Attachment 51 – Appendix 10.7
High Level Waste Building
Specifications

Where information regarding treatment, management, and disposal of the radioactive source, byproduct material, and/or special nuclear components of mixed waste (as defined by the Atomic Energy Act of 1954, as amended) has been incorporated into this permit, it is not incorporated for the purpose of regulating the radiation hazards of such components under the authority of this permit and chapter 70.105 RCW. In the event of any conflict between Permit Condition III.10.A. and any statement relating to the regulation of source, special nuclear, and byproduct material contained in portions of the permit application that are incorporated into this permit, Permit Condition III.10.A. will prevail.

Additional appendices will be added to this appendix as new information is incorporated into this permit.

Drawings and Documents

Attachment 51 – Appendix 10.7

High Level Waste Building
Specifications

The following drawings have been incorporated into Appendix 10.7 and can be viewed at the Ecology Richland Office. **New drawings are in bold lettering**.

Drawing/Document Number	Description
24590-HLW-3PS-AE00-TP001, Rev 0	Engineering Specification for HLW Melters
24590-HLW-3PS-MBT0-TP001, Rev 2	Engineering Specification for Silver Mordenite Column Design and Fabrication
24590-HLW-3PS-MEE0-TP001, Rev 1	Engineering Specification for HEPA Filter Preheaters
24590-HLW-3PS-MQR0-TP002, Rev 2	**Engineering Specification for HLW System HDH Canister Rinse Bogie**
RESERVED	RESERVED

R10482123

ISSUED BY
RPP-WTP PDC

RIVER PROTECTION PROJECT – WASTE TREATMENT PLANT

ENGINEERING SPECIFICATION

FOR

High Level Waste Melters

MARK A. SCOTT, STATE OF WASHINGTON, 19183, REGISTERED PROFESSIONAL ENGINEER 2/3/05 EXPIRES 04/01/05	LOUIS SCOTT GOAD, STATE OF WASHINGTON, 35745, REGISTERED PROFESSIONAL ENGINEER 2/3/05 EXPIRES 10/18/05	WALTER PAUL DROSJACK, STATE OF WASHINGTON, 4123, REGISTERED PROFESSIONAL ENGINEER 2/1/05 EXPIRES 6/6/05
STRUCTURAL	ELECTRICAL	MECHANICAL & OTHER

Content applicable to ALARA? ☒ Yes ☐ No

ADR No.
N/A

Rev

NOTE: Contents of this document are Dangerous Waste Permit affecting.

Quality Designator

QL

DOE Contract No.
DE-AC27-01RV14136

REV	DATE	REASON FOR REVISION	BY	CHECK	REVIEW	QA	APEM/DEM
0	1/31/05	Issued for permitting use.	R.P. Casassa	M. Hall	R. D. Peters	N/A	W. Eaton

SPECIFICATION No. 24590-HLW-3PS-AE00-TP001 **Rev** 0

Notice

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the US Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

Contents

Notice ii
1 General 1
1.1 Scope 1
1.2 Definitions 1
1.3 Acronyms 2
2 Applicable Documents 2
2.1 Referenced Codes and Industry Standards 2
2.2 Other Reference Documents/Drawings 3
3 Design Requirements 3
3.1 General Functional Requirements 4
3.2 Performance Requirements 6
3.3 Design Conditions 6
3.4 Mechanical Requirements 7
3.5 Structural Requirements 9
3.6 Electrical Requirements 12
3.7 Controls and Instrumentation Requirements 14
3.8 Maintenance Requirements 14
4 Quality Assurance Requirements 15
4.1 General 15
5 Documentation and Submittals 15
5.1 General 15
5.2 Submittals 15

Appendices

Appendix A Melter Services and Connections Interface Details (4 pages total) ..... A-i
Appendix B Melter Design Interface Details (10 pages total) ..... B-i

1 General

1.1 Scope

A. This Specification provides performance requirements for the design of High Level Waste (HLW) vitrification melters for the River Protection Project - Waste Treatment Plant (RPP-WTP) at the Hanford, Washington Site of the Department of Energy (DOE). The performance requirements cover all phases of melter life, including assembly, transport, startup, commissioning, operation and maintenance, decommissioning, and disposal.
B. This Specification has been written for Contract No. 24590-101-TSA-W-000-0010 and is supported by Ref 2.2D. Controls and instrumentation requirements for melter design have been incorporated into Ref 2.2B.
C. The melters include, but are not limited to, the following major structures, systems, and components (SSCs): glass containment, glass and glass discharge heating, refractory cooling, instrumentation, offgas cooling and collection, waste and glass feed, glass frit addition for startup, glass discharge, and seismic restraint.
D. The subcontractor shall base the design on the information provided in this Specification, the referenced documents herein and the current contract documents.
E. See Ref 2.2D for melter design scope of work.
F. Additional research and technology testing by the subcontractor, to aid in the design, shall be in accordance with the contract documents.

1.2 Definitions

A. Base - Structural platform that supports the melter during transport and operation. Base includes structural steel and bracing, and cooling water panel structures. Base also includes plates that provide a portion of the gas barrier. The base has elements that restrain the melter during operation.
B. Contractor - Bechtel National, Inc.
C. Design Life - The baseline time, based on calculation, analysis, experience or testing, over which the SSC will safely maintain its original function.
D. Transportation System - Melter components that aid in the transport and positioning of the melter during transportation, installation, operation, decommissioning and disposal.
E. Lid - Structural cover over the top of the melter plenum space that supports lid plenum refractory and all components mounted through it. Lid also includes plates that provide a portion of the gas barrier.
F. Normal Operation - constitutes all regular and scheduled melter activities geared towards production of glass product at or near design throughput, i.e., feeding, pouring, idling, and scheduled SSC changeout.
G. Walls - Melter and discharge chamber exterior structural steel.
H. Overpack - Portable structural enclosure mounted on rail wheels that will be used for transporting new melters and disposing of failed or spent melters. Overpack will provide restraint, containment, contamination control, and radiation shielding during melter transport and disposal activities.
I. Subcontractor - Duratek, Inc.
J. Vendor - A manufacturer or supplier providing materials and/or services to the subcontractor.
K. Gas Barrier - Structural steel plate consisting of the walls and the internal surfaces of the lid and base. The gas barrier serves to support the offgas-related function of the shell, while providing controlled air in-leakage to the melter plenum.
L. Frit - Glass particulate of a size and geometry suitable for direct feed into the melter.

M. Shell - Structural elements of the melter that ensure confinement of bulk molten glass, should it migrate through the refractory. Also supports the offgas system by providing a confinement boundary to direct offgas into the melter offgas system. The shell is comprised of the base, walls, and lid.

1.3 Acronyms

Acronyms used in this Specification include:

CCTV	Closed Circuit Television
DOE	Department of Energy
ICD	Interface Control Document
HLW	High Level Waste
RPP-WTP	River Protection Project-Waste Treatment Plant
SC	Seismic Category
SSC	Systems, Structures, and Components
wg	Water Gage (pressure measurement)

2 Applicable Documents

2.1 Referenced Codes and Industry Standards

Unless otherwise noted, all codes and standards referenced herein, and in the documents referenced in Section 2.2, shall be to the latest editions, addenda, and supplements at the time of award.

A. Deleted
B. Deleted
C. American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
   1. IEEE Std 141, *Recommended Practice for Electric Power Distribution for Industrial Plants* (1986)
   2. IEEE Std 260.1, *American National Standard Letter Symbols for Units of Measurement* (1993)
   3. IEEE Std 315, *Graphic Symbols for Electrical and Electronics Diagrams* (reaffirmed 1993)
   4. IEEE Std 399, *Recommended Practice for Industrial and Commercial Power Systems Analysis* (1997)
   5. IEEE Std 1202, *Standard for Flame Testing of Cables for Use in Cable Tray in Industrial and Commercial Occupancies* (1991)
D. American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
   1. ASME B31.3, Process Piping (1996)
   2. ASME Section III, Division I, Subsection NC, Rules for Construction of Nuclear Facility Components (2001)
   3. ASME Section VIII, Division I, Rules for Construction of Pressure Vessels (2001)
   4. ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities(1989)
   5. ASME NQA-2a, Part 2.7, Quality Assurance Requirements of Computer Software for Nuclear Facility Applications (1990)

6. ASME Section II, Material Specifications (2001)

E. Code of Federal Regulations (CFR) - 29 CFR 1910, Subpart S, *Occupational Safety and Health Administration, Electrical* (most current revision)

F. National Electrical Manufacturers Association (NEMA):
   1. NEMA WC, *Wire and Cable Standards* (1999)
   2. NEMA/ICEA (Insulated Cable Engineers Association), *Power Cable Ampacities* (1999)

G. National Fire Protection Association (NFPA)
   1. NFPA 70, *National Electrical Code* (1999)
   2. NFPA 497, *Recommended Practice for Classification of Hazardous Locations for Electrical Installations in Chemical Process Areas* (1997)

H. Underwriters Laboratories Inc (UL) - UL 508, *Standard for Safety Electric Industrial Control Equipment* (1999)

I. American Welding Society (AWS)
   1. AWS D1.1, *Structural Welding Code; Steel*
   2. AWS D1.6, *Structural Welding Code; Stainless Steel*

J. American National Standards Institute/American Institute of Steel Construction (ANSI/AISC)
   1. AISC N690, Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities (1994)

K. American Institute of Steel Construction (AISC) -AISC M016-89, Manual of Steel Construction - Allowable Stress Design, Ninth Edition (as tailored in Appendix C of Ref. N)

2.2 Other Reference Documents/Drawings

A. Deleted

B. Document No. 24590-WTP-3PS-J000-T0001, Rev 1, *Engineering Specification for Melter Systems C&I Work Specification*

C. Deleted

D. Statement of Work for Subcontract No. 24590-CM-SRA-HM00-00001, *Modeling and Design of Melters*

E. Deleted

F. Deleted

G. Contractor Correspondence No. 025802, *Contract No. DE-AC27-01RV14136 - Letter Subcontract Number 24590-101-TSA-W000-0010, Comments to Duratek's 30 % Design Package Submittal*

H. Document No. 24590-HLW-S0C-S15T-00009, Rev 0C, *HLW Vitrification Building Seismic Analysis-In-Structure Response Spectra (ISRS)*

I. Document No. 24590-WTP-3PS-SS90-T0001, Rev. 1, *Engineering Specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks*

J. Document No. 24590-WTP-DC-ST-04-001, Rev. 1, *Seismic Analysis and Design Criteria*

K. Drawing No. 24590-HLW-DD-S13T-00071, Rev. 2, *HLW Vitrification Building Structural Melter Seismic Restraint Embed Sections and Details*

L. Calculations No. 24590-HLW-DDC-S13T-00034, Rev. A, *Melter Seismic Restraint Embeds*

M. Document No. 24590-WTP-3PS-FB01-T0001, Rev. 1, *Engineering Specification for Structural Design Loads for Seismic Category III & IV Equipment and Tanks*

N. Document No. 24590-WTP-SRD-ESH-01-001-02, Rev ~~01~~ 31, *Safety Requirements Document, Volume II*

3 Design Requirements

The body of this specification identifies the functional design requirements for melter design. Appendices A and B, "Melter Services and Connections Interface Details" and "Melter Design Interface

Details" respectively, identify detailed design requirements and interfaces that have evolved from the functional design requirements for achieving the specified melter operating life and availability. The detailed design requirements and interfaces also provide a basis for designing the services and facilities that will support melter handling and operations.

3.1 General Functional Requirements

A. Other Functional Requirements - Other design requirements are defined in the melter design work performed in accordance with Contract No. 24590-101-TSA-W-000-0010 and submitted as the 30 percent design package, and contractor comments to the 30 percent design package (Ref. 2.2G). The package is referred to as the baseline design in this Specification. See also Ref 2.2D.

B. Containment System: The containment system will serve to support the credited safety functions of the melter shell, which are to ensure bulk confinement of radioactive materials during normal, abnormal and accident conditions, and to prevent exposures that may result in consequences to the co-located worker and facility worker above radiation exposure standards in the SRD. The containment system includes the melter shell and other elements: the refractory (and refractory thermocouples), cooling panels, jack bolts, and offgas ventilation.
   1. Coordinate with contractor to include design features for simplifying remote disassembly of a failed melter.
   2. The melter shell shall provide bulk confinement of glass in the event of refractory failure. The melter is not required to operate after a seismic event exceeding certain lateral acceleration limits, as defined in section 3.5; however, the shell shall maintain structural integrity and remain in place in accordance with the structural requirements outlined herein.
   3. Jack bolts: Design jack bolt system to prevent formation of significant gaps between refractory bricks. Bolt adjustment shall allow for:
      a. Remote operation in the melter cave.
      b. Support and adjustment of cooling panels and refractory during assembly, installation, startup, and operation.
   4. Melter Lid: Design shall include, but not be limited to, the following functions:
      a. Support all melter components mounted on and through it.
      b. Support refractory overhanging melter plenum, and thermal expansion of refractory during operation.
      c. Provide a continuous gas barrier in conjunction with wall and base gas barrier plates.
      d. Provide refractory cooling.
   5. Deleted.
   6. Melter Base: Base will perform the following functions:
      a. Support melter during transport, operation and maintenance, decommissioning, and disposal phases.
      b. Accommodate integrated transportation system.
      c. Provide contractor-coordinated interfaces with overpack and facility restraints.
      d. Provide flatness tolerances for refractory installation.
      e. Provide refractory cooling.
      f. Provide support for refractory during melter assembly, transport, installation, and operation.
      g. House melter services including drains and refractory water-cooling panels.
   7. Confinement of offgas is provided by the gas barrier portions of the shell, with engineered inbleeds. Inbleed openings shall be limited so that bulk flow of glass will be controlled should it leak from the refractory.

C. Heating System
   1. Heating system includes the electrodes (including extensions), startup heaters, discharge chamber heaters, and thermocouples.

2. After melter startup, glass shall be direct joule-heated.
3. Thermocouples shall provide continuous temperature monitoring while the melter is in service.

D. Feed System
1. Feed system includes temporary configuration for frit addition at startup, feed nozzles, associated feed lines (internal to melter only) for operation, and plenum thermocouples.
2. Subcontractor shall use best available information for locating feed nozzles over the glass pool to optimize processing rates.

E. Glass Pour System
1. Glass pour system includes glass pool level detectors, risers and airlift lances, troughs, dams, and discharge chamber structures.
2. Metallic Membrane (dam): Dam between the glass pool and discharge chamber shall prevent leakage of glass from the melt pool to the discharge chamber. Dam shall also limit leakage of air directly into the melter plenum through refractory seams over the melter lifetime.
3. Discharge Trough: Design trough to aid in maintaining glass temperature during pouring. Optimize trough slope and cross section for pouring and reduction of glass fiber formation.

F. Melter Disposal and Decommissioning: Coordinate with contractor to define general design requirements for melter disposal and decommissioning. Contractor will define specific disposal and decommissioning criteria after design is complete.

G. Melter Controls and Instrumentation: See Ref 2.2B for specific melter-related functional requirements for controls and instrumentation.

H. Transportation System: System will perform the following functions:
1. Support roller/wheel assemblies for melter transport on facility and overpack rails.
2. Guide and position melter on facility and overpack rails.
3. Interface with contractor-supplied drive systems that conform to subcontractor-defined melter movement criteria (see Appendix B).
4. Remain functional after an operational earthquake event as defined in Section 3.5A5: roller/wheel bearings shall remain functional and the rollers/wheels shall remain on the rails.
5. Allow for replacement by an identical melter after end-of-life or failure.

I. General Melter Component Design
1. Components requiring replacement during the design life of the melter shall be designed for ease of remote replacement and disposal. Where required, provide installed spare capacity.
2. Use of commercially available components and equipment without modifications will be optimized to the extent practical, except for components requiring optimization/value engineering studies per Ref 2.2D.
3. Subcontractor shall coordinate with contractor to determine applicability of modular design to minimize assembly and replacement times.
4. A power manipulator and an overhead maintenance crane will accommodate remote removal/replacement of modular components and equipment during startup and operation. Subcontractor shall coordinate with contractor to determine individual handling, routing, and access requirements so as not to exceed the operating parameters of the handling equipment.
5. Conductive individual components and equipment in contact with the molten glass shall be electrically isolated from the melter structure, base and lid, and from SSCs physically connecting the melter to the rest of the facility.
6. All components shall be designed to withstand thermal expansion during normal operations and function within established design parameters (e.g., interface locations and positioning features).
7. Deleted.

J. Agitation System
1. Agitation system includes bubblers and glass pool viewing system.
2. Arrangement and configuration of bubblers shall aid in optimizing melter throughput.

3. Each bubbler assembly, in coordination with the contractor, shall be designed for individual removal and replacement.

K. Restraint System
1. Subcontractor shall design an anchor system, per the structural requirements below, to lock melter in place during operation, including pin, restraint, and interface to building embedments as shown in Ref. 2.2 K.
2. In order to fully account for construction tolerances, interfacing dimensions shall be placed on hold for fabrication until after placement of the embedments in the field. As-built dimension will be provided by the project when available.

3.2 Performance Requirements

A. Design Life
1. The facility is expected to operate for approximately 40 years.
2. The melter, excluding consumable SSCs specified by the subcontractor, shall have a minimum 5-year design life.
3. Refer to Appendix B for predicted subcontractor-defined design lives of selected SSCs to support target availability.
4. Deleted.
5. Subcontractor shall document bases for declaring the design lives of the melter and all associated SSCs.

B. Melter Throughput and Availability
1. Baseline throughput shall be one and one half (1.5) metric tons of glass/day, per melter. The melter shall be designed to allow production rates of three (3.0) metric tons of glass/day with an increase in agitation/bubbling rate.
2. Melter shall transform a slurry mixture of pretreated high level waste (HLW) and blended glass formers into a homogeneous glass melt. See Appendix B for waste and test feeds and glass composition data. Contractor will be responsible for controlling the feed chemistry composition within referenced boundary limits.
3. Target baseline availability for the melter is 83%. Subcontractor shall interface with contractor to ensure that melter design supports goal.

3.3 Design Conditions

A. Site Data (Applicable to Melter Transport in Overpack)
1. Elevation: 662 to 684 feet above mean sea level.
2. Site Climatological Data:

Ambient Air Temperature	Minimum: - 23 °F, Maximum: 113 °F
Rate of Increase	Maximum: 26 °F per 20 min
Rate of Decrease	Maximum: 24 °F per hour
Relative Humidity	Maximum: 100 %, Minimum 5 %

B. Facility Data

1. Building layouts and equipment general arrangements are predicated on the melter and melter component dimensions shown in Appendix B. Subcontractor shall notify contractor of any changes to dimensions and/or equipment maintenance envelope requirements.
2. Melter Ventilation:
   a. Melter will be operated as part of a cascaded ventilation system.
   b. Melter cave will be a primary confinement zone, held at a nominal 1 to 1.4-in. wg negative pressure with respect to surrounding secondary confinement zones.
   c. Melter plenum pressure will be maintained at a nominal 5-in wg negative pressure with respect to the cave.
3. Indoor Temperatures: See Appendix B for melter cave temperature range.
4. Radiation Dosages: See Appendix B for radiation design interface requirements impacting melter design.
5. Melter Utility Services:
   a. Contractor is currently providing the following services to the melters: electrical power, cooling water, process water, demineralized water, purge air, instrument air, and argon.
   b. Pressure, flow, conditioning, and other control requirements will be adjusted by contractor to suit application at the delivery point.
   c. Subcontractor shall identify any other liquids or gases required over the melter lifetime.
   d. Subcontractor shall coordinate with contractor to define utilities that require normal service or backup services.
   e. Subcontractor shall identify critical melter services where stoppage would result in rapid failure of associated component or melter system (see Appendix B). Include estimates of time to failure.
   f. Subcontractor shall specify required service operating parameters at contract boundary, with contractor input on selected design operating criteria.
6. Deleted

3.4 Mechanical Requirements

See Appendix A for melter service and connection interface details and Appendix B for the balance of melter design interface details.

A. Discharge Chamber
   1. For baseline discharge chamber operation, glass discharge will alternate between the two chambers for every other canister. The switch between chambers will not occur until a canister has been filled.
   2. Each discharge chamber shall be designed for a throughput of three (3) metric tons per day.
B. Feed Nozzles
   1. Feed nozzles shall be designed for a throughput of three (3) metric tons per day, with all nozzles operating.
   2. Contractor will provide the following to each feed nozzle:
      a. A dedicated feed line and pump.
      b. Cooling water.
      c. Air and water purge.
   3. Subcontractor shall coordinate with contractor to design glass frit addition system, for use during melter startup. Subcontractor shall be responsible for design of frit discharge "nozzle" that will penetrate the melter lid.
C. Viewing Systems
   1. Design one (1) closed circuit television (CCTV) and associated system for viewing plenum area and cold cap.

2. CCTV will be used on an intermittent basis, as operation and maintenance requirements dictate. It will be removed from the melter when not in use. Design CCTV to be removable and replaceable with remote handling equipment.
3. Coordinate with contractor for design and incorporation of glass discharge viewing equipment, to be supplied by contractor.
4. Viewing ports shall be purged to prevent buildup of solids and other contaminants.
5. Cool CCTV ports as required.

D. Refractory Expansion Control System
1. Design jack bolts to actively control refractory expansion without operator intervention. Remote operation of, and access to, the bolts shall be maintained.
2. Coordinate with Contractor to provide a means of locally monitoring cooling panel and refractory movement with visual indicators.

E. Melter Cooling Water System
1. Provide water cooling using panels around the glass pool, plenum, and discharge chambers as required. Contractor will be responsible for water supply to the panels.
2. Cooling panels shall be designed in accordance with Ref 2.1D3.
3. Cooling panel design shall be such that internal pressure and/or temperature induced distortions will not place undue stress against the melter refractory.
4. Design cooling panels to be emptied at melter changeout or decommissioning.
5. Coordinate with contractor for overall cooling water system design, including instrumentation and controls, external to the melter.

F. Melter Offgas System
1. See Appendix A for sizes of primary and standby offgas pipes.
2. Each pipe shall accommodate anticipated melter in-leakage and purge streams. In-leakage streams include, but are not limited to, room air inflow from lid-mounted component removal/replacement operations, and inflow from the discharge chambers. Purges include gas inflows from the film coolers, feed nozzles, bubblers, and airlift lance.
3. Offgas pipe routing from the melter to the submerged bed scrubbers will be defined by the contractor.
4. Design and configuration of the primary offgas film cooler will reduce the offgas temperature and minimize solids deposition during the various modes of operation to support downstream offgas system operation. See Appendix B for additional requirements affecting film cooler design.
5. Film cooler design shall incorporate a means for internal cleaning. This operation may be assisted with remote handling equipment in the melter cave.
6. Provide redundant pressure measurement for the melter plenum.

G. Piping
1. All cooling water piping, feed piping and pour flanges shall be per Ref 2.1D1. Piping seismic design shall be in accordance with Ref 2.1D2, Appendices N and F. See Appendix A for piping fluid service categories. Subcontractor shall provide documentation for justification of service class selected where different than what is shown.
2. Joints: Use of all joints other than butt-welded shall be submitted for contractor review and approval.
3. Piping Nozzle Slopes: See Appendix B for slopes of selected utility and service lines.
4. Disconnects: Coordinate with contractor to define remote disconnect requirements at the melter-facility boundaries.
5. Drains: Provide low-point "floor" drains between the gas barrier and the refractory for the maximum credible leak from a complete break of one cooling water panel pipe. Coordinate with contractor to provide leak detection equipment at the drains. Design drains to prevent clogging from particle waste and to minimize inflow of air due to the melter operating at a vacuum.

H. Material Requirements

1. Subcontractor shall define all melter SSC material requirements in accordance with this Specification and applicable codes and standards. Where deviations are required, subcontractor shall notify contractor before proceeding with design.
2. Materials selected shall be able to withstand the corrosive environment caused by the melter feed, glass, and offgases for SSC lifetimes given in Section 3.2A2 and Appendix B. Combustible materials shall not be used without prior approval from contractor.
3. Subcontractor shall consider environmental, durability, corrosion and erosion factors during material selection. At a minimum, subcontractor shall evaluate the following characteristics:
   a. Surface finish
   b. Chemical resistance
   c. Radiation resistance
   d. Pressure effects (cyclical)
   e. Temperature effects
   f. Hardness (possibility of galling and fretting)
   g. Fatigue (cyclic stresses both with and without the presence of aggressive chemicals).
4. Corrosion monitoring capability during operations is not required.

I. Bubblers
1. Bubbler assemblies shall be isolated from the melter lid and lid jumpers to prevent electrical short-circuiting.
2. Coordinate with contractor to define air/gas supply requirements.

3.5 Structural Requirements

See Appendix A for melter service and connection details and Appendix B for the balance of melter design interface details.

A. General
1. In order to perform its credited safety function, the melter shell must maintain structural integrity and remain in place to preclude potential impacts to SC-I items during and after a seismic event. Thus the melter shell and restraints are SC-II, and shall be seismically qualified in accordance with Ref. 2.2.I.
   a. The "appropriate in-structure response spectra" cited by Ref. 2.2.I for dynamic analysis shall envelope the 3 % damped ISRS at building lines 10 & C and 11 & M from reference 2.2.H.
   b. Subcontractor shall submit a Seismic Qualification Report consistent with the requirements of Ref. 2.2.I.
2. Maintaining structural integrity as required above does not preclude limited yielding of the gas barrier portion of the melter shell during a seismic event, providing the following general and safety requirements are met:
   a. Permanent effects resulting from SC-II loading shall not prevent the melter from being removed from the facility and placed in its overpack.
   b. Permanent effects resulting from SC-II loading shall not allow for the bulk flow of molten glass.
   c. In order to maintain the integrity of the offgas system, which is an SC-III system, the shell shall maintain an appropriate factor of safety against yield when subjected to appropriately combined SC-III loadings.
3. During transport and normal operating conditions, the deflection under load shall be limited to allow for proper refractory performance.
4. Subcontractor shall design an anchor system, per SC-II, to lock melter in place, including pin, restraint, and interface to building embeds.

5. Subcontractor shall verify through analysis that the melter will remain capable of normal operation after a lateral seismic acceleration at the base of the melter of 0.061g in any horizontal direction.
6. For melter transport into the facility, subcontractor shall conduct analyses and provide documentation to ensure that refractory arrangement and integrity is maintained. Notify contractor if additional or temporary means of refractory restraint are advantageous.
7. The design of the electrodes and the melter dam shall address creep over the life of the component.

B. Melter Base
   1. See Appendix B for additional structural related interface details.

C. Transportation System
   1. Rollers/Wheels:
      a. Subcontractor shall consider worst potential load type combination in determining roller/wheel load capacity.
      b. Provide vertical adjustment capability (passive and/or active) to accommodate slight differences in transport rail elevation.
   2. Fasteners, Anchors, and Positioning Devices: Coordinate with contractor to establish design and interface requirements for all phases of melter life.
   3. See Appendix B for transportation system interface details.

D. Loadings
   1. Dead Loads: Design shall consider the combined weight of all melter SSCs. Other static loads to be considered include:
      a. Temporary rigging equipment during transport.
      b. Weight corresponding to maximum glass volume during operations.
      c. Circulated cooling fluids during operations.
      d. Encasement of all voids with grout during decommissioning.
   2. Live Loads: Subcontractor shall coordinate with contractor to develop loading requirements and limits related to transport, maintenance, decommissioning, and jumper attachment.
   3. Seismic loads:
      a. For SC-II systems and components, seismic loads shall be determined in accordance with Ref 2.2.I.
      b. For SC-III systems and components, the seismic loading shall be determined in accordance with the Ref 2.2.M using the following parameters:
         i. Rp=3.0
         ii. hx=3.0
         iii. hr=68
      c. Alternately, SC-III seismic response may be determined by means of scaling the response from the SC-II analysis
         i. The scale factor shall be the ratio of the static base shear of the melter as determined by ref 2.2.M to the largest base shear value determined in the SC-II analysis
   4. Pressure Gradients: The gas barrier walls shall be evaluated to withstand the operating pressure range of the offgas lines identified in Appendix A.
   5. Other Loads:
      a. Thermal induced loads to be experienced during startup, normal operations, and idling.
      b. Piping reaction loads during normal operation.
      c. Impact wrench load. Maximum design load is 450 ft-lbs.
   6. See Appendix B for melter static and live load detail requirements.
   7. Load Combinations: .
      a. The melter is to be analyzed for the loads and combined loads appropriate to the seismic category (SC) of the component being considered as listed below.

i. SC-II elements: load combinations are based on the Structural Analysis and Design Criteria (Ref. 2.2.J) and ANSI/AISC N690 (Ref. 2.1.J.1)
ii. SC-III elements: load combinations are based on the Engineering Specification for Structural Design Loads for Seismic Category III & IV Equipment and Tanks (Ref. 2.2.M)

b. Notations
i. D = Dead Load
ii. L = Live Load
iii. E = Earthquake
iv. Fμ = Inelastic Energy Absorption Factor
v. To = Thermal Loads during Operating Conditions
vi. Ro = Operating Pipe Reaction Load
vii. S = Allowable Stress per Allowable Stress Design Method

c. SC-II load combinations
i. Non-earthquake load combinations, all elements
(a) S = D + L
(b) S = D + L+ Ro + To
(c) For primary plus secondary stresses, the allowable limits above are increased by a factor of 1.5
ii. All elements except those in compression and shear, or for bolted connections
(a) 1.6S = D + L +Ro + To + E / Fμ
iii. For elements in compression and shear, and for bolted connections
(b) 1.4S = D + L +Ro + To + E / Fμ

d. SC-III load combinations
i. S = D + L
ii. S = D + L+ Ro + To
iii. For primary plus secondary stresses, the allowable limits above are increased by a factor of 1.5
iv. S = 0.75 (D + L + Ro + To + E / 1.4)

8. Allowable Stresses
a. Allowable stresses for plate and prismatic elements shall be determined using methods consistent with good structural engineering practice and the applicable Code, regardless of the method of analysis.
i. SC-II allowable stresses are per Ref. 2.1.J.1
ii. SC-III allowable stresses are per Ref. 2.1.K

9. Analysis: For 3D finite element analyses (FEA), in absence of code language governing allowable stresses, the following analysis approach shall be utilized:
a. Criteria for stresses in SC-II elements
i. Stress in elements loaded in tension, compression or bending shall be maximum principal stress criteria
ii. Stress in elements loaded in shear shall be Tresca stress (maximum shear stress)
b. Criteria for stresses in SC-III elements
i. Stress in all elements, regardless of loading, may be Von Mises (maximum distortion energy) criteria
c. Combined responses may be determined by superposition of responses from individual finite element models, provided appropriate explanation and justification is given.

10. Support Reactions
a. Support reactions for all SC-II load cases and combinations shall be submitted in accordance with section 7.2 of reference 2.2 I.

b. SC-II seismic reactions at the interface of the melter base seismic pin and lug shall not exceed the following limits, per Ref. 2.2.L. Loads may act in all directions concurrently.
   i. 250 kip east-west
   ii. 250 kip north-south
   iii. 100 kip vertical
c. SC-II seismic reactions at each "tailhook" bracket shall not exceed 90 kips vertically, per Ref. 2.2.L. No other loads are permitted on the tailhooks.

E. Other
1. Buckling
   a. To ensure that elements in the load path maintain their structural integrity, appropriate methods of analysis shall be employed to analyze elements subject to buckling and other failure modes that are not predictable by FEA
      i. To preclude buckling due to shear loads, plate elements shall be stiffened as required in the Code
      ii. The allowable stress of elements subject to buckling due to compressive loads shall be reduced appropriately as required by the Code.
   b. Highly localized areas of stress determined by FEA to be above the allowable stress, are to be considered according to the Code commentary (Reference 2.1.J.1, section CQ1.5), providing that engineering judgments are documented and justified where used.
2. Structural welding shall be per Refs. 2.1.I.1 and 2.1.I.2
3. Material properties for structural analysis shall be per Ref. 2.1.D.6

3.6 Electrical Requirements

See Appendix A for melter service and connection details and Appendix B for the balance of melter design interface details.

A. General
1. The following code references apply to this section: Refs 2.1C1 through 2.1C5, 2.1E, 2.1F1, 2.1F2, 2.1G1, 2.1G2, and 2.1H.
2. Subcontractor shall specify the following:
   a. Minimum and maximum values of the following electrical parameters associated with the Joule heating process for HLW glass envelopes: AC/DC power, voltage, current, waveform, and frequency.
   b. Melter protective interlocks required on the power source to the melter electrodes.
   c. Electrode firing configuration.
   d. Instrumentation and control requirements for the power source to the electrodes, discharge heaters, and startup heaters.

B. Electrode Power
1. Electrodes and extension buses shall be capable of carrying the current at the voltage required for all modes of melter operation.
2. Minimize connection resistance if the extension bus and electrode are two separate components.
3. Connector for making external connections to the extension buses shall allow for expansion and contraction of the extension bus.
4. Magnetic Coupling: Extension buses shall not cause magnetic coupling with the materials through which they pass.
5. Electromagnetic Interference: To the extent practical, the configuration of the extension buses shall maximize magnetic field cancellation.

C. Discharge Heater Power

1. Discharge heaters shall be matched to the extent practical with respect to resistance, operating current, and voltage.
2. Each discharge heater assembly shall be designed with a plug-type connector integral to the heater assembly.
3. The discharge heaters shall be electrically isolated from each other and from the melter structure.

D. Startup Heater Power
1. Startup heaters shall be matched to the extent practical with respect to resistance, operating current, and voltage.
2. Design power connectors to each heater assembly, with coordination from Contractor.
3. The startup heaters shall be electrically isolated from each other and from the melter structure.

E. Cable
1. Refer to Ref 2.1F1 for general cable design standards.
2. Cables routed within the melter envelope shall be rated for the maximum ambient temperature encountered.
3. Cable insulation and jacket material shall be of the low flammability type, per Ref 2.1C5.
4. Cable insulation and jacket material shall be resistant to heat, moisture, impact, radiation, and ozone as required for the expected operating environment.
5. Cables shall be supported or routed in raceway within the melter structure.
6. Power cables of size # 2/0 and larger will be single conductor or triplexed.
7. Instrument cables shall be single-pair, triad-twisted and shielded, or multi-pair with shielded pair and overall shield and drain wire.
8. Control cables shall be multi-conductor and color coded in accordance with Ref 2.1F1, Standard Method. Coordinate with contractor to determine requirements for spare conductors that shall be included in multi-conductor control and instrumentation cables.
9. Instrument and thermocouple cables will be single pair twisted and shielded, or multi-pair cable with individual pair shielded and overall shield.
10. Minimum Conductor Sizes:
    a. #12 AWG for power circuits.
    b. #14 AWG for control circuits (120 VAC, 125 VDC) and instrument power circuits.
    c. #18 AWG for instrumentation - single pair cable.
    d. #20 AWG for instrumentation - multi pair cable.

    Note: Instrumentation conductors include low-level voltage, current, or digital electrical signal connections to sensing and actuating devices.
11. See Appendix A on conductors for normal and instrument power circuits, control circuits, and instrumentation (both single pair cable and multi pair cable). Instrumentation conductors include low level voltage, current, or digital electrical signal connections to sensing and actuating devices.
12. Cables shall be physically separated in accordance with the function and voltage class as follows:
    a. Low-voltage power AC and DC cables.
    b. High-level signal and control or discrete on/off control cables (120 VAC, 125 VDC).
    c. Controls with critical safety requirements as determined by contractor.
    d. Cables for general instrumentation (i.e., low-level analog and digital signals and data communication).

F. Deleted

G. Grounding
1. Metal sections of melter lid, base, structure, and containment system shall be electrically interconnected.
2. The HLW melters are grounded via contact between the facility rails and the wheels of the melter base.
3. Deleted

4. Deleted.

3.7 Controls and Instrumentation Requirements

A. Controls Requirements: For melter design requirements, related to control logic, sequence of operations, and control software and hardware, see Ref 2.2B. Controls system design is in contractor's scope of work unless stated otherwise in Ref 2.2B.
B. Instrumentation Requirements
   1. For melter design requirements related to instrumentation see Ref 2.2B.
   2. Appendix A contains instrumentation connection interface details related to specific melter SSCs.

3.8 Maintenance Requirements

A. General
   1. Design of all nonstructural SSCs shall be optimized for safe and effective remote maintenance. To the extent practical, the design will:
      a. Minimize downtime, and impacts to overall operation of the facility.
      b. Keep maintenance activities simple and straightforward, suitable for a power manipulator and an overhead maintenance crane.
      c. Minimize requirement for special tools and equipment for maintenance.
      d. Modularize SSCs for remote maintenance, access, and replacement.
      e. Demonstrate best possible access to controls, protective interlocks, and SSCs for maintenance.
      f. Minimize impact on interfacing SSCs while performing maintenance on targeted SSCs.
      g. Allow for the gathering of diagnostic information where possible to determine melter life.
      h. Incorporate features to aid in replacement of SSCs that do not meet the melter design life requirement of five years.
   2. Subcontractor shall perform failure modes and effects analyses on the critical SSCs identified in Ref 2.2D:
      a. Specify what critical SSCs need to be maintained and inspected, specify maintenance and inspection requirements, and provide data on predicted availability.
      b. Identify potential failures for critical SSCs, and recovery sequences.
      c. Identify and implement sufficient redundancy requirements to minimize impact on glass production.
   3. Subcontractor shall interface with contractor to ensure that access around melters is sufficient for inspection of all external melter surfaces, per Appendix B.
   4. Subcontractor shall identify all special tools and equipment for maintenance.
   5. All removable or replaceable components and equipment shall have lifting bails designed to interface with the overhead maintenance crane or power manipulator. See Appendix B for maintenance handling criteria.
   6. Subcontractor shall coordinate with contractor to optimize melter maintenance access, taking into account facility layout and maintenance support equipment and services outside of the subcontractor's scope of work.
B. Baseline Component Design Lives: See Appendix B for melter component design lives. Subcontractor shall advise contractor of changes, including component additions and deletions as well as improvements in baseline lifetimes.

4 Quality Assurance Requirements

4.1 General

A. Subcontractor and sub-tier vendors shall perform all design work in accordance with a contractor-approved quality assurance plan which meets the applicable requirements of Ref 2.1D4, and in accordance with Ref. 2.1D5.
B. Subcontractor shall be responsible for all sub-tier vendor quality assurance requirements during design.
C. See Ref 2.2D for quality assurance requirements pertaining to specific melter SSCs.
D. The contractor reserves the right to review design work in progress to assess the effectiveness of the subcontractor's quality system at any time during the design process. Assessments performed by the contractor shall in no way relieve the subcontractor of any contractual responsibilities.

5 Documentation and Submittals

5.1 General

A. See Ref 2.2D for submittal format, transmission, and review requirements.

5.2 Submittals

A. See Ref 2.2D for specific melter system submittal requirements not specified herein.

Appendix A

Melter Services and Connections Interface Details (4 pages total)

ITEM IDENTIFIER	DESCRIPTION	CONNEC-TION NUMBER	LINE SIZE, INCH	OPS MODE	SERVICE TYPE	NOMINAL FLOW / AMPS	NOMINAL PRESSURE / VOLTS AT POINT OF USE	NOMINAL TEMPER-ATURE, F	DESIGN LIMIT FLOW / AMPS (NOTE 59)	DESIGN LIMIT PRESSURE / VOLTS (NOTE 59)	DESIGN LIMIT TEMPER-ATURE, F	CRITICAL SERVICE	FLUID SERVICE CATEGORY (NOTE 59)	CONNEC-TION TYPE	NOTES
por18	AIR SUPPLY - AIR LIFT/RISER PURGE GAS (TYPICAL OF 2)	N12, N13	3/8	INTERMITTENT	IA-2	3 SCFM	3 PSIG	113	N/A	<15 PSIG	240	NO	D	STAUBLI	14, 53, 24
agi13	AIR SUPPLY - BUBBLER (TYPICAL OF 5)	N05, 6, 7, 8, 9	1/2	CONTINUOUS	IA-2	3 SCFM	10 PSIG	113	N/A	<15 PSIG	240	YES	D	STAUBLI	14, 15, 24
agi08	AIR SUPPLY - BUBBLER OR STARTUP HEATER, SPARE	N11	1/2	SPARE	IA-2	3 SCFM	10 PSIG	113	N/A	<15 PSIG	240	NO	D	STAUBLI	29
htm18	AIR SUPPLY - ELECTRODE COOLING (TYPICAL OF 2)	N/A	1	CONTINUOUS	IA-2	50 SCFM	N/A	113	N/A	25 PSIG	113	NO	D	STAUBLI	
htm19	AIR SUPPLY - ELECTRODE EXTENSION COOLING (TYPICAL OF 2)	N/A	1	CONTINUOUS	IA-2	10 SCFM	N/A	113	N/A	25 PSIG	113	YES	D	STAUBLI	
ogp12	AIR SUPPLY - FUTURE STANDBY FILM COOLER	N03B	2	SPARE	IA-1	N/A	N/A	113	N/A	<15 PSIG	240	YES	D	SPECIAL	
ogp13	AIR SUPPLY - ITS PLENUM PRESSURE TAP	N10A	1/2	CONTINUOUS	IA-1	0.2 SCFH	5 PSIG	113	N/A	5 PSIG	240	YES	D	STAUBLI	
ogs03	AIR SUPPLY - LINE PURGE, STANDBY OFFGAS	N/A	2	CONTINUOUS	IA-1	30 - 160 SCFM	5 PSIG	113	N/A	<15 PSIG	240	NO	D	SPECIAL	
ogp09	AIR SUPPLY - PLENUM (STAND BY OFF GAS) VACUUM MEASUREMENT	N56	3/8	CONTINUOUS	IA-2	0.2 SCFH	0 PSIG	113	N/A	<15 PSIG	240	NO	D	STAUBLI	34
vew01	AIR SUPPLY - PLENUM CCTV COOLING (IF INSTALLED)	N36	1/2	CONTINUOUS (IF CCTV INSTALLED)	IA-1	15 SCFM	10 PSIG	113	N/A	<15 PSIG	240	YES	D	STAUBLI	28
ogp03	AIR SUPPLY - FILM COOLER	N03A	2	CONTINUOUS	IA-1	309 SCFM	0 PSIG	113	N/A	<15 PSIG	240	NO	D	SPECIAL	35
lkd01	AIR SUPPLY - SHELL LEAK DETECTOR (REDUNDANT PLENUM VACUUM)	N33	3/8	CONTINUOUS	IA-1	0.2 SCFH	1	113	N/A	<15 PSIG	240	NO	D	STAUBLI	
por19	ARGON SUPPLY - AIR LIFT/RISER PURGE GAS (TYPICAL OF 2)	N12, N13	3/8	CONTINUOUS	IA-2	0.2 SCFH	0 PSIG	113	N/A	<15 PSIG	240	YES	D	STAUBLI	14
lvl01	ARGON SUPPLY - LEVEL DETECTOR, DENSITY LEG	N34B	3/8	CONTINUOUS	Ar	1 SCFH	2 PSIG	113	N/A	<15 PSIG	240	YES	D	STAUBLI	
lvl02	ARGON SUPPLY - LEVEL DETECTOR, LEVEL LEG	N34A	3/8	CONTINUOUS	Ar	1 SCFH	3 PSIG	113	N/A	<15 PSIG	240	YES	D	STAUBLI	
drn01	DRAIN - MELTER SHELL	N32	1	RARE (ONLY IF LEAK OCCURS)	N/A	N/A	0 PSIG	113	N/A	N/A	113	NO	N/A	N/A	40
fed16	FEED SUPPLY - FEED NOZZLE (TYPICAL OF 2)	P01, P02	3/4	CONTINUOUS	N/A	1 GPM	35 PSIG	113	N/A	166 PSIG	360	NO	D	STAUBLI	64
fed07	FRIT ADDITION FUNNEL	P02	3	STARTUP ONLY	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NO	N/A	3-BOLT FLANGE	6, 30
htd21	POWER - DISCHARGE CHAMBER HEATER (TYPICAL OF 8 FOR EAST & WEST, PAIRED CONNECTIONS)		N/A	CONTINUOUS	ELEC-TRICAL	30-50 A	0 - 202 V	N/A	50 A	600 V	500	NO	N/A	MULTI-CONTACT	

ITEM IDENTIFIER	DESCRIPTION	CONNEC-TION NUMBER	LINE SIZE, INCH	OPS MODE	SERVICE TYPE	NOMINAL FLOW / AMPS	NOMINAL PRESSURE / VOLTS AT POINT OF USE	NOMINAL TEMPER-ATURE, F	DESIGN LIMIT FLOW / AMPS (NOTE 59)	DESIGN LIMIT PRESSURE / VOLTS (NOTE 59)	DESIGN LIMIT TEMPER-ATURE, F	CRITICAL SERVICE	FLUID SERVICE CATEGORY (NOTE 59)	CONNEC-TION TYPE	NOTES
htd22	POWER - DISCHARGE CHAMBER HEATER, AUXILIARY, TYPICAL OF 2		N/A	RARE	ELEC-TRICAL	20 A	208 V	N/A	35 A	600 V	500	NO	N/A	MULTI-CONTACT	11
hts06	POWER - STARTUP HEATER (TYPICAL OF 5)	P05, 6, 7, 8, 9	N/A	STARTUP ONLY	ELEC-TRICAL	115 A	320 V	N/A	150 A	600 V	113	NO	N/A	NONE	6, 29
ogp11	OFFGAS - MAIN PORT	P03	8	CONTINUOUS	N/A	N/A	-5 IN W.G.	400 - 1000	N/A	-100 IN. W.G.	1000	NO	M	3-BOLT FLANGE	37
ogs02	OFFGAS - STANDBY PORT	P04	8	RARE	N/A	N/A	-5 IN W.G.	400 -1000	N/A	-100 IN. W.G	1000	NO	M	3-BOLT FLANGE	37
ogp10	POWER - FILM COOLER CLEANER	N58	N/A	RARE	ELEC-TRICAL	5 A	480 VAC	N/A	N/A	N/A	N/A	NO	N/A	LEMO	
vew02	POWER - CCTV. PLENUM	N59	N/A	CONTINUOUS (IF CCTV INSTALLED)	ELEC-TRICAL	3 A	120 VAC	N/A	N/A	N/A	N/A	NO	N/A	LEMO	
htm20	POWER - ELECTRODE (TYPICAL OF 2)	N/A	N/A	CONTINUOUS	ELEC-TRICAL	1500 - 6000 A	75 - 320 VAC	N/A	6300	350 VAC	N/A	YES	N/A	SPECIAL	
vew05	SIGNAL - CCTV, PLENUM	N60	N/A	CONTINUOUS (IF CCTV INSTALLED)	ELEC-TRICAL	N/A	1 V	N/A	N/A	N/A	N/A	NO	N/A	LEMO	
ogp01	SIGNAL - FILM COOLER CLEANER LIMIT SWITCH, DOWN	N59	N/A	RARE	SIGNAL	2 A	120 VAC	N/A	N/A	10 PSIG	N/A	NO	N/A	LEMO	
ogp02	SIGNAL - FILM COOLER CLEANER LIMIT SWITCH, UP	N59	N/A	RARE	SIGNAL	2 A	120 VAC	N/A	N/A	25 PSIG	N/A	NO	N/A	LEMO	
ogs07	SPARE SERVICE - CONNECTION TO STANDBY OFFGAS	N57	3/8	RARE	IA-2	N/A	-5 IN W.G.	113	N/A	N/A	150	NO	D	STAUBLI	
agi14	SPARE SERVICE - PORT (TYPICAL OF 4)	N/A	1/2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	150	NO	N/A	STAUBLI	
tmp49	TC - EAST DISCHARGE CHAMBER, THERMOWELL #1 (TYPICAL OF 2 VIA COMMON CONNECTION)	N/A	N/A	CONTINUOUS	THERMO-COUPLE SIGNAL	N/A	N/A	N/A	N/A	N/A	N/A	NO	N/A	LEMO	
tmp50	TC - EAST DISCHARGE CHAMBER, THERMOWELL #2 (TYPICAL OF 2 VIA COMMON CONNECTION)	N/A	N/A	CONTINUOUS	THERMO-COUPLE SIGNAL	N/A	N/A	N/A	N/A	N/A	N/A	NO	N/A	LEMO	
tmp45	TC - EAST ELECTRODE, (3 FOR ELECTRODE, 2 FOR COOLING AIR EXHAUST ALL VIA COMMON CONNECTION)	N/A	N/A	CONTINUOUS	THERMO-COUPLE SIGNAL	N/A	N/A	N/A	N/A	N/A	N/A	NO	N/A	LEMO	
tmp53	TC - EAST REFRACTORY THERMOWELL (TYPICAL OF 5 VIA COMMON CONNECTION)	N/A	N/A	CONTINUOUS	THERMO-COUPLE SIGNAL	N/A	N/A	N/A	N/A	N/A	N/A	NO	N/A	LEMO	
tmp47	TC - GLASS POOL & PLENUM, EAST THERMOWELL (TYPICAL OF 5 VIA COMMON CONNECTION)	N/A	N/A	CONTINUOUS	THERMO-COUPLE SIGNAL	N/A	N/A	N/A	N/A	N/A	N/A	NO	N/A	LEMO	
tmp48	TC - GLASS POOL & PLENUM, WEST THERMOWELL (TYPICAL OF 5 VIA COMMON CONNECTION)	N/A	N/A	CONTINUOUS	THERMO-COUPLE SIGNAL	N/A	N/A	N/A	N/A	N/A	N/A	NO	N/A	LEMO	

ITEM IDENTIFIER	DESCRIPTION	CONNEC-TION NUMBER	LINE SIZE, INCH	OPS MODE	SERVICE TYPE	NOMINAL FLOW / AMPS	NOMINAL PRESSURE / VOLTS AT POINT OF USE	NOMINAL TEMPER-ATURE, F	DESIGN LIMIT FLOW / AMPS (NOTE 59)	DESIGN LIMIT PRESSURE / VOLTS (NOTE 59)	DESIGN LIMIT TEMPER-ATURE, F	CRITICAL SERVICE	FLUID SERVICE CATEGORY (NOTE 59)	CONNEC-TION TYPE	NOTES
tmp51	TC - WEST DISCHARGE CHAMBER, THERMOWELL #1 (TYPICAL OF 2 VIA COMMON CONNECTION)	N/A	N/A	CONTINUOUS	THERMO-COUPLE SIGNAL	N/A	N/A	N/A	N/A	N/A	N/A	NO	N/A	LEMO	
tmp52	TC - WEST DISCHARGE CHAMBER, THERMOWELL #2 (TYPICAL OF 2 VIA COMMON CONNECTION)	N/A	N/A	CONTINUOUS	THERMO-COUPLE SIGNAL	N/A	N/A	N/A	N/A	N/A	N/A	NO	N/A	LEMO	
tmp46	TC - WEST ELECTRODE (3 FOR ELECTRODE, 2 FOR COOLING AIR EXHAUST, ALL VIA COMMON CONNECTION)	N/A	N/A	CONTINUOUS	THERMO-COUPLE SIGNAL	N/A	N/A	N/A	N/A	N/A	N/A	NO	N/A	LEMO	
tmp54	TC - WEST REFRACTORY THERMOWELL (TYPICAL OF 5 VIA COMMON CONNECTION)	N/A	N/A	CONTINUOUS	THERMO-COUPLE SIGNAL	N/A	N/A	N/A	N/A	N/A	N/A	NO	N/A	LEMO	
por06	VENT - EAST DISCHARGE CHAMBER	N47A	2	CONTINUOUS	N/A	17 SCFM	N/A	907	17 SCFM	-5 PSIG	1000	NO	N/A	3 BOLT FLANGE	33
por14	VENT - WEST DISCHARGE CHAMBER	N46A	2	CONTINUOUS	N/A	17 SCFM	N/A	907	17 SCFM	-5 PSIG	1000	NO	N/A	3 BOLT FLANGE	33
clg32	WATER RETURN - COOLING PANEL TOTAL BASED ON 95 F SUPPLY	N/A	N/A	N/A	CW	45 GPM	N/A	120	45 GPM	150 PSIG	366	YES	NS		
clg01	WATER RETURN - COOLING BASE	N21	1	CONTINUOUS	CW	10 GPM	50 PSIG	120	10 GPM	150 PSIG	366	YES	NS		
clg24	WATER RETURN - COOLING, EAST WALL	N25	1	CONTINUOUS	CW	10 GPM	50 PSIG	120	10 GPM	150 PSIG	366	YES	NS		
clg26	WATER RETURN - COOLING, NORTH WALL	N24	1	CONTINUOUS	CW	10 GPM	50 PSIG	120	10 GPM	150 PSIG	366	YES	NS		
clg28	WATER RETURN - COOLING, SOUTH WALL	N23	1	CONTINUOUS	CW	5 GPM	50 PSIG	120	5 GPM	150 PSIG	366	YES	NS		
clg30	WATER RETURN - COOLING, WEST WALL	N22	1	CONTINUOUS	CW	10 GPM	50 PSIG	120	10 GPM	150 PSIG	366	YES	NS		
clg02	WATER SUPPLY - COOLING, BASE	N16	1	CONTINUOUS	CW	10 GPM	50 PSIG	95	10 GPM	150 PSIG	366	YES	NS	STAUBLI	
clg25	WATER SUPPLY - COOLING, EAST WALL	N20	1	CONTINUOUS	CW	10 GPM	50 PSIG	95	10 GPM	150 PSIG	366	YES	NS	STAUBLI	
clg27	WATER SUPPLY - COOLING, NORTH WALL	N19	1	CONTINUOUS	CW	10 GPM	50 PSIG	95	10 GPM	150 PSIG	366	YES	NS	STAUBLI	
clg29	WATER SUPPLY - COOLING, SOUTH WALL	N18	1	CONTINUOUS	CW	5 GPM	50 PSIG	95	5 GPM	150 PSIG	366	YES	NS	STAUBLI	
clg31	WATER SUPPLY - COOLING, WEST WALL	N17	1	CONTINUOUS	CW	10 GPM	50 PSIG	95	10 GPM	150 PSIG	366	YES	NS	STAUBLI	
fed14	WATER SUPPLY - FEED NOZZLE FLUSH TYPICAL OF 2	N/A	N/A	INTERMITTENT	DIW	2 GPM	35 PSIG	95	2 GPM	150 PSIG	366	NO	N/A	N/A	

ITEM IDENTIFIER	DESCRIPTION	CONNEC-TION NUMBER	LINE SIZE, INCH	OPS MODE	SERVICE TYPE	NOMINAL FLOW / AMPS	NOMINAL PRESSURE / VOLTS AT POINT OF USE	NOMINAL TEMPER-ATURE, F	DESIGN LIMIT FLOW / AMPS (NOTE 59)	DESIGN LIMIT PRESSURE / VOLTS (NOTE 59)	DESIGN LIMIT TEMPER-ATURE, F	CRITICAL SERVICE	FLUID SERVICE CATEGORY (NOTE 59)	CONNEC-TION TYPE	NOTES
ogp04	WATER SUPPLY - FILM COOLER WASH (INJECTED VIA FILM COOLER AIR LINE)	N/A	N/A	INTERMITTENT	DIW	1 GPM	25 PSIG	95	1 GPM	135 PSIG	366	NO	N/A	N/A	
fed06	WATER SUPPLY -PREFEED PLENUM COOLING WATER, EAST FEED	N01B	3/4	INTERMITTENT	DIW	1 GPM	25 PSIG	95	1 GPM	135 PSIG	366	NO	N/A	STAUBLI	
fed09	WATER SUPPLY -PREFEED PLENUM COOLING WATER, WEST FEED	N02B	3/5	INTERMITTENT	DIW	1 GPM	25 PSIG	95	1 GPM	135 PSIG	366	NO	N/A	STAUBLI	
ogs01	WATER SUPPLY - STANDBY OFFGAS PIPE SPRAY, SAME CONNECTION AS ogs03	N/A	N/A	INTERMITTENT	DIW	1 GPM	25 PSIG	95	1 GPM	135 PSIG	366	NO	NS	STAUBLI	

SERVICE TYPE

Ar	WELDING GRADE ARGON
CW	COOLING WATER, DEMINERALIZED, FILTERED TO <2 MICRON, NO CORROSION INHIBITORS, CL < 40 PPM, SULFATE <100 PPM, TDS <340 PPM, TOTAL SUSPENDED SOLIDS, <300 PPM, TOTAL HARDNESS < 170 PPM
IA-1	INSTRUMENT AIR PER ANSI/ISA-S7.0.01-1996
IA-2	INSTRUMENT AIR WITH EXTRA FILTRATION FOR PARTICULATE, WATER, AND HYDROCARBONS
DIW	DEMINERALIZED WATER

1 COOLING WATER SUPPLY TEMPERATURE IS TO BE GREATER THAN MELTER GALLERY AIR TEMP TO PREVENT CONDENSATION

6 INSTALLED DURING MELTER STARTUP

11 DISCHARGE CHAMBER AUX HEATERS NOT NORMALLY CONNECTED. HEATER TO BE USED FOR POUR FLANGE GLASS BLOCKAGE RECOVERY

14 AIR LIFT DISCHARGES ARE OPERATED INTERMITTENTLY ONE AT A TIME. ARGON IS PURGED THROUGH THE AIR LIFT AT 0.2 SCFH WHEN GLASS IS NOT BEING DISCHARGED

24 N/A = NOT APPLICABLE

28 COOLING AIR WILL BE EXHAUSTED INTO MELTER CAVE

29 BUBBLER AND STARTUP HEATERS FIT THE SAME LID NOZZLES

30 FRIT ADDITION AND FEED NOZZLES FIT SAME LID NOZZLES

34 LEVEL DETECTOR REFERENCE LEG AND MELTER PLENUM PRESSURE COMBINED MEASUREMENT FROM STANDBY OFGFGAS PORT

35 MAY INCLUDE WATER FLUSH FOR FILM COOLER

37 TEMP MAY BE HIGHER IF FILM COOLER AND AIR INJECTION STOPS DURING PRESSURE TRIP

40 SEAL POT OR TRAP REQUIRED

50 ONCE PER 4 HOURS THE FEED LINES ARE FLUSHED. THIS OCCURS FOR EACH OF THE 6 ADS PUMPS/FEEDLINES, OR 1.5 GPH PER MELTER. APPROX ONCE PER MONTH, FLUSH EACH FEED NOZZLE FOR APPROX 30 MIN.

53 AIR FLOWS DURING POURS ONLY, APPROX. 30 MIN EVERY 3 HR. ARGON USED AS A CONTINUOUS PURGE, EVEN DURING POURS (ABOUT 1 SCFH)

54 WATER USED TO COOL PLENUM AFTER IDLE FLOW FROM ONLY 1 NOZZLE IS SUFFICIENT, DURATION APPROX 30 MIN.

59 UNLESS OTHERWISE NOTED, THE OPERATING DESIGN LIMITS MUST BE BASED ON PROCESS VALUES DEFINED BY RPP-WTP ENGINEERING. WHERE PROCESS VALUES DIFFER FROM THE B31.1 PIPING/TUBING SERVICE CLASS, THE SERVICE CLASS IS GOVERNING.

