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7. Abstract

Westinghouse Hanford Company is investigating alternative means to pretreat the wastes in the Hanford radioactive waste storage tanks. Alternatives include (but are not limited to) in-tank pretreatment, use of above ground transportable compact processing units (CPU) located adjacent to a tank farm, and fixed processing facilities. This document provides the functions and requirements for a CPU to remove cesium from tank waste as a demonstration of the CPU concept. It is therefore identified as the Cesium Demonstration Unit (CDU).

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**FUNCTIONS AND REQUIREMENTS FOR THE
CESIUM DEMONSTRATION UNIT**

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WESTINGHOUSE HANFORD COMPANY

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for the
U.S. DEPARTMENT OF ENERGY,
RICHLAND OPERATIONS OFFICE
RICHLAND, WASHINGTON

**FUNCTIONS AND REQUIREMENTS FOR THE
CESIUM DEMONSTRATION UNIT**

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FUNCTIONS AND REQUIREMENTS FOR THE CESIUM DEMONSTRATION UNIT

1.0 INTRODUCTION

This functions and requirements (F&R) document defines the top-level design criteria and requirements for the Cesium Demonstration Unit (CDU). This document incorporates references to the governing portions of the Code of Federal Regulations (CFR), U.S. Department of Energy (DOE) Orders, Washington Administrative Codes (WAC), Westinghouse Hanford Company (WHC) procedures, and other relevant codes and standards to be used in the design of the CDU.

The F&R is the cornerstone of the technical baseline, and is placed under formal configuration control. After the F&R is established, any modification to this document will require formal approval by the U.S. Department of Energy, Richland Operations Office (RL) through the engineering change control process.

The F&R provides technical requirements in the following categories: general, specific, safety, environmental, safeguards and security, and quality assurance. The general requirements are those that would apply to any liquid waste treatment facility at the Hanford Site. The specific requirements relate to the individual functions assigned to the CDU. The safety requirements, environmental requirements, safeguard and security requirements, and quality assurance requirements are considered both general and specific requirements. These requirements are taken from upper-tier requirements documents such as DOE Orders and WHC standards, federal and state laws, and safety requirements (nuclear, industrial, and environmental related).

The format for the F&R has been developed based on a letter from RL to WHC (Brown 1993). All lower-tier design requirements documents shall be based on the requirements established here and provide evidence of traceability back to these requirements.

1.1 JUSTIFICATION AND BASIS OF NEED

1.1.1 Renegotiated Tri-Party Agreement

The U.S. Environmental Protection Agency (Region X), Washington State Department of Ecology, and RL renegotiated the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1992), also known as the Tri-Party Agreement. The revised Agreement was approved and signed by all parties in January 1994 (Ecology et al. 1994). The revised Tri-Party Agreement modified the Tank Waste Remediation System (TWRS) which in turn modified the Pretreatment Program.

1.1.2 TWRS Functions and Requirements

The TWRS F&R document, DOE/RL-92-60, *Tank Waste Remediation System Functions and Requirements*, Rev. 1 (January 17, 1994 draft),* defines the Level 5 and 6 functions decomposed from TWRS Function 4.2.2.1, "Pretreat Waste." These functions serve as the functional basis of the Pretreatment Program and Initial Pretreatment Module (IPM) Project.

The CDU fulfills, in part, the following TWRS low-level waste (LLW) pretreatment functions.

<u>Number</u>	<u>Description</u>
4.2.2.1.1	Prepare Tank Waste Liquids and High-Level Waste (HLW) Solids
4.2.2.1.2.1	Collect and Route Supernates
4.2.2.1.2.2	Remove Radionuclides from Alkaline Liquid
4.2.2.1.2.5	Accumulate and Transfer Separated Radionuclides
4.2.2.1.2.6	Support LLW Pretreatment Processes

The compact processing unit (CPU) concept (as described in Section 1.2) is being considered as a facility concept for the IPM. Industrial/commercial experience with the CPU concept is limited to commercial nonradioactive and low-activity radioactive processing. The cesium ion-exchange process has been selected to demonstrate the CPU concept. This demonstration is known as the CDU.

