.3.3 Outfall Structures

Outfall structures were compartmentalized structures used to direct and disperse the liquid effluent from the retention basin to the Columbia River. The structures were box-like and constructed of reinforced concrete with concrete or rip-rap spillways. Two of the three outfalls (116-B-8 and 132-C-2) have been demolished to near-grade level and backfilled.

Effluent discharges often overflowed the outfall structure and exceeded the capacity of the spillways resulting in contamination of surrounding soils down to the river's edge.

1.4.4 Contaminated Soils

In addition to contaminated soil in liquid waste disposal sites, there are unknown quantities of contaminated soils associated with effluent pipeline and retention basin leaks. The early concrete effluent lines were the most notorious for producing leaks. Therefore, there is a high probability of substantial areas of contaminated soils; the locations of these areas are generally not known.

Radionuclide contamination is not expected to be evenly distributed in the soil; evidence suggests contaminants tend to adsorb disproportionately on the smaller sized soil fractions. A size analysis, typical of Hanford soils, is given as follows (WHC 1990):

Fraction	Size	Wt%
Boulders	30.5 to 61.0 cm	5.0
Large cobbles	15.2 to 30.5 cm	13.5
Small cobbles	0.9 to 15.2 cm	31.5
Fine pebbles	0.2 to 0.9 cm	5.7
Very fine	to 2 mm	3.7
pebbles	to 1 mm	7.8
Very coarse	to 0.5 mm	6.6
sand	to 0.25 mm	9.0
Coarse sand	to 0.125 mm	5.0
Medium sand	to 0.0625 mm	3.9
Find sand	to 0.0313 mm	2.9
Very fine sand	to 0.0038 mm	5.4
Silt		
Pan		

Soils were contaminated from leaks in both B and C retention basins. Adams et al. (1984) reports an estimated inventory of 420 Ci associated with the 107-B Basin, 72% of which lies adjacent to and below the basin. Of the 187 Ci associated with the 107-C Basins, 93% lies adjacent to and below the basins. The depth of contamination is not known; however, due to the large volumes of water that leaked, the contamination is expected to extend to the groundwater. The depth to groundwater varies from about 44 to 86 ft.

1.4.5 Potential Contaminants

Based on disposal history of operations in the 100-B/C Area, lists of contaminants have been compiled and documented in the operable unit work plans (DOE 1990a,b,c) for conducting CERCLA RI/FS investigations. These lists of contaminants and associated sampling data were evaluated against background and regulatory limits and were assessed for toxicological significance as part of the DOE/RL (1992). The resulting contaminants were categorized into two types:

- Potential contaminants of concern--Those contaminants which, based on past sampling and analysis, have been detected at concentrations that exceed background concentrations and regulatory limits and that are of toxicological significance in accordance with EPA screening criteria.

- Suspect contaminants--Those contaminants which, based on past sampling and analysis, have not been detected at concentrations that exceed either background or regulatory limits and are of toxicological significance.

The resulting list of contaminants is tabulated as follows:

Substance	Potential Contaminant	Suspect Contaminant
Radionuclides:		
Carbon-14	x	
Cobalt-60	x	
Nickel-63	x	
Strontium-90	x	
Technetium-99	x	
Cesium-137	x	
Europium-152	x	
Europium-154	x	
Plutonium-238	x	
Plutonium-239/240	x	
Metals:		
Arsenic		x
Barium		x
Cadmium		x
Chromium		x
Iron		x
Lead	x	
Mercury		x
Nickel		x
Sodium		x
Zinc		x

Substance	Potential Contaminant	Suspect Contaminant
Other inorganic compounds/ions:		
Asbestos	x	
Chloride		x
Fluoride	x	
Nitrate	x	
Sulfate		x
Organic compounds:		
PCBs	x	
Petroleum Products	x	

Note that these data do not list VOC as potential or suspect contaminants. The disposal history for the 100-B/C operation does not indicate routine use or disposal of volatile organics. Nevertheless, there remains a possibility that small quantities of such materials may have been disposed of, and if so, would likely be in the 100-B/C solid waste disposal sites.

2.0 FUNCTIONAL REQUIREMENTS

The Materials Handling and Analytical System to be specified as part of the 100-B/C Macroengineering Prototype Project shall comply with applicable requirements of all state and federal laws, regulations, DOE orders, and criteria, including cited references. Section 6.0 contains a listing of these documents.

For design purposes, the Materials Handling and Analytical System shall be considered as a nonreactor nuclear facility.

The Materials Handling and Analytical System shall be designed to:

- Operate within the boundary of the 100-B/C Area up to the edge of existing buildings
- Be transportable, not consisting of permanent structures (all foundations shall be temporary)
- Remove all waste material within project scope at a rate compatible with the remediation schedule, i.e., within a 6-yr demonstration/remediation time frame
- Excavate, convey, and transport waste materials in bulk
- Remove all soils contaminated above cleanup criteria from the 100-B/C Area
- Remove all pipelines (land and river)

- Demolish all man-made structures within project scope
- Segregate waste into:
  - radioactive, high-activity waste, non-TRU
  - radioactive, low-activity waste, non-TRU
  - TRU waste
  - radioactive, high-activity, non-TRU, hazardous mixed waste
  - radioactive, low-activity, non-TRU, hazardous mixed waste
  - hazardous waste
  - nonradioactive/nonhazardous waste
- Process organic waste constituents to meet RCRA LDR treatment limits
- Process all liquids such that no liquids are transported to the 200 Area disposal site
- Identify and segregate intact drums and compressed gas cylinders
- Segregate intact drum contents into waste types as required for bulk waste segregation
- Depressurize compressed gas cylinders for safe handling; process gas components for disposal
- Size reduce materials, as needed, to accommodate the conveyance/ transport method
- Volume reduce compactible waste, including pipe
- Suppress dusts to minimize contamination spread from contaminated soils, structures, and buried wastes
- Provide an analytical system with associated procedures to:
  - identify radiation and chemical hazards for worker safety
  - locate contamination boundaries
  - characterize waste for the purpose of segregation by waste type and determination of processing requirements
  - identify unexpected and/or special hazard materials
  - verify decontamination of equipment and personnel
- Convey and transport waste material in a manner that protects the environment from the spread of contamination and meets the functional design criteria of the 200 Area disposal site
- Transport waste to the 200 Area disposal site at a rate compatible with the excavation system
- Restore excavated waste sites and disturbed areas as necessary to meet land use requirements.

The design of all electrical, mechanical, and instrument systems shall provide for return to the safest mode in event of failure. Interlocks and alarms shall be provided, as appropriate, on all systems or components to prevent operation in a manner that may affect safety or be detrimental to the equipment. Systems required for safety or crucial processes (where recovery operations would be expensive or hazardous) shall be provided with redundant or backup systems. Human factors engineering shall be used throughout the design to minimize the probability of operator error. The systems shall be designed so that the occurrence of nonroutine process upset conditions, including design basis accidents, would not result in unacceptable safety consequences, as defined in Section 5.7.3.

3.0 PROCESS DESIGN CRITERIA

Volume of waste material to be excavated/demolished shall be determined as part of the conceptual design effort.

The project shall consist of two phases:

- A demonstration phase in which all systems, components, and procedures are developed and proven to be workable for each site type
- A remediation phase, following the demonstration phase, which focuses on completion of site remediation and restoration.

For design, assume that operations for the demonstration phase shall occur in one 8-h shift each day, 5 d/wk. Operations for the remediation phase shall occur in two 8-h shifts per day, 5 d/wk. For design purposes, it shall be assumed that there are 5 h of productive work (e.g., excavation or demolition) per 8-h shift.

3.1 ANALYTICAL SYSTEM

The functional requirements of the analytical system (Section 2.0) shall be achieved by rapid field screening methods, utilizing instrumentation systems to provide real-time or near real-time analyses, and sampling/analysis that can be accomplished rapidly in a mobile field laboratory. Pre-characterization, i.e, characterization performed prior to actual waste excavation, shall be minimized except as may be required to develop or validate real-time characterization methods and/or rapid-turnaround sampling/analytical procedures. To the extent possible, existing data shall be utilized that defines the nature and extent of contamination at the 100-B/C waste sites.

Criteria for design of the analytical system are specified for two types of materials: soil wastes and solid wastes. Soil wastes do not contain any significant portion of solid wastes, and are contaminated with concentrations of radioactive and/or chemical substances that exceed the cleanup criteria defined in Section 3.2. Solid wastes are primarily non-soil materials that include such substances as metals, concrete, glass, wood, paper, plastic, and cloth. Solid wastes may exist in any size, shape or form ranging from small particles to very large items of equipment or structures. Data on solid waste forms and quantity estimates are summarized in Section 1.4.1. Solid wastes may contain some admixed soils, in which case it shall be assumed that the admixture is handled as solid waste rather than soil. Solid wastes may or may not be contaminated at levels exceeding cleanup criteria. Characterization criteria are defined separately for soil and solid wastes due to the distinctly different ways in which such materials are characterized. In general, characterization of solid wastes is more complex than characterization of soils. Specific criteria for near real-time characterization of soils and solid wastes are defined in the following sections.

3.1.1 Soils

3.1.1.1 Field Screening

The analytical system shall make maximum use of real-time instrumentation and/or monitors to detect radioactivity and VOC. Use of real-time instrumentation for other chemical constituents shall be considered, if practical capability is available. The use of such instrumentation shall provide:

- On-line monitoring of the approximate boundaries of contamination in the excavation sites during excavation; fully quantitative verification of contamination shall be provided by sampling and analysis.

- An initial screening of the contamination type and levels for the purpose of segregating waste(s) by contamination type and/or levels.

The configuration of real-time or near real-time instrumentation and/or monitors shall consider hand-held devices, vehicle mounted devices, or devices that are attached to conveyance equipment. The design shall, in all cases, comply with the requirements of worker and environmental protection (Section 3.3.1). The design shall consider measurements of contamination at the excavation face either immediately before or during excavation. The design shall also consider measurements made at points associated with conveyance of material away from the excavation face.

Instrumentation shall, as a minimum, provide the means for the following:

- Detection of substances emitting beta/gamma radiation at levels from background to greater than 200 mrem/h (measured at the surface)

- Detection of TRU constituents whose total concentration exceeds 100 nCi/g

- Detection of the presence of VOC.

Field instrumentation shall be capable of performing reliably under the physical conditions posed at the point of measurement. If instrumentation is not available that can practically meet these requirements, then the system design shall consider alternative approaches that rely on rapid-turnaround sampling and analysis to accomplish the site/waste screening objectives. Field instrumentation for worker protection is discussed in Section 3.3.1.

3.1.1.2 Sampling and Analysis

Sampling and rapid-turnaround analysis of soil materials shall be performed to verify concentrations of radiological and chemical contamination detected by field screening instrumentation. Rapid-turnaround is defined as less than 24 h. Such verification shall:

- Confirm that the excavation has proceeded to a point such that soils beyond the point of excavation meet the cleanup criteria (Section 3.2)

- Confirm that the excavated materials have been appropriately segregated by contaminant type and/or contamination level (Section 3.2.2). Waste materials shall not be placed in the disposal site until rapid-turnaround analytical results are available.

To achieve rapid-turnaround capability, use of procedures and systems shall be considered that involve automated sampling devices, automated analytical devices, portable equipment, and/or on-site mobile laboratories. At a minimum, sampling and rapid-turnaround analysis capability shall be provided to measure the following parameters:

- Gross beta/gamma radioactivity from background to surface radiation rates exceeding 200 mrem/h

- Concentrations of TRU materials from nondetectable to greater than 100 nCi/g

- Concentrations of all hazardous chemical constituents for which compliance with cleanup criteria is required (Section 3.2).

The conceptual design shall develop a designation methodology with meets the requirements of WAC-173-303.

Sample frequency and sample size shall generally consider:

- The pre-determined nature of site contamination as defined by historical site data

- The variability of waste composition for a given site

- Excavation, transport, and conveyance methods

- Disposal site permitting requirements for record keeping

- Cost and time associated with sampling and analysis

- Other relevant factors.

In general, sample frequency and sample size shall be such that analytical results are adequately representative of the excavated soil materials and that the overall level of sampling and analysis is cost effective. The adequacy of the sampling depends on the data quality objectives and the physical limitations imposed by the waste matrix. The data quality objectives shall be determined during the conceptual design phase of this project. Limited pre-characterization may be considered to provide correlations that allow less real-time sampling and analysis. Sampling and analysis requirements will be subject to negotiation with regulatory agencies. If the above requirements for sampling and rapid-turnaround analysis cannot be met, the design shall consider alternatives available to meet cleanup objectives.

Normal-turnaround sampling and analysis shall be performed to provide:

- Certification of site cleanup upon completion of waste excavation
- Confirmation of sampling and rapid-turnaround analysis
- A validated permanent record of the composition of wastes disposed at the 200 Area disposal site.

Normal-turnaround sampling and analysis is defined as analytical work performed at a laboratory onsite or offsite. Analytical Level III (EPA 1987) shall be used for confirmation of rapid-turnaround sampling and analysis. Analytical Level IV (CLP) is reserved for certification of site cleanup. For constituents not covered by these protocols, other validated methods shall be used.

The sample frequency and percentage of normal turnaround samples will be subject to regulatory agency negotiation.

3.1.2 Solid Wastes

3.1.2.1 Field Screening

Field screening of bulk solid wastes will be similar to soils with some exceptions resulting from differences in the composition and physical characteristics of the waste materials. For solid wastes, the design shall consider visual observation as a preliminary means of determining the boundary of the solid waste. As with soil wastes, real-time instrumentation shall be used to provide initial screening of the contamination type and levels for the purpose of segregating waste(s) by contamination type and/or levels. However, the utilization of field screening instruments may be limited by the highly variable composition and physical characteristics of the wastes. For example, determining TRU content of bulk solid wastes may not be practical with current instrument technology. The design shall identify specific deficiencies and limitations in technology and/or ability to achieve the objectives and shall propose potential alternatives for further consideration.

Intact drums represent a special case of solid waste that must be characterized in a manner different than bulk solid wastes. Intact drums may contain:

- Bulk materials
- Free liquids
- Smaller containers

- Organics
- Materials presenting hazards such as fire, explosion, reactivity, corrosivity, or sudden pressure release.

Intact drums may be encountered in the burial grounds. A means of determining the presence of intact drums prior to excavation of burial grounds shall be considered, so as to increase the probability that drums can be removed intact from the burial grounds. Engineered controls and/or systems shall be considered to ensure worker safety in the event drums are ruptured. To the extent possible, intact drums shall be segregated from the excavation for special handling. Field screening systems and/or procedures shall be provided to safely:

- Determine contents of intact drums to differentiate
  - pressurized contents
  - smaller containers
  - free liquids
  - organics
- Depressurize drums, if necessary
- Segregate contents by material type
- Combine and/or process segregated materials along with bulk materials of the same type.

3.1.2.2 Sampling and Analysis

Unlike soil wastes, obtaining representative samples of solid wastes that have highly variable composition and physical characteristics may not be achievable, although some limited characterization may still be possible for some types of solid waste. The conceptual design shall consider the cost tradeoffs associated with characterization versus incremental disposal cost. That is, it may not be cost effective to attempt characterization for other than instrument screening for beta/gamma radiation and VOC. Further, the volumes of solid wastes are small relative to soil wastes and it may be more cost effective to forgo chemical analysis and plan to meet LDR requirements by methods such as stabilization/solidification. Similarly, process knowledge and past sampling indicates that the TRU content of solid wastes is low, i.e., likely well below 100 nCi/g (Section 1.4.1). For this reason, rigorous characterization of solid wastes to determine TRU content may be limited to confirmatory spot testing and suspect items.

3.2 CLEANUP CRITERIA

3.2.1 Site Cleanup

The design shall provide a remedial system capable of compliance with all state and federal ARAR. The principal applicable requirement for the purpose of determining soil/solid waste cleanup standards is the State of Washington Model Toxics Control Act (MTCA) Cleanup Regulations codified in WAC 173-340. These cleanup regulations invoke applicable federal and other state statues and regulations as requirements under MTCA. That is, compliance with MTCA establishes compliance with other laws and regulations, since MTCA requires the cleanup standards to be "at least as stringent as all applicable state and federal laws." Under MTCA, applicable requirements include both legally applicable requirements and relevant and appropriate requirements (WAC 173-340-710). The MTCA regulations define radionuclides as hazardous substances (WAC 173-340-200). For radioactive substances, potential federal ARAR include the Atomic Energy Act of 1954 and its implementing regulations in 40 CFR 191, which establish radiation protection standards for management and disposal of high level and TRU waste and spent nuclear fuel. Principal guidance to-be-considered for establishing specific releases of radioactive substances are defined in DOE Order 5400.5. MTCA regulations promulgate specific soil cleanup standards for two land use options:

- Residential use
- Industrial/commercial use.

Land use decisions have not yet been made for any of the 100 Areas. However, for design purposes, industrial/commercial standards shall be assumed for estimating volumes/areas of contamination to be remediated. Soil cleanup standards under MTCA are specifically defined in WAC 173-340-745.

Under MTCA, numerical limits for radionuclides have not yet been promulgated. Thus, for initial design purposes, limits shall be established using appropriate radiation protection standards as guidelines (e.g., Residual Radioactivity Modeling Program, DOE RL 5820.2A and WHC 1988a).

3.2.2 Segregation and Treatment of Contaminated Material

To the extent possible, the excavated materials shall be physically segregated into the material types as shown in Table 7.

Table 7. Material Types.

Material type no.	Description	Principal criteria
1	Radioactive only Low-activity Non-TRU	Nondangerous per WAC 173-303 designation <200 mrem/h beta/gamma <100 nCi/g TRU
2	Radioactive only High-activity Non-TRU	Nondangerous per WAC 173-303 designation >200 mrem/h beta/gamma <100 nCi/g TRU
3	Mixed waste Low-activity Non-TRU	Dangerous per WAC 173-303 designation <200 mrem/h beta/gamma <100 nCi/g TRU
4	Mixed waste High-activity Non-TRU	Dangerous per WAC 173-303 designation >200 mrem/h beta/gamma <100 nCi/g TRU
5	TRU Waste	>100 nCi/g TRU
6	Dangerous Waste Nonradioactive	Dangerous per WAC 173-303 designation Nonradioactive per WHC 1988a
7	Nonradioactive Nondangerous	Nonradioactive per WHC 1988a Nondangerous per WAC 173-303

Soils of material type 7 shall be used as excavation backfill; solid wastes of material type 7 shall be disposed of separately per WAC 173-304. Material type 5 shall be transported to the 200 Area where it will be interim stored in retrievable form. Material types 3, 4, and 6 shall be processed in the 100 Area waste handling system such that the RCRA LDR Regulations in 40 CFR 268.40 - 268.44 (equivalent state regulations given in WAC 173-303-140) are met for organic constituents whose concentrations exceed the treatment standards of those regulations. Wastes containing concentrations of inorganic contamination in excess of the RCRA LDR treatment standards shall be treated in the 200 Area. The material shall be segregated in the 100 Area and transported separately from the other waste materials. Radioactive and radioactive-mixed waste shall be managed according to DOE-RL 5820.2A.

3.3 PERSONNEL PROTECTION REQUIREMENTS

3.3.1 Worker Protection

Design for protection of the health and safety of workers shall implement all applicable DOE orders, regulations, and guidance. The design shall comply with environmental and worker safety requirements to reduce hazardous material and radiation exposures to as low as reasonably achievable (ALARA). Guidance shall include DOE practices and guidance documents and the National Institute for Occupational Safety and Health (NIOSH) "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities" (NIOSH 1985).

The design shall specify job control procedures, specialized equipment, and/or engineered controls, as necessary and appropriate to protect workers and reduce exposure to hazardous and radioactive materials to ALARA. Specific requirements are defined as follows:

- When accessing an unknown environment, personnel shall use protective equipment suitable for handling radioactive waste contaminated with VOC.

- Personnel-operated excavation or other equipment that involves access to the contaminated waste shall be designed and/or modified to protect the operator from radiation, chemical, or other hazards associated with the waste operations. Such design/modifications shall consider the need for:
  - radiation shielding
  - self-contained breathing air supply
  - emergency/evacuation provisions
  - monitoring systems
  - protection from special hazards such as fires or explosions
  - protection from heat and/or cold
  - remote operation

- Capability for personnel survey and decontamination shall be provided

- The design shall include continuous monitoring and/or sampling of the air in areas where workers are present to quantify hazards such that worker protection, mitigating actions and/or evacuation procedures can be implemented. Monitoring systems shall consider the need to monitor:
  - oxygen concentration
  - explosivity/flammability
  - toxic vapors and gases
  - radiation
  - airborne particulates.

3.3.2 Public and Non-involved Worker Protection

The public and all non-involved workers shall be protected from injury and exposure to toxic materials, radiation, and other hazards in accordance with DOE Order 5480.11 and DOE-RL 5480.11.

Many of the procedures, equipment, and engineered controls used to protect workers (Section 3.3.1) serve to protect the health and safety of the public and non-involved workers. The key features providing this protection are:

- Incorporating safety features capable of withstanding design basis accidents

- Minimizing accident potential with engineered controls

- Reducing exposures to ALARA

- The design shall include continuous monitoring and/or sampling of the air at the boundaries of the work site to quantify hazards such that public and non-involved worker protection, mitigating actions, and/or evacuation procedures can be implemented. Monitoring systems shall consider the need to monitor:
  - toxic vapors and gases
  - radiation
  - airborne particulates.

3.4 EQUIPMENT REQUIREMENTS

The materials handling equipment will be directly exposed to a wide range of climatic conditions and shall therefore be designed to meet the conditions described in Hanford Plant Standard SDC-5.1, Section C, "Outdoor Design Environment," for process structures and equipment. Operability of the equipment shall not be compromised by the full range of precipitation nor shall it be compromised by fluctuations of meteorological conditions typical of Hanford's daily or seasonal cycles. Specific process requirements for each type of operation are described below.

The materials handling equipment shall be capable of:

- Handling all material types (Section 1.4 and Section 3.2.2), except where a specific equipment item is specifically dedicated to handle a certain material type

- Handling all waste forms within the scope of work

- Operating at a rate consistent with the overall demonstration/ remediation schedule (either singly or in multiples)

- Minimizing contamination spread

- Minimizing secondary waste generation.

The materials handling equipment shall consider:

- Incorporating dust limiting design features
- Bulk and/or containerized transfer of contaminated materials.

Equipment design shall consider systems that are:

- Reliable (have low maintenance)
- Commercially available with minimum modifications
- Maneuverable
- Transportable
- Low capital and operating cost
- Easy to decontaminate
- Powered by a clean power source.

3.4.1 Excavation Requirements

Excavation shall be used to remove uncontaminated (overburden) and contaminated soil, buried solid wastes, and pipelines. Design criteria for excavation equipment are given as follows:

- The design shall consider excavation of soils containing boulders exceeding 2-ft diameter

- The design shall consider excavation without the use of shoring; although shoring can be considered in limited situations if operationally and economically advantageous

- Side slope angle shall be specified for consideration of operational safety

- The excavation equipment shall be capable of excavating to the water table

- For excavation of buried waste, the design shall consider systems offering a high degree of excavation control and selectivity to minimize the quantity of uncontaminated, co-excavated surrounding soil and to allow special hazard materials such as intact drums and compressed gas cylinders to be identified and handled safely

- Handling of intact drums, compressed gas cylinders and/or other materials requiring special handling shall not substantially interfere with excavation operations. That is, such handling should be performed 'off-line' to the extent possible.

For buried pipelines, the excavation equipment shall be capable of:

- Excavating land pipelines buried up to 15 ft below grade

- Excavating river pipelines at high river stage (estimated at 40 ft of water depth).

Interim storage of contaminated excavated material shall be provided for the purpose of awaiting analytical results from mobile laboratories prior to 200 Area transport. Interim storage may be considered for other purposes, such as to maintain operational efficiency if there is no other alternative. With the exception of uncontaminated material (type 7), interim storage shall:

- Be fully contained to minimize potential for contamination spread
- Not produce new contaminated areas
- Minimize double handling of waste materials.

3.4.2 Demolition Requirements

The demolition system shall be capable of demolishing all man-made structures, including pipelines, within the scope of the project (Section 1.3) and size reducing the demolition debris sufficient to meet waste transport requirements. Demolition systems will also be required to size reduce large objects excavated from the burial grounds.

The structures consist of concrete structures, steel tanks, buried vertical culvert pipe and concrete/steel pipelines. Descriptions of the structures are given in Section 1.4.3.

Demolition system design shall also consider:

- Transportability, i.e., ability to move from site to site

- Ability to convey waste forms to the transport system

- Flexibility for handling a wide variety of structural materials, waste forms, and hazards

- Minimization of fugitive dust.

The specific requirements for each type of structure are listed below.

3.4.2.1 Concrete Structures

The demolition system shall be:

- Capable of demolishing steel reinforced concrete slabs up to 5 ft thick in both vertical and horizontal configurations; separation of reinforcing-bar from concrete will not be required, however, concrete sections will require sufficient size reduction to accommodate transport

- Capable of operating both above and below grade.

3.4.2.2 Steel Tanks

The demolition system shall be capable of dismantling the two steel retention basins; steel plate shall be size reduced to accommodate transport and to minimize disposal volume.

3.4.2.3 Pipelines and Buried Culvert Pipe

The demolition system shall be:

- Capable of demolishing the pipe excavated from land or river pipeline systems including the effluent line valve boxes, man-ways, tie lines, junction boxes and river anchors

- Capable of demolishing the buried vertical culvert pipes used as solid waste disposal units

- Capable of size reducing steel pipe to accommodate transport and to minimize disposal volume.

3.4.2.4 Large Objects

The demolition system shall be capable of size reducing large pieces of equipment, such as milling machines, process tubes, control rods, process and steam piping, process vessels, valves, etc. These objects shall be size reduced by the demolition system to accommodate transport and disposal.

3.4.3 Waste Processing

Depending on the results of waste characterization (Section 3.1), all excavated materials and demolition debris shall be segregated into the seven material types described in Section 3.2.2. Additional segregation shall be provided for waste materials as follows:

- Compactible solid wastes
- Free liquids
- Intact drums
- Compressed gas cylinders
- Wastes containing organics above LDR limits
- Wastes containing inorganics above LDR limits.

For these materials, additional processing shall be provided as follows:

- Compactible solid wastes shall be volume reduced to minimize disposal volume

- Free liquids shall be destroyed, removed, or solidified to meet disposal requirements

- Intact drums shall be processed to determine contents, and if necessary, the contents shall be segregated by waste type and combined with bulk wastes of the same type
- Compressed gas cylinders shall be depressurized and the gases treated to meet disposal requirements
- Wastes containing organic contaminants whose concentrations exceed LDR limits shall be processed to meet the requirements specified in Section 3.2.2
- Wastes containing inorganic contaminants whose concentrations exceed LDR limits shall not be processed in the 100-B/C Area system, but shall be transported to the 200 Area for handling.

3.4.4 Material Transport

All waste material contaminated above the cleanup criteria (Section 3.2) shall be transported to the 200 Area disposal site (approximately 10 mi one way). The transportation system shall:

- Comply with DOE Order 5480.3 and DOE Notice N 5480.3, "Safety Requirements for Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes"
- Minimize the generation of secondary waste
- Minimize the release of contaminated waste to the environment while the waste is in transport.

If waste containerization is necessary, containerization systems shall be compatible with the mode of transport and shall meet the functional design criteria of the disposal site. The design shall consider standardization of packages and/or transport containers.

Design of the transport system shall consider utilization, to the extent possible, of the existing Hanford transportation infrastructure.

3.5 SITE RESTORATION

The 100-B/C Area will be restored after cleanup to a condition that is consistent with the future intended use and is protective of the environment. It shall be assumed that the land will be restored for industrial use. The excavation shall be backfilled to the extent possible using the available uncontaminated soil overburden, stockpiled during excavation operations, and using additional imported soil from outside the excavation area (if needed). The design shall perform an economic analysis that considers recontouring versus backfilling. The backfilled and/or recontoured excavations shall be compacted to prevent substantial subsidence. Topsoil shall be imported and applied over backfilled/recontoured excavations as necessary to support natural vegetation growth. If necessary to reduce erosion potential, the design shall consider revegetation over all disturbed areas. Selection of vegetation species shall be compatible with natural vegetation in the area.

3.6 DUST CONTROL

The design shall provide dust suppression and control systems for control of fugitive dust generated during excavation and demolition operations. Dust control systems shall:

- Control the spread of contamination outside of the excavation area, to the extent possible
- Provide protection of onsite workers to meet ALARA principles
- Be portable or transportable
- Contain no hazardous materials
- Minimize generation of other secondary wastes
- Minimize mobilization of contaminants to the groundwater to the extent possible
- Not interfere with waste characterization.

The design shall consider both passive and active dust suppression systems. Passive dust control systems include inherent design features in excavation and material handling equipment, and wind screens. Active systems include water and chemical sprays and fixants.

Provisions shall be made to stabilize any surficial contamination remaining at the end of a work shift. Stabilization shall meet the same requirements as dust suppression.

3.7 SUPPORT SERVICES

Support services shall be provided for personnel associated with the project. Numbers of personnel shall be determined as part of the design effort based on the specifications of specific systems and activities. Support service requirements are listed as follows:

- Office space for operations support personnel, as required
- Men's and women's rest rooms and change rooms with Special Work Permit clothing areas separate from personal clothing areas; the design shall assume 70% men and 30% women.
- A personnel decontamination area
- Special Work Permit and non-regulated (soiled and clean) clothing receiving, storage, and loadout areas
- General storage areas including facilities for receipt, storage, and movement of all required operating supplies.
- Equipment for receipt, storage, makeup, and disposal of dry materials, process additives, and decontamination materials

- Parking lots, site stabilization, drainage, and lighting
- Equipment maintenance facilities.

3.8 DESIGN LIFE

Design life of systems and system components shall be determined as part of the design effort. Although the specified duration of the field remediation activities is 6 yr, the optimum design life of components may be different and should be based on optimizing the tradeoffs between initial costs and replacement costs of competing designs. That is, it may be economically advantageous to replace some high wear items more frequently rather than attempting to design them for long life. If however, the design life is short, the systems or components should be readily replaceable.

Design life shall also consider that, upon completion of the 100-B/C prototype project, salvageable equipment and systems could be utilized in future Hanford Site remedial programs.

4.0 WEATHER ENCLOSURES

Optional weather enclosures shall be considered to facilitate continuation of excavation and demolition operations in adverse weather conditions such as wind. The need for enclosures was the subject of a Value Engineering Study conducted during the period March 2 through 6, 1992. Results of the study are documented in "Preliminary Value Engineering Study Report" (LATA 1992). The value engineering team conducted an analysis of the contaminated dust generation potential for both liquid and solid waste sites, and the expected resultant effects on both non-project related onsite staff and offsite individuals. The study concluded that excavation and material handling can be conducted in an open air environment without exceeding onsite or offsite regulatory limits. Although the study did not endorse the use of enclosures, it left the issue open for further evaluation as a design consideration. Therefore, for purposes of this functional design criteria, weather enclosures shall be considered for use in the 100-B/C prototype project based on further evaluation of their economic benefit. Specific functional and process criteria for weather enclosures are provided below.

4.1 FUNCTIONAL CRITERIA

The principal function of the weather enclosures shall be to allow continued operations during adverse weather conditions which would otherwise require suspension of operations; using a weather enclosure, operations would continue unless the severity of weather conditions exceeded the design limits of the enclosure, i.e., weather conditions became so severe as to compromise operational safety.

The use of the enclosure shall not increase the risk to onsite workers, to non-involved workers, or to the public. The enclosure shall be designed such that it is not a required component of the Materials Handling and

Analytical System, i.e., all such operations can be conducted safely and efficiently without the enclosure.

Additional functional criteria are specified as follows:

- The enclosure shall be transportable or movable from site to site; permanent buildings or structures requiring permanent foundations shall not be allowed

- The enclosure shall be transportable or movable within the excavation boundaries of a waste site, if the structure is not large enough to span the entire extent of the excavation

- All ancillary supports such as: foundations, anchors, and tracks shall be temporary and shall be designed for removal upon completion of excavation at a specific waste site

- The enclosure shall be free standing and compatible with all materials handling and analytical systems and components, including, but not limited to, provision for sufficient head space for excavation/demolition operations

- Use of the enclosure shall not cause unacceptable interference with material handling and analytical system operations

- Use of the enclosure shall not cause unacceptable delays in meeting the overall remediation schedule

- The enclosure shall be capable of safe operation up to the limits established as design basis climatic conditions (Section 4.2); it shall be assumed that climatic conditions exceeding the design basis would require cessation of operations and evacuation of personnel from the enclosure.

4.2 PROCESS CRITERIA

Enclosures would be exposed to the climatic conditions experienced at the 100-B/C Area of the Hanford Site, and therefore must be designed to meet the conditions described in Hanford Plant Standard SDC-5.1, Section C, "Outdoor Design Environment," for process structures and equipment. Operability of the system shall not be compromised by the full range of precipitation nor shall it be compromised by fluctuations of other meteorological conditions typical of Hanford's daily or seasonal cycles. Enclosure design shall consider all anticipated structural loadings as required by DOE Order 6430.1A, Section 0111, "Structural Design."

4.2.1 Heating, Ventilating, and Air Conditioning (HVAC)

Adequate ventilation shall be provided to protect workers operating within the enclosure. Ventilation design shall consider:

- Emissions of exhaust gases from fuel-powered vehicles or other motorized equipment
- Buildup of hydrocarbons or other flammable or explosive vapors or gases
- Fires
- Hazards associated with inhalation of contaminated particulates (dust) or toxic gases and vapors
- Maintaining oxygen levels within allowable limits.

Use of personnel protective equipment shall be considered as an alternative to enclosure ventilation for worker protection against the hazards listed previously.

Ventilation systems shall be transportable.

4.2.2 Electrical

The design shall consider the need to protect electrical and electronic equipment for enclosure-specific devices (including HVAC) to eliminate power surges, drop outs, lightning interferences, static electricity, or radio wave interferences. The following shall be considered:

- Power conditioning systems for enclosure-specific equipment and safety systems sensitive to power supply disruptions
- Installed spare wiring runs
- Separately routed instrument and power wiring, shielded where required.

4.2.3 Utility and Lighting Requirements

Electric power shall be provided as necessary to supply the enclosure ventilation system and any ancillary systems associated with the enclosure. General requirements for electric power supplies are specified in Section 5.4.

The design shall consider the use of lighting permanently mounted on enclosure structures. Portable lighting systems shall be considered as an alternative.

4.2.4 Fire Protection

See Section 5.7.4.

4.2.5 Decontamination, Decommissioning, and Future Utilization

During its use, a weather enclosure may become contaminated by hazardous and radioactive constituents. However, it is intended that the enclosures be available for continuous use at multiple sites during the life of the 100-B/C prototype project. At the end of the 100-B/C program, it is desirable that all enclosures be decontaminated for further utilization in follow-on remedial programs, unless such decontamination is not economically practical. If enclosures and/or their components cannot be economically decontaminated or salvaged, the contaminated components shall be disposed as waste material.

The enclosures shall be designed to facilitate decontamination. To achieve this objective, the design features specified in Section 5.3 shall be considered.

5.0 GENERAL REQUIREMENTS

5.1 COMMUNICATIONS

The project shall provide:

- Two-way communications systems for personnel working in or around the excavation or demolition areas
- Hands-free wireless communications for personnel using respiratory protection
- Emergency alarms
- Telephone service.

The design shall consider transmittal of data to and from the Hanford Local Area Network (HLAN).

5.2 ENVIRONMENTAL PROTECTION

This project shall be designed to minimize the impact on the environment in accordance with DOE Order 5400.1, "General Environmental Protection Program," DOE Order 5480.4, "Environmental, Safety, and Health Protection Standards," and other associated codes and standards.

5.3 DECONTAMINATION, DECOMMISSIONING, AND FUTURE UTILIZATION

Design of the systems and components that may become contaminated with radioactive or other hazardous materials shall incorporate measures to simplify decontamination. Such items as service piping shall be kept to a minimum and shall be arranged to facilitate decontamination. All equipment and systems in contact or potential contact with radioactive materials shall be designed with materials of construction that are resistant to decontamination solutions and processes.

The systems and components shall incorporate the following design features that aid in decontamination, decommissioning, and/or future utilization, wherever practical:

- Surfaces shall be designed to be easily flushed with a minimum quantity of water or decontamination solution
- Surface coatings shall be compatible with decontaminating agents
- Waterproofed penetrations shall be used to provide protection during spraying and hosing-type decontamination efforts
- Waterproofed fixtures and outlets with Ground Fault Circuit Interrupters
- Continually sloped piping systems to avoid pooling
- Physical provisions for cleaning and draining piping systems
- Construction materials resistant to hazardous materials, radiation, process solutions and decontamination agents. Those materials not resistant shall be nonabsorbent or easily replaceable.
- Skid mounted equipment or systems with fasteners, piping and service connections designed for easy access and manipulation
- Rigging and attachment points to facilitate removal of skids or equipment
- Piping and service connections designed for easy access.

Systems and components shall be finished with washable or strippable coverings, unless there is no alternative. To the extent possible, cracks, crevices, and joints shall be caulked, sealed, or finished smooth to prevent contaminated material accumulation in inaccessible areas. Finishes shall comply with Section 0900-99, Special Facilities, DOE Order 6430.1A. Upon completion of the project, the components that are salvageable shall be decontaminated and released for reuse or resale. All other equipment shall be processed and disposed as waste material.

5.4 UTILITY REQUIREMENTS

The project shall provide the following utilities:

- Sanitary (potable) water
- Raw (process) water for dust suppression, decontamination, etc., if required
- Fuel for equipment
- Electrical power
- Sanitary sewage disposal.

All utility systems shall be portable or transportable, to the extent possible. Installation of permanent systems shall be avoided unless there is no alternative. Tie-ins to existing utility systems, such as electrical service, are acceptable, although the design shall also consider the use of portable electric generation equipment for appropriate applications.

Electrical and electronic equipment shall be designed or protected as necessary to eliminate power surges, drop outs, lightning interferences, static electricity or radio wave interferences. Power conditioning systems shall be provided for all equipment and safety systems sensitive to power supply disruptions. Instrument and power wiring shall be routed separately and properly shielded where required. The electrical design shall consider the requirements of DOE 6430.1A, Section 16. Backup power shall be provided for all critical systems.

5.5 OPERATING AND MAINTENANCE REQUIREMENTS

The systems and equipment provided by this project shall be designed to minimize the exposure of operations and maintenance personnel to radioactive and hazardous substances. ALARA principles shall be a primary consideration in evaluating design options.

The design shall consider the use of equipment with enhanced access and ease of maintenance, as follows:

- Equipment with a proven industry service record
- Interchangeable, or readily available parts
- Access for visual inspection
- Access for disassembly
- Maintenance with standard tools
- Easy refueling without need to decontaminate equipment.

The design shall also specify preventive maintenance program requirements for the systems and equipment.

5.6 QUALITY ASSURANCE

Quality Assurance activities for all contractors involved in design, construction, and testing phases of the project shall be formulated and executed in accordance with the quality assurance plan (to be developed). The plan shall ensure:

- System is designed to meet the program requirements
- Prepared plans and specifications adequately cover quality assurance requirements
- Construction is performed in accordance with the design
- Testing is performed to confirm the adequacy of design, quality of construction, and quality of manufactured components.

Program requirements established in the quality assurance plan shall be consistent with DOE-RL Order 5700.6C, "Quality Assurance", which requires the use of appropriate American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance (NQA-1) requirements.

5.6.1 Project Documentation

Equipment, systems, and processes shall be designed using sound engineering and appropriate standards. Design work, including changes, shall incorporate applicable requirements and design bases. Design interfaces shall be identified and controlled. The adequacy of design products shall be verified or validated by independent organizations. Verification and validation work shall be completed before approval and implementation of the design.

5.6.2 Sampling and Analysis

Sampling and analysis of screening samples (analyzed in mobile laboratories) shall be consistent with Analytical Level II criteria defined in "Data Quality Objectives for Remedial Response Activities" (EPA 1987). Sampling and analysis for confirmation of screening analysis shall be consistent with Analytical Level III criteria for chemical analysis. Sampling and analysis for certification of site cleanup shall be consistent with Analytical Level IV. For constituents not covered by these protocols, other methods may be used but these methods shall be validated.

5.7 SAFETY AND SAFETY-RELATED EQUIPMENT

The project objective shall be that no single credible component failure shall result in unacceptable safety consequences. Unacceptable safety consequences are:

- Nuclear Criticality
- Explosion

- Fire (other than a localized minor fire such as might be caused by the shorting of electrical equipment)
- Exposure of personnel to ionizing radiation in excess of DOE Order 5480.11 limits
- Exposure of the public to radiation in excess of DOE Order 5400.5 limits
- Exposure of personnel to toxic chemical agents in excess of Threshold Limit Values established by the American Conference of Governmental Industrial Hygienists
- Instantaneous release of radioactivity (airborne or liquid) from the facility in excess of 5,000 times the limits specified in DOE Order 5400.5 measured at the point of discharge.

5.7.1 Safety Classes

Design of the Materials Handling and Analytical System shall include engineered features and systems to prevent release of contamination such that neither nonproject related onsite workers nor offsite individuals are exposed to contamination exceeding established allowable limits. Based on findings of the Value Engineering Study (LATA 1992), contamination releases resulting from simultaneous failure of these systems would not expose nonproject related workers and/or offsite individuals to radioactive, hazardous, or toxic material above established limits. Therefore, the Materials Handling and Analytical System is classified as a low-hazard nonreactor nuclear facility in accordance with the criteria of the "Nonreactor Facility Safety Analysis Manual" (WHC 1989).

The Materials Handling and Analytical System fits into the definition of a "nonreactor nuclear facility" only in a broad sense. Most of the requirements of DOE Order 6430.1A are written for design of a "facility," which is defined as "buildings or other structures..." The Material Handling and Analytical System consists primarily of mobile excavation equipment and transportable conveyance systems, and as such, is technically not a "facility." Therefore, many of the sections of the guidance criteria in DOE Order 6430.1A may not be applicable.

The following -99 sections of DOE Order 6430.1A are applicable to the design of nonreactor facilities:

- 0110-99.0 Architectural and Special Design Requirements
- 0111-99.0 Structural Design Requirements
- 0200-99.0 Site Development
- 0273-99.0 Water Pollution Controls
- 0275-99.0 Industrial Waste water Treatment
- 0285-99.0 Solid Waste Systems
- 0900-99.0 Finishes, General
- 1530-99.0 Fire Protection
- 1540-99.0 Plumbing/Service Piping
- 1550-99.0 Heating, Ventilating and Air Conditioning Systems
- 1589-99.0 Air Pollution Control

- 1660-99.0 Special Systems.

The design shall include a review of each -99 section to determine if it is applicable to the Material Handling and Analytical System and, if so, the applicable requirements shall be incorporated in the design.

Preliminary evaluation of the systems and components to be provided by this project has indicated there is no safety classification higher than safety class 3. The Facility Use Category for this project is "low."

The processes and systems provided by this project will continue to undergo evaluations for safety impacts during the subsequent design phases of the project. These evaluations will be documented in the Preliminary Safety Analysis Report and the Final Safety Analysis Report (Section 5.7.3).

5.7.2 Criticality

The waste materials to be excavated from the contaminated sites contain small amounts of fissile materials in such forms and concentrations that the occurrence of a nuclear criticality is highly unlikely. The need for criticality detection and alarm systems shall be a consideration during the design.

5.7.3 Safety Analysis

The Materials Handling and Analytical System shall be evaluated for potential risks to the operators, public, and the environment in accordance with DOE Order 5481.1B and 6430.1A, Section 0110-5.2.

5.7.4 Fire Protection

The design shall provide safety features capable of:

- Withstanding the Design Basis Fire in accordance with DOE requirements and allowable limits

- Protection of personnel from injury

- Continuation of operations by minimizing accident potential

- Limitation of loss or damage to property and personnel (DOE Order 5480.7).

The design shall comply with the following:

- DOE/EV-0043
- DOE 5480.4, Attachment 2, Section 2.C
- DOE 5480.7
- DOE 6430.1A, Section 1550, Fire Protection.

The design shall also comply with the requirements of regulations given in Title 29 of the Code of Federal Regulations (CFR), Part 1926, "Safety and

Health Regulations for Construction" and 29 CFR 1910 "Occupational Safety and Health Standards." Except as required by other sections of these criteria, National Fire Protection Association (NFPA), Part 101 "Life Safety Code" shall apply where 29 CFR 1926 and 29 CFR 1910 do not apply or where NFPA 101 exceeds the requirements of 29 CFR 1926 and 29 CFR 1910.

5.7.5 Hazardous Materials Control

The design shall incorporate features that provide safe handling, storage, usage, monitoring, recovery, and control of all hazardous materials and wastes. The design shall incorporate features that prevent the inadvertent mixing or release of hazardous materials that are potentially incompatible or could result in toxic or hazardous product and/or byproducts. Administrative controls shall be used to provide proper control of hazardous and toxic materials and to prevent releases where engineered barriers are not feasible.

5.7.6 Radiation and Contamination Control

All locations where personnel are expected to work that could potentially contain radioactive materials shall be continuously monitored for direct radiation (gamma/neutron) and airborne contamination (alpha/beta).

The design shall provide:

- Monitors for air sampling, dose rate, count rate, and permanent record of monitoring results
- Self-survey stations equipped with hand, foot, and body counters
- Fresh breathing air at all major process areas
- Shielding to prevent personnel radiation exposure from exceeding the limits specified in the "Radiation Protection" Manual (WHC 1991b) and to maintain all contamination exposure to ALARA (DOE/EV/1830-T5, "Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA))".

5.8 SECURITY AND SAFEGUARDS

Adequate security shall be provided to preclude unauthorized access and to protect government property. Security provisions shall comply with DOE Order 6430.1A.

6.0 GENERAL CRITERIA AND STANDARDS

Engineering and construction shall be in accordance with applicable sections of the following codes and standards. The latest edition of all codes and standards in effect at the start of design shall be used:

(a) DOE-RL Order 4700.1 "Project Management Systems"

(b) DOE-RL Order 5440.1A "Implementation of the National Environmental Policy Act at the Richland Operations Office"

(c) DOE-RL Order 5480.1B "Environmental Protection, Safety, and Health Protection Program for Richland Operations"

(d) DOE-RL Order 5480.4B "Environmental Protection, Safety, and Health Protection Standards for Richland Operations"

(e) DOE-RL Order 5480.5 "Safety of Nuclear Facilities"

(f) DOE-RL Order 5480.7A "Fire Protection"

(g) DOE-RL Order 5480.10A "Industrial Hygiene Program"

(h) DOE Order 5400.1, "General Environmental Protection Program"

(i) DOE Order 5400.5, "Radiation Protection of the Public and the Environment"

(j) DOE Order 5480.3, "Safety Requirements for Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes"

(k) DOE Notice N 5480.3, "Safety Requirements for Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes"

(l) DOE Order 5480.4, "Environmental Protection, Safety, and Health Protection Standards"

(m) DOE Order 5480.7, "Fire Protection"

(n) DOE Order 5480.11, "Radiation Protection for Occupational Workers"

(o) DOE Order 5481.1B, "Safety Analysis and Review System"

(p) DOE Order 5483.1A "Occupational Safety and Health Program for DOE Contractor Employees at Government-Owned Contractor-Operated Facilities"

(q) DOE Order 5635.1A "Control of Classified Documents and Information"

(r) DOE/EV-0043 "Standard on Fire Protection for Portable Structures"

(s) DOE-RL Order 5700.1A "Quality Assurance"

(t) DOE-RL Order 5700.3 "Cost Estimating, Analysis, and Cost Standardization"

(u) DOE-RL Order 5820.2A "Radioactive Waste Management"

(v) DOE Order 6430.1A "General Design Criteria"

(w) DOE-RL Order 6430.1C "Hanford Plant Standards/Specifications"

(x) DOE/EV-0043, "Standard on Fire Protection for Portable Structures"

(y) DOE/EV/1803-T5, "A Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA)"

(z) WHC-CM-1-3 "Management Requirements and Procedures"

(aa) WHC-CM-4-2 "Quality Assurance"

(ab) WHC-CM-4-3 "Industrial Safety Standards"

(ac) WHC-CM-4-9 "Radiological Design"

(ad) WHC-CM-4-10 "Radiation Protection"

(ae) WHC-CM-4-11 "ALARA Protection Program"

(af) WHC-CM-4-29 "Nuclear Criticality Safety"

(ag) WHC-CM-4-46 "Non-reactor Facility Safety Analysis"

(ah) WHC-CM-6-1, "Standard Engineering Practices"

(ai) WHC-CM-7-5 "Environmental Compliance Manual"

(aj) Hanford A/E Standards - The interfacing of this project with other Hanford projects, facilities, and operations can best be accomplished by use of Hanford A/E Standards. Where such interfacing is required, these standards shall be followed. Where "national consensus" codes are more applicable, they shall be used. Hanford A/E Standards shall be used as guides and other Hanford Plant Standards shall be used as reference. Pertinent Hanford Standards are listed as follows:

SDC 1.1 "Functional Design Criteria, Specifications, Acceptance Test Procedures and Certified Vendor Information Files"

SDC 1.2 "Hanford Plant Standards and National Codes and Standards"

SDC 1.3 "Preparation and Control of Engineering and Architectural Drawings"

SDC 4.1 "Design Load for Structures"

SDC 5.1 "Standard Design Criteria for Heating, Ventilating and Air Conditioning"

(ak) American National Standards Institute (ANSI)
A58.1, "Minimum Design Loads for Buildings and other Structures"

(al) American Society of Mechanical Engineers (ASME)
ASME NQA-1 "Quality Assurance Program Requirements for Nuclear Facilities"

(am) Washington Administrative Code (WAC) Chapter 173-303, "Dangerous Waste Regulations"

(an) Resource Conservation and Recovery Act (RCRA); 40 CFR Parts 261-268

(ao) Comprehensive Environmental Response, Compensation and Liability Act (CERCLA); 40 CFR Part 300

(ap) Model Toxics Control Act (MTCA) Cleanup Regulations; WAC 173-340

(aq) 29 CFR 1910, Code of Federal Regulations, Title 29, Part 1910, Occupational Safety and Health Standards

(ar) 29 CFR 1926, Code of Federal Regulations, Title 29, Part 1926, Safety and Health Regulations for Construction.

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