64 PROCESS VALUES ARE BASED ON PILOT MELTER DATA AND DESIGN DEVELOPMENT. ACTUAL MELTER OPERATING/DESIGN CRITERIA MAY VARY DEPENDING ON FINAL SYSTEM DESIGN BY RPP-WTP

Appendix B

Melter Design Interface Details (10 pages total)

Tag	Component (2, 3)	Interface Detail (2, 3)	Interface Criteria	System/ Area Locators	Comments
agi07	bubbler	component weight	290.31 lb.	HSH	
agi08	bubbler	intermediate in-facility storage criteria	consumable template has storage positions for 8 consumables with 11 in dia. bases	HSH	note 5
agi02	bubbler	operating life	MTTF - 2 mos	HSH	
agi03	bubbler	remote handling requirements	3 inch across flats for captive fasteners, 1-1/4 inch ACME thread, nut retainer, standard lifting bail for 5 ton and 17 ton crane hook	HSH	
vew09	cctv - for melter plenum	component weight	250 lb. max	HSH	
vew07	cctv - for melter plenum	dimensions - envelope	16.75" dia. X 34.31" tall	HSH	
vew14	cctv - for melter plenum	intermediate in-facility storage criteria	consumable template has storage positions for 8 consumables with 11 in dia. bases	HSH	note 5
vew02	cctv - for melter plenum	operating life	MTTF - 12 mos	HSH	
vew05	cctv - for melter plenum	remote handling requirements	2 inch across flats for captive fasteners, 1-1/4 inch ACME thread, nut retainer, standard lifting bail for 5 ton and 17 ton crane hook	HSH	
enc49	cooling panel expansion indicators	adjustment interface/connection	adjustments to indicators not necessary	HSH	
enc46	cooling panel expansion indicators	quantity	*21 total - 6 on east wall, 9 on north wall, 6 on west wall*	HSH	
enc48	cooling panel expansion indicators	viewing criteria	need to view a 4" diameter wheel at a steep viewing angle. Approximately 60-90 degrees	HSH	jumper placement by project may affect view
enc17	datum point - facility reference	coordinates of melter datum in plant coordinate system	*melter 1: N. 3806' - 7 1/4" E. 10149' - 1" Elev. 2' - 11" melter 2:* N. 3806' - 7 1/4" E. 10042' - 1" Elev. 2' - 11"	30	*note 5.*
enc18	datum point - facility reference	description of physical location	located 7.75 inches to south of pour spouts center line on west rail center line at elev. 2'-11"	30	
enc38	datum point - facility reference	dimensional tolerance for locating datum point in melter cave	to be determined by project after completion of melter design	HSH	note 5
enc21	datum point - melter reference	description of physical location (x,y,z location from which all melter dimensions originate from)	point on top center of west rail, on centerline of seismic restraint pin. See enc18 and res04	30	
enc41	datum point - melter reference	fabrication/ assembly dimensional tolerances	+/- 0.031" (0.0156" for the hole on the end truck and 0.0156" for the holes(s) in the restraint	30	
por24	discharge chamber lid	component weight	1642 lb.	HSH	
por23	discharge chamber lid	dimensions - envelope	33.125" x 40.0" plan, 19.125" high from bottom of refractory to top of cover, 34.25" high from bottom of refractory to top of lifting lugs	HSH	
por06	discharge chamber lid	operating life	MTTF - 30 mos	HSH	
por05	discharge chamber lid	remote handling requirements	5 inch across flats for captive fasteners, 1-1/4 inch ACME thread, nut retainer, standard lifting bail for 5 ton and 17 ton crane hook; alignment device will protect heater elements from damage during installation (see maintenance tools)	HSH	

Tag	Component (2, 3)	Interface Detail (2, 3)	Interface Criteria	System/ Area Locators	Comments
enc26	drain - for annulus spaces	drain configuration	elbow directed downward with "flapper valve" on end, drains onto pour cave cover	HMP	
enc36	drain - for annulus spaces	leak detection configuration for drain	shell leak detector level probe will be located with its tip roughly in elbow of drain. If leak develops, water will build up to about 5" wc, then any additional water will drip out of flapper valve.	HMP	
enc51	drain - for annulus spaces	physical location	lower northwest corner of melter	HMP	
enc52	drain - for annulus spaces - leak detection equipment	operating life	MTTF - life of melter	HSH	
env32	facility rails	configuration	rectangular, 2.5" wide, flat, top of rail elevation 2'-11", east/west rail stops 11-3/4"/11-3/4" north of building grid K	HMH	
env33	facility rails	load limits - horizontal	Design anchorage of rail for 10% of vertical load on wheel	HMH	conforms to wheel vendor design recommendations and Crane Manufacturers Association of America (CMAA)
env67	facility rails	load limits - vertical	Assume 2 times wheel rating in env52 for occasional overload	HMH	
env36	facility rails	material/finish/coating/heat treating	17-4PH stainless, condition H900, yield stress = 183ksi, RMS 63 to 125, no coating.	HMH	
env39	facility rails	maximum rail gap	8 inches	HMH	Subcontractor comfortable crossing any rail gap smaller than 20.5 inches (wheel spacing), less 2 inches (load distribution per CMAA 70, 3.3.2.3), less any rail tapers used. A 7.5 inch rail gap between the HLW melter overpack and the HLW vitrification facility rails will be acceptable.
env40	facility rails	size/configuration	2.5" wide, must be flat, no more than a 1/32" chamfer (or radius) on edges, at least 1" tall for rail flange clearance. Top of rail elevation 2'-11", rails stop 11-3/4" north of building grid K.	HMH	
env41	facility rails	tolerances - horizontal lateral /parallel	horizontal lateral deviation +/- 0.04" over a 6 foot rail span, parallelism of rails in horizontal plane +/- 0.04" for each 16 foot span (non-cumulative)	HMH	
env34	facility rails	vertical/levelness tolerance	0.060"	HSH/HMH	Requirement driven by facility rail flatness tolerance
fed14	feed nozzle	component weight	108 lb.	HSH	
fed11	feed nozzle	dimensions - envelope	13" dia. flange X 23.88" long	HSH	
fed21	feed nozzle	intermediate in-facility storage criteria	consumable template has storage positions for 8 consumables with 11 in dia. bases	HSH	note 5. Feed nozzle to be stored in Consumable Template
fed03	feed nozzle	operating life	MTTF - life of melter	HSH	

Tag	Component (2, 3)	Interface Detail (2, 3)	Interface Criteria	System/ Area Locators	Comments
fed07	feed nozzle	remote handling requirements	5 inch across flats for captive fasteners, 1-1/4 inch ACME thread, nut retainer, standard lifting bail for 5 ton and 17 ton crane hook	HSH	
fed19	feed nozzle - glass frit addition	component weight	132 lb.	HSH	
fed16	feed nozzle - glass frit addition	configuration	project design requirement. Will be configured to interface with subcontractor port design.	HSH	shall interface with consumable bucket with gate valve on bottom to accept bulk charge of frit w/o metering
fed20	feed nozzle - glass frit addition	intermediate in-facility storage criteria	consumable template has storage positions for 8 consumables with 11 in dia. bases	HSH	note 5. Storage location will be determined by project operations
fed05	feed nozzle - glass frit addition	remote handling requirements	4 inch across flats for captive fasteners, 1 1/4 inch ACME thread, nut retainer, standard lifting bail for 5 ton and 17 ton crane hook	HSH	
ogs13	film cooler	component weight	251 lb.	HSH	
ogs11	film cooler	dimensions - envelope	22" dia. flange x 23.5" long, from bottom to top of flange	HSH	
ogs36	film cooler	intermediate in-facility storage criteria	consumable template has storage positions for 8 consumables with 11 in dia. bases	HSH	note 5
ogs03	film cooler	operating life	MTTF - 36 mos	HSH	
ogs05	film cooler	remote handling requirements	2 inch across flats for captive fasteners, 1-1/4 inch ACME thread, nut retainer, standard lifting bail for 5 ton and 17 ton crane hook	HSH	
ogs17	film cooler cleaner	component weight	1000 lb. max	HSH	
ogs16	film cooler cleaner	dimensions - envelope	to be verified after melter design is complete	HSH	
ogs37	film cooler cleaner	intermediate in-facility storage criteria	consumable template has storage positions for 8 consumables with 11 in dia. bases	HSH	note 5. On hold
ogs06	film cooler cleaner	operating life	MTTF - 12 mos	HSH	
ogs08	film cooler cleaner	remote handling requirements	3 inch across flats for captive fasteners, 1-1/4 inch ACME thread, nut retainer, standard lifting bail for 5 ton and 17 ton crane hook	HSH	
plv05	glass pool level detector	component weight	102 lb.	HSH	
plv07	glass pool level detector	dimensions - envelope	76.2" long to bottom of flange, 87.22" long to top of fixed lifting bail, 13" dia flange, total width is 13.94"	HSH	
plv09	glass pool level detector	intermediate in-facility storage criteria	consumable template has storage positions for 8 consumables with 11 in dia. bases	HSH	note 5
plv02	glass pool level detector	operating life	MTTF - 9 mos	HSH	
plv04	glass pool level detector	remote handling requirements	4 inch across flats for captive fasteners, 1-1/4 inch ACME thread, nut retainer, standard lifting bail for 5 ton and 17 ton crane hook	HSH	
por28	glass riser airlift lance	component weight	81 lb.	HSH	
por27	glass riser airlift lance	dimensions - envelope	87.75" long to top of plug, 95.71" long to top of fixed lifting bail, 13" dia flange	HSH	

Tag	Component (2, 3)	Interface Detail (2, 3)	Interface Criteria	System/ Area Locators	Comments
por31	glass riser airlift lance	intermediate in-facility storage criteria	consumable template has storage positions for 8 consumables with 11 in dia. bases	HSH	note 5
por10	glass riser airlift lance	operating life	MTTF - life of melter	HSH	
por12	glass riser airlift lance	remote handling requirements	6 inch across flats for captive fasteners, 1-1/4 inch ACME thread, nut retainer, standard lifting bail for 5 ton and 17 ton crane hook	HSH	
enc45	jackbolt	adjustment interface/connection	PaR 3000 with parallel grip hand interfaces directly with adjuster. Max torque 185 in-lb.	HSH	
enc27	jackbolt	monitoring plan during startup and for general maintenance	final plan to be determined. May only need periodic (monthly basis) monitoring using in-cave cctv's	HSH	
enc44	jackbolt	quantity	21 total - 6 on east wall, 9 on north wall, 6 on west wall	HSH	
enc28	jackbolt	viewing criteria	direct visual with in-cave camera	HSH	Direct visibility or visibility with melter cave CCTV
enc03	melter - castable refractory	allowable sit times before bakeout	12 months+	BOF	Subcontractor design objective
enc54	melter - general	bolt torque limit for use of remote impact wrench	450 ft-lb. max	HSH	
env08	melter - general	clearance criteria for maintenance and equipment access	limited or no access at sides or under jumpers to east. Items on east side requiring visual monitoring to be angled to north or south.	HSH	Cable attachment points front and rear. Accessible with 300-750 ft-lb. variable torque impact wrench at jackbolt sites and jumper sites
env61	melter - general	clearance criteria for services under melter	no services or obstructions to exist between top of rails up to bottom of melter base (cross beams), except for tailhooks.	HSH	
env55	melter - general	component/consumable lifting design criteria	lifting bales/devices designed to 3 times yield	HSH	
enc10	melter - general	design for remote breakdown of melter in event of catastrophic failure	lid designed to be removed for decontamination and for access to pool for glass removal using remote operated in-cave equipment. Actual process for lid removal to be defined by project after melter design is complete.	HSH	Open Issue for alternate molten glass removal; drawings cited do not include cradle concept
enc31	melter - general	dimensions - envelope	172" N-S x 164" E-W x 146" high (installed component height from top of rail). 157" high to top of extended lifting bails, 134" high to top of melter shell.	HMH	
env13	melter - general	electrical grounding connections - location and connection details	use off-gas jumper, standby off-gas jumper, and two feed jumpers, requires that the submerged bed scrubber and feed tank be grounded.	GRE	
env14	melter - general	guard rails and safety barriers - configuration and loads for startup	guard rails and safety barriers are not a project requirement	HSH	note 5
enc16	melter - general	lifting bail design for consumables/ replaceable equipment	listed separately for each component - see remote handling criteria	HSH	
env05	melter - general	maintenance tool needs	discharge heater assembly handling stands, spreader bar and installation alignment/ guide tool; cover plates; melter wheel power package; electrode thermocouple installation and guide tool; commissioning glass pool sampler	HSH	

Tag	Component (2, 3)	Interface Detail (2, 3)	Interface Criteria	System/ Area Locators	Comments
env68	melter - general	Radiation dose rate - external	sides: 39.6 rem/hr, front/back: 65.3 rem/hr, bottom: 12.5 rem/hr, top (no decon): 84.0 rem/hr, top (w/ decon) 4.50 rem/hr	HSH	Combined dose for 0" shielding. For other cases, see reference p. 33 of 36.
enc39	melter - general	thermal movement (maximum) of any nozzle, from centroid of melter	0.156"	HSH	
enc42	melter - general	tolerances - fabrication/assembly dimensional tolerances for flexible connections from melter datum point	+/- 0.078" (includes melter datum point location tolerance, +/- 0.032" for positioning lid wrt melter datum, 0.015" for position tolerance for each hole from machining)	HMH/HMP	specific tolerances defined on Subcontractor melter assembly drawings
enc43	melter - general	tolerances - fabrication/assembly dimensional tolerances for hard connections from melter datum point	+/- 0.078" (includes melter datum point location tolerance, +/- 0.032" for positioning lid wrt melter datum, 0.015" for position tolerance for each hole from machining)	HMH/HMP	specific tolerances defined on Subcontractor melter assembly drawings
enc15	melter - general	use of common ports between operating modes	bubblers and startup heaters are the only consumables that utilize a common port	HMP	
enc01	melter - general	weight - empty and operating	176,695 lb. without glass, 199,029 lb. with glass	HMH	tolerances not included
env58	melter - lid	handling cradle configuration	handling cradle will be attached to melter lid for flipping and shipping. Lifting/ transportation devices to bolt to cradle.	BOF	
env62	melter - lid	handling cradle requirements for assembly/transport	accommodates flipping of melter lid 180 degrees; does not interfere with castable refractory installation; protects lid studs, lid and refractory during bake-out and transportation; supports discharge chamber top surface to prevent buckling of lid side walls	BOF	
env63	melter - lid	handling cradle requirements for decommissioning	imported into cave via overpack; interfaces with in-cave embeds; is handled in cave with 12' lifting beam and remote tooling (impact wrench, etc.); able to be decontaminated; designed for high-cycle vibration from jackhammer during refractory breakout	HSH	
env57	melter - lid	handling criteria	melter lid must be safely flipped during assembly, transportation, and decommissioning (see env62 and env63 for specific requirements)	BOF	
env59	melter - lid	lifting/flipping loads	total lifted weight not to exceed 17 tons (capacity of in-cave crane)	HSH	
ogs18	melter - operation	annular space in-leakage air quality	unfiltered cave air	HOP	
gls01	melter - operation	glass composition - forming chemicals by waste envelope	reference composition for envelope D tank AZ101 is glass 98-31	HMP	
gls07	melter - operation	glass electrical conductivity	0.1 – 0.7 S/cm @ 1100 – 1200°C	HMP	
gls13	melter - operation	glass frit composition	Al_2O_3 - 13.57%, CaO - 0.40%, K_2O - 2.01%, MgO - 2.11%, P_2O_5 - 3.42%, ZnO - 3.12%, B_2O_3 - 17.29%, Fe_2O_3 - 0.70%, Li_2O - 2.51%, Na_2O - 15.88%, SiO_2 - 38.99%; Viscosity ~ 50 poise @ 1125°C, Conductivity ~0.35 S/cm @ 1125C, Liquidus < 900°C	HMP	**Composition subject to change based on long term idling requirements during commissioning.**
por26	melter - operation	glass pool level range during operation	43" - 43.8"	HMP	
gls09	melter - operation	glass pool liquidus temperature, range	<950°C	HMP	
htg13	melter - operation	glass pool temperature range	1100 - 1200° C w/ setpoint at 1150° C	HMP	

Tag	Component (2, 3)	Interface Detail (2, 3)	Interface Criteria	System/ Area Locators	Comments
gls11	melter - operation	glass viscosity @ operating temp, range	10 to 150 Poise at 1100°C	HMP	
vnt04	melter - operation	heat loss through melter shell to cave, feed mode	78 kW	C5V	
vnt05	melter - operation	heat loss through melter shell to cave, idle mode	85kW	C5V	
env60	melter - operation	maximum/minimum ambient temperatures in melter cave	113F / 59F	C5V	
ogs24	melter - operation	offgas temperature downstream of film cooler - during feed - normal and design ranges	207 - 249 C	HOP	
ogs25	melter - operation	offgas temperature downstream of film cooler - during idle - normal and design ranges	313 C	HOP	
ogs20	melter - operation	offgas temperature in plenum - during feed - normal and design ranges	400 - 550 C	HOP	
ogs21	melter - operation	offgas temperature in plenum - during idle - normal and design ranges	1000 C	HOP	
wst06	melter - operation	waste feed characteristics - normal waste	per simulated waste used in pilot melter tests. will depend on actual composition of tank waste delivered to project. Tank AZ101 with 98-31 glass adequately defines waste composition for melter design purposes	HMP	
wst07	melter - operation	waste feed characteristics - range of feed variation	will depend on actual composition of tank waste delivered to project. Tank AZ101 with 98-31 glass adequately defines waste composition for melter design purposes	HMP	
fed12	melter - operation	waste feed distribution through feed nozzles with respect to operating modes	two nozzles are required for proper plenum pool cold cap distribution, regardless of operating mode	HMP	
env54	melter - seismic	in-structure seismic response spectra	Ref. 2.2.H, Plots 106, 107, 108 @ 0' elevation, Joint J-12-1, Node 5423	30	"Seismic Qualification of Seismic Category I/II Equipment and Tanks"
env66	melter - seismic	remote handling requirements for seismic restraints	hex head bolt, 2" across flats for engaging seismic pin with remote impact wrench.	HSH	pins are provided with each melter
res03	melter - seismic	restraint loads	west pin 180,317 lb. east/west, 109,012 lb. north/south, 210,708 lb. resultant. East pin 0 lb. east/west, 109,012 lb. north/south, 109,012 lb. resultant applied at 1'-5 1/2" above top of embedded plate (elev. 4'-2"). Vertical load at each tailhook restraint: 56,870 lb. upward	HSH	
res04	melter - seismic	restraint location	pins: 7.75" South of Col. Line K, on centerlines of rails; Tailhooks: pin centerlines 8.25" inboard of rail centerlines at elev. 2'-11.395" (0.395" above rail), south face mounts at 136.23" north of melter datum. North face of facility pin receiver plate to be 135.5" north of melter datum.	HSH	
res05	melter - seismic	restraint quantity	four restraints, including two "tailhooks" for overturning	HSH	

Tag	Component (2, 3)	Interface Detail (2, 3)	Interface Criteria	System/ Area Locators	Comments
env56	melter - seismic	seismic restraint bracket envelope	pins: east embed horiz mounting surface - 1'-8" x 4'-6" at elev. 2'-8 1/2"; West horiz - 1'-8" x 4'-6" at elev. 2'-8 1/2", vertical surface 1'-6" high x 4'-6" at 7'-2" from melter centerline.North edge of east/west embed at 10 3/4" / 4 1/4" south of building grid K. Tailhook: 6" wide bracket with pin hangs below melter 2.605" below top of rail just inside of wheels. Tailhook receiver dimension: 7.5" wide bracket w/ 3"dia. hole and 3.75" edge distance (including at clipped corners). Mat'l: 1.5" thk. 304L SS.	HSH	
env69	melter - seismic	seismic restraint embedment tolerances for manufacture	East embed: top of plate at flat to within 0.015"; West embed: top of plate east of vertical plate flat to within 0.015"; perpendicularity and flatness of east face if vertical plate: +/- 1/16" of 90 degree plane. Excluded from above areas of horizontal and vertical surfaces: A 45 degree dianonal 3/8" fillet plane at the intersection corner of the two plates. Fillet weld build-up shall not penetrate this plane. Plate length dimensions not listed above +/- 1/8".	CS&A	tolerances are needed to ensure that no additional modification of seismic lug assemblies is required in field.
env 70	melter - seismic	seismic restraint embedment tolerances for placement in field	East embed: location of north and west edges of plate +/- 1/8". Top of plate elevation +0", -1/8" and level within 1/16"; West embed: location of north and east edges of plate +/- 1/8". Top of plate at lug base area (east of vertical plate): elevation +0", -1/8" and level within 1/16", location of east foace of vertical plate +1/8", -0" of indicated distance from melter centerline and parallel to melter centerline within 1/16"	CS&A	
res06	melter - seismic	seismic restraint installation requirements	Restraint lug base north edge to be installed 5.5" south of melter datum; center of tongue to align with rail centerline. Hole in lug is marked with melter moved into position, then removed from base for machining hole. Lug base is welded in place and lug is realigned horizontally using shims on sides; belleville spring washers are used to lock in final vertical position. Lug base welds are bevel welds along pour cave walls and at top edge of west base, fillets elsewhere.	HSH	one-time set up required for first melter in cave will not apply to subsequent melters
res02	melter - seismic	seismic restraint interface configuration	Subcontractor designed pin attachment (WTP-M-21730) welds to embed in melter cave. Tailhook for uplift on north end: 2.5" dia. 3" long pins facing south and fitting into 3" dia. receiving holes. See env56	HSH	
env51	melter - transport	guidance system - criteria for locating and setting melter in facility	guidance and location tolerances of flanged wheels on west rail and seismic pins	HMH	
env28	melter - transport	loads and moments transferred to melter	Towing lug on north side of melter designed for 0.23 times melter weight	HMH	load is to drag full melter with some, but not all wheels seized up.

Tag	Component (2, 3)	Interface Detail (2, 3)	Interface Criteria	System/ Area Locators	Comments
env65	melter - transport	loads and moments transferred to melter	Towing lug on south side of melter designed for 0.5 times melter weight	HSH	load is to drag full melter from overpack with all of the wheels seized. Must overcome static friction of wheels on overpack rails. Lubrication will be applied to overpack rails prior to insertion of spent melter.
env19	melter - transport	max acceleration/deceleration x/y/z during transport (new melter only)	0.1 g	HMH	
env27	melter - transport	remote handling requirements for cave import	use PaR installed "shepherds hook" with capacity to drag melter from overpack.	HSH	
env31	melter - transport	stop/deceleration mechanism for melter import (into cave)	proximity switch/stop switch mounted on in-cave wall	HSH	
clg02	piping - cooling water	slope of cooling water piping	no slope required for operational purposes	PCW	must have the ability to blow out dry with air
enc40	piping - offgas nozzle	thermal movement	0.076"	HMP	
ogs38	piping - standby offgas	operating life	MTTF - life of melter	HSH	
prm05	plenum pressure sensor	component weight	170 lb., about the same as a blank plug	HSH	
prm07	plenum pressure sensor	dimensions - envelope	26" dia. x 64" tall	HSH	
prm09	plenum pressure sensor	intermediate in-facility storage criteria	consumable template has storage positions for 16 consumables with 7 in dia. bases	HSH	note 5
prm02	plenum pressure sensor	operating life	MTTF - life of melter	HSH	
prm04	plenum pressure sensor	remote handling requirements	7 inch across flats for captive fasteners, 1-1/4 inch ACME thread, nut retainer, standard lifting bail for 5 ton and 17 ton crane hook	HSH	
enc53	plugs - lid spares	operating life	MTTF - life of melter	HSH	
htg18	startup heater	component weight	1074 lb. for 5 heaters, 215 lb. each	HSH	
htg14	startup heater	dimensions - envelope	16.75" dia. flange x 64.0" to top of cable enclosure	HSH	
htg19	startup heater	intermediate in-facility storage criteria	consumable bucket and template to be devised by project	HSH	note 5
htg02	startup heater	operating life	MTTF - 3 mos	HSH	operating life is for heater elements. Rest of heater should last life of melter
htg04	startup heater	remote handling requirements	6 inch across flats for captive fasteners, 1-1/4 inch ACME thread, nut retainer, standard lifting bail for 5 ton and 17 ton crane hook	HSH	
htg21	thermocouple - discharge chamber	component weight	16 lb.	HSH	
htg24	thermocouple - discharge chamber	intermediate in-facility storage criteria	consumable template has storage positions for 16 consumables with 7 in dia. bases	HSH	note 5
tmp29	thermocouple - discharge chamber	operating life	MTTF - 12 mos	HSH	

Tag	Component (2, 3)	Interface Detail (2, 3)	Interface Criteria	System/ Area Locators	Comments
htg25	thermocouple - discharge chamber	remote handling requirements	use standard lifting bail for 5 ton and 17 ton crane hook	HSH	
htg22	thermocouple - discharge chamber thermowell	dimensions - envelope	5.25" dia plug x 58.19" from bottom of thermocouple to top of lifting bail	HSH	
tmp31	thermocouple - electrode extensions	component weight	16 lb.	HSH	
tmp32	thermocouple - electrode extensions	dimensions - envelope	5.25" dia plug x 61.69" from bottom of thermocouple to top of lifting bail	HSH	
tmp33	thermocouple - electrode extensions	intermediate in-facility storage criteria	consumable template has storage positions for 16 consumables with 7 in dia. bases	HSH	note 5
tmp34	thermocouple - electrode extensions	operating life	MTTF - 12 mos	HSH	
tmp35	thermocouple - electrode extensions	remote handling requirements	horizontal insertion	HSH	
tmp17	thermocouple - plenum/pool	component weight	16 lb.	HSH	
tmp26	thermocouple - plenum/pool	intermediate in-facility storage criteria	consumable template has storage positions for 16 consumables with 7 in dia. bases	HSH	note 5
tmp37	thermocouple - plenum/pool	operating life	MTTF - 9 mos	HSH	
tmp06	thermocouple - plenum/pool	remote handling requirements	use standard lifting bail for 5 ton and 17 ton crane hook	HSH	
tmp19	thermocouple - refractory	component weight	16 lb.	HSH	
tmp27	thermocouple - refractory	intermediate in-facility storage criteria	consumable template has storage positions for 16 consumables with 7 in dia. bases	HSH	note 5
tmp07	thermocouple - refractory	operating life	MTTF - greater than 12 mos	HSH	
tmp09	thermocouple - refractory	remote handling requirements	use standard lifting bail for 5 ton and 17 ton crane hook	HSH	
tmp30	thermowell - discharge chamber	operating life	MTTF - 12 mos	HSH	
tmp39	thermowell - plenum/pool	component weight	99 lb.	HSH	
tmp15	thermowell - plenum/pool	dimensions - envelope	13" dia flange x 94.52" long from bottom to top of fixed lifting bail	HSH	
tmp38	thermowell - plenum/pool	operating life	MTTF - 9 mos	HSH	
tmp18	thermowell - refractory	dimensions - envelope	7.0" dia x 113.84" long	HSH	

Tag	Component (2, 3)	Interface Detail (2, 3)	Interface Criteria	System/ Area Locators	Comments
vnt07	vent insert - discharge chamber	operating life	MTTF - 30 mos	HSH	
vnt06	vent line - discharge chamber	operating life	MTTF - 30 mos	HSH	
env42	wheels	friction coefficient between melter and facility melter rails	0.23	HMH	estimated value
env11	wheels	remote handling requirements	no remote adjustments required	HSH	
env47	wheels	type/materials	Demag Model DRS315, cast iron	HMH	
env52	wheels	wheel load capacity	48,500 lb. for Demag Model DRS315.	HMH	
env43	wheels	wheel load distribution - over all wheels	Max - 26,800 lb.	HMH	
env44	wheels	wheel location and spacing	outside, 148" rail span (c-c), east/west side: south wheel centerline 22.5"/24.5" from seismic pin respectively	HMH	
env45	wheels	wheel quantity	7 wheels per side, spaced approximately 20.55" center-to-center	HMH	

Notes

1 Column Descriptions
"Tag" - Detail identifier. Not to be reused.
"Component" - Description of specific melter SSC for which the interface detail is associated, use as a sorting column.
"Interface Detail" - Description of interface/design detail in question. Use "Component" column for complete detail description.
"Interface Criteria" - Interface/design data, based on requirements in the specification.
"System/Area Locators" - developed in accordance with project procedures, identifies impacted discipline.
"Comments" - For providing status and/or additional clarification.

2 Write key words first, followed by secondary description if necessary.
3 Use these columns together to fully define interface detail.
4 N/A - not applicable
5 Interproject interface detail, not a subcontractor/project interface detail.

ISSUED BY
RPP-WTP PDC

R10384506

RIVER PROTECTION PROJECT – WASTE TREATMENT PLANT

ENGINEERING SPECIFICATION

FOR

Silver Mordenite Column Design and Fabrication

MARK W. HOFFMANN
STATE OF WASHINGTON
0030952
REGISTERED
PROFESSIONAL ENGINEER
9/26/04

EXPIRES 12/10/04

This bound document contains a total of 51 pages.

Content applicable to ALARA? ☒ **Yes** ☐ **No**

ADR No. **Rev**
N/A

Quality Designator
QL
DOE Contract No. DE-AC27-01RV14136

NOTE: Contents of this document are Dangerous Waste Permit affecting.

REV	DATE	REASON FOR REVISION	BY	CHECK	REVIEW	QA	APEM/DEM
2	9/26/04	Issued for Permitting Use				N/A	
1	1/28/04	Issued for Permitting Use	K Brightman	D Pease	C Morley	n/a	M Hoffmann
0	10/28/02	Issued for Permitting Use	J. Jackson	C. Morley	S. Kirk	n/a	n/a

SPECIFICATION No. 24590-HLW-3PS-MBT0-TP001 **Rev** 2

Notice

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the US Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

Contents

Notice ii
1 Scope 1
1.1 Project Description and Location 1
1.2 Equipment, Material, and Services Required 1
1.3 Work by Others 4
1.4 Acronyms and Definitions 4
1.5 Safety/Quality/Seismic Classifications 8
2 Applicable Documents 8
2.1 General 8
2.2 Codes 9
2.3 Industry Standards 9
2.4 Reference Documents/Drawings 10
3 Design Requirements 11
3.1 General Requirements 11
3.2 Basic Function 13
3.3 Performance 13
3.4 Design Conditions 14
3.5 Environmental Conditions 15
3.6 Loadings 16
3.7 Housing and Mounting Frame Requirements 16
3.8 Support Frame Requirements 17
3.9 Adsorber Requirements 17
3.10 Platform and Catwalk Requirements 18
3.11 Piping and Manifold Requirements 19
3.12 Lifting Requirements 19
3.13 Discharge Roughing Filter Requirements 19
3.14 Bag-in/Bag-out Procedure Requirements 19
3.15 Special Tool Requirements 20
3.16 Toolbox Requirements 21
3.17 CFD Model and Analysis Requirements 21
3.18 Thermal Analysis Requirements 22
3.19 Silver Mordenite Column Design Analysis Requirements 24
3.20 Accessibility and Maintenance 26
4 Materials 26

4.1 Construction 26
4.2 Positive Material Identification 28
4.3 Prohibited Materials 28
4.4 Storage of Special Materials (e.g., stainless steel) prior to work 28
5 Fabrication 29
5.1 General Requirements 29
5.2 Assembly 29
5.3 Tolerances 29
5.4 Welding Fabrication Requirements 30
5.5 Insulation 31
6 Tests and Inspections 32
6.1 General Requirements 32
6.2 Welding Inspection Requirements 33
6.3 Personnel Qualifications 34
6.4 Shop Tests 34
6.5 Field Tests 35
6.6 Bag-in/Bag-out Procedure Demonstration 35
7 Preparation for Shipment 36
7.1 General Requirements 36
7.2 Cleanliness 36
7.3 Painting 36
7.4 Tagging 36
7.5 Packaging 37
7.6 Documentation 37
7.7 Shipment Preparation Instructions 37
8 Quality Assurance 38
8.1 General Requirements 38
8.2 Quality (Q) Related Components 38
9 Configuration Management 39
10 Documentation and Submittals 39
10.1 General 39
10.2 30 % Design Review 40
10.3 90 % Design Review 40
10.4 Drawings 40
10.5 Calculations 41

10.6 Schedules 41

11 References 41

Figures

Figure 1 Typical Silver Mordenite Column 42

Figure 2 Typical Silver Mordenite Column Adsorber 43

Figure 3 Silver Mordenite Column Layout in HLW Facility 44

Figure 4 Crane Layout with Clearance Limitations for Silver Mordenite Adsorber Replacement 45

Figure 5 Silver Mordenite Column Support Frame and Anchorage 46

1 Scope

1.1 Project Description and Location

The Hanford Tank Waste Treatment and Immobilization Plant (WTP) is a complex of waste treatment facilities where the US Department of Energy (DOE) Hanford Site tank waste will be pretreated and immobilized into stable glass form via vitrification. The WTP Contractor will design, build, and startup the WTP pretreatment and vitrification facilities for the DOE Office of River Protection (ORP). The waste treatment facilities will pretreat and immobilize the low activity waste (LAW) and high level waste (HLW) currently stored in underground storage tanks at the Hanford Site.

The Hanford Site occupies an area of about 560 square miles and is located along the Columbia River, north of Richland, WA in the U.S.A. The WTP Facility will be constructed at the east end of the 200 East Area of the Hanford Site. The counties of Benton, Franklin, and Grant surround the Hanford Site.

1.2 Equipment, Material, and Services Required

This specification provides the requirements for the design, analysis, fabrication, project management, quality assurance, inspection, testing, qualification, and labeling of two (2) silver mordenite columns, a catwalk to connect the column platforms, associated filters, gaskets, fasteners, and special tools for use in the WTP HLW facility. This specification also provides the requirements for the creation, demonstration, design, fabrication, quality assurance, inspection, testing, qualification, and supply of silver mordenite, testing equipment, testing apparatus, testing materials, manuals, instructions, and procedures.

The scope of work for the Seller includes all work necessary to provide two (2) completely functional Silver Mordenite Columns specifically defined in this specification and its addenda and attachments. Work shall include, but is not limited to, the following:

1.2.1 Provide fully detailed designs, drawings, supporting calculations, supporting analyses, supporting models, procedures, and all labor, materials, fasteners, tooling, equipment, apparatus, instrumentation, shop drawings, and services necessary to manufacture, test, inspect, insulate, label, and package for shipment two (2) silver mordenite columns and catwalk to connect the column platforms in accordance with this specification and the attached data sheets that are in Section 2 of the Material Requisition (MR). Refer to Paragraph 3.1.6 for what shall be included as part of silver mordenite columns to be provided.

1.2.2 Provide Buyer with a breakdown (by paragraph) of the following codes, industry standards, and referenced documents to be applied to each aspect of the silver mordenite column detailed design, drawings, analysis, fabrication, quality assurance, inspection, testing, qualification, labeling, packaging, handling, and shipment for review prior to beginning the detailed design:

- ASME AG-1-1997
- ASME AG-1a-2000
- ASME N509-1989

If an entire section or part of the above listed codes and standards applies, a breakdown by paragraph is not required. Only the part or section shall be listed.

1.2.3 Provide a three-dimensional (3-D) computational fluid dynamics (CFD) model and analysis of the silver mordenite columns.

1.2.4 Provide a thermal analysis of the silver mordenite columns, column support frame, support base material, and catwalk.

1.2.5 Provide an analysis from a silver mordenite expert (defined in 1.4.2) of the silver mordenite column design to determine expected adsorbent changeout frequency.

1.2.6 In addition to the field testing requirements set forth in ASME AG-1, Section TA, and/or ASME N509, Section 9, conduct the following acceptance tests in the shop, on each silver mordenite columns, with exception to the airflow distribution test (which shall be performed on a single column to verify design), prior to shipment:

- Visual Inspection
- Structural Capability Test
- Mounting Frame Pressure Leak Test
- System Bypass Test
- Differential Pressure Test
- Airflow Distribution Test

1.2.7 Provide testing media for conducting shop acceptance tests if silver mordenite is not available in time. Issue manufacturer's information for testing media to the Buyer for review prior to purchase.

1.2.8 Provide challenge gas as defined in 1.4.2. As applicable per testing requirements, provide challenge gas injection and sampling ports/manifolds.

1.2.9 As applicable per testing requirements, provide all piping connections for challenge gas injection and sampling, pressure drop indication, pressure testing, leak testing, air flow distribution testing, and bypass testing required per this specification and its addenda and attachments.

1.2.10 Provide the services of a technical representative during installation and acceptance testing in the field. Provide all tooling, equipment, material, apparatus, instrumentation, and challenge gas necessary to conduct all field testing and inspections called for in this specification, applicable standards, applicable codes, and referenced documents. Provide travel, room, and board required.

1.2.11 Provide fully detailed designs, drawings, supporting calculations, procedures, and all labor, materials, fasteners, tooling, equipment, and services necessary to manufacture, test, inspect, and package for shipment two (2) sets (one for each column) of special tools to enable personnel to remove and install all fasteners, covers, lids, hold-downs, etc. necessary for removing and replacing silver mordenite column adsorbers and discharge roughing filters. Only manufacturer's information is required for tools readily available in the commercial market.

1.2.12 Provide a detailed bag-in/bag-out procedure for removal and replacement of the silver mordenite column adsorbers and discharge roughing filters. Seller may propose alternate method of replacement for Buyer review.

1.2.13 If full suite protection is required for bag-in/bag-out procedure, provide all personnel, equipment, apparatus, labor, Personnel Protection Equipment (PPE), materials, film, special tools, glovebags, bags, HEPA filters, etc. to simulate field conditions. Demonstrate, and videotape the bag-in/bag-out procedure using one of the fully assembled silver mordenite columns. Provide copies of the demonstration videotape, a glovebag (if required), one (1) unused bag, and any filters required for the demonstration.

1.2.14 Provide the services of a trainer to train Buyer maintenance personnel on the bag-in/bag-out procedure at the Buyer's offices in Richland, WA. Provide all materials, travel, room, and board required.

1.2.15 Select discharge roughing filters and gaskets for columns per the silver mordenite manufacturer's recommendation and this specification. Provide two (2) sets of discharge roughing filters and gaskets for each column in addition to all sets required for shop and field testing.

1.2.16 Provide material certified test reports, welding procedures, welder qualifications, insulation installation procedures, surface preparation and coating procedures, testing procedures, testing results, quality assurance procedures, quality control inspection results, and all other procedures and documentation required per this specification and its addenda and attachments.

1.2.17 Provide transportation, storage, and installation instructions for the silver mordenite column adsorbers per the silver mordenite manufacturer's recommendation and this specification.

1.2.18 Provide packaging and package the silver mordenite columns, column support frames, column catwalk, support frame shim packs, column adsorbers, roughing filters, gaskets, special tools, and silver mordenite for shipment to the WTP HLW facility site.

1.2.19 Provide all equipment, instrumentation, labor, and materials to test lifting points to be provided on the silver mordenite columns, column catwalk, column support frames, and adsorbers in the shop.

1.2.20 Provide Material Safety Data Sheets (MSDSs) for silver mordenite and all other materials used in the construction of the silver mordenite columns, column support frames, and shim packs.

1.2.21 Provide one (1) support frame for mounting each silver mordenite column to be provided (total two (2) support frames required). Provide fully detailed designs, drawings, supporting calculations, procedures, and all labor, material, fasteners, tooling, equipment, instrumentation apparatus, shop drawings, and services necessary to manufacture, test, inspect, prime, and prepare for shipment support frames in accordance with this specification.

1.2.22 Provide column support base insulation material required to insulate Buyer's concrete foundation in accordance with the requirements of this specification.

1.2.23 Provide shim pack(s) for each point silver mordenite column support attached to Buyer's foundation embed plates. Each shim pack shall include one (1) 0.25" shim and two (2) 0.120", 0.060", 0.036", 0,010", and 0.005" shims. Provide drawings, and all labor, materials, tooling, equipment, and services necessary to manufacture, prime, inspect, and prepare for shipment shim packs.

1.2.24 Provide storage and installation instructions for silver mordenite column support frames.

1.3 Work by Others

Any item not specifically listed as being supplied by the Buyer shall be provided by the Seller. The Buyer shall supply the following:

1.3.1 Shipping to jobsite.

1.3.2 Unloading and storage of all material and equipment at jobsite.

1.3.3 Installation labor at jobsite.

1.3.4 Concrete foundation, embed plates, and anchor bolts.

1.3.5 Operator Training.

1.3.6 Piping external to the silver mordenite column.

1.3.7 Pressure drop indicators for pressure drop piping connections.

1.3.8 Insulation required at support frames, shims, and embeds.

1.4 Acronyms and Definitions

1.4.1 Acronyms

3-D	Three-Dimensional
AGS	American Glovebox Society
AIHA	American Industrial Hygiene Association
ALARA	As Low As Reasonably Achievable
ANS	American Nuclear Society
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society for Nondestructive Testing
ASTM	American Society of Testing Materials
AWS	American Welding Society
CFD	Computational Fluid Dynamics

CFR	Code of Federal Regulations
DBE	Design Basis Event
DOE	US Department of Energy
ERDA	Energy Research and Development Administration
ERPG	Emergency Response Planning Guideline
ESF	Engineered Safety Feature
HEPA	High Efficiency Particulate Air
HLW	High Level Waste
HOP	Melter Offgas Treatment System
HVAC	Heating, Ventilation, and Air Conditioning
ITS	Important to Safety
LAW	Low Activity Waste
MR	Material Requisition
MSDS	Material Safety Data Sheet
NACE	National Association of Corrosion Engineers
NDE	Nondestructive Evaluation/Examination
NPH	Natural Phenomena Hazard
NPS	Nominal Pipe Size
OBE	Operating Basis Earthquake
ORP	DOE Office of River Protection
OSHA	Occupational Safety and Health Administration
PIP	Process Industry Practices
PMI	Positive Material Identification
PP	Personnel Protection
PPE	Personal Protection Equipment
ppmV	parts per million
psf	pounds per square foot (lb/ft^2)
QA	Quality Assurance
QAM	Quality Assurance Manual
QL	Quality Level
QL-2	Quality Level 2
RFQ	Request for Quote
RRC	Risk Reduction Class
SDC	Safety Design Class
SDS	Safety Design Significant
SC	Seismic Category

SC-3	Seismic Category 3 or Seismic Category III
scfm	Standard Cubic Feet per Minute
SRD	Safety Requirements Document
SS	Stainless Steel
SSC	System, Structures, and Component
TBD	To Be Determined
UL	Underwriters Laboratories, Inc.
WAC	Washington Administrative Code
w.g.	Water Gage
WTP	Hanford Tank Waste Treatment and Immobilization Plant

1.4.2 Definitions

Adsorbent: A solid having the ability to concentrate other substances on its surface. For this specification the adsorbent is silver mordenite (see silver mordenite definition).

Adsorber: A device or vessel containing adsorbent (e.g., an adsorber cell filled with adsorbent).

Adsorber Cell: A modular container for an adsorbent, with provision for sealing to a mounting frame, which can be used singly or in multiples to build up a system of any airflow capacity.

Adsorber Bank: Two or more adsorbers, in parallel, secured in a single mounting frame within the same housing. (e.g., Each silver mordenite column to be supplied per this specification is an adsorber bank containing 36 adsorbers.).

ALARA: As Low As Reasonably Achievable. ALARA documentation requirements apply to SSCs that have the potential to affect doses, contamination levels, or releases to the environment.

Bag-in/Bag-out: A method of introducing and removing items from a contaminated enclosure that prevents the spread of contamination.

Buyer's Representative(s): The Buyer's designee(s), who shall witness onsite operations at the seller and sub-seller sites and perform onsite inspections and surveillances.

Bypass, Leakage: A pathway through which contaminated air can escape treatment by the installed HEPA and/or adsorber banks. Examples are leaks in filters and filter mounting frames, defective or inefficient isolation dampers that result in the uncontrolled flow through adjacent plenums, and unsealed penetrations for electrical conduits, pipes, floor drains, etc.

C3: Contamination classification for plant areas that are ordinarily free of contamination, but have the potential of being contaminated.

Challenge Gas: A gas of known characteristics, under specified conditions, used for the purpose of testing. For in-shop and in-place/field testing of adsorbers required by this specification. The challenge gas to be used shall depend on what is recommended by the silver mordenite manufacturer. Challenge gas shall be an environmentally safe non-ozone depleting substance, if possible.

Discharge Roughing Filter: A micro-efficiency filter to be installed in the silver mordenite column housing downstream of the silver mordenite adsorbers for capture of abraded silver mordenite particles.

Engineered Safety Feature (ESF): A nuclear air treatment system, HVAC system, gas processing system, or a component that serves to control and limit the consequences of releases of energy and radioactivity in the event of occurrences as described in ANSI/ANS 51.1 and 52.1.

Glovebag: A temporary barrier to contain or prevent the spread of contamination generally during system maintenance or production. The area or component is surrounded by the portable glovebox boundary material, usually a flexible plastic film. Personnel perform work inside the glovebag through glovesleeves and gloves while remaining outside the containment area. Other access ports are provided to allow for equipment and service penetrations as necessary. Additional openings can be provided through the use of zippers, velcro closures, and bag-out ports.

HEPA Filter: A high efficiency particulate air filter having a fibrous medium with a particle removal efficiency of at least 99.97 % when tested with essentially monodispersed 0.3 μm test aerosol particles.

HEPA Filter Bank: Two or more HEPA filters, in parallel, secured in a single mounting frame within the same housing.

Important to Safety (ITS): SSCs that serve to provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the workers and the public. ITS encompasses the broad class of facility features addressed (not necessarily explicitly) in the top-level radiological, nuclear, and process safety standards and principles that contribute to the safe operation and protection of workers and the public during all phases and aspects of facility operations (i.e., normal operation as well as accident mitigation). ITS includes SSCs designated as Safety Design Class (SDC), Safety Design Significant (SDS), and Risk Reduction Class (RRC).

Mounting Frame: A structure against which adsorbers may be snugly mounted and supported in a position that permits the passage of air or gas and provides a surface to hold the sealing gasket, thereby avoiding a potential bypass or leakage path for the non-filtered air or gas.

Paragraph: When a paragraph of this specification, referenced documents, referenced codes, or referenced standards is referenced in this specification, the paragraph referenced <u>and</u> all subparagraphs and sub-subparagraphs of the paragraph referenced shall be considered inclusive.

Quality Level 2 (QL-2): SDS items. QL-2 shall also be used to identify other items and activities for which NQA-1 (1989) compliance is required.

Rad: A unit of energy absorbed from ionizing radiation, equal to 100 ergs per gram or 0.01 joules per kilogram of irradiated material.

Risk Reduction Class: RRC SSCs are ITS SSCs that are neither SDC nor SDS.

R3: Radiation classification for plant areas considered average. At early design stages, when insufficient information is available regarding worker occupancy, an initial target radiation level of 2.5 mRad/hr is to be used for the R3 classification.

Safety Design Class (SDC): is an SSC whose safety function is to prevent a worker or the maximally exposed member of the public from receiving a radiological exposure that exceeds the accident exposure standards defined in the Safety Requirements Document (SRD). An SDC is also an SSC whose safety function is to prevent a worker or the maximally exposed member of the public from receiving a chemical exposure that exceeds the exposure standards defined in the SRD, or an SSC credited for the prevention of a criticality event.

Safety Design Significant (SDS): SSCs needed to achieve compliance with the radiological or chemical exposure standards for the public and workers during normal operation; and SSCs that can, if they fail or malfunction, place frequent demands on or adversely affect the function of SDC SSCs.

Seismic Category 3(III) Equipment (SC-3): (a) SDC and SDS SSCs that do not have a natural phenomena hazard (NPH) safety function. (b) SSCs that have a seismic safety function solely because they protect workers and members of the public from exposure to chemical hazards. (c) Risk Reduction Class (RRC) SSCs that provide primary confinement of significant inventories of radioactive materials, but in amounts less than quantities that require an SDC or SDS designation.

Silver Mordenite: Shall refer to C-Chem AG-900 (10 x 16 mesh, cylindrical pellets) hydrogen reduced silver mordenite. A form of silver zeolite (AgZ).

Silver Mordenite Column: An adsorber bank.

Silver Mordenite Expert: One who has extensive knowledge regarding the characteristics and application of silver mordenite for radioactive iodine adsorption. Must have a minimum of five (5) years experience.

Special Tools: Any tooling required to perform maintenance on the silver mordenite column or for silver mordenite adsorber and discharge roughing filter removal and replacement. Includes tools that must be specially designed and fabricated and tools that are readily available in the commercial market.

Testing Media: Media that could be used (if necessary) to conduct shop testing that requires adsorbent media to be installed in the silver mordenite columns. Media shall be identical in size and shape to C-Chem AG-900 (10 x 16 mesh, cylindrical pellets) hydrogen reduced silver mordenite and be able to adsorb challenge gas long enough to conduct required shop acceptance testing.

Water Gage (w.g.): The units for air pressure typically expressed in inches of water column height (e.g., 60 inches w.g.). Equivalent to water column (w.c.).

1.5 Safety/Quality/Seismic Classifications

The quality level (QL) and seismic category (SC) of the silver mordenite columns are specified on the data sheets in Section 2 of the MR. The QL and SC for the column support frames shall be the same as the silver mordenite columns.

2 Applicable Documents

2.1 General

2.1.1 Work shall be done in accordance with the referenced codes, standards, and documents listed below, which are an integral part of this specification.

2.1.2 When specific chapters, sections, parts, or paragraphs are listed following a code, industry standard, or reference document, only those chapters, sections, parts, or paragraphs of the document are applicable and shall be applied. If a date or revision is not listed in section 2, the latest issue, including addenda, at the time of request for quote (RFQ) shall apply. The dates and revisions listed in section 2 shall apply to all subsequent references to codes and standards within this specification. When more than one code, standard, or referenced document covers the same topic, the requirements for all must be met with the most stringent governing.

2.2 Codes

2.2.1 ASME AG-1-1997, Code on Nuclear Air and Gas Treatment, Sections AA, FD, FF, FG, and TA

2.2.2 ASME AG-1a-2000, Addenda to ASME AG-1-1997 Code on Nuclear Air and Gas Treatment, Section HA

2.2.3 ASME B31.3-1996, Process Piping

2.2.4 ASME B30.20-1993, Below-The -Hook Lifting Devices

2.2.5 ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1, Rules for Construction of Pressure Vessels

2.2.6 AWS D1.6, Structural Welding Code-Stainless Steel

2.2.7 WAC 296-24, General Safety and Health Standards

2.3 Industry Standards

2.3.1 AGS-G001 ©1998, Guideline for Gloveboxes, Second Edition

2.3.2 ASME N509-1989, Nuclear Power Plant Air-Cleaning Units and Components, Sections 1, 2, 3, 4 (Paragraphs 4.3, 4.4, 4.6.1 through 4.6.7.2, 4.12, 4.13(a)), 5 (Paragraphs 5.6.5.5 and 5.6.5.6), 7 (Paragraph 7.2), 8 (Paragraph 8.2), 9, Appendix C, and Appendix D

2.3.3 ASME N510-1989 (Rev. 1995), Testing of Nuclear Air Treatment Systems, Sections 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 13, 15, and Appendices

2.3.4 ASME NQA-1-1989, Quality Assurance Program Requirements for Nuclear Facilities

2.3.5 ASME Y14.100, Engineering Drawing Practices

2.3.6 ASTM A240/A240M, Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels

2.3.7 ASTM C533, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation

2.3.8 ASTM C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation

2.3.9 ASTM C692, Standard Test Method for Evaluating the Influence of Thermal Insulations on External Stress Corrosion Cracking Tendency of Austenitic Stainless Steel

2.3.10 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel

2.3.11 ASTM C871, Standard Test Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate, and Sodium Ions

2.3.12 ASTM C929, Standard Practice for Handling, Transporting, Shipping, Storage, Receiving, and Application of Thermal Insulation Materials for Use in Contact with Austenitic Stainless Steel

2.3.13 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials

2.3.14 ASTM F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

2.3.15 ASTM F594, Standard Specification for Stainless Steel Nuts

2.3.16 ERDA 76-21, Nuclear Air Cleaning Handbook, Chapter 1 (All), Chapter 2 (Paragraphs 2.1 through 2.4.16), Chapter 3 (Paragraphs 3.1, 3.4.1, 3.4.2, 3.4.5, 3.4.6), Chapter 4 (Paragraphs 4.3 through 4.3.5, 4.5.9), Chapter 7 (All), Chapter 8 (All), Chapter 9 (Paragraph 9.4.1)

2.3.17 NACE Standard RP0198, The Control of Corrosion Under Thermal Insulation and Fireproofing Materials-A Systems Approach

2.3.18 PIP INIH1000, Hot Insulation Installation Details

2.3.19 PIP INSH2000, Installation of Hot Service Insulation Systems

2.4 Reference Documents/Drawings

2.4.1 24590-WTP-DC-ST-01-001, Structural Design Criteria

2.4.2 24590-WTP-3PS-G000-T0001, General Specification for Supplier Quality Assurance Program Requirements

2.4.3 24590-WTP-3PS-G000-TP002, Specification for Positive Material Identification (PMI)

2.4.4 24590-WTP-3PS-G000-T0003, General Specification for Packaging, Handling and Storage Requirements

2.4.5 24590-WTP-3PS-NWP0-T0001, Engineering Specification for General Welding and NDE Requirements for Supplier Fabricated Piping

2.4.6 24590-WTP-3PS-P000-T0001, Engineering Specification for Piping Material Classes

2.4.7 24590-WTP-3PS-SS00-T0001, Engineering Specification for Welding of Carbon Structural Steel

2.4.8 24590-WTP-3PS-SS00-T0002, Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel

2.4.9 24590-WTP-3PS-FB01-T0001, Engineering Specification for Structural Design Loads for Seismic Category III and IV Equipment and Tanks

2.4.10 24590-WTP-3PS-AFPS-T0001, Engineering Specification for Shop Applied Special Protective Coatings for Steel Items and Equipment

3 Design Requirements

3.1 General Requirements

3.1.1 The silver mordenite columns, catwalk between the columns, and column support frames shall be designed per this specification, the applicable documents listed in section 2 of this specification, and the attached data sheets that are in Section 2 of the MR.

3.1.2 The detailed design of the silver mordenite columns, catwalk between the columns, and column supports shall be performed by personnel who have, at a minimum, past experience in the design, fabrication, and testing of silver zeolite adsorber banks or HEPA filter banks to meet the requirements set forth in ASME AG-1, ASME AG-1a, and NQA-1. Qualifications for personnel conducting the detailed design of the silver mordenite columns shall be provided to the Buyer for review.

3.1.3 All calculations, modeling, analyses, drawings, and documentation shall be performed and/or completed using U.S. customary units.

3.1.4 The design of the two (2) silver mordenite columns to be provided shall be identical except for platform layout details and catwalk layout details (see Figure 3). See Figures 1 and 3 for column outlet termination points.

3.1.5 The CFD model and analysis, thermal analysis, silver mordenite column design analysis, and seismic analysis to be provided per this specification must verify that the final detailed design of the silver mordenite columns and column support frames meet the requirements set forth in this specification and its addenda and attachments.

3.1.6 Each silver mordenite column shall include all items shown or implied in Figure 1 including, but not limited to, the following:

- housing with inlet, outlet, mounting frame, mounting channel base with anchorage provisions, platform supports, discharge roughing filter receiver, piping connections and manifolds for testing and sampling, piping connections for pressure drop indication, insulation supports and hold-downs, column lifting lugs, adsorber hold-downs, adsorber cover hold-downs, internal baffles, and mixing vanes (if mixing vanes required)
- adsorbers
- adsorber covers
- discharge roughing filter with access cover
- gaskets for sealing adsorbers to mounting frame, adsorber covers, and discharge roughing filter cover
- insulation with jacketing
- platform with grating and guardrails
- catwalk platform with grating and guardrails
- tool box

One (1) of the silver mordenite columns shall also include an access ladder.

3.1.7 The silver mordenite columns shall be designed in a bank configuration with 36 silver mordenite adsorbers per column mounted to a mounting frame within a housing (refer to Figure 1). The inlet and outlet shall be at opposite ends with the melter offgas entering into an upper plenum (inlet plenum), flowing in parallel through the adsorbers to a lower plenum (outlet plenum), passing through a replaceable discharge roughing filter, and finally exiting.

3.1.8 Each silver mordenite column shall be designed for uniform offgas distribution so that the offgas velocity readings through each adsorber are within ± 20 % of the calculated average when operating at ± 10 % of the silver mordenite column's design flowrate.

3.1.9 As applicable per testing requirements, all testing and sampling piping, connections, ports, and manifolds shall be permanently attached to the silver mordenite columns and easily accessible for shop and field testing. The Seller shall work closely with the Buyer to determine best locations for testing and sampling piping, connections, ports, and manifolds.

3.1.10 The silver mordenite columns shall be designed for use with the bag-in/bag-out procedure to be developed by the Seller to facilitate adsorber and discharge roughing filter removal and replacement operations from the silver mordenite column's platform. The Seller shall work closely with the Buyer on developing the bag-in/bag-out procedure.

3.1.11 A platform with guardrails shall be permanently attached to the top of each silver mordenite column to enable access to the top of the columns for adsorber removal. The silver mordenite column platforms shall be joined by a catwalk using mechanical fasteners after installation (refer to Figure 1 and Figure 3). There shall be a three (3) foot wide opening, with a safety gate or chain installed, in the guardrail of one (1) of the column platforms to facilitate adsorber removal to grade. A ladder, with a safety gate or chain installed in column guardrail opening, shall be permanently affixed to the northwest corner of the northern silver mordenite column to facilitate access to the platforms.

3.2 Basic Function

3.2.1 The silver mordenite columns are part of the HLW HOP system to remove gaseous radioactive iodine (I-129) from the melter offgas stream. The columns will also remove other gaseous halogens, such as fluorine and chlorine.

3.2.2 Melter offgas is generated from the vitrification of HLW slurry feed by a joule-heated ceramic melter. The offgas consists primarily of:

- Air from inleakage into the melter, instrumentation, purges, and melter bubbler operation (if used)
- Water evaporated from the melter feed
- Acid gases (i.e., CO_2, NO_x, SO_x, etc.) generated from anion decomposition
- Aerosols from dried melter feed and melter cold-cap reaction solids, and
- Semivolatile chemicals generated from the molten glass pool

3.3 Performance

3.3.1 The silver mordenite columns shall be designed and fabricated to meet the mechanical and process requirements on the attached data sheets in Section 2 of the MR and the design requirements given in this specification.

3.3.2 The silver mordenite columns, catwalk, and support frame shall be designed for a minimum service life of 40 years.

3.3.3 The silver mordenite columns shall have a minimum adsorbent life expectancy (before requiring changeout due to halogen breakthrough) of five (5) years when operating 8,760 hours per year.

3.3.4 Pressure boundary leakage shall be no greater than 0.2 % of rated flowrate at a minimum leakage test pressure equal to 150 % of maximum operating pressure.

3.3.5 The adsorber bypass leakage shall be no greater than 0.1 % of rated flow at 99.9 % efficiency.

3.3.6 Each silver mordenite column shall have uniform offgas flow distribution such that velocity readings through each adsorber within the column (36 total) do not exceed ±20 % of the calculated average when operating within ±10 % of design flowrate.

3.3.7 At maximum design temperature, the insulation jacket temperature and all uninsulated portions of the silver mordenite columns, column support frames, embed plates, and shims, with potential for personnel exposure, shall not exceed 140 °F.

3.3.8 The Seller shall select a column base support insulating material that shall prevent the Buyer's concrete foundation from exposure to temperatures exceeding 100 °F.

3.3.9 Temperature of embed plate to concrete interface shall not exceed 150 °F (refer to Figure 5) with the average temperature of the concrete area under the columns not exceeding 100 °F.

3.4 Design Conditions

3.4.1 Refer to the silver mordenite column data sheets in Section 2 of the MR.

3.4.2 The silver mordenite columns shall be designed so that the overall housing length (excluding insulation) does not exceed 19'-9 1/4", the overall width (including insulation) does not exceed 15'-3 1/8", and the overall height does not exceed 7'-0" when measuring from the bottom of the column to the top of the column's platform grating (refer to Figure 1). Only the outlet can extend above the grating. The height of the outlets above the grating shall be the minimum required to enable replacement of the discharge roughing filters from the column platforms. **Every effort shall be made by the designer performing the detailed design to minimize the overall dimensions of the silver mordenite column while still meeting the requirements of this specification and its addenda and attachments.**

3.4.3 Each silver mordenite column platform may be extended up to 3.75 inch past the outlet end of the column housing to enable platforms to be connected once the columns are installed at the Buyer's facility (refer to Figure 3). This is to accommodate up to 7.5 inch of insulation between the columns.

3.4.4 The silver mordenite columns shall be considered non-ESF as defined in ASME AG-1, Article AA-1000.

3.4.5 The silver mordenite columns shall meet Level C service limits as defined in ASME AG-1, Paragraph AA-4214.

3.4.6 The following silver mordenite column nominal inlet conditions shall apply:

- Flowrate: 1,200 scfm (may fluctuate from 1,100 scfm to 1,400 scfm)
- Temperature: ≅ 330 °F
- Pressure: (-)0.97 psig
- Halogens: ≅ 0.02 lb/d (may fluctuate between 0.02 and 0.1 lb/d)
- NO_x: ≅ 0.35 lb/h
- Primary Offgas Components:

$N_2 \rightarrow$	69.7 % by volume
$O_2 \rightarrow$	18.7 % by volume
$H_2O \rightarrow$	10.3 % by volume
$CO_2 \rightarrow$	0.37 % by volume
$Ar \rightarrow$	0.83 % by volume

3.4.7 The following silver mordenite column process requirements shall apply for design:

- Halogen Adsorption Efficiency: 99.9 %
- Iodine Adsorption Efficiency: 99.9%
- Design Flowrate: 1500 scfm
- Maximum Superficial Velocity: 0.8 ft/s
- Maximum Design Temperature: 330 °F
- Minimum Adsorbent Life Expectancy: 5 y
- Hours of Operation: 8760 h/y
- Maximum Pressure Drop: 10 inch w.g.
- Maximum Operating Pressure: ± 1.5 psig
- Maximum Design Pressure ± 3.0 psig

3.4.8 Silver mordenite column support frames shall be designed so that the overall length does not exceed 19'-9 ¼" (excluding insulation), and the overall width does not exceed 15'-3 1/8" (excluding insulation).

3.4.9 Approximately ½ inches of shim plates will be stacked at embed locations for leveling support frames (refer to Figure 5). Once leveled, the following will be completed to anchor column support frames to Buyer's foundation:

- Shim plates will be field welding together
- Support frames will be field welded to shim plates
- Shim plates will be field welded to embed plates

3.4.10 Drawings showing embed plate details and silver mordenite column embed plates locations are included in Section 2 of the MR. Embed plates for silver mordenite columns are located between column lines 7 & 9 and C & G on drawings. Embed plates are type "C".

3.4.11 No portion of the silver mordenite column support frames, or shims for leveling support frames, shall come in contact with Buyer's foundation.

3.5 Environmental Conditions

3.5.1 The silver mordenite columns and column support frames will be installed indoors in an R2/C2 area maintained between 59 °F and 95 °F dry-bulb temperature during normal operation. Radiation exposure is targeted to be 0.25 mRad/hr.

3.5.2 Prior to installation, the silver mordenite columns and column support frames may be stored outdoors at ambient temperature extremes ranging from (-)30 F dry-bulb to 117 F dry-bulb and with a relative humidity of 0-100 %.

3.6 Loadings

3.6.1 The silver mordenite columns, catwalk, and column support frames shall be self-supporting, capable of carrying the static loads of components, and capable of handling the stresses imposed during shipment, installation, operation, and an earthquake.

3.6.2 Loads to be considered for the structural design of the silver mordenite columns shall be in accordance with applicable codes, standards, and reference documents listed in section 2 of this specification. As a minimum, loadings and stresses to be imposed shall meet Level C service limits as described in ASME AG-1, Paragraph AA-4214 and shall be in accordance with Buyer specification 24590-WTP-3PS-FB01-T0001, *Engineering Specification for Structural Design Loads for Seismic Category III and IV Equipment and Tanks*. Loadings and stresses imposed for design of the column housings shall also be in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1.

3.6.3 Loads to be used for the structural design of the silver mordenite column support frames shall be in accordance with Buyer specification 24590-WTP-3PS-FB01-T0001, *Engineering Specification for Structural Design Loads for Seismic Category III and IV Equipment and Tanks.*

3.7 Housing and Mounting Frame Requirements

3.7.1 The silver mordenite column housings and associated mounting frames shall be designed per ASME AG-1a, Section HA, ASME AG-1, Section FG, and all other applicable codes and standards listed in section 2 of this specification. The housing pressure boundary for each silver mordenite column shall also be designed generally in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1.

3.7.2 Each silver mordenite column housing and associated mounting frame shall be designed so that the adsorbers are automatically centered and aligned when inserted to ensure proper gasket seating and sealing. The design shall ensure that the gasket and sealing surface is not damaged during insertion and removal operations.

3.7.3 Housings shall have adsorber access covers for each adsorber to facilitate removal and replacement of the adsorbers from the silver mordenite column platform.

3.7.4 Each housing shall have platform supports and be able to withstand maximum platform loadings without damage. Refer to subsection 3.10 for platform loadings.

3.7.5 One (1) of the housings shall have ladder supports designed to withstand maximum ladder loadings without damage. Refer to subsection 3.10 for ladder loadings.

3.7.6 Each housing shall have two (2) 3/4 inch flanged piping connections for installation of pressure drop indication across the discharge roughing filter. Seller shall work with Buyer to determine exact location and configuration of piping connections.

3.7.7 Housings shall have discharge roughing filter access covers to facilitate removal and replacement of the discharge roughing filters.

3.7.8 Fasteners, hold-downs, etc. for securing the adsorbers to the mounting frame and the adsorber access covers to the housing shall be accessible from the platforms on the top of the silver mordenite columns. The only additional operation required for adsorber removal after the access covers are removed shall be to connect the crane hook to the adsorber lifting lug.

3.7.9 Internal baffles, turning vanes, and cross-venting holes shall be provided in the inlet plenum, as required, to achieve balanced flow through the adsorbers.

3.7.10 The housing outlet shall terminate facing in the upward direction.

3.7.11 Each housing shall be insulated on the sides, top, bottom, and ends, and have insulation supports, hold-downs, and fasteners. Piping and testing connections shall also be insulated. Insulation design and installation shall be per applicable codes and standards listed in section 2 of this specification. The thermal code shall be PP.

3.7.12 Adequate insulation flexibility shall be provided in the silver mordenite column housing insulation to allow longitudinal and circumferential expansion and contraction of the silver mordenite column insulation, housing, and housing attachments for temperatures ranging from ambient to maximum design temperature.

3.7.13 Insulation shall be designed to provide a continuous waterproof, weather, and environmental barrier.

3.8 Support Frame Requirements

3.8.1 Column support frames shall be designed in accordance with applicable sections of Buyer specification 24590-WTP-DC-ST-01-001, *Structural Design Criteria*.

3.8.2 Column support frame shall contain the base support material used to insulate the Buyer's concrete foundation.

3.8.3 Column support frame and insulation base material must meet the thermal requirements of this specification and the seismic requirements of Buyer specification 24590-WTP-3PS-FB01-T0001, *Engineering Specification for Structural Design Loads for Seismic Category III and IV Equipment and Tanks*.

3.9 Adsorber Requirements

3.9.1 The silver mordenite column adsorbers shall be designed per ASME AG-1, Sections FD and FF, and all other applicable codes and standards listed in section 2 of this specification.

3.9.2 The design of the adsorber cells for the silver mordenite columns shall be completed by a silver mordenite expert (defined in 1.4.2) with experience in silver mordenite adsorber design. Seller shall provide personnel qualifications to the Buyer for review prior to beginning adsorber design.

3.9.3 Each adsorber shall be able to fit into a standard 55-gallon drum (excluding lifting lug). A standard 55 gallon drum has an internal diameter of 22 1/2 inch and a height of 33 1/4 inch.

3.9.4 Each adsorber shall hold at least 5.75 ft^3 of silver mordenite and have a cartridge bed length of 31.75 inch.

3.9.5 Each adsorber shall have a configuration per Figure 2, and be removable through the top of the silver mordenite columns via a bag-in/bag-out operation.

3.9.6 The lifting lugs for the adsorber cells shall be securely attached during silver mordenite column operation, but shall be removable if necessary.

3.9.7 The lifting lugs for the adsorber cells shall be sized and configured so that personnel are not required to break the plane of the adsorber access openings in the silver mordenite column housings to connect the crane hook for adsorber removal operations. Seller may propose a method other than using a crane hook with a lifting lug to the Buyer for meeting this criteria (e.g., a grab, grapple, etc.). Alternate methods must be compatible with Buyer's crane and be submitted for Buyer's review prior to implementing into the detailed design.

3.9.8 Adsorbers shall be designed so that gasket material remains completely attached to the adsorber during removal operations.

3.10 Platform and Catwalk Requirements

3.10.1 The silver mordenite column platforms and catwalk shall be designed to meet the requirements set forth in WAC 296-24, General Safety and Health Standards, Buyer specification 24590-WTP-DC-ST-01-001, *Structural Design Criteria*, and all other applicable codes and standards listed in section 2 of this specification.

3.10.2 The silver mordenite column platforms shall be designed to provide a removal route for each column adsorber individually. Platform shall have a grid of removable grating sections to accomplish this (one section per adsorber).

3.10.3 The silver mordenite column platforms and catwalk between the columns shall include guardrails. The guardrails shall be made out of piping.

3.10.4 The guardrails shall be designed per WAC 296-24-750 and to handle additional loading imposed by a fully loaded toolbox (refer to 3.15) without failure during normal operation.

3.10.5 The minimum combined floor dead load and 100 psf live load for the column platforms and catwalk shall be 150 psf.

3.10.6 The fixed ladder to be installed on one of the silver mordenite columns shall meet the requirements set forth in WAC 296-24-810. Use a concentrated live load of 300 pounds for the ladder design.

3.10.7 The silver mordenite column platforms and catwalk must be able to be attached without welding after the columns are placed in the HLW facility.

3.10.8 All openings in guardrails of each silver mordenite column platform shall have a safety gate or chain designed per the requirements of WAC 296-24-750.

3.11 Piping and Manifold Requirements

All piping (excluding guardrails), piping connections (includes column inlet and outlet), ports, and manifolds shall be per the requirements set forth in Buyer specification 24590-WTP-3PS-P000-T0001, *Engineering Specification for Piping Material Classes*, for piping material service class S11V.

3.12 Lifting Requirements

3.12.1 Lifting lugs shall be installed on each silver mordenite column, catwalk, and column support frame for balanced lifting and handling. Seller shall identify the weight and center of gravity of each column, the catwalk, and column support frame and submit a report for Buyer review.

3.12.2 Installation of each silver mordenite column and column support frame shall be completed separately by a single crane operation.

3.12.3 All lifting attachments shall have either a safety factor of three (3), based on material yield strength, or five (5), based on the material ultimate strength, whichever is more conservative meeting the requirements of ASME B30.20.

3.12.4 The lifting lugs and any supplied lifting equipment (i.e. spreader beam, structural lifting devices, etc.) shall be designed in accordance with the requirements of ASME B30.20 and permit lifting the silver mordenite columns, the catwalk, and column support frames without distortion or damage to the components.

3.12.5 The silver mordenite column, catwalk, and column support frame lifting lugs must be accessible from the top without removal of insulation, covers, and guardrails.

3.12.6 The lifting lugs must accept standard lifting equipment. Chain blocks or braiding shall not be permitted. Shackles must be Crosby or equivalent meeting Federal Specification RR-C-271D.

3.12.7 Sampling and testing connections and ports shall not be used for lifting.

3.12.8 All lifting points on silver mordenite columns and column adsorbers, catwalk, and column support frames shall be proof tested in-situ. Test and examination certificates shall be in accordance with the requirements of ASME B30.20 and shall be provided to the Buyer for review.

3.13 Discharge Roughing Filter Requirements

The discharge roughing filters for the silver mordenite columns shall be rated for at least 330°F and have a minimum capacity of two (2) times the design flowrate.

3.14 Bag-in/Bag-out Procedure Requirements

3.14.1 Seller shall provide a detailed bag-in/bag-out procedure for removal and replacement of the silver mordenite column adsorbers and discharge roughing filters using PPE, bags, a glovebag (if required), special tools, and a standard one-half ton overhead traveling crane. Refer to Figure 3 and Figure 4 for room and crane clearance limitations.

3.14.2 Seller shall work with Buyer to determine PPE requirements to be included in the procedure for personnel conducting adsorber and roughing filter removal and replacement.

3.14.3 The bag-in/bag-out procedure shall be based on conducting adsorber and discharge roughing filter replacement when the silver mordenite columns are not in operation. The temperature of the silver mordenite columns shall be no greater than 100 °F.

3.14.4 If a glovebag is required to perform the bag-in/ bag-out procedure, it shall conform to AGS-G001, and ERDA 76-21, Paragraph 2.2.1 and Chapter 7. Seller shall work with Buyer to determine whether or not a glovebag will be necessary.

3.14.5 Drawings of bags and glovebag (if glovebag is required) to be used shall be included in the bag-in/bag-out procedure. Drawings shall show configuration with dimensions and identify any equipment, filters, and/or apparatus to be an integral part of the bags and glovebag. Drawings shall also identify material, manufacturer, and/or model numbers of all bag and glovebag components.

3.14.6 The bag-in/bag-out procedure shall be written to ensure that, after adsorber or discharge roughing filter access cover removal and bag installation, adsorber or filter confinement is not broken at any time.

3.14.7 Only one (1) adsorber access cover shall be removed at any time when performing the bag-in/bag-out procedure.

3.14.8 After any one (1) of the adsorber access covers or the discharge roughing filter access cover is removed, a vacuum will be drawn on the silver mordenite column to ensure that approximately 5 scfm of air will be drawn into the silver mordenite column adsorber or discharge roughing filter opening.

3.14.9 Personnel shall not need to break the plane of the adsorber or discharge roughing filter access openings in the silver mordenite columns at any time to perform the bag-in/bag-out procedure.

3.14.10 The bag-in/bag-out procedure shall be able to be safely completed with crane clearance and lifting constraints shown in Figure 4.

3.14.11 At no time during completion of the bag-in/bag-out procedure shall personnel performing the procedure need to extend any part of their bodies below the adsorbers when the adsorbers are attached to the crane.

3.15 Special Tool Requirements

3.15.1 Special tools shall be designed for use with the bag-in/bag-out procedure to be proposed by the Seller.

3.15.2 Special tools shall be fabricated using stainless steel.

3.15.3 All special tooling shall be designed to handle at least four (4) times the expected load without yielding.

3.16 Toolbox Requirements

3.16.1 Toolboxes for special tools shall be affixed to the top rail of the platform guardrails per the configuration shown in Figure 1 and Figure 3.

3.16.2 Toolboxes shall have hinged lids with positive latching mechanisms. Padlocks shall be able to be installed on latching mechanisms.

3.16.3 Toolbox shall be designed to hold at least 4 times the intended load and have 50 % more capacity than required to house all special tools.

3.17 CFD Model and Analysis Requirements

3.17.1 The 3-D CFD model, required per section 1 of this specification, shall demonstrate the effects of internal structures and components on offgas flow distribution through the adsorbers in the silver mordenite columns.

3.17.2 The 3-D CFD model shall include the following components of the silver mordenite columns:

- housing including inlet (with transition fittings or piping to inlet plenum), outlet (including transition fittings or piping from outlet plenum), inlet plenum, mounting frame, outlet plenum, discharge roughing filter, manifolds for testing and sampling, and any required internal baffles, mixing vanes, and/or cross-venting holes
- adsorbers with hold-downs
- adsorber covers
- discharge roughing filter

3.17.3 The 3-D graphical results from the CFD model shall include:

- analysis of changes to the silver mordenite columns to enhance offgas flow effectiveness
- analysis of the effect of including additional baffles, mixing vanes, and/or cross-venting holes as required to study local offgas flow effects to achieve uniform offgas flow distribution through the adsorbers
- analysis of changes to the silver mordenite column to minimize the overall dimensions

3.17.4 The 3-D graphical results from the CFD model shall demonstrate uniform offgas flow distribution through the adsorbers so that the offgas velocity readings through each adsorber in the silver mordenite columns are within ± 20 % of the calculated average when operating at ± 10 % of the silver mordenite column's design flowrate.

3.17.5 Provide pressure drop to velocity relationship per foot of silver mordenite bed length as part of the CFD analysis.

3.17.6 The Seller shall provide the documented results from the 3-D CFD analysis in report form to the Buyer. The CFD report shall provide a complete offgas flow analysis and shall include 3-D graphical results of the model and any calculations performed. The reports shall, at a minimum, include:

- definition of analysis objective
- identification of equipment for analysis
- general description of equipment supplemented by drawings and sketches
- functional requirements per this specification and its addenda and attachments
- purpose of analysis
- definition of design criteria and inputs with corresponding sources
- results of literature searches and other applicable background data
- applicable codes, standards, and reference documents per section 2 of this specification broken down by chapter, section, and paragraph, as applicable
- analysis methodology
- description of computer(s) used to conduct analysis
- description of software/computer programs used for modeling and any calculations required, including program name, program revision, description of program capabilities and limitations, justification for choice of program, and evidence and description of program validation method
- assumptions (indicate those that must be verified as the design proceeds)
- analyses conducted with results
- summary of analysis results
- conclusions
- location for Buyer review signatures

All assumptions shall be plainly identified and data presented (including their uncertainty) with precise logic. Actual accomplishments of the work shall be clearly stated.

3.17.7 The final CFD report shall convey information to several disciplines, many of whom may be less familiar with the general subject than the authors. Care shall be taken to use simple statements and expressions and to make statements as concise as possible. If highly technical terms are necessary, they shall be adequately explained and defined.

3.18 Thermal Analysis Requirements

3.18.1 Method of thermal analysis shall be proposed by the Seller.

3.18.2 The thermal analysis shall include the effects of stresses resulting from potential variations in temperatures due to startup, normal operation, shutdowns, and thermal cycling of the silver mordenite columns. The analysis shall consider that the column platforms shall be connected together with mechanical fasteners during normal operation.

3.18.3 The thermal analysis shall determine the thickness and extent of insulation required on the sides, ends, and top of silver mordenite columns, column support frames, embed plates, and shims, to ensure that the insulation jacket temperature and all exterior uninsulated portions of the silver mordenite columns, with potential for personnel exposure, do not exceed 140 °F at maximum design temperature and that the total heat loss is limited to 12 Kw per unit.

3.18.4 The thermal analysis shall determine the thickness and extent of insulation required on the bottom of the silver mordenite columns so that the temperature of embed plate to concrete interfaces do not exceed 150 °F and the temperature of support base to concrete interface do not exceed 100 °F (refer to Figure 5). Thermal analysis shall confirm Seller's column support insulation material meets requirements of this specification, addenda, and attachments.

3.18.5 The thermal analysis shall determine the maximum allowable inlet and outlet nozzle loadings and displacements in all directions at maximum design temperature.

3.18.6 The base temperature for construction shall be assumed to be 70 °F. Refer to the attached data sheets that are in Section 2 of the MR for maximum design temperature, operational temperature extremes, and thermal cycling data.

3.18.7 The thermal analysis shall include the following components of the silver mordenite columns:

- housing with inlet, outlet, mounting frame, mounting channel base with anchorage, platform supports, discharge roughing filter receiver, piping connections and manifolds for testing and sampling, insulation supports and hold-downs, adsorber hold-downs, adsorber cover hold-downs, internal baffles, and mixing vanes (if mixing vanes required)
- adsorbers
- catwalk
- adsorber covers
- discharge roughing filter with access cover
- gaskets for sealing adsorbers to mounting frame, adsorber covers, and discharge roughing filter cover
- insulation with jacketing
- platform with grating and guardrails

3.18.8 The thermal analysis shall include column support frame, shims, embed plates, Buyer's foundation, and any insulation required on support frame, shims, and embed plates.

3.18.9 The thermal analysis results shall demonstrate that the silver mordenite columns, catwalk, and support frame are adequate for a 40 year service life. For design purposes, use a thermal cycle frequency of 13 cycles every 3 years for the life of the plant (40 years).

3.18.10 The Seller shall provide the documented results of the thermal analysis in report form to the Buyer. The thermal analysis report shall provide a complete thermal analysis of the silver mordenite columns, catwalk, and support frame and shall include 3-D graphical results of models and all calculations performed, as applicable to the analysis approach chosen. The report shall, at a minimum, include:

- definition of analysis objective
- identification of equipment for analysis
- general description of equipment supplemented by drawings and sketches
- functional requirements per this specification and its addenda and attachments
- purpose of analysis
- definition of design criteria and inputs with corresponding sources
- results of literature searches and other applicable background data
- applicable codes, standards, and reference documents per section 2 of this specification broken down by chapter, section, and paragraph, as applicable
- analysis methodology
- description of computer(s) used to conduct analysis
- description of any software/computer programs used for modeling and any calculations required, including program name, program revision, description of program capabilities and limitations, justification for choice of program, and evidence and description of program validation method
- assumptions (indicate those that must be verified as the design proceeds)
- analyses conducted with results
- summary of analysis results
- conclusions
- location for Buyer review signatures

All assumptions shall be plainly identified and data presented (including their uncertainty) with precise logic. Actual accomplishments of the work shall be clearly stated.

3.18.11 The final thermal analysis report shall convey information to several disciplines, many of whom may be less familiar with the general subject than the authors. Care shall be taken to use simple statements and expressions and to make statements as concise as possible. If highly technical terms are necessary, they shall be adequately explained and defined.

3.19 Silver Mordenite Column Design Analysis Requirements

3.19.1 The design analysis of the silver mordenite columns shall be conducted by a silver mordenite expert (defined in 1.4.2) to determine the expected adsorbent changeout frequency for the final silver mordenite column design. Seller shall provide personnel qualifications to the Buyer for review prior to beginning adsorber design.

3.19.2 Analysis shall be conducted considering operation of the silver mordenite columns at design conditions.

3.19.3 Analysis shall determine expected adsorbent changeout frequency for the following two (2) halogen loading conditions:

- 0.02 lb/d
- 0.1 lb/d

3.19.4 Assume that the offgas flow through the adsorbers in the silver mordenite columns may vary up to ± 20 % from the average with the system operating at ± 10 % of design flowrate.

3.19.5 The Seller shall provide the documented results of the silver mordenite column analysis with any graphical results, as applicable, in report form to the Buyer prior to fabricating the columns. The report shall, at a minimum, include:

- definition of analysis objective
- identification of equipment for analysis
- general description of equipment supplemented by drawings and sketches
- functional requirements per this specification and its addenda and attachments
- purpose of analysis
- definition of design criteria and inputs with corresponding sources
- results of literature searches and other applicable background data
- applicable codes, standards, and reference documents per section 2 of this specification broken down by chapter, section, and paragraph, as applicable
- analysis methodology
- description of computer(s) used to conduct analysis
- description of any software/computer programs used for modeling and any calculations required, including program name, program revision, description of program capabilities and limitations, justification for choice of program, and evidence and description of program validation method
- assumptions (indicate those that must be verified as the design proceeds)
- analyses conducted with results
- summary of analysis results
- conclusions
- location for Buyer review signatures

3.19.6 All assumptions shall be plainly identified and data presented (including their uncertainty) with precise logic. Actual accomplishments of the work shall be clearly stated.

3.19.7 The final silver mordenite column design analysis report shall convey information to several disciplines, many of whom may be less familiar with the general subject than the authors. Care shall be taken to use simple statements and expressions and to make statements as concise as possible. If highly technical terms are necessary, they shall be adequately explained and defined.

3.20 Accessibility and Maintenance

Accessibility and maintenance requirements shall be per this specification and its addenda and attachments.

4 Materials

4.1 Construction

4.1.1 Materials used in the construction of the silver mordenite columns shall conform to the requirements of ASME AG-1, Article AA-3000, ASME AG-1a, Article HA-3000, and this specification. Material property and performance data for any materials not covered in ASME AG-1, ASME AG-1a or this specification shall be submitted to the Buyer for review prior to incorporation into the design of the silver mordenite columns. Performance data shall indicate that material is acceptable for environmental and specific service conditions.

4.1.2 All materials used in the construction of the silver mordenite columns shall be resistant to radiation levels indicated in subsection 3.5 of this specification and be able to operate under environmental and design conditions described in ASME N509, paragraph 4.4 and this specification.

4.1.3 Seller shall maintain a record of ASTM numbers, material test reports, and manufacturer material certifications for all materials used for construction of the silver mordenite columns, catwalk, support frame, and base support insulation. Seller shall provide copies to the Buyer.

4.1.4 All materials used in the manufacture of the silver mordenite columns, column support frames, and shims shall be new and unused. Where specific criteria are not provided, material selection shall be determined by the Seller and have properties and composition suitable for the specific service conditions and consistent with this specification and its addenda and attachments.

4.1.5 Dissimilar metal couples shall be avoided. Materials classified in different groups are considered dissimilar and incompatible due to corrosion potential.

4.1.6 The silver mordenite columns shall be made of the materials listed in the silver mordenite column data sheets in Section 2 of the MR. Adsorber cells, adsorber covers, and access roughing filter covers shall be constructed of 316 L stainless steel. The column platforms, catwalk, and toolboxes shall be made of 304 L stainless steel. All fasteners, hold-downs, and adsorber covers shall be 316 L or 304 L stainless steel.

4.1.7 The discharge roughing filter frame shall be composed entirely of 316 L stainless steel.

4.1.8 The insulation to be installed on the silver mordenite columns shall be calcium silicate jacketed with 304 stainless steel. Column support base insulation material shall be per Seller to meet concrete temperature requirement. The calcium silicate shall meet the requirements of ASTM C533, Type I, and shall be marked continuously to designate that no asbestos is present. The insulation thickness to be installed shall be as determined in the thermal analysis. The stainless steel jacketing shall be 0.024 inch thick flat and smooth sheet, and conform to ASTM A240. The jacketing shall be furnished in the annealed or soft condition with a regular 2B mill finish and have a factory applied moisture barrier.

4.1.9 Insulating materials shall be uniform in thickness when installed and without irregular surfaces, voids, gaps, or depressions greater than 1/8 inch. Use sectional, segmental, cut block, or preformed insulation and jackets as much as possible to enhance the uniformity. The Seller may use mineral wool blanket insulation on irregular surfaces and around intricate shapes. Column support base insulation material shall be per Seller to meet concrete temperature requirement.

4.1.10 Mineral wool insulation materials shall have less than 30 % cumulative shot as determined by ASTM C612, Annex A1. The density shall not be less than eight (8) pounds per cubic foot with a thermal conductivity of 0.40 Btu-inch square foot per °F at a mean temperature of 200 °F.

4.1.11 Cements, mastics, and adhesives used shall be suitable for the maximum design temperature of the silver mordenite columns. The mixing of cements, mastics, etc., shall be done with deionized water.

4.1.12 The following insulation holding materials are permissible:

- 18-gage wire
- 0.025 inch × 3/4 inch wide straps (0.025 inch × 1/2 inch wide straps for 2 inch and smaller pipe)
- 1 inch hexagonal mesh netting (0.025 inch three-twist stainless steel 18-8 wire)
- wing seals

4.1.13 All calcium silicate and other insulating materials used on the silver mordenite columns shall be qualified for use on austenitic stainless steel in accordance with ASTM C795 by conforming to the preproduction test requirements of ASTM C692 and the confirming quality control requirements for chemical analysis of ASTM C871.

4.1.14 All insulation shall meet ASTM E84 fire hazard rating not to exceed 25 for flame spread and 50 for fuel contributed and smoke developed. Ratings used are determined by Underwriters Laboratories, Inc. (UL).

4.1.15 All insulation screws shall be stainless steel No. 8 × 1/2 inch self-drilling.

4.1.16 Silver mordenite to be supplied per this specification shall be C-Chem AG-900 (10X16 mesh, cylindrical pellets) hydrogen reduced silver mordenite.

4.1.17 Testing media to be used to conduct shop testing shall be identical in size and shape to C-Chem AG-900 (10 × 16 mesh, cylindrical pellets) hydrogen reduced silver mordenite. Testing media shall be compatible with all testing agents to be used in the testing and qualification of the silver mordenite columns. Testing media shall be compatible with the silver mordenite column materials of construction.

4.1.18 All stainless steel bolts and studs shall conform to ASTM F593.

4.1.19 All stainless steel nuts shall conform to ASTM F594.

4.1.20 Material used in the construction of silver mordenite column support frames shall be resistant to radiation levels indicated in subsection 3.5 on this specification.

4.2 Positive Material Identification

Refer to Buyer specification 24590-WTP-3PS-G000-TP002, *Specification for Positive Material Identification (PMI)*, for PMI requirements.

4.3 Prohibited Materials

4.3.1 Mercury and other low melting point metals, their alloys, or materials containing such metals as their basic constituents shall not be used in the construction of the silver mordenite columns, column support frames, or shims.

4.3.2 Molybdenum and halides shall not be used in direct contact with stainless steel.

4.3.3 Asbestos shall not be included in any component of the silver mordenite columns.

4.3.4 Carbon steel shall not be included in any component of the silver mordenite columns or catwalk.

4.3.5 Halide containing materials shall not be used in any component of the silver mordenite columns.

4.4 Storage of Special Materials (e.g., stainless steel) prior to work

4.4.1 Stainless steel is susceptible to corrosion caused by the contact and interaction with incompatible materials. All stainless steel material shall be stored in separate areas away from other materials.

4.4.2 Storage of silver mordenite and testing media shall be per the manufacturers instructions to prevent contamination and degradation. Silver mordenite and testing media storage requirements and instructions shall be provided by the Seller to the Buyer for review prior to purchase.

4.4.3 Storage of insulation and insulation components shall be per ASTM C929 and all other applicable codes, standards, and reference documents in section 2 of this specification.

5 Fabrication

5.1 General Requirements

5.1.1 The silver mordenite columns, catwalk, and column support frames shall be fabricated per this specification and the applicable documents listed in section 2 of this specification.

5.1.2 ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1 shall only be applied to the fabrication of the housing pressure boundary of the silver mordenite columns. The housing pressure boundary shall be fabricated generally in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1.

5.1.3 All tolerances, surface flatness, and finish requirements for assembly and fabrication shall be determined and specified by the Seller when completing the detailed design to meet performance requirements set forth in this specification and its addenda and attachments. At a minimum, all tolerances, surface flatness, and finish requirements shall be per this section and all applicable codes, standards, and reference documents in section 2 of this specification.

5.1.4 Identification of fabrication methods shall be included in the detailed design of the silver mordenite columns and column support frames.

5.1.5 All fabrication shall be performed by personnel qualified in accordance with this specification and applicable documents in section 2 of this specification.

5.2 Assembly

5.2.1 Flatness of the completed silver mordenite columns, catwalk, and column support frames shall be 1/8 inch per foot minimum, with no greater than 3/16 inch over the entire length, except for areas around cutouts. Areas around cutouts shall be flat within 1/16 inch per foot.

5.2.2 Cutout locations shall be within ± 1/8 inch and cutout size shall be within ± 1/16 inch.

5.2.3 The silver mordenite columns, catwalk, column support frames, and shims shall have rounded edges that are both smooth and not sharp to the touch.

5.2.4 The method of fabrication shall minimize the number and amount of seams, overlaps, or other discontinuities, which could trap radioactive contamination.

5.3 Tolerances

5.3.1 Thickness tolerances shall conform to the requirements of the referenced commercial standard. In the absence of such criteria, allowable thickness shall be plus 0.010 inch, minus 0.005 inch.

5.3.2 General dimension tolerances as a minimum shall be per the following:

Decimals -

- X.X ± 0.2 inches
- X.XX ± 0.12 inches
- X.XXX ± 0.062 inches

Angles -

- ± 2°

5.3.3 Nozzle and flange alignment shall be within ±0.5 degrees of design conditions.

5.3.4 Tolerances for insulation sheet metal thickness and wire diameter shall be ±12 % of nominal.

5.4 Welding Fabrication Requirements

5.4.1 Seller shall develop detailed welding, weld inspection, NDE, and weld repair procedures for fabrication of the silver mordenite columns, catwalk, and support frame and submit them to the Buyer for review prior to fabrication. Procedures shall include acceptance criteria. The procedures shall conform to the following, as applicable:

- Buyer Specification 24590-WTP-3PS-SS00-T0002
- Buyer Specification 24590-WTP-3PS-NWP0-T0001
- ASME AG-1a, Article HA-6000
- ASME AG-1, Articles FD-6000 and FG-6000
- ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1
- ASME B31.3, Category M Fluid Service
- AWS D1.6

5.4.2 Silver mordenite column welding, weld inspection, NDE, and weld repair shall be carried out in accordance with the applicable procedures developed per the previous paragraph.

5.4.3 Silver mordenite column welder qualifications shall be performed in accordance with ASME Section VIII or AWS as required.

5.4.4 Welding or material manipulation shall be carried out indoors and only when the ambient, piping, or plate temperature is above 41 °F, or higher where elevated temperatures are called for by a process.

5.4.5 Personnel performing silver mordenite column weld inspections shall be qualified in accordance with ASME AG-1, Paragraph AA-6335, ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1, and Buyer specification 24590-WTP-3PS-SS00-T0002, *Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel.*

5.4.6 Repairs required as a result of weld rejection by either the Buyer's or Seller's final inspection shall be fully documented in accordance with Seller's Quality Assurance Program (QAP). Silver mordenite column weld repairs shall be performed in accordance with ASME AG-1, subsubarticle AA-6330 and ASME Boiler and Pressure Vessel Code, Section VIII (housing pressure boundary only). Weld repair records shall be included with Seller's quality verification document package to be submitted to Buyer.

5.4.7 Joints and seams shall be fabricated in accordance with ASME AG-1a, subsubarticle HA-4330 and ASME Boiler and Pressure Vessel Code, Section VIII (housing pressure boundary only).

5.4.8 Each silver mordenite column procedure shall be prepared and qualified in accordance with the requirements of the listed specifications and standards in 5.4.1 above or ASME Section VIII, whichever is more stringent.

5.4.9 Seller shall develop detailed welding, weld inspection, NDE, and weld repair procedures for fabrication of the silver mordenite column support frames and submit them to the Buyer for review prior to fabrication. Procedures shall include acceptance criteria. Procedures shall be in accordance with Buyer specification 24590-WTP-3PS-SS00-T0002, *Engineering Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel.*

5.4.10 Silver mordenite column support frame welding, weld inspection, NDE, and weld repair shall be carried out in accordance with the applicable procedures developed per the previous paragraph.

5.4.11 Silver mordenite column support frame welder qualifications shall be performed in accordance with Buyer specification 24590-WTP-3PS-SS00-T0002, *Engineering Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel.*

5.5 Insulation

5.5.1 The Seller shall provide detailed insulation installation procedures complete with sketches showing methods and details for applying and securing insulation, metal jacketing, etc., to the silver mordenite columns and support frames. The insulation procedures shall be in accordance with PIP INIH1000, PIP INSH 2000, and NACE Standard RP0198, and this specification. The insulation installation procedures shall be reviewed by the Buyer prior to commencement of work to install insulation on the silver mordenite columns.

5.5.2 Insulation shall be stored, handled, and installed in accordance with the procedures developed per 5.5.1 above, PIP INSH2000, and Buyer specification 24590-WTP-3PS-G000-T0003, *General Specification for Packaging, Handling and Storage Requirements.*

5.5.3 Seller personnel used for supervising insulation installation shall have a minimum of five (5) years experience in such work. All other personnel shall have special training and will work under the supervision of personnel having a minimum of five (5) years experience. Training records for personnel shall be provided to Buyer's Representative upon request.

5.5.4 Surfaces to be insulated shall be dry and free of loose scale, dirt, and oil before the insulation is applied.

5.5.5 All insulation materials shall be stored, mixed, thinned, and applied in accordance with the manufacturer's printed instructions. All conflicts between this specification and the manufacturer's instruction shall be brought to the attention of the Buyer for resolution.

5.5.6 Insulation thicknesses greater than three (3) inch shall be applied in multiple layers with staggered joints. Each layer of multiple layer and double insulation shall be held in place separately.

5.5.7 Provide removable/replaceable insulation on flanges, manholes, doors, and access openings.

5.5.8 Stainless steel jacketing to be installed on curved surfaces and piping shall be machine rolled for circumferential fit.

5.5.9 Provide continuous jacketing with an overlap of 2 inch minimum between sections. Standard process industry practices shall be followed.

5.5.10 Exposed edges of stainless steel jacketing shall be machine-bent or rolled to eliminate sharp corners.

5.5.11 The jacketing shall be secured with 3/4 inch stainless steel bands. One-half inch stainless steel bands shall be used for 2 inch and smaller piping.

5.5.12 Securely fasten metal jacketing on flat surfaces of silver mordenite columns on maximum 18 inch centers.

5.5.13 All cut ends of wire shall be embedded into the insulation.

5.5.14 The use of screws as holding material for insulation is unacceptable.

5.5.15 No insulation shall be installed on the silver mordenite columns until a written release has been obtained from the Buyer's Representative by the Seller.

6 Tests and Inspections

6.1 General Requirements

6.1.1 The silver mordenite columns, catwalk between the column platforms, and column support frames shall be tested and inspected per this specification and the applicable documents listed in section 2 of this specification.

6.1.2 Seller shall conduct and be responsible for all testing and inspections required per this specification, applicable codes, applicable standards, and reference documents.

6.1.3 Seller shall submit a detailed test and inspection plan identifying all the inspections and tests planned, including recommended witness and hold points. Buyer's inspector will advise the Seller of witness and hold points and identify the shop tests that the Buyer intends to witness.

6.1.4 Seller shall develop and submit to Buyer detailed test procedures for conducting all shop and field acceptance testing required per this specification, applicable codes, standards, and reference documents for review by the Buyer prior to silver mordenite column fabrication. Procedures shall include acceptance criteria and detailed drawings of the shop and field testing configurations. Seller shall identify on drawings location of taps, ports, piping connections, and/or manifolds made on housing and ductwork in order to take measurements during shop and field tests. These taps, ports, piping connections, and/or manifolds shall be temporarily capped for use in the field during acceptance testing. Seller shall provide instructions on permanently sealing these taps after field acceptance testing. Drawings shall be scaleable and shall include plan and elevation views of the following:

- silver mordenite column
- any Seller furnished materials, fittings, and ductwork required to perform the tests
- Seller furnished discharge roughing filter
- all Seller furnished equipment, apparatus, and instrumentation

6.1.5 Seller shall develop and submit to Buyer detailed testing and inspection procedures for conducting all testing and inspections required per this specification, applicable codes, standards, and reference documents for review by the Buyer prior to silver mordenite column fabrication.

6.1.6 Seller shall complete reports of all testing and inspections and submit them to Buyer. Reports shall identify the component tested, date performed, applicable test procedure, acceptance criteria, person performing the test or inspection, test results, and conclusions. Drawings of test setups shall be included. All testing and inspection results shall be certified.

6.1.7 Control and calibration of measuring and test equipment shall be in accordance with ASME AG-1, subsubarticle AA-5130.

6.1.8 All testing and inspection instruments used to conduct testing on the silver mordenite columns and column platform shall meet the requirements set forth in ASME AG-1, Article TA-3000. All testing and inspection instruments shall be in calibration and traceable to the appropriate national standard.

6.1.9 Any non-conforming work shall be redone by the Seller at Seller's cost.

6.2 Welding Inspection Requirements

6.2.1 Silver mordenite column welds shall be inspected, examined, and tested in accordance with ASME AG-1, subsubarticle AA-6330, ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1 (housing pressure boundary only), Buyer specification 24590-WTP-3PS-SS00-T0002, *Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel*, and Buyer specification 24590-WTP-3PS-NWP0-T0001, *Engineering Specification for General Welding and NDE Requirements for Supplier Fabricated Piping*. Surface inspections shall be performed using the dye penetrant method.

6.2.2 Silver mordenite column support frame welds shall be inspected, examined, and tested in accordance with Buyer specification 24590-WTP-3PS-SS00-T0002, *Engineering Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel.*

6.3 Personnel Qualifications

6.3.1 All inspection and testing shall be performed by personnel qualified per the requirements set forth in this specification and all applicable documents in section 2 of this specification.

6.3.2 Seller shall submit personnel qualification documents, including years of experience for Seller's inspection and test personnel, for Buyer review.

6.4 Shop Tests

6.4.1 Seller shall provide all materials, labor, tools, equipment, apparatus, instrumentation, testing media, and challenge gas to conduct all shop testing on the silver mordenite columns.

6.4.2 All shop tests requiring that adsorbent media be installed in the silver mordenite columns shall be conducted using silver mordenite if available in time to meet delivery schedule requirements in Section 1 of the MR. The Seller shall ensure that the silver mordenite does not become contaminated or degraded at any time before, during, or after completion of shop testing.

6.4.3 In the event that the silver mordenite is not available in time for shop acceptance testing due to silver mordenite production limitations, testing media shall be used. Testing media shall be loaded into adsorber cells and tested per applicable portions of ASME AG-1, Article FD-5000. Seller shall issue manufacturer's information for testing media to the Buyer for review prior to purchase.

6.4.4 Seller shall conduct the following acceptance tests in the shop on each unit using air at ambient temperature, with exception to the airflow distribution test (which shall be performed on a single column to verify design), prior to shipment:

- Visual Inspection
- Structural Capability Test
- Mounting Frame Pressure Leak Test
- System Bypass Test
- Differential Pressure Test
- Airflow Distribution Test

All silver mordenite column shop acceptance testing procedures shall conform to ASME AG-1 (Section TA), N509 (Section 9), and ERDA 76-21 (Chapter 8).

6.4.5 Pneumatic testing per ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1 shall be conducted on the silver mordenite column housing pressure boundary. **U-stamp and National Board Registration for the silver mordenite columns are not required.**

6.4.6 Structural Capability Test: Conduct at (+) 4 psig and (-) 4 psig and ambient conditions.

6.4.7 Mounting Frame Pressure Leak Test: Leakage shall not exceed 0.2 % of design flowrate at a minimum testing pressure equal to 150 % of maximum operating pressure.

6.4.8 System Bypass Test: At ± 10 % of design flowrate through the silver mordenite column, challenge gas leakage rate shall not exceed 0.1 % at 99.9 % efficiency.

6.4.9 The Seller shall conduct proof testing in-situ on the silver mordenite column, catwalk, and support frame lifting points in the shop.

6.4.10 All test results shall be documented, certified, and submitted to the Buyer for review.

6.5 Field Tests

6.5.1 Seller shall provide the services of a technical representative during all field testing required per this specification, applicable codes, applicable standards, and reference documents. Seller shall provide all tooling, equipment, material, apparatus, instrumentation, and challenge gas necessary to conduct all field testing and inspections.

6.5.2 All silver mordenite column field acceptance testing procedures shall conform to ASME AG-1 (Section TA), N509 (Section 9), and ERDA 76-21 (Chapter 8).

6.6 Bag-in/Bag-out Procedure Demonstration

6.6.1 Seller shall provide all personnel, equipment, apparatus, labor, PPE (if applicable), materials, film, special tools, glovebags, bags, HEPA filters, etc. to simulate field conditions, demonstrate, and videotape the bag-in/bag-out procedure to be provided by the Seller per this specification.

6.6.2 Demonstration shall be conducted in Seller's shop on one (1) of the fully assembled silver mordenite columns and witnessed by Buyer's Representatives. The column to be used for the demonstration shall be chosen by the Buyer.

6.6.3 Demonstration shall include removal and replacement of one adsorber cell loaded with silver mordenite (or testing media) and the discharge roughing filter(s) for one of the silver mordenite columns. Actual adsorber cell to be removed shall be chosen by the Buyer.

6.6.4 When conducting the demonstration, Seller personnel shall be wearing all PPE required per the final bag-in/bag-out procedure.

6.6.5 Field conditions shall be simulated in the shop when performing the bag-in/bag-out procedure demonstration, which will include pulling a vacuum on the silver mordenite column and imposing crane clearance, room clearance, and lifting constraints shown in Figure 3 and Figure 4.

7 Preparation for Shipment

7.1 General Requirements

7.1.1 The silver mordenite columns, and catwalk shall be packaged/prepared for shipment, handled, and stored in accordance with Buyer specification 24590-WTP-3PS-G000-T0003, and ASME AG-1a, Article HA-7000 (Level C).

7.1.2 The silver mordenite column adsorbers shall be packaged/prepared for shipment, handled, and stored in accordance with Buyer specification 24590-WTP-3PS-G000-T0003, and ASME AG-1, Article FF-7000 (Level B).

7.1.3 The silver mordenite columns, adsorbers, catwalk, column support frames, and shims shall not be packaged for shipping until all shop tests and inspections have been performed and the Buyer's Representative reviews the results.

7.1.4 Silver mordenite column support frames and shims shall be packaged/prepared for shipment, handled, and stored in accordance with Buyer specification 24590-WTP-3PS-G000-T0003, *General Specification for Packaging, Handling and Storage Requirements*.

7.2 Cleanliness

7.2.1 Cleanliness shall be per the applicable documents in Paragraphs 7.1.1 and 7.1.2 above.

7.2.2 Solvents and cleaning solutions used on stainless steel shall have a halogen content of less than 200 ppm.

7.3 Painting

If applicable, support frames and shims shall be primed. Surface preparation, primer application, inspection, and repair shall be in accordance with Buyer specification 24590-WTP-3PS-AFPS-T0001, *Shop Applied Special Protective Coatings for Steel Items and Equipment*.

7.4 Tagging

7.4.1 Tagging of the silver mordenite columns shall be as specified in ASME AG-1a, Article HA-9000 and shall include associated plant item number specified in the attached data sheets that are in Section 2 of the MR.

7.4.2 A stainless steel nameplate shall be rigidly attached to the northwest corner of the silver mordenite column housings (refer to Figure 3) in a prominent position for ease of visibility and include:

- manufacturer's name
- shop location
- date of manufacture
- serial number

- equipment ratings (pressure, flow, temperature)
- plant item number
- weight of assembly
- purchase order number

7.4.3 Nameplates shall be visible after the insulation is installed, or a duplicate nameplate shall be provided on the top of the insulation.

7.4.4 All field testing materials and filters shall be tagged as required for field testing.

7.4.5 A stainless steel nameplate shall be rigidly attached to the northwest corner of the silver mordenite column support frames and include:

- Manufacturer's name
- Shop location
- Date of manufacture
- Serial number
- Plant item number for associated silver mordenite column
- Weight
- Purchase order number

7.5 Packaging

Packaging shall be per Paragraphs 7.1.1 and 7.1.2 above.

7.6 Documentation

7.6.1 Seller shall ensure that appropriate documentation is prepared and, if required, signed by the appropriate person (s). The shipping documentation shall accurately reflect specific traceability to the items being shipped.

7.6.2 Seller shall ensure that appropriate documentation is prepared for the silver mordenite columns, catwalk, column support frames, and shims. At a minimum, documentation shall include the following information, as applicable:

- Manufacturer name, model number, and serial number
- Plant Item Number

7.7 Shipment Preparation Instructions

Shipment of items shall be conducted in accordance with ASME AG-1a, Article HA-7300, Buyer specification 24590-WTP-3PS-G000-T0003, and ASTM C929.

7.7.1 The silver mordenite columns shall be shipped as completely assembled except for adsorbers. Adsorbers and catwalk shall be shipped separately.

7.7.2 Weatherproof shipping lists (two per packaged item) shall be prepared and submitted, and shall clearly identify the contents of each package sent to the Buyer. All submittals and shipping boxes shall be identified with the Buyer's purchase order number.

7.7.3 Buyer shall provide a complete identification and location of temporary material contained within the equipment for shipment, handling, or storage that must be removed prior to commissioning (e.g., shipping blocks, desiccant bags, components shipped inside larger sections, etc.). In addition, the Seller shall provide instructions for removal of temporary materials, as required.

7.7.4 The silver mordenite columns, adsorbers, catwalk, column support frames, and shims shall be mounted on skids, in crates, or in boxes as suited for the intended method of transport. Lifting weight and center of gravity shall be clearly marked on both the equipment and its shipping documents.

8 Quality Assurance

8.1 General Requirements

8.1.1 The Seller's QAP Requirements are included in Buyer specification 24590-WTP-3PS-G000-T0001, *General Specification for Supplier Quality Assurance Program Requirements*.

8.1.2 Seller's QAP Manual shall be submitted to Buyer for review in accordance with Buyer specification 24590-WTP-3PS-G000-T0001, *General Specification for Supplier Quality Assurance Program Requirements*.

8.1.3 Seller's QAP, as a minimum, shall contain the requirements detailed in the Supplier Quality Assurance Program Requirements Data Sheets listed in Section 2 of the MR.

8.2 Quality (Q) Related Components

8.2.1 Seller shall have in place a QAP meeting the requirements of ASME-NQA-1, marked as applicable in Supplier Quality Assurance Program Requirements Data Sheet attached to the MR, and Buyer specification 24590-WTP-3PS-G000-T0001, *General Specification for Supplier Quality Assurance Program Requirements*.

8.2.2 The successful bidder must pass a pre-award survey by the Buyer. Seller shall demonstrate that its quality program is in compliance with the procurement quality requirements listed in the Supplier Quality Assurance Program Requirements Data Sheet. The Seller shall allow the Buyer, its agent, and DOE access to their facility and records pertaining to this purchase order for the purpose of Quality Assurance (QA) Audits and Surveillance at mutually agreed times.

8.2.3 All items shall be manufactured in accordance with the Seller's QAP that meets the requirements of ASME NQA-1, and has been previously evaluated and accepted by the WTP Quality Organization.

8.2.4 Seller shall submit their QAP and work plan to Buyer for review prior to commencement of work. The plan shall include documents and procedures to implement the work and include a matrix of essential QA elements cross referenced with the documents/procedures.

9 Configuration Management

Equipment and/or components covered by this specification are identified with Plant Item Numbers shown in the attached data sheets in Section 2 of the MR. Each item shall be identified in accordance with Tagging in section 7 of this specification.

10 Documentation and Submittals

10.1 General

10.1.1 Seller shall submit to Buyer all detailed designs, documentation, procedures, instructions, calculations, analyses, models, manufacturer data, inspection reports, test reports, certifications, certificates, manuals, MSDSs, video tapes, and drawings required per this specification, the applicable codes, standards, and reference documents in section 2 of this specification, and the MR.

10.1.2 All detailed designs, drawings, shop drawings, supporting calculations, supporting analyses, supporting models, procedures, instructions, manufacturer data, operation manuals, and maintenance manuals shall be issued to the Buyer for review prior to manufacture of the silver mordenite columns, column catwalk, special tools, and/or the purchase of special tools, filters, and gaskets.

10.1.3 Seller shall submit storage requirements and instructions for Buyer's review.

10.1.4 Seller shall submit to Buyer Engineering and Quality Verification documents in the forms and quantities shown in Form G-321-E, Engineering Document Requirement, and Form G-321-V, Quality Verification Document Requirements attached to the MR.

10.1.5 Seller shall submit a report identifying any deviations and/or conflicts per Section 2 of the MR to the Buyer for review.

10.1.6 Each documentation transmittal package shall have a documentation inventory sheet attached listing all documents and the number of pages each.

10.1.7 Data sheets in Section 2 of the MR shall be marked-up by the Seller and submitted to the Buyer for review with the detailed design. Seller shall fill in all information that is marked as TBD and mark-up actual overall silver mordenite column dimensions based on the detailed design.

10.1.8 Seller shall provide all operation manuals, maintenance manuals, and spare parts lists for silver mordenite column components, as applicable.

10.2 30 % Design Review

10.2.1 Seller shall conduct a 30 % design review with the Buyer. Seller shall submit all drawings, procedures, calculations, analyses, and information necessary to conduct the 30 % design review to the Buyer for review.

10.2.2 Finalized outline dimensions of the silver mordenite columns, catwalk, and support frame shall be included in the 30 % design review. Finalized dimensions shall, at a minimum, include the following:

- overall dimensions for silver mordenite columns
- silver mordenite column inlet and outlet nozzle locations
- roughing filter location and size
- testing port and manifold locations and size
- adsorber cell overall dimensions
- mounting details (anchor size, location, layout, etc.)
- dimensioned layout of silver mordenite columns showing column inlet and outlet locations, discharge roughing filter locations, ladder location, testing port locations, manifold locations, and openings in column platform guardrails
- dimensioned layout of the catwalk and column supports frames.
- preliminary bag-in/bag-out plan

10.2.3 Provide maximum allowable inlet and outlet nozzle loadings in all directions with column material yield strength value for silver mordenite columns per thermal analysis results.

10.2.4 Provide silver mordenite column anchorage design loads.

10.2.5 Provide MSDS for Seller's recommended challenge gas.

10.3 90 % Design Review

Seller shall conduct a 90 % design review with the Buyer. Seller shall submit all drawings, procedures, calculations, analyses, and information necessary to conduct the 90 % design review to the Buyer for review.

10.4 Drawings

10.4.1 Seller shall provide all drawings required per this specification and the applicable documents in section 2 of this specification.

10.4.2 All drawings shall be produced per the drawing practices set forth in ASME Y14.100, Engineering Drawing Practices.

10.5 Calculations

All calculations to be provided shall be orderly, complete, and sufficiently clear to permit verification. The body of the calculations shall include:

- a concise statement of the purpose of the calculation
- input data, applicable criteria, and stated assumptions
- a list of references used, including drawings, codes, standards, and computer programs (indicate the version or issue date)
- a discussion of rationale used for design assumption basis
- equations used for all computations
- numerical calculations including identification of units used
- a concise statement addressing the calculation results and/or recommendations
- a table of contents for complex calculations

10.6 Schedules

10.6.1 A detailed schedule of engineering, document submittals, material purchases, fabrication, shop tests, and shipment shall be submitted.

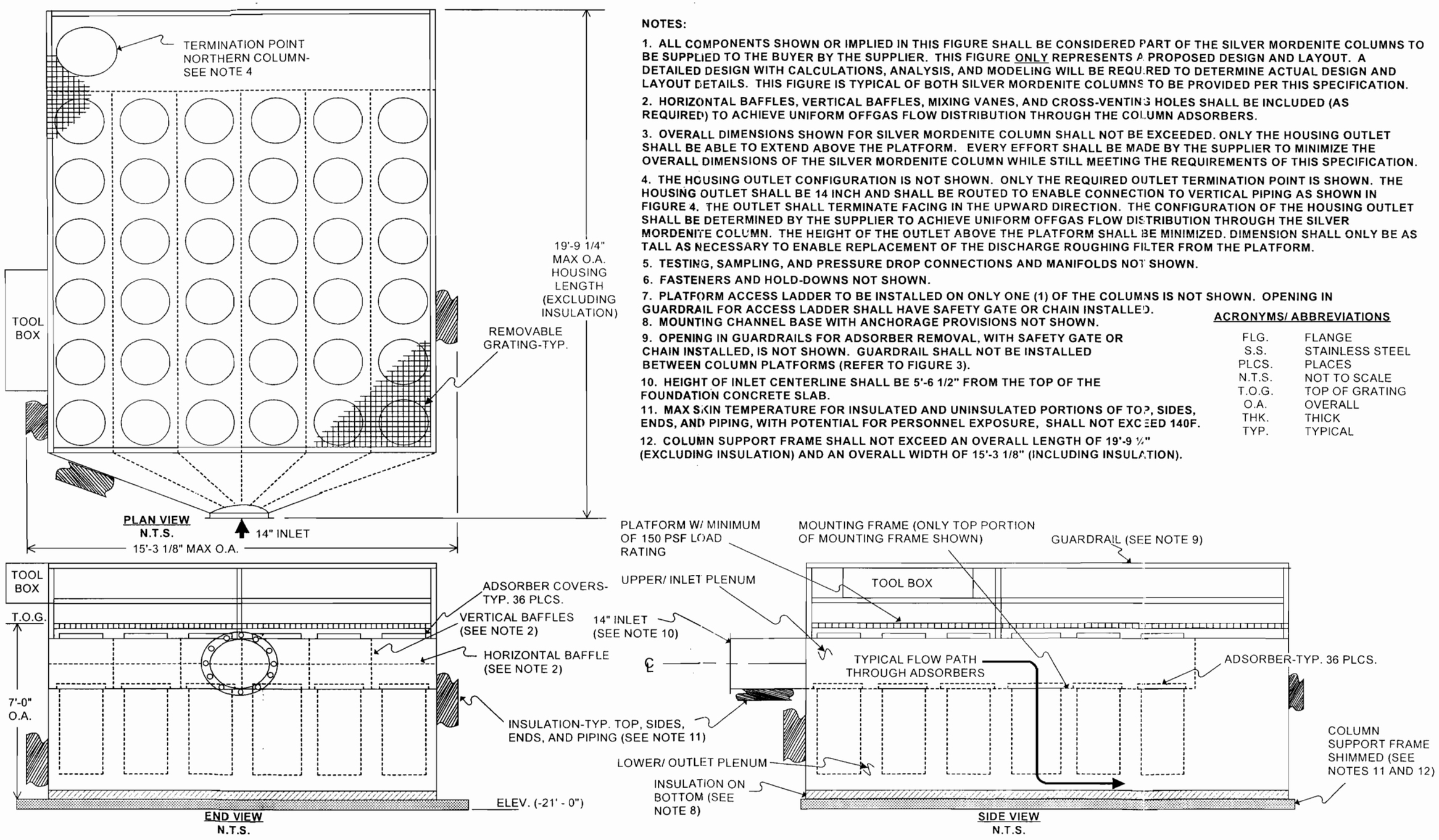
10.6.2 All procedures and instructions shall be completed and submitted to the Buyer a minimum of eight (8) weeks prior to silver mordenite column, catwalk, and support frame shipment.

11 References

Incorporated Design Changes

- 24590-WTP-SDDR-PROC-03-0003
- 24590-WTP-SDDR-PROC-03-0137
- 24590-WTP-SDDR-PROC-03-0138
- 24590-WTP-SDDR-PROC-03-0139
- 24590-WTP-SDDR-PROC-03-0252
- 24590-HLW-3PN-MBT0-00002
- 24590-WTP-SDDR-PROC-03-0385
- 24590-WTP-SDDR-PROC-03-0411
- 24590-HLW-3PN-MBT0-00003
- 24590-WTP-SDDR-PROC-04-00132
- 24590-WTP-SDDR-PROC-04-00136
- 24590-WTP-SDDR-PROC-04-00200
- 24590-WTP-SDDR-PROC-04-00202
- 24590-WTP-SDDR-PROC-04-00256
- 24590-WTP-SDDR-PROC-04-00300

Figure 1 **Typical Silver Mordenite Column**



NOTES:

1. ALL COMPONENTS SHOWN OR IMPLIED IN THIS FIGURE SHALL BE CONSIDERED PART OF THE SILVER MORDENITE COLUMNS TO BE SUPPLIED TO THE BUYER BY THE SUPPLIER. THIS FIGURE ONLY REPRESENTS A PROPOSED DESIGN AND LAYOUT. A DETAILED DESIGN WITH CALCULATIONS, ANALYSIS, AND MODELING WILL BE REQUIRED TO DETERMINE ACTUAL DESIGN AND LAYOUT DETAILS. THIS FIGURE IS TYPICAL OF BOTH SILVER MORDENITE COLUMNS TO BE PROVIDED PER THIS SPECIFICATION.
2. HORIZONTAL BAFFLES, VERTICAL BAFFLES, MIXING VANES, AND CROSS-VENTING HOLES SHALL BE INCLUDED (AS REQUIRED) TO ACHIEVE UNIFORM OFFGAS FLOW DISTRIBUTION THROUGH THE COLUMN ADSORBERS.
3. OVERALL DIMENSIONS SHOWN FOR SILVER MORDENITE COLUMN SHALL NOT BE EXCEEDED. ONLY THE HOUSING OUTLET SHALL BE ABLE TO EXTEND ABOVE THE PLATFORM. EVERY EFFORT SHALL BE MADE BY THE SUPPLIER TO MINIMIZE THE OVERALL DIMENSIONS OF THE SILVER MORDENITE COLUMN WHILE STILL MEETING THE REQUIREMENTS OF THIS SPECIFICATION.
4. THE HOUSING OUTLET CONFIGURATION IS NOT SHOWN. ONLY THE REQUIRED OUTLET TERMINATION POINT IS SHOWN. THE HOUSING OUTLET SHALL BE 14 INCH AND SHALL BE ROUTED TO ENABLE CONNECTION TO VERTICAL PIPING AS SHOWN IN FIGURE 4. THE OUTLET SHALL TERMINATE FACING IN THE UPWARD DIRECTION. THE CONFIGURATION OF THE HOUSING OUTLET SHALL BE DETERMINED BY THE SUPPLIER TO ACHIEVE UNIFORM OFFGAS FLOW DISTRIBUTION THROUGH THE SILVER MORDENITE COLUMN. THE HEIGHT OF THE OUTLET ABOVE THE PLATFORM SHALL BE MINIMIZED. DIMENSION SHALL ONLY BE AS TALL AS NECESSARY TO ENABLE REPLACEMENT OF THE DISCHARGE ROUGHING FILTER FROM THE PLATFORM.
5. TESTING, SAMPLING, AND PRESSURE DROP CONNECTIONS AND MANIFOLDS NOT SHOWN.
6. FASTENERS AND HOLD-DOWNS NOT SHOWN.
7. PLATFORM ACCESS LADDER TO BE INSTALLED ON ONLY ONE (1) OF THE COLUMNS IS NOT SHOWN. OPENING IN GUARDRAIL FOR ACCESS LADDER SHALL HAVE SAFETY GATE OR CHAIN INSTALLED.
8. MOUNTING CHANNEL BASE WITH ANCHORAGE PROVISIONS NOT SHOWN.
9. OPENING IN GUARDRAILS FOR ADSORBER REMOVAL, WITH SAFETY GATE OR CHAIN INSTALLED, IS NOT SHOWN. GUARDRAIL SHALL NOT BE INSTALLED BETWEEN COLUMN PLATFORMS (REFER TO FIGURE 3).
10. HEIGHT OF INLET CENTERLINE SHALL BE 5'-6 1/2" FROM THE TOP OF THE FOUNDATION CONCRETE SLAB.
11. MAX SKIN TEMPERATURE FOR INSULATED AND UNINSULATED PORTIONS OF TOP, SIDES, ENDS, AND PIPING, WITH POTENTIAL FOR PERSONNEL EXPOSURE, SHALL NOT EXCEED 140F.
12. COLUMN SUPPORT FRAME SHALL NOT EXCEED AN OVERALL LENGTH OF 19'-9 ¼" (EXCLUDING INSULATION) AND AN OVERALL WIDTH OF 15'-3 1/8" (INCLUDING INSULATION).

ACRONYMS/ ABBREVIATIONS

FLG.	FLANGE
S.S.	STAINLESS STEEL
PLCS.	PLACES
N.T.S.	NOT TO SCALE
T.O.G.	TOP OF GRATING
O.A.	OVERALL
THK.	THICK
TYP.	TYPICAL

Figure 2 Typical Silver Mordenite Column Adsorber

NOTES:

1. ADSORBERS SHALL BE SIZED TO FIT INSIDE OF A STANDARD 55-GALLON DRUM, NOT INCLUDING LUG FOR LIFTING.
2. ADSORBER CELLS SHALL BE ALL 316L STAINLESS STEEL CONSTRUCTION.
3. THIS FIGURE REPRESENTS TYPICAL CONFIGURATION FOR ALL SILVER MORDENITE ADSORBERS (36 EACH COLUMN).
4. ADSORBER LIFTING LUG SHALL BE SECURELY ATTACHED TO EACH ADSORBER DURING OPERATION OF THE SILVER MORDENITE COLUMNS, BUT SHALL BE REMOVABLE.
5. LIFTING LUG CONFIGURATION SHOWN IS ONLY PRELIMINARY. ACTUAL CONFIGURATION FOR LIFTING LUG SHALL BE DETERMINED BY THE SUPPLIER WHEN COMPLETING THE DETAILED DESIGN.

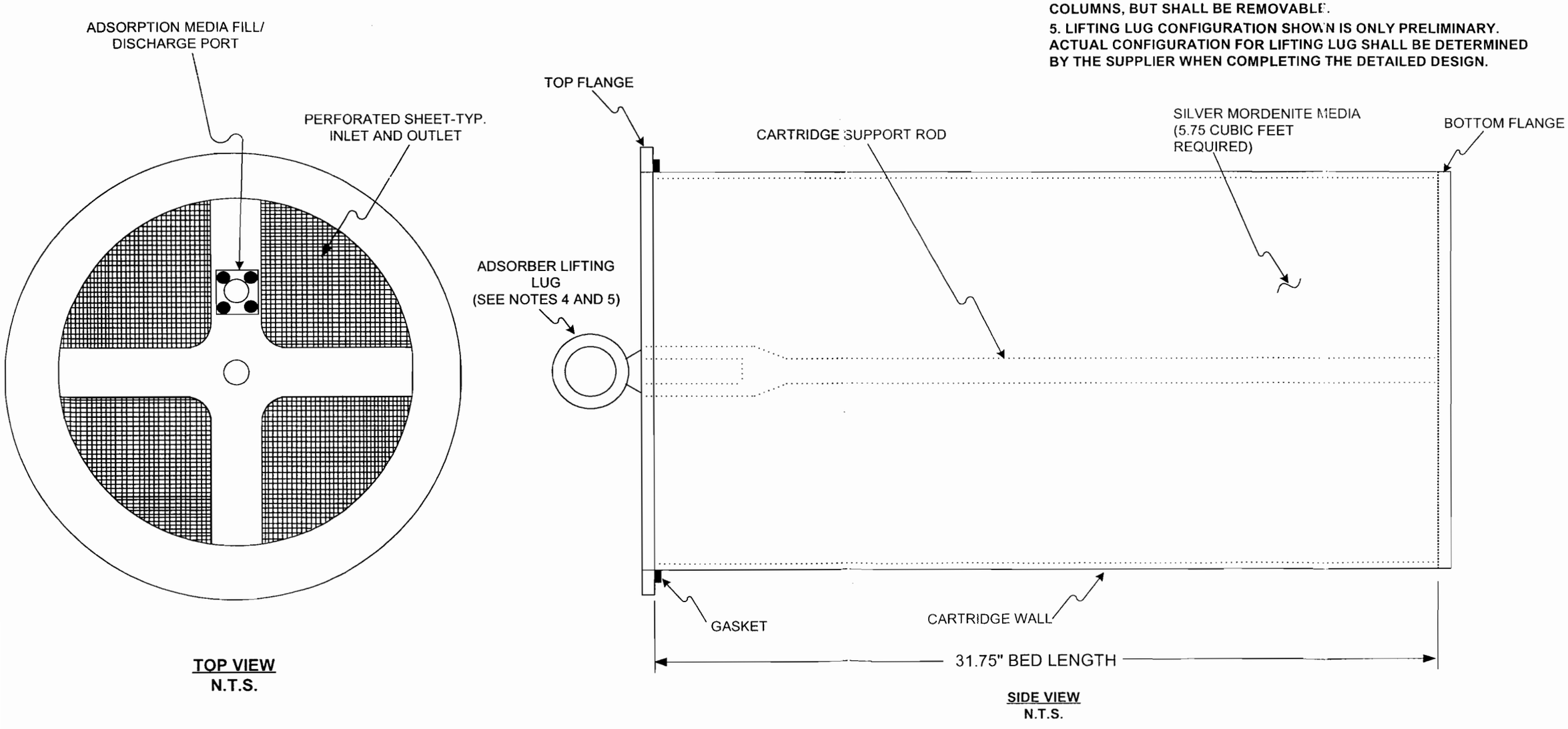
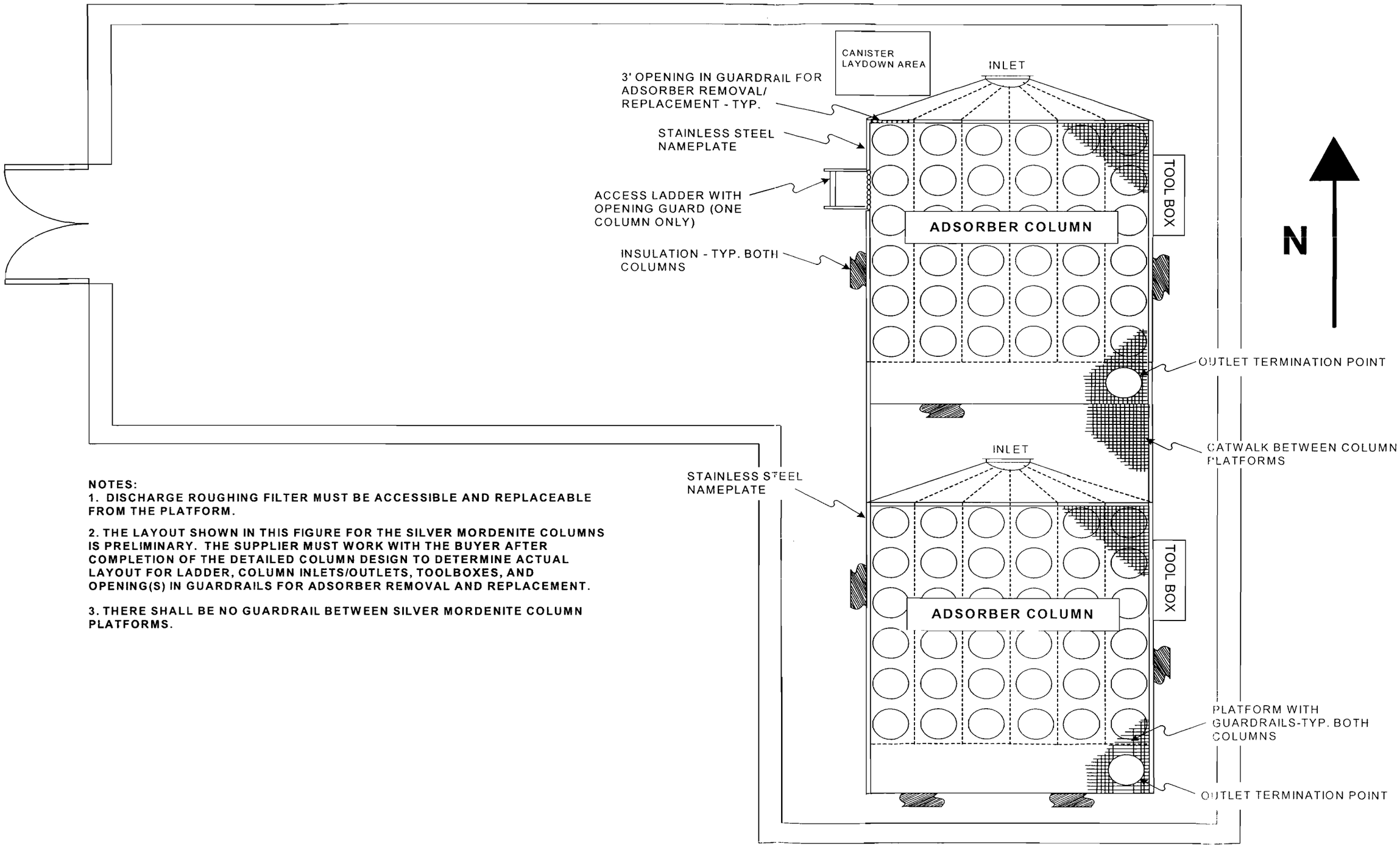


Figure 3 **Silver Mordenite Column Layout in HLW Facility**



NOTES:

1. DISCHARGE ROUGHING FILTER MUST BE ACCESSIBLE AND REPLACEABLE FROM THE PLATFORM.

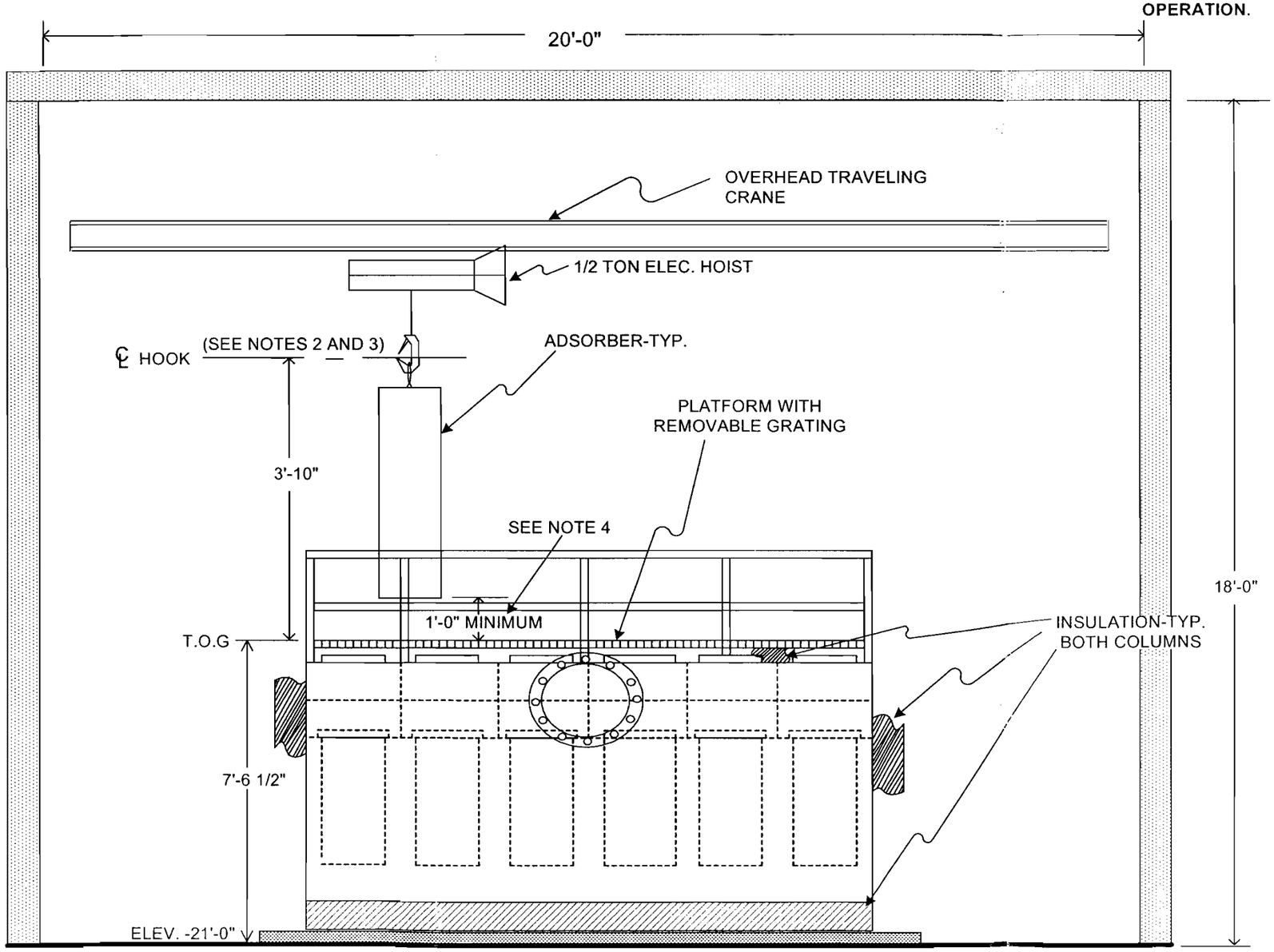
2. THE LAYOUT SHOWN IN THIS FIGURE FOR THE SILVER MORDENITE COLUMNS IS PRELIMINARY. THE SUPPLIER MUST WORK WITH THE BUYER AFTER COMPLETION OF THE DETAILED COLUMN DESIGN TO DETERMINE ACTUAL LAYOUT FOR LADDER, COLUMN INLETS/OUTLETS, TOOLBOXES, AND OPENING(S) IN GUARDRAILS FOR ADSORBER REMOVAL AND REPLACEMENT.

3. THERE SHALL BE NO GUARDRAIL BETWEEN SILVER MORDENITE COLUMN PLATFORMS.

Figure 4 **Crane Layout with Clearance Limitations for Silver Mordenite Adsorber Replacement**

NOTES:

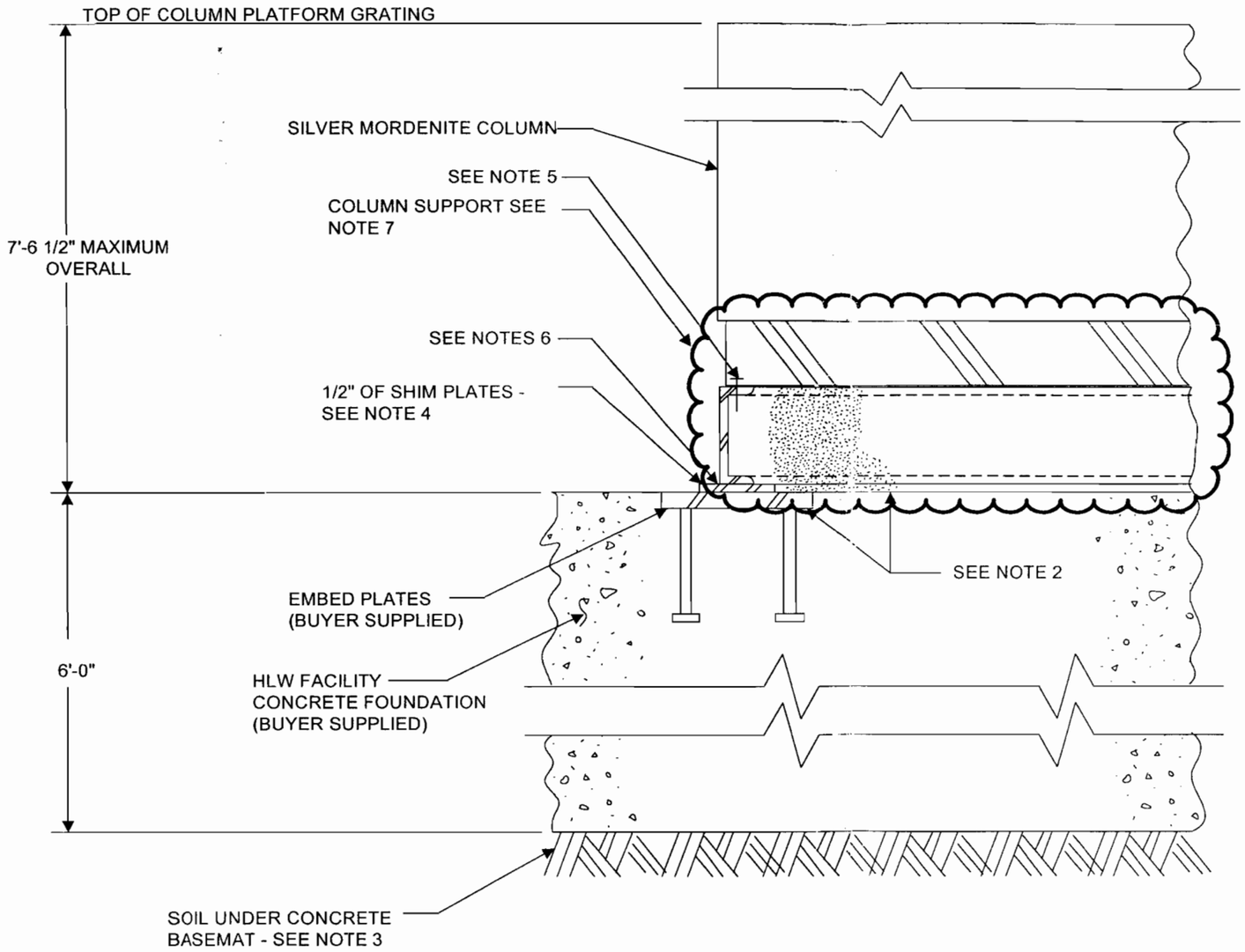
1. REFER TO FIGURE 3 FOR ROOM LAYOUT.
2. MAXIMUM CRANE HOOK LIFT HEIGHT.
3. SUPPLIER MAY PROPOSE USING SOMETHING OTHER THAN A CRANE HOOK AS REQUIRED TO MEET SPECIFICATION REQUIREMENTS (E.G. GRAB, GRAPPLE, ETC.).
4. CLEARANCE FROM T.O.G. TO BOTTOM OF ADSORBER SHALL BE 1'-0" AT MINIMUM TO ENABLE COMPLETION OF BAG-IN/BAG-OUT OPERATION.



ACRONYMS/ ABBREVIATIONS

FLG.	FLANGE
S.S.	STAINLESS STEEL
PLCS.	PLACES
N.T.S.	NOT TO SCALE
T.O.G.	TOP OF GRATING
O.A.	OVERALL
THK.	THICK

Figure 5 **Silver Mordenite Column Support Frame and Anchorage**



NOTES:

1. ALL ITEMS SHOWN IN THIS FIGURE SHALL BE SUPPLIED BY SELLER UNLESS IDENTIFIED AS BUYER SUPPLIED.
2. SURFACE TO CONCRETE INTERFACES SHALL NOT EXCEED 100 F. EMBED PLATE TO CONCRETE INTERFACES SHALL NOT EXCEED 150 F.
3. DATA REGARDING SOIL TEMPERATURE BELOW CONCRETE BASEMAT IS UNAVAILABLE.
4. SHIM PLATES ARE FOR LEVELING FRAME PRIOR TO MOUNTING SILVER MORDENITE COLUMN. SHIM PLATES SHALL BE SUPPLIED BY SELLER.
5. BOLTS/STUDS SHALL BE USED TO ANCHOR SILVER MORDENITE COLUMN TO COLUMN SUPPORT FRAME. ANCHOR BOLTS/STUDS SHALL EITHER BE WELDED TO FRAME OR MECHANICALLY FASTENED BY SELLER IN SHOP (I.E., GROUTING OF ANCHOR BOLTS IS NOT PERMITTED).
6. AFTER COLUMN SUPPORT FRAME IS LEVELED ON SHIMS, SHIM PLATES SHALL BE FIELD WELDED TOGETHER AND FIELD WELDED TO EMBED PLATES BY BUYER. SUPPORT FRAME SHALL BE FIELD WELDED TO SHIMS BY BUYER. SELLER SHALL PROVIDE WELDING PROCEDURE, SPECIFY WELD TYPES, AND SPECIFY EXTENT OF WELDING REQUIRED.
7. SELLER SHALL DESIGN COLUMN SUPPORT FRAME TO MEET THERMAL AND SEISMIC REQUIREMENTS OF THIS SPECIFICATION. THE HEIGHT OF COLUMN SUPPORT SHALL NOT EXCEED 12 INCHES.

ISSUED BY
RPP-WTP PDC

R10384190

RIVER PROTECTION PROJECT – WASTE TREATMENT PLANT

ENGINEERING SPECIFICATION

FOR

HEPA Filter Preheaters

MARK W. HOFFMANN
STATE OF WASHINGTON
0030952
REGISTERED
PROFESSIONAL ENGINEER
9/26/04
EXPIRES 12/10/04

This bound document contains a total of 21 pages.

Content applicable to ALARA? ☒ **Yes** ☐ **No**

ADR No.
N/A

Rev

NOTE: Contents of this document are Dangerous Waste Permit affecting.

Quality Designator
QL
DOE Contract No. DE-AC27-01RV14136

REV	DATE	REASON FOR REVISION	BY	CHECK	REVIEW	QA	APEM/DEM
1	9/26/04	Issued for Permitting Use				N/A	
0	4/18/04	Issued for Permitting Use	Kathy Brightman	Anthony Cutrona	Chris Morley	N/A	Mark Hoffmann

SPECIFICATION No. 24590-HLW-3PS-MEE0-TP001 **Rev** 1

Notice

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the US Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

Contents

1 Scope 1
1.1 Project Description and Location 1
1.2 Equipment, Material, and Services Required 1
1.3 Work by Others 2
1.4 Acronyms, Abbreviations and Definitions 2
1.5 Quality Level 3
1.6 Seismic Category 3
2 Applicable Documents 4
2.1 General 4
2.2 Codes and Standards 4
2.3 Reference Documents/Drawings 4
3 Design Requirements 5
3.1 Basic Function 5
3.2 Performance 6
3.3 Preheater Design 6
3.4 Environmental Conditions 7
3.5 Loading 7
3.6 Electrical Requirements 8
3.7 Instrumentation and Control Requirements 8
3.8 Thermal Analysis Requirements 9
3.9 Thermal Insulation Requirements 10
3.10 Radiation Shielding Requirements 10
3.11 Lifting Requirements 10
3.12 Accessibility and Maintenance 11
4 Materials 11
4.1 General 11
4.2 Prohibited Materials 12
5 Fabrication 12
5.1 General 12
5.2 Welding 12
5.3 Cleaning, Finishing, and Coating 13
6 Tests and Inspections 13
6.1 General 13
6.2 Personnel Qualifications 13

6.3 Shop Tests 13
7 Preparation for Shipment 14
7.1 General 14
7.2 Tagging 15
7.3 Shipping, Handling and Storage Instructions 15
8 Quality Assurance (QA) 15
8.1 General Requirements 15
8.2 Quality Related Components 15
9 Configuration Management 16
10 Documentation and Submittals 16
10.1 General 16
10.2 Calculations 16
10.3 Schedules 17

1 Scope

1.1 Project Description and Location

The Hanford Tank Waste Treatment and Immobilization Plant (WTP) is a complex of waste treatment facilities where the US Department of Energy (DOE) Hanford Site tank waste will be pretreated and immobilized into a stable glass form via vitrification. The WTP contractor will design, build, and start up the WTP pretreatment and vitrification facilities for the DOE Office of River Protection.

The Hanford Site occupies an area of about 560 square miles along the Columbia River, north of Richland, WA in the USA. The WTP facilities will be constructed at the 200 East Area of the Hanford Site. The site elevation varies from 662 feet to 684 feet above mean sea level.

1.2 Equipment, Material, and Services Required

This specification establishes the minimum requirements for the performance, design, analysis, materials, fabrication, testing, inspection, quality assurance, qualification, documentation, and preparation for shipment of HEPA (High Efficiency Particulate Air) Filter Preheaters.

The scope of work for the Seller includes all work defined in this specification and its addenda and attachments. The scope of work for the Seller shall include, but is not limited to, the following:

1.2.1 Provide design, materials, fabrication, testing, inspection, preparation for shipment, documentation, and submittals of HEPA Filter Preheaters in accordance with this specification, and its addenda, the material requisition (MR), and referenced codes, standards and documents.

1.2.2 Provide Buyer with a breakdown (by paragraph) of the codes, standards, and referenced documents to be applied to each aspect of design, drawings, analyses, fabrication, quality assurance, inspection, testing, qualification, labeling, packaging, handling, and shipment of the HEPA Filter Preheaters for review prior to beginning of detailed design. If an entire section or part of the above listed codes and standards applies, a breakdown by paragraph is not required. Only the part or section shall be listed.

1.2.3 Each HEPA Filter Preheater shall include, but is not limited to, the following:

- An in-cast liner
- A mounting frame
- A plenum with an inlet nozzle, an outlet nozzle, and heating element wells
- Electric heating elements
- Preheater control system
- Local control panel
- Thermowells (one each for inlet and outlet)
- Steel plating for radiation shielding
- Thermal insulation and insulation support lugs

1.2.4 Provide instructions for transportation, storage, handling, and installation of the HEPA Filter Preheaters per Seller's recommendations and the requirements of this specification.

1.2.5 Package and prepare the HEPA Filter Preheaters for shipment to the WTP site. Packaging shall be sufficient to allow for outdoor storage for a period of up to one (1) year at the WTP site. Environmental conditions for storage are found in section 3.4 of this specification.

1.2.6 Provide and submit procedures, reports, manuals, and all documentation per this specification, and Forms G-321-E and G-321-V of the MR.

1.2.7 Provide operating and maintenance manuals.

1.2.8 Each HEPA Filter Preheater shall be assembled and wired to the fullest extent in the shop, requiring minimum assembly, installation, and connection to Buyer's piping, electrical power supply, and control interface.

1.2.9 Code stamp and National Board registration for the Preheaters are not required.

1.3 Work by Others

Any item not specifically listed as being supplied by the Buyer shall be provided by the Seller. The Buyer shall supply the following:

1.3.1 Transportation of the HEPA Filter Preheaters.

1.3.2 Handling, storage, and installation of the HEPA Filter Preheaters at the Buyer's job-site.

1.3.3 Electric power to the HEPA Filter Preheaters.

1.3.4 External wiring and cabling to the HEPA Filter Preheaters.

1.4 Acronyms, Abbreviations and Definitions

1.4.1 Acronyms and Abbreviations

ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
CFR	Code of Federal Regulations
DOE	US Department of Energy
FMEA	Failure Mode and Effects Analysis
HEPA	High Efficiency Particulate Air
ICN	Integrated Control Network
IEEE	Institute of Electrical and Electronics Engineers
MDS	Mechanical Data Sheet
MR	Material Requisition
PMI	Positive Material Identification
QA	Quality Assurance
QAP	Quality Assurance Program
WTP	Hanford Tank Waste Treatment and Immobilization Plant
PPJ	Programmable Protection System

1.4.2 Definitions

C2: Contamination classification for plant areas that are normally uncontaminated but have the potential to be contaminated. Equipment and personnel are confirmed to be uncontaminated before exit to uncontrolled areas.

C5: Contamination classification for plant areas that are considered high contamination areas. Personnel access to C5 areas is not normally permitted.

Design Basis Earthquake: A specification of the ground motion at the site. For the WTP site, the Design Basis Earthquake is defined by horizontal and vertical acceleration response spectra anchored to a peak ground acceleration of 0.26g and 0.18g, respectively.

Preheaters: Refers to the HEPA Filter Preheaters.

MDSs: Refers to the mechanical data sheets for the HEPA Filter Preheaters.

MR: Refers to the material requisition for the HEPA Filter Preheaters.

R2: Radiation classification for areas with a target dose equivalent rate of 0.250 mrem/hr. It is a controlled area with no limit on occupancy for general employees subject to compliance with basic procedures.

R5: Radiation classification for areas considered high or very high radiation areas. Personnel access to R5 areas is not normally permitted.

Safety Design Class (SDC): Structures, systems, and components whose safety function is to prevent a worker or the maximally exposed member of the public from receiving a radiological exposure that exceeds the exposure standards defined in the Safety Requirements Document.

Safety Design Significant (SDS): Structures, systems, and components that are required to ensure that exposure standards for normal operation are not exceeded, whose failure would directly prevent an SDC item from performing it's safety function, or that implements the defense-in-depth requirements of the Safety Requirements Document.

1.5 Quality Level

The quality level identifies the quality requirements to be applied to the equipment. Quality requirements are specifically defined on the associated mechanical data sheets (MDSs) and supplier quality assurance program requirements data sheets. Refer to the MDSs for the quality level designations of the Preheaters.

1.6 Seismic Category

Specific requirements for the designated seismic categories are defined in 24590-WTP-3PS-SS90-T0001, *Engineering Specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks*. Refer to the MDSs for the seismic category designations of the Preheaters.

2 Applicable Documents

2.1 General

2.1.1 Work shall be done in accordance with the referenced codes, standards, and documents listed below, which are an integral part of this specification.

2.1.2 When specific chapters, sections, parts, or paragraphs are listed following a code, industry standard, or reference document, only those chapters, sections, parts, or paragraphs of the document are applicable and shall be applied. If a date or revision is not listed in section 2, the latest issue, including addenda, at the time of request for quote shall apply. The dates and revisions listed in section 2 shall apply to all subsequent references to codes and standards within this specification. When more than one code, standard, or referenced document covers the same topic, the requirements for all must be met with the most stringent governing.

2.2 Codes and Standards

2.2.1 10 CFR 835, *Occupational Radiation Protection.*

2.2.2 ACI 349-01 / 349R-01, *Code Requirements for Nuclear Safety Related Concrete Structures (ACI 349-01) and Commentary (ACI 349R-01).*

2.2.3 ANSI/AISC N690-1994, *Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities.*

2.2.4 ASME AG-1-1997 with AG-1-a-2000 Addenda, Sections AA, CA and TA, *Code on Nuclear Air and Gas Treatment.*

2.2.5 ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, *Rules for Construction of Pressure Vessels.*

2.2.6 ASME-NQA-1-1989, *Quality Assurance Program Requirements for Nuclear Facilities.*

2.2.7 IEEE 323-1983, *Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations (Tailored).*

2.2.8 IEEE 344-1987, *Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations (Tailored).*

2.3 Reference Documents/Drawings

2.3.1 24590-WTP-3PS-AFPS-T0001, *Engineering Specification for Shop Applied Special Protective Coatings for Steel Items and Equipment.*

2.3.2 24590-WTP-3PS-EKP0-T0001, *Engineering Specification for Electrical Requirements for Packaged Equipment.*

2.3.3 24590-WTP-3PS-G000-T0001, *General Specification for Supplier Quality Assurance Program Requirements.*

2.3.4 24590-WTP-3PS-G000-TP002, *Engineering Specification for Positive Material Identification (PMI).*

2.3.5 24590-WTP-3PS-G000-T0003, *Engineering Specification for Packaging, Handling, and Storage Requirements.*

2.3.6 24590-WTP-3PS-JQ06-T0003, *Engineering Specification for Seismic Qualification of Control and Electrical Systems and Components.*

2.3.7 24590-WTP-3PS-JQ07-T0001, *Engineering Specification for Instrumentation for Package Systems.*

2.3.8 24590-WTP-3PS-MV00-TP001, *Engineering Specification for Pressure Vessel Design and Fabrication.*

2.3.9 24590-WTP-3PS-MVB2-T0001, *Engineering Specification for Welding of Pressure Vessels, Heat Exchangers and Boilers.*

2.3.10 24590-WTP-3PS-NN00-T0001, *Engineering Specification for Hot and Anti-Sweat Thermal Insulation.*

2.3.11 24590-WTP-3PS-SS90-T0001, *Engineering Specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks.*

2.3.12 24590-WTP-MV-M59T-00007, *Thermowell Connection Standard Details.*

2.3.13 24590-WTP-MV-M59T-00009, *Lifting Lugs Standard Details.*

2.3.14 24590-WTP-3PS-JQ06-T0005, *Environmental Qualification Specification for Control and Electrical Systems and Components.*

2.3.15 24590-WTP-3PS-FB01-T0001, *Engineering Specification for Structural Design Loads for Seismic Category III and IV Equipment and Tanks.*

3 Design Requirements

3.1 Basic Function

The HEPA Filter Preheaters are located upstream of their respective HEPA filters in the offgas stream. The Preheaters are used to ensure the offgas stream temperature is sufficiently above the dew point to prevent moisture condensation in the HEPA filters.

The Preheaters are located in a 48" thick concrete wall that serves as a radiation and contamination boundary to separate the *R5/C5* area from the *R2/C2* area (see section 3.4.2).

3.2 Performance

3.2.1 The Preheaters shall be designed, fabricated and tested per the mechanical and performance requirements of this specification, the MDSs and the MR. Seller shall submit updated MDSs with the required information for review by the Buyer per Form G-321-E of the MR.

3.2.2 Seller shall recommend additional operating parameters to be monitored for the Preheaters to achieve their required performance.

3.2.3 The Preheaters, except for the heating elements, shall be designed to operate for a minimum service life of 40 years.

3.2.4 The required mean time to failure for each heating element is 5 years @ 8760 hours of use per year. Bidder shall propose the expected mean time to failure if it is less than the required mean time to failure.

3.3 Preheater Design

3.3.1 As Low As Reasonably Achievable (ALARA) principles shall be applied to the design of the Preheaters per 10 CFR 835, *Occupational Radiation Protection*.

3.3.2 Seller shall design the Preheaters to the requirements of:

- this specification
- ASME AG-1 Articles AA-4000 and CA-4400
- ASME Section VIII, Division 1
- the MDSs
- the MR

3.3.3 The Preheaters shall be designed to maintain the radiation, contamination, and pressure boundaries between the *R5/C5* area and *R2/C2* area at any time.

3.3.4 The offgas stream shall be contained within each Preheater plenum. The confinement boundary for the offgas stream shall be designed in accordance with ASME Boiler and Pressure Vessel Code Section VIII, Division 1. Seller shall provide code calculations per Form G-321-E of the MR.

3.3.5 Nozzle design, loading and reinforcement shall be in accordance with Buyer specification 24590-WTP-3PS-MV00-TP001, *Engineering Specification for Pressure Vessel Design and Fabrication*. Seller shall provide nozzle loading calculations per Form G-321-E of the MR.

3.3.6 The Preheaters shall meet Level B service limits as defined in article AA-4214 of ASME AG-1.

3.3.7 Refer to the MDSs for corrosion allowance requirements.

3.3.8 Seller shall design the Preheaters to fit within the space envelope specified in the MDSs. The local control panels shall be located in the *R2/C2* area in close proximity with their respective Preheaters. The dimensions of each local control panel shall not exceed 24 inches wide by 24 inches deep by 72 inches high.

3.3.9 Seller shall provide the operating and shipping weights for the Preheaters.

3.3.10 Seller shall provide a detail design of the in-cast liner in accordance with ACI 349/349R, Appendix B and ANSI/AISC N690. The concrete compressive strength is 4000 pounds per square inch. Refer to the MDSs for the material of construction of the in-cast liner.

3.3.11 Seller shall provide equipment reliability figures for all major components and sub-components of the Preheaters and the basis for those figures. Where possible, the Seller shall compare the figures for the equipment in this specification to similar equipment sold and serviced by the Seller. The definition of components and sub-components is at Seller's discretion. The reliability figures shall include, as a minimum, the following:

- Mean time between failure.
- Estimated modes of failure (example, dielectric breakdown, element overheat, etc.).
- Estimated time that is required to perform the recommended maintenance, as applicable (mean time to repair, MTTR).

The data above shall be based on the physical and environmental conditions delineated in this specification. The source for all estimates and any underlying assumptions shall be stated.

3.3.12 Seller shall provide detailed operating, and maintenance instructions, in the form of a manual or similar, for the Preheaters.

3.4 Environmental Conditions

3.4.1 The Preheaters shall be able to withstand outdoor storage without damage prior to installation at ambient temperature ranging from –23°F to 113°F with relative humidity ranging from 5% to 100%.

3.4.2 The Preheaters are cast into a 48" thick concrete wall which serves as the boundary between an *R2/C2* area and an *R5/C5* area. The *R2/C2* area will be maintained between 66°F dry bulb and 80°F dry bulb with relative humidity between 30% and 100%. The *R5/C5* area will be maintained between 59°F dry bulb and 113°F dry bulb with relative humidity between 5% and 100%.

3.4.3 The air pressures for *R2/C2* areas and *R5/C5* areas are respectively -0.1" and -1.4" water column relative to atmospheric pressure.

3.4.4 Deleted.

3.5 Loading

3.5.1 Seller shall design the Preheaters to be self-supporting and be capable of handling the loads and moments imposed on the Preheaters during testing, packaging, shipping, handling, storage, installation, operation, and a Design Basis Earthquake. Seller shall provide calculations to support the design basis.

3.5.2 Loads to be considered for the structural design of the Preheaters shall be in accordance with the codes, standards, and referenced documents listed in section 2 of this specification. As a

minimum, loadings and stresses to be imposed shall meet Level B service limits as defined in article AA-4214 of ASME AG-1.

3.5.3 Seller shall perform seismic analysis and qualification per the requirements of Buyer specification 24590-WTP-3PS-SS90-T0001, *Engineering Specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks*, and 24590-WTP-3PS-FB01-T0001, *Engineering Specification for Structural Design Loads for Seismic Category III and IV Equipment and Tanks*. Refer to section 2 of the MR for the attached In-Structure Acceleration Response Spectra.

3.6 Electrical Requirements

3.6.1 Electrical requirements for the Preheaters shall be in accordance with Buyer specification 24590-WTP-3PS-EKP0-T0001, *Engineering Specification for Electrical Requirements for Packaged Equipment.*

3.6.2 Seller shall environmentally qualify all electrical system components per Buyer specification 24590-WTP-3PS-JQ06-T0005, *Environmental Qualification Specification for Control and Electrical Systems and Components.*

3.6.3 Seller shall determine the life of Quality Level 1 and Quality Level 2 electrical equipment and components (refer to the Quality Level designation in the MDSs) that are susceptible to significant thermal and radiation aging in accordance with IEEE 323.

3.6.4 The available power supply for the Preheaters are:

- 120 Volts, alternating current, uninterrupted power supply (by others)
- 480 Volts, alternating current (by others)

3.7 Instrumentation and Control Requirements

3.7.1 Seller shall design and fabricate each Preheater and respective heating control system in accordance with Buyer specification 24590-WTP-3PS-JQ07-T0001, *Engineering Specification for Instrumentation for Package Systems*.

3.7.2 Buyer specification 24590-WTP-3PS-JQ06-T0003, *Engineering Specification for Seismic Qualification of Control and Electrical Systems and Components* shall apply to Seismic Category I instrumentation as well as control systems and components.

3.7.3 Seller shall environmentally qualify all control system components per Buyer specification 24590-WTP-3PS-JQ06-T0005, *Environmental Qualification Specification for Control and Electrical Systems and Components.*

3.7.4 Seller shall provide instrumentation, controls, interlocks, and logic control required for the Preheaters to achieve their required performance.

3.7.5 Seller shall provide the ability for functional testing of the Preheaters, and the Preheater control system.

3.7.6 Thermowell design shall be in accordance with Buyer document 24590-WTP-MV-M59T-00007, *Thermowell Connection Standard Details*. Each thermowell shall extend at least 5 inches into the plenum of each Preheater.

3.7.7 Seller shall provide over-temperature protection for each heating element.

3.7.8 Seller shall provide a local control panel for each Preheater. Each local control panel shall include, but is not limited to, the following:

- Start and stop controls
- Hand Off Automatic Controls
- Offgas inlet and outlet temperature indication
- Preheater On/Off indication
- Fault indication for each heating element
- Over-temperature protection and alarm for each heating element
- Inlet temperature isolated analog output to ICN
- Outlet temperature isolated analog output to ICN
- Fault (any) isolated discrete output to PPJ
- Failure (any) isolated discrete output to PPJ
- All control set points shall be adjustable from the Preheater control system operator interface.

3.7.9 Deleted.

3.7.10 The High-Level Waste Melter Offgas System Preheater control system shall maintain a delta temperature setpoint through the Preheater. Delta temperature setpoint will be maintained in the local Preheater controller.

3.7.11 The High-Level Waste Pulse Jet Ventilation System Preheater shall be designed to maintain offgas humidity at a level sufficient to preclude condensing conditions within the HEPA filters downstream of the Preheater. Humidity levels in the air stream shall be inferred from the air temperature measured at the inlet to the heater.

3.8 Thermal Analysis Requirements

3.8.1 Seller shall demonstrate, in the form of a calculation or similar, that the Preheaters are able to withstand all the thermal stresses in their 40 year service life.

3.8.2 Seller shall provide thermal analysis to:

- Confirm the Preheaters perform to the requirements of this specification, the MDSs, the MR, and referenced codes, standards and documents.
- Confirm the surface temperature of the concrete walls adjacent to the Preheaters do not exceed the maximum allowed temperature per section 3.9.2.
- Determine the requirement for personal protection on the *R2/C2* side of the Preheaters.

3.8.3 The method of analysis shall be proposed by the Seller.

3.8.4 The thermal analysis shall include startup, normal operation, upset, and shutdown conditions.

3.8.5 Seller shall provide thermal stress calculations for the Preheater design.

3.8.6 Seller shall provide nozzle displacement for normal operating and upset conditions.

3.9 Thermal Insulation Requirements

3.9.1 Seller shall provide insulation in accordance with Buyer specification 24590-WTP-3PS-NN00-T0001, *Engineering Specification for Hot and Anti-Sweat Thermal Insulation*.

3.9.2 The maximum allowable surface temperature of the concrete wall in contact with the Preheaters is 100°F.

3.9.3 Seller shall determine the surface temperature on the *R2/C2* side of the Preheaters and provide personnel protection insulation if the temperature exceeds 140°F.

3.9.4 The *R5/C5* side of the Preheaters shall not be insulated.

3.9.5 Seller shall provide a method for easy and safe replacement of thermal insulation that does not meet the design life of 40 years.

3.10 Radiation Shielding Requirements

3.10.1 Seller shall design and provide 13.4" of equivalent steel radiation shielding as shown on the MDSs.

3.10.2 Deleted.

3.10.3 Radiation shielding shall be designed using overlapping layers of shielding plates to achieve the required shielding thickness. The shielding design shall incorporate features for safe and easy assembly and removal of the shielding plates.

3.10.4 Shielding plates or shielding plugs that must be removed for Preheater maintenance shall not exceed 500 pounds each. The minimum shielding plate thickness shall be 1".

3.10.5 Shielding plates and shielding plugs not routinely removed for Preheater maintenance shall not exceed 2500 pounds each. The minimum shielding plate thickness shall be 1".

3.10.6 Each shielding component shall be uniquely identified using 1/2" high stamped characters to assist assembly and have suitable attachment points for balanced lifting and assembly.

3.10.7 Seller shall provide an assembly map to show the on-site assembly sequence of shielding components.

3.11 Lifting Requirements

3.11.1 Sizing of lifting lugs shall be in accordance with Buyer document 24590-WTP-MV-M59T-00009, *Lifting Lugs Standard Details*.

3.11.2 Lifting lug design shall be justified by calculation for eye pullout, bending, weld strength, and Preheater stress for the intended method of lift and material used.

3.11.3 Lifting lugs shall be stamped with the Preheater dry weight as defined by the Seller.

3.11.4 Lifting lugs shall be installed on each Preheater for balanced lifting and handling.

3.12 Accessibility and Maintenance

3.12.1 Preheater maintenance as well as replacement of heating elements shall be performed from the *R2/C2* area. The Preheaters will not be accessible for maintenance from the *R5/C5* area once they are put in operational service.

3.12.2 Refer to the MDSs for the allowable space for operations and maintenance of each Preheater in the *R2/C2* area.

3.12.3 Seller shall provide a list of equipment and components requiring maintenance or replacement over the 40 year minimum service life of the Preheaters. The list shall include recommendations for frequency of maintenance and replacement. Seller shall provide a spare parts list.

4 Materials

4.1 General

4.1.1 All materials of construction for the Preheaters shall conform to the requirements of:

- this specification
- ASME AG-1 Articles AA-3000, CA-3400 and CA-3500
- the MDSs
- the MR

4.1.2 All materials used shall be new and free of defects.

4.1.3 All materials used shall be resistant to deterioration when used in a radioactive environment for a minimum service life of 40 years.

4.1.4 Seller shall furnish legible copies of Certified Material Test Reports or Material Manufacturer's Certificate of Compliance for all materials used for the construction of the Preheaters.

4.1.5 Seller shall not substitute materials without written approval from the Buyer.

4.1.6 Seller shall maintain a positive system of identification of materials used in the fabrication of the Preheaters in accordance with Buyer specification 24590-WTP-3PS-G000-TP002, *Engineering Specification for Positive Material Identification (PMI)*.

4.1.7 Seller shall provide Material Safety Data Sheets for all applicable materials used in the construction of the Preheaters.

4.2 Prohibited Materials

4.2.1 Mercury, lead, aluminum, zinc, their alloys, or materials containing such metals as their basic constituents shall not be used in the construction of the Preheaters. Teflon shall not be used in the construction of the Preheaters too.

4.2.2 Molybdenum, sulfides, and halides shall not be used in direct contact with stainless steel.

4.2.3 Materials that contain halides shall not be used in any component of the Preheaters.

4.2.4 Asbestos shall not be included in any component of the Preheaters.

4.2.5 Carbon steel shall not be included in any component of the Preheaters that comes into direct contact with the offgas stream.

5 Fabrication

5.1 General

5.1.1 Fabrication of the Preheaters shall conform to the requirements of:

- this specification
- ASME AG-1 Articles AA-6000 and CA-6000
- the MDSs
- the MR

5.1.2 The confinement boundary for the offgas stream shall be fabricated to the requirements of ASME Boiler and Pressure Vessel Code Section VIII, Division 1, and Buyer specification 24590-WTP-3PS-MV00-TP001, *Engineering Specification for Pressure Vessel Design and Fabrication*.

5.1.3 All edges shall be rounded and smooth to the touch.

5.1.4 Seller shall determine and specify tolerances, surface flatness, and finish requirements for assembly and fabrication of the Preheaters at the detailed design stage. At a minimum, all tolerances, surface flatness, and finishes shall be in accordance with all applicable codes, standards, and references documents in section 2 of this specification.

5.2 Welding

5.2.1 Welding of the Preheaters other than the containment boundary for the offgas stream shall conform to the requirements of:

- this specification
- ASME AG-1 Articles AA-6300 and CA-6120
- the MDSs
- the MR

5.2.2 The containment boundary for the offgas stream shall be welded to the requirements of Buyer specification 24590-WTP-3PS-MVB2-T0001, *Engineering Specification for Welding of Pressure Vessels, Heat Exchangers and Boilers,* where applicable.

5.2.3 Seller shall submit procedures and qualifications per the applicable codes and specifications.

5.2.4 All welds along the contamination confinement boundary shall be continuous.

5.3 Cleaning, Finishing, and Coating

5.3.1 Cleaning, finishing, and coating of the Preheaters shall conform to the requirements of:

- ASME AG-1 Articles AA-6500 and CA-6200
- Buyer specification 24590-WTP-3PS-AFPS-T0001, *Engineering Specification for Shop Applied Special Protective Coatings for Steel Items and Equipment,* where applicable

6 Tests and Inspections

6.1 General

6.1.1 Seller shall conduct and be responsible for all testing and inspections of the Preheaters per the requirements of this specification, ASME AG-1 Articles AA-5000 and CA-5400, and all applicable references in section 2 of this specification.

6.1.2 Seller shall develop and submit detailed procedures for all tests and inspections for the Preheaters per the requirements of this specification, applicable codes, standards, reference documents, and Form G-321-E of the MR for Buyer review.

6.1.3 Seller shall complete and submit reports of all testing and inspections per Form G-321-V of the MR. Each report shall identify the component tested or inspected, date performed, applicable procedures, acceptance criteria, person performing the test or inspection, results, and conclusions.

6.1.4 Control and calibration of measuring and test equipment shall be in accordance with article AA-5130 of ASME AG-1.

6.2 Personnel Qualifications

6.2.1 All inspections and tests shall be performed by personnel qualified per the requirements of this specification and all applicable references in section 2 of this specification.

6.2.2 Seller shall submit personnel qualification documents of Seller's inspection and test personnel, for Buyer review.

6.3 Shop Tests

6.3.1 Seller shall provide all materials, labor, tools, equipment, appurtenances, and instrumentation to conduct all shop tests on the Preheaters.

6.3.2 Seller shall conduct tests and inspections specified in ASME AG-1 Articles AA-5000 and CA-5400 on each Preheater.

6.3.3 Seller shall conduct visual inspection on the Preheaters and provide an inspection checklist for Buyer review.

6.3.4 Seller shall conduct radiography and liquid penetrant examinations on each Preheater in accordance with ASME AG-1 Article AA-5300 and Buyer specification 24590-WTP-3PS-MV00-TP001, *Engineering Specification for Pressure Vessel Design and Fabrication*, where applicable.

6.3.5 Seller shall conduct pneumatic leak test on the plenum of each Preheater in accordance with ASME Boiler and Pressure Vessel Code, Section V and Buyer specification 24590-WTP-3PS-MV00-TP001, *Engineering Specification for Pressure Vessel Design and Fabrication.*

6.3.6 Seller shall demonstrate that the Preheaters are able to maintain the contamination and pressure boundaries between the *R5/C5* area and *R2/C2* area at any time.

6.3.7 Instrumentation and control systems shall be functionally tested, inspected, and calibrated in accordance with ASME AG-1 and Buyer specification 24590-WTP-3PS-JQ07-T0001, *Engineering Specification for Instrumentation for Package Systems.*

6.3.8 Seller shall provide all equipment, instrumentation, labor, and materials to perform a lifting test in the shop, demonstrating that the lifting lugs or attachment points are adequate to support the Preheaters without any distortion. Seller shall provide a shop test report on lifting points provided on each Preheater.

6.3.9 All test results shall be documented, certified, and submitted to Buyer for review.

7 Preparation for Shipment

7.1 General

7.1.1 The Preheaters shall be prepared for shipment in accordance with:

- Buyer specification 24590-WTP-3PS-G000-T0003, *Engineering Specification for Packaging, Handling and Storage Requirements*
- ASME AG-1 Article CA-7000

7.1.2 All results of shop tests and inspections for the Preheaters shall be reviewed by the Buyer prior to preparing and packaging the Preheaters for shipment.

7.1.3 Seller shall verify, by calculation, that the Preheaters and its internals will withstand loads occurring during shipping, handling, and installation.

7.2 Tagging

7.2.1 A stainless steel nameplate shall be permanently and rigidly affixed to each Preheater containing, as a minimum, the following information:

- Seller's name and serial number
- year of manufacture
- Buyer's purchase order number
- plant item number as furnished by the Buyer
- capacity, kW
- electrical characteristics, V/Phase/Hz

7.2.2 The information shall be stamped or etched on the nameplate using characters no less than 1/4" tall.

7.2.3 The attachment and location of nameplates shall be in accordance of Articles AA-9130 and AA-9140 of ASME AG-1.

7.2.4 All packages shall be clearly and suitably tagged to at least show the Seller's name, Buyer's name, plant item number, purchase order number, package contents, parts list, and handling instructions for each package.

7.3 Shipping, Handling and Storage Instructions

7.3.1 Seller shall submit shipping weights as well as detailed shipping, handling, and storage instructions for the Preheaters prior to its shipment per Form G-321-E of the MR.

8 Quality Assurance (QA)

8.1 General Requirements

8.1.1 Seller's Quality Assurance Program (QAP) requirements are specified in Buyer specification 24590-WTP-3PS-G000-T0001, *General Specification for Supplier Quality Assurance Program Requirements*.

8.1.2 Seller's QAP manual shall be submitted to the Buyer for review in accordance with Buyer specification 24590-WTP-3PS-G000-T0001, *General Specification for Supplier Quality Assurance Program Requirements*.

8.1.3 Seller's QAP, as a minimum, shall contain the requirements detailed in the Supplier Quality Assurance Program Requirements data sheet listed in Section 2 of the MR.

8.2 Quality Related Components

8.2.1 Seller shall have in place a QAP meeting the requirements of ASME-NQA-1, marked as applicable in Supplier Quality Assurance Program Requirements Data Sheet attached to the

MR, and Buyer specification 24590-WTP-3PS-G000-T0001, *General Specification for Supplier Quality Assurance Program Requirements*.

8.2.2 The successful bidder must pass a pre-award survey by the Buyer. Seller shall demonstrate that its quality program is in compliance with the procurement quality requirements listed in the Supplier Quality Assurance Program Requirements Data Sheet. Seller shall allow the Buyer, its agents, and DOE access to their facility and records pertaining to this purchase order for the purpose of QA audits and surveillance at mutually agreed times.

8.2.3 All items shall be manufactured in accordance with Seller's QAP that meets the requirements of ASME NQA-1, and has been previously evaluated and accepted by the WTP Quality Assurance Organization.

8.2.4 Seller shall submit their QAP and work plan to the Buyer for review prior to commencement of work. The plan shall include documents and procedures to implement the work and include a matrix of essential QA elements cross referenced with the documents or procedures.

9 Configuration Management

9.1 The equipment covered by this specification is identified with the plant item number shown in the MDSs. The equipment shall be identified in accordance with section 7.2, Tagging, of this specification.

9.2 Substitutions and deviations must be in accordance with section 2 of the MR.

10 Documentation and Submittals

10.1 General

10.1.1 Seller shall submit to Buyer all detailed designs, documentation, procedures, instructions, calculations, analyses, models, manufacturer data, inspection reports, test reports, certified material test reports, certifications, certificates, manuals (including operations and maintenance manuals), Material Safety Data Sheets, spare parts list, and drawings required per this specification, its addenda and attachments, the MR, and referenced codes, standards and Buyer documents.

10.1.2 Seller shall submit to Buyer the Engineering and Quality Verification documents in the forms, quantities, and timing shown in Form G-321-E, *Engineering Document Requirements*, and Form G-321-V, *Quality Verification Document Requirements*, in Section 3 of the MR.

10.1.3 Each documentation transmittal package shall have a documentation inventory sheet attached listing all documents and the number of pages in each package.

10.2 Calculations

10.2.1 All calculations to be provided to the Buyer shall be orderly, complete, and sufficiently clear to permit verification. The body of the calculations shall include, but are not limited to:

- a concise statement of the purpose of the calculation
- input data, applicable criteria, and stated assumptions
- a list of references used, including drawings, codes, standards, and computer programs (indicate the version or issue date)
- a discussion of rationale used for design assumption basis
- equations used for all computations
- numerical calculations including identification of units used
- a concise statement addressing the calculation results and/or recommendations
- a table of contents for complex calculations

10.3 Schedules

10.3.1 A detailed schedule of engineering, document submittals, material purchases, fabrication, shop tests, and shipment shall be submitted using Form 15EX in Section 3 of the MR.

Engineering Document Review

EDR No.* 24590- Rev.*

Return to Preparer:	Kathy Brightman	MS6-P2	371-4520
	Name (Print)	*Location*	*Telephone*
	MS-Vessel Group	7/29/04	8/03/04
	Discipline	*Date*	*Comments Due Date*

INTERNAL ENGINEERING DISTRIBUTION

Reviewer / Recipient	Discipline	Mail Stop	Info Only Recipient	Reviewer / Recipient	Discipline	Mail Stop	Info Only Recipient
Dan Pfluger	MS-CTRL	MS4-D2					

EXTERNAL REVIEWING ORGANIZATIONS

Point of Contact	Organization	Mail Stop	Point of Contact	Organization	Mail Stop
☐ Betty Tornow	Project Director	MS14-3C	☐ Karen Vacca	Operations	MS12-B
☐ Betty Tornow	Project Manager	MS14-3C	☐ Amorette Pryor	Project Administrative Services	MS11-B
☐ Mike Jewell	Acquisition Services	MS2-A	☐ Buck Payne	Project Controls	MS4-A2
☐ Liz Hagie	Business Services	MS14-3C	☐ Sean Sunday	Quality Assurance	MS14-4B
☐ Paul Petrusha	Construction	MS4-A1	☐ Joyce Hurley	Safety Assurance	MS14-4A
☒ Emmy Sauceda	Environmental & Nuclear Safety	MS4-C1			

Safety screenings are required for some design documents, such as PFDs, P&IDs, MHDs, V&IDs, ITS electrical single line diagrams, Plant Design GA plans, specifications for QL-1/QL-2 items, system descriptions, **and** DCNs, SCN, FCRs, and SDCNs that affect any of these documents. Refer to **section 3.1 of 24590-WTP-GPP-SREG-002** for a complete list of the design documents requiring safety screenings.

NOTE: This is not intended to be an all-inclusive list of the documents that go to E&NS for review. Engineering documents might also require review by E&NS for purposes other than conducting a safety screening/evaluation.

SAFETY SCREENING (to be completed by E&NS)

Refer to procedure 24590-WTP-GPP-SREG-002, section 3.5 and Appendices 3 and 4 for guidance in answering this question. If the answer to the following question is Yes, perform a safety evaluation in accordance with the procedure, and provide the SE number below. See Appendix 3 for information on minor changes.

Does this change affect the safety envelope (SRD and applicable facility SED[s]), or is it a "broad scope" change?	☐ Yes ☒ No ☐ Minor Only
	SE #

Basis *(Provide basis for both parts of the question, and for both a "Yes" or "No" decision. Provide a brief basis for "minor only" changes.)*:

Print/Type Name of AB Reviewer	*Initial*	*Date*	*Print/Type Name of FNS Supervisor/ Regulatory Safety Manager*	*Initial*	*Date*

DOCUMENTS REVIEWED

Document Number	Next Rev	Document Number	Next Rev
24590-WTP-~~3PS~~-MEE0-TP001	1		
HLW 07-25-04			

* Assigned by E&NS; only for EDRs that are also safety screenings.

Engineering Document Review

EDR No.* 24590- Rev.*

Return to Preparer:	Kathy Brightman	MS6-P2	371-4520
	Name (Print)	*Location*	*Telephone*
	MS-Vessel Group	7/29/04	8/03/04
	Discipline	*Date*	*Comments Due Date*

REVIEW RESULTS

Reviewer: DCPfluger *Name (Print)* Organization: CE MS Return Date: 8/2/04

☐ Accepted, no comments. ☒ Accepted, comments not mandatory. ☐ Mandatory comments.

REVIEW STATUS: My organization's review of this document is NOT required for future revisions or changes. ☐ Check only if applicable

Notes/Comments:

Comments Resolved:

Print/Type Name	*Signature*	*Date*

* Assigned by E&NS; only for EDRs that are also safety screenings.

Engineering Document Review

EDR No.* 24590- Rev.*

RECEIVED JUL 29 2004 By 6246

Return to Preparer:	Kathy Brightman	MS6-P2	371-4520
	Name (Print)	*Location*	*Telephone*
	MS-Vessel Group	7/29/04	8/03/04
	Discipline	*Date*	*Comments Due Date*

INTERNAL ENGINEERING DISTRIBUTION

Reviewer / Recipient	Discipline	Mail Stop	Info Only Recipient	Reviewer / Recipient	Discipline	Mail Stop	Info Only Recipient
Dan Pfluger	MS-CTRL	MS4-D2					

EXTERNAL REVIEWING ORGANIZATIONS

Point of Contact	Organization	Mail Stop	Point of Contact	Organization	Mail Stop
☐ Betty Tornow	Project Director	MS14-3C	☐ Karen Vacca	Operations	MS12-B
☐ Betty Tornow	Project Manager	MS14-3C	☐ Amorette Pryor	Project Administrative Services	MS11-B
☐ Mike Jewell	Acquisition Services	MS2-A	☐ Buck Payne	Project Controls	MS4-A2
☐ Liz Hagie	Business Services	MS14-3C	☐ Sean Sunday	Quality Assurance	MS14-4B
☐ Paul Petrusha	Construction	MS4-A1	☐ Joyce Hurley	Safety Assurance	MS14-4A
☒ Emmy Sauceda	Environmental & Nuclear Safety	MS4-C1			

Safety screenings are required for some design documents, such as PFDs, P&IDs, MHDs, V&IDs, ITS electrical single line diagrams, Plant Design GA plans, specifications for QL-1/QL-2 items, system descriptions, **and** DCNs, SCN, FCRs, and SDCNs that affect any of these documents. Refer to **section 3.1 of 24590-WTP-GPP-SREG-002** for a complete list of the design documents requiring safety screenings

NOTE: This is not intended to be an all-inclusive list of the documents that go to E&NS for review. Engineering documents might also require review by E&NS for purposes other than conducting a safety screening/evaluation.

SAFETY SCREENING (to be completed by E&NS)

Refer to procedure 24590-WTP-GPP-SREG-002, section 3.5 and Appendices 3 and 4 for guidance in answering this question If the answer to the following question is Yes, perform a safety evaluation in accordance with the procedure, and provide the SE number below See Appendix 3 for information on minor changes

Does this change affect the safety envelope (SRD and applicable facility SED[s]), or is it a "broad scope" change?	☐ Yes ☒ No ☐ Minor Only
	SE #

Basis *(Provide basis for both parts of the question, and for both a "Yes" or "No" decision. Provide a brief basis for "minor only" changes.)*:

Print/Type Name of AB Reviewer	*Initial*	*Date*	*Print/Type Name of FNS Supervisor/ Regulatory Safety Manager*	*Initial*	*Date*

DOCUMENTS REVIEWED

Document Number	Next Rev	Document Number	Next Rev
24590-WTP-~~3PS~~-MEE0-TP001	1		
NEW A 7-25-04			

* Assigned by E&NS, only for EDRs that are also safety screenings.

Engineering Document Review

EDR No * 24590- Rev.*

Return to Preparer:	Kathy Brightman	MS6-P2	371-4520
	Name (Print)	*Location*	*Telephone*
	MS-Vessel Group	7/29/04	8/03/04
	Discipline	*Date*	*Comments Due Date*

REVIEW RESULTS

Reviewer: J Markillie *Name (Print)* Organization: Environmental Return Date: 8/4/2004

☐ Accepted, no comments. ☐ Accepted, comments not mandatory. ☒ Mandatory comments.

REVIEW STATUS: My organization's review of this document is NOT required for future revisions or changes ☐ Check only if applicable

Notes/Comments:

Comments Resolved: J Markillie *Print/Type Name* JM *Signature* 8/5/2004 *Date*

* Assigned by E&NS; only for EDRs that are also safety screenings.

R10686796

RIVER PROTECTION PROJECT – WASTE TREATMENT PLANT

ENGINEERING SPECIFICATION

FOR

ISSUED BY
RPP-WTP PDC

HLW System HDH Canister Rinse Bogie

PHILIP MALCOLM SNIDER
STATE OF WASHINGTON
37080
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES: 01/13/08

Content applicable to ALARA? ☒ **Yes** ☐ **No**

ADR No.
N/A

Rev

Quality Designator
Q
DOE Contract No. DE-AC27-01RV14136

NOTE: Contents of this document are Dangerous Waste Permit affecting.

REV	DATE	BY	CHECK	REVIEW	E&NS	QA	APEM/DEM
2	6/27/06	J. Hancock	PAUL MEEUWSEN	PHIL SNIDER	N/A	FOR S. ALKERMAN	D. J. Wilsey
1	3/18/04	J. Sandberg	J. Hancock	L. Harrison	N/A	G. T. Warner	D. J. Wilsey
0	10-10-02	J. Hancock	L. Hopkinson	N/A	N/A	G. T. Warner	D. J. Wilsey

SPECIFICATION No.
24590-HLW-3PS-MQR0-TP002

Rev
2

Revision History

Revision	Reason for Revision
0	Issued for Permitting Use
1	Issued for Permitting Use
2	Issued for Permitting Use

Notice

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the US Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

Contents

1 Scope 1
1.1 Project Description and Location 1
1.2 Equipment, Material, and Services Required 1
1.3 Work by Others 3
1.4 Definitions and Abbreviations 3
1.4.1 Definitions 3
1.4.2 Abbreviations 3
1.5 Safety/Quality Classifications 5
1.5.1 Important to Safety 5
1.5.2 Non Important to Safety 5
1.5.3 Equipment Classifications 6
2 Applicable Documents 7
2.1 General 7
2.2 Codes and Standards 7
2.3 WTP Project Specifications 9
2.4 WTP Design Documents 10
2.4.1 Design Proposal Drawings (DPDs) 10
2.4.2 Mechanical Data Sheets (MDSs) 10
2.4.3 Reference Drawings and Data Sheets 11
2.5 Other WTP Documents 11
3 System Description 11
4 Equipment Description 12
4.1 Canister Rinse Bogie 12
4.2 Canister Rinse Vessel 13
4.3 Canister Rinse Bogie Rails 14
4.4 Canister Rinse Bogie Seismic Rails 14
4.5 Canister Rinse Bogie Service Tracks 14
4.6 Canister Rinse Bogie Recovery System 15
4.7 Canister Rinse Bogie Spool Piece 15
4.8 Canister Rinse Vessel Lid 15
5 Design Requirements 15
5.1 General 15
5.2 Mechanical Requirements 18
5.2.1 Canister Rinse Bogie 18
5.2.2 Canister Rinse Vessel 20
5.2.3 Canister Rinse Bogie Rails 22
5.2.4 Canister Rinse Bogie Seismic Rails 22
5.2.5 Canister Rinse Bogie Service Tracks 23
5.2.6 Canister Rinse Bogie Recovery System 23

5.2.7 Canister Rinse Bogie Spool Piece 24
5.2.8 Canister Rinse Vessel Lid 24

5.3 Performance 24
5.3.1 Design Life 24
5.3.2 Duty Cycles 24
5.3.3 Speeds 25
5.3.4 Positional Accuracy 25

5.4 Design Conditions 25

5.5 Environmental Conditions 25

5.6 Design Loads 26
5.6.1 General 26
5.6.2 Static Loads 26
5.6.3 Dynamic loads 26
5.6.4 Seismic Loads 27

5.7 Electrical Requirements 28

5.8 Instrumentation and Control Requirements 30
5.8.1 General 30
5.8.2 Interfaces Between Buyer and Seller 31
5.8.3 Bogie Positioning Control 32
5.8.4 Communication Network Interface 32

6 Materials 33

7 Fabrication 34

8 Tests and Inspections 34

8.1 General 34

8.2 Shop Tests 35
8.2.1 General 35
8.2.2 Canister Rinse Bogie 35
8.2.3 Canister Rinse Vessel 36
8.2.4 Canister Rinse Bogie Rails 36
8.2.5 Canister Rinse Bogie Service Tracks 37
8.2.6 Canister Rinse Bogie Recovery System 37

8.3 Temporary Structures 37

8.4 Cyclic Tests 38

8.5 Weld Inspections 38

9 Preparation for Shipment 38

9.1 General 38

9.2 Cleaning and Coating 39

9.3 Tagging 39

10 Quality Assurance 40

10.1 QA requirements specific to item(s) or service 40

10.2 Program QA Elements 40

11 Documentation and Submittals 40

11.1 General **40**

11.2 Quality Assurance Manual **41**

11.3 Design Compliance Matrix **41**

11.4 Safety Equipment List **41**

11.5 Software Requirements Document **41**

11.6 Drawings **42**
- 11.6.1 General 42
- 11.6.2 Arrangement Drawings: 42
- 11.6.3 Assembly Drawings: 43
- 11.6.4 Shop Fabrication/Detail Drawings: 43
- 11.6.5 Installation Drawings: 43

11.7 Calculations **44**

11.8 Design Reviews **45**
- 11.8.1 Contract Award Kick-Off Meeting 45
- 11.8.2 20% Design Review 46
- 11.8.3 50% Design Review 46
- 11.8.4 90% Design Review 46

11.9 Deleted **47**

11.10 Material Test Reports **47**

11.11 Spare Parts List **47**

11.12 Inspection and Test Plan **48**

11.13 Manuals **48**

11.14 Documentation Incorporated by Reference **49**

Appendices

Appendix A Instrumentation and Control Interfaces **A-1**

Appendix B Seismic Response Spectra **B-1**

Appendix C ALARA Design Review (ADRs) **C-1**

Appendix D Deleted **D-1**

Appendix E Deleted **E-1**

Appendix F Deleted **F-1**

Appendix G Deleted **G-1**

Appendix H Human Factor Codes and Standards **H-1**

1 Scope

1.1 Project Description and Location

1.1.1 The Office of River Protection (ORP) and its contractors manage 177 underground radioactive waste storage tanks at the Hanford Site in Washington. These tanks contain approximately 55.5 million US gallons of radioactive waste. Bechtel National, Inc. (BNI) has entered into a contract with the US Department of Energy (DOE) to design, construct, and commission a Hanford Tank Waste Treatment and Immobilization Plant (WTP) to process and vitrify the waste into a stable form that is suitable for permanent storage. The WTP will be constructed in the 200 East Area of the Hanford Site, near Richland, Washington. The main facilities within the WTP complex will be the Pretreatment (PTF), Low-Activity Waste (LAW) and High-Level Waste (HLW) Facilities.

1.2 Equipment, Material, and Services Required

1.2.1 This engineering specification covers the equipment, materials and services required for the design and supply of the HLW Canister Decontamination Handling (HDH) System, Canister Rinse Bogie and associated equipment.

1.2.2 A bogie is a four (4) wheeled trolley that travels on a pair of parallel rails.

1.2.3 The Canister Rinse Bogie is used to transport Immobilized High-Level Waste (IHLW) Canisters containing radioactive material from one location to another during process activities. A vessel located on the bogie holds the canister and performs a pre-wash of the canister at an intermediate station. The bogie travels in a process tunnel during normal operation, but has the ability to leave the tunnel and enter an adjoining room for maintenance purposes. A shield door separates the process and maintenance areas, and provides radiological shielding.

1.2.4 This specification supports Material Requisition (MR) No. 24590-QL-MRA-MQTS-00002

1.2.5 The Seller shall design, fabricate, inspect and functionally test equipment as specified in this specification. The equipment shall be fabricated and assembled in compliance with this specification, referenced codes and standards, and detail drawings reviewed by the Buyer. The Seller is responsible for:

- Design
- Procurement of materials
- Fabrication
- Assembly
- Tagging equipment with a component tag number (CTN)
- Functional Testing
- Examination/inspection
- Packaging and preparation for shipping
- Loading of equipment on Buyer arranged conveyance
- Umbilical electric cable located in Bogie Maintenance Area, see Section 3

- Submittals as identified in the submittal requirements found in the Purchase Order (PO) and this specification
- Installation, Operation, and Maintenance Manuals
- Lists of recommended spare parts
- Field support for installation and testing

1.2.6 The Seller shall provide the following equipment and any other equipment as necessary to perform the requirements identified in this specification:

Plant Item Number 24590-HLW-	**Description**
MQ-HDH-TRLY-00003	Canister Rinse Bogie
MV-HDH-VSL-00001	Canister Rinse Bogie Decon Vessel
MH-HDH-RAIL-00002	Canister Rinse Bogie Rails
MH-HDH-RAIL-00004	Canister Rinse Bogie Seismic Rails
MH-HDH-MHAN-00016	Canister Rinse Vessel Service Track
MH-HDH-MHAN-00017	Canister Rinse Bogie Service Track
MH-HDH-RCVY-00009	Canister Rinse Bogie Recovery System
MH-HDH-MHAN-00011	Canister Rinse Bogie Spool Piece
MH-HDH-MHAN-00015	Canister Rinse Vessel Lid
MP-HDH-PMP-00001	Bogie Decon Canister Pump
JC-HDH-PNL-00001	Canister Rinse Bogie ASD Control Cabinet

1.2.7 The Seller shall provide any special lifting equipment and tools, for assembly (or disassembly), installation, or maintenance of the bogie and associated equipment.

1.2.8 The Buyer shall provide a "mock-up" canister for shop testing, see Section 8.2 of this specification.

1.2.9 The Seller shall verify the accuracy and applicability of design information to meet the requirements identified in this specification. The Seller is encouraged to propose design improvements, which could result in quality, performance, cost, or schedule benefits beyond those offered by the Design Proposal Drawings (DPDs), and Mechanical Data Sheets (MDSs) accompanying the Purchase Order.

1.2.10 All requests for substitutions, modifications, or relaxation of this specification or requirements specified in the referenced documents shall be identified in writing for the consideration of the Buyer. For DPDs and MDSs, the following shall be considered required elements: parameters indicated as bounding ("max", "min", "not-to-exceed", or similar qualifier); information present on the DPDs and MDSs that includes the term "required", "mandatory", "shall", or similar term; components or equipment identified as pre-selected or mandatory by the Buyer. The Seller shall document such changes in a Supplier Deviation Disposition Request (SDDR) in accordance with Section 2 of the Purchase Order.

1.2.11 The following items and services will be supplied by the Buyer and are not included in the Seller's scope of work:

- Embed plates embedded in structural concrete to which equipment is anchored

- Waste Neutralization Vessel (PI. No. 24590-HLW-MV-HDH-VSL-P0003)
- Shipment from Seller's location to the Hanford receiving location
- Unloading at Hanford receiving location
- Field assembly, installation, erection and field testing of the bogie, vessel, and associated equipment
- Field startup, test, and run-in labor and materials
- Installation of conduit and wiring from the Seller provided control cabinets to the Buyer's Motor Control Center (MCC), Buyer's Controller, and Buyer's Remote I/O
- Mains electric power supply and connections
- Field touch-up painting
- Programming of the bogie control system
- Startup and commissioning
- Mock-up canister

1.3 Work by Others

1.3.1 The Seller may subcontract portions of the work, including any portion of the design, fabrication, manufacturing, or inspection, provided it meets the conditions of this specification and the Buyer's approval is obtained.

1.3.2 The Seller shall be ultimately responsible for the completeness and quality of all materials and services provided.

1.4 Definitions and Abbreviations

1.4.1 Definitions

1.4.1.1 Buyer: Bechtel National, Inc. (BNI)

1.4.1.2 Offeror: The party submitting a proposal for the equipment and/or services described in this specification.

1.4.1.3 Seller: The party selected to provide the equipment and/or services described in this specification.

1.4.1.4 Shall: Indicates a mandatory requirement in order to comply

1.4.1.5 Should: Indicates a recommendation for compliance

1.4.2 Abbreviations

ANSI	American National Standards Institute
AISC	American Institute of Steel Construction
API	American Petroleum Institute
ASD	Adjustable Speed Drive
ASME	American Society of Mechanical Engineers
AWS	American Welding Society
BNI	Bechtel National, Inc.
CFR	Code of Federal Regulations

CM	Commercial Quality
CMAA	Crane Manufacturers Association of America
CTN	Component Tag Number
DOE	Department of Energy
DPD(s)	Design Proposal Drawing(s)
EMI	Electromagnetic Interface
HDH	HLW Canister Decontamination Handling
HLW	High-Level Waste
HMI	Human-Machine Interface
ICN	Integrated Control Network
ICS	Industrial Controls and Systems
IEEE	Institute of Electrical and Electronics Engineers
IHLW	Immobilized High-Level Waste
IJB	Instrument Junction Box
I/O	Input/Output
ISA	Instrumentation, Systems, and Automation Society
ITS	Important to Safety
LAW	Low-Activity Waste
LOI	Local Operator Interface
MCC	Motor Control Center
MDS(s)	Mechanical Data Sheet(s)
MHD(s)	Mechanical Handling Diagram(s)
MR	Material Requisition
MSDS	Material Safety Data Sheet
MTR(s)	Material Test Report(s)
NDE	Non-Destructive Examination
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Agency
NQA	Nuclear Quality Assurance
ORP	Office of River Protection
OSHA	Occupational Safety and Health Administration
P&ID(s)	Piping and Instrumentation Diagram(s)
PO	Purchase Order
PTF	Pretreatment Facility
PTFE	Polytetrafluoroethylene
QAP	Quality Assurance Program
QL	Quality Level
RFI	Radio Frequency Interface
RIO	Remote I/O
SC	Seismic Category
SDC	Safety Design Class
SDDR	Supplier Deviation Disposition Request
SDS	Safety Design Significant
SSC(s)	Structures, Systems or Components
TEFC	Totally Enclosed Fan Cooled
TFE	Tetrafluoroethylene
UBC	Uniform Building Code
UL	Underwriters Laboratories

WNRF	Weld Neck Raised Face
WTP	Hanford Tank Waste Treatment and Immobilization Plant

1.5 Safety/Quality Classifications

1.5.1 Important to Safety

1.5.1.1 Structures, Systems, and Components (SSCs) that serve to provide reasonable assurance that the facility can operate without undue risk to the health and safety of the workers and public are classified as Important to Safety (ITS). ITS encompasses the broad class of facility features addressed in the top-level radiological, nuclear, and process safety standards and principles that contribute to the safe operation and protection of workers and the public during all phases and aspects of facility operations (i.e., normal operation and accident mitigation).

1.5.1.2 SSCs designated as ITS are classified as either Safety Design Class (SDC) or Safety Design Significant (SDS).

- The classification Safety Design Class (QL-1) is assigned to SSCs that prevent or mitigate offsite public, worker, or co-located worker radiological exposures that could exceed the standards.

- The classification Safety Design Significant (QL-2) is assigned to SSCs that ensure the that radiological standards for normal operation are not exceeded.

1.5.1.3 For Quality Assurance requirements of ITS SSCs refer to Section 10 of this specification.

1.5.2 Non Important to Safety

1.5.2.1 SSCs designated as Non-ITS, or Commercial Quality (CM), are those SSCs not classified as SDS, SDC, or Immobilized High-Level Waste (IHLW) product-quality affecting. Non-ITS items are manufactured using standard commercial practices as required by applicable industry standards, with the quality requirements identified in the Seller's Quality Assurance Program (QAP).

1.5.2.2 For Quality Assurance requirements of Non-ITS SSCs refer to Section 10 of this specification.

1.5.3 Equipment Classifications

1.5.3.1 The table below identifies equipment that have components designated as ITS.

Equipment	Components	Safety Classification (Quality Level)	Critical Characteristics
Canister Rinse Bogie	All components that maintain structural integrity (i.e. load path items) of the bogie and vessel support stand. These include but are not limited to, bogie chassis, vessel support stand, uplift restraints, bumpers, bogie rail end stops, and bolted/welded connections on the load path, including connections to bogie chassis.	SDS (QL-2)	Maintain vessel and canister on bogie and prevent bogie from derailing under normal operating conditions (following a wheel failure) or an SC-II design basis earthquake.
	All other components (including drive system and wheel modules)	Non-ITS	N/A
Canister Rinse Bogie Seismic Rails	All load path components that maintain the structural integrity, including bolted/welded connections.	SDS (QL-2)	Prevent bogie from derailing under normal operating conditions (following a wheel failure) or an SC-II design basis earthquake.
	All other components	Non-ITS	N/A

1.5.3.2 All other equipment identified in this specification are designated as Non-ITS. SSCs, identified as Non-ITS can include, but are not limited to, non-load path items and proprietary items such as motors, gearboxes and winches.

1.5.3.3 For seismic loading requirements, refer to Section 5.6.4 of this specification.

2 Applicable Documents

2.1 General

2.1.1 Work shall be carried out in accordance with, but not limited to, the applicable codes and standards listed in the following subsections. The specific revision or effective date identified, as well as the specific revision or effective date of codes and standards that they incorporate by reference (daughter codes and standards) shall be followed. If a date or revision is not identified, the latest issue, including addenda, in effect at the date of contract award or later, shall be used. Deviation from the dated codes and standards shall only apply with the agreement of the Buyer, or when in accordance with Sections 6.5 and 6.6 of this specification.

2.1.2 The Seller shall refer to Section 2 of the Purchase Order for the appropriate revisions of the WTP project documents identified in Sections 2.3, 2.4 and 2.5 of this specification.

2.1.3 Any known or suspected conflicts between the specifications, drawings, and the applicable codes and standards, shall be brought to the attention of the Buyer, via a SDDR, for resolution prior to start of work.

2.1.4 Where requirements in this specification exceed code requirements, this specification shall govern.

2.1.5 Deleted

2.2 Codes and Standards

2.2.1 American Society of Mechanical Engineers (ASME)

ASME NQA-1-1989, *Quality Assurance Program Requirements for Nuclear Facility Applications*

ASME B&PV Section VIII Division 1, *Rules for Construction of Pressure Vessels DIVISION 1 Non-Interfiled (Boiler and Pressure Vessel Codes)*

ASME B31.3 -1996, *Process Piping*

ASME NOG-1-2002, *Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)*

ASME/ANSI B73.2M, *Specification for Vertical In-Line Centrifugal Pumps for Chemical Process*

ASME B46.1, *Surface Texture (Surface Roughness, Waviness & Lay)*

2.2.2 American Welding Society (AWS)

AWS D1.1 2002, *Structural Welding Code – Steel*

AWS D1.6, *Structural Welding Code – Stainless Steel*

2.2.3 American Institute of Steel Construction (AISC)

AISC MO16, *Manual of Steel Construction, Allowable Stress Design, 9th Edition*

2.2.4 Crane Manufacturers Association of America (CMAA)

CMAA 70-2000, *Specification for Top Running Electric Overhead Traveling Cranes*

2.2.5 Department of Energy (DOE) Orders and Directives

DOE O 414.1A, *Quality Assurance*

2.2.6 Instrumentation, Systems, and Automation Society (ISA)

ISA 5.1, *Instrument Symbols and Identification*

2.2.7 National Electrical Manufacturers Association (NEMA)

NEMA, MG-1-1998, *Motors and Generators*

2.2.8 Institute of Electrical and Electronics Engineers (IEEE)

IEEE Std 1023-1988, *IEEE Guide for the Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations*

IEEE Std 1205-2000, *IEEE Guide for Assessing, Monitoring, and Mitigating Aging Effects on Class 1E Equipment used in Nuclear Power Generating Stations, Annex D*

2.2.9 Code of Federal Regulations (CFR)

FED-STD 595B-1994, *Colors Used in Government Procurement*

10 CFR Part 830, *Quality Assurance Criteria*

2.2.10 Uniform Building Code (UBC)

UBC-1997, *Uniform Building Code*

2.2.11 Underwriters Laboratories (UL)

UL 508 -1999, *Standard for Safety Industrial Control Equipment*

2.2.12 National Fire Protection Association (NFPA)

NFPA Volume 70, 1999 National Electric Code (NEC)

2.2.13 Department of Defense and Energy Standards, Nuclear Regulations

MIL-STD-1472F Human Engineering

DOE-HDBK-1140, 2001	Human Factors/Ergonomics Handbook for the Design for Ease of Maintenance
NUREG-0700	Human System Interface Design Review Guidelines
NUREG-0711	Human Factors Engineering Program Review Model

2.2.14 American Society of Testing Materials (ASTM)

ASTM A554 Standard Specification for Welded Stainless Steel Mechanical Tubing.

2.2.15	EN 292-1	Safety of Machinery - Basic Concepts, General Principles of Design - Part 1; Basic Terminology, Methodology.
2.2.16	EN 292-2	Safety of Machinery - Basic Concepts, General Principles of Design - Part 2; Technical Principle and Specifications.
2.2.17	ISO 281:1990	Roller bearings - Dynamic load ratings and rating life.
2.2.18	AGMA 908	Geometry Factors for Determining Pitting Resistance and Bending Strength of Spur, Helical, and Herringbone Gear Teeth.
2.2.19	AGMA 2001	Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gears.

2.3 WTP Project Specifications

2.3.1 24590-WTP-3PS-M000-T0002, Rev 0, *General Specification for Mechanical Handling Equipment Design and Manufacture,* Bechtel National, Inc., Richland, Washington. Sections which do not apply to this equipment: 3.5.8.1, 3.5.8.2, 3.5.8.5, 3.6, 3.7, 4.1.9, 4.1.10, 4.1.11, 4.1.12, 4.10.1, 4.10.4, 4.12, and 4.13.

2.3.2 24590-WTP-PER-PL-02-001, Rev 6, *Engineering Specification for Piping Material Classes*, Bechtel National, Inc., Richland, Washington. Section which does not apply to this equipment: 3.12.

2.3.3 24590-WTP-3PS-EKP0-T0001, Rev 2, *Engineering Specification for Electrical Requirements for Packaged Equipment*, Bechtel National, Inc., Richland, Washington. Sections which do not apply to this equipment: 6.4.2.3, 6.4.3.1, 6.6.1, 6.6.3, and 6.8.

2.3.4 24590-WTP-3PS-JQ07-T0001, Rev 1, *Engineering Specification for Instrumentation for Package Systems*, Bechtel National, Inc., Richland, Washington. Sections which do not apply to this equipment: 3.4.5.1, 3.4.5.2.3, 3.4.5.4.4, 3.4.5.9, 3.4.5.10, 3.4.5.12, 3.4.5.13, 3.4.5.14, 3.4.5.15, 3.4.5.16, 3.4.5.17, 3.7.1, 3.8.3, 3.8.4, 3.8.6, 3.8.7, and 3.8.8.1.

2.3.5 24590-WTP-3PS-MUMI-T0002, Rev 2, *Engineering Specification for Low Voltage Induction Motors,* Bechtel National, Inc., Richland, Washington. Sections which do not apply to this equipment: 5.1.1, 5.3, and 5.4.1.

2.3.6 24590-WTP-3PS-JD02-T0001, *Engineering Specification for Intelligent Drives for Packaged Equipment,* Bechtel National, Inc., Richland, Washington

2.3.7 Deleted.

2.3.8 24590-WTP-3PS-G000-T0003, *Engineering Specification for Packaging, Handling, and Storage Requirements*, Bechtel National, Inc., Richland, Washington

2.3.9 24590-WTP-3PS-AFPS-T0001, *Engineering Specification for Shop Applied Special Protective Coatings for Steel Items and Equipment,* Bechtel National, Inc., Richland, Washington

2.3.10 24590-WTP-3PS-G000-T0001, *General Specification for Supplier Quality Assurance Program Requirements,* Bechtel National, Inc., Richland, Washington

2.3.11 24590-WTP-3PS-SS00-T0001, Rev 5, *Welding of Carbon Structural Steel*, Bechtel National, Inc., Richland, Washington. Section which does not apply to this equipment: 8.18.

2.3.12 24590-WTP-3PS-SS00-T0002, *Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel*, Bechtel National, Inc., Richland, Washington

2.3.13 24590-WTP-3PS-JV15-T0001, *Engineering Specification for Actuators for On/Off Valves*, Bechtel National, Inc., Richland, Washington

2.3.14 24590-WTP-3PS-PV00-T0001, Rev 1, *Engineering Specification for Technical Supply Conditions for Valves*, Bechtel National, Inc., Richland, Washington. Section which does not apply to this equipment: 5.4.

2.4 WTP Design Documents

2.4.1 Design Proposal Drawings (DPDs)

Document Number	Document Description
24590-HLW-M0-HDH-00013	Canister Rinse Bogie Arrangement
24590-HLW-M0-HDH-P0012001	Canister Rinse Bogie
24590-HLW-M0-HDH-P0012002	Canister Rinse Bogie
24590-HLW-M0-HDH-00008	Canister Rinse Bogie Rails
24590-HLW-M0-HDH-00010	Canister Rinse Bogie Seismic Rails
24590-HLW-M0-HDH-00043	Canister Rinse Bogie Service Tracks
24590-HLW-M0-HDH-00029	Canister Rinse Bogie Recovery System

2.4.2 Mechanical Data Sheets (MDSs)

Document Number	Document Description

Document Number	Document Description
24590-HLW-M0D-HDH-00029	Canister Rinse Bogie Spool Piece
24590-HLW-M0D-HDH-00030	Canister Rinse Vessel Lid
24590-HLW-MPD-HDH-00001	HDH-PMP-00001 Canister Rinse Bogie Pump
24590-HLW-MVD-HDH-P0009	HDH-VSL-00001 Canister Rinse Bogie Vessel

2.4.3 Reference Drawings and Data Sheets

Document Number	Document Description
24590-HLW-M6-HDH-P0002	P&ID – HLW Canister Decontamination Handling System
24590-HLW-M0-HDH-00001001	DPD, Canister Rinse Bogie Decon/Maint Shield Door Arrangement
24590-HLW-M0-HDH-00001002	DPD, Canister Rinse Bogie Decon/Maint Shield Door Arrangement & Details
24590-HLW-M0-HDH-00002	DPD, Canister Rinse Bogie Decon/Maint Shield Door Embed Plates
24590-HLW-M0-30-00001001	HLW Test Canister Assembly
24590-HLW-M0D-HDH-00002	MDS, Canister Rinse Bogie Maint Crane 1
24590-HLW-M0D-HDH-00003	MDS, Canister Rinse Bogie Maint Crane 2

2.5 Other WTP Documents

2.5.1 24590-WTP-3PD-MQTS-00002, *Supplier Quality Assurance Program Requirements Data Sheet*, Bechtel National, Inc., Richland, Washington

2.5.2 24590-WTP-3PD-MQTS-00004, *Supplier Quality Assurance Program Requirements Data Sheet*, Bechtel National, Inc., Richland, Washington

2.5.3 24590-HLW-S0C-S15T-00009, Rev 0D, *HLW Vitrification Building Seismic Analysis - In-Structure Response Spectra (ISRS),* Bechtel National, Inc., Richland, Washington.

2.5.4 24590-HLW-S0C-S15T-00039, Rev D, *HLW Vitrification Building Seismic Analysis - Enveloped In-Structure Response Spectra,* Bechtel National, Inc., Richland, Washington.

3 System Description

3.1 The Canister Rinse Bogie operates in the HLW Canister Decontamination Handling (HDH) System.

3.2 The Canister Rinse Bogie travels in the Canister Rinse Tunnel (Room H-B039B) during normal operations. The Canister Rinse Tunnel is classified as a C5/R5 and C3/R3 transition zone. Maintenance activities are performed in an adjoining Bogie Maintenance Area (Room H-B039A), separated by a shield door from the process area. The Bogie Maintenance Area is classified as C3/R3. For environmental conditions and definitions of the classification of areas

refer to project specification 24590-WTP-3PS-M000-T0002, *General Specification for Mechanical Handling Equipment Design and Manufacture.*

3.3 Where dual classifications are identified on the DPDs, for example, C5/R5 and C3/R3, they indicate a transition zone where the room is designated as C5/R5 when a container is present and C3/R3 when a container is not present.

3.4 The Canister Rinse Bogie transfers glass filled IHLW Canisters from a position below the Canister Handling Cave (Room H-136) to a position below the Canister Decontamination, Swabbing and Monitoring Cave (Room H-133). A vessel located on the bogie holds the canister and performs a pre-wash of the canister at an intermediate station.

3.5 The purpose of the pre-wash is to perform a general rinse of the canister prior to transfer into the Canister Decontamination, Swabbing and Monitoring Cave.

3.6 The basic operations are as follows:

- Bogie and vessel positioned under the hatch located in the Canister Handling Cave
- Canister lowered into vessel, through hatch, by overhead crane located in the Canister Handling Cave
- Bogie, vessel and canister travel to the Canister Rinse Station
- Canister rinse cycle, see Section 4.2 of this specification
- Bogie, vessel and canister travel to a position under the hatch located in the Canister Decontamination, Swabbing, and Monitoring Cave
- Canister removed from bogie after 30 minute drying period, through hatch, by overhead crane located in the Canister Decontamination, Swabbing, and Monitoring Cave
- Bogie and vessel travel to a position under the hatch located in the Canister Handling Cave

3.7 Process and electrical services are provided to the bogie and vessel through service tracks (energy chains) located in the Canister Rinse Tunnel. When the bogie requires transferring from the process area to the maintenance area the service tracks and the service connections (process and electrical) are manually disconnected from the bogie at the shield door aperture and parked on a bracket located at the door aperture. A Seller provided umbilical electrical cable, located in the maintenance area, is manually connected to the bogie terminal box allowing the bogie to transfer into the maintenance area. The umbilical electrical cable provides the power and control to the bogie only. Once the bogie is located in the maintenance area the shield door is closed prior to any maintenance activities being performed.

4 Equipment Description

4.1 Canister Rinse Bogie

4.1.1 The bogie is a motorized trolley used for transporting IHLW Canisters containing radioactive material from one location to another during process activities.

4.1.2 The bogie is driven by an on-board geared motor, and travels on a pair of floor-mounted rails.

4.1.3 Power and control are provided to the bogie through a service track.

4.1.4 The bogie control system uses bogie mounted proximity switches and the motor brake to control the process stopping positions of the bogie

4.1.5 The bogie control system uses a bogie mounted ultimate travel limit switch to prevent the bogie from impacting the rail end stops in the event of a proximity (positioning) switch failure.

4.1.6 A stand mounted to the bogie chassis supports the Canister Rinse Vessel.

4.1.7 Restraints mounted to the side of the vessel support stand, in conjunction with the seismic rails (see Section 4.4), prevent the bogie from overturning or derailing in the event of a wheel failure or a seismic event.

4.2 Canister Rinse Vessel

4.2.1 The vessel is mounted to a support frame located on the bogie chassis. The vessel locates the canister for transfer and provides the containment and associated services for canister washing.

4.2.2 An inflatable seal mounted to the top flange of the vessel provides the seal between the vessel and the spool piece (see Section 4.7) to provide containment of the water spray during the rinse cycle. Process air is supplied to the inflatable seal from the Buyer's plant utility system through a 1" pipe, and has a line pressure of 90 - 100 psig. The line pressure is reduced to 25 psig by a pressure regulator for the inflatable seal air supply.

4.2.3 A series of spray nozzles located in the vessel directs demineralized water to spray the entire surface of the canister. The proposal drawings provided with this specification show an upper and lower spray ring. This allows the canister to be sprayed in stages due to the limiting flow rate. Demineralized water is supplied to the vessel from the Buyer's plant utility system through a 2" pipe, and has a maximum flow rate of 90 gpm and pressure 60 psig.

4.2.4 The maximum batch transfer to the vessel is 360 gallons. Maximum batch transfer is defined as the maximum water volume transferred to the vessel during the rinse cycle.

4.2.5 Two (2) solenoid operated on/off control valves divert the water flow between the upper and lower spray rings while a centrifugal pump continually discharges the water from the vessel during the rinse cycle. Water is discharged from the vessel to the Buyer's Waste Neutralization Vessel through a 2" pipe.

4.2.6 A high-high level switch and continuous level instrument monitor the water levels in the vessel during the rinse cycle.

4.2.7 The following rinse cycle is based on the proposal drawings provided with this specification:

- Pressurize the inflatable seal to make the seal between the vessel and the spool piece.

- Open the upper demineralized water line for the upper spray ring to begin the water wash.
- After the vessel has filled to 10 gallons, confirm that the vessel discharge pump has begun discharging the water at 80 gpm.
- After washing with 180 gallons of water in 2 minutes, close upper demineralized water line. After 2.5 minutes the vessel should be fully drained (check the level indicator on the vessel).
- Open the lower demineralized water line for the lower spray ring to finish the water wash.
- After the vessel has filled to 10 gallons, check that the vessel discharge pump has begun discharging the water at 80 gpm.
- After washing with 180 gallons of water in 2 minutes, close lower demineralized water line. After the vessel is emptied (2.5 minutes), ensure the vessel discharge pump is shut off.
- Depressurize the inflatable seal.

4.2.8 The pressurized demineralized water and plant process air are provided to, and removed from, the vessel through a dedicated process service track. Power and control are provided to the vessel equipment through the same service track that provides the electrical services to the bogie.

4.3 Canister Rinse Bogie Rails

4.3.1 The bogie rails run between the Canister Rinse Tunnel and the Bogie Maintenance Area. The rail supports are mounted on embeds located in the floor.

4.3.2 The rails guide the bogie between the process stations maintaining the relative position of the bogie to the process stations.

4.3.3 End-stops are located at the end of the rails to prevent bogie over-travel.

4.4 Canister Rinse Bogie Seismic Rails

4.4.1 The seismic rails are mounted on embeds located in the North and South walls of the Canister Rinse Tunnel.

4.4.2 The seismic rails, in conjunction with the bogie restraints, prevent the bogie from overturning or derailing in the event of a wheel failure or a seismic event.

4.5 Canister Rinse Bogie Service Tracks

4.5.1 Two (2) service tracks (energy chains) are located in the Canister Rinse Tunnel. One service track provides the routing for the electrical services to the bogie and the vessel, the other provides the routing for process services (water and air) to the vessel. The service tracks are dynamic tracks that allow movement of the bogie while maintaining fixed connections at the entry to and exit from the track for connection and routing of services.

4.5.2 The proposed design includes 4 cable systems: (1) mechanical handling power - bogie motor, (2) mechanical handling instrumentation - position sensors/limit switches, (3) process power - pumps and valves, (4) process instrumentation - level switches and transmitters.

4.5.3 The proposed design includes 3 process hoses: (1) water supply, (2) water discharge, and (3) air supply.

4.5.4 A Seller supplied bracket, at the shield door aperture, allows the service tracks to be parked in position prior to transferring the bogie into the maintenance area.

4.6 Canister Rinse Bogie Recovery System

4.6.1 The recovery system provides a means of recovering the bogie in the event of a component failure that would cause the bogie to become immobile.

4.6.2 In a recovery event the bogie is towed by a recovery block located at the West end of the bogie rail. The recovery block is connected, via a static cable, to a wall-mounted electric winch located in the maintenance area.

4.6.3 In a recovery event the canister is either removed from a position directly under the Canister Handling Cave (if the bogie has not moved from its park position), or the bogie is recovered to a position under the Canister Decontamination, Swabbing and Monitoring Cave where the canister is removed. The bogie is then recovered into the Bogie Maintenance Area where hands-on maintenance can be performed.

4.7 Canister Rinse Bogie Spool Piece

4.7.1 The spool piece is mounted to an embed located on the ceiling of the Canister Rinse Tunnel at the Canister Rinse Station. The spool piece provides the sealing surface for the vessel mounted inflatable seal.

4.8 Canister Rinse Vessel Lid

4.8.1 The vessel lid is placed over the top of the vessel while the bogie and vessel are located in the maintenance area. The vessel lid minimizes the potential for transfer of radioactive particulate (contamination) from inside the vessel while it is located in the maintenance area. The vessel lid is stored in the maintenance area.

5 Design Requirements

5.1 General

5.1.1 System components and equipment provided in accordance with this specification shall not exceed the bounding equipment envelope dimensions implied or explicitly indicated on the DPDs and MDSs referenced in Section 2.4 of this specification.

5.1.2 Equipment weights shall not exceed the bounding weights indicated on the DPDs and MDSs without Buyer authorization. The Seller shall be responsible for any analysis required to

determine embed loadings for equipment weights exceeding the bounding weights indicated on the DPDs and MDS, and are subject to Buyer review.

5.1.3 System components and equipment provided in accordance with this specification shall utilize the facility concrete embedments as depicted in the DPDs and MDSs referenced in Section 2.4 of this specification. Equipment mountings shall be capable of accommodating embed plate placement and orientation tolerances specified in sections 5.1.3.1 and 5.1.3.2 of this specification.

5.1.3.1 Tolerances for concrete placement shall be in accordance with the Table for Concrete Placement Tolerances, unless noted otherwise on the project drawings.

Table for Concrete Placement Tolerances

Component	Category	Tolerance
Footings	Lateral Alignment – As cast to center of individual footing.	0.02 times width of footing in direction of misplacement but not more than 2 in.
	Horizontal dimension for unformed members cast against soil. 2 feet or less Over 2 feet, but less than 6 feet Over 6 feet	 +3 in. or –1/2 in +6 in. or –1/2 in. +12 in. or –1/2 in.
	Level Alignment – Top of footings	+1/2 in. and –2 in.
	Cross-Sectional Dimensions – Horizontal dimension of formed members.	+2 in. and –1/2 in.
	Cross-Sectional Dimensions – Vertical dimension (thickness)	+5%
	Relative Alignment – Single footing side and top surface slope with respect to specified plane.	+1 in. within 10 feet
Cast-In-Place Concrete for Buildings	Vertical Alignment/Plumbness – (Lines, surfaces, and rises): Outside corner of exposed corner columns and control joint grooves in concrete exposed to view.	±1 in. ±1/2 in.
	Lateral Alignment: (Horizontal Location) Members Centerline location of openings 12 in. or smaller in slabs and edge location of larger openings. Sawcuts, joints, and weakened plane embeds	 ±1 in. ±1/2 in. ±3/4 in.

	Level Alignment:	
	Elevation of top of slabs and other formed surfaces before removal of shoring	±3/4 in.
	Elevation of lintels, sills, parapets, horizontal grooves, and other lines exposed to view	±1/2 in.
	Elevation of slabs on grade	±3/4 in.
	Cross-Sectional Dimensions: Members such as columns, beams, piers, or walls with thickness:	
	12 in. dimension or less	+ 3/8 in. or –1/4 in.
	More than 12 in. dimension but not over 3 ft dimension	+ 1/2 in. of –3/8 in.
	Over 3 ft dimension	+ 1 in. or –3/4 in.
	Relative Alignment:	
	Vertical alignment of outside corner of exposed corner columns and control joint grooves in concrete exposed to view	±1/4 in. in 10 ft.
	All other formed surfaces may slope in 10 ft with respect to the specified plane	±3/8 in. in 10 ft.
	Offset between adjacent pieces of formwork facing material shall not exceed:	
	Surfaces that receive special protective coatings-Class B See Section 3.1.4 for further clarifications.	± 1/4 in.
	For a Class C surface	±1/2 in.
	Openings Through Members:	
	Cross-sectional size of openings	–1/4 in. or +1 in.
	Location of centerline of opening	±1/2 in.

5.1.3.2 Placement tolerances for embedded items shall be in accordance with the Table for Embedded Item Placement Tolerances, unless noted otherwise on the project drawings:

Table for Embedded Item Placement Tolerances

Conditions	Embed Type	Tolerance
Lateral alignment in both directions in the plane of the slab or wall. Level alignment through the slab or wall.	Standard Embeds per drawing 24590-WTP-DD-S13T-00002	±2 in.

5.1.4 Equipment standardization shall be employed throughout equipment designs where safety requirements and cost requirements can be satisfied. Items performing similar duties should,

as far as possible, be standardized so that one particular make, model and size can be used in all similar applications.

5.1.5 The design shall consider human factors engineering and ergonomic requirements to ensure good human factor principles, guidelines, and methods are integrated into equipment design in accordance with IEEE Std 1023-1988 *IEEE Guide for the Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations*. The codes and standards identified in Appendix H, or buyer approved equal, shall be used to implement IEEE Std 1023. The specific human factor attributes applying to the equipment shall be invoked.

5.1.6 For general design requirements of mechanical handling equipment refer to project specification 24590-WTP-3PS-M000-T0002, *General Specification for Mechanical Handling Equipment Design & Manufacture,* excluding sections 3.5.8.1, 3.5.8.2, 3.5.8.5, 3.6, 3.7, 4.1.9, 4.1.10, 4.1.11, 4.1.12, 4.10.1, 4.10.4, 4.12, and 4.13.

5.1.7 Equipment that is not painted (or otherwise coated) and exposed to radiation that can cause surface contamination shall have decontaminable surface finishes of 63 microinches (or better) roughness average in accordance with ASME B46.1. Except when the equipment is infrequently handled or decontaminated, in which case it can have decontaminable surface finishes of 125 microinches (or better) roughness average in accordance with ASME B46.1.

5.2 Mechanical Requirements

5.2.1 Canister Rinse Bogie

5.2.1.1 The bogie shall be designed to travel on stainless steel fabricated rails with rail centers of 82 inches, see Section 5.2.3.

5.2.1.2 The bogie shall be capable of transporting a glass filled IHLW Canister, weighing 9260 lbs (max), and the Canister Rinse Vessel including rinse water.

5.2.1.3 Special attention shall be paid to the bogie chassis, to ensure plain surfaces can be cleaned easily, and potential contamination traps are minimized. Tube sections should be used in preference to structural 'I' beams and channels. All tubing shall be sealed to prevent the ingress of contamination. Drain holes shall be provided wherever water may collect during wash down, except in sealed tubing.

5.2.1.4 The bogie chassis shall accommodate a support frame for the Canister Rinse Vessel. The support frame shall be capable of supporting the vessel while located on the bogie.

5.2.1.5 The bogie chassis and vessel support frame shall be fitted with appropriate lifting features to assist with maintenance activities, using an overhead crane, while the bogie is located in the maintenance area. The combined weight of the bogie chassis and the vessel support frame shall not exceed 10,000 lbs. The Seller shall provide any special lifting equipment required. The Buyer will provide to the Seller details of the crane hook prior to final design.

5.2.1.6 The bogie chassis and vessel support frame should be fabricated from ASTM A36 steel. Proprietary items shall be "as supplied" providing they are suitable for the operating conditions.

5.2.1.7 The bogie chassis shall accommodate equipment associated with the Canister Rinse Vessel.

5.2.1.8 The vessel support frame shall have location features to aid in the alignment and set down of the Canister Rinse Vessel.

5.2.1.9 The bogie shall have two driven wheels.

5.2.1.10 The bogie shall be guided by two (2) double flanged wheels on one side of the bogie. The opposite two wheels shall be plain. The flanged wheels shall be located on the same rail as the recovery winch. The wheel flanges shall be of adequate size to withstand skew forces from track misalignment and forces imposed due to recovering the bogie with a seized drive system.

5.2.1.11 Clearances between wheel flanges and rail, accounting for manufacturing tolerances, shall be sufficient to allow free running of the bogie while achieving the required positional tolerances in accordance with Section 5.3.4 of this specification.

5.2.1.12 Seismic restraints shall be mounted to the vessel support frame, to prevent the bogie from derailing in the event of a flanged wheel failure under normal operation, or an SC-II design basis earthquake, in accordance with Sections 1.5.3 and 5.6 of this specification.

5.2.1.13 The drive system and wheel modules shall be designed for ease of maintenance and replacement.

5.2.1.14 The bogie shall have four (4) bumpers, one at each corner of the bogie; to prevent damage to the bogie, shield door, or rail end-stops. The bumpers shall be designed to absorb the impact of a fully laden bogie, traveling at full operating speed, with a closed shield door, such that the resulting force imparted on the shield door does not exceed 1500 lbf.

5.2.1.15 There shall be two (2) proximity switches mounted on the bogie chassis for operational positioning of the bogie.

5.2.1.16 There shall be one (1) ultimate-travel limit switch mounted on the bogie chassis to prevent over travel of the bogie in the event of a proximity switch failure. The limit switch shall be capable of operating with the bogie traveling in both directions.

5.2.1.17 Adjustable proximity switch targets and limit switch strikers shall be supplied with the bogie as required per the system drawings. The targets and strikers shall be designed to be adjustable for on-site installation.

5.2.1.18 A means of detecting a canister is present in the vessel shall be provided.

5.2.1.19 The bogie shall be designed to limit individual wheel loads during normal operation to less than 1/3 of the total laden bogie weight while traveling on rails installed per paragraph 5.2.3.5. This requirement can be demonstrated by analysis or test.

5.2.1.20 Gears and gearboxes, shall comply with AGMA Standards, or, EC Machinery Directive 98/37/EC, EN 292-1 & 292-2 *Safety of Machinery*, and ISO 281 - 1990 *Roller bearings, Dynamic load ratings and rating life.*

5.2.2 Canister Rinse Vessel

5.2.2.1 The vessel shall be designed in accordance with ASME B&PV Section VIII, Division 1, except that code stamping is not required.

5.2.2.2 Process piping shall be designed in accordance with the applicable requirements identified in ASME B31.3 and project specification 24590-WTP-PER-PL-02-001, *Engineering Specification for Piping Material Classes,* excluding section 3.12. The piping material class for interfacing to the Buyer provided piping shall be S11B.

5.2.2.3 The centrifugal discharge pump shall be in accordance with the requirements identified in ASME/ANSI B73.2M *Specification for Vertical In-Line Centrifugal Pumps for Chemical Process.*

5.2.2.4 The vessel shall have lifting features to allow the vertical removal of the vessel from the bogie, using an overhead crane, while located in the maintenance area. Pipe connections shall be configured such that vessel can be removed easily. The weight of the vessel and internal components shall not exceed 10,000 lbs. The Seller shall provide any special lifting equipment required. The Buyer will provide to the Seller details of the crane hook prior to final design.

5.2.2.5 The design of the spray system shall ensure that the spray pattern is generally in a downward direction, minimizing "back spray" within the vessel, and providing full coverage of the canister surface. The canister can be sprayed in stages due to the limit on flow rate. If the canister is sprayed in stages it shall be sprayed from top to bottom.

5.2.2.6 The Seller shall make every effort to minimize the volume of water used during the rinse cycle while achieving the full coverage of the canister.

5.2.2.7 The vessel shall contain guides and a pedestal for locating and seating the canister. The guides internal diameter shall be 27 inches ± 1/4 inch. This diameter takes into account misalignment, due to tolerance build-up, between the bogie and the overhead crane during loading and unloading of the canister. The guides shall be designed such that the potential for scratching of the canister surface is minimized during loading and unloading.

5.2.2.8 The container guides shall be configured such that spray coverage is not affected. Lifting features shall be located at the top of the guides to allow removal from the vessel, using an overhead crane, while the bogie is located in the maintenance area. The Seller shall provide any special lifting equipment required. The Buyer will provide to the Seller details of the crane hook prior to final design.

5.2.2.9 The spray system shall be removable from the vessel without the requirement for hands on access to the internals of the vessel. Pipe connections shall be located at the top of the vessel and shall be arranged to allow manual disconnection and removal of the spray system, using an overhead crane, while the bogie is located in the maintenance area. The

Seller shall provide any special lifting equipment required. The Buyer will provide to the Seller details of the crane hook prior to final design.

5.2.2.10 The vessel piping and internal components shall be designed to minimize contamination traps and maximize contamination removal through rinsing.

5.2.2.11 The inflatable seal shall be mounted to the top flange of the vessel. The seal shall be capable of containing the water spray in the vessel during the rinse cycle.

5.2.2.12 The centrifugal discharge pump shall be capable of discharging water from the vessel such that the static head of water does not contact the canister or compromise the spray nozzles.

5.2.2.13 The vessel shall have a high-high penetration point for a level switch to detect the maximum static head of water. The penetration shall be a 2" Weld Neck Raised Face (WNRF) flange. Initiation of the high-high level switch shall terminate the spray sequence.

5.2.2.14 The vessel shall have an external chamber located on the side of the vessel for a continuous level instrument. The external chamber shall have a minimum internal diameter of 2". The top of the chamber shall be flanged for device mounting. The bottom leg of the chamber shall interconnect to the vessel drain pipe at the bottom of the vessel. The top leg of the chamber shall penetrate the vessel at a point above the maximum static head of water such that the operating range of the level instrument places the maximum static head of water at the 50% - 75% point of the level instruments range. The continuous level instrument shall initiate the discharge of the rinse water at a set level.

5.2.2.15 Transmitters for both the level switch, and the continuous level instrument, will be mounted in the corridor adjacent to the transfer tunnel.

5.2.2.16 The vessel shall have a vent pipe located within the vessel for venting during the normal rinse cycle. The design of the vent pipe should address the unlikely event of slight pressurization of the vessel during normal spraying operations that would cause a water column to be pushed through the vent pipe. An air in-bleed near the top of the vent pipe will allow air to escape the vessel if the bottom of the vent pipe becomes submerged. An in-bleed is defined as a hole in the pipe that either has a small bent tube, plating, or other method for baffling mist from entering the hole, while allowing air to escape through it. The vent pipe shall run from a point just below the top of the vessel to a point just above the canister bottom, creating an arduous path to prevent the release of mist carryover from the vessel. The Seller shall determine during shop tests the levels of mist carryover released from the vent pipe, see Section 8.2.3 of this specification.

5.2.2.17 The control valves shall be of the pneumatic operated actuator type. The control valves shall meet the applicable requirements identified in 24590-WTP-3PS-JV15-T0001, *Engineering Specification for Actuators for On/Off Valves*, and 24590-WTP-3PS-PV00-T0001, *Engineering Specification for Technical Supply Conditions for Valves,* excluding section 5.4.

5.2.2.18 The operating position of the control valves shall be monitored by position switches on the actuator. The actuator shall operate the valve to a "failed closed" condition in the event of power failure.

5.2.2.19 The vessel, and associated rigid piping supplying demineralized water to the vessel, shall be constructed from 316L stainless steel.

5.2.2.20 The canister shall not come into contact with any material other than stainless steel.

5.2.2.21 The vessel shall accommodate all static, dynamic, and seismic loads in accordance with Section 5.6 of this specification.

5.2.3 Canister Rinse Bogie Rails

5.2.3.1 The rail assembly shall be fabricated from a suitable grade stainless steel, with the running rail made from an age-hardened martensitic stainless steel.

5.2.3.2 The rail hardness shall be suitable for the intended application, but as a minimum shall be greater than that of the wheel. The rail and wheels should both be of similar high hardness to avoid unnecessary wear, and shall be of a dissimilar material such that galling does not take place.

5.2.3.3 End-stops shall be provided at the ends of each rail. The end-stops shall be capable of withstanding the impact of a fully laden bogie traveling at full operating speed, without exceeding allowable stresses.

5.2.3.4 The Seller shall provide shim packs for site adjustment to achieve the required installation tolerances. Refer to Section 3.5.3 of project specification 24590-WTP-3PS-M000-T0002, *General Specification for Mechanical Handling Equipment Design & Manufacture*, for details of installation features.

5.2.3.5 The bogie rails shall be fabricated to achieve the following installation tolerances:

Rail Span	± 1/8 inch
Rail straightness	± 1/8 inch
Rail elevation	± 1/8 inch
Difference in rail heights	± 1/16 inch

5.2.4 Canister Rinse Bogie Seismic Rails

5.2.4.1 The seismic rails shall prevent the bogie from derailing in the event of a flanged wheel failure under normal operation, or an SC-II design basis earthquake, in accordance with Sections 1.5.3 and 5.6 of this specification.

5.2.4.2 The seismic rails shall be constructed from a suitable grade stainless steel.

5.2.4.3 The seismic rails shall accommodate the full process travel of the bogie.

5.2.4.4 The seismic rails shall be adjustable in both the vertical and the North-South directions for on-site setting. Refer to Section 3.5.3 of project specification 24590-WTP-3PS-M000-T0002, *General Specification for Mechanical Handling Equipment Design & Manufacture*, for details of installation features.

5.2.5 Canister Rinse Bogie Service Tracks

5.2.5.1 One (1) each service track shall be provided for electrical cables and process hoses associated with the operation of the Canister Rinse Bogie and Canister Rinse Vessel.

5.2.5.2 The service track for the process hoses shall be located on the South side of the bogie. The service track for the electrical cables shall be located on the North side of the bogie.

5.2.5.3 The service tracks shall be capable of operating over the full process movement of the bogie and have sufficient additional capacity to transfer the bogie to the shield door aperture.

5.2.5.4 The process service track shall be capable of accommodating the loads exerted when the process hoses (water and air) are pressurized.

5.2.5.5 The service tracks shall contain sufficient lengths of electrical cable and process hoses to allow for remaking of connections at the Buyer's facility to the Buyer provided cables and piping. The Buyer will provide to the Seller interface details prior to final design.

5.2.5.6 The service tracks, electrical cables and process hoses shall be capable of being manually disconnected and reconnected to the bogie at the shield door aperture.

5.2.5.7 The electrical cables and process hoses shall be capable of being easily disconnected and reconnected to the bogie using quick disconnect type connectors. The process hose connectors shall be of the non spill double shutoff type. The Seller shall consider the use of manifolds or multi-pin connectors to simplify the operation with the aim to minimize operator time while the shield door is in the open position.

5.2.5.8 The service tracks shall provide protection for the cable and hoses as the bogie moves to prevent them from becoming entangled or damaged.

5.2.5.9 The service tracks shall be constructed from a suitable grade stainless steel.

5.2.5.10 The tracks shall be of an open construction to allow for ease of decontamination and access to electrical cables and process hoses for inspection.

5.2.6 Canister Rinse Bogie Recovery System

5.2.6.1 The bogie recovery system shall be capable of recovering a fully laden bogie with a seized drive system, as a minimum.

5.2.6.2 The wire rope shall be polyethylene sheathed for ease of decontamination.

5.2.6.3 The design shall ensure that proper fleet angles are maintained between the winch and the pulley to ensure correct cable winding during recovery.

5.2.6.4 The Seller shall provide all support structures required for mounting of the recovery winches to the embeds identified on the DPDs.

5.2.6.5 The gearbox shall be capable of being decoupled from the winch drum to allow periodic maintenance. The decoupling process shall be a simple procedure with minimal effort by maintenance personnel.

5.2.6.6 The recovery block shall be capable of being pushed along the rails by the bogie to its park position.

5.2.7 Canister Rinse Bogie Spool Piece

5.2.7.1 The spool piece shall provide the sealing surface for the vessel mounted inflatable seal.

5.2.7.2 The spool piece shall include features to allow on-site adjustment of the sealing face to accommodate the inflatable seal operating parameters and installation tolerances. Refer to Section 3.5.3 of project specification 24590-WTP-3PS-M000-T0002, *General Specification for Mechanical Handling Equipment Design & Manufacture*, for details of installation features.

5.2.7.3 The spool piece shall be constructed from a suitable grade stainless steel.

5.2.8 Canister Rinse Vessel Lid

5.2.8.1 The vessel lid shall be fitted with appropriate lifting features to assist with handling, using an overhead crane located in the maintenance area. The Seller shall provide any special lifting equipment. The Buyer will provide to the Seller details of the crane hook prior to final design.

5.2.8.2 The lid shall contain guide features to assist with the location of the lid over the vessel.

5.2.8.3 The lid shall not interfere with the inflatable seal.

5.2.8.4 The lid shall be constructed from a suitable grade stainless steel.

5.3 Performance

5.3.1 Design Life

5.3.1.1 All equipment shall be designed to operate over a plant life of 40 years and in accordance with the duty cycles identified in Section 5.3.2 of this specification.

5.3.1.2 It is recognized that some commercially available components may not have a design life of 40 years. These components shall be configured and incorporate features to allow hands-on maintenance and replacement.

5.3.2 Duty Cycles

5.3.2.1 A cycle consists of the complete movement of a bogie from its starting position to its final destination and back to its starting position, including all process activities between.

5.3.2.2 The Canister Rinse Bogie is subject to the following duty cycles:

Duty Cycles (per year)		Duty Cycles (per day)
Min	Max	Max
180	730	2

5.3.3 Speeds

5.3.3.1 The Canister Rinse Bogie shall travel between process stations at a nominal speed of 10 ft per minute (normal) and shall ramp down when approaching a station to a suitable creep speed which maintains throughput and positional accuracy. The Seller shall determine and document the creep speed during testing.

5.3.3.2 After each process stop, the bogie shall ramp up to the normal operating speed. The Seller shall confirm the suitability of the acceleration and deceleration rates during the shop tests, to ensure smooth starting and stopping of the bogie.

5.3.3.3 The Canister Rinse Bogie shall be recovered at an appropriate speed to ensure smooth movement of the bogie during the full recovery travel. The proposal drawings show the recovery speed at 1 ft per minute. However, the Seller shall determine the most appropriate speed whether identical to the proposal or otherwise.

5.3.4 Positional Accuracy

5.3.4.1 The Canister Rinse Bogie shall be capable of repeatable positioning to within ±1/8 inch in all directions. The accuracy is required to minimize misalignment, due to tolerance build-up, between the bogie and the overhead crane used to load/unload the canister.

5.4 Design Conditions

5.4.1 For general design conditions refer to Section 3.3 of project specification 24590-WTP-3PS-M000-T0002, *General Specification for Mechanical Handling Equipment Design & Manufacture.*

5.5 Environmental Conditions

5.5.1 For Hanford Site Climatological Data refer to Section 1 of the Purchase Order, *Information and Instructions to Bidders.*

5.5.2 For general facility internal conditions refer to Section 3.4 of project specification 24590-WTP-3PS-M000-T0002, *General Specification for Mechanical Handling Equipment Design & Manufacture.*

5.5.3 The bogie, vessel, and associated equipment may be subject to decontamination prior to hands-on maintenance being performed. This could include wiping equipment with wet rags and washing with water or dilute nitric acid.

5.5.4 The Canister Rinse Tunnel will be subject to periodic washdown with demineralized water, from a fixed spray system, to maintain general cleanliness of the tunnel.

5.6 Design Loads

5.6.1 General

5.6.1.1 The equipment identified in this specification shall accommodate all static, dynamic, and seismic loads, in accordance with this section and the requirements identified in Sections 1.5.3 and 5.2.

5.6.1.2 For normal service conditions a bogie shall be treated as a crane trolley and shall be evaluated in accordance with the applicable requirements identified in CMAA 70.

5.6.1.3 The bogie and bogie components, SC-I and SC-II SSCs, shall be seismically qualified to not fail during all operating conditions, including the design basis earthquake, and shall be in accordance with the requirements of ASME NOG-1-2002, *Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder),* Sections 4150 and 5481. Extraordinary loadings, in addition to the loadings identified in CMAA 70, Section 3.3.2, shall include seismic acceleration loads identified in Section 5.6.4, and test loads (125%) applied during load test. The permissible stresses for seismic conditions shall be in accordance with CMAA 70, Section 3.4.3. Stress Level and Case 3.

5.6.1.4 Design of SC-III and SC-IV SSCs shall be governed by the provisions of AISC MO16, *Manual of Steel Construction, Allowable Stress Design, 9th Edition.*

5.6.1.5 ITS (load path) items shall be designed in accordance with ASME NOG-1-2002, Sections 4130, 4200, 4300, 4400, 5100, 5300, 5456 and 5458, as applicable.

5.6.1.6 For SC-II SSCs, loads shall be combined in accordance with ASME NOG-1-2002. For SC-III and SC-IV SSCs, loads shall be combined in accordance with the Uniform Building Code (UBC) Section 1612.3.2.

5.6.2 Static Loads

5.6.2.1 The bogie shall be capable of transporting a glass filled IHLW Canister, weighing 9260-lbs (max), and the canister rinse vessel during normal operation under the duty cycles identified in Section 5.3.2 of this specification.

5.6.2.2 Canister dimensions:

Diameter:	24.12 inches (maximum) 24 inches (nominal)
Height:	177.165 inches (maximum) 176.75 inches (nominal)

5.6.3 Dynamic loads

5.6.3.1 The bogie, vessel, and bogie rails shall be capable of withstanding impact loads from the canister under normal service conditions. Under normal service conditions the crane hoist operating speed at point of impact will be 5 feet per minute maximum.

5.6.3.2 The bogie and bogie rails shall be capable of withstanding all loads associated with impacts to the rail end-stops by the bogie (with load) traveling at full operating speed.

5.6.4 Seismic Loads

5.6.4.1 The following table identifies equipment requiring seismic protection and their associated Seismic Category (SC). Definitions of the seismic categories:

Seismic Category I (SC-I):
SSC important to safety and which has a seismic safety function.

Seismic Category II (SC-II):
SSC important to safety, whose failure during a seismic event could prevent a Seismic Category I SSC from performing its seismic safety function.

Seismic Category III (SC-III):
(a) SSC important to safety, but without seismic safety function.
(b) SSC not important to safety, but which has an inventory of radioactive or hazardous material in an amount less than that which would lead to an "important to safety" designation.

Seismic Category IV (SC-IV):
SSC not important to safety and without an inventory of radioactive or hazardous material, but requiring seismic protection.

Plant Item Number 24590-HLW-	**Description**	**Seismic Category**
MQ-HDH-TRLY-00003	Canister Rinse Bogie	SC-II
MV-HDH-VSL-00001	Canister Rinse Bogie Decon Vessel	SC-III
MH-HDH-RAIL-00002	Canister Rinse Bogie Rails	SC-III
MH-HDH-RAIL-00004	Canister Rinse Bogie Seismic Rails	SC-II
MH-HDH-MHAN-00016	Canister Rinse Vessel Service Track	SC-III
MH-HDH-MHAN-00017	Canister Rinse Bogie Service Track	SC-IV
MH-HDH-RCVY-00009	Canister Rinse Bogie Recovery System	SC-IV
MH-HDH-MHAN-00011	Canister Rinse Bogie Spool Piece	SC-IV
MP-HDH-PMP-00001	Bogie Decon Canister Pump	SC-III

5.6.4.2 Where specific seismic requirements are identified in Section 1.5.3, for the Canister Rinse Bogie and the Canister Rinse Bogie Seismic Rails, the applicable components shall be designed to SC-II. All other components shall be designed to SC-III.

5.6.4.3 SSCs designated SC-II, see Section 1.5.3 of this specification, the seismic loads imparted on the equipment shall be evaluated in accordance with the response spectra identified in the table below. A damping value of 7% shall be used.

Equipment	Seismic Response Spectra Reference
Canister Rinse Bogie (24590-HLW-MQ-HDH-TRLY-00003, and associated equipment)	See 24590-HLW-S0C-S15T-00009 Rev 0D Fig. 10 Seismic Response at -31 ft and -21 ft Elevation, East-West Fig. 11 Seismic Response at -31 ft and -21 ft Elevation, North-South Fig. 12 Seismic Response at -31 ft and -21 ft Elevation, Vertical
Canister Rinse Bogie Seismic Rails (24590-HLW-MH-HDH-RAIL-00004, and associated equipment)	See 24590-HLW-S0C-S15T-00039 Rev D Sheet No. B-9, Fig. B-7 Seismic Response, East-West Sheet No. B-10, Fig. B-8 Seismic Response, North-South Sheet No. B-11, Fig. B-9 Seismic Response, Vertical

5.6.4.4 For SSCs designated as SC-III, the seismic loads shall be evaluated in accordance with the Uniform Building Code (UBC), Section 1632, using the following parameters:

Ip = 1.5

Ca = 0.24

hr = 91

hx = rail elevation

5.6.4.5 For all other SSCs, the seismic loads imparted on the equipment shall be evaluated in accordance with the Uniform Building Code (UBC), Section 1632, using the parameters above with an Ip of 1.0.

5.6.4.6 The 200 East Area of the Hanford Site is located in Seismic Zone 2B.

5.7 Electrical Requirements

5.7.1 The requirements in 24590-WTP-3PS-EKP0-T0001, *Engineering Specification for Electrical Requirements for Packaged Equipment*, excluding sections 6.4.2.3, 6.4.3.1, 6.6.1, 6.6.3, and 6.8, shall apply to this specification. Where there is a conflict between this specification and 24590-WTP-3PS-EKP0-T0001, the Seller shall report all conflicts to the Buyer. At such time, all conflicts shall be resolved.

5.7.2 All electrical equipment and material, including industrial control panels and cabinets that are assemblies of industrial control devices, shall be suitable for installation and use in conformity with the provisions of NFPA 70. Suitability of equipment shall be evidenced by listing or labeling as a completed assembly by Underwriters Laboratories (UL). Equipment and assemblies not listed or labeled shall be required to bear a UL "Field Evaluated Product" mark. Equipment and materials listed, labeled or field evaluated by other nationally recognized testing laboratories (NRTLs) as recognized by OSHA, may be accepted only after receipt of prior written approval from the Buyer.

5.7.3 The Seller shall provide all cables and multi-conductor cable systems from the bogie and associated equipment to the Buyer's designated interface point, see Section 5.8.2. The Seller

shall recommend connector types at the Buyer's interface for connection to the Buyer-provided cabling.

5.7.4 All cables shall be evaluated for radiation tolerance by addressing IEEE Std 1205-2000, *IEEE Guide for Assessing, Monitoring, and Mitigating Aging Effects on Class 1E Equipment used in Nuclear Power Generating Stations, Annex D* for acceptable insulation for radiation environments. Generally Tetrafluoroethylene (TFE) and Polytetrafluoroethylene (PTFE) should be avoided in radiation areas.

5.7.5 The Seller shall provide details of the electrical cable end connections (at bogie terminal box) to the Buyer for interfacing of the Seller provided umbilical electrical cable, located in the maintenance area. Unique pin arrangements and/or color coding shall be provided for the electrical connectors to prevent incorrect engagement.

5.7.6 The Seller shall specify within the proposal the full load amp and voltage rating for the bogie and associated electrically powered equipment.

5.7.7 When more than one motor is powered from a single control cabinet the Seller shall specify the ampere rating for the main over current device serving the cabinet.

5.7.8 Induction motors shall meet the requirements of 24590-WTP-3PS-MUMI-T0002, *Engineering Specification for Low Voltage Induction Motors*, excluding sections 5.1.1, 5.3, and 5.4.1, and shall be of a Totally Enclosed Fan Cooled (TEFC) type. Deviation from the specifications shall be submitted, on an SDDR form, to the Buyer and may be accepted based on the application and technical requirements. When deviating from the specifications, the motors shall comply with the equivalent International Electrotechnical Commission standard (IEC). The Seller shall provide certification that the manufacturer satisfactorily performed standard and routine tests on electric motors.

5.7.9 Flux Vector or Servo Drives shall meet the requirements of 24590-WTP-3PS-JD02-T0001, *Engineering Specification for Intelligent Drives for Packaged Equipment.*

5.7.10 All electrical equipment and electrical cables shall be suitable for the environment in which they will operate.

5.7.11 Separate disconnects shall be provided from the control cabinet for each major component. Seller shall provide all necessary schematics, wiring diagrams and details necessary to facilitate installation and connection to Buyer's system.

5.7.12 All conductors shall be numbered on both ends for ease of identification.

5.7.13 Cable design and construction shall take account of Electromagnetic Interface (EMI) and Radio Frequency Interface (RFI).

5.7.14 Individual and overall shields shall be provided, as appropriate, to ensure that circuits are not subjected to or affected by interference. The shields shall be terminated at individual slip rings/brush gears. The Buyer will then make arrangements to terminate them at a suitable ground point. All special grounding design requirements are the responsibility of the Seller.

5.7.15 The Seller shall be responsible for assuring operability of the cable system under all design conditions.

5.7.16 In addition to tagging requirements defined in Engineering Specification for Instrumentation for Packaged Systems, 24590-WTP-3PS-JQ07-T0001 Rev 1, and Engineering Specification for Electrical Requirements for Packaged Equipment, 24590-WTP-3PS-EKP0-T0001 Rev 2. Tags subject to high radiation environments, stainless steel is preferred.

5.8 Instrumentation and Control Requirements

5.8.1 General

5.8.1.1 The requirements in project specification 24590-WTP-3PS-JQ07-T0001, *Engineering Specification for Instrumentation for Package Systems,* excluding sections 3.4.5.1, 3.4.5.2.3, 3.4.5.4.4, 3.4.5.9, 3.4.5.10, 3.4.5.12, 3.4.5.13, 3.4.5.14, 3.4.5.15, 3.4.5.16, 3.4.5.17, 3.7.1, 3.8.3, 3.8.4, 3.8.6, 3.8.7, and 3.8.8.1, shall apply to this specification. Where there is a conflict between this specification and 24590-WTP-3PS-JQ07-T0001, the Seller shall report all conflicts to the Buyer. At such time, all conflicts shall be resolved.

5.8.1.2 Control panels, including Supplier Packaged Equipment panels, shall be provided with an Alarm Test function such as a "push to test" button that verifies that alarm indicating functions operate satisfactorily. In order to maintain consistent operation between equipment items, this requirement shall apply to all alarm indicating lights, including LED's. This requirement is limited to alarm indications and is not applicable to other indications.

5.8.1.3 The Seller shall be responsible for the final determination of the required level and type of controls and instrumentation necessary for the proper operation and monitoring of the Seller's proposed system. Any changes to the required control and monitoring features shall be reflected in the Seller's submittals for control and instrumentation (as required by this specification and the G321-E form) and shall be subject to Buyer authorization. The Seller's submittals that necessitate changes to the control and instrumentation shall not generally require that an SDDR be submitted. An SDDR shall be submitted if the Seller's control and instrumentation submittals fail to reflect incorporation of any functional requirement of the supplied equipment (as described in this specification, DPDs, or Arrangement).

5.8.1.4 The Seller shall provide, as early as practicable in the design process (but no later than as required by the submittal schedule), required control and instrumentation submittals necessary to support the Buyer's revisions to their Mechanical Handling Diagrams (MHDs). These submittals are required in order to finalize the relevant facility interfaces (e.g., wall penetrations, conduit, and Integrated Control Network interfacing) to suit the Buyer's construction schedules.

5.8.1.5 To ensure commonality across project equipment, 24590-WTP-3PS-JQ07-T0001 identifies preferred instrument vendors for some components. Components not included in the specification are selected at the Seller's discretion with review and permission to proceed from the Buyer unless otherwise specifically stated within this specification.

5.8.1.6 The Seller shall provide all limit switches and proximity switches as required in the design of the bogie system, and shall meet the requirements of sections 3.4.5.7 and 3.4.5.8 of 24590-WTP-3PS-JQ07-T0001.

5.8.1.7 The bogie control systems shall utilize the Integrated Control Network (ICN) platform described in 24590-WTP-3PS-JQ07-T0001.

5.8.1.8 Instrumentation for control and positioning is defined on the DPDs. The instrument tag numbers on the DPDs shall be used to tag instruments. Additional instruments provided by the Seller shall be tagged using ISA 5.1, and sequence numbers provided by the Buyer.

5.8.1.9 The Seller shall provide to the Buyer control logic diagrams and a structured description of the control requirements, procedures, interlocks, and sequences of operation necessary to perform the basic functions of the bogie, vessel, and associated equipment. Documentation of the control requirements shall conform to the requirements of 24590-WTP-3PS-JQ07-T0001, Section 3.5, *Control Software.*

5.8.1.10 The Buyer will develop the application software that controls the bogie, vessel, and associated equipment identified in this specification. All Human Machine Interfaces (HMI), including facility control room HMI, Local Operator Interfaces (LOI), and Bogie Maintenance Areas, will be interfaced to and controlled by the Buyer-developed Intergrated Control Network (ICN). The Buyer's software shall be tested during the Seller's Factory Acceptance Tests (FAT).

5.8.1.11 Motor drives and other 'intelligent' devices as applicable shall have Profibus DP® capability where feasible.

5.8.1.12 Where integral brake motors are used on adjustable speed drives the brake shall be wired independently from the motor winding. All brakes shall be "fail-on" in the event of loss of power.

5.8.1.13 All instrumentation and instrument cables shall be suitable for the environment in which they will operate.

5.8.1.14 The Seller shall provide a phase monitor relay to provide protection against phase loss, phase reversal, phase unbalance, undervoltage and overvoltage of the 3Ph 480 voltage feed to Seller's equipment.

5.8.2 Interfaces Between Buyer and Seller

5.8.2.1 General

5.8.2.1.1 This specification identifies equipment that is classified as a "Type B-Option 1" package. A "Type B" package is one in which the Seller provides the starters/drives and shall have the equipment located near the Seller's equipment in a Seller provided control cabinet.

5.8.2.2 Type B Package

5.8.2.2.1 Appendix A, Figure 1, shows a pictorial representation of a "Type B-Option 1" package definition that the Seller shall comply with. This Type B package shall include Seller provided equipment control cabinets that include Seller provided starters/drives, control transformers, Profibus DP® interface(s), Fiber Optic cable interfaces, control wiring interface, etc. The Buyer will be responsible for the Profibus DP® cable from the Buyer Controller, the control signal wiring from the Remote I/O (RIO), a single 480 VAC, 3 phase power supply from the Buyer's MCC to the Seller's equipment control cabinets. The Buyer will also be responsible for all cabling between the Seller's equipment control cabinet and the Seller's equipment "skid" with the exception of specialty cable. Specialty cable is defined as cable assemblies normally part of the equipment package such as drag chains and festoon or cable that is not included in the Buyer's standard cable list. For the purpose of this specification, a "skid" is defined as the part of a Seller's package which is shipped pre-assembled and pre-wired.

5.8.3 Bogie Positioning Control

5.8.3.1 Bogie shall have a minimum of two proximity switches mounted to the bogie chassis used for operational positioning of the bogie. Both switches shall provide a signal under normal operating conditions.

5.8.3.2 The bogie utilizes two (2) or three (3) targets for each stopping position as required per the system drawings. The first target, approached from a specific direction (two targets required if approaching stopping position from two directions), is used to slow the bogie to creep speed; the second target stops the bogie. To achieve positional accuracy, the bogie may require to be stopped by approaching the target from one direction only. In this case the bogie will proceed past the stopping point then reverse to approach the position target from the designated stopping direction.

5.8.3.3 Under a recovery event the bogie mounted proximity switches are also used to position the bogie, in conjunction with the proximity switch targets, at the appropriate process station for canister removal.

5.8.3.4 The recovery winch drive shall include a Profibus DP® interface to enable operation from the Buyer's LOI.

5.8.4 Communication Network Interface

The Buyer has selected the Industrial^{IT} platform from ABB, Inc. as the primary control system for the WTP Facility. A Profibus DP® communication network will be used to communicate to drives and intelligent positioning instruments. The Seller shall provide the following components for a fiber optic cable interface:

5.8.4.1 Profibus DP Communication Interface

5.8.4.1.1 The Seller shall provide a native Profibus DP® slave interface for the control panel or instrument and the associated drivers (GSD files) for communication with the Buyer's

control system. The interface should support communication speeds up to 12 Mbit/sec over the Profibus DP® network.

5.8.4.2 Fiber Optic Connections

5.8.4.2.1 The Seller shall provide a fiber optic connection external to the control panel or instrument per the following requirements:

a) The Seller shall install a Hirschmann OZD Profi 12M G12 fiber optic converter within the control panel or near the instrument for each communication network.
b) The Seller shall patch the Hirschmann fiber optic converter(s) to a fiber optic patch plate where the Buyer will terminate the Buyer's fiber optic cable(s). The patch plate shall utilize MT-RJ multimode fiber optic connectors.
c) The Seller shall use multimode 62.5/125 glass fiber in the patch cable with appropriate connectors on each end of the patch cable to connect between the fiber optic converter and the patch plate. Any unused fiber optic connections shall be fitted with protective caps to guard against extraneous light and dirt.
d) The Seller shall derive the appropriate power for the fiber optic converter(s) from the control panel. A separate power supply shall be provided for each communication network.

5.8.4.3 Alternate Communication Interface

5.8.4.3.1 If a native Profibus DP® interface is not available, then the Seller may propose an alternate communication interface or network that is compatible with the Buyer's control system for Buyer review.

If an alternate communication interface is proposed:

a) The Seller shall provide all necessary interfaces or converters required to provide the Buyer's control system with the appropriate communications.
b) The Seller shall provide any required drivers, software, and protocol conversion information to the Buyer for design, development, testing, and maintenance of the supplied networks and interfaces for the period of performance of the contract, including software or firmware upgrades or revisions.

6 Materials

6.1 For general material requirements refer to Section 4 of 24590-WTP-3PS-M000-T0002, *General Specification for Mechanical Handling Equipment Design & Manufacture*, and applicable requirements identified in the project specifications referenced in this document. Sections 4.1.9, 4.1.10, 4.1.11, 4.1.12, 4.10.1, 4.10.4, 4.12, and 4.13 of 24590-WTP-3PS-M000-T0002 do not apply.

6.2 The Seller may use cast iron for the bogie wheels and wheel housings provided they meet the design requirements identified in Section 5 of this specification.

6.3 For specific material requirements refer to Section 5 of this specification.

6.4 Welded stainless steel mechanical tubing, conforming to ASTM A554, is acceptable for use, in the manufacture of structural members and support brackets.

6.5 All material supplied to ASTM standards, pertaining to QL or ITS equipment, shall be in accordance with the codes and standards identified in Section 2 of this specification, otherwise an SDDR shall be submitted to the Buyer, to obtain a material equivalency. Equivalency of materials shall, as a minimum, consider physical and chemical properties.

6.6 All material supplied to ASTM standards, pertaining to CM, Non-ITS equipment, shall be in accordance with any year of the standard.

7 Fabrication

7.1 For general fabrication requirements refer to Section 5 of 24590-WTP-3PS-M000-T0002, *General Specification for Mechanical Handling Equipment Design & Manufacture*, and applicable requirements identified in the project specifications referenced in this document.

7.2 Welding shall be in accordance with the applicable requirements identified in project specification 24590-WTP-3PS-SS00-T0001, *Specification for Welding of Carbon Structural Steel*, excluding section 8.18, and in accordance with 24590-WTP-3PS-SS00-T0002, *Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel.*

7.3 The vessel shall be fabricated in accordance with ASME B&PV Section VIII, Division 1, except that code stamping is not required.

7.4 Process piping shall be fabricated in accordance with the applicable requirements identified in ASME B31.3, Category D Fluid Service.

8 Tests and Inspections

8.1 General

8.1.1 Test and inspections shall be performed in accordance with the requirements identified in this section and the project specifications referenced in this document.

8.1.2 The Seller shall be responsible for performing and documenting all inspections and testing necessary to demonstrate compliance with all relevant specifications, drawings, and related standards.

8.1.3 Shop tests identified in section 8.2 are defined as Factory Acceptance Tests (FAT). A FAT procedure shall be submitted to the Buyer along with the Inspection and Test Plan. FAT reports shall also be submitted to the Buyer.

8.2 Shop Tests

8.2.1 General

8.2.1.1 The Seller shall perform, in-house, full-scale, Buyer-witnessed, functional testing of the bogie, vessel, and associated equipment, to demonstrate, as a minimum, the requirements identified in this section.

8.2.1.2 The Seller may combine some of the tests providing each requirement can be verified.

8.2.1.3 The tests and demonstrations identified in this specification are not limiting, and shall not relieve the Seller of their responsibilities to fully test and demonstrate the performance of the bogie, vessel, and associated equipment, to the satisfaction of Buyer, in accordance with the Buyer-reviewed Inspection and Test Plan.

8.2.1.4 Where maintenance tests are identified they shall be performed wearing appropriate personnel protective clothing (e.g. gloves, coveralls) to simulate in-cell maintenance conditions. The Buyer will provide, to the Seller, the appropriate personnel protective clothing prior to performing the maintenance tests. The tests shall be video taped, timed, and recorded in the maintenance procedures.

8.2.1.5 The bogie control and instrumentation shall be tested in accordance with a defined schedule. All steps shall be taken to ensure that tests are realistic and representative of the bogie operating sequences. Operation of switches and contacts shall be via movement of the bogie and not by the shorting or open circuit action of terminals.

8.2.1.6 The Seller shall provide all wiring, electrical feeds, power supplies, transformers, operator panels, test equipment, and connections for shop testing of the bogie and associated equipment.

8.2.1.7 The Seller shall be responsible for any alterations to the Seller's facility that may be required to perform the tests, and any additional equipment and materials required.

8.2.1.8 The Buyer shall provide a "mock-up" canister, fabricated from a cylindrical tube, replicating the canister envelope dimensions, key features, and weight, for performing the shop tests.

8.2.1.9 The Seller shall notify the Buyer of any failed tests or defective components following testing. All corrective actions suggested by the Seller shall be reviewed by the Buyer prior to implementation and subsequent re-testing.

8.2.2 Canister Rinse Bogie

8.2.2.1 The Seller shall replicate normal service design load conditions (with and without canister), and operating speeds, as required, to represent the normal operating conditions of the bogie.

8.2.2.2 The Seller shall ensure that, as a minimum, the following requirements are demonstrated and verified in accordance with the requirements identified in Section 5.2.1 of this specification:

- Smooth and free running of the drive shaft, gearbox, and wheels, through the full operating travel of the bogie.
- Running clearances between interfacing equipment through the full operating travel of the bogie.
- Bogie operating speeds in accordance with Sections 5.3.3 and 5.8.3 of this specification.
- Positional accuracy of the bogie in accordance with Sections 5.3.4 and 5.8.3 of this specification.
- Operation of the ultimate-travel limit switch.
- Maximum buffer impact load.
- Proof load test the bogie and rails to 1.25 times rated load capacity.
- Lubrication points are accessible without major disassembly.
- Removal and replacement of maintainable and modular components.

8.2.3 Canister Rinse Vessel

8.2.3.1 The Seller shall ensure that, as a minimum, the following requirements are demonstrated and verified in accordance with the requirements identified in Section 5.2.2 of this specification:

- Perform a hydrostatic leak test of the vessel, pump and associated piping by filling the vessel with water to the top flange and holding for a minimum of one (1) hour, after which, run the pump until all water is discharged from the vessel.
- Inspection and testing of the vessel, pump and associated piping as required by the applicable requirements identified in ASME B&PV Section VIII Division 1, ANSI B73.2M, and ASME B31.3.
- Functional testing of the spray system using the "mock-up" canister. The spray test shall be performed such that full visual observation of the spray coverage and "back spray" can be achieved by eye and with a video camera. Part of the test should be performed using food coloring or dye to aid in visualization.
- Level of mist carryover released from the vent tube during the rinse cycle.
- Operation of the inflatable seal and the sealing interface with the spool piece.
- Inspect and test the control valves in accordance with the applicable requirements identified in 24590-WTP-3PS-JV15-T0001, *Engineering Specification for Actuators for On/Off Valves*, and 24590-WTP-3PS-PV00-T0001, *Engineering Specification for Technical Supply Conditions for Valves,* excluding section 5.4.
- Performance of the level switch and continuous level instrument.
- Canister set-down at nominal handling speed of 5 feet per minute.
- Disconnection of the vessel services and removal of the vessel from the bogie.
- Mounting of vessel on the bogie and reconnection of the vessel services.
- Removal and installation of the canister guides and spray rings.

8.2.4 Canister Rinse Bogie Rails

8.2.4.1 During performance and maintenance testing, the Seller shall ensure that, as a minimum, the following requirements are demonstrated and verified in accordance with the requirements identified in Section 5.2.3 of this specification.

- Assemble rail sections and verify rail alignment to drawing tolerances and CMAA 70.

8.2.5 Canister Rinse Bogie Service Tracks

8.2.5.1 The Seller shall ensure that, as a minimum, the following requirements are demonstrated and verified in accordance with the requirements identified in Section 5.2.5 of this specification:

- Service tracks are moved freely by the bogie through the full operating travel.
- Replicate on-site shield door aperture interfaces and demonstrate the disconnection and reconnection of the electrical and process services and service tracks.

8.2.6 Canister Rinse Bogie Recovery System

8.2.6.1 The Seller shall ensure that, as a minimum, the following requirements are demonstrated and verified in accordance with the requirements identified in Section 5.2.6 of this specification:

- Proof load test the cable connection to the recovery block to 1.25 times the winch rating.
- Recovery of the bogie (with load), with a seized drive system, over the full operating travel of the bogie.
- Monitor and record the bogie recovery forces at incremental positions as the bogie moves along the rails. The recovery block, rails and cable shall be inspected following the test. The results shall be documented in the Inspection and Test Report.
- During the recovery test stop the bogie at a proximity switch target to demonstrate the stopping accuracy.
- Repositioning of the recovery block at the end of the rail using the bogie to push the recovery block into position.
- Decoupling of the recovery winch gearbox from the winch drum.

8.3 Temporary Structures

8.3.1 The Seller shall supply a test rig, as required, in the form of temporary structures that simulate the site conditions for the bogie and associated equipment. This shall include replicating key facility interfaces to verify equipment clearances.

8.3.2 The plant installation relationship between the bogie and associated equipment shall be maintained for the shop tests.

8.3.3 The structures provided shall be designed to allow safe access for viewing at equipment levels.

8.3.4 For in-cell equipment, which may lack conventional guarding, the Seller shall apply, as a minimum, the OSHA requirements to protect personnel from the danger of moving equipment during shop tests.

8.4 Cyclic Tests

8.4.1 Following satisfactory completion in all specific shop tests, cyclic testing shall be conducted on the bogie over the full operating travel. As a minimum requirement, 5 consecutive full cycles shall be completed within a period that shall not exceed 120% of the predicted nominal duration for such a program, subject to all duty restrictions.

8.4.2 The cyclic tests shall follow the on-site sequence of operations, with exception of the rinse cycle, as defined in Section 3 of this specification. For the rinse cycle the Seller shall demonstrate the operation of the inflatable seal and incorporate an appropriate time delay to replicate the rinse cycle. The "mock-up" canister shall be used to replicate normal service design load conditions.

8.4.3 Following completion of the cyclic tests a general visual inspection shall be performed on the equipment with results from the inspection being documented in the Inspection and Test Report.

8.5 Weld Inspections

8.5.1 Weld inspections and Non-Destructive Examinations (NDE) shall be performed in accordance with project specification 24590-WTP-3PS-SS00-T0001, excluding section 8.18, and in accordance with 24590-WTP-3PS-SS00-T0002, and welding standards AWS D1.1 and AWS D1.6, unless specified otherwise.

8.5.2 All welds shall be visually inspected.

8.5.3 As a minimum, all load-bearing welds shall be non-destructively examined by either liquid penetrant or magnetic particle examination as appropriate to the material and configuration.

8.5.4 All welds that maintain the structural integrity of the bogie, in accordance with the Important to Safety (ITS) requirements identified in section 1.5.3 of this specification, shall be non-destructively examined. Full penetration welds shall be examined by either radiographic or ultrasonic examination, as appropriate to the material and configuration. Partial penetration and fillet welds shall be examined by magnetic particle or liquid penetrant examination, as appropriate to the material and configuration.

8.5.5 The Seller shall perform 100% radiographic examination of the vessel and associated piping in accordance with the applicable requirements identified in ASME B&PV Section VIII, Division 1 and ASME B31.3.

9 Preparation for Shipment

9.1 General

9.1.1 Packaging, shipping, handling, and storage shall be performed in accordance with Project Specification 24590-WTP-3PS-G000-T0003, *Engineering Specification for Packaging, Handling and Storage Requirements*, and Section 7 of the Purchase Order.

9.2 Cleaning and Coating

9.2.1 Surfaces shall be cleaned and coated in accordance with 24590-WTP-3PS-AFPS-T0001, *Engineering Specification for Shop Applied Special Protective Coatings for Steel Items and Equipment*. The paint system to be used for the bogie and associated equipment shall be in accordance with System Code T as identified in 24590-WTP-3PS-AFPS-T0001.

9.2.2 The final paint color for all equipment as applicable shall be in accordance with Appendix E of 24590-WTP-3PS-AFPS-T0001.

9.2.3 All Manufacturers Standard Coating (Mfg. Std) must be identified on Appendix H of 24590-WTP-3PS-AFPS-T0001, and be submitted to the Buyer, along with technical data sheets and Material Safety Data Sheets (MSDS).

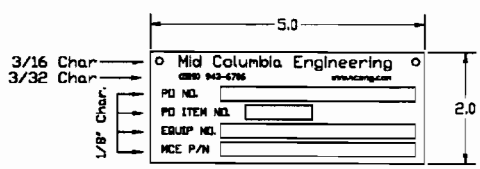
9.2.4 Stainless Steel shall not be coated.

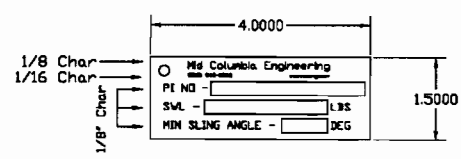
9.3 Tagging

9.3.1 The equipment shall be tagged in accordance with the following:

- A separate stainless steel nameplate shall be provided to include the Buyer's plant item number (identification number) and purchase order number.
- The separate stainless steel nameplate shall have the information impressed, stamped, or etched directly on the stainless steel surface with characters at least 1/8" inch high. The nameplate, where physically possible, shall be secured to the body of the equipment by corrosion resistant screws tapped into a low stress area of the assembly, or welded, so the structural integrity and functional capability of the assembly are not impaired. If it is not physically possible to secure the nameplate to the body of the equipment, then the nameplate shall be attached using a stainless steel wire.
- Instruments shall be tagged according to *Specification for Instrumentation for Package Systems*, 24590-WTP-3PS-JQ07-T0001, Rev 1, Section 8.

(Example)





10 Quality Assurance

10.1 QA requirements specific to item(s) or service

10.1.1 The Seller's Quality Assurance Program (QAP) requirements are specified in 24590-WTP-3PS-G000-T0001, *General Specification for Supplier Quality Assurance Program Requirements*, and in the Supplier Quality Assurance Program Requirements Data Sheet(s) included in the procurement documents.

10.1.2 The Seller's QAP Manual shall be submitted to Buyer for review in accordance with 24590-WTP-3PS-G000-T0001.

10.1.3 For SSCs indicated in this specification as ITS, the Seller shall have and maintain a Buyer approved Quality Assurance Program meeting the applicable sections of ASME NQA-1-1989, as per 24590-WTP-3PS-G000-T0001, and the Supplier Quality Assurance Program Requirements Data Sheet, 24590-WTP-3PD-MQTS-00002.

10.1.4 For SSCs indicated in this specification as Non-ITS, or Commercial Quality, the Seller shall have and maintain a Buyer approved Quality Assurance Program meeting the applicable sections of DOE Order O 414.1A, as per 24590-WTP-3PS-G000-T0001, and the Supplier Quality Assurance Program Requirements Data Sheet, 24590-WTP-3PD-MQTS-00004.

10.1.5 The Seller, including all sub-tier suppliers providing items or services, that affect, or may affect, nuclear safety of DOE nuclear facilities shall, as a minimum, have a quality assurance program in place that complies with the requirements of 10 CFR Part 830.122.

10.1.6 Should any portion of the work defined within this specification be subcontracted, these requirements shall be passed on to the sub-contractor as applicable to the work being performed.

10.2 Program QA Elements

10.2.1 The Seller's QAP as a minimum, shall contain the requirements detailed in the Supplier Quality Assurance Program Requirements Data Sheets listed in Section 2 of the Purchase Order.

11 Documentation and Submittals

11.1 General

11.1.1 Documentation shall be submitted to the Buyer in accordance with this specification, and as summarized on the G321-E and G321-V forms in section 3 of the Purchase Order. The G321-V form lists all the documents required for quality verification and the G321-E form lists those engineering documents required.

11.1.2 General requirements and submittal procedures are also covered in Section 3 of the Purchase Order. Each document to be submitted must be listed on the "Seller's Index/Schedule" (Form 15EX). This form tracks the scheduled and actual delivery of each submittal.

11.2 Quality Assurance Manual

11.2.1 The Offeror's Quality Assurance Manual shall be submitted to the Buyer with the Offeror's proposal in accordance with the G321-E form.

11.3 Design Compliance Matrix

11.3.1 The Seller shall develop a matrix that tabulates the design requirements of this specification and the applicable requirements in the referenced project specifications, identifying the method of compliance. The matrix shall describe how each requirement is met including narrative as well as references to drawings, calculations, and/or other specific documentation that demonstrates compliance.

11.3.2 The matrix shall be included as a preliminary document in the 50% design review package. The preliminary document shall form the template for the final document.

11.3.3 The matrix shall be included as a final document in the 90% design review package.

11.4 Safety Equipment List

11.4.1 The Safety Equipment List shall identify which components of the supplied equipment are to be provided as Important to Safety (ITS) or Commercial Quality (CM).

11.4.2 The Safety Equipment List shall be based on the requirements identified in Sections 1.5.3 and 10.1 of this specification.

11.4.3 The Offeror shall provide a Safety Equipment List with the Offeror's proposal that communicates the Offeror's understanding of which components of the equipment identified in this specification are to be provided as ITS and which components are to be provided as CM. The list shall be a detailed listing of components for the supplied equipment along with the designation of each item in the list as either CM or ITS.

11.4.4 The Safety Equipment List, or specific components of the Safety Equipment List, shall be submitted to the Buyer for review and permission to proceed prior to procurement of materials. The document shall be submitted with the 50% design review package as a preliminary document and at the 90% design review as a final document.

11.5 Software Requirements Document

11.5.1 The Seller shall develop a Software Requirements Document that describes the protocols and requirements for programming the bogie control system. The document shall be submitted with the 50% and 90% design review package as a preliminary document and as a final document following shop tests.

11.6 Drawings

11.6.1 General

11.6.1.1 The Seller shall prepare and submit drawings per Section 3 of the MR, Drawings and Data Requirements.

11.6.1.2 The Seller shall prepare drawings in accordance with American Society of Mechanical Engineers (ASME) Y14 series, Engineering Drawing and Related Document Practice. The drawings shall be assigned a unique number in accordance with Section 3 of the MR, Drawings and Data Requirements.

11.6.1.3 SELLER shall specify all dimensions, tolerances, materials, surface finishes, weld symbols, special filler material used, torque values, set points and special fabrication instructions on drawings supplied to BUYER.

11.6.1.4 SELLER drawings shall show critical interface dimensions and their tolerances as specified by BUYER on DPDs or MDSs. This information shall be identified by using an asterisk or another method and note shall be included that explains how to distinguish these dimensions.

11.6.1.5 Seller drawings shall include as a minimum, but not be limited to, the following:

- Descriptive title blocks that are relevant to the information on the drawing
- Notes that will clarify all vague or obscure details that would not otherwise be understandable without a note
- A drawing cross-reference section that will cross-reference other drawings/documents that are relevant to make drawings more complete or more understandable
- A bill of material that will list all items shown on an assembly drawing
- Legend of symbols. Symbols shall be used consistently throughout all drawings related to weld systems

11.6.1.6 Sufficient information shall be included on these drawings to permit manufacture of any replacement parts in the event that the original Seller is not able to supply parts at the time future needs may arise. All drawings shall be specific to the system addressed in this specification and shall be exact up to the time of delivery. The final set of drawings are to be "as-built" drawings. Drawings that are "typical" shall not be provided.

11.6.1.7 Where required, the Seller shall prepare MDSs on data sheets furnished by the Buyer.

11.6.2 Arrangement Drawings:

11.6.2.1 An arrangement drawing shall be submitted at all the design reviews for each piece of equipment. These drawings shall show all major dimensions, supports, arrangements,

interfaces, and component identification numbers where appropriate. These drawings shall also show weight(s) and center of gravity (CG) location(s) for installation.

11.6.3 Assembly Drawings:

11.6.3.1 An assembly drawing shall be submitted at the formal, final design closeout meeting for each piece of equipment. These drawings shall show the arrangement of the equipment's components, junction boxes, and interfaces with existing systems/structures. These drawings shall identify utilities required to be supplied by the facility.

11.6.3.2 General assembly drawings shall identify sub-assemblies and drawings.

11.6.3.3 Bill of Materials shall contain the minimum following information:

- an item number for each individual part or material,
- quantity of an item or part,
- description of an item or part,
- reference code (ASTM, ANSI) of an item or part,
- material callout or SELLER part number.

11.6.3.4 Component identification numbers shall be included on drawings where appropriate.

11.6.4 Shop Fabrication/Detail Drawings:

11.6.4.1 Shop Fabrication/Detail drawings of all designed components shall be submitted for the formal, final design closeout meeting. Component identification numbers shall be included on drawings where appropriate.

11.6.4.2 All nameplates and labels shall be shown.

11.6.5 Installation Drawings:

11.6.5.1 An installation drawing shall be submitted for the formal, final design closeout meeting for each piece of equipment. These drawings shall detail modifications required to accommodate equipment installation. Component identification numbers shall be included on drawings where appropriate.

11.6.5.2 The installation drawings shall clearly indicate lifting and rigging points and safe lifting load at each for initial installation and any other lifting evolutions.

11.6.6 Any proposed changes to required elements identified on the Buyer's DPDs, as defined in Section 1.2 of this specification, shall be submitted to the Buyer via SDDR in accordance with Section 2 of the Purchase Order.

11.7 Calculations

11.7.1 Calculations shall be submitted to the Buyer to document engineering analysis performed to verify the adequacy of the supplied equipment designs, including calculations for stress, deflection, and fatigue, for seismic and normal service conditions, electrical loads and machine component selection (e.g., motors, bearings, gears, and drive shafts).

11.7.2 The Seller shall submit, as early as practical in the design process (but no later than as required by the Buyer approved schedule), an analysis of the reaction loads at all embeds and other support locations.

11.7.3 Stress reports and additional calculations affecting ITS components (including calculations for Non-ITS components that may affect ability of the ITS related component to perform the associated ITS function) shall be subject to the requirements of the applicable sections of ASME NQA-1-1989.

11.7.4 If commercial off the shelf computer software is used in performing calculations, it shall be validated before use in the documents it supports. The validation test report shall be provided to the Buyer and shall meet, as a minimum, the following requirements:

- Validation testing shall be performed to a Seller approved procedure
- The testing shall validate the functions and requirements relevant to calculations that it supports
- The test environment conditions shall be described
- Testing shall be performed on the same computer platform that the calculations will be performed.

11.7.5 Spreadsheet and mathematical program calculations shall be treated like hand calculations. Each equation used in the spreadsheet or program shall be presented in the calculation so the result can be reproduced by hand calculations. The title and version of the program shall also be provided. Evidence of hand calculation reproduction at all key steps in the spreadsheet or program shall be presented in the calculation.

11.7.6 English system units of measure shall be used.

11.7.7 Calculations and analyses shall be validated, checked, and approved by qualified personnel independent of the preparer. All calculations shall be provided as part of the design report. Independent reviewers shall be qualified in the subject area and shall not have participated in the calculations and analysis under review. Check review comments are subject to audit.

11.7.8 Seismic calculations and analyses shall be validated, checked, and approved by qualified personnel independent of the preparer. Evidence shall be provided that both the preparer, the checker, and the independent reviewer are fully qualified including a minimum of 10 years experience in structural seismic analysis. Preliminary seismic calculations shall be provided at the 50 % design review. Final seismic calculations shall be provided at the 90 % design review.

11.7.9 The Seller shall ensure that independent checking of critical calculations that bear on long-term performance and reliability are performed.

11.7.10 References shall be provided for all physical properties and/or derived physical quantity data and used as input to calculations or analysis.

11.7.11 References shall be provided for all formulas or references extracted from applicable codes and standards.

11.7.12 Checking shall be performed to confirm the accuracy of the calculations. The checker shall be capable of originating the document. The checker shall not be the originator. Calculations shall be checked and approved prior to use for design or other calculation input.

11.7.13 All calculations shall include headers (on all pages) with the following information:

- Calculation number
- Project name
- Revision
- Author
- Date Subject
- Pagination

11.7.14 All calculations shall include the following sections:

- Objective
- Inputs
- Background
- Applicable codes and standards
- Methodology
- Assumptions
- Calculations
- Results and discussions
- References
- Attachments

11.7.15 Attachments to calculations shall include the following information (on every page):

- Calculation number
- Revision
- Page numbering

11.8 Design Reviews

11.8.1 Contract Award Kick-Off Meeting

11.8.1.1 The contract award kick-off meeting will be an informal discussion conducted at the Seller's facility to ensure the newly awarded contract is clear and concise, and that the Seller has a clear understanding of the scope of the contract.

11.8.1.2 The Seller shall provide to the Buyer, a minimum of five (5) working days prior to the scheduled meeting, copies of documentation or information that is expected to be discussed and/or presented in the meeting. Documentation may be provided as either hard copies or as electronic files via email.

11.8.2 20% Design Review

11.8.2.1 The first interim review will be an informal review conducted at the Buyer's facility after approximately 20% of the design is completed. Preliminary design media, including arrangement and assembly drawings, calculations and analyses will be reviewed by the Buyer. The Seller shall be prepared to discuss any Seller recommended changes to the approaches indicated on the Buyer's proposal drawings and identify any conflicts with equipment envelope dimensions. The Seller shall participate in the design review and shall be prepared to discuss any comments.

11.8.2.2 The Seller shall be responsible for producing and submitting meeting minutes, as a formal document of record.

11.8.3 50% Design Review

11.8.3.1 The second interim review will be an informal review conducted at the Buyer's facility after approximately 50% of the design is completed. Preliminary design media, including arrangement and assembly drawings, calculations and analyses, Design Compliance Matrix, Software Requirements Document, and Safety Equipment List shall be provided to the Buyer for review. The preliminary design media shall be provided to the Buyer at a mutually agreed time prior to the scheduled meeting. The Seller shall participate in the design review and shall be prepared to discuss any comments.

11.8.3.2 Upon buyer's approval, Seller may be authorized to procure (at Buyer's risk) "specific long-lead items", upon satisfactory completion of 50% design review of these items. The Seller shall transmit a detailed list of the "specific long-lead items" that require procurement prior to obtaining code [1] status on the formal drawing submittal. The Seller shall provide sufficient reference documentation for the Buyer to review and authorize the early procurement of these "specific long-lead items".

11.8.3.3 The Seller shall be responsible for producing and submitting meeting minutes, as a formal document of record.

11.8.4 90% Design Review

11.8.4.1 At the conclusion of definitive design, a formal 90% design review will be conducted at the Buyer's facility in accordance with WTP procedures. The (draft) final design report, including all design media, supporting calculations and analyses, Design Compliance Matrix, Software Requirements Document, Safety Equipment List, and other required submittals that document the design, shall be provided to the Buyer.

11.8.4.2 The Seller is encouraged to provide to the Buyer copies of documentation or information that is expected to be discussed and presented at the design review approximately 5 working

days prior to the scheduled meeting (if not previously submitted in accordance with the submittal schedule).

11.8.4.3 The Seller shall participate in the design review and present the design, including discussion of the provided submittals.

11.8.4.4 Following the design review meeting, the Buyer will formally transmit comments or other requests on the design submittals. The Seller is required to provide response/resolution to the Buyer's comments in accordance with the submittal schedule, or request deviation from the Buyer's requirements through use of the Buyer's SDDR form.

11.8.4.5 The resolved/corrected submittals shall be provided in the final design report in accordance with the submittal schedule.

11.8.4.6 The Seller shall be responsible for producing and submitting meeting minutes, as a formal document of record.

11.9 Deleted

11.9.1 Deleted.

11.9.2 Deleted.

11.10 Material Test Reports

11.10.1 The Seller shall submit to the Buyer, a complete package of Material Test Reports (MTRs) for all stock steel used for components designated as ITS in Section 1.5.3 of this specification, and as required per the applicable codes and standards referenced in this specification, validating critical parameters as applicable.

11.11 Spare Parts List

11.11.1 The Seller shall provide to the Buyer a recommended spare parts list for all equipment within the Seller's scope of supply for the preventive maintenance of three distinct classifications of spare parts. The Seller's recommendations are to address a startup and warranty period, operational spare parts, and capital spare parts. The recommendations shall also include intervals of replacement based on the operating life of the equipment subject to the duty cycles identified in this specification.

- Startup and warranty spare parts are those parts that may be required at any time during equipment installation, startup, testing, and unit operation through the warranty period.
- The operational spare parts are those parts that require replacement at regular intervals to maintain continuous operation of the supplied equipment and/or system.
- Capital spare parts are major parts or equipment that provide reliable equipment operation throughout the plant life and having a significant lead time for manufacture and delivery.

11.11.2 The spare parts list shall include names of manufacturers with appropriate model numbers and special ordering instructions (if applicable) for replaceable parts. The spare parts list shall also include pricing and delivery information valid for one year after delivery of the equipment.

11.12 Inspection and Test Plan

11.12.1 The Seller shall prepare a detailed Inspection and Test Plan including insertion of Buyer-designated source inspection/witness notification points in accordance with Section 5 of the Purchase Order.

11.12.2 Prior to starting work, the plan shall be submitted to the Buyer for review.

11.12.3 The plan shall include, but not be limited to, the following:

- Equipment to be inspected and tested
- Description of inspection and tests to be performed
- Sequential points for inspection and tests to be performed
- Each characteristic or attribute to be evaluated
- The inspection and test report form to be used
- Other requirements as required by Codes, Standards, or Purchase Order

11.12.4 The plan shall include provisions for increased hold and notification points as the project progresses.

11.12.5 The results of the inspections and tests shall be documented in the Inspection and Test Report.

11.12.6 The Seller shall provide an inspection and test procedure documenting the process followed for determining that specified requirements (dimensions, properties, performance results, etc.) are met.

11.13 Manuals

11.13.1 The Seller shall provide a clearly written instruction manual(s). The manual(s) shall include:

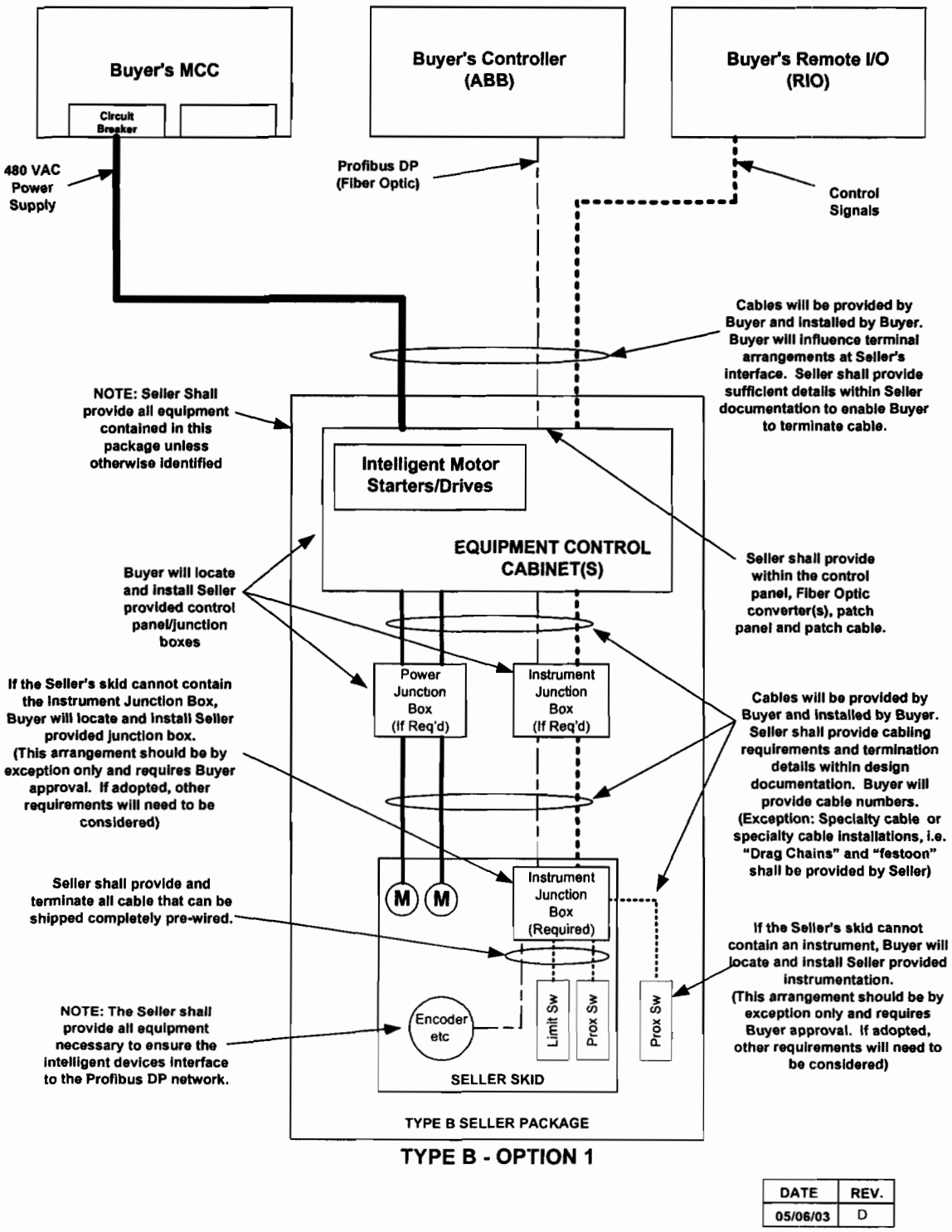
- Storage maintenance instructions
- Rigging instructions
- Installation instructions
- Spare parts list
- General description of the equipment identifying as applicable, significant technical characteristics, test and adjustment information, and safety and warning notices
- Instructions for equipment operation (start-up, shut down, normal, and abnormal), referencing drawings and diagrams as appropriate
- General maintenance instructions
- Recommended inspection points if any, with procedures and period for inspection
- Maintenance instructions for any required lubrication

11.14 Documentation Incorporated by Reference

24590-WTP-SDDR-PROC-05-00180	Material Equivalency.
24590-WTP-SDDR-M-05-00117	Material Equivalency.

Appendix A Instrumentation and Control Interfaces

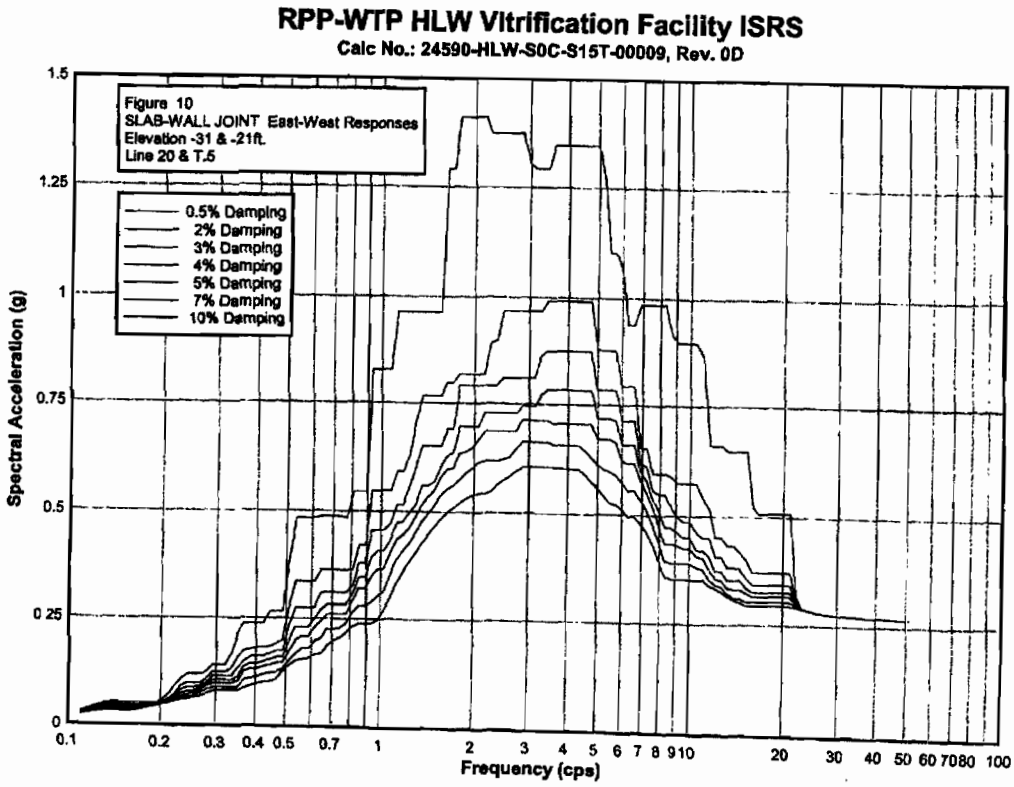
Figure 1 "Type B" Package

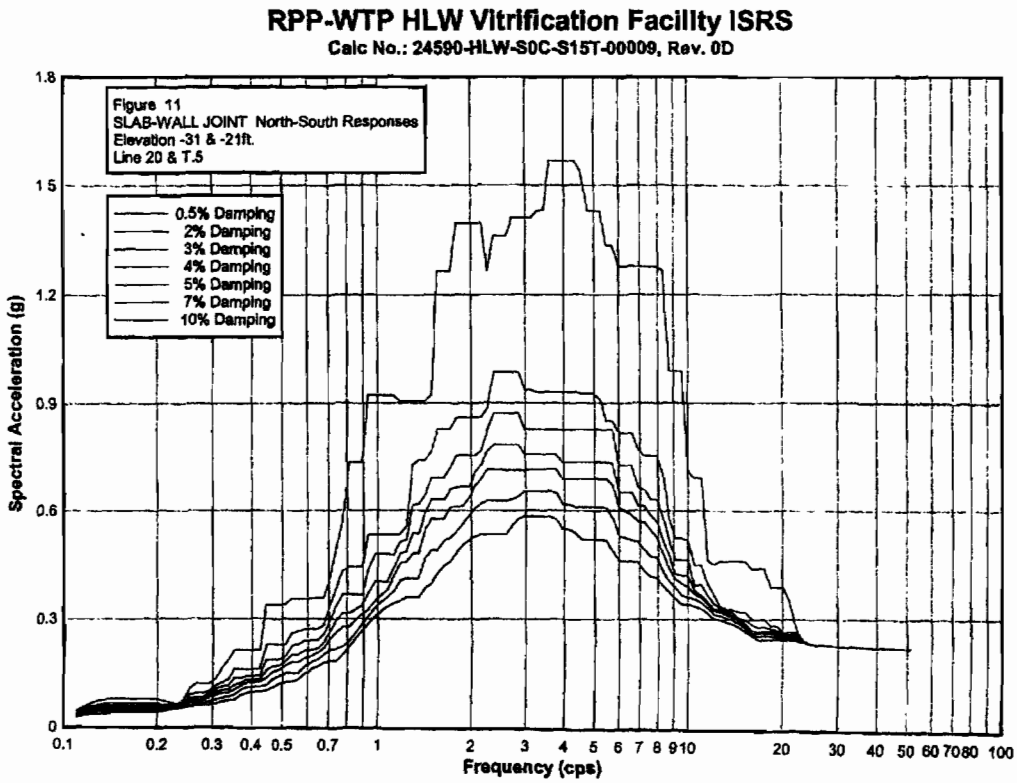


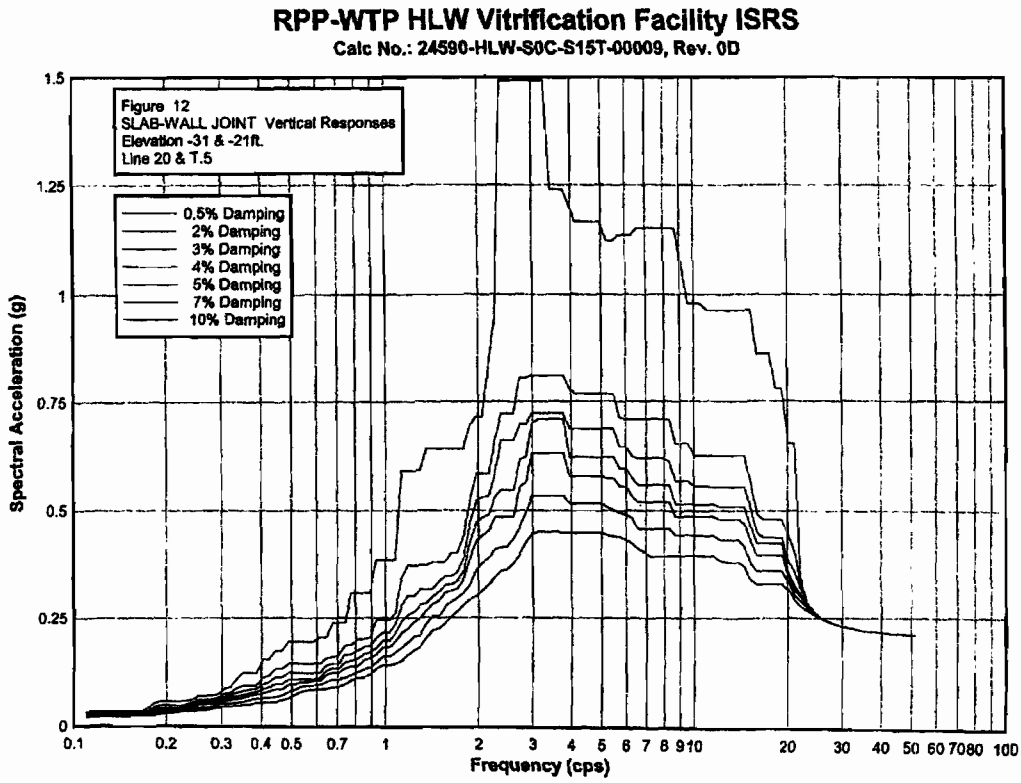
TYPE B - OPTION 1

DATE	REV.
05/06/03	D

Appendix B Seismic Response Spectra




RPP-WTP HLW Vitrification Facility ISRS
Calc No.: 24590-HLW-S0C-S15T-00009, Rev. 0D
Figure 11
SLAB-WALL JOINT North-South Responses
Elevation -31 & -21ft.
Line 20 & T.5
0.5% Damping
2% Damping
3% Damping
4% Damping
5% Damping
7% Damping
10% Damping
Spectral Acceleration (g)
1.8
1.5
1.2
0.9
0.6
0.3
0
0.1
0.2
0.3
0.4
0.5
0.7
1
2
3
4
5
6
7
8
9
10
20
30
40
50
60
70
80
100
Frequency (cps)

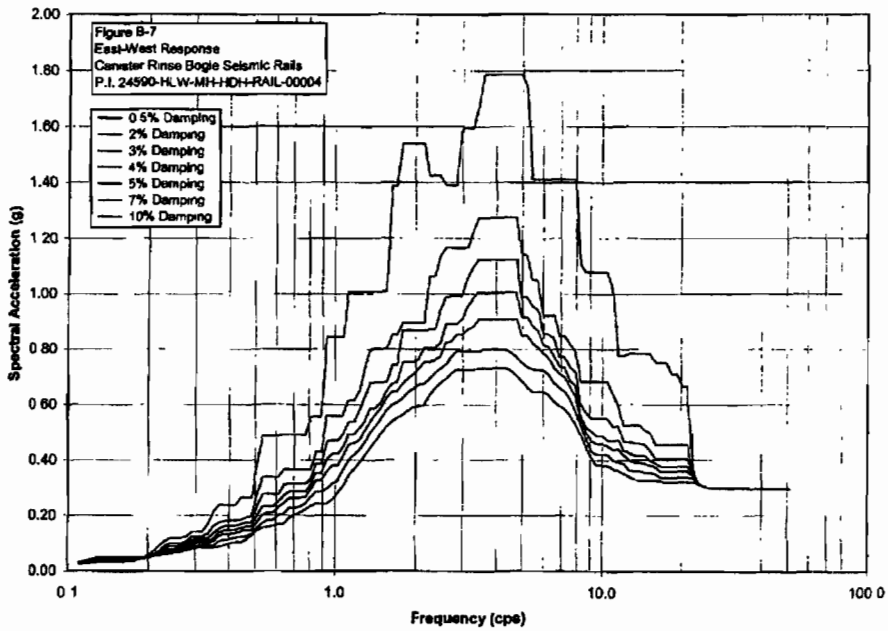

RPP-WTP HLW Vitrification Facility ISRS
Calc No.: 24590-HLW-S0C-S15T-00009, Rev. 0D
Figure 12
SLAB-WALL JOINT Vertical Responses
Elevation -31 & -21ft.
Line 20 & T.5
0.5% Damping
2% Damping
3% Damping
4% Damping
5% Damping
7% Damping
10% Damping
Spectral Acceleration (g)
1.5
1.25
1
0.75
0.5
0.25
0
0.1
0.2
0.3
0.4
0.5
0.7
1
2
3
4
5
6
7
8
9
10
20
30
40
50
60
70
80
100
Frequency (cps)

CALCULATION SHEET

PROJECT: RPP-WTP
JOB NO.: 24590
CALC NO.: 24590-HLW-S0C-S15T-00039
SHEET REV: 0
SHEET NO.: B-9

BY: Ed Ulle
DATE: 6/19/05

SUBJECT: HLW Vitrification Building Seismic Analysis – Enveloped In-Structure Response Spectra

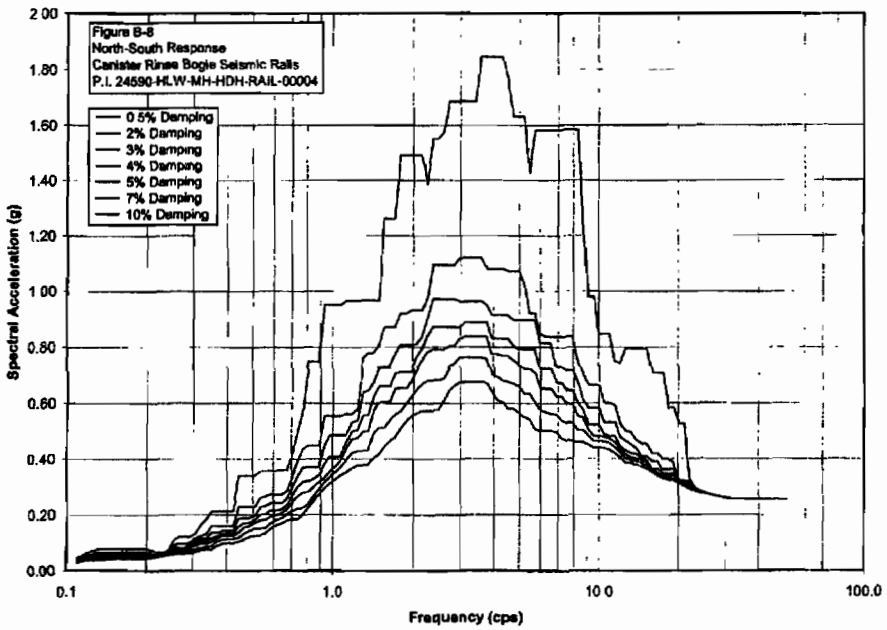


CALCULATION SHEET

PROJECT: RPP-WTP
JOB NO : 24590
CALC NO.: 24590-HLW-S0C-S15T-00039
SHEET REV 0
SHEET NO B-10

BY: Ed Lilla
DATE: 8/19/05

SUBJECT: HLW Vitrification Building Seismic Analyses – Enveloped In-Structure Response Spectra

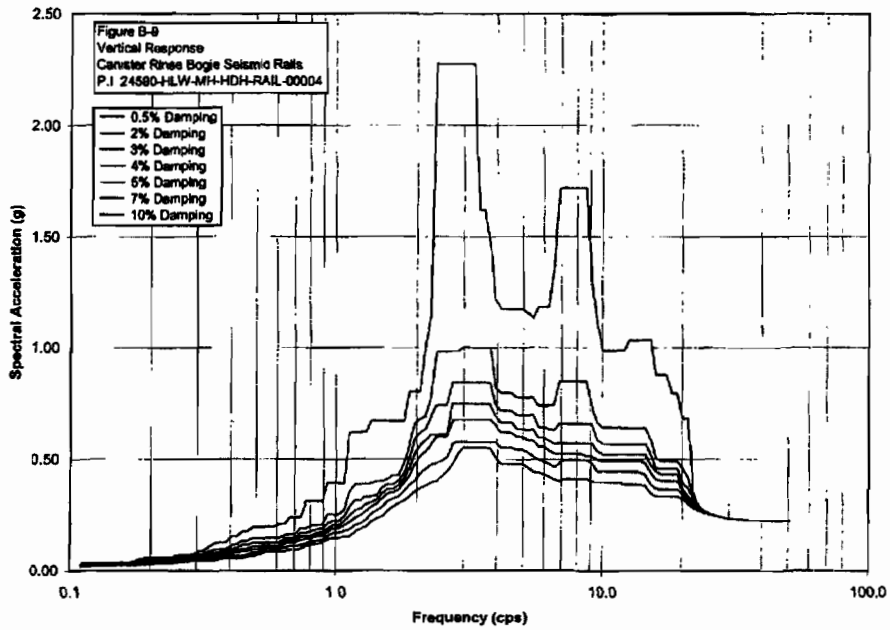


CALCULATION SHEET

PROJECT: RPP-WTP
JOB NO. 24590
CALC NO : 24590-HLW-S0C-S15T-00039
SHEET REV: D
SHEET NO.: B-11

BY: Ed Ulle
DATE: 8/19/05

SUBJECT: HLW Vitrification Building Seismic Analysis – Enveloped In-Structure Response Spectra



Appendix C ALARA Design Review (ADRs)

24590-HLW-ADR-M-02-005	HLW Canister Rinse Bogie Services Design Evaluation, Rev. 1
24590-HLW-ADR-M-02-006	HLW Bogie Recovery Systems, Rev 1
24590-HLW-ADR-M-02-007	Rinse Bogie Energy Chain, Rev 1
24590-HLW-ADR-M-02-013	Power and Control Supplies for the Canister Rinse Bogie (System HDH), Drum Transfer Bogie (RWH) and Cask Transfer Bogie (RWH), Rev. 1
24590-HLW-ADR-M-02-048	ALARA Review of HLW System Bogies, Rev. 1
24590-HLW-ADR-M-02-050	ALARA Design Review for HLW System HDH & RWH Bogie Rails, Rev. 0

Appendix D Deleted

Appendix E Deleted

Appendix F Deleted

Appendix G Deleted

Appendix H Human Factor Codes and Standards

IEEE 1023-1988 Application Areas for Mechanical Handling	Applicable Human Factor Attributes	Applicable Code, Standard, or Requirement
3.0 Planning for Human Factors Engineering		
	HFE Program Management	NUREG-0711, Section 2
	Human Reliability Analysis	NUREG-0711, Sec. 7
	Functional Requirements Analysis and Function Allocation	NUREG-0711, Section 4
	Human Factors Engineering Program Review	NUREG-0711
	Human Engineering Information Display	Part 1 of NUREG-0700, Rev 1
4.1 Task considerations	Task Analysis	NUREG-0711, Section 5
4.2 Environmental considerations:		
	Environment, Internal Design Conditions	See Section 5.5 of this specification
	Acoustical Noise	MIL-STD-1472F, sec. 5.8.3
	Anthropometric Data	MIL-STD-1472F, sec. 5.6.3
	Illuminance & Illumination	MIL-STD-1472F, Sections 5.8.2, 5.10.5
4.3 Equipment considerations		
	Cranes, Material Handling and construction	MIL-STD-1472F, section 5.12.8
	Vibration	MIL-STD-1472F, Section 5.8.4
	Remote Handling Equipment	
	• Controls: General	DOE-STD-1140-2001 Section 2.5
	• Handle and Grasp Area Design	DOE-STD-1140-2001 Section 2.13
	• Remote Handling	MIL-STD-1472F Section 5.10
	• Self-Alignment	MIL-STD-1472F Section 5.10.1.1
	• Quick-Disconnect	MIL-STD-1472F Section 5.10.1.2
	• Fasteners	MIL-STD-1472F Section 5.10.1.3
	• Lock or Latching	MIL-STD-1472F Section 5.10.1.4
	• Feedback	MIL-STD-1472F Section 5.10.2
	• Manipulators	MIL-STD-1472F Section 5.10.3

IEEE 1023-1988 Application Areas for Mechanical Handling	Applicable Human Factor Attributes	Applicable Code, Standard, or Requirement
	• Position Control	MIL-STD-1472F Section 5.10.3.2
	• Mutual Force Reflection	MIL-STD-1472F Section 5.10.3.2
	• Degrees of Freedom	MIL-STD-1472F Section 5.10.3.2
	• Power Assist	MIL-STD-1472F Section 5.10.3.3
	• Viewing Equipment	MIL-STD-1472F Section 5.10.4
	• Direct Viewing	MIL-STD-1472F Section 5.10.4.2
	• Viewing Angle	MIL-STD-1472F Section 5.10.4.3
	• Indirect Viewing	MIL-STD-1472F Section 5.10.4.4
	Viewing Equipment - Coding	MIL-STD-1472F Section 5.10.4.5
	Viewing Equipment - Lettering	MIL-STD-1472F Section 5.10.4.6
	• Illumination - Reflected Light	MIL-STD-1472F Section 5.10.5.1
	• Threshold Viewing	MIL-STD-1472F Section 5.10.5.2
4.4 Personnel Considerations		
	Hand Tools	DOE-HDBK-1140-2001 Section 4.7
	Interface Design Evaluation,(Human Machine Interface)	NUREG-0711, Section 8
	Labeling	MIL-STD-1472F, section 5.5
4.5 Nuclear Operations Considerations		
	Remote Handling (Power Manipulators)	MIL-STD-1472F, section 5.10.3
	Workplace Design	Part III of NUREG-0700, Rev 2, Section 12
	Workstation Design	Part III of NUREG-0700, Rev 2, Section 11.1
	Radiological Hot Workshops	DOE-HDBK-1140-2001, Section3.4
4.6 Documentation Considerations	No attribute identified	
5. Methodology	No attribute identified	
5.1 None observational methods	No attribute identified	
5.2 Observational methods	No attribute identified	
5.3 Expert Opinion Techniques	No attribute identified	
	Procedure Development	NUREG-0711, Section 9
	Task Analysis	NUREG-0711, Section 5,
6: Implementation in		

IEEE 1023-1988 Application Areas for Mechanical Handling	Applicable Human Factor Attributes	Applicable Code, Standard, or Requirement
Design, Operations, Testing and Maintenance process	Maintenance/Maintainability	DOE-HDBK-1140-2001, Section 5.2 & Section 6.6
6.1 Program Plan		
	Training Program Development	NUREG-0711, Section 10
6.2 Documenting HFE in the Design, Operations, Testing and Maintenance Process		
	Verification and Validation	NUREG-0711, Section 11
	Maintenance/Maintainability	DOE-HDBK-1140-2001, Section 5.2 & Section 6.6
6.3 Operational Experience Review:		
	Operating Experience Review	NUREG-0711, Section 3
	Staffing & Qualifications	NUREG-0711, Section 6

Attachment 51 – Appendix 10.8
High Level Waste Building
Engineering Calculations

Where information regarding treatment, management, and disposal of the radioactive source, byproduct material, and/or special nuclear components of mixed waste (as defined by the Atomic Energy Act of 1954, as amended) has been incorporated into this permit, it is not incorporated for the purpose of regulating the radiation hazards of such components under the authority of this permit and chapter 70.105 RCW. In the event of any conflict between Permit Condition III.10.A. and any statement relating to the regulation of source, special nuclear, and byproduct material contained in portions of the permit application that are incorporated into this permit, Permit Condition III.10.A. will prevail.

Additional appendices will be added to this appendix as new information is incorporated into this permit.

Drawings and Documents

Attachment 51 – Appendix 10.8

High Level Waste Building
Engineering Calculations

The following drawings have been incorporated into Appendix 10.8 and can be viewed at the Ecology Kennewick Office. **New drawings are in bold lettering.**

Drawing/Document	**Description**
24590-HLW-PER-M-02-003, Rev 3	Flooding Volume Calculation for the HLW Facility
RESERVED	RESERVED

R10343186

Document title: **Flooding Volume for the HLW Facility**

Contract number: DE-AC27-01RV14136

Department: Mechanical Systems

Author(s): J Medina

ISSUED BY
PER-WTP PDC
INIT 8/3/04 DATE

Principal author signature:

Document number: 24590-HLW-PER-M-02-003, Rev 3

Checked by: Y May

Checker signature:

Date of issue: 3 August 2004

Issue status: Issued for Permitting Use

Approved by: J Schneider

Approver's position: HLW Area Project Engineering Manager

Approver signature:

ERIC B. ISERN
STATE OF WASHINGTON
33449
REGISTERED
PROFESSIONAL ENGINEER
8/3/04
EXPIRES: 07/28/05

This bound document contains a total of 55 sheets

River Protection Project
Waste Treatment Plant
2435 Stevens Center Place
Richland, WA 99352
United States of America
Tel: 509 371 2000

Notice

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the US Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

History Sheet

Rev	Date	Reason for revision	Revised by
0	15 December 2002	Issued for permitting use.	D Leaphart
1	14 May 2003	Issued for permitting use. Major revision to include Elevation 0 ft.	L Fong
2	8 October 2003	Issued for permitting use. Major revision to include all elevations.	L Fong
3	3 August 2004	Issued for permitting use.	J Medina

Contents

Notice ii
History Sheet iii
Acronyms and Abbreviations v
1 Introduction 1
2 Applicable Documents 1
3 Description 1
3.1 Flooding Volume Description for HLW Facility at −21 Ft Elevation 1
3.2 Flooding Volume Description for HLW Facility at 0 Ft Elevation 7
3.3 Flooding Volume Description for HLW Facility at 37 Ft Elevation 12

Appendices

Appendix A Calculation of Volume and Liner Height ..... A-i

Acronyms and Abbreviations

BNI	Bechtel National, Inc.
DMST	demister
Ellip	semi-ellipsoidal
F&D	flanged and dished
HCP	HLW concentrate receipt process system
HEME	high efficiency mist eliminators
HFP	HLW melter feed process system
HLW	high-level waste
HOP	melter offgas treatment process system
HSH	HLW melter cave support handling system
MLTR	melter
MTU	miscellaneous treatment unit
RLD	radioactive liquid waste disposal system
SBS	submerged bed scrubber
VSL	vessel
WESP	wet electrostatic precipitator
WAC	*Washington Administrative Code*

1 Introduction

The *Washington Administrative Code*, WAC 173-303-640(4)(e), requires a secondary containment be designed and operated that contains 100 % of the capacity of the largest vessel within its boundary for vessel systems containing dangerous waste. The containment, if applicable, shall be designed to contain the water from the fire-protection system over the minimum design area for a 20-minute period. This report discusses the assessment of the flooding volume that is required to be contained for the high-level waste (HLW) vitrification facility.

2 Applicable Documents

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

3 Description

3.1 Flooding Volume Description for HLW Facility at −21 Ft Elevation

The cells and respective vessels are shown on the *HLW Vitrification Building General Arrangement (Permit) Plan at El -21' -0"*, 24590-HLW-P1-P01T-P0001, Rev 6.

3.1.1 SBS Drain Collection Cell No 2

One vessel containing dangerous waste is located in the SBS drain collection cell no 2 (H-B005):

HOP-VSL-00904 melter 2 SBS condensate receiver vessel

In the event of a line break or vessel failure, flooding could occur in the cell. The flood volume (V_{FL}) is the fire water volume plus the largest of the following:

- the total volume of the largest vessel
- 110 % of the maximum operating volume of the largest vessel
- the other flooding source

The total volume is defined as the internal volume of the vessel/MTU including the shell and both heads. For conservatism, the displaced volume of the vessel internals is neglected. The maximum operating volume is the volume of the vessel before the fluid overflows (up to the overflow nozzle).

The melter 2 SBS condensate receiver vessel has a total volume of 9941 US gal (1329 ft^3) and the 110 % maximum operating volume is 10,936 US gal (1462 ft^3). Another flooding source is from the floor drain of the west section of melter cave no 2 (H-0106), which is 4653 US gal (622 ft^3). This 4653 US gal is the melter 2 submerged bed scrubber's total volume as described in section 3.2.2. Since 110 % maximum operating volume of 10,936 US gal (1462 ft^3) is larger than the total volume and the source from the floor drain, this volume is used to calculate the cell liner height.

Fire sprinklers are not provided in this area and the above floor drain is the only contribution from other areas; therefore, a volume addition is not included in the flood volume. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Thus, the flood volume is 11,482 US gal (1535 ft^3).

The available flood area of the room into which the liquid could flow is calculated to be 252 ft^2. The available flood area of the room is the area of the room minus the cross-sectional area (footprint) of the vessels/miscellaneous treatment units (MTUs) excluding the failed vessel/MTU in the room, and miscellaneous piping and equipment that would be submerged in the flood volume. The minimum required liner height is calculated by dividing the flood volume of 11,482 US gal (1535 ft^3) by the available flood area of the room (252 ft^2). The minimum required liner height for the SBS drain collection cell no 2 (H-B005) is 6.1 ft. Details are provided in Appendix A.

3.1.2 Wet Process Cell (South)

The wet process cell (H-B014) floor area is divided into north and south sections by the drum transfer tunnel (H-B015). Four vessels containing dangerous waste are located in the south section of the wet process cell (H-B014):

RLD-VSL-00007	acidic waste vessel
RLD-VSL-00008	plant wash and drains vessel
HCP-VSL-00001*	HLW concentrate receipt vessel 1
HCP-VSL-00002*	HLW concentrate receipt vessel 2

* Note: HCP-VSL-00001 and HCP-VSL-00002 have been deleted from the design. However, for purpose of this report, the vessels are left in as a bounding minimum liner height dimension.

In the event of a line break or vessel failure, flooding could occur in the cell. The flood volume (V_{FL}) is the fire water volume plus the largest of the following:

- the total volume of the largest vessel
- 110 % of the maximum operating volume of the largest vessel
- the other flooding source

The total volume is defined as the internal volume of the vessel/MTU including the shell and both heads. For conservatism, the displaced volume of the vessel internals is neglected. The maximum operating volume is the volume of the vessel before the fluid overflows (up to the overflow nozzle).

Both concentrate receipt vessels (HCP-VSL-00001 and HCP-VSL-00002) are of equal size and are the largest vessels in the room. The total volume (V_{TOT}) of one of the concentrate receipt vessels is 20,061 US gal (2682 ft^3), which is greater than 110 % of the maximum operating volume.

Fire sprinklers are not provided in this area, and there is no contribution from other areas; therefore, a volume addition is not included in the flood volume. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Thus, the flood volume (V_{FL}) of 21,064 US gal (2816 ft^3) is used to calculate the south section minimum required liner height of the wet process cell.

The available flood area of the room into which the liquid could flow is calculated to be 725 ft^2. The available flood area of the room is the area of the room minus the cross-sectional area (footprint) of the vessels/MTUs excluding the failed vessel/MTU in the room, and miscellaneous piping and equipment that would be submerged in the flood volume. The liner height is calculated by dividing the flood volume of 21,064 US gal (2816 ft^3) by the available flood area of the room (725 ft^2). The minimum required liner height for the south section of the wet process cell is 3.9 ft. The details of the liner height determination are provided in Appendix A.

3.1.3 Wet Process Cell (North)

One vessel containing dangerous waste is located in the north section of the wet process cell (H-B014):

RLD-VSL-00002 offgas drains collection vessel

In the event of a line break or vessel failure, flooding could occur in the cell. The flood volume (V_{FL}) is the fire water volume plus the largest of the following:

- the total volume of the largest vessel
- 110 % of the maximum operating volume of the largest vessel
- the other flooding source

The total volume is defined as the internal volume of the vessel/MTU including the shell and both heads. For conservatism, the displaced volume of the vessel internals is neglected. The maximum operating volume is the volume of the vessel before the fluid overflows (up to the overflow nozzle).

The offgas drains collection vessel (RLD-VSL-00002) has a total volume of 344 US gal (46 ft^3). Since the total volume is greater than 110 % of the maximum operating volume, the total volume is used to calculate the minimum required liner height.

Fire sprinklers are not provided in this area, and there is no contribution from other areas; therefore, a volume addition is not included in the flood volume. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Thus, the flood volume of 359 US gal (48 ft^3) is used to calculate the north section of the wet process cell minimum required liner height.

The available flood area of the room into which the liquid could flow is calculated to be 306 ft^2. The available flood area of the room is the area of the room minus the cross-sectional area (footprint) of the vessels/MTUs excluding the failed vessel/MTU in the room, and miscellaneous piping and equipment that would be submerged in the flood volume. The minimum required liner height is calculated by dividing the flood volume of 359 US gal (48 ft^3) by the available flood area of the room (306 ft^2). The minimum required liner height for the north section of the wet process cell (H-B014) is 0.2 ft. Details are provided in Appendix A.

3.1.4 SBS Drain Collection Cell No 1

One vessel containing dangerous waste is located in the SBS drain collection cell no 1 (H-B021):

HOP-VSL-00903 SBS condensate receiver vessel

In the event of a line break or vessel failure, flooding could occur in the cell. The flood volume (V_{FL}) is the fire water volume plus the largest of the following:

- the total volume of the largest vessel
- 110 % of the maximum operating volume of the largest vessel
- the other flooding source

The total volume is defined as the internal volume of the vessel/MTU including the shell and both heads. For conservatism, the displaced volume of the vessel internals is neglected. The maximum operating volume is the volume of the vessel before the fluid overflows (up to the overflow nozzle).

The SBS condensate receiver vessel (HOP-VSL-00903) has a total volume of 9941 US gal (1329 ft^3) and the 110 % maximum operating volume is 10,936 US gal (1462 ft^3). Another flooding source is from the floor drain of the west section of melter cave no 1 (H-0117), which is 4653 US gal (622 ft^3). This 4653 US gal is the melter 1 submerged bed scrubber's total volume as described in section 3.2.5. Since 110 % maximum operating volume of 10,936 US gal (1462 ft^3) is larger than the total volume and the source from the floor drain, this is the volume used to calculate the cell liner height.

Fire sprinklers are not provided in this area and the above floor drain is the only contribution from other areas; therefore, a volume addition is not included in the flood volume. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Thus, the flood volume is 11,482 US gal (1535 ft^3).

The available flood area of the room into which the liquid could flow is calculated to be 252 ft^2. The available flood area of the room is the area of the room minus the cross-sectional area (footprint) of the vessels/MTUs excluding the failed vessel/MTU in the room, and miscellaneous piping and equipment that would be submerged in the flood volume. The minimum required liner height is calculated by dividing the flood volume of 11,482 US gal (1535 ft^3) by the available flood area of the room (252 ft^2). The minimum required liner height for the SBS drain collection cell no 1 (H-B021) is 6.1 ft. Details are provided in Appendix A.

3.1.5 Canister Decon Cave

Three vessels containing dangerous waste are located in the canister decon cave (H-B035):

HDH-VSL-00002	canister decon vessel 1
HDH-VSL-00004	canister decon vessel 2
HDH-VSL-00003	waste neutralization vessel

In the event of a line break or vessel failure, flooding could occur in the cell. The flood volume (V_{FL}) is the fire water volume plus the largest of the following:

- the total volume of the largest vessel
- 110 % of the maximum operating volume of the largest vessel
- the other flooding source

The total volume is defined as the internal volume of the vessel/MTU including the shell and both heads. For conservatism, the displaced volume of the vessel internals is neglected. The maximum operating volume is the volume of the vessel before the fluid overflows (up to the overflow nozzle).

The waste neutralization vessel (HDH-VSL-00003) is the largest vessel, with a total volume of 5326 US gal (712 ft^3). The 110 % of the maximum operating volume for the vessel is 5356 US gal (716 ft^3), which is greater than the total volume, and used to calculate the cell liner height.

Fire sprinklers are not provided in this area; therefore, fire water is not added in the flood volume and there is no contribution from other areas. As a result, a volume addition is not included in the flood volume. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Thus, the flood volume is 5625 US gal (752 ft^3).

The available flood area of the room into which the liquid could flow is calculated to be 227 ft^2. The available flood area of the room is the area of the room minus the cross-sectional area (footprint) of the vessels/MTUs excluding the failed vessel/MTU in the room, and miscellaneous piping and equipment that would be submerged in the flood volume. The minimum required liner height is calculated by dividing the flood volume of 5625 US gal (752 ft^3) by the available flood area of the room (227 ft^2). The minimum required liner height for the canister decon cave (H-B035) is 3.4 ft. Details are provided in Appendix A.

3.1.6 Canister Rinse-Bogie Maintenance Room

One vessel containing dangerous waste is located in the canister rinse-bogie maintenance room (H-B039A):

HDH-VSL-00001 rinse tunnel canister rinse vessel

The rinse tunnel canister rinse vessel (HDH-VSL-00001) could be moved on a bogie into the canister rinse-bogie maintenance room (H-B039A) to receive manual maintenance. The minimum secondary containment (protective coating) height is calculated assuming the rinse tunnel canister rinse vessel (HDH-VSL-00001) is transferred from the canister rinse tunnel (H-B039B) into the canister rinse-bogie maintenance room (H-B039A).

In the event of a line break or vessel failure, flooding could occur in the cell. The flood volume (V_{FL}) is the fire water volume plus the largest of the following:

- the total volume of the largest vessel
- 110 % of the maximum operating volume of the largest vessel
- the other flooding source

The total volume is defined as the internal volume of the vessel/MTU including the shell and both heads. For conservatism, the displaced volume of the vessel internals is neglected. The maximum operating volume is the volume of the vessel before the fluid overflows (up to the overflow nozzle).

The rinse tunnel canister rinse vessel (HDH-VSL-00001) has a total volume of 3590 US gal (480 ft^3). The 110 % of the maximum operating volume for the vessel is 3949 US gal (528 ft^3), which is greater than the total volume, and used to calculate the cell liner height.

There is no contribution from other areas, but an automatic fire extinguishing system is provided in the canister rinse-bogie maintenance room (H-B039A). At the fire water (sprinkler discharge) flow density of 0.20 US gal/min/ft^2 for a 20-minute duration, the fire water volume is 3168 US gal (424 ft^3). To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Thus, the flood volume is 7480 US gal (1000 ft^3) for the canister rinse-bogie maintenance room (H-B039A). The canister rinse-bogie maintenance room (H-B039A) and canister rinse tunnel (H-B039B) are interconnected and flooding overflows from one room into the other room. The flood volume for the canister rinse-bogie maintenance room (H-B039A) is larger than canister rinse tunnel (H-B039B); therefore, the flood volume for the canister rinse-bogie maintenance room (H-B039A) of 7151 US gal (956 ft^3) is used to determine the liner height.

The available flood area is the sum of the cross-sectional areas of both rooms into which the liquid could flow; this is calculated to be 1349 ft^2. The available flood area of the room is the area of the room minus the cross-sectional area (footprint) of the vessels/MTUs excluding the failed vessel/MTU in the room, and miscellaneous piping and equipment that would be submerged in the flood volume. The liner height is calculated by dividing the flood volume of 7151 US gal (956 ft^3) by the available flood area of the room (1349 ft^2). The minimum secondary containment (protective coating) height for the canister rinse-bogie maintenance room (H-B039A) is 0.8 ft. Details are provided in Appendix A.

3.1.7 Canister Rinse Tunnel

One vessel containing dangerous waste is located in the canister rinse tunnel (H-B039B):

HDH-VSL-00001 rinse tunnel canister rinse vessel

In the event of a line break or vessel failure, flooding could occur in the cell. The flood volume (V_{FL}) is the fire water volume plus the largest of the following:

- the total volume of the largest vessel
- 110 % of the maximum operating volume of the largest vessel
- the other flooding source

The total volume is defined as the internal volume of the vessel/MTU including the shell and both heads. For conservatism, the displaced volume of the vessel internals is neglected. The maximum operating volume is the volume of the vessel before the fluid overflows (up to the overflow nozzle).

The rinse tunnel canister rinse vessel (HDH-VSL-00001) has a total volume of 3590 US gal (480 ft^3). The 110 % of the maximum operating volume for the vessel is 3949 US gal (528 ft^3), which is greater than the total volume, and used to calculate the cell liner height.

There is no contribution from other areas, but an automatic fire extinguishing system is provided in canister rinse tunnel (H-B039B). At the fire water (sprinkler discharge) flow density of 0.20 US gal/min/ft^2 for a 20-minute duration, the fire water volume is 2228 US gal (298 ft^3). To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to

the flood volume. Thus, the flood volume is 6485 US gal (867 ft^3) for canister rinse tunnel (H-B039B). The canister rinse-bogie maintenance room (H-B039A) and canister rinse tunnel (H-B039B) are interconnected and flooding overflows from one room into the other room. The flood volume for the canister rinse-bogie maintenance room (H-B039A) is larger than canister rinse tunnel (H-B039B); therefore, the flood volume for the canister rinse-bogie maintenance room (H-B039A) of 7175 US gal (956 ft^3) is used to determine the liner height.

The available flood area of the room into which the liquid could flow is calculated to be 1349 ft^2. The available flood area of the room is the area of the room minus the cross-sectional area (footprint) of the vessels/MTUs excluding the failed vessel/MTU in the room, and miscellaneous piping and equipment that would be submerged in the flood volume. The minimum required liner height is calculated by dividing the flood volume of 7151 US gal (956 ft^3) by the available flood area of the room (1349 ft^2). The minimum required liner height required for the canister rinse tunnel (H-B039B) is 0.8 ft. Details are provided in Appendix A.

3.2 Flooding Volume Description for HLW Facility at 0 Ft Elevation

The cells and respective vessels or miscellaneous treatment units (MTUs) are shown on the *HLW Vitrification Building General Arrangement (Permit) Plan at El 0'- 0"*, 24590-HLW-P1-P01T-P0002, Rev 3.

3.2.1 Melter Cave No 2 (South)

Four vessels containing dangerous waste are located in the south section of melter cave no 2 (H-0106):

HFP-DMST-00003	melter 2 feed prep vessel demister
HFP-DMST-00004	melter 2 feed vessel demister
HFP-VSL-00005	melter 2 feed preparation vessel
HFP-VSL-00006	melter 2 feed vessel

In the event of a line break or vessel failure, flooding could occur in the cell. The flood volume (V_{FL}) is the fire water volume plus the largest of the following:

- the total volume of the largest vessel
- 110 % of the maximum operating volume of the largest vessel
- the other flooding source

The total volume is defined as the internal volume of the vessel/MTU including the shell and both heads. For conservatism, the displaced volume of the vessel internals is neglected. The maximum operating volume is the volume of the vessel before the fluid overflows (up to the overflow nozzle).

The demisters (HFP-DMST-00003 and HFP-DMST-00004) are directly flanged to the top of melter feed and feed preparation vessels. These demisters are considered part of the connecting vessel. The melter 2 feed preparation vessel (HFP-VSL-00005) and melter 2 feed vessel (HFP-VSL-00006) are the same size. Each vessel with its connecting demister has a total volume of 8445 US gal (1129 ft^3). Each vessel's 110 % maximum operating volume is 8512 US gal (1138 ft^3), which is larger than the total volume; therefore, this volume is used to calculate the cell liner height.

Fire sprinklers are not provided in this area; therefore, fire water is not added in the flood volume and there is no contribution from other areas. As a result, a volume addition is not included in the flood volume. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Thus, the flood volume for this room is 8939 US gal (1195 ft^3). This is the volume used to calculate the cell liner height.

The available flood area of the room into which the liquid could flow is calculated to be 315 ft^2. The available flood area of the room is the area of the room minus the cross-sectional area (footprint) of the vessels/MTUs excluding the failed vessel/MTU in the room, and miscellaneous piping and equipment that would be submerged in the flood volume. The minimum required liner height is calculated by dividing the flood volume of 8939 US gal (1195 ft^3) by the available flood area of the room (315 ft^2). The minimum required liner height for the south section of melter cave no 2 (H-0106) is 3.8 ft. Details are provided in Appendix A.

3.2.2 Melter Cave No 2 (West)

Three MTUs containing dangerous waste are located in the west section of melter cave no 2 (H-0106):

HOP-SCB-00002	melter 2 submerged bed scrubber
HOP-HEME-00002A	melter 2 high efficiency mist eliminator
HOP-HEME-00002B	melter 2 high efficiency mist eliminator

In the event of a line break or vessel/MTU failure, flooding could occur in the cell. The flood volume (V_{FL}) is the fire water volume plus the largest of the following:

- the total volume of the largest vessel/MTU
- 110 % of the maximum operating volume of the largest vessel/MTU
- the other flooding source

The total volume is defined as the internal volume of the vessel/MTU including the shell and both heads. For conservatism, the displaced volume of the vessel internals is neglected. The maximum operating volume is the volume of the vessel/MTU before the fluid overflows (up to the overflow nozzle).

The largest vessel/MTU in the area is the melter 2 submerged bed scrubber (HOP-SCB-00002). The melter 2 submerged bed scrubber (HOP-SCB-00002) has a total volume of 4653 US gal (622 ft^3), which is greater than 110 % of its maximum operating volume.

Fire sprinklers are not provided in this area; therefore, fire water is not added in the flood volume and there is no contribution from other areas. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Thus, the flood volume is 4884 US gal (653 ft^3).

The available flood area of the room into which the liquid could flow is calculated to be 340 ft^2. The available flood area of the room is the area of the room minus the cross-sectional area (footprint) of the vessels/MTUs excluding the failed vessel/MTU in the room, and miscellaneous piping and equipment that would be submerged in the flood volume. The minimum required liner height is calculated by dividing the flood volume of 4884 US gal (653 ft^3) by the available flood area of the room (340 ft^2). The minimum required liner height for the west section of melter cave no 2 (H-0106) is 2.0 ft. Details are provided in Appendix A.

3.2.3 Melter Cave No 2 (Central)

One MTU containing dangerous waste is located in the central section of melter cave no 2 (H-0106):

HMP-MLTR-00002	HLW melter 2

Because molten glass leaking from the melter (HMP-MLTR-00002) solidifies upon contact with the floor, neither a flood volume nor a minimum-required liner height needs to be calculated. Nevertheless, a stainless steel liner is provided to facilitate the containment of potential spills from either the jumpers or the feed lines. The minimum liner height is 0.5 ft. Fire sprinklers are not provided in this area.

3.2.4 Melter Cave No 1 (South)

Four vessels containing dangerous waste are located in the south section of melter cave no 1 (H-0117):

HFP-DMST-00001	melter 1 feed prep vessel demister
HFP-DMST-00002	melter 1 feed vessel demister
HFP-VSL-00001	melter 1 feed preparation vessel
HFP-VSL-00002	melter 1 feed vessel

In the event of a line break or vessel failure, flooding could occur in the cell. The flood volume (V_{FL}) is the fire water volume plus the largest of the following:

- the total volume of the largest vessel
- 110 % of the maximum operating volume of the largest vessel
- the other flooding source

The total volume is defined as the internal volume of the vessel/MTU including the shell and both heads. For conservatism, the displaced volume of the vessel internals is neglected. The maximum operating volume is the volume of the vessel before the fluid overflows (up to the overflow nozzle).

The demisters (HFP-DMST-00001 and HFP-DMST-00002) are directly flanged to the top of melter feed vessel and feed preparation vessel. These demisters are considered part of the connecting vessel. The melter 1 feed preparation vessel (HFP-VSL-00001) and melter 1 feed vessel (HFP-VSL-00002) are the same size. Each vessel with its connecting demister has a total volume of 8445 US gal (1129 ft^3). Each vessel's 110 % maximum operating volume is 8512 US gal (1138 ft^3), which is larger than the total volume; therefore, this volume is used to calculate the cell liner height.

Fire sprinklers are not provided in this area; therefore, fire water is not added in the flood volume and there is no contribution from other areas. As a result, a volume addition is not included in the flood volume. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Thus, the flood volume for this room is 8939 US gal (1195 ft^3). This is the volume used to calculate the cell liner height.

The available flood area of the room into which the liquid could flow is calculated to be 315 ft^2. The available flood area of the room is the area of the room minus the cross-sectional area (footprint) of the vessels/MTUs excluding the failed vessel/MTU in the room, and miscellaneous piping and equipment that would be submerged in the flood volume. The minimum required liner height is calculated by dividing the flood volume of 8939 US gal (1195 ft^3) by the available flood area of the room (315 ft^2). The minimum required liner height for the south section of melter cave no 1 (H-0117) is 3.8 ft. Details are provided in Appendix A.

3.2.5 Melter Cave No 1 (West)

Three MTUs containing dangerous waste are located in the west section of melter cave no 1 (H-0117):

HOP-SCB-00001	melter 1 submerged bed scrubber
HOP-HEME-00001A	melter 1 high efficiency mist eliminator
HOP-HEME-00001B	melter 1 high efficiency mist eliminator

In the event of a line break or vessel failure, flooding could occur in the cell. The flood volume (V_{FL}) is the fire water volume plus the largest of the following:

- the total volume of the largest vessel/MTU
- 110 % of the maximum operating volume of the largest vessel/MTU
- the other flooding source

The total volume is defined as the internal volume of the vessel/MTU including the shell and both heads. For conservatism, the displaced volume of the vessel internals is neglected. The maximum operating volume is the volume of the vessel/MTU before the fluid overflows (up to the overflow nozzle).

The largest vessel/MTU in the area is the melter 1 submerged bed scrubber (HOP-SCB-00001). The melter 1 submerged bed scrubber (HOP-SCB-00001) has a total volume of 4653 US gal (622 ft^3), which is greater than 110 % of its maximum operating volume.

Fire sprinklers are not provided in this area; therefore, fire water is not added in the flood volume and there is no contribution from other areas. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Thus, the flood volume is 4884 US gal (653 ft^3).

The available flood area of the room into which the liquid could flow is calculated to be 340 ft^2. The available flood area of the room is the area of the room minus the cross-sectional area (footprint) of the vessels/MTUs excluding the failed vessel/MTU in the room, and miscellaneous piping and equipment that would be submerged in the flood volume. The minimum required liner height is calculated by dividing the flood volume of 4884 US gal (653 ft^3) by the available flood area of the room (340 ft^2). The

minimum required liner height for the west section of melter cave no 1 (H-0117) is 2.0 ft. Details are provided in Appendix A.

3.2.6 Melter Cave No 1 (Central)

One MTU containing dangerous waste is located in the central section of melter cave no 1 (H-0117):

HMP-MLTR-00001 HLW melter 1

Because molten glass that leaks from the melter (HMP-MLTR-00001) solidifies upon contact with the floor, neither a flood volume nor a minimum-required liner height needs to be calculated. Nevertheless, a stainless steel liner is provided to facilitate the containment of potential spills from either the jumpers or the feed lines. The minimum liner height is 0.5 ft. Fire sprinklers are not provided in this area.

3.2.7 Melter 2 Equipment Decontamination Pit

One vessel containing dangerous waste is located in the melter 2 equipment decontamination pit (H-0304A):

HSH-TK-00002 decontamination tank melter cave 2

In the event of a line break or vessel failure, flooding could occur in the cell. The flood volume (V_{FL}) is the fire water volume plus the largest of the following:

- the total volume of the largest vessel
- 110 % of the maximum operating volume of the largest vessel
- the other flooding source

The total volume is defined as the internal volume of the vessel/MTU including the shell and both heads. For conservatism, the displaced volume of the vessel internals is neglected. The maximum operating volume is the volume of the vessel before the fluid overflows (up to the overflow nozzle).

The decontamination tank melter cave 2 (HSH-TK-00002) has a total volume of 3964 US gal (530 ft^3), and a 110 % maximum operating volume of 4361 US gal (583 ft^3). Since 110 % maximum operating volume of 4361 US gal (583 ft^3) is larger than the total volume, this is the volume used to calculate the cell liner height.

Fire sprinklers are not provided in this area; therefore, fire water is not added in the flood volume and there is no contribution from other areas. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Thus, the flood volume is 4578 US gal (612 ft^3).

The available flood area of the room into which the liquid could flow is calculated to be 190 ft^2. The available flood area of the room is the area of the room minus the cross-sectional area (footprint) of the vessels/MTUs excluding the failed vessel/MTU in the room, and miscellaneous piping and equipment that would be submerged in the flood volume. The minimum required liner height is calculated by dividing the flood volume of 4578 US gal (612 ft^3) by the available flood area of the room (190 ft^2). The minimum required liner height for the melter 2 equipment decontamination pit (H-0304A) is 3.3 ft. Details are provided in Appendix A.

3.2.8 Melter 1 Equipment Decontamination Pit

One vessel containing dangerous waste is located in the melter 1 equipment decontamination pit (H-0310A):

HSH-TK-00001 decontamination tank melter cave 1

In the event of a line break or vessel failure, flooding could occur in the cell. The flood volume (V_{FL}) is the fire water volume plus the largest of:

- the total volume of the largest vessel
- 110 % of the maximum operating volume of the largest vessel
- the other flooding source

The total volume is defined as the internal volume of the vessel/MTU including the shell and both heads. For conservatism, the displaced volume of the vessel internals is neglected. The maximum operating volume is the volume of the vessel before the fluid overflows (up to the overflow nozzle).

The decontamination tank melter cave 1 (HSH-TK-00001) has a total volume of 3964 US gal (530 ft^3), and a 110 % maximum operating volume of 4361 US gal (583 ft^3). Since 110 % maximum operating volume of 4361 US gal (583 ft^3) is larger than the total volume, this is the volume used to calculate the cell liner height.

Fire sprinklers are not provided in this area; therefore, fire water is not added in the flood volume and there is no contribution from other areas. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Thus, the flood volume is 4578 US gal (612 ft^3).

The available flood area of the room into which the liquid could flow is calculated to be 190 ft^2. The available flood area of the room is the area of the room minus the cross-sectional area (footprint) of the vessels/MTUs excluding the failed vessel/MTU in the room, and miscellaneous piping and equipment that would be submerged in the flood volume. The minimum required liner height is calculated by dividing the flood volume of 4578 US gal (612 ft^3) by the available flood area of the room (190 ft^2). The minimum required liner height for the melter 1 equipment decontamination pit (H-0310A) is 3.3 ft. Details are provided in Appendix A.

3.3 Flooding Volume Description for HLW Facility at 37 Ft Elevation

The cells and respective vessels or miscellaneous treatment units (MTUs) are shown on the *HLW Vitrification Building General Arrangement (Permit) Plan at El. 37'-0"*, 24590-HLW-P1-P01T-P0004, Rev 0.

3.3.1 Active Services Cell Melter No 2

One MTU containing dangerous waste is located in the active services cell melter no 2 (H-0302):

HOP-WESP-00002 melter 2 wet electrostatic precipitator

In the event of a line break or vessel failure, flooding could occur in the cell. The flood volume (V_{FL}) is the fire water volume plus the largest of the following:

- the total volume of the largest vessel
- 110 % of the maximum operating volume of the largest vessel
- the other flooding source

The total volume is defined as the internal volume of the vessel/MTU including the shell and both heads. For conservatism, the displaced volume of the vessel internals is neglected. The maximum operating volume is the volume of the vessel before the fluid overflows (up to the overflow nozzle).

The melter 2 wet electrostatic precipitator (HOP-WESP-00002) has a total volume of 6515 US gal (871 ft^3), and a 110 % maximum operating volume is 7166 US gal (958 ft^3). Since 110 % maximum operating volume of 7166 US gal (958 ft^3) is larger than the total volume, this is the volume used to calculate the cell liner height.

Fire sprinklers are not provided in this area, and there is no contribution from other areas; therefore, a volume addition is not included in the flood volume. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Thus, the flood volume is 7525 US gal (1006 ft^3).

The available flood area of the room into which the liquid could flow is calculated to be 1860 ft^2. The available flood area of the room is the area of the room minus the cross-sectional area (footprint) of the vessels/MTUs excluding the failed vessel/MTU in the room, and miscellaneous piping and equipment that would be submerged in the flood volume. The minimum required liner height is calculated by dividing the flood volume of 7525 US gal (1006 ft^3) by the available flood area of the room (1860 ft^2). The minimum required liner height for the active service duct melter 2 (H-0302) is 0.6 ft. Details are provided in Appendix A.

3.3.2 Active Services Cell Melter No 1

One MTU containing dangerous waste is located in the active services cell melter no 1 (H-0308):

HOP-WESP-00001 melter 1 wet electrostatic precipitator

In the event of a line break or vessel failure, flooding could occur in the cell. The flood volume (V_{FL}) is the fire water volume plus the largest of:

- the total volume of the largest vessel
- 110 % of the maximum operating volume of the largest vessel
- the other flooding source

The total volume is defined as the internal volume of the vessel/MTU including the shell and both heads. For conservatism, the displaced volume of the vessel internals is neglected. The maximum operating volume is the volume of the vessel before the fluid overflows (up to the overflow nozzle).

The melter 1 wet electrostatic precipitator (HOP-WESP-00001) has a total volume of 6515 US gal (871 ft^3), and a 110 % maximum operating volume is 7166 US gal (958 ft^3). Since 110 % maximum

operating volume of 7166 US gal (958 ft^3) is larger than the total volume, this is the volume used to calculate the cell liner height.

Fire sprinklers are not provided in this area, and there is no contribution from other areas; therefore, a volume addition is not included in the flood volume. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Thus, the flood volume is 7525 US gal (1006 ft^3).

The available flood area of the room into which the liquid could flow is calculated to be 1860 ft^2. The available flood area of the room is the area of the room minus the cross-sectional area (footprint) of the vessels/MTUs excluding the failed vessel/MTU in the room, and miscellaneous piping and equipment that would be submerged in the flood volume. The minimum required liner height is calculated by dividing the flood volume of 7525 US gal (1006 ft^3) by the available flood area of the room (1860 ft^2). The minimum required liner height for the active service duct melter 1 (H-0308) is 0.6 ft. Details are provided in Appendix A.

Appendix A

Calculation of Volume and Liner Height

Appendix A
Calculation of Volume and Liner Height

1 Purpose

The purpose of this calculation is to determine the secondary containment (liner or protective coating) heights in the dangerous waste permit regulated process cells for the high-level waste (HLW) vitrification facility.

2 Criteria and Design Input

The criteria and design input with their sources are listed below.

1 Liners are used as secondary containment and are all stainless steel except for H-B039A (canister rinse-bogie maintenance room), which has a protective coating.

2 The containment liner is sized to contain 100 % of the total volume (V_{TOT}) of the largest vessel/MTU in the respective cell, or 110 % of the maximum operating volume (V_{Max}) of the largest vessel/MTU. The maximum operating volume is the volume of the vessel/MTU up to the overflow nozzle. The larger of the two is used to size the minimum required liner height.

3 As applicable, the secondary containment shall be designed to handle the volume of fire water from the fire-protection system over the minimum design area for 20 minutes, in addition to 100 % capacity of the largest vessel.

4 The room dimensions are based on the following drawings. The equipment and vessels identified for permitting are also shown on these drawings.

24590-HLW-P1-P01T-P0001, Rev 5
24590-HLW-P1-P01T-P0002, Rev 3
24590-HLW-P1-P01T-P0004, Rev 0

5 The wet process cell (H-B014) floor area is divided into north and south sections by the drum transfer tunnel (H-B015) as shown in the following drawings:

24590-HLW-P1-P01T-P0008, Rev 7
24590-HLW-P1-P01T-P0009, Rev 6
24590-HLW-P1-P01T-P0010, Rev 6
24590-HLW-P1-P01T-P0011, Rev 7

6 The melter cave no 1 (H-0117) and melter cave no 2 (H-0106) floor areas are divided into north, south, and central sections as shown in the following drawings:

24590-HLW-P1-P01T-P0008, Rev 7
24590-HLW-P1-P01T-P0009, Rev 6
24590-HLW-P1-P01T-P0010, Rev 6
24590-HLW-P1-P01T-P0011, Rev 7

7 The automatic fire extinguishing system provides fire water (sprinkler discharge) flow density of 0.20 US gal/min/ft^2 for ordinary hazard occupancies for areas less than 1500 ft^2, as specified in the *Automatic Sprinkler System Handbook*, Figure 7-2.3.1.2.

8 The canister rinse-bogie maintenance room (H-B039A) and canister rinse tunnel (H-B039B) are interconnected and flooding overflows from one room into the other room.

9 The minimum liner height is the calculated liner height rounded up.

3 Assumptions

The following assumptions were used to develop this calculation.

1 To calculate the liner heights conservatively, all vessels/MTUs are supported on the floor as depicted on the following drawings:

24590-HLW-P1-P01T-P0008, Rev 7
24590-HLW-P1-P01T-P0009, Rev 6
24590-HLW-P1-P01T-P0010, Rev 6
24590-HLW-P1-P01T-P0011, Rev 7

2 The liquid level of the failed vessel/MTU empties or leaks down to the liner height. No verification is required for this assumption since this is the maximum volume that can leak out of a vessel/MTU.

3 This calculation assumes that the area beneath the non-failed vessel/MTU does not contain any spilled liquids. This assumption does not need verification, since applying this assumption results in a conservative value for the minimum required liner height.

4 The total volume calculated without any vessel internals is the largest volume for a vessel/MTU; therefore, verification is not required for this assumption.

5 To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. This assumption requires verification after final design.

6 The floor is sloped, and the calculated minimum liner height is from the high point of the floor to the top of the liner, which neglects the accumulated volume below the high point. No verification is needed since applying this assumption results in a conservative value for the minimum required liner height.

7 Automatic fire suppression systems are not provided in areas of high radiation and low combustible loading. The permitted rooms (H-B005, H-B014, H-B021, H-B035, H-0106, H-0117, H-0302, H-

0304A, H-308 and H-0310A) are assumed high radiation and low combustible loading areas. This assumption requires verification after final design.

8 Total volume is the total internal vessel/MTU volume including shell and both vessel heads. The displaced volume of the vessel/MTU internals is neglected for conservatism.

9 HCP-VSL-00001 and HCP-VSL-00002 are the largest vessels in the south portion of the wet process cell (H-B014 South) and the basis for determining the minimum required liner height for that cell. The vessels have been deleted from the HLW design, however the liner height as shown in this calculation will still include them. This represents a bounding minimum liner height. This is a conservative assumption and does not require verification.

4 Methodology

The total volume and the maximum operating volume for each vessel/MTU are calculated based on their respective vessel/MTU data. As stated in the Assumptions and the Criteria and Design Input sections, the vessels/MTUs are completely filled. The largest vessel/MTU leaks into the room up to the minimum required liner height. For areas with fire extinguishing systems, the fire water volume is added to the flood volume.

4.1 Nomenclature

A_C	available flood area, ft^2
A_{Eq}	equipment cross-sectional area (footprint) of vessel or miscellaneous treatment unit (MTU), ft^2
A_{Rm}	area of the room, ft^2
d	depth of vessel or MTU head, ft
D	inside vessel or MTU diameter, ft
D_{Eq}	maximum vessel or MTU overall diameter (includes vessel jacket), ft
L	room length, ft
LH	calculated liner or protective coating height (inside distance of the secondary containment between the high point of the sloped floor to the top of the liner), ft
LH_{min}	minimum required liner or protective coating height is the calculated liner height rounded up
L_{OF}	distance from bottom tangent line of the vessel to the bottom of the overflow nozzle, ft
L_{OV}	overall length of the vessel or MTU, ft
L_{T-T}	tangent-to-tangent distance of the vessel or MTU, ft
MTU	miscellaneous treatment unit
N	number of ellipsoidal (Ellip) or flanged and dished (F&D) or right-circular cone heads
V_{FL}	flood volume, ft^3
V_{FW}	fire water volume, ft^3

V_{HD}	volume of the vessel or MTU head, ft^3
V_{Max}	maximum operating volume, ft^3
V_S	volume of the tangent-to-tangent portion of the vessel, ft^3
V_{TOT}	total volume, ft^3
V_{XMax}	110 % of maximum operating volume, ft^3
W	room width, ft
ΣA_{Eq}	sum of the cross-sectional areas of all vessels/equipment in the room, ft^2

4.2 Vessel/MTU Calculation

Calculations are based on vessel/MTU input design parameters, diameter, shell length, and head type. The calculations are as follows:

1 Shell volume

$$V_S = \pi/4\ D^2\ L_{T\text{-}T},\ ft^3$$

2 Vessel/MTU head volume, from the *Pressure Vessel Design Manual* (Moss, 1987)

a 2:1 semi-ellipsoidal (Ellip) head

$$V_{HD} = \pi D^3/24,\ ft^3$$

b 100 % to 6 % flanged and dished (F&D) head

$$V_{HD} = 0.0847\ D^3,\ ft^3$$

c Right circular cone head (*Mark's Handbook for Mechanical Engineers*, 9th Edition, page 2-10)

$$V_{HD} = (1/3)\ \pi\ (D/2)^2\ d,\ ft^3$$

where d = 0.289 D for 30° right cone (section 4.2.3.c)

$$V_{HD} = (1/3)\ \pi\ (D/2)^2\ (0.289\ D)$$

$$V_{HD} = 0.0757\ (D^3),\ ft^3$$

3 Depth of vessel head, from the *Pressure Vessel Design Manual*

a 2:1 semi-ellipsoidal head

$$d = 0.25\ D,\ ft$$

b 100 % – 6 % F&D head

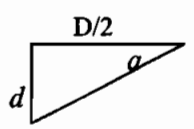
$$d = 0.162\ D,\ ft$$

c. 30° right circular cone head

$$d = (D/2)\ \tan a$$

$$d = (D/2)\ \tan 30^\circ$$

$$d = 0.289\ d,\ ft$$



4 Total volume

$$V_{TOT} = V_S + N\,V_{HD},\ ft^3$$

5 Maximum operating volume

$$V_{Max} = V_{HD} + \pi/4\ D^2\ (L_{OF}),\ ft^3$$

6 110 % of maximum operating volume

$$V_{XMax} = 1.1V_{Max},\ ft^3$$

4.3 Fire Water Volume

The fire water volume is based on fire water flow density (worst case) of 0.20 US gal/min/ft^2 for 1500 ft^2 of fire area for 20 minutes in accordance with section 2, Criteria and Design Input, item 9.

Thus, the fire water (V_{FW}) is:

$$V_{FW} = (0.20\ \text{US gal/min/ft}^2)\ (A_{Rm}\ \text{ft}^2)\ (20\ \text{min})$$
$$V_{FW} = 4.0A_{Rm}\ \text{US gal}$$

4.4 Flood Volume

The flood volume (V_{FL}) is the fire water volume (section 2, Input, item 3) plus the largest of:

- the total volume of the largest vessel (section 2, Input, item 2)
- 110 % of the maximum operating volume of the largest vessel (section 2, Input, item 2)
- the other flooding source

In addition, to account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume (section 3, Assumptions, item 5).

4.5 Equipment Cross-Sectional Area of Vessel/MTU

The equipment cross-sectional area (footprint) (A_{Eq}) for each vessel/MTU in the room and sum of the equipment cross-sectional footprints (ΣA_{Eq}) are calculated as follows:

equipment cross-sectional area $(A_{Eq}) = (\pi/4)D_{Eq}^2,\ ft^2$

where D_{Eq} is the maximum vessel or MTU overall diameter (includes vessel jacket)

sum of major equipment $\Sigma A_{Eq} = (A_{Eq})_1 + (A_{Eq})_2 + (A_{Eq})_3 + \ldots + (A_{Eq})_n,\ ft^2$

where subscript $_{1, 2, 3,}$ and $_n$ are 1st, 2nd, 3rd, and nth vessel/MTU

4.6 Room Area

The room area (A_{Rm}) is calculated as follows:

room area (A_{Rm}) = WL, ft^2

where *W* is the room width and *L* is the room length

4.7 Available Flood Area

The available flood area (A_C) is equal to the room area (A_{Rm}) minus the sum of the equipment cross-sectional area footprint (ΣA_{Eq}), excluding the failed vessel/MTU. **Note:** the liquid level of the failed vessel is reduced to the liner height:

$A_C = A_{Rm} - \Sigma A_{Eq}$, ft^2

4.8 Calculated Liner Height (LH)

LH = flood volume/available flood area

or, LH = V_{FL}/A_C, ft

4.9 Minimum Required Liner Height (LHmin)

The minimum required liner height is the calculated liner height in feet rounded up.

4.10 Precision of the Calculated Values

a Calculated volume to nearest ft^3 or gal

b Calculated area to the nearest ft^2

c Calculated liner height or depth of the vessel head to the nearest 0.01 ft

d Minimum required liner height to be rounded up to the next 0.1 ft

5 Calculation

The complete calculations for vessel volumes and liner height are as follows for each process cell.

5.1 SBS Drain Collection Cell No 2 (H-B005)

The area of the SBS drain collection cell no 2 (H-B005) is 14.8 ft × 17 ft. This cell contains one vessel with the following vessel/MTU data:

Vessel/MTU	D Inside Diameter, ft	D_{Eq} Max Equip Diameter, ft	L_{T-T} Tangent to tangent, ft	L_{OF} Overflow Nozzle Height, ft	Bottom Vessel Head	Top Vessel Head
HOP-VSL-00904	12	12.36	7.75	no overflow	Ellip	Ellip

1 Vessel HOP-VSL-00904 Calculation

shell volume, $V_S = \pi/4\ D^2\ L_{T\text{-}T}$

$V_S = (\pi/4)\ (12)^2\ (7.75) = 877\ ft^3$

vessel head volume for semi-ellipsoidal head

$V_{HD} = \pi\ D^3/24$

$V_{HD} = \pi\ (12)^3/24 = 226\ ft^3$

depth of vessel head for semi-ellipsoidal head

$d = 0.25\ D$

$d = 0.25\ (12) = 3.00\ ft$

total volume

$V_{TOT} = V_S + N\ V_{HD}$

$V_{TOT} = 877 + 2(226) = 1329\ ft^3$

$V_{TOT} = 1329\ ft^3\ (7.48\ gal/ft^3) = 9941$ US gal

maximum operating volume

$V_{Max} = V_{TOT}$ since there is no overflow nozzle, thus

$V_{Max} = 1329\ ft^3$

110 % of maximum operating volume

$V_{XMax} = 1.1\ V_{Max} = 1.1\ (1329) = 1462\ ft^3$

$V_{XMax} = 1462\ ft^3\ (7.48\ gal/ft^3) = 10{,}936$ US gal

vessel footprint or area

$A_{Eq} = (\pi/4)D_{Eq}^2 = (\pi/4)(12.36)^2 = 120\ ft^2$

2 Room Area = WL = 14.8 ft (17 ft) = 252 ft^2

3 Room is in a C5/R5 area therefore no fire water is required. Thus $V_{FW} = 0\ ft^3$.

4 Another flood source is from the floor drain in cell H-0106 (west) that overflows 4653 US gal (622 ft^3) into this cell (section 5.9.1a).

5 The flood volume is the larger of the total volume, or 110 % of the maximum operating volume of the largest vessel or other flooding source plus fire water. In addition, to account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Since V_{XMax} is larger than V_{TOT} for the HOP-VSL-00904 and the other flooding source:

$V_{FL} = 1.05\ (V_{XMax} + V_{FW}) = 1.05\ (1462 + 0) = 1535\ ft^3$

$V_{FL} = 1535\ ft^3\ (7.48\ gal/ft^3) = 11{,}482$ US gal

6 The available flood area is equal to the room area minus the sum of the equipment footprint excluding the leaking vessel/MTU:

$A_C = A_{Rm} = 252\ ft^2$

7 The liner height is calculated as follows:

LH = flood volume/available flood area
$LH = V_{FL}/A_C$
LH = 1535/252 = 6.09 ft

8 The minimum required liner height is the calculated liner height rounded up, or:

$LH_{min} = 6.1$ ft

5.2 Wet Process Cell - South (H-B014 South)

The area of the wet process cell (H-B014 South) is 18 ft × 64 ft and contains four vessels with the following vessel/MTU data:

Vessel/MTU	D Inside Diameter, ft	D_{Eq} Max Equip Diameter, ft	L_{T-T} Tangent to Tangent, ft	L_{OF}, Overflow Nozzle Height, ft	Bottom Vessel Head	Top Vessel Head
RLD-VSL-00007	13	13.12	15.5	14.35	F&D	F&D
RLD-VSL-00008	13	13.12	9.75	8.60	Ellip	Ellip
HCP-VSL-00001*	13.5	14.12	15.83	14.35	F&D	F&D
HCP-VSL-00002*	13.5	14.12	15.83	14.35	F&D	F&D

* Note: HCP-VSL-00001 and HCP-VSL-00002 have been deleted from the design. However, for purpose of this calculation, the vessels are left in as a bounding minimum liner height dimension.

1 Vessel Calculations

a RLD-VSL-00007

shell volume, $V_S = \pi/4\ D^2\ L_{T-T}$

$V_S = (\pi/4)\ (13)^2\ (15.5) = 2057\ ft^3$

vessel head volume for F&D head

$V_{HD} = 0.0847\ D^3$

$V_{HD} = 0.0847\ (13)^3 = 186\ ft^3$

depth of vessel head for F&D head

$d = 0.162\ D$

$d = 0.162\ (13) = 2.11$ ft

total volume

$V_{TOT} = V_S + N\ V_{HD}$

$V_{TOT} = 2057 + 2\ (186) = 2429\ ft^3$

maximum operating volume

$V_{Max} = V_{HD} + \pi/4\ D^2\ (L_{OF}),\ ft^3$

$V_{Max} = 186 + (\pi/4)\ (13)^2\ (14.35) = 2091\ ft^3$

110 % of maximum operating volume

$V_{XMax} = 1.1\ V_{Max} = 1.1\ (2091) = 2300\ ft^3$

vessel footprint or area

$A_{Eq} = (\pi/4)D_{Eq}^2 = (\pi/4)(13.12)^2 = 135\ ft^2$

b RLD-VSL-00008

shell volume, $V_S = \pi/4\ D^2\ L_{T\text{-}T}$

$V_S = (\pi/4)\ (13)^2\ (9.75) = 1294\ ft^3$

vessel head volume for semi-ellipsoidal head

$V_{HD} = \pi D^3/24,\ ft^3$

$V_{HD} = \pi\ (13)^3/24 = 288\ ft^3$

depth of vessel head for semi-ellipsoidal head

$d = 0.25\ D$

$d = 0.25\ (13) = 3.25\ ft$

total volume

$V_{TOT} = V_S + N\ V_{HD}$

$V_{TOT} = 1294 + 2\ (288) = 1870\ ft^3$

maximum operating volume

$V_{Max} = V_{HD} + \pi/4\ D^2\ (L_{OF}),\ ft^3$

$V_{Max} = 288 + (\pi/4)\ (13)^2\ (8.60) = 1429\ ft^3$

110 % of maximum operating volume

$V_{XMax} = 1.1\ V_{Max} = 1.1\ (1429) = 1572\ ft^3$

vessel footprint or area

$A_{Eq} = (\pi/4)D_{Eq}^2 = (\pi/4)13.12^2 = 135\ ft^2$

c HCP-VSL-00001 or HCP-VSL-00002

shell volume, $V_S = \pi/4\ D^2\ L_{T\text{-}T}$

$V_S = (\pi/4)\ (13.5)^2\ (15.83) = 2266\ ft^3$

vessel head volume for F&D head

$V_{HD} = 0.0847\ D^3$

$V_{HD} = 0.0847\ (13.5)^3 = 208\ ft^3$

depth of vessel head for F&D head

$d = 0.162\ D$

$d = 0.162\ (13.5) = 2.19\ ft$

total volume

$V_{TOT} = V_S + N\ V_{HD}$

$V_{TOT} = 2266 + 2\ (208) = 2682\ ft^3$

$V_{TOT} = 2682\ ft^3\ (7.48\ gal/ft^3) = 20{,}061$ US gal

maximum operating volume

$V_{Max} = V_{HD} + \pi/4\ D^2\ (L_{OF})$, ft^3
$V_{Max} = 208 + (\pi/4)\ (13.5)^2\ (14.35) = 2262\ ft^3$

110 % of maximum operating volume
$V_{XMax} = 1.1\ V_{Max} = 1.1\ (2262) = 2488\ ft^3$

vessel footprint or area
$A_{Eq} = (\pi/4)D_{Eq}^2 = (\pi/4)14.12^2 = 157\ ft^2$

2 Room Area = WL = 18 ft (64 ft) = 1152 ft^2

3 Room is in a C5/R5 area therefore no fire water is required. Thus $V_{FW} = 0\ ft^3$.

4 The flood volume is the larger of the total volume or 110 % of the maximum operating volume of the largest vessel plus fire water. The largest vessel in this room is HCP-VSL-00001 or HCP-VSL-00002. In addition, to account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Since V_{TOT} is larger than V_{XMax} and fire water was not added to the flood volume:

$V_{FL} = 1.05\ (V_{TOT} + V_{FW}) = 1.05\ (2682 + 0) = 2816\ ft^3$
$V_{FL} = 2816\ ft^3\ (7.48\ gal/ft^3) = 21{,}064$ US gal

5 The available flood area is equal to the room area minus the sum of the equipment footprint excluding the leaking vessel/MTU, or:

$A_C = A_{Rm} - A_{Eq1} - A_{Eq2} - A_{Eq3}$

where A_{Eq1} for RLD-VSL-00007 footprint
A_{Eq2} for RLD-VSL-00008 footprint
A_{Eq3} for HCP-VSL-00001 footprint

Assuming HCP-VSL-00002 is the leaking vessel, thus

$A_C = 1152 - 135 - 135 - 157 = 725\ ft^2$

6 The liner height is calculated as follows:

LH = flood volume/available flood area
$LH = V_{FL}/A_C$
LH = 2816/725 = 3.88 ft

7 The minimum required liner height is the calculated liner height rounded up, or:

$LH_{min} = 3.9$ ft

5.3 Wet Process Cell - North (H-B014 North)

The area of wet process cell (H-B014 North) is 18 ft × 17 ft and contains one vessel with the following vessel/MTU data:

Vessel/MTU	D Inside Diameter, ft	D_{Eq} Max Equip Diameter, ft	L_{T-T} Tangent to Tangent, ft	L_{OF} Overflow Nozzle Height, ft	Bottom Vessel Head	Top Vessel Head
RLD-VSL-00002	3.5	3.56	4	3.33	F&D	F&D

1 Vessel RLD-VSL-00002 Calculation

shell volume, $V_S = \pi/4\ D^2\ L_{T-T}$

$V_S = (\pi/4)\ (3.5)^2\ (4.0) = 38\ ft^3$

vessel head volume for F&D head

$V_{HD} = 0.0847\ D^3$

$V_{HD} = 0.0847\ (3.5)^3 = 4\ ft^3$

depth of vessel head for F&D head

$d = 0.162\ D$

$d = 0.162\ (3.5) = 0.57\ ft$

total volume

$V_{TOT} = V_S + N\ V_{HD}$

$V_{TOT} = 38 + 2\ (4) = 46\ ft^3$

$V_{TOT} = 46\ ft^3\ (7.48\ gal/ft^3) = 344\ gal$

maximum operating volume

$V_{Max} = V_{HD} + \pi/4\ D^2\ (L_{OF}),\ ft^3$

$V_{Max} = 4 + (\pi/4)\ (3.5)^2\ (3.33) = 36\ ft^3$

110 % of maximum operating volume

$V_{XMax} = 1.1\ V_{Max} = 1.1\ (36) = 40\ ft^3$

vessel footprint or area

$A_{Eq} = (\pi/4)D_{Eq}^2 = (\pi/4)(3.56)^2 = 10\ ft^2$

2 Room Area = WL = 18 ft (17 ft) = 306 ft^2

3 Room is in a C5/R5 area therefore no fire water is required. Thus $V_{FW} = 0\ ft^3$.

4 The flood volume is the larger of the total volume or 110 % of the maximum operating volume of the largest vessel plus fire water. In addition, to account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Since V_{TOT} is larger than V_{XMax} and fire water was not added to the flood volume:

$$V_{FL} = 1.05\ (V_{TOT} + V_{FW}) = 1.05\ (46 + 0) = 48\ ft^3$$

$V_{FL} = 48\ ft^3\ (7.48\ gal/ft^3) = 359\ gal$

5 The available flood area is equal to the room area minus the sum of the equipment footprint excluding the leaking vessel/MTU, or:

$A_C = A_{Rm} = 306\ ft^2$

6 The liner height is calculated as follows:

LH = flood volume/available flood area
$LH = V_{FL}/A_C$
$LH = 48/306 = 0.16\ ft$

7 The minimum required liner height is the calculated liner height rounded up, or:

$LH_{min} = 0.2\ ft$

5.4 SBS Drain Collection Cell No 1 (H-B021)

The area of the SBS drain collection cell no 1 (H-B021) is 14.8 ft × 17 ft. This cell contains one vessel with the following vessel/MTU data:

Vessel/MTU	D Inside Diameter, ft	D_{Eq} Max Equip Diameter, ft	L_{T-T} Tangent to Tangent, ft	L_{OF} Overflow Nozzle Height, ft	Bottom Vessel Head	Top Vessel Head
HOP-VSL-00903	12	12.36	7.75	no overflow	Ellip	Ellip

1 Vessel HOP-VSL-00903 Calculation

shell volume, $V_S = \pi/4\ D^2\ L_{T-T}$
$V_S = (\pi/4)\ (12)^2\ (7.75) = 877\ ft^3$

vessel head volume for semi-ellipsoidal head
$V_{HD} = \pi\ D^3/24$
$V_{HD} = \pi\ (12)^3/24 = 226\ ft^3$

depth of vessel head for semi-ellipsoidal head
$d = 0.25\ D$
$d = 0.25\ (12) = 3.00\ ft$

total volume
$V_{TOT} = V_S + N\ V_{HD}$
$V_{TOT} = 877 + 2(226) = 1329\ ft^3$
$V_{TOT} = 1329\ ft^3\ (7.48\ gal/ft^3) = 9941$ US gal

maximum operating volume
$V_{Max} = V_{TOT}$ since there is no overflow nozzle, thus
$V_{Max} = 1329\ ft^3$

110 % of maximum operating volume

$V_{XMax} = 1.1\ V_{Max} = 1.1\ (1329) = 1462\ ft^3$

$V_{XMax} = 1462\ ft^3\ (7.48\ gal/ft^3) = 10{,}936$ US gal

vessel footprint or area

$A_{Eq} = (\pi/4)D_{Eq}^2 = (\pi/4)(12.36)^2 = 120\ ft^2$

2 Room Area = WL = 14.8 ft (17 ft) = 252 ft^2

3 Room is in a C5/R5 area therefore no fire water is required. Thus $V_{FW} = 0\ ft^3$.

4 Another flood source is from floor drain in cell H-0117 (west) that overflows 4653 US gal (622 ft^3) into this cell (section 5.11.1a).

5 The flood volume is the larger of the total volume or 110 % of the maximum operating volume of the largest vessel or other flood source plus fire water. In addition, to account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Since V_{XMax} is larger than V_{TOT} for the HOP-VSL-00903 and the other flooding source:

$V_{FL} = 1.05\ (V_{XMax} + V_{FW}) = 1.05\ (1462 + 0) = 1535\ ft^3$

$V_{FL} = 1535\ ft^3\ (7.48\ gal/ft^3) = 11{,}482$ US gal

6 The available flood area is equal to the room area minus the sum of the equipment footprint excluding the leaking vessel/MTU:

$A_C = A_{Rm} = 252\ ft^2$

7 The liner height is calculated as follows:

LH = flood volume/available flood area

$LH = V_{FL}/A_C$

LH = 1535/252 = 6.09 ft

8 The minimum required liner height is the calculated liner height rounded up, or:

$LH_{min} = 6.1$ ft

5.5 Canister Decon Cave (H-B035)

The area of canister decon cave (H-B035) is 11 ft × 21.5 ft and contains three vessels with the following vessel/MTU data:

Vessel/MTU	D Inside Diameter, ft	D_{Eq} Max Equip Diameter, ft	L_{T-T} Tangent to Tangent, ft	L_{OF} Overflow Nozzle Height, ft	Bottom Vessel Head	Top Vessel Head
HDH-VSL-00002	2.5	2.55	16.75	15.24	Ellip	Flat

Vessel/MTU	D Inside Diameter, ft	D_{Eq} Max Equip Diameter, ft	L_{T-T} Tangent to Tangent, ft	L_{OF} Overflow Nozzle Height, ft	Bottom Vessel Head	Top Vessel Head
HDH-VSL-00004	2.5	2.55	16.75	15.24	Ellip	Flat
HDH-VSL-00003	7	7.1	17.0	16.17	F&D	F&D

1 Vessel Calculations

a HDH-VSL-00002 or HDH-VSL-00004

shell volume, $V_S = \pi/4\ D^2\ L_{T-T}$

$V_S = (\pi/4)\ (2.5)^2\ (16.75) = 82\ ft^3$

vessel head volume for semi-ellipsoidal head

$V_{HD} = \pi D^3/24,\ ft^3$

$V_{HD} = \pi(2.5)^3/24 = 2\ ft^3$

depth of vessel head for semi-ellipsoidal head

$d = 0.25\ D$

$d = 0.25\ (2.5) = 0.63\ ft$

total volume

$V_{TOT} = V_S + N\ V_{HD}$

$V_{TOT} = 82 + 2 = 84\ ft^3$

maximum operating volume

$V_{Max} = V_{HD} + \pi/4\ D^2\ (L_{OF}),\ ft^3$

$V_{Max} = 2 + (\pi/4)(2.5)^2\ (15.24) = 77\ ft^3$

110 % of maximum operating volume

$V_{XMax} = 1.1\ V_{Max} = 1.1\ (77) = 85\ ft^3$

vessel footprint or area

$A_{Eq1} = (\pi/4)\ D_{Eq}^2 = (\pi/4)(2.55)^2 = 5\ ft^2$ for HDH-VSL-00002

$A_{Eq2} = (\pi/4)\ D_{Eq}^2 = (\pi/4)(2.55)^2 = 5\ ft^2$ for HDH-VSL-00004

b HDH-VSL-00003

shell volume, $V_S = \pi/4\ D^2\ L_{T-T}$

$V_S = \pi/4\ (7)^2\ (17) = 654\ ft^3$

vessel head volume for F&D head

$V_{HD} = 0.0847\ D^3$

$V_{HD} = 0.0847\ (7)^3 = 29\ ft^3$

depth of vessel head for F&D head

$d = 0.162\ D$

$d = 0.162\ (7) = 1.13\ ft$

total volume

$V_{TOT} = V_S + N\ V_{HD}$
$V_{TOT} = 654 + 2\ (29) = 712\ ft^3$
$V_{TOT} = 712\ ft^3\ (7.48\ gal/ft^3) = 5326$ US gal

maximum operating volume

$V_{Max} = V_{HD} + \pi/4\ D^2\ (L_{OF}) ft^3$
$V_{Max} = 29 + (\pi/4)\ (7)^2\ (16.17) = 651\ ft^3$

110 % of maximum operating volume

$V_{XMax} = 1.1\ V_{Max} = 1.1\ (651) = 716\ ft^3$
$V_{TOT} = 716\ ft^3\ (7.48\ gal/ft^3) = 5356$ US gal

vessel footprint or area

$A_{Eq3} = (\pi/4) D_{Eq}^2 = (\pi/4)(7.1)^2 = 40\ ft^2$

2 Room Area = WL = 11 ft (21.5 ft) = 237 ft^2

3 Room is in a C5/R5 area therefore no fire water is required. Thus $V_{FW} = 0\ ft^3$.

4 The flood volume is the larger of the total volume, or 110 % of the maximum operating volume of the largest vessel plus fire water. In addition, to account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. The largest vessel in this room is HDH-VSL-00003. Since V_{XMax} is greater than V_{TOT}:

$V_{FL} = 1.05\ (V_{XMax} + V_{FW}) = 1.05\ (716 + 0) = 752\ ft^3$
$V_{FL} = 752\ ft^3\ (7.48\ gal/ft^3) = 5625$ US gal

5 The available flood area is equal to the room area minus the sum of the equipment footprint excluding the leaking vessel/MTU, or:

$A_C = A_{Rm} - A_{Eq1} - A_{Eq2}$

where A_{Eq1} for HDH-VSL-00002 footprint
A_{Eq2} for HDH-VSL-00004 footprint

$A_C = 237 - 5 - 5 = 227\ ft^2$

6 The liner height is calculated as follows:

LH = flood volume/available flood area
$LH = V_{FL}/A_C$
LH = 752/227 = 3.31 ft

7 The minimum required liner height is the calculated liner height rounded up, or:

$LH_{min} = 3.4$ ft

5.6 Canister Rinse- Bogie Maintenance Room (H-B039A)

The canister rinse-bogie maintenance room (H-B039A) and canister rinse tunnel (H-B039B) are interconnected and flood from one room into the other room. The canister rinse-bogie maintenance room (H-B039A) is 23.3 ft × 34 ft and canister rinse tunnel (H-B039B) is 11.3 ft × 49.3 ft. The canister rinse-bogie maintenance room and the canister rinse tunnel are considered as one area and contain one vessel with the following vessel/MTU data:

Vessel/MTU	D Inside Diameter, ft	D_{Eq} Max Equip Diameter, ft	L_{T-T} Tangent to Tangent, ft	L_{OF} Overflow Nozzle Height, ft	Bottom Vessel Head	Top Vessel Head
HDH-VSL-00001	5.83	5.92	17.0	no overflow	Ellip	Flat

1 Vessel HDH-VSL-00001 Calculation

shell volume, $V_S = \pi/4\ D^2\ L_{T-T}$

$V_S = (\pi/4)\ (5.83)^2\ (17.0) = 454\ ft^3$

vessel head volume for semi-ellipsoidal head

$V_{HD} = \pi D^3/24,\ ft^3$

$V_{HD} = \pi(5.83)^3/24 = 26\ ft^3$

depth of vessel head for semi-ellipsoidal head

$d = 0.25\ D$

$d = 0.25\ (5.83) = 1.46\ ft$

total volume

$V_{TOT} = V_S + N\ V_{HD}$

$V_{TOT} = 454 + 26 = 480\ ft^3$

$V_{TOT} = 480\ ft^3\ (7.48\ gal/ft^3) = 3590$ US gal

maximum operating volume

with no overflow and flat top head, V_{Max} is

$V_{Max} = V_{Tot}$

$V_{Max} = 480\ ft^3$

110 % of maximum operating volume

$V_{XMax} = 1.1\ V_{Max} = 1.1\ (480) = 528\ ft^3$

$V_{XMax} = 528\ ft^3\ (7.48\ gal/ft^3) = 3949$ US gal

vessel footprint or area

$A_{Eq} = (\pi/4)D_{Eq}^2 = (\pi/4)(5.92)^2 = 28\ ft^2$

2 Room areas, where each room area (A_{Rm}) = WL

a Room H-B039A

$A_{Rm1} = (23.3\ ft)\ (34\ ft) = 792\ ft^2$

b Room H-B039B

$A_{Rm2} = (11.3 \text{ ft})(49.3 \text{ ft}) = 557 \text{ ft}^2$

c Rooms H-B039A and H-B039B

$A_{Rm} = A_{Rm1} + A_{Rm2} = 792 \text{ ft}^2 + 557 \text{ ft}^2 = 1349 \text{ ft}^2$

3 An automatic fire protection system is provided in the canister rinse-bogie maintenance room (H-B039A). The fire water volume is based on fire water flow density (worst case) of 0.2 US gpm/ft^2 for 1500 ft^2 of fire area for 20 minutes. Thus, the fire water is:

$V_{FW} = (0.2 \text{ US gpm/ft}^2)(A_{Rm} \text{ ft}^2)(20 \text{ min})$
$V_{FW} = 4.0A_{Rm} = 4.0\ (792) = 3168 \text{ US gal}$
$V_{FW} = 3168 \text{ gal} / (7.48 \text{ gal/ ft}^3) = 424 \text{ ft}^3$

4 The flood volume is the larger of the total volume or 110 % of the maximum operating volume of the largest vessel plus fire water. In addition, to account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Since V_{XMax} is larger than V_{TOT}:

$V_{FL} = 1.05\ (V_{XMax} + V_{FW}) = 1.05\ (528 + 424) = 1000 \text{ ft}^3$
$V_{FL} = 1000 \text{ ft}^3\ (7.48 \text{ gal/ft}^3) = 7480 \text{ US gal}$

5 The available flood area is equal to the room area minus the sum of the equipment footprint excluding the leaking vessel/MTU. Since the canister rinse-bogie maintenance room (H-B039A) and canister rinse tunnel (H-B039B) are interconnected and flood from one room into the other room, the available flood area is the sum of both rooms:

$A_C = A_{Rm1} + A_{Rm2} = 792 \text{ ft}^2 + 557 \text{ ft}^2 = 1349 \text{ ft}^2$

6 The calculated secondary containment (protective coating) height is calculated as follows:

LH = flood volume/available flood area
$LH = V_{FL}/A_C$
$LH = 1000/1349 = 0.74 \text{ ft}$

7 The minimum required protective coating height is the calculated height rounded up, or:

$LH_{min} = 0.8 \text{ ft}$

5.7 Canister Rinse Tunnel (H-B039B)

The canister rinse tunnel (H-B039B) and the canister rinse-bogie maintenance room (H-B039A) are interconnected and flood from one room into the other room. The canister rinse-bogie maintenance room (H-B039A) is 23.3 ft × 34 ft and canister rinse tunnel (H-B039B) is 11.3 ft × 49.3 ft. The canister rinse-bogie maintenance room and the canister rinse tunnel are considered to be one area and contain one vessel with the following vessel/MTU data:

Vessel/MTU	D Inside Diameter, ft	D_{Eq} Max Equip Diameter, ft	L_{T-T} Tangent to Tangent, ft	L_{OF} Overflow Nozzle Height, ft	Bottom Vessel Head	Top Vessel Head
HDH-VSL-00001	5.83	5.92	17.0	no overflow	Ellip	Flat

1 Vessel HDH-VSL-00001 Calculation

shell volume, $V_S = \pi/4\ D^2\ L_{T-T}$

$V_S = (\pi/4)\ (5.83)^2\ (17.0) = 454\ ft^3$

vessel head volume for semi-ellipsoidal head

$V_{HD} = \pi D^3/24,\ ft^3$

$V_{HD} = \pi(5.83)^3/24 = 26\ ft^3$

depth of vessel head for semi-ellipsoidal head

$d = 0.25\ D$

$d = 0.25\ (5.83) = 1.46\ ft$

total volume

$V_{TOT} = V_S + N\ V_{HD}$

$V_{TOT} = 454 + 26 = 480\ ft^3$

$V_{TOT} = 480\ ft^3\ (7.48\ gal/\ ft^3) = 3590$ US gal

maximum operating volume

with no overflow and flat top head, V_{Max} is

$V_{Max} = V_{TOT}$

$V_{Max} = 480\ ft^3$

110 % of maximum operating volume

$V_{XMax} = 1.1\ V_{Max} = 1.1\ (480) = 528\ ft^3$

$V_{XMax} = 528 ft^3\ (7.48\ gal/ft^3) = 3949$ US gal

vessel footprint or area

$A_{Eq} = (\pi/4) D_{Eq}^2 = (\pi/4)(5.92)^2 = 28\ ft^2$

2 Room area, where each room area (A_{Rm}) = WL

a Room H-B039A

$A_{Rm1} = (23.3\ ft)\ (34\ ft) = 792\ ft^2$

b Room H-B039B

$A_{Rm2} = (11.3\ ft)\ (49.3\ ft) = 557\ ft^2$

c Rooms H-B039A and H-B039B

$A_{Rm} = A_{Rm1} + A_{Rm2} = 792\ ft^2 + 557\ ft^2 = 1349\ ft^2$

3 An automatic fire protection system is provided in canister rinse tunnel (H-B039B). The fire water volume is based on fire water flow density (worst case) of 0.2 US gpm/ft^2 for 1500 ft^2 of fire area for 20 minutes. Thus, the fire water is:

V_{FW} = (0.2 US gpm/ft^2) (A_{Rm} ft^2) (20 min)
$V_{FW} = 4.0A_{Rm} = 4.0\ (557) = 2228$ US gal
V_{FW} = 2228 gal/(7.48 gal/ft^3) = 298 ft^3

4 The flood volume is the larger of the total volume, or 110 % of the maximum operating volume of the largest vessel plus fire water. In addition, to account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Since V_{XMax} is larger than V_{TOT}:

$V_{FL} = 1.05\ (V_{XMax} + V_{FW}) = 1.05\ (528 + 298)$
V_{FL} = 867 ft^3 for H-B039B
V_{FL} = 867 ft^3 (7.48 gal/ft^3) = 6485 US gal

The canister rinse tunnel (H-B039B) and the canister rinse-bogie maintenance room (H-B039A) are interconnected and flood from one room into the other room. Since the flood volume for room H-B039A is larger than H-B039B, the flood volume for H-B039A is used in calculating the liner height:

V_{FL} for H-B039A = V_{FL} = 1000 ft^3
V_{FL} = 1000 ft^3 (7.48 gal/ft^3) = 7480 US gal

5 The available flood area is equal to the room area minus the sum of the equipment footprint excluding the leaking vessel/MTU. Since the canister rinse-bogie maintenance room (H-B039A) and the canister rinse tunnel (H-B039B) are interconnected and flooding overflows from one room into the other room, the available flood area is the sum of both rooms:

$A_C = A_{Rm1} + A_{Rm2}$ = 792 ft^2 + 557 ft^2 =1349 ft^2

6 The liner height is calculated as follows:

LH = flood volume/available flood area
LH = V_{FL}/A_C
LH = 1000/1349 = 0.74 ft

7 The minimum required liner height is the calculated liner height rounded up, or:

LH_{min} = 0.8 ft

5.8 Melter Cave No 2 - South (H-0106 South)

The south area of the melter cave no 2 (H-0106 South) is 14.75 ft x 30.5 ft - 3 ft x 6 ft - 1.67 ft x 7.5 ft. This cell contains four vessels with the following vessel/MTU data:

Vessel/MTU	D Inside Diameter, ft	D_{Eq} Max Equip Diameter, ft	L_{T-T} Tangent to Tangent, ft	L_{OF} Overflow Nozzle Height, ft	Bottom Vessel Head	Top Vessel Head
HFP-DMST-00003	0.530	0.552	1.75	na	flat	flat
HFP-DMST-00004	0.530	0.552	1.75	na	flat	flat
HFP-VSL-00005	11	11.52	9.5	9.70	F&D	F&D
HFP-VSL-00006	11	11.52	9.5	9.70	F&D	F&D

1 Vessel Calculations

The HFP-DMST-00003 is directly flanged to HFP-VSL-00005, and HFP-DMST-00005 is directly flanged to HFP-VSL-00006. These demisters are considered part of the connecting vessel. Thus, the volumes from the demisters are added to their connecting vessel (HFP-VSL-00005 or 00006) total tank volume:

a HFP-DMST-00003 or HFP-VSL-00004

$V_{TOT} = V_S = \pi/4\ D^2\ L_{T-T}$

demister volume = $V_{Dem} = (\pi/4)\ (0.530)^2\ (1.75) = 0.4\ ft^3$

b HFP-VSL-00005 or HFP-VSL-00006

shell volume, $V_S = \pi/4\ D^2\ L_{T-T}$

$V_{TOT} = (\pi/4)\ (11)^2\ (9.5) = 903\ ft^3$

vessel head volume for F&D head

$V_{HD} = 0.0847\ D^3$

$V_{HD} = 0.0847\ (11)^3 = 113\ ft^3$

depth of vessel head for F&D head

$d = 0.162\ D$

$d = 0.162\ (11) = 1.78\ ft$

c HFP-VSL-00005 with HFP-DMST-00003 or HFP-VSL-00006 with HFP-DMST-00004

total vessel volume for the HFP vessel with its demister is:

V_{TOT} = [HFP – VSL volume] + [demister volume]

$V_{TOT} = [V_S + N\ V_{HD}] + [V_{Dem}]$

$V_{TOT} = [903 + 2(113)] + [(\pi/4)\ (0.530)^2\ (1.75)]$

$V_{TOT} = [1129] + [0.4]$

$V_{TOT} = 1129\ ft^3$ (with demister)

$V_{TOT} = 1129\ ft^3\ (7.48\ gal/ft^3) = 8445$ US gal

maximum operating volume

$V_{Max} = V_{HD} + \pi/4\ D^2\ (L_{OF}),\ ft^3$

$V_{Max} = 113 + (\pi/4\ )(11)^2\ (9.7) = 1035\ ft$

110 % of maximum operating volume

$V_{XMax} = 1.1\ V_{Max} = 1.1\ (1035) = 1138\ ft^3$

$V_{XMax} = 1138\ ft^3\ (7.48\ gal/ft^3) = 8512$ US gal

vessel footprint or area

$$A_{Eq} = (\pi/4)D_{Eq}^2 = (\pi/4)(11.52)^2 = 104 \text{ ft}^2$$

2 Room Area = WL = 14.75 ft (30.5 ft) - 3 ft (6 ft) - 1.67 ft (7.5 ft) = 419 ft^2

3 Room is in a C5/R5 area therefore no fire water is required. Thus $V_{FW} = 0$ ft^3.

4 The flood volume is the larger of the total volume, or 110 % of the maximum operating volume of the largest vessel plus fire water. In addition, to account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Since V_{XMax} is larger than V_{TOT}:

$$V_{FL} = 1.05\ (V_{XMax} + V_{FW}) = 1.05\ (1138 + 0) = 1195 \text{ ft}^3$$
$$V_{FL} = 1195 \text{ ft}^3\ (7.48 \text{ gal/ft}^3) = 8939 \text{ US gal}$$

5 The available flood area is equal to the room area minus the sum of the equipment footprint excluding the leaking vessel/MTU. In addition, the demisters footprints are immaterial since they are located above the HFP vessels:

$$A_C = A_{Rm} - A_{Eq1}$$

where A_{Eq1} for HFP-VSL-00005 footprint

Assuming HFP-VSL-00006 is the leaking vessel, thus
$A_C = 419 - 104 = 315$ ft^2

6 The liner height is calculated as follows:

LH = flood volume/available flood area
$LH = V_{FL}/A_C$
LH = 1195/315 = 3.79 ft

7 The minimum required liner height is the calculated liner height rounded up, or:

$LH_{min} = 3.8$ ft

5.9 Melter Cave No 2 - West (H-0106 West)

The west area of the melter cave no 2 (H-0106 west) is 13.08 ft x 30.58 -8 ft x 1.5 ft. This cell contains three MTUs with the following vessel/MTU data:

Vessel/MTU	D Inside Diameter, ft	D_{Eq} Max Equip Diameter, ft	L_{T-T} Tangent to Tangent, ft	L_{OF} Overflow Nozzle Height, ft	Bottom Vessel Head	Top Vessel Head
HOP-SCB-00002	10	10.36	5.75	4.5	F&D	F&D
HOP-HEME-00002A	5.5	5.58	12.17	no overflow	F&D	F&D
HOP-HEME-00002B	5.5	5.58	12.17	no overflow	F&D	F&D

1 MTU Calculations

a HOP-SCB-00002

shell volume, $V_S = \pi/4\ D^2\ L_{T\text{-}T}$

$V_S = \pi/4\ (10)^2\ (5.75) = 452\ ft^3$

vessel head volume for F&D head

$V_{HD} = 0.0847\ D^3$

$V_{HD} = 0.0847\ (10)^3 = 85\ ft^3$

depth of vessel head for F&D head

$d = 0.162\ D$

$d = 0.162\ (10) = 1.62\ ft$

total volume

$V_{TOT} = V_S + N\ V_{HD}$

$V_{TOT} = 452 + 2\ (85) = 622\ ft^3$

$V_{TOT} = 622\ ft^3\ (7.48\ gal/ft^3) = 4653$ US gal

maximum operating volume

$V_{Max} = V_{HD} + \pi/4\ D^2\ (L_{OF}),\ ft^3$

$V_{Max} = 85 + \pi/4\ (10)^2\ (4.5) = 438\ ft^3$

110 % of maximum operating volume

$V_{XMax} = 1.1\ V_{Max} = 1.1\ (438) = 482\ ft^3$

vessel footprint or area

$A_{Eq} = (\pi/4)D_{Eq}^2 = (\pi/4)(10.36)^2 = 84\ ft^2$

b HOP-HEME-00002A or HOP-HEME-00002B

shell volume, $V_S = \pi/4\ D^2\ L_{T\text{-}T}$

$V_S = \pi/4\ (5.5)^2\ (12.17) = 289\ ft^3$

vessel head volume for F&D head

$V_{HD} = 0.0847\ D^3$

$V_{HD} = 0.0847\ (5.5)^3 = 14\ ft^3$

depth of vessel head for F&D head

$d = 0.162\ D$

$d = 0.162\ (5.5) = 0.89\ ft$

total volume

$V_{TOT} = V_S + N\ V_{HD}$

$V_{TOT} = 289 + 2\ (14) = 317\ ft^3$

maximum operating volume

$V_{Max} = V_{TOT}$ since there is no overflow nozzle, thus

$V_{Max} = 317\ ft^3$

110 % of maximum operating volume

$V_{XMax} = 1.1\ V_{Max} = 1.1\ (317) = 349\ ft^3$

vessel footprint or area

$A_{Eq} = (\pi/4)D_{Eq}^2 = (\pi/4)(5.58)^2 = 24\ ft^2$

2 Room Area = WL = (13.08 ft) (30.58 ft) - (8 ft) (1.5 ft) = 388 ft^2

3 Room is in a C5/R5 area therefore no fire water is required. Thus $V_{FW} = 0\ ft^3$.

4 Flood volume is the larger of the total volume or 110 % of the maximum operating volume of the largest vessel plus fire water. The largest vessel/MTU in this room is HOP-SCB-00001. In addition, to account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Since V_{TOT} is larger than V_{XMax} and fire water was not added to the flood volume:

$V_{FL} = 1.05\ V_{TOT} = 1.05\ (622) = 653\ ft^3$
$V_{FL} = 653\ ft^3\ (7.48\ gal/ft^3) = 4884$ US gal

5 Available flood area is equal to the room area minus the sum of the equipment footprint excluding the leaking vessel/MTU, or:

$A_C = A_{Rm} - A_{Eq1} - A_{Eq2}$

where A_{Eq1} for HOP-HEME-00002A footprint
A_{Eq2} for HOP-HEME-00002B footprint

$A_C = 388 - 24 - 24 = 340\ ft^2$

6 Liner height is calculated as follows:

LH = flood volume/available flood area
$LH = V_{FL}/A_C$
LH = 653/340 = 1.92 ft

7 The minimum required liner height (LH_{min}) is the calculated liner height rounded up, or:

$LH_{min} = 2.0$ ft

5.10 Melter Cave No 1 - South (H-0117 South)

The south area of the melter cave no 1 (H-0117 South) is 14.75 ft x 30.5 ft - 3 ft x 6 ft - 1.67 ft x 7.5 ft. This cell contains four vessels with the following vessel/MTU data:

Vessel/MTU	D Inside Diameter, ft	D_{Eq} Max Equip Diameter, ft	L_{T-T} Tangent to Tangent, ft	L_{OF} Overflow Nozzle Height, ft	Bottom Vessel Head	Top Vessel Head
HFP-DMST-00001	0.530	0.552	1.75	na	flat	flat
HFP-DMST-00002	0.530	0.552	1.75	na	flat	flat
HFP-VSL-00001	11	11.52	9.5	9.70	F&D	F&D
HFP-VSL-00002	11	11.52	9.5	9.70	F&D	F&D

1 Vessel Calculations

The HFP-DMST-00001 is directly flanged to HFP-VSL-00001 and HFP-DMST-00002 is directly flanged to HFP-VSL-00002. These demisters are considered part of the connecting vessel. Thus, the volumes of the demisters are included to their connecting vessel (HFP-VSL-00001 or 00002) total tank volume.

a HFP-DMST-00001or 00002

$V_{TOT} = V_S = \pi/4\ D^2\ L_{T-T}$

$V_{TOT} = (\pi/4)\ (0.530)^2\ (1.75) = 0.4\ ft^3$

b HFP-VSL-00001 or HFP-VSL-00002

shell volume, $V_S = \pi/4\ D^2\ L_{T-T}$

$V_S = (\pi/4)\ (11)^2\ (9.5) = 903\ ft^3$

vessel head volume for F&D head

$V_{HD} = 0.0847\ D^3$

$V_{HD} = 0.0847\ (11)^3 = 113\ ft^3$

depth of vessel head for F&D head

$d = 0.162\ D$

$d = 0.162\ (11) = 1.78\ ft$

c HFP-VSL-00001 with HFP-DMST-00001 or HFP-VSL-00002 with HFP-DMST-00002

total vessel volume for HFP vessel with its demister is:

V_{TOT} = [HFP – VSL volume] + [demister volume]

$V_{TOT} = [V_S + N\ V_{HD}]$ + [demister volume]

$V_{TOT} = [903 + 2(113)] + [(\pi/4)\ (0.530)^2\ (1.75)]$

$V_{TOT} = [1129] + [0.4]$

$V_{TOT} = 1129\ ft^3$ (with demister)

$V_{TOT} = 1129\ ft^3\ (7.48\ gal/ft^3) = 8445$ US gal

maximum operating volume

$V_{Max} = V_{HD} + \pi/4\ D^2\ (L_{OF}),\ ft^3$

$V_{Max} = 113 + (\pi/4)(11)^2\ (9.7) = 1035\ ft^3$

110 % of maximum operating volume

$V_{XMax} = 1.1\ V_{Max} = 1.1\ (1035) = 1138\ ft^3$

$V_{XMax} = 1138\ ft^3\ (7.48\ gal/ft^3) = 8512$ US gal

vessel footprint or area

$A_{Eq} = (\pi/4)D_{Eq}^2 = (\pi/4)(11.52)^2 = 104\ ft^2$

2 Room area = WL = 14.75 ft (30.5 ft) - 3 ft (6 ft) - 1.67 ft (7.5 ft) = 419 ft^2

3 Room is in a C5/R5 area therefore no fire water is required. Thus $V_{FW} = 0\ ft^3$.

4 The flood volume is the larger of the total volume or 110 % of the maximum operating volume of the largest vessel plus fire water. In addition, to account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Since V_{XMax} is larger than V_{TOT}:

$V_{FL} = 1.05\ (V_{XMax} + V_{FW}) = 1.05\ (1138 + 0) = 1195\ ft^3$

$V_{FL} = 1195\ ft^3\ (7.48\ gal/ft^3) = 8939$ US gal

5 The available flood area is equal to the room area minus the sum of the equipment footprint excluding the leaking vessel/MTU, or:

$A_C = A_{Rm} - A_{Eq1}$

where, A_{Eq1} for HFP-VSL-00001 footprint

Assuming HFP-VSL-00002 is the leaking vessel, thus

$A_C = 419 - 104 = 315\ ft^2$

6 The liner height is calculated as follows:

LH = flood volume/available flood area

$LH = V_{FL}/A_C$

LH = 1195/315 = 3.79 ft

7 The minimum required liner height (LH_{min}) is the calculated liner height rounded up, or:

$LH_{min} = 3.8$ ft

5.11 Melter Cave No 1 - West (H-0117 West)

The west area of the melter cave no 1 (H-0117 West) is 13.08 ft x 30.58 -8 ft x 1.5 ft. This cell contains three MTUs with the following vessel/MTU data:

Vessel/MTU	D Inside Diameter, ft	D_{Eq} Max Equip Diameter, ft	L_{T-T} Tangent to Tangent, ft	L_{OF} Overflow Nozzle Height, ft	Bottom Vessel Head	Top Vessel Head
HOP-SCB-00001	10	10.36	5.75	4.5	F&D	F&D

Vessel/MTU	D Inside Diameter, ft	D_{Eq} Max Equip Diameter, ft	L_{T-T} Tangent to Tangent, ft	L_{OF} Overflow Nozzle Height, ft	Bottom Vessel Head	Top Vessel Head
HOP-HEME-00001A	5.5	5.58	12.17	no overflow	F&D	F&D
HOP-HEME-00001B	5.5	5.58	12.17	no overflow	F&D	F&D

1 MTU Calculations

a HOP-SCB-00001

shell volume, $V_{Sb} = \pi/4\ D^2\ L_{T-T}$

$V_{Sb} = \pi/4\ (10)^2\ (5.75) = 452\ ft^3$

vessel head volume for F&D head

$V_{HD} = 0.0847\ D^3$

$V_{HD} = 0.0847\ (10)^3 = 85\ ft^3$

depth of vessel head for F&D head

$d = 0.162\ D$

$d = 0.162\ (10) = 1.62\ ft$

total volume

$V_{TOT} = V_S + N\ V_{HD}$

$V_{TOT} = 452 + 2\ (85) = 622\ ft^3$

$V_{TOT} = 622\ ft^3\ (7.48\ gal/ft^3) = 4653$ US gal

maximum operating volume

$V_{Max} = V_{HD} + \pi/4\ D^2\ (L_{OF})\ ft^3$

$V_{Max} = 85 + \pi/4\ (10)^2\ (4.5) = 438\ ft^3$

110 % of maximum operating volume

$V_{XMax} = 1.1\ V_{Max} = 1.1\ (438) = 482\ ft^3$

vessel footprint or area

$A_{Eq} = (\pi/4)D_{Eq}^2 = (\pi/4)(10.36)^2 = 84\ ft^2$

b HOP-HEME-00001A or HOP-HEME-00001B

shell volume, $V_S = \pi/4\ D^2\ L_{T-T}$

$V_S = \pi/4\ (5.5)^2\ (12.17) = 289\ ft^3$

vessel head volume for F&D head

$V_{HD} = 0.0847\ D^3$

$V_{HD} = 0.0847\ (5.5)^3 = 14\ ft^3$

depth of vessel head for F&D head

$d = 0.162\ D$

$d = 0.162\ (5.5) = 0.89\ ft$

total volume

$V_{TOT} = V_S + N\ V_{HD}$
$V_{TOT} = 289 + 2\ (14) = 317\ ft^3$

maximum operating volume

$V_{Max} = V_{TOT}$ since there is no overflow nozzle, thus,
$V_{Max} = 317\ ft^3$

110 % of maximum operating volume

$V_{XMax} = 1.1\ V_{Max} = 1.1\ (317) = 349\ ft^3$

vessel footprint or area

$A_{Eq} = (\pi/4)D_{Eq}^2 = (\pi/4)(5.58)^2 = 24\ ft^2$

2 Room Area (A_{Rm}) = WL = (13.08 ft) (30.58 ft) - (8 ft) (1.5 ft) = 388 ft^2

3 Room is in a C5/R5 area therefore no fire water is required. Thus $V_{FW} = 0\ ft^3$.

4 The flood volume is the larger of the total volume or 110 % of the maximum operating volume of the largest vessel plus fire water. The largest vessel/MTU in this room is HOP-SCB-00001. In addition, to account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Since V_{TOT} is larger than V_{XMax} and fire water was not added to the flood volume:

$V_{FL} = 1.05\ V_{TOT} = 1.05\ (622) = 653\ ft^3$
$V_{FL} = 653\ ft^3\ (7.48\ gal/ft^3) = 4884$ US gal

5 The available flood area is equal to the room area minus the sum of the equipment footprint excluding the leaking vessel/MTU, or:

$A_C = A_{Rm} - A_{Eq1} - A_{Eq2}$

where A_{Eq1} for HOP-HEME-00001A footprint
A_{Eq2} for HOP-HEME-00001B footprint

$A_C = 388 - 24 - 24 = 340\ ft^2$

6 The liner height is calculated as follows:

LH = flood volume/available flood area
$LH = V_{FL}/A_C$
LH = 653/340 = 1.92 ft

7 The minimum required liner height is the calculated liner height rounded up to the next half-foot, or:

$LH_{min} = 2.0$ ft

5.12 Melter 2 Equipment Decontamination Pit (H-0304A)

The melter 2 tank area (H-0304A) is 9.5 ft × 20 ft and contains one vessel with the following vessel/MTU data:

Vessel/MTU	D Inside Diameter, ft	D_{Eq} Max Equip Diameter, ft	L_{T-T} Tangent to Tangent, ft	L_{OF} Overflow Nozzle Height, ft	Bottom Vessel Head	Top Vessel Head
HSH-TK-00002	6	6.1	18.17	na	cone	flat

1 Vessel HSH-TK-00002 Calculation

shell volume, $V_S = \pi/4\ D^2\ L_{T-T}$

$V_S = (\pi/4)\ (6)^2\ (18.17) = 514\ ft^3$

vessel head volume for right circular cone head

$V_{HD} = 0.0757\ (D^3),\ ft^3$

$V_{HD} = 0.0757\ (6^3)$

$V_{HD} = 16\ ft^3$

total volume

$V_{TOT} = V_S + N\ V_{HD}$

$V_{TOT} = 514 + 16 = 530\ ft^3$

$V_{TOT} = 530\ ft^3\ (7.48\ gal/ft^3) = 3964$ US gal

maximum operating volume

with no overflow and flat top head, V_{Max} is:

$V_{Max} = V_{TOT}$

$V_{Max} = 530 ft^3$

110 % of maximum operating volume

$V_{XMax} = 1.1\ V_{Max} = 1.1\ (530) = 583\ ft^3$

$V_{XMax} = 583\ ft^3\ (7.48\ gal/ft^3) = 4361$ US gal

vessel footprint or area

$A_{Eq} = (\pi/4)D_{Eq}^2 = (\pi/4)(6.1)^2 = 29\ ft^2$

2 Room Area = WL

$A_{Rml} = (9.5\ ft)\ (20\ ft) = 190\ ft^2$

3 Room is in a C5/R5 area therefore no fire water is required. Thus $V_{FW} = 0\ ft^3$.

4 The flood volume is the larger of the total volume or 110 % of the maximum operating volume of the largest vessel plus fire water. In addition, to account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Since V_{XMax} is larger than V_{TOT}:

$V_{FL} = 1.05\ (V_{XMax} + V_{FW}) = 1.05\ (583) = 612\ ft^3$

$V_{FL} = 612\ ft^3\ (7.48\ gal/ft^3) = 4578$ US gal

5 The available flood area is equal to the room area minus the sum of the equipment footprint excluding the leaking vessel/MTU:

$A_C = 190\ ft^2$

6 The liner height is calculated as follows:

LH = flood volume/available flood area
$LH = V_{FL}/A_C$
$LH = 612/190 = 3.22$ ft

7 The minimum required liner height is the calculated liner height rounded up, or:

$LH_{min} = 3.3$ ft

5.13 Melter 1 Equipment Decontamination Pit (H-0310A)

The melter 1 tank area (H-0310A) is 9.5 ft × 20 ft and contains one vessel with the following vessel/MTU data:

Vessel/MTU	D Inside Diameter, ft	D_{Eq} Max Equip Diameter, ft	L_{T-T} Tangent to Tangent, ft	L_{OF} Overflow Nozzle Height, ft	Bottom Vessel Head	Top Vessel Head
HSH-TK-00001	6	6.1	18.17	na	cone	flat

1 Vessel HSH-TK-00001 Calculation

shell volume, $V_S = \pi/4\ D^2\ L_{T-T}$
$V_S = (\pi/4)\ (6)^2\ (18.17) = 514\ ft^3$

vessel head volume for right circular cone head
$V_{HD} = 0.0757\ (D^3),\ ft^3$
$V_{HD} = 0.0757\ (6^3)$
$V_{HD} = 16\ ft^3$

total volume
$V_{TOT} = V_S + N\ V_{HD}$
$V_{TOT} = 514 + 16 = 530\ ft^3$
$V_{TOT} = 530\ ft^3\ (7.48\ gal/ft^3) = 3964$ US gal

maximum operating volume
with no overflow and flat top head, V_{Max} is:
$V_{Max} = V_{TOT}$
$V_{Max} = 530\ ft^3$

110 % of maximum operating volume
$V_{XMax} = 1.1\ V_{Max} = 1.1\ (530) = 583\ ft^3$
$V_{XMax} = 583\ ft^3\ (7.48\ gal/ft^3) = 4361$ US gal

vessel footprint or area

$A_{Eq} = (\pi/4)D_{Eq}^2 = (\pi/4)(6.1)^2 = 29\ ft^2$

2 Room area = WL

$A_{Rm1} = (9.5\ ft)\ (20\ ft) = 190\ ft^2$

3 Room is in a C5/R5 area therefore no fire water is required. Thus $V_{FW} = 0\ ft^3$.

4 The flood volume is the larger of the total volume or 110 % of the maximum operating volume of the largest vessel plus fire water. In addition, to account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Since V_{XMax} is larger than V_{TOT}:

$V_{FL} = 1.05\ (V_{XMax} + V_{FW}) = 1.05\ (583 + 0) = 612\ ft^3$
$V_{FL} = 612\ ft^3\ (7.48\ gal/ft^3) = 4578$ US gal

5 The available flood area is equal to the room area minus the sum of the equipment footprint excluding the leaking vessel/MTU:

$A_C = 190\ ft^2$

6 The liner height is calculated as follows:

LH = flood volume/available flood area
$LH = V_{FL}/A_C$
$LH = 612/190 = 3.22$ ft

7 The minimum required liner height is the calculated liner height rounded up, or:

$LH_{min} = 3.3$ ft

5.14 Active Services Cell Melter No 2 (H-0302)

The area of the active services cell melter no 2 is 20 ft × 93 ft. This cell contains one MTU with the following vessel/MTU data:

Vessel/MTU	D Inside Diameter, ft	D_{Eq} Max Equip Diameter, ft	L_{T-T} Tangent to Tangent, ft	L_{OF} Overflow Nozzle Height, ft	Bottom Vessel Head	Top Vessel Head
HOP-WESP-00002	7	7.1	21.87	none	F&D	Flat

1 HOP-WESP-00002 Calculation

shell volume, $V_S = \pi/4\ D^2\ L_{T-T}$
$V_S = (\pi/4)\ (7)^2\ (21.87) = 842\ ft^3$

vessel head volume for F&D head
$V_{HD} = 0.0847\ D^3$
$V_{HD} = 0.0847\ (7)^3 = 29\ ft^3$

depth of vessel head for F&D head

$d = 0.162\ D$

$d = 0.162\ (7) = 1.13$ ft

total volume

$V_{TOT} = V_S + N\ V_{HD}$

$V_{TOT} = 842 + 1(29) = 871\ ft^3$

$V_{TOT} = 871\ ft^3\ (7.48\ gal/ft^3) = 6515$ US gal

maximum operating volume

Since the vessel has no overflow, thus assumed:

$V_{Max} = V_{TOT}$, ft^3

$V_{Max} = 871\ ft^3$

110 % of maximum operating volume

$V_{XMax} = 1.1\ V_{Max} = 1.1\ (871) = 958\ ft^3$

$V_{XMax} = 958\ ft^3\ (7.48\ gal/ft^3) = 7166$ US gal

vessel footprint or area

$A_{Eq} = (\pi/4)D_{Eq}^2 = (\pi/4)(7.1)^2 = 40\ ft^2$

2 Room area = WL = 20 ft (93 ft) = 1860 ft^2

3 Room is in a C5/R5 area therefore no fire water is required. Thus $V_{FW} = 0\ ft^3$.

4 The flood volume is the larger of the total volume or 110 % of the maximum operating volume of the largest vessel plus fire water. In addition, to account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Since V_{XMax} is larger than V_{TOT}:

$V_{FL} = 1.05\ (V_{XMax} + V_{FW}) = 1.05\ (958 + 0) = 1006\ ft^3$

$V_{FL} = 1006\ ft^3\ (7.48\ gal/ft^3) = 7525$ US gal

5 The available flood area is equal to the room area minus the sum of the equipment footprint excluding the leaking vessel/MTU, or:

$A_C = A_{Rm} - A_{Eq1} = A_{Rm}$

where, $A_{Eq1} = 0$

$A_C = 1860\ ft^2$

6 The liner height is calculated as follows:

LH = flood volume/available flood area

$LH = V_{FL}/A_C$

$LH = 1006/1860 = 0.54$ ft

7 The minimum required liner height is the calculated liner height rounded up, or:

$LH_{min} = 0.6$ ft

5.15 Active Services Cell Melter No 1 (H-0308)

The area of the active services cell melter no 1 is 20 ft × 93 ft. This cell contains one MTU with the following vessel/MTU data:

Vessel/MTU	D Inside Diameter, ft	D_{Eq} Max Equip Diameter, ft	L_{T-T} Tangent to Tangent, ft	L_{OF} Overflow Nozzle Height, ft	Bottom Vessel Head	Top Vessel Head
HOP-WESP-00001	7	7.1	21.87	none	F&D	Flat

1 HOP-WESP-00001 Calculation

shell volume, $V_S = \pi/4\ D^2\ L_{T-T}$

$V_S = (\pi/4)\ (7)^2\ (21.87) = 842\ ft^3$

vessel head volume for F&D head

$V_{HD} = 0.0847\ D^3$

$V_{HD} = 0.0847\ (7)^3 = 29\ ft^3$

depth of vessel head for F&D head

$d = 0.162\ D$

$d = 0.162\ (7) = 1.13$ ft

total volume

$V_{TOT} = V_S + N\ V_{HD}$

$V_{TOT} = 842 + 1(29) = 871\ ft^3$

$V_{TOT} = 871\ ft^3\ (7.48\ gal/ft^3) = 6515$ US gal

maximum operating volume

Since the vessel has no overflow:

$V_{Max} = V_{TOT}$, ft^3

$V_{Max} = 871\ ft^3$

110 % of maximum operating volume

$V_{XMax} = 1.1\ V_{Max} = 1.1\ (871) = 958\ ft^3$

$V_{XMax} = 958\ ft^3\ (7.48\ gal/ft^3) = 7166$ US gal

vessel footprint or area

$A_{Eq} = (\pi/4) D_{Eq}^2 = (\pi/4)(7.1)^2 = 40\ ft^2$

2 Room area = WL = 20 ft (93 ft) = 1860 ft^2

3 Room is in a C5/R5 area therefore no fire water is required. Thus $V_{FW} = 0\ ft^3$.

4 The flood volume is the larger of the total volume or 110 % of the maximum operating volume of the largest vessel plus fire water. In addition, to account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume. Since V_{XMax} is larger than V_{TOT}:

$$V_{FL} = 1.05\ (V_{XMax} + V_{FW}) = 1.05\ (958 + 0) = 1006\ ft^3$$
$$V_{FL} = 1006\ ft^3\ (7.48\ gal/ft^3) = 7525\ US\ gal$$

5 The available flood area is equal to the room area minus the sum of the equipment footprint excluding the leaking vessel/MTU, or:

$$A_C = A_{Rm} - A_{Eq1} = A_{Rm}$$

where $A_{Eq1} = 0$

$$A_C = 1860\ ft^2$$

6 The liner height is calculated as follows:

LH = flood volume/available flood area
$LH = V_{FL}/A_C$
LH = 1006/1860 = 0.54 ft

7 The minimum required liner height is the calculated liner height rounded up, or:

$$LH_{min} = 0.6\ ft$$

6 Summary

The summary of the minimum required liner height is as follows for each process cell.

Room	Vessel/MTU	Vessel Inside Diameter, ft	Vessel T-T length, ft	Flood Volume ft^3 (gal)	Room Size W ft × L ft (Area ft^2)	Available Flood Area [a], ft^2	Minimum Required Liner Height, ft
H-B005	HOP-VSL-00904	12	7.75	1535 (11,482)	14.8 × 17 (252)	252	6.1
H-B014 South	RLD-VSL-00007 RLD-VSL-00008 HCP-VSL-00001 HCP-VSL-00002	13 13 13.5 13.5	15.5 9.75 15.83 15.83	2816 (21,064)	18 ft × 64 (1152)	725	3.9
H-B014 North	RLD-VSL-00002	3.5	4	48 (359)	18 × 17 (306)	306	0.2
H-B021	HOP-VSL-00903	12	7.75	1535 (11,482)	14.8 × 17 (252)	252	6.1
H-B035	HDH-VSL-00002 HDH-VSL-00004 HDH-VSL-00003	2.5 2.5 7	16.75 16.75 17.0	752 (5625)	11 × 21.5 (237)	227	3.4

Room	Vessel/MTU	Vessel Inside Diameter, ft	Vessel T-T length, ft	Flood Volume ft^3 (gal)	Room Size W ft × L ft (Area ft^2)	Available Flood Area [a], ft^2	Minimum Required Liner Height, ft
H-B039A	HDH-VSL-00001	5.83	15.6	956 (7151)	23.3 × 34 + 11.3 × 49.3 (1349)	1349	0.8
H-B039B	HDH-VSL-00001	5.83	15.6	956 (7151)	23.3 × 34 + 11.3 × 49.3 (1349)	1349	0.8
H-0106 South	HFP-VSL-00005 w/ HFP-DMST-00003 HFP-VSL-00006 w/HFP-DMST-00004	11 11	9.5 9.5	1195 (8939)	14.75 x 30.5 - 3 x 6 - 1.67 x 7.5 (419)	315	3.8
H-0106 West	HOP-SCB-00002 HOP-HEME-00002A HOP-HEME-00002B	10 5.5 5.5	5.75 12.17 12.17	653 (4884)	13.08 x 30.58 - 8 x 1.5 (388)	340	2.0
H-0106 Central	HMP-MLTR-00002	Liner height is not calculated. The liner is provided to facilitate the containment of potential spills from jumpers and piping.					0.5
H-0117 South	HFP-VSL-00001 w/ HFP-DMST-00001 HFP-VSL-00002 w/ HFP-DMST-00002	11 11	9.5 9.5	1195 (8939)	14.75 x 30.5 - 3 x 6 - 1.67 x 7.5 (419)	315	3.8
H-0117 West	HOP-SCB-00001 HOP-HEME-00001A HOP-HEME-00001B	10 5.5 5.5	5.75 12.17 12.17	653 (4884)	13.08 x 30.58 - 8 x 1.5 (388)	340	2.0
H-0117 Central	HMP-MLTR-00001	Liner height is not calculated. The liner is provided to facilitate the containment of potential spills from jumpers and piping.					0.5
H-304A	HSH-TK-00002	6	18.17	612 (4578)	9.5 × 20 (190)	190	3.3
H-310A	HSH-TK-00001	6	18.17	612 (4578)	9.5 × 20 (190)	190	3.3
H-0302	HOP-WESP-00002	7	21.87	1006 (7525)	20 × 93 (1860)	1860	0.6
H-0308	HOP-WESP-00001	7	21.87	1006 (7525)	20 × 93 (1860)	1860	0.6

[a] Available flood area is equal to the room area minus the sum of the equipment footprint excluding the leaking vessel/MTU.

7 References

Project Documents

24590-HLW-P1-P01T-P0001, Rev 6, *HLW Vitrification Building General Arrangement (Permit) Plan at El −21 Ft -0 In.*

24590-HLW-P1-P01T-P0002, Rev 3, *HLW Vitrification Building General Arrangement (Permit) Plan at El 0 Ft -0 In.*

24590-HLW-P1-P01T-P0004, Rev 0, *HLW Vitrification Building General Arrangement (Permit) Plan at El 37 Ft -0 In.*

24590-HLW-P1-P01T-P0008, Rev 7, *HLW Vitrification Building General Arrangement (Permit) Sections A-A, B-B, & C-C.*

24590-HLW-P1-P01T-P0009, Rev 6, *HLW Vitrification Building General Arrangement (Permit) Sections D-D, E-E & F-F.*

24590-HLW-P1-P01T-P0010, Rev 6, *HLW Vitrification Building General Arrangement (Permit) Sections G-G & H-H.*

24590-HLW-P1-P01T-P0011, Rev 7, *HLW Vitrification Building General Arrangement (Permit) Sections J-J & K-K.*

Other Documents

Puchovsky M. 1999. *Automatic Sprinkler System Handbook.* National Fire Protection Association.

Moss D. 1987. *Process Vessel Design Manual.* Gulf Publishing Co.

Avallone, Eugene A. and Baumeister III, Theodore. *"Marks' Handbook for Mechanical Engineer"*, 9th Edition, McGraw-Hill Book Company

Attachment 51 – Appendix 10.9
High Level Waste Building
Material Selection Documentation

Where information regarding treatment, management, and disposal of the radioactive source, byproduct material, and/or special nuclear components of mixed waste (as defined by the Atomic Energy Act of 1954, as amended) has been incorporated into this permit, it is not incorporated for the purpose of regulating the radiation hazards of such components under the authority of this permit and chapter 70.105 RCW. In the event of any conflict between Permit Condition III.10.A. and any statement relating to the regulation of source, special nuclear, and byproduct material contained in portions of the permit application that are incorporated into this permit, Permit Condition III.10.A. will prevail.

Additional appendices will be added to this appendix as new information is incorporated into this permit.

Drawings and Documents

Attachment 51 – Appendix 10.9
High Level Waste Building
Material Selection Documentation

The following drawings have been incorporated into Appendix 10.9 and can be viewed at the Ecology Richland Office. See Appendix 7.9 for material selection documentation common to the Pretreatment, LAW, HLW, and Laboratory buildings. **New drawings are in bold lettering**.

Drawing/Document	**Description**
24590-HLW-N1D-HDH-P0003, Rev 1	Material Selection Data Sheet for HDH-VSL-00002/4
24590-HLW-N1D-HDH-P0005, Rev 1	Material Selection Data Sheet for HDH-VSL-00003
24590-HLW-N1D-HDH-P0007, Rev 1	Material Selection Data Sheet for HDH-VSL-00001
24590-HLW-N1D-HMP-P0001, Rev 0	Material Selection Data Sheet for HLW HMP-MLTR-00001 & 2
24590-HLW-N1D-HOP-P0001, Rev 0	Material Data Sheet for HOP-HX-00002/4
24590-HLW-N1D-HOP-P0002, Rev 0	Selection Data Sheet for HOP-WESP-00001/2
24590-HLW-N1D-HOP-P0003, Rev 0	Material Selection Data Sheet for HOP-ADBR-00001A/1B/2A/2B
24590-HLW-N1D-HOP-P0004, Rev 1	Material Selection Data Sheet for HOP-SCO-00001/4
24590-HLW-N1D-HOP-P0005, Rev 1	Material Selection Data Sheet for HOP-SCR-00001/2
24590-HLW-N1D-HOP-P0006, Rev 1	Material Selection Data Sheet for HOP-ABS-00002/3
24590-HLW-N1D-HOP-P0007, Rev 0	Material Data Sheet for HOP-HX-00002/4
24590-HLW-N1D-HOP-P0009, Rev 2	Material Selection Data Sheet for HOP-VSL-00903/4
24590-HLW-N1D-HOP-P0010, Rev 0	Material Selection Data Sheet for HOP-SCB-00001/2
24590-HLW-N1D-HSH-P0001, Rev 0	Material Selection Data Sheet for HSH-TK--00001/2
24590-HLW-N1D-RLD-P0001, Rev 0	Material Selection Data Sheet for RLD-VSL-00007
24590-HLW-N1D-RLD-P0002, Rev 0	Material Selection Data Sheet for RLD-BRKPT-00007/9
24590-HLW-N1D-RLD-P0006, Rev 0	Material Selection Data Sheet for RLD-VSL-00008
24590-HLW-N1D-RLD-P0009, Rev 0	Material Selection Data Sheet for RLD-BRKPT-00004
24590-HLW-N1D-RLD-P0013, Rev 0	Material Selection Data Sheet for RLD-VSL-00002
RESERVED	RESERVED

PLANT ITEM MATERIAL SELECTION DATA SHEET

HDH-VSL-00002 & HDH-VSL-00004 (HLW)
Canister Decon Vessels

ISSUED BY
RPP-WTP PDC

R10592511

- Design Temperature (°F) (max/min): 225/40
- Design Pressure (psig) (internal/external): 15/atm
- Location: out cell

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on attached sheets 6 and 7

Operating Modes Considered:

- The tank is filled with the acidic decontamination solution at normal operating temperature.

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00		X
316L (S31603)	1.18		X
6% Mo (N08367/N08926)	7.64		X
Alloy 22 (N06022)	11.4		X
Ti-2 (R50400)	10.1	X	

Recommended Material: UNS R50400

Recommended Corrosion Allowance: 0.040 inch (includes 0.024 inch corrosion allowance and 0.004 inch erosion allowance)

Process & Operations Limitations:

None identified

STEVEN WAKEMAN VAIL
STATE OF WASHINGTON
39250
REGISTERED PROFESSIONAL ENGINEER

12/1/05

EXPIRES: 12/07/07

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

This bound document contains a total of 7 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
1	12/1/05	Issued for Permitting Use		HMK	SMVail
0	3/15/04	Issued for Permitting Use	DLA	JRD	APR

PLANT ITEM MATERIAL SELECTION DATA SHEET

Corrosion Considerations:

Canister decontamination vessels hold the filled canister and the ceric nitrate solution during decontamination. Heating and cooling coils are used to maintain the decontamination solution at 149 °F. After the decontamination solution is drained from the vessel, spray rings rinse the canister with nitric aid and demineralized water.

a General Corrosion
Corrosion rates of 304 stainless steel in Ce-IV/nitric acid solutions depend on temperature, nitric acid concentration, and cerium concentration, but are typically about 350 mpy. Thus, the neat solution is good for decontamination of stainless steel but cannot be stored in stainless steel containers.

There are no published data on the dissolution rate of Ti-2 by $Ce(NO_3)_4/HNO_3$ solutions. However, Craig (1989) states that Ti is very resistant to nitric acid except that in the 20-70% concentration range (maximum at 45%), the corrosion rate is relatively high. The use of about 12% acid minimizes this. Corrosion is inhibited by Ti^{+4}, Cr^{+6}, and Fe^{+3} ions as well as by other oxidizing ions. Ce^{+4} is not mentioned. However, it is expected to behave similarly.

Zirconium, according to Craig (1989), can crack in concentrated nitric acid, such as might be present in condensed vapors. Consequently, it is not more appealing than Ti.

West Valley Nuclear Services has not examined their Ti-2 vessel for corrosion. However, they do not believe it has been a problem. The reason Ti was selected was that it was recommended by Battelle-Northwest (PNNL). PNNL recommended it because electrodes used in several earlier studies were Ti and had not visibly degraded.

Conclusion:
Ti appears to be an acceptable alloy although there are no published data, or known unpublished data, on the topic. Based on an examination of the chemical and electrochemical behaviors of Ti alloys and Ce^{+4} solutions, no problem appears to exist.

b Pitting Corrosion
No data are available. Ti is resistant to pitting in chloride solutions although the effects of a highly oxidizing medium, such as Ce^{+4}, with chloride are unknown. However, in this system, there should be no chloride except for that brought over with any ^{137}Cs contamination. According to Meigs (2000), this should amount only to 0.13 Ci of ^{137}Cs, equivalent to about 1.5 mg of Cs and therefore 0.4 mg of chloride. With approximately 800 L of solution, the chloride is expected to be about 0.5 ppb.

Pitting of the canister is not expected to be a concern because of the low chloride concentration, the high nitrate concentration, and the high general corrosion rate.

Conclusion:
Pitting of the canister is not considered a problem as long as the 304L meets specifications. Pitting of the Decontamination Vessel is not a concern.

c End Grain Corrosion
No published data, but not expected to be a concern.

Conclusion:
Not likely in this system.

d Stress Corrosion Cracking
Cracking of the canister is not a concern at the stated conditions because there is too much nitrate, too little chloride, and the uniform corrosion rate is too high. Work by Mackey (2000) showed post-decontamination cracking of the canister is not a concern.

No reports of cracking of Ti in this environment are known.

Conclusion:
Ti-2 is acceptable.

PLANT ITEM MATERIAL SELECTION DATA SHEET

e Crevice Corrosion
See Pitting.

Conclusion:
See Pitting.

f Corrosion at Welds
West Valley reports no problems. Proper welding techniques will be required (H_2, O_2, or N_2 shall not be present in the welding cover gas).

Conclusion:
Weld corrosion is not considered a problem.

g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions are not conducive to microbial growth.

Conclusion:
MIC is not considered a problem.

h Fatigue/Corrosion Fatigue
Corrosion fatigue is not expected to be a problem except possibly in the coils and their entry point into the vessel – these lines will be used alternately for heating and cooling the acid and will undergo severe stresses. Design and material will accommodate this.

Conclusions
Proper design and material choice mitigates this concern.

i Vapor Phase Corrosion
West Valley has encountered no problems.

Conclusion:
Not expected to be a concern.

j Erosion
Velocities are expected to be low. Erosion allowance of 0.004 inch for components with low solids content (< 2 wt%) at low velocities is based on 24590-WTP-RPT-M-04-0008.

Conclusion:
Not expected to be a concern.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
No contacting surfaces expected.

Conclusion:
Not applicable.

m Galvanic Corrosion
The canister is expected to be anodic relative to the vessel. The canister is purposely being corroded and so this state is acceptable. It is unknown whether hydrogen will be generated at the Ti surface. Because of the strong oxidizing nature of the solution, hydrogen, if present, is not expected to survive long enough to diffuse into the Ti.

Conclusion:
The hydrogen generation rate at the Ti-2 surface is not expected to be a concern.

PLANT ITEM MATERIAL SELECTION DATA SHEET

n Cavitation
None expected.

Conclusion:
Not believed to be of concern.

o Creep
The temperatures are too low to be a concern.

Conclusion:
Not applicable.

p Inadvertent Addition of Nitric Acid
Vessels normally contain nitric acid and operate at a low pH.

Conclusion:
Not applicable.

PLANT ITEM MATERIAL SELECTION DATA SHEET

References:

1. 24590-WTP-RPT-M-04-0008, Rev. 2, *Evaluation Of Stainless Steel Wear Rates In WTP Waste Streams At Low Velocities*
2. 24590-WTP-RPT-PR-04-0001, Rev. B, *WTP Process Corrosion Data*
3. Craig, BD, Editor, 1989, *Handbook of Corrosion Data*, ASM International, Metals Park, OH 44073
4. Mackey, DB, Personal communication to JR Divine, 24 March, 2000
5. Meigs, R, Personal communication: to D E Larson, 22 March 2000, amount of soluble Cs on the canister.

Bibliography:

1. Bray, LA, 1988, *Development of a Chemical Process Using Nitric Acid-Cerium (IV) for Decontamination of High-Level Waste Canisters*, Battelle, Pacific Northwest Laboratory, Richland, WA 99352
2. Bray, LA, MR Elmore, KJ Carson, RJ Elovich, GM Richardson, and LD Anderson, 1992, *Decontamination Testing of Radioactive-Contaminated Stainless Steel Coupons Using a Ce(IV) Solution*, Battelle, Pacific Northwest Laboratory, Richland, WA 99352
3. Bray, LA and JR Divine Telecon, March 2000

PLANT ITEM MATERIAL SELECTION DATA SHEET

24590-WTP-RPT-PR-04-0001, Rev. B
WTP Process Corrosion Data

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Canister decon vessel (HDH-VSL-00002, HDH-VSL-00004)

Facility HLW

In Black Cell? No

Chemicals	Unit[1]	Contract Maximum		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l	1.15E-03	1.92E-03			
Chloride	g/l					
Fluoride	g/l					
Iron	g/l	7.39E-01	7.37E-01			
Nitrate	g/l	2.42E+02	2.42E+02			
Nitrite	g/l					
Phosphate	g/l					
Sulfate	g/l					
Mercury	g/l					
Carbonate	g/l					
Undissolved solids	wt %	5.45E-02	5.45E-02			
Other (Pb)	g/l	2.23E-04	1.69E-04			
Other(Cerium)	g/l	6.81E+01	6.81E+01			
pH	N/A					Note 3
Temperature	°F					Note 2

List of Organic Species:

References

System Description: 24590-HLW-3YD-HDH-00001, Rev 0
Mass Balance Document: 24590-WTP-M4C-V11T-00005, Rev A
Normal Input Stream #: HDH01, HDH05, HDH03, NAR21A/B
Off Normal Input Stream # (e.g., overflow from other vessels):
P&ID: 24590-HLW-M6-HDH-00001, Rev 1
PFD: 24590-HLW-M5-V17T-00006, Rev 4
Technical Reports:

Notes:

1. Concentrations less than 1x 10^{-4} g/l do not need to be reported; list values to two significant digits max.
2. Tmin 40 °F, Tnorm 149 °F, Tmax 225 °F (24590-HLW-MVD-HDH-00006, Rev 1)
3. Approximately pH 0 to 0.5 (24590-HLW-M4C-HDH-00001, Rev A).

Assumptions

5.2.4 Canister Decontamination Vessel (HDH-VSL-00002, HDH-VSL-00004)

Routine Operations

The canister decontamination vessel is used to hold the filled canister and ceric nitrate solution during the decontamination process. High-pressure steam at 343 °F is supplied to raise the solution temperature from 68 °F to 149 °F and is held at 149 °F for 6 hours during the decontamination process. Heating and cooling coils maintain the temperature of the liquid at 149 °F. The nitric acid solution is drained from the vessel. Spray rings will rinse the canister with nitric acid and demineralized water. The canister is then removed from the vessel.

Non-Routine Operations that Could Affect Corrosion/Erosion

None identified.

R10630666

PLANT ITEM MATERIAL SELECTION DATA SHEET

ISSUED BY
RPP-WTP PDC

HDH-VSL-00003 (HLW)
Waste Neutralization Vessel

- Design Temperature (°F) (max/min): 237/16
- Design Pressure (psig) (max/min): 15/FV
- Location: out cell

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on sheets 5 and 6

Operating Modes Considered:

- The vessel is filled with the acidic decontamination solution at normal operating temperature.
- The vessel reaches a maximum operating temperature of 212°F.
- Off-normal conditions assume that raw ceric nitrate is accidentally sent to HDH-VSL-00002 and recovery involves transferring the $Ce(NO_3)_4$ into HDH-VSL-00003 for neutralization.

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00	X	
316L (S31603)	1.18		X
6% Mo (N08367/N08926)	7.64		X
Alloy 22 (N06022)	11.4		X
Ti-2 (R50400)	10.1		X

Recommended Material: 304 (max 0.030% C; dual certified)

Recommended Corrosion Allowance: 0.04 inch (includes 0.024 inch corrosion allowance and 0.016 inch erosion allowance)

Process & Operations Limitations:

- H_2O_2 must be present prior to or be introduced concurrently with the decontamination waste from HDH-VSL-00002.

STEVEN WAKEMAN VAIL
STATE OF WASHINGTON
39250
REGISTERED PROFESSIONAL ENGINEER
EXPIRES: 12/07/05

9/15/05

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

This bound document contains a total of 6 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
1	9/15/05	Issued for Permitting Use			
0	3/19/04	Issued For Permitting Use	DLA	JRD	SWV

PLANT ITEM MATERIAL SELECTION DATA SHEET

Corrosion Considerations:

This vessel is a holding point for the neutralization of the spent decontamination solution, steam condensate, nitric acid and demineralized water rinses from the canister decontamination vessel as well as rinse water from HDH-VSL-00001 prior to transfer to the PT facility.

a General Corrosion
During normal operation, the cerium IV will mostly be consumed in the canister decon vessel and what is not will be rapidly destroyed by the peroxide in the neutralization vessel. Under these circumstances, 304L would be a suitable vessel material. Corrosion rates of 304 stainless steel in Ce-IV/nitric acid solutions depend on temperature, nitric acid concentration, and cerium concentration, but are typically about 350 mpy. Thus, the solution containing Ce^{+4} is good for decontamination of stainless steel and therefore cannot be stored in stainless steel containers. If it were assumed that 1% of the Ce^{+4} remains when the solution reaches HDH-VSL-00003 and it is present for 40 years corroding stainless steel, then a stainless vessel would suffer about a 3 mpy corrosion rate or about 120 mil. However, because the Ce IV is diluted in the 304L vessel and rapidly neutralized, little corrosion is expected.

It is estimated that if an unused, undiluted batch of Ce IV is put into the 304L vessel and not neutralized twice a year, very little vessel corrosion would occur. According to Bray (1988, 1992), the amount of Ce^{+4} in a given batch is sufficient to remove less than 10 μm of stainless steel. If this occurs twice a year for 40 years, then about 800 μm (32 mil) would be consumed. This is less than the recommended corrosion allowance of 40 mils. Therefore, 304L is satisfactory.

According to Davis (1987), acid peroxide solutions corrode Ti-2 at rates of up to 30 mpy. Leaks of acid peroxide into a Ti-2 vessel would be deleterious.

Conclusion:
Based on relative corrosion rates and the worse case operating conditions, 304L or 316L can be used.

b Pitting Corrosion
In this system, there should be no chloride except for that brought over with any ^{137}Cs contamination. This should amount only to 0.13 Ci of ^{137}Cs, equivalent to about 1.5 mg of Cs and therefore 0.4 mg of chloride. With approximately 800 L of solution, the chloride is expected to be about 0.5 ppb.

Pitting of 304L is not expected to be a concern because of the low chloride concentration and the high nitrate concentration.

Conclusion:
Pitting of 304L is not considered a problem with the proposed solution.

c End Grain Corrosion
No published data, but not expected to be a concern. 304L stainless steel is acceptable for the vessel and no attack is expected.

Conclusion:
Not likely in this system.

d Stress Corrosion Cracking
Cracking is not a concern at the stated conditions; there is too much nitrate and too little chloride. It has been shown that post-decontamination cracking of the canister is not a concern and this vessel sees similar conditions. Therefore, 304L is suitable.

Conclusion:
304L is acceptable.

e Crevice Corrosion
See Pitting.

Conclusion:
See Pitting

f Corrosion at Welds
None anticipated.

Conclusion:
Weld corrosion is not considered a problem.

PLANT ITEM MATERIAL SELECTION DATA SHEET

g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions are not conducive to microbial growth.

Conclusion:
MIC is not considered a problem.

h Fatigue/Corrosion Fatigue
Corrosion fatigue is not expected to be a problem.

Conclusions
Not a problem.

i Vapor Phase Corrosion
Not expected to be a problem.

Conclusion:
Not expected to be a problem.

j Erosion
Velocities within the vessel are expected to be small. A general erosion allowance of 0.016 inch is adequate for components with solids content less than 27.3 wt%.

Conclusion:
Not expected to be a concern.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
No contacting surfaces expected.

Conclusion:
Not applicable.

m Galvanic Corrosion
Not a problem.

Conclusion:
Not a problem.

n Cavitation
None expected.

Conclusion:
Not a concern.

o Creep
The temperatures are too low to be a concern.

Conclusion:
Not applicable.

p Inadvertent Addition of Nitric Acid
Vessel receives nitric acid during normal operations.

Conclusion:
Not applicable.

PLANT ITEM MATERIAL SELECTION DATA SHEET

References:

1. 24590-WTP-RPT-M-04-0008, Rev. 2, *Evaluation Of Stainless Steel Wear Rates In WTP Waste Streams At Low Velocities*
2. 24590-WTP-RPT-PR-04-0001, Rev. B, *WTP Process Corrosion Data*
3. Bray , LA, 1988, *Development of a Chemical Process Using Nitric Acid-Cerium (IV) for Decontamination of High-Level Waste Canisters,* Battelle, Pacific Northwest Laboratory, Richland, WA 99352
4. Bray, LA, MR Elmore, KJ Carson, RJ Elovich, GM Richardson, and LD Anderson, 1992, *Decontamination Testing of Radioactive-Contaminated Stainless Steel Coupons Using a Ce(IV) Solution*, Battelle, Pacific Northwest Laboratory, Richland, WA 99352
5. Davis, JR (Ed), 1987, *Corrosion, Vol 13,* In "Metals Handbook", ASM International, Metals Park, OH 44073
6. Mackey, DB Personal communication to JR Divine, 24 March, 2000
7. Meigs, R, Personal communication to D E Larson, 22 March 2000, amount of soluble Cs on the canister.

Bibliography:

1. Craig, BD, Editor, 1989, *Handbook of Corrosion Data*, ASM International, Metals Park, OH 44073
2. Davis, JR (Ed), 1994, *Stainless Steels*, In ASM Metals Handbook, ASM International, Metals Park, OH 44073

PLANT ITEM MATERIAL SELECTION DATA SHEET

OPERATING CONDITIONS

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Waste neutralization vessel (HDH-VSL-00003)

Facility HLW

In Black Cell? No

Chemicals	Unit[1]	Contract Maximum		Non-Routine (Note 5)		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l	1.12E-03	1.87E-03	1.15E-03	1.92E-03	
Chloride	g/l					
Fluoride	g/l					
Iron	g/l	7.18E-01	7.16E-01	7.39E-01	7.37E-01	
Nitrate	g/l	7.64E+01	7.64E+01	2.42E+02	2.42E+02	
Nitrite	g/l					
Phosphate	g/l					
Sulfate	g/l					
Mercury	g/l					
Carbonate	g/l					
Undissolved solids	wt %	0.70%	0.70%	5.45%	5.45%	
Other (H2O2)	g/l	3.14E+02	3.14E+02	2.23E-04	1.69E-04	Note 2
Other (Cerium)	g/l	6.22E+00	6.22E+00	6.81E+01	6.81E+01	Note 3
pH	N/A					
Temperature	°F					Note 4
						Note 5

List of Organic Species:

Notes:

1. Concentrations less than 1x 10^{-4} g/l do not need to be reported; list values to two significant digits max.
2. 30 wt% hydrogen peroxide is added as a reagent to deactivate cerium nitrate.
3. HDH-VSL-00002/4 overflow to this vessel and contain cerium nitrate, nitric acid.
4. Tmin 59 °F (BOD), Tnorm 113 °F.
5. HDH-VSL-00002 and HDH-VSL-00004 overflow to this vessel .

Assumptions

PLANT ITEM MATERIAL SELECTION DATA SHEET

5.2.5 Waste Neutralization Vessel (HDH-VSL-00003)

Routine Operations

The waste neutralization vessel (HDH-VSL-00003) is used as a holding point for the neutralization of the spent decontamination solution from the canister decontamination vessel, steam condensate, nitric acid and demineralized water rinses from the canister decontamination vessel, steam jet dilution, and wash water from the rinse tunnel canister rinse vessel (HDH-VSL-00001) prior to transfer to the PT facility. The waste neutralization vessel is equipped with service piping for demineralized water and process air, ventilation, level, temperature, and pressure transmitters, three steam ejectors (dual ejectors to the RLD-VSL-00007 and one to completely empty the waste neutralization vessel to the plant wash and drains vessel (RLD-VSL-00008), an overflow line, nozzles for the canister decontamination vessel's overflow and steam condensate, effluents from the canister decontamination vessels (HDH-VSL-00002/4) and rinse tunnel canister rinse vessel (HDH-VSL-00001), hydrogen peroxide and NaOH addition.

Non-Routine Operations that Could Affect Corrosion/Erosion

- HDH-VSL-00002 overflows to this vessel.
- HDH-VSL-00004 overflows to this vessel.

PLANT ITEM MATERIAL SELECTION DATA SHEET

R10633654

HDH-VSL-00001 (HLW)
Rinse Tunnel Canister Rinse Vessel

ISSUED BY
RPP-WTP PDC

- Design Temperature (°F) (max/min): 212/50
- Design Pressure (psig) (internal/external): 10/atm
- Location: out cell

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on sheets 5 and 6

Small amounts of chloride, fluoride, and sulfate are expected to be on the canister surface. The material dissolved in the wash must be kept dilute and no evaporation allowed.

Assumptions:
Surfaces will be kept clean. Vessel will be rinsed with DIW and drained dry. It is assumed that no solids will accumulate.

Operating Modes Considered:
- The vessel contains a canister and is sprayed with water at the normal operating temperature.

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00		X
316L (S31603)	1.18	X	
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1	X	

Recommended Material: 316 (max 0.030% C; dual certified)

Recommended Corrosion Allowance: 0.040 inch (includes 0.024 inch corrosion allowance and 0.004 inch erosion allowance)

Process & Operations Limitations:
- Develop procedure for water flushing and rinsing.

STEVEN WAKEMAN VAIL
STATE OF WASHINGTON
39250
REGISTERED PROFESSIONAL ENGINEER
EXPIRES: 12/07/05

10/10/05

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

This bound document contains a total of 6 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
1	10/10/05	Issued for Permitting Use			
0	3/15/04	Issued for Permitting Use	DLA	JRD	APR

PLANT ITEM MATERIAL SELECTION DATA SHEET

Corrosion Considerations:

The filled canister is placed in the HDH-VSL-00001 after lid-closure. While in the rinse vessel, the canister is sprayed with DIW to remove loose contamination from the canister.

a General Corrosion
The uniform corrosion rate of the 300 series stainless steels in DIW at temperatures up to about boiling are generally considered small, <1 mpy.

Conclusion:
304L or 316L are acceptable for this system.

b Pitting Corrosion
Chloride is notorious for causing pitting of stainless steel type alloys in neutral solutions. The pH in this vessel is near neutral but no reportable quantities of halides will be present. Pitting is unlikely unless the solution is stagnant or the halides are allowed to concentrate by evaporation.

Conclusion:
A clean vessel of 304L is expected to be satisfactory. Due to temperature and possible evaporation and associated build-up of solids, more pitting resistant alloys such as 316L are recommended.

c End Grain Corrosion
End grain corrosion only occurs in metal with exposed end grains and in highly oxidizing acid conditions.

Conclusion:
Not applicable to this system.

d Stress Corrosion Cracking
The exact amount of chloride required to stress corrosion crack stainless steel is unknown. In part this is because the amount varies with temperature, metal sensitization, the environment and because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even as little as 10 ppm can lead to cracking under some conditions. Generally, as seen in Sedriks (1996) and Davis (1994), stress corrosion cracking does not usually occur below about 140°F. Further, the use of "L" grade stainless reduces the opportunity for sensitization and, therefore, the likelihood of cracking.

Conclusion:
The use of 304L and 316L are expected to be acceptable with 316L marginally better.

e Crevice Corrosion
The comments on Pitting are equally valid here.

Conclusion:
The Pitting conclusions are applicable.

f Corrosion at Welds
Weld corrosion is not considered a problem in the proposed environment.

Conclusion:
Weld corrosion is not considered a problem for this system.

g Microbiologically Induced Corrosion (MIC)
MIC is commonly observed at the expected pH and temperature conditions. It is less likely because of the use of DIW. If the system is dried, the high radiation field is expected to prevent MIC.

Conclusion:
MIC is not considered a problem.

PLANT ITEM MATERIAL SELECTION DATA SHEET

h Fatigue/Corrosion Fatigue
Corrosion fatigue is not a concern.

Conclusions
Not considered a problem

i Vapor Phase Corrosion
The vapor phase portion of the tank will be continually washed. Prevention of evaporation will minimize the opportunity for vapor phase corrosion.

Conclusion:
No vapor phase corrosion is anticipated.

j Erosion
Velocities are expected to be low. Erosion allowance of 0.004 inch for components with low solids content (< 2 wt%) at low velocities is based on 24590-WTP-RPT-M-04-0008.

Conclusion:
Not expected to be a concern.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
Not applicable.

Conclusion:
Not applicable.

m Galvanic Corrosion
Not applicable.

Conclusion:
Not applicable.

n Cavitation
Not applicable.

Conclusion:
Not applicable.

o Creep
Not applicable.

Conclusion:
Not applicable.

p Inadvertent Addition of Nitric Acid
Higher chloride contents and higher temperatures usually require higher alloy materials. Nitrate ions inhibit the pitting and crevice corrosion of stainless alloys. Furthermore, nitric acid passivates these alloys; therefore, lower pH values brought about by increases in the nitric acid content of process fluid will not cause higher corrosion rates for these alloys. The upset condition that was most likely to occur is lowering of the pH of the vessel content by inadvertent addition of 1 M nitric acid. Lowering of pH may make a chloride-containing solution more likely to cause pitting of stainless alloys. Increasing the nitric acid content of the process fluid adds more of the pitting-inhibiting nitrate ion to the process fluid. In addition, adding the nitric acid solution to the stream will dilute the chloride content of the process fluid. In the case of HDH-VSL-00001, there is no reportable chloride concentration, so lowering the pH from neutral to acidic would not be a concern.

Conclusion:
The recommended materials will be able to withstand a plausible inadvertent addition of 1 M nitric acid.

PLANT ITEM MATERIAL SELECTION DATA SHEET

References:

1. 24590-WTP-RPT-M-04-0008, Rev. 2, *Evaluation Of Stainless Steel Wear Rates In WTP Waste Streams At Low Velocities*
2. 24590-WTP-RPT-PR-04-0001, Rev. B, *WTP Process Corrosion Data*
3. Davis, JR, 1994, *Stainless Steels*, In ASM Metals Handbook, ASM International, Metals Park, OH 44073
4. Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., New York, NY 10158

Bibliography:

1. Hamner, NE, 1981, *Corrosion Data Survey*, Metals Section, 5th Ed, NACE International, Houston, TX 77218
2. Jones, RH (Ed.), 1992, *Stress-Corrosion Cracking*, ASM International, Metals Park, OH 44073
3. Koch, GH, 1995, *Localized Corrosion in Halides Other Than Chlorides*, MTI Pub No. 41, Materials Technology Institute of the Chemical Process Industries, Inc., St Louis, MO 63141
4. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158
5. Van Delinder, LS (Ed), 1984, *Corrosion Basics*, NACE International, Houston, TX 77084

PLANT ITEM MATERIAL SELECTION DATA SHEET

OPERATING CONDITIONS

24590-WTP-RPT-PR-04-0001, Rev. B
WTP Process Corrosion Data

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Rinse tunnel canister rinse vessel (HDH-VSL-00001)

Facility HLW

In Black Cell? No

Chemicals	Unit[1]	Contract Maximum		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l					
Chloride	g/l					
Fluoride	g/l					
Iron	g/l					
Nitrate	g/l					
Nitrite	g/l					
Phosphate	g/l					
Sulfate	g/l					
Mercury	g/l					
Carbonate	g/l					
Undissolved solids	wt %					
Other (NaMnO4, Pb,...)	g/l					
Other	g/l					
pH	N/A					Note 3
Temperature	°F					Note 2

List of Organic Species:

References

System Description: 24590-HLW-3YD-HDH-00001, Rev 0
Mass Balance Document: 24590-WTP-M4C-V11T-00005, Rev A
Normal Input Stream # : HDH13, HDHXX (canister soluble solids)
Off Normal Input Stream # (e.g., overflow from other vessels): N/A
P&ID: 24590-HLW-M6-HDH-00002, Rev 1
PFD: 24590-HLW-M5-V17T-00006, Rev 4
Technical Reports:

Notes:

1. Concentrations less than 1x 10^{-4} g/l do not need to be reported; list values to two significant digits max.
2. Tmin 50 °F, Tnorm 68 °F, Tmax 212 °F (24590-HLW-MVD-HDH-00009, Rev 0)
3. Average will be pH 7

Assumptions

PLANT ITEM MATERIAL SELECTION DATA SHEET

5.2.3 Rinse Tunnel Canister Rinse Vessel (HDH-VSL-00001)

Routine Operations

The rinse tunnel canister rinse vessel (HDH-VSL-00001) is located on the rinse bogie in the canister rinse bogie tunnel. The rinse tunnel canister rinse vessel is used for transporting and washing the filled canisters. The water rinse cleans loose contamination from the canister to keep the decontamination cave as clean as possible. The rinse tunnel canister rinse vessel has the bogie decon canister pump running during the batch transfers so that the batch is pumped out as the batch is added in. Therefore, the rinse tunnel canister rinse vessel is not required to hold the entire batch volume of demineralized water during normal operations. The rinse tunnel canister rinse vessel is equipped with service piping for demineralized water, a spray ring assembly that rinses the entire canister, level transmitter and a level switch, a pump suction line and centrifugal pump from the rinse tunnel canister rinse vessel (HDH-VSL-00001) to the waste neutralization vessel (HDH-VSL-00003), and a plant service air line for the inflatable seal.

Non-Routine Operations that Could Affect Corrosion/Erosion

None identified.

R10637293

24590-HLW-N1D-HMP-P0001
Rev. 0

PLANT ITEM MATERIAL SELECTION DATA SHEET

HMP-MLTR-00001 & 2 (HLW)
HLW Melter 1 & 2 Gas Barrier and Cooling Panels

- Design Temperature (°F) (gas barrier/cooling panels): 411/366
- Design Pressure (gas barrier/cooling panels): -100" wc/150 psig

ISSUED BY
RPP-WTP PDC

Contents of this documents are Dangerous Waste Permit affecting

Operating conditions are as stated on sheet 4

Materials Considered:

Material (UNS No.)	Acceptable Material	Unacceptable Material
Carbon Steel		X
304L (S30403)		X
316L (S31603)	X*	
6% Mo (N08367/N08926)		X
Alloy 276 (N10276)	X	
Alloy 22 (N06022)		X
Alloy 690 (N06690)	X	
Ti-2 (R50400)		X

Recommended Material: Containment: Alloy 690 and Alloy 276
Cooling panels within the gas barrier: Alloy 276

*316L is suitable for cooling panels located outside of the gas barrier only

Recommended Corrosion Allowance: 0.00 inch

Process & Operations Limitations:

- None

STEVEN WAKEMAN VAIL
STATE OF WASHINGTON
39250
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES: 12/07/05

10/28/05

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

This bound document contains a total of 4 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
0	10/28/05	Issue for Permitting Use			

PLANT ITEM MATERIAL SELECTION DATA SHEET

Corrosion Considerations:

The HLW melter is "encapsulated" in a mostly Hastelloy® C-276 outer shell with a lid of Inconel® 690, though some air in-leakage is permitted. Within the outer shell are cooling pads constructed of Hastelloy® C-276 (24590-101-TSA-W000-0010-418-01). There is no stainless steel or carbon steel within the gas barrier.

The operating temperatures for HLW components range from approximately 130 °F to 135 °F at the cooling pads to about 411 °F at the lid. The gas compositions for the HOP system are used as a conservative limit. Because the offgas from the melter contains about 27% water, condensation is feasible at these temperatures. The presence of NOx and SOx is expected to result in a condensate at the cooling panels with a pH ≤1.5; some chloride will be present along with fluoride.

a General Corrosion
At the lid temperature of 411 °F, the corrosion is expected to be less than that of the offgas line which is Inconel® 690 and operates at about 1200 °F.

At the cooling panels, the lower temperature and the relatively high chromium content of the alloys is expected to keep the general corrosion rate much less than 1 mpy.

Conclusion:
No significant corrosion is expected. Therefore, no massive loss of containment is expected.

b Pitting Corrosion
At the relatively low pH, estimated at approximately 1.5 in the condensed solution, the halide concentration, which is low in the gas phase, is expected to be relatively low. Nevertheless, there is some concern about the pitting of Inconel® 690 which has no molybdenum; the pitting rate is expected to be small (Special Metals 2002). The Hastelloy® C-276 is expected to be immune from pitting at these temperatures and conditions (Haynes Int'l 1987).

Conclusion:
There is some concern about the pitting of the Inconel® 690. There are no data available to give rates but it is expected that the liner will not have significant penetration in the five years of melter life.

c End Grain Corrosion
Acid concentrations are not sufficiently high to be a concern.

Conclusion:
Not a concern.

d Stress Corrosion Cracking
The high nickel content of the alloys is expected to minimize the probability of cracking.

Conclusion:
Not a significant concern.

e Crevice Corrosion
The concerns are similar to those noted in the pitting section. The main concern is whether there are crevices where condensate can collect.

Conclusion:
Same as the pitting conclusions.

f Corrosion at Welds
Corrosion at welds is not considered a problem in the proposed environment.

Conclusion:
Weld corrosion is not considered a problem under that anticipated operating conditions.

g Microbiologically Induced Corrosion (MIC)
Not a concern for the conditions and materials.

Conclusion:
Not a concern.

h Fatigue/Corrosion Fatigue
Thermal cycles should not be more than a few per day. Therefore, corrosion fatigue is not a concern.

Conclusions
Not a concern.

PLANT ITEM MATERIAL SELECTION DATA SHEET

i Vapor Phase Corrosion
Not a concern, as noted in the general corrosion section.

Conclusion:
Not a concern.

j Erosion
There is no fluid flow.

Conclusion:
Not a concern.

k Galling of Moving Surfaces
No moving surfaces are expected.

Conclusion:
Galling is not a concern.

l Fretting/Wear
No contacting surfaces expected.

Conclusion:
No fretting concern.

m Galvanic Corrosion
There is not a significant potential difference between the alloys.

Conclusion:
Not a concern

n Cavitation
There is no fluid flow.

Conclusion:
Not a concern.

o Creep
The temperatures are too low to have an effect.

Conclusion:
Not a concern.

P Inadvertent Addition of Nitric Acid
There is no practical method of adding nitric acid.

Conclusion:
Not a concern.

PLANT ITEM MATERIAL SELECTION DATA SHEET

References

1. 24590-101-TSA-W000-0010-418-01, *HLW Melter Materials Selection Report.*
2. CCN 120764, e-mail from M Hall to JR Divine, 24 March 2005, "Melter Materials and Operating Conditions."
3. Hastelloy® alloy C-276, 1987, Haynes International, Inc.
4. Inconel alