SEP 28 1999 (21) Station 15

ENGINEERING DATA TRANSMITTAL

1. EDT 623410

2. To: (Receiving Organization) Distribution	3. From: (Originating Organization) Characterization Engineering	4. Related EDT No.: NA
5. Proj./Prog./Dept./Div.: Characterization	6. Design Authority/ Design Agent/Cog. Eng.: F.R. Reich	7. Purchase Order No.: NA
8. Originator Remarks: For approval		9. Equip./Component No.: NA
		10. System/Bldg./Facility: 200G
11. Receiver Remarks: 11A. Design Baseline Document? [] Yes [X] No		12. Major Assm. Dwg. No.: N/A
		13. Permit/Permit Application No.: NA
		14. Required Response Date: N/A

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Desig-nator	(G) Reason for Trans-mittal	(H) Origi-nator Dispo-sition	(I) Receiv-er Dispo-sition
1	HNF-4404	All	0	DESIGN COMPLIANCE MATRIX, WASTE SAMPLE CONTAINER FILLING SYSTEM FOR NESTED, FIXED-DEPTH SAMPLING SYSTEM	N/A	1	1	

16. KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 4. Review 2. Release 5. Post-Review 3. Information 6. Dist. (Receipt Acknow. Required)	1. Approved 4. Reviewed no/comment 2. Approved w/comment 5. Reviewed w/comment 3. Disapproved w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION
(See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name (K) Signature (L) Date (M) MSIN	(G) Reason	(H) Disp.	(J) Name (K) Signature (L) Date (M) MSIN
1	1	Char. Proj. Mgr. R.M. Boger 9/27/99 S7-12	1		Project Mgr. KA Gasper 9/28/99 H6-~~27~~
1	1	Design Authority GP Janicek 9/16/99 S7-12	1	1	Quality Assurance ~~DC Board~~ T.L. Caster 9-8-99 S7-03
1	1	Cog Eng. RG Brown 8/24 S7-12	1	1	Operations ~~WJ Kennedy~~ J.P. Sickels S7-03
1	1	Cog Mgr. JS Schofield 8/31/99 S7-12	1		Safety J.A. Ranschau 9/8/99 S7-07
1	1	Char. Project JL Smalley 8/24/99 S7-12	1		

18.	19.	20.	21. DOE APPROVAL (if required)
F.R. Reich FR Reich 6/30/99 Signature of EDT Originator Date	K.A. Gasper 9/28/99 K.A. Gasper Authorized Representative for Receiving Organization Date	G.P. Janicek 9/16/99 G.P. Janicek Design Authority/ Cognizant Manager Date	Ctrl. No. [] Approved [] Approved w/comments [] Disapproved w/comments

BD-7400-172-2 (05/96) GEF097

S

DESIGN COMPLIANCE MATRIX WASTE SAMPLE CONTAINER FILLING SYSTEM FOR NESTED, FIXED-DEPTH SAMPLING SYSTEM

R.M. Boger

Prepared for
Lockheed Martin Hanford Corporation, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: 623410 UC: 2070
Org Code: 74900 Charge Code: CACN/COA 108931/BA10
B&R Code: EW3120074 Total Pages: 26
KN

Key Words: Waste sampling, Design Compliance Matrix, LAW, HLW, RCRA sampling, Container filling system, design functions

Abstract:

This design compliance matrix document provides specific design related functional characteristics, constraints, and requirements for the container filling system that is part of the nested, fixed-depth sampling system. This document addresses performance, external interfaces, ALARA, Authorization Basis, environmental and design code requirements for the container filling system. The container filling system will interface with the waste stream from the fluidic pumping channels of the nested, fixed-depth sampling system and will fill containers with waste that meet the Resource Conservation and Recovery Act (RCRA) criteria for waste that contains volatile and semi-volatile organic materials. The specifications for the nested, fixed-depth sampling system are described in a Level 2 Specification document (HNF-3483, Rev. 1). The basis for this design compliance matrix document is the Tank Waste Remediation System (TWRS) desk instructions for design Compliance matrix documents (PI-CP-008-00, Rev. 0).

TRADEMARK DISCLAIMER. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

Printed in the United States of America. To obtain copies of this document, contact: Document Control Services, P.O. Box 950, Mailstop H6-08, Richland WA 99352, Phone (509) 372-2420; Fax (509) 376-4989.

Karen L. Noland 9/28/99
Release Approval Date

SEP 2 8 1999
DATE:
STA: 15
HANFORD RELEASE
ID: 21
Release Stamp

Approved for Public Release

DESIGN COMPLIANCE MATRIX -

WASTE SAMPLE CONTAINER FILLING SYSTEM

FOR

NESTED, FIXED-DEPTH SAMPLING SYSTEM

HNF-4404

REVISION 0

Prepared for Lockheed Martin Hanford Corporation
Characterization Engineering Group
Richland, Washington

by

F. R. REICH

COGEMA Engineering Corporation
Richland, Washington

June 1999

TABLE OF CONTENTS

TABLE OF FIGURES

LIST OF TABLES

APPENDIX

DESIGN COMPLIANCE MATRIX
WASTE SAMPLE CONTAINER FILLING SYSTEM
FOR
NESTED, FIXED-DEPTH SAMPLING SYSTEM

1.0 Introduction

The final disposal of Hanford's high level wastes (HLW) and low activity wastes (LAW) will be implemented with a privatization contract with BNFL, Inc. (BNFL) (Tank Waste Remediation System Privatization Contract DE-AC06-96RL13308, Mod. No. A006, 1996, U.S. Department of Energy (DOE), Richland, Washington, with BNFL, Inc.). A nested, fixed-depth sampling system (here in referred to as the sampling system) is being developed to provide waste samples that will be used to verify tank waste contents prior to transferring the waste to BNFL for pre-treatment and glassification (BNFL 1998a and BNFL 1998b). This sampling system will extract waste samples from 8 elevations in the tank and will fill and package sample containers for shipment with the Hanford Pig transportation system. The container system, addressed in this document, will interface with the sampling system waste stream and will be an integral part of the sampling system. The sampled waste will be used for validating waste properties as required by the privatization contract.

2.0 Purpose

This design compliance matrix document provides a comprehensive list of design related functions, requirements, and specifications for the container filling system that will be part of the sampling system. The basis for this document is a Tank Waste Remediation Systems (TWRS; in FY 2000 to be known as the River Protection Program (RPP) desk instruction (Janicek 1997). The function of the sample container filling system is to fill sample containers with representative waste (representative of the waste being delivered to it by the sampling system) that can meet Resource Conservation Recovery Act (RCRA) criteria for volatile and semi-volatile organic materials (SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods)*. The specifications for the sampling system are described in a Level 2 Specification document (Reich 1999).

3.0 Conceptual Sampling System

Figure 1 shows a conceptual sampling system deployed in a tank riser. The container filling system will interface with the waste steam from the fluidic based, sampling channels of the sampling system (located in the multi-port sampler module). The sample container filling system will be installed in the container filling chamber with piping that connects it to a valve manifold that is connected to the sampling channels. The valve manifold will allow waste from each of the 8 sampling channels (from 8 elevations in the tank) to be "pumped" into the container filling chamber. The excess tank waste flowing

through the sample filling system will be returned to the waste tank through the sampling system's waste return line.

Empty waste sample containers will be loaded into the container filling system via a special pass-through port. Manipulators will position the empty containers in the sample filling station. The sample filling station will connect the sample container with the waste flow stream. The sample container will be filled in a manner that is consistent with RCRA requirements for sampling materials that contain volatile and semi-volatile organics. After the container is filled, it will be sealed per RCRA volatile organic requirements. The filled sample container will then be washed with a water spray to decontaminate its outer surfaces. The mechanical hardware of the sample filling chamber will move the container into a pass-through chamber where it will be "handed-off" to a second manipulator. This manipulator will place it into the Steel Pig by passing it through a bagging station. The bag will be sealed and then the cover attached to the Steel Pig. The sample container will then be ready for transport. The sample materials will be transported to the 222S lab and to BNFL.

The sampling system that the container filling system is mounted in, and interfaced to, will provide any utility support needed for the operation of the container filling station (such as compressed air, water, and electrical power). These utilities will be obtained from the sampling system utility support modules. The sample container filling station control panel (if required) will be integrated into the sampling system's control panel module. Electrical power and flushing water will be provided by the sampling systems buffered power source and temperature controlled flushing water reservoir.

All sample system filling operations, including sample container handling, shall be manual operations, completed by an operator with remote manipulators and controls that penetrate through the walls of the sample filling chamber.

4.0 Design Requirements

Design requirements within the design compliance matrix (DCM) are divided into two logical parts: functional characteristics and constraints. To aid in the presentation of the results of the DCM, these parts are further divided using the guidance presented in the RPP administrative procedure, *Functional Requirements and Technical Criteria (WHC 1996a)*. To illustrate this division, the basic functional characteristics and constraints for the bottle filling system are presented in Table 1.

The functional characteristics describe the purpose of the equipment in terms of its required functions and external interfaces. The equipment must perform these functions while exposed to the environmental conditions listed in Section 5.4 below. The manipulator hardware of the container filling system that is external to the sealed chamber containing the filling hardware must survive the environmental conditions for components that are outside of the container filling system chamber. Hardware inside the container filling system chamber will make contact with waste and gas from the tank.

This hardware must be capable of handling the physical, chemical, and radioactive properties of the waste and gases generated in the waste.

The design is in compliance with the requirements if it performs the required functions within the constraints of the safety requirements, environmental regulations, design codes, and operational requirements imposed on it by the tank farms systems.

The design requirements contained herein are based on the criteria identified in the Level 2 Specification document and other River Protection Program (RPP) documentation. The Design Compliance Matrix, shown in Appendix B, lists all the requirements and design attributes for the container filling system.

5.0 Sample Filling Station Functions, Specifications, and Interfaces.

The detailed specifications for the container filling system are given below. The alternatives to the specifications listed below can be used, provided cost effectiveness is demonstrated and the alternatives maintain the safety, quality and performance levels. However, alternatives shall not be used or implemented unless they have been approved in writing by the PHMC.

5.1 Performance

It is essential that the waste sampling and container filling systems meet performance criteria/specifications if the sampling system is to provide waste samples for the BNFL privatization contract. The performance criteria include:

- Provide waste samples from the PHMC feed tanks to meet Phase 1 B privatization contract waste sampling needs for LAW and HLW wastes.
- The waste samples shall have physical, chemical, and radiological characteristics that are representative of the waste material being input to the container filling system from the fluidic pumps within +/- 5 % of the wastes mean values (within a 95% confidence level).
- The maximum waste sample cross-contamination from residual waste from a prior sample and from residual purging water shall be less than 0.5 % by volume.
- The performance criteria for the 500-mL container and for filling it include the following:
  - The sample container will be a single use, non-recycle container with a minimum waste fill volume of 500 ml, capable of handling the waste streams pressure and flow parameters.
  - The preferred time that is needed to transfer 500-ml of waste to a sample container after it is in the filling position is less 5 minutes.
  - Fill a total of 15 liters of waste, in 500-ml containers, within an 8-hour time period.

- The fill methods, sample container, and filled waste containers shall conform with the RCRA criteria for samples containing volatile and semi-volatile organic materials:

- Sample containers shall be completely filled at the time of sampling so that when the closed container is inverted, no headspace (air space) is visible.
- The sample containers shall be hermetically sealed before removal from the filling chamber. The sample containers shall not be opened prior to analysis to preserve their integrity.
- The container materials, including cap/sealing materials, shall not add trace organic or inorganic materials to the sample. Glass or metal containers with Teflon*gaskets, or Teflon lined silicone may be used. Plastic or rubber materials shall not be used for container materials that make contact with the tank waste that is inside the container.
- Liquids and solids shall be introduced into the containers in a manner that will not introduce gas bubbles into the sample waste. Agitation of the waste will be minimized to reduce the potential for driving off volatile waste constituents.

- The filling system shall have an operational lifetime of 20 years, with only minor repair and maintenance, or shall be designed with components that can easily be replaced.
  - A modular design will be used to facilitate maintenance, repair, and decommissioning.
  - It is preferred that all maintenance and repair be remote operations. However, maintenance and repair can be done in the field using glove bag systems.
  - The minimum time between required maintenance and repair actions shall be 60 days.

- The system shall recover and resume normal operation after a 24 hour, off-normal shutdown (emergency) where the system may become plugged with tank waste. The recovery from precipitation and/or settling based waste shall be completed in a 4-hr time period, without requiring special entry into the sampling chamber.
- The system shall recover, using remote methods, from a damaged or broken sample container and be capable of resuming normal filling operations. The recovery operation shall be completed without the need for special penetration into the sampling chamber.
- The piping, valves, etc. of the filling hardware shall be designed so that all surface areas that contact flowing tank waste are naturally flushed out with the flowing tank waste that is being returned to the waste tank.

5.2 External Interface

The major interfaces for the container filling hardware interfaces are critical for the integration and operation of the container filling system that will be located on the sampling system.

- Interface with the nested, fixed-depth sampling system.
  - Fill sample containers with waste supplied by the waste flow stream from the sampling system's fluidic pumping system. The flow stream properties include:

Teflon is a trademark of E. I. du Pont de Nemours & Co., Wilmington, DE. KN

  - 30 second (typical) flow pulse (can be shortened or lengthened by 25 to 30%)
  - Flow volume of 3 liters minimum during a single flow pulse
  - Waste pressures up to 120-psig.

- Interface with container handling hardware.
  - ♦ All operations (sample container movement, decontamination, capping, unplugging, capping etc.) shall be completed with simple, remote mechanical hardware that is manually operated from outside of the chamber.

- The alternatives for sample containers shall include the current Hanford "grab" sample bottle that is a glass bottle with the dimensions of 2.703 in. O.D. by 6.672 in. long - Owens-Brockway bottle C-7651 (drawing FR-16990-A-2. These dimensions do not include the wide-mouth screw cap.) with a potentially modified cap.
- The filled sample container, including the sealed, plastic over-bag (for contamination control), shall fit within the dimensional limits (3.38 in ID x 7.5 in long) of the Hanford Steel Pig without the used of force. The recommended maximum size of the container with the plastic bag is 3 in OD x 7.0 in long.
- Interface with the sampling system's container insertion port and container handling hardware, packaging chamber and utilities. Pressurized (heated to prevent freezing) flush water will be provided by the sampling system utility module.
- Compatible with the current 222S laboratory procedures for handling waste containers.

Modifications, if required, should be only minor changes to the procedures. No new tooling shall be required. It is desired that no additional hot cell operator training shall be required.

5.3 Safety Requirements

The safety requirements protect the environment and operating personnel from being contaminated by tank waste. Compliance with the safety requirements ensures that the personnel, the public, and the environment are not exposed to unacceptable risks of radiation and contamination.

5.3.1 Safety/ALARA

The container filling system shall be designed on concepts that support ALARA (as low as reasonably achievable):

- All components making contact with tank wastes or a tank waste environment shall be designed and fabricated with materials that can easily be decontaminated with water.
- Construction materials shall have surface finish and/or coatings that inhibit the adhesion and accumulation of waste materials.
- The container filling system hardware shall include effluent pathways and smooth contours for the gravity draining of flush water and residual waste to preclude the

accumulation of radioactive or other hazardous materials in relatively inaccessible areas such as cracks, and corners.

- It is preferred that a filled sample container have no contamination on its outer surfaces after being filled and capped/sealed. The sample container filling system shall have means to water purge/flush all waste carrying hardware and all hardware making contact with the waste.
- The filling system shall include water spray means to remotely decontaminate the outer surfaces of a filled waste container and the surfaces of the filling system hardware.

The system shall be designed to be fail-safe, such that in the event of a failure or off-normal event, the system shall cease operation in a manner that will allow failure assessment, repair, recovery, and maintenance to proceed in a safe manner. The design shall maintain positive control of the sample container and the waste within the sample All actions with waste and the waste container shall be designed to minimize waste spillage and prevent the loss of control with an empty and filled sample containers..

5.3.2 Safety/Authorization Basis

Criteria related to safety and Authorization Basis include:

- Compliance with NFPA 70, Class I Division 1 Group B flammable gas criteria/conditions or provide equivalent safety.
- The filling system shall be constructed of spark-resistant material or rendered incapable of producing a spark that has sufficient energy to combust a flammable hydrogen gas atmosphere.
- Potential electrostatic ignition sources shall be controlled by electrical bonding and grounding.
- Any exposed polymer materials shall be rendered incapable of electrostatic charge or discharge.

5.4 Environmental Constraints

The environment in which the container filling system must operate includes the general tank farm environment, tank dome airspace environment, and the environment from direct contact with tank waste.

- The tank waste to be handled by the container filling system shall be LAW and HLW envelopes A, B, C, and D as defined in the Phase 1 B privatization contract and tank waste from the source tanks for these waste envelopes (see Appendix A for specific waste descriptions). The physical, chemical, and radioactive properties of the waste include:
  - Liquid, slurry/sludge, and solid phase materials
  - Viscosity: 1-80 cp
  - Specific Gravity: Average 1.0-1.4

- Particle size: (>5 microns to 4,000 microns with 99% of the particles < 500 microns)
- Radioactivity: <1000 rad/hr (based on contact with a 500 ml glass bottle of AZ-102 slurry)
- Solids content: 35% by wt. (This is the maximum content that is expected to be found in concentrated slurries and tank heels which may have to be pumped by the lower sampling channels of the sampling system. It is not the maximum expected solids content that the sampling system will need to operate with to support the BNFL privatization contract).
- Temperature range: 50 to 200 °F
- pH: 7-14
- Chemical composition: as per the privatization contract envelopes A, B, C, and D definitions (see Appendix A)

- The container filling hardware that is inside the filling chamber shall be exposed to an environment similar to that of the tank dome airspace, and may become covered with residual task waste and purging/flushing water. The environment for the filling chamber will include:

  - Radioactivity: <1000 rad/hr at the waste surface (based on contact with a 500 ml glass bottle of AZ-102 slurry)
  - Waste solids content: 20% by wt. (Maximum concentration to support the BNFL privatization contract)
  - Temperature range: 50 to 200 °F
  - Aerosols and airborne waste solids and water wash liquids
  - Relative humidity: 10 to 100%
  - pH: 7-14
  - Chemical composition: as per privatization contract envelope A, B, C, and D definitions (see Appendix A)

- The container filling components that are outside of the filling chamber will be exposed to the tank farm environment that will include the following conditions:

  - Temperature Range:
    - Operating: -20 to 120 °F
    - Non-operating: -20 to 150 °F

  - Moisture:
    - Rainfall up to 2 in./hr
    - Snow accumulation of up to 2 ft
    - Relative humidity: 4 to 100%

  - Wind speed: Maximum of 80 mph, standby condition, 25 mph maximum operating condition.
  - Dust: Capable of withstanding blowing sand and dust, and ash fallout.

- All enclosures and cabinets, controls for components that are outside of the filling chamber shall be insect and rodent-proofed.

5.5 Design Codes

The design codes of particular interest for the container sampling system are shown below. Compliance to these codes will be provided by qualified system designers and fabricators, with verification at critical steps in the design, development, and testing of the container filling system.

- The electrical design and fabrication shall be according to the National Electrical Code, NFPA 70, National Fire Protection Association criteria, latest version
- The mechanical design and fabrication shall be according to ASME Boiler and Pressure Vessel Code, latest version.
- Design areas with human factor impacts shall be in accordance with the criteria identified in MIL-Std 1472D and NUREG 0700 that includes the following:

    - Human factors engineering shall be included in all aspects of the system development, design and fabrication (conceptual design to final deployment of a system).
    - The system shall be designed for all qualified Hanford operators.

5.6 Other Requriements

There are additional design features, important to the container filling system, that typically ensure that the container filling system will be reliable, provide acceptable performance, and will be more easily maintained and operated. These include the following:

- All piping and valves carrying tank waste and flush and drain water shall have means for temperature control to prevent freezing. Temperature control with the waste carrying components shall be used to adjust the temperature of the waste contacting components to match the tank waste, prior to initiating a filling operation.
- All components shall be constructed of stainless steel or demonstrated to be compatible with the waste properties as specified above.

6.0 References

Reich, F, R., 1999, HNF-3483, Rev. 1, *Level 2 Specification for the Nested, Fixed-Depth Sampling System and the At-Tank Analysis System*, prepared by COGEMA Engineering Corp., Richland, Washington for Lockheed Martin Hanford Corporation, Richland, Washington.

Janicek, G. P, 1997, Correspondence No. 75200-95-013, *Issuance of New Characterization Engineering Projects Desk Instruction: PI-CP-088-00*, Lockheed Martin Hanford Corporation, Richland, Washington.

Tanks Waste Remediation System Privatization Contract DE-AC06-96RL13308, Mod. No. A006, 1998, U.S. Department of Energy, Richland, Washington.

BNFL, 1999a, March 1999, *Tank Waste Remediation System Privatization Project, Interface Control Document ICD-19*, between DOE and BNFL Inc. for Low Activity Waste, BNFL-5193-ID-19, Rev. 2A, prepared for the U.S. Department of Energy, Richland Operations under Contract DE-AC06-RL13308 by BNFL, Inc., Richland, Washington.

BNFL, 1999b, March 1999, *Tank Waste Remediation System Privatization Project, Interface Control Document ICD-20, between DOE and BNFL Inc. for High-Level Waste*, BNFL-5193-ID-20, Rev. 2A, prepared for the U.S. Department of Energy, Richland Operations under Contract DE-AC06-RL13308 by BNFL, Inc., Richland, Washington.

SW-846, *Test Methods for Evaluating Solid Wastes, Physical/Chemical Properties*, U.S. Environmental Protection Agency, Office of Solid Waste, Washington, DC.

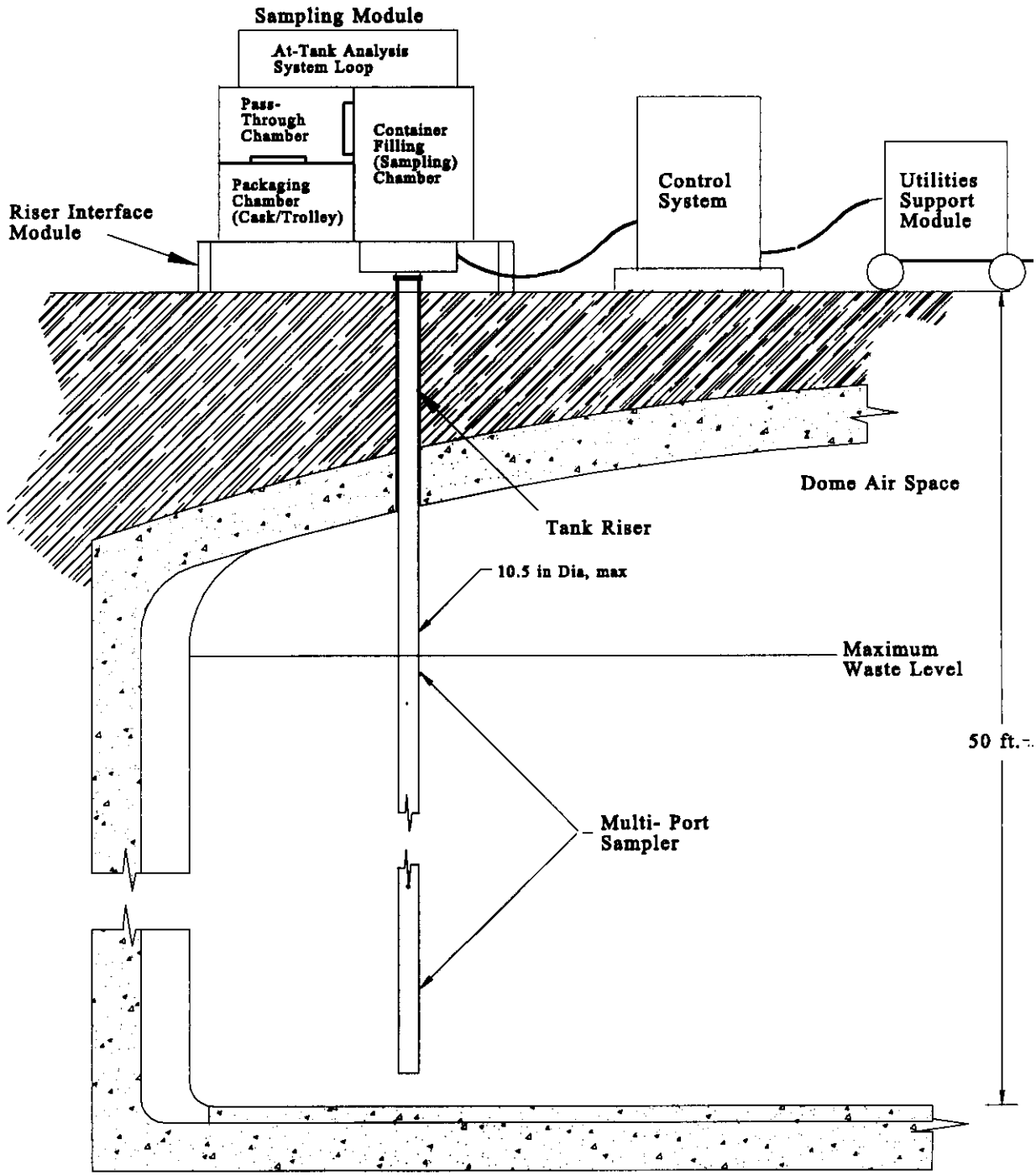

Figure 1 Nested, Fixed-Depth Sampling System, With a Bottle Filling System, Deployed in a Waste Tank Riser.

Table 1 Basic Functional Characteristics and Constraints for the Container Filling System.

FUNCTIONAL CHARACTERISTICS
Performance and External Interface Requirements
• The container filling system shall interface with, and be integrated into, the nested, fixed-depth sampling system. • The container filling system shall fill 500 ml containers with LAW and HLW tank waste that is representative of the waste stream being delivered to the filling system. • The utilities (flush water, etc.) required by the filling system shall be derived from the nested, fixed-depth sampling system utility system. • The filled containers shall be transportable with the Hanford Pig transport system. • All operations with the container filling system shall be manual, using manipulators penetrating the wall of the sealed chamber that the container filling system is mounted in. • The container filling system shall interface with the waste stream provided by the nested, fixed-depth sampling system.
CONSTRAINTS
Safety Requirements
• The container filling system shall comply with tank farm flammable gas criteria for waste contacting systems. • The tank dome load from the container filling system shall be part of the total allocated weight limit for the nested, fixed-depth sampling system. • Personnel radiation exposure shall be ALARA.
Environmental Regulations
• Waste shall be controlled and contained at all times, with waste and flushing water residue from the container filling system acceptable for returning to the waste tank.
Major Design Codes
• Prevailing and relevant design standards and codes shall be followed.
Other Requirements
• The container filling system shall be fail-safe such that in the event of a failure, assessment, repair, and maintenance can safely proceed. • The container filling system shall be operable by all qualified Hanford tank farm operators.

APPENDIX A

LAW and HLW Envelopes

LAW and HLW Envelopes

A.1 Low Activity Waste (LAW) Envelopes

The Low Activity Wastes (LAW) specification in the River Protection Program (RPP) (formerly Tank Waste Remediation System (TWRS)) Privatization contract (Contract No. DE-AC06-96RL13308) establishes three waste envelopes for LAW: waste envelopes A, B, and C. Each waste envelope provides the compositional maximums of chemical and radioactive constituents in the waste feed to be treated. The concentration limits for the LAW feed to be transferred by DOE to the contractor for LAW services in Tables A-1 and A-2 apply to the soluble fraction only. The waste feed will be delivered with a sodium concentration between 3M and 10M and up to 2 wt% solids (dry basis). The insoluble fraction characterization will include measurements of Al, Cr, P, S, Si, Na, TIC, TOC, ^{90}Sr, ^{137}Cs, ^{60}Co, ^{154}Eu, ^{155}Eu, and total alpha concentrations. Trace quantities of unspecified radionuclides, chemicals, and other impurities may be present in the waste feed. All feed (soluble and insoluble components) will meet the Tank Farm Operations specifications given in OSD-T-151-00007 (except for free hydroxide), the *TWRS System Basis of Interim Operation (BIO)* (WHC-SD-WM-BIO-001), and *Technical Safety Requirements* (WHC-SD-WM-TSR-006 Rev. E*)*. The radiochemical inventory of the waste feed at the time of delivery shall be compared to the specification limits to assess compliance. The specifications for ^{60}Co, ^{154}Eu, and ^{155}Eu shall apply at the time of delivery for LAW immobilization.

The LAW feed will not contain a visible, separate organic phase, but will generate gases, including hydrogen and ammonia, at a nearly constant rate and a nearly uniform composition. The maximum ^{137}Cs concentration equivalent in the transferred feed shall be less than 6 Ci/liter. To handle the waste, permits, licenses, and other such regulatory approvals will be required in accordance with the requirements of Standard 4, "Safety, Health and Environmental Program" and Clause H.12, "Environmental Permits and Applications." Trace constituents, not previously identified through past characterization of Hanford tank waste and/or process testing, may be found in the LAW waste feed after start of Phase 1B.

A.1.1 References

WHC-SD-WM-BIO-001, Rev. E. September 1996, *Tank Waste Remediation System Basis for Interim Operation.* Westinghouse Hanford Company, Richland, Washington.

WHC-SD-WM-TSR-006, Revision E. October 1996, *Tank Waste Remediation System Technical Safety Requirements*, Section 5.7, "TWRS Technical Safety Requirements." Westinghouse Hanford Company, Richland, Washington.

Code of Federal Regulations, 10 CFR 61 "*Licensing Requirements for Land Disposal of Radioactive Waste*," U.S. Nuclear Regulatory Commission, Washington D.C,

OSD-T-151-00007. Rev. H-16. November 20, 1995. *Operating Specification for 241-AN, AP, AW, AY, AZ, and SY Tank Farms*. Westinghouse Hanford Company, Richland, Washington.

Table A-1 LAW Chemical Composition, Soluble Fraction Only

Chemical Analyte	Maximum Ratio: Analyte (mole) to Sodium (mole)		
	Envelope A	Envelope B	Envelope C
Al	2.5 E-01	2.5 E-01	2.5 E-01
Ba	1.0 E-04	1.0 E-04	1.0 E-04
Ca	4.0 E-02	4.0 E-02	4.0 E-02
Cd	4.0 E-03	4.0 E-03	4.0 E-03
Cl	3.7 E-02	8.9 E-02	3.7 E-02
Cr	6.9 E-03	2.0 E-02	6.9 E-03
F	9.1 E-02	2.0 E-01	9.1 E-02
Fe	1.0 E-02	1.0 E-02	1.0 E-02
Hg	1.4 E-05	1.4 E-05	1.4 E-05
K	1.8 E-01	1.8 E-01	1.8 E-01
La	8.3 E-05	8.3 E-05	8.3 E-05
Ni	3.0 E-03	3.0 E-03	3.0 E-03
NO_2	3.8 E-01	3.8 E-01	3.8 E-01
NO_3	8.0 E-01	8.0 E-01	8.0 E-01
Pb	6.8 E-04	6.8 E-04	6.8 E-04
PO_4	3.8 E-02	1.3 E-01	3.8 E-02
SO_4	1.0 E-02	7.0 E-02	2.0 E-02
TIC[1]	3.0 E-01	3.0 E-01	3.0 E-01
TOC[2]	5.0 E-01	5.0 E-01	5.0 E-01
U	1.2 E-03	1.2 E-03	1.2 E-03

Notes: 1.) Mole of inorganic carbon atoms/mole sodium
2.) Mole of organic carbon atoms/mole sodium.

Table A-2. LAW Radionuclide Content, Soluble Fraction Only

	MAXIMUM RATIO: Radionuclide (Bq) to sodium (mole)		
Radionuclide	Envelope A	Envelope B	Envelope C
TRU[2]	4.8 E+05	4.8 E+05	3.0 E+06
^{137}Cs	4.3 E+09	2.0 E +10	4.3 E+09
^{90}Sr	4.4 E+07	4.4 E+07	8.0 E+08
^{99}Tc	7.1 E+06	7.1 E+06	7.1 E+06
^{60}Co	6.1 E+04	6.1 E+04	3.7 E+05
^{154}Eu plus ^{155}Eu	1.2 E+06	1.2 E+06	4.3 E+06

Notes: 1.) The activity limit shall apply to the feed certification date.
2.) TRU is defined in accordance with 10 CFR Part 61.55.

Some radionuclides, such as ^{90}Sr and ^{137}Cs, have daughters with relatively short half-lives. These daughters have not been listed in this table. However, they are present in concentrations associated with the normal decay chains of the radionuclides.

A.2 High-Level Waste

The high-level waste (HLW) specification in the TWRS privatization contract (Contract No. DE-AC06-96RL13308, Amendment A006, August, 1998) identifies the slurry composition for the HLW and the unwashed solids composition (Envelope D). The HLW slurry will contain a mixture of liquids (Envelopes A, B, or C) and solids (Envelope D). The compositional range of the liquid fraction is defined above in Section A.1 for the LAW Envelope Definition. The composition range of the Envelope D unwashed solids is given in Tables A-3, A-4, and A-5. The feed concentration will be between 10 and 200 grams of unwashed solids/liter.

Compositions for Envelope D unwashed solids are defined in terms of elemental or anion concentrations and radionuclide activities per 100 grams equivalent non-volatile waste oxides. The non-volatile waste oxides include sodium oxide and silicon oxide. The feed components identified are waste components important to establishing the waste oxide loading in the HLW glass. Only these components have concentration limits that will be used to provide the basis for certification that the HLW feed is within specification limits. The concentrations of these components in the waste are not expected to be exceeded. Trace quantities of unspecified radionuclides, chemicals, and other impurities may be present in the waste feed.

The HLW feed will not contain a visible separate organic phase. The HLW will generate gases due to radiolysis, including hydrogen and ammonia, at a nearly constant

rate and nearly uniform composition. To handle the HLW, permits, licenses, and other such regulatory approvals will be required. Trace constituents not previously identified through past characterization of Hanford tank waste and/or process testing may be found in the HLW feed after start of Phase 1B.

A 2.1 References

DOE/RL-88-21. 1996. *Double-Shell Tank System Unit Permit Application.* U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Table A-3. High-Level Waste Feed Unwashed Solids Maximum Non-Volatile Component Composition (grams per 100 grams non-volatile waste oxides).

NON-VOLATILE ELEMENT	MAXIMUM (grams/100 grams waste oxides)	NON-VOLATILE ELEMENT	MAXIMUM (grams/100 grams waste oxides)
As	0.16	Pu	0.054
B	1.3	Rb	0.19
Be	0.065	Sb	0.84
Ce	0.81	Se	0.52
Co	0.45	Sr	0.52
Cs	0.58	Ta	0.03
Cu	0.48	Tc	0.26
Hg	0.1	Te	0.13
La	2.6	Th	0.52
Li	0.14	Tl	0.45
Mn	6.5	V	0.032
Mo	0.65	W	0.24
Nd	1.7	Y	0.16
Pr	035	Zn	0.42

Table A-4. High-Level Waste Feed Unwashed Solids Maximum Volatile Component Composition (grams per 100 grams non-volatile waste oxides).

VOLATILE COMPONENTS	MAXIMUM (grams/ 100 grams waste oxides)
Cl	0.33
CO_3^{-2}	30
NO_2	36 (Total NO_2/ NO_3)as NO_3
NO_3	
TOC	11
CN	1.6
NH_3	1.6

Table A- 5. High-Level Waste Feed Unwashed Solids Maximum Radionuclide Composition (Curies per 100 grams non-volatile oxides).

ISOTOPE	MAXIMUM (Ci/ 100 grams waste oxides)	ISOTOPE	MAXIMUM (Ci/ 100 grams waste oxides)
^{3}H	6.5 E-05	^{154}Eu	5.2 E-02
^{14}C	6.5 E-6	^{155}Eu	2.9 E-02
^{60}Co	1 E-02	^{233}U	9.0 E-07
^{90}Sr	1 E+01	^{235}U	2.5 E-07
^{99}Tc	1.5 E-02	^{237}Np	7.4 E-05
^{125}Sb	3.2 E-02	^{238}Pu	3.5 E-04
^{126}Sn	1.5 E-04	$2^{39}Pu$	3.1 E-03
^{129}I	2.9 E-07	^{241}Pu	2.2 E-02
^{137}Cs	1.0 E+01	^{241}Am	9.0 E-02
^{152}Eu	4.8 E-04	$^{243+244}Cm$	3.0 E-03

Table A- 6. Additional High-Level Waste Feed Composition for Non-Volatile Components (grams per 100 grams non-volatile waste oxides).

NON-VOLATILE ELEMENT	MAXIMUM (grams/ 100 grams waste oxides)	NON-VOLATILE ELEMENT	MAXIMUM (grams/ 100 grams waste oxides)
Ag	0.55	Ni	2.4
Al	14	P	1.7
Ba	4.5	Pb	1.1
Bi	2.8	Pd	0.13
Ca	7.1	Rh	0.13
Cd	4.5	Ru	0.35
Cr	0.68	S	0.65
F	3.5	Si	19
Fe	29	Ti	1.3
K	1.3	U	14
Mg	2.1	Zr	15
Na	19		

APPENDIX B

Design Compliance Matrix – Waste Container Filling System

Design Compliance Matrix - Waste Container Filling System

	REQUIREMENTS					SOLUTION			VERIFICATION	
Count	Criteria	Source	Basis	Requirement Type	Notes/Assumptions/Implications	Design Attribute	Component	Config. Control Ref.	Engineering Evaluation Description	Verified By?
	Enter functional or design criteria exactly as stated in the requirements source document.	Enter source doc.	Enter origin of requirement if other than Source	Performance Ext. Interface Safety Environmental Design Code Other	Enter all additional information which amplifies, qualifies, justifies,...etc. the criteria statement.	Describe the manner in which the design purports to fulfill the criteria statement - be as specific as possible.	Enter component name if Source is specific		Provide discussion on method, evidence, reasoning used, ...etc., to verify that the design complies with requirements - be specific - include any qualifications, if appropriate.	Person or group attesting to verif. (initialed)
1	Sample LAW and HLW tank waste to meet PHMC Phase 1 B privatization contract sampling needs	HNF-3483 Rev. 2 (Reich 1999)	TWRS Privatization Contract DE-AC06-96RL13308, Mod. No. A006, 1997	1 Performance	The waste constituents will be from the LAW and HLW waste in the tanks selected for the Phase 1 B privatization contract.	Sampling system and sample container compatible with HLW and LAW waste				
2	Representative Waste Sampling (Chemical, radiological, and physical properties)	HNF-3483 Rev. 2 (Reich 1999)	TWRS Privatization Contract DE-AC06-96RL13308, Mod. No. A006, 1996	1 Performance		Chemical, pysical, and radiological content within +/- 5% of the mean value (within a 95% confidence level) of the waste being "pumped" to the filling system.				
3	Sample cross-contamination	HNF-3483 Rev. 2 (Reich 1999)	Engineering Judgement	1 Performance	The filling system will be interfaced to 8 sampling channels, sampling waste at 8 elevations in the waste tank. Purge water will be used to flush the system.	The maximum waste sample cross-contamination from residual waste from a prior sample and from residual purging water shall be less than 0.5 % by volume.				
4	Container volume and filling time	HNF-3483 Rev. 2 (Reich 1999)	Engineering Judgement - Provide samples as least as fast as base-line "grab" sampling method.	1 Performance		Fill 500 ml container. Transfer 500 ml of waste to sampler container in less than 5 minutes. Fill total of 15 liters (30 containers) in an 8-hour sampling campaign				
5	RCRA volatile and semi-volatile organic sampling compliance	HNF-3483 Rev. 2 (Reich 1999)	Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. SW-846	1 Performance		No void space, no bubbles, fully sealed container, no trace organic contaminants, and no vacuum used on sample material				
6	Operational Lifetime and maintenance and repair	HNF-3483 Rev. 2 (Reich 1999)	Design, test data, performance with similar systems	1 Performance	TWRS Privatization Contract DE-AC06-96RL13308, Mod. No. A006, 1996, U.S. Department of Energy, Richland, Washington.	Operational lifetime of 20 years. Modular design. Remote maintenance and repair. Minimum of 60 days between maintenance intervals.				

	REQUIREMENTS					SOLUTION			VERIFICATION	
Count	Criteria	Source	Basis	Requirement Type	Notes/Assumptions/Implications	Design Attribute	Component	Config. Control Ref.	Engineering Evaluation Description	Verified By?
7	Sample waste plugging recovery.	HNF-3483 Rev. 2 (Reich 1999)	Engineering Judgement - Emergency actions may shutdown sampling system and not allow completion of lay-up, flushing operations.	1 Performance	Phosphate wastes may precipitate from temperature change and solids may settle.	Recover after 24-hr off-normal emergency shut-down. Recovery from plugging in 4-hours with flushing only and resume normal operation.				
8	Broken or failed container/cap recovery	HNF-3483 Rev. 2 (Reich 1999)	Engineering Judgement	1 Performance	Broken glass sampling container in filling station	Recovery and resume normal operation without special entry into sampling chamber.				
9	Flushing with flowing waste	HNF-3483 Rev. 2 (Reich 1999)	Engineering Judgement	1 Performance		Recover, resuming filling, from broken container or faulty cap without entry into chamber				
10	Interface with fluidics based, nested, fixed-depth sampling system	HNF-3483 Rev. 2 (Reich 1999)	Engineering Judgement - Pumping system will provide representative waste from 8 tank elevations	2 External Interface	Non-continuous pumping action. Compatible container handler and waste flow stream piping, simple remote manipulator handling.	Waste Flow Stream:30 second pulse (typical), 3 liter flow minimum/pulse, pressure to 100 psig max. Sampler flushing system, manual remote container handling system.				
11	Transport in the Hanford Pig system	HNF-3483 Rev. 2 (Reich 1999)	Dimensions of container and plastic bag	2 External Interface	Maximum container size shall include the plastic bag and tie-off	Fit into Steel Pig overpack with no insertion/removal force. Steel Pig interior 3.38" dia. X 7.5" long. (container max dim 3.0" OD x 7.0" L)(				
12	System support utilities	HNF-3483 Rev. 2 (Reich 1999)	Engineering Judgement	2 External Interface	Flushing water for flushing and decontamination	Use all utilities provided from sampling system utility skids				
13	222S Laboratory interface		Engineering Judgment - Cost/time impact if current procedures need revision	2 External Interface	Use the current 500 ml grab sample bottle	Use current 222S Lab procedures for sample handling				

	REQUIREMENTS					SOLUTION			VERIFICATION	
Count	Criteria	Source	Basis	Requirement Type	Notes/Assumptions/Implications	Design Attribute	Component	Config. Control Ref.	Engineering Evaluation Description	Verified By?
14	Fill 500 ml "grab" sampling bottle	HNF-3483 Rev. 2 (Reich 1999)	Engineering Judgement - Cost/schedule impact. Minimum sample size of 1.5 liters would be three 500 ml containers. (ICD-19, BNFL-5193-ID-19, Rev. 2)	2 External Interface	Preferred container is current "grab" sample bottle as new tests, validation, procedures, etc. would be required with new container.	Minimum sample is 1.5 liters (three 500 ml containers). Container should be maximum of 3.0" dia. X 7.0" long.				
15	Water spray decontamination/clean-up	HNF-3483 Rev. 2 (Reich 1999)		3 Safety/ ALARA	General Design - Radiological Control	Smooth surfaces, no cracks/crevises/pockets, gravity drain of wash residues				
16	Fail safe design	HNF-3483 Rev. 2 (Reich 1999)		3 Safety/ ALARA	Fails so that off-normal chamber penetration not required.	Fails in safe manner, such that failure assessment, repair, and maintenance can safely proceed.				
17	Contamination control	HNF-3483 Rev. 2 (Reich 1999)		3 Safety/ ALARA	General Construction - Radiological Control. Minimize spread of contamination.	Minimize decontamination requirements and waste generation.				
18	Flammable gas environment qualified	HNF-SD-WM-TSR-006, Rev. 0.	NFPA 70, Class I Division 1 Group B criteria or equivalent safety criteria.	3 Safety/ AB	Documentation to show compatibility with Class 1 Division 1 Group B criteria needed.	Potential ignition souces shall be tested per national standards to show that they are nonsparking or analyzed and shown not to be capable of causing an igintion. Equipment shall be approved by the Flammable Gas Evaluation Advisory Board (FGEAB).				
19	Waste Handling Hardware Compatalbe with LAW and HLW Properties (chemical, radiological, physical)	HNF-3483 Rev. 2 (Reich 1999)	*TWRA-P Project Technical Report A-2*, BNFL-5193-TR-01, Rev. 0., 1998	4 Environmental	BNFL-5193-TR-01 defines chemical consitiuents for A, B, C, and D.	Stainless steel construction compatible with LAW and HLW waste envelopes A, B, C, and D.				
20	Dorne intrusive componetnts compatible with moisture, chemical, radiological, and physical properties	HNF-3483 Rev. 2 (Reich 1999)	*TWRA-P Project Technical Report A-2*, BNFL-5193-TR-01, Rev. 0., 1999	4 Environmental	BNFL-5193-TR-01 defines chemical consitiuents for A, B, C, and D.	Stainless steel construction compatible with LAW and HLW waste envelopes A, B, C, and D.				

REQUIREMENTS						SOLUTION			VERIFICATION	
Count	Criteria	Source	Basis	Requirement Type	Notes/Assumptions/Implications	Design Attribute	Component	Config. Control Ref.	Engineering Evaluation Description	Verified By?
21	Compatibility with Tank Farm environment	HNF-3483 Rev. 2 (Reich 1999)	Engineering Judgement	4 Environmental		Stainless steel construction compatible with Tank Farm environmeent (temperature, moistuer, dust, insects, rodents, etc.)				
22	General electrical design and fabrication	HNF-3483 Rev. 2 (Reich 1999)	NFPA 70, National Fire Protection Association	5 Design Code						
23	General mechanical design and fabrication	HNF-3483 Rev. 2 (Reich 1999)	ASME Boiler and Pressure Vessel Code and/or ASME B31.3 Process Piping	5 Design Code		Stainless steel for chemical and radiation waste environment. Waste pressure of up to 100 psig.				
24	Design for human factors engineering	HNF-3483 Rev. 2 (Reich 1999)	MIL-Std 1472D and NUREG 0700	5 Design Code		Male and female operators				
25	Waste Temperature Control	HNF-3483 Rev. 2 (Reich 1999)		6 Other	Prevent liquids from freezing and waste from precipitating	All waste carrying piping shall temperature control				
26	Construction Materials	HNF-3483 Rev. 2 (Reich 1999)		6 Other		Stainless steel or comparable material for chemical and radiation waste environment.				

DISTRIBUTION

Number of Copies	Address	
(4)	U.S. Department of Energy, Richland Operations Office	
	R. Carreon	A0-21
	C. S. Louie	A0-21
	J. F. Thompson, Jr.	S7-54
	C. Welliver	A0-21
(2)	DOE Public Reading Room	H2-53
(2)	Central Files	~~A3-88~~ KN B1-07
(17)	Lockheed Martin Hanford Corporation	
	J. N. Appel	A3-03
	D. G. Baide	S5-05
	J. H. Baldwin	R3-73
	D. C. Board	S7-07
	R. G. Brown	S7-12
	T. W. Crawford	R3-73
	D. L. Dykeman	S7-12
	K. A. Gasper	A3-03
	K. M. Hall	R2-12
	G. P. Janicek	S7-12
	W. J. Kennedy	S7-10
	L. D. Pennington	S7-01
	J. A. Ranschau	S7-07
	J. S. Schofield	S7-12
	A. M. Templeton	R2-12
	K. A. White	S5-13
	J. A. Voogd	R2-53
(2)	Numatic Hanford Corporation	
	R. M. Boger	S7-12
	P. J. Certa	R3-73
(5)	Pacific Northwest National Laboratory	
	S. A. Bailey	K5-08
	B. A. Carteret	K9-91
	R. L. Gilchrist	K9-91
	M. W. Rinker	K5-22
	K. D. Weimers	A021

(4) COGEMA-Engineering Corporation

J. L. Smalley	S7-12
F. R. Reich (3)	H1-19