1.2 PROJECT DESCRIPTION

The CDU will demonstrate the CPU facility concept and its viability for application to full-scale LLW pretreatment. The CDU will provide an early demonstration of pretreatment of supernate stored in the Hanford Site double-shell tanks for future immobilization.

The CDU will be capable of exploring key pretreatment issues such as solid/liquid separation, organic fouling of ion-exchange resin, ion-exchange column configuration, ion-exchange material selection, etc. Early examination of these issues will reduce overall technical and cost risks in designing and constructing the LLW pretreatment facility.

Equipment and maintenance concepts that are new to the Hanford Site will be used in the CDU. The CDU will provide operating and maintenance experience with these new concepts that will be applicable to the LLW pretreatment facility.

*Approval of this F&R document by RL does not approve or imply approval of the January 17, 1994, draft of DOE/RL-92-60, Rev. 1. Subsequent approval of the document by RL may require a modification of this F&R document.

Operation of the CDU will be initiated in such a time that design, construction, operations, and maintenance experience with the CDU will support the design and construction of the LLW pretreatment facility.

1.2.1 CDU Capabilities

The CDU will have the following capabilities.

- Demonstrate a deployable facility concept.
- Separate solids from the feed stream.
- Remove cesium to a high DF (DF = 1,000 to 10,000).
- Collect and transfer HLW and LLW streams.
- Test various ion-exchange resins for removal of cesium (elutable and nonelutable resins).

Recommendations on throughput rate, feed DFs, and waste tank selection for the CDU demonstration have been provided to RL (Gasper 1994).

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2.0 GENERAL REQUIREMENTS

This section establishes the design requirements that would apply to any waste treatment facility at the Hanford Site. The requirements are taken primarily from upper-tier requirement documents such as DOE Orders and WHC standards.

2.1 GENERAL DESIGN REQUIREMENTS

The design shall be in accordance with radioactive waste management requirements identified in the relevant sections of DOE Orders 5820.2A, *Radioactive Waste Management* (DOE 1988a) and 6430.1A, *General Design Criteria* (DOE 1989).

1. The design shall satisfy facility design requirements identified in DOE Order 6430.1A, Section 1323.
2. The mechanical design shall be in accordance with DOE Order 6430.1A, Sections 0110-99.0 and 1300 and relevant sections of Divisions 10, 11, and 15.
3. The architectural and structural design shall be in accordance with DOE Order 6430.1A, Sections 0110 and 0111 and relevant sections of Divisions 2, 3, 4, 5, 6, 7, 8, and 9.
4. Design loads, load combinations, and acceptance criteria will be established in accordance with HPS-SDC-4.1, "Design Loads for Structures" (RL 1993a).
5. The fire protection design shall be in accordance with DOE Order 6430.1A, Sections 0110-6, 0110-99.0.6, 0200-99.8.4, 0727, 0800-1.2, 0800-2.2, 0900-2, 1052, 1530, 1161-3, 1670-2, and 1671-2; and with DOE RLIP 5480.7, *Fire Protection* (DOE-RL 1990).
6. The instrumentation and control design shall be in accordance with DOE Order 6430.1A, Sections 1300, 1595, and 1660-99.
7. Communication requirements shall comply, as applicable, with DOE Order 6430.1A, Sections 1670 and 1671.
8. The heating, ventilating, and air conditioning designs shall be in accordance with DOE Order 6430.1A, Sections 1161 and 1550, and the relevant sections of Division 11; and with DOE RLIP 5480.7, Section 7.
9. The electrical design shall be in accordance with DOE Order 6430.1A, Sections 1605, 1630, 1639, 1640, 1650, 1655, 1660, 1685, and 1694.
10. The human factors design shall be in accordance with DOE Order 6430.1A, Section 1300-12.4.

11. The lighting design shall be in accordance with DOE Order 6430.1A, Sections 1650 and 1655.
12. The facilities layout shall be in accordance with DOE Order 6430.1A, Sections 0110-8, -11, -99.0, and 1300-11.1.
13. The designs shall be in accordance with the decommissioning requirements of DOE Order 6430.1A, Section 1300-11.2; DOE Order 5820.2A, Chapter 5; and WAC 173-303-610.
14. The process design shall be in accordance with the testing requirements of DOE Order 6430.1A, Section 1300-3.6.
15. The radiation and effluent monitoring design shall be in accordance with 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants (NESHAP);" DOE Order 6430.1A, Sections 1300-1.4.4, -6.5, and -9; and DOE Orders 5400.5, *Radiation Protection of the Public and the Environment* (DOE 1990); 5480.11, *Radiation Protection for Occupational Workers* (DOE 1988b); and 5820.2A, Chapter 1; and DOE RLIP 5480.11, *Radiation Protection for Occupational Workers* (DOE-RL 1991a).
16. The government-furnished equipment and long-lead equipment requirements shall be described in the conceptual design criteria and/or project design criteria.
17. Lifting, rigging, operations, and maintenance requirements shall be in accordance with DOE/RL-92-36, *Hanford Site Hoisting and Rigging Manual*, January 15, 1993 (RL 1993b).
18. The construction requirements shall be described in the conceptual design criteria and/or project design criteria.
19. The facility design shall be in accordance with the energy conservation requirements given in DOE Order 6430.1A, Section 0110-12.
20. The design shall be maintainable in accordance with DOE Order 6430.1A, Section 1300-3.5.
21. The process design shall be in accordance with the operability requirements of DOE Order 6430.1A, Sections 0110-3, -4, and -9.

2.2 INTERFACE PERFORMANCE REQUIREMENTS

The requirements for interface performance are as follows.

1. Outgoing streams to tank farms shall conform to OSD-T-151-00007, *Unclassified Operating Specifications for the 241-AN, AP, AW, AY, AZ and SY Tank Farms* (Godfrey et al. 1992).
2. Incoming waste streams shall be from tank farm waste tanks.

3. The CDU design shall include provisions for transported items to be packaged in accordance with WHC-CM-2-14, *Hazardous Materials Packaging and Shipping*; 10 CFR 71.51, "Additional Requirements for Type B Packages;" and WHC-EP-0063-4, *Hanford Site Radioactive Solid Waste Acceptance Criteria* (Willis et al. 1991).

2.3 GENERAL UTILITY REQUIREMENTS

The general utility requirements are as follows.

1. Facilities and services shall be designed for year-round operations, as specified in HPS-SDC-5.1, "Heating, Ventilating, and Air Conditioning" (DOE-RL 1979).
2. The design of underground utilities shall be in accordance with DOE Order 6430.1A, Sections 0203, 0260, 0262, and 0266.
3. Existing site utilities shall be used to the maximum extent practicable.

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3.0 SPECIFIC CRITERIA/REQUIREMENTS

This section establishes design requirements that are unique to the CDU Project. These requirements are derived from the functional analysis of the CDU mission statement.

3.1 PRODUCT REQUIREMENTS

The following product requirements apply to the CDU Project.

1. The CDU shall be capable of processing supernatant tank waste at a steady-state flow rate of 0.3 L/s (5 gal/min). To meet this requirement, the goal of the CDU is to demonstrate flow rates in the range of 0.06 to 0.6 L/s (1 to 10 gal/min).
2. The CDU will achieve cesium DFs in the range of 1,000 to 10,000.
3. The initial CDU process design shall be based on the feed composition given in Tables 3-1 and 3-2 and have the capability to adapt to a wide variety of tank wastes. The sensitivity of the process to variations in this feed composition shall be addressed as the design is developed.
4. The CDU product stream shall have a transuranic concentration less than 20 Nci/g at 5 M sodium.

3.2 PROCESS DESIGN REQUIREMENTS

The following process design requirements apply to the CDU Project.

1. The CDU shall provide for the receipt of tank farm supernate.
2. The CDU shall provide the capability to connect with future modules.
3. The CDU shall accommodate LLW and HLW product transfer.
4. The CDU shall accommodate LLW and HLW resin product transfer.
5. The CDU design shall include the provisions required for eluting or noneluting resins.
6. The CDU shall provide the capability to preferentially measure process parameters in situ with provisions to collect process samples of the product streams for external analysis.
7. The CDU shall have ion-exchange columns that are capable of being operated in various arrangements and configurations.
8. The CDU shall be designed to accommodate and test various ion-exchange media.

Table 3-1. Chemical Composition of Tank 241-AW-101.*

Constituent	Average concentration	Constituent	Average concentration
Aluminum	1.03 E+00 <u>M</u>	Sodium	1.00 E+01 <u>M</u>
Arsenic	<1.33 E-07 <u>M</u>	Titanium	<9.88 E-05 <u>M</u>
Barium	<6.80 E-05 <u>M</u>	Uranium	9.39 E-04 <u>M</u>
Bismuth	<5.79 E-04 <u>M</u>	Zinc	<4.84 E-03 <u>M</u>
Cadmium	<1.08 E-05 <u>M</u>	Zirconium	<5.54 E-04 <u>M</u>
Calcium	8.26 E-04 <u>M</u>	Ammonia	1.45 E-02 <u>M</u>
Chromium	3.08 E-03 <u>M</u>	Carbonate	2.05 E-01 <u>M</u>
Copper	<3.81 E-04 <u>M</u>	Chloride	1.46 E-01 <u>M</u>
Iron	<7.86 E-04 <u>M</u>	Cyanide	1.03 E-03 <u>M</u>
Lead	<1.46 E-03 <u>M</u>	Hydroxide	5.07 E+00 <u>M</u>
Magnesium	2.15 E-03 <u>M</u>	Fluoride	<4.02 E-03 <u>M</u>
Manganese	4.76 E-04 <u>M</u>	Nitrite	2.19 E+00 <u>M</u>
Mercury	<1.57 E-01 mg/L	Nitrate	3.46 E+00 <u>M</u>
Molybdenum	6.00 E-04 <u>M</u>	Phosphate	2.22 E-02 <u>M</u>
Potassium	1.07 E+00 <u>M</u>	Sulfate	1.07 E-02 <u>M</u>
Selenium	4.20 E-07 <u>M</u>	Total organic carbon	2.46 E+00 g/L
Silicon	<4.36 E-03 <u>M</u>	Water	4.36 E+01 wt%
Silver	<3.10 E-04 <u>M</u>	Density	1.56 E+00 g/cm ³

*Source: *Grout Treatment Facilities Waste Feed Projection*, WHC-SD-WM-TI-528, Rev. 0, Westinghouse Hanford Company, Richland, Washington, 1993.

9. The CDU shall be designed for a minimum full-capacity plant availability of 50%. Downtime required for modifying the CDU for different operating setups (e.g., resin-type changes, feeds, and other parameters) need not be considered in meeting this requirement.
10. The CDU operations requirements shall be described in the conceptual design criteria and/or project design criteria.
11. Design of the CDU facility and equipment shall be based on a 10-year design life except for those systems necessary for safe shutdown before decontamination and decommissioning.

Table 3-2. Cesium Demonstration Unit Input Source Terms
Radionuclide Composition of Tank 241-AW-101.*

Constituent	Average concentration	Constituent	Average concentration
H-3	2.23 E-5 Ci/gal	I-129	1.15 E-6 Ci/gal
C-14	1.40 E-6 Ci/gal	Cs-134	1.97 E-03 Ci/gal
Co-60	7.34 E-5 Ci/gal	Cs-137	1.83 E+00 Ci/gal
Se-79	1.82 E-6 Ci/gal	Np-237	8.18 E-06 Ci/gal
Sr/Y-90	3.82 E-3 Ci/gal	Pu-239/240	4.31 E-06 Ci/gal
Nb-94	2.58 E-04 Ci/gal	Am-241	4.54 E-06 Ci/gal
Tc-99	5.75 E-4 Ci/gal	Cm-243/244	1.87 E-07 Ci/gal
Ru/Rh-106	1.58 E-3 Ci/gal	--	--

*Source: *Grout Treatment Facilities Waste Feed Projection*, WHC-SD-WM-TI-528, Rev. 0, Westinghouse Hanford Company, Richland, Washington, 1993.

NOTE: 1 Ci/gal = 0.624 Ci/L

3.3 SPECIFIC DESIGN REQUIREMENTS

The following specific design requirements apply to the CDU Project.

1. The process module(s) of the CDU shall be capable of being cold tested in a testing facility.
2. The CDU shall be designed for offsite modular construction.
3. Normal process operations shall be performed from a central process control unit.
4. Key process parameters shall be monitored and alarms and interlocks provided as appropriate.
5. A manually initiated emergency shutdown system shall be provided. The need for an automatic emergency shutdown system will be assessed during the conceptual design phase.

3.4 SITE CHARACTERISTICS

The site characteristics shall be described in the conceptual design criteria and/or project design criteria.

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4.0 SAFETY REQUIREMENTS

This section establishes the design requirements necessary to ensure safe operation of a waste treatment facility at the Hanford Site. The requirements are taken primarily from upper-tier requirement documents such as DOE Orders and WHC standards.

4.1 GENERAL

4.1.1 Abnormal Operation

1. The facility design shall include provisions to monitor, alarm, and interlock as appropriate on detection of abnormal conditions in accordance with DOE Order 6430.1A, Section 1300-12.4.8.
2. The facility shall be designed to ensure safe channeling of energy and material flows (e.g., rupture discs, seal pots, fault-to-ground electrical circuitry, and siphon breakers) in accordance with DOE Order 6430.1A, Section 1323-5.1.

4.1.2 Design Basis Accidents

The facility shall be designed to withstand the effects of design basis accidents in accordance with DOE Order 6430.1A, Section 1300.

4.1.3 Safety Class-Related Design/Analysis Criteria

1. The application of design/analysis criteria shall be based on safety classification. Structures, systems, and components shall be classified and designed in accordance with DOE Order 6430.1A; WHC-CM-6-1, *Standard Engineering Practices*, EP-1.4, "Safety Classification;" and WHC-CM-1-3, *Management Requirements and Procedures*, MRP 5.46, "Safety Classification of Systems, Components, and Structures."
2. The preliminary safety evaluation shall be in accordance with DOE RLIP 4700.1A, *Project Management System* (DOE-RL 1991b). The safety analysis results from the preliminary safety evaluation shall be consistent with the design.

4.1.4 Hazards Classification and Hazardous Material

1. The facility design shall include provisions required for handling hazardous materials as identified in DOE Order 5480.3, *Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes* (DOE 1985).

2. The justification for use of any hazardous material (as defined by WAC 173-303) shall be approved by the Operations and Maintenance Contractor before hazardous materials usage is incorporated into the design.

4.2 CRITICALITY SAFETY

The criticality safety design shall be in accordance with WHC-CM-4-29, *Nuclear Criticality Safety*.

4.3 RADIATION PROTECTION

1. The shielding design shall be in accordance with the radiation protection requirements of DOE Order 6430.1A, Section 1300-6.2; and WHC-CM-1-6, *Radio'logical Control Manual*. For guidance, WHC-CM-4-9, *Radiological Design*, shall be used.
2. The facility design shall include provisions required for the application of the health physics requirements contained in DOE Order 5480.11; WHC-CM-1-6; and WHC-CM-4-11, *ALARA Program Manual*.

4.4 INDUSTRIAL SAFETY

1. The facility shall be designed in accordance with the industrial safety requirements of WHC-CM-4-3, *Industrial Safety Manual*.
2. The facility shall implement the safety features and requirements of WHC-CM-1-3, MRP 5.46, based on the preliminary safety classes established during conceptual design.

4.5 FIRE PROTECTION

1. The fire protection system shall be designed in accordance with DOE Orders 5480.4, *Environmental Protection, Safety, and Health Protection Standards* (DOE 1984); 5480.7A, *Fire Protection* (DOE 1993); DOE RLIP 5480.4C, *Environmental Protection, Safety, and Health Protection Standards for RL* (DOE-RL 1992); DOE RLIP 5480.7; WHC-CM-4-41, *Fire Protection Program Manual*; the National Fire Protection Association (NFPA) National Fire Codes (including NFPA 101-1988, *Life Safety Code* [NFPA 1988] and NFPA 241-1993, *Safeguarding Construction, Alteration, and Demolition Operations* [NFPA 1993]); and the Uniform Fire Code to the extent that it is implemented by WAC 173-303.
2. The design for the fire protection and detection system shall comply with the requirements of DOE Order 6430.1A, Sections 1530-3, -4, -5, -6, -7, -8, -9, and -99.0; Sections 1670-1, -2, -3; and Section 1671-2.

4.6 TRAFFIC SAFETY

Vehicular and pedestrian traffic circulation shall be in accordance with DOE Order 6430.1A, Section 0281.

4.7 EMERGENCY PLANNING

The facility shall be designed to support and facilitate emergency activities.

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5.0 ENVIRONMENTAL REQUIREMENTS

This section establishes the design requirements necessary for environmental compliance at the Hanford Site. The requirements are taken primarily from upper-tier requirement documents such as DOE Orders, CFRs, and WACs.

5.1 REGULATORY COMPLIANCE

1. The facility design shall comply with the requirements of DOE Order 5820.2A; 40 CFR 260, "Hazardous Waste Management System: General;" 40 CFR 261, "Identification and Listing of Hazardous Waste;" 40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities;" 40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities;" and 10 CFR 1021, "National Environmental Policy Act (NEPA)."
2. New construction items shall be designed in accordance with the *Resource Conservation and Recovery Act of 1976* requirements defined in WAC 173-303.
3. Upgrades to existing systems or portions of existing systems, which may be necessary to bring such systems into compliance, are beyond the scope of this project.

5.2 ENVIRONMENTAL RELEASES

1. Releases of radioactive material and nonradiological hazardous material shall not exceed the criteria given in WHC-CM-7-5, *Environmental Compliance*, and shall be in compliance with WAC 173-303.
2. Portions of the facility that provide confinement for radioactive contamination shall be ventilated and exhausted in accordance with the requirements of WHC-CM-4-9; WAC 173-460, "Controls for New Sources of Toxic Air Pollutants;" and WAC 246-247, "Radiation Protection - Air Emissions."
3. Radionuclide monitoring systems shall be in accordance with the requirements of 40 CFR 61, Appendix A, and DOE Order 5400.5.

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6.0 SAFEGUARDS AND SECURITY REQUIREMENTS

This section establishes design security requirements for a waste treatment facility at the Hanford Site. The requirements are taken primarily from DOE Orders.

6.1 SECURITY

Physical protection of the facilities shall comply with DOE Order 6430.1A, Section 0283 and DOE Order 5632.6, *Physical Protection of DOE Property and Unclassified Facilities* (DOE 1988c).

6.2 SAFEGUARDS

Safeguard requirements shall be evaluated and included in the conceptual design criteria and/or project design criteria.

6.3 ACCESS AND ADMINISTRATIVE CONTROLS

Site fencing shall comply with DOE Order 6430.1A, Sections 0280-1 and 0283-3.

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7.0 QUALITY ASSURANCE REQUIREMENTS

This section establishes design quality assurance requirements for a waste treatment facility at the Hanford Site. The requirements are taken primarily from upper-tier requirement documents such as DOE Orders and WHC standards.

7.1 QUALITY ASSURANCE PROGRAM

1. The Quality Assurance Program shall ensure compliance with applicable provisions of DOE Order 5700.6C, *Quality Assurance* (DOE 1991) and ASME NQA-1-1989, *Quality Assurance Program Requirements for Nuclear Facilities* (ASME 1989) (current addenda) for all safety class items.
2. A graded approach may be used to apply the Quality Assurance Program requirements in accordance with WHC-CM-1-3, MRP 5.46.

7.2 GRADED QUALITY ASSURANCE PROGRAM

1. Design activities shall be conducted under the applicable quality assurance requirements as presented in the specific project-related Quality Assurance Program plans and the implementing project procedures and instructions.
2. Quality Assurance Program requirements and procedural control shall be selectively applied. The selective application and the degree of application assigned to structures, systems, and components shall be commensurate with their function in preventing or mitigating the consequences of hazard and postulated design basis accidents.
3. The selective application of the Quality Assurance Program requirements shall be determined based on the safety class designation.

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8.0 CODES AND STANDARDS

8.1 CODE OF FEDERAL REGULATIONS

- 10 CFR 71, "Additional Requirements for Type B Packages," *Code of Federal Regulations*, as amended.
- 10 CFR 1021, "National Environmental Policy Act (NEPA)," *Code of Federal Regulations*, as amended.
- 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants (NESHAP)," *Code of Federal Regulations*, as amended.
- 40 CFR 260, "Hazardous Waste Management System: General," *Code of Federal Regulations*, as amended.
- 40 CFR 261, "Identification and Listing of Hazardous Waste," *Code of Federal Regulations*, as amended.
- 40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*, as amended.
- 40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*, as amended.

8.2 U.S. DEPARTMENT OF ENERGY-HEADQUARTERS

- DOE, 1984, *Environmental Protection, Safety, and Health Protection Standards*, DOE Order 5480.4, U.S. Department of Energy, Washington, D.C.
- DOE, 1985, *Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes*, DOE Order 5480.3, U.S. Department of Energy, Washington, D.C.
- DOE, 1988a, *Radioactive Waste Management*, DOE Order 5820.2A, U.S. Department of Energy, Washington, D.C.
- DOE, 1988b, *Radiation Protection for Occupational Workers*, DOE Order 5480.11, U.S. Department of Energy, Washington, D.C.
- DOE, 1988c, *Physical Protection of DOE Property and Unclassified Facilities*, DOE Order 5632.6, U.S. Department of Energy, Washington, D.C.
- DOE, 1989, *General Design Criteria*, DOE Order 6430.1A, U.S. Department of Energy, Washington, D.C.
- DOE, 1990, *Radiation Protection of the Public and the Environment*, DOE Order 5400.5, U.S. Department of Energy, Washington, D.C.

- DOE, 1991, *Quality Assurance*, DOE Order 5700.6C, U.S. Department of Energy, Washington, D.C.
- DOE, 1993, *Fire Protection*, DOE Order 5480.7A, U.S. Department of Energy, Washington, D.C.

8.3 U.S. DEPARTMENT OF ENERGY, RICHLAND OPERATIONS OFFICE

8.3.1 Orders

- DOE-RL, 1990, *Fire Protection*, DOE RLIP 5480.7, U.S. Department of Energy-Richland Operations Office, Richland, Washington.
- DOE-RL, 1991a, *Radiation Protection for Occupational Workers*, DOE RLIP 5480.11, U.S. Department of Energy-Richland Operations Office, Richland, Washington.
- DOE-RL, 1991b, *Project Management System*, DOE RLIP 4700.1A, U.S. Department of Energy-Richland Operations Office, Richland, Washington.
- DOE-RL, 1992, *Environmental Protection, Safety, and Health Protection Standards for RL*, DOE RLIP 5480.4C, U.S. Department of Energy-Richland Operations Office, Richland, Washington.

8.3.2 Hanford Plant Standards

- DOE-RL, 1979, "Heating, Ventilating, and Air Conditioning," HPS-SDC-5.1, Rev. 6, *Hanford Plant Standards*, U.S. Department of Energy-Richland Operations Office, Richland, Washington.
- RL, 1993a, "Design Loads for Structures," HPS-SDC-4.1, Rev. 12, *Hanford Plant Standards*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

8.3.3 Documents

- RL, 1993b, *Hanford Site Hoisting and Rigging Manual*, January 15, 1993, DOE/RL-92-36, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

8.4 FEDERAL, STATE, AND LOCAL LAWS, REGULATIONS, AND GUIDELINES

- Ecology, EPA, and DOE, 1992, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

Ecology, EPA, and DOE, 1994, *Hanford Federal Facility Agreement and Consent Order*, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, Olympia, Washington.

WAC 173-460, "Controls for New Sources of Toxic Air Pollutants," *Washington Administrative Code*, Olympia, Washington.

WAC 246-247, "Radiation Protection--Air Emissions," *Washington Administrative Code*, Olympia, Washington.

8.5 NATIONAL CONSENSUS CODES AND STANDARDS

ASME, 1989, *Quality Assurance Program Requirements for Nuclear Facilities*, ASME NQA-1-1989, American Society of Mechanical Engineers, New York, New York.

NFPA, 1988, *Life Safety Code*, NFPA 101-1988, National Fire Protection Association, Quincy, Massachusetts.

NFPA, 1993, *Safeguarding Construction, Alteration, and Demolition Operations*, NFPA 241-1993, National Fire Protection Association, Quincy, Massachusetts.

8.6 WHC STANDARDS

WHC-CM-1-3, *Management Requirements and Procedures*, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-1-6, *Radiological Control Manual*, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-2-14, *Hazardous Materials Packaging and Shipping*, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-4-3, *Industrial Safety Manual*, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-4-9, *Radiological Design*, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-4-11, *ALARA Program Manual*, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-4-29, *Nuclear Criticality Safety*, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-4-41, *Fire Protection Program Manual*, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-6-1, *Standard Engineering Practices*, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-7-5, *Environmental Compliance*, Westinghouse Hanford Company, Richland, Washington.

Willis, N. P., and G. C. Triner, 1991, *Hanford Site Radioactive Solid Waste Acceptance Criteria*, WHC-EP-0063-4, Westinghouse Hanford Company, Richland, Washington.

8.7 OTHER

Brown, R. W., 1993, "Project W236B, Initial Pretreatment Module (IPM) Baseline Documentation," Letter to President, Westinghouse Hanford Company, November 24, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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WHC, 1993, *Grout Treatment Facilities Waste Feed Projection*, WHC-SD-WM-TI-528, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

9.0 GLOSSARY

ACRONYMS AND ABBREVIATIONS

CDU	Cesium Demonstration Unit
CFR	Code of Federal Regulations
CPU	compact processing unit
DF	decontamination factor
DOE	U.S. Department of Energy
F&R	functions and requirements
HLW	high-level waste
IPM	Initial Pretreatment Module
LLW	low-level waste
NFPA	National Fire Protection Association
RL	U.S. Department of Energy, Richland Operations Office
TWRS	Tank Waste Remediation System
WAC	Washington Administrative Code
WHC	Westinghouse Hanford Company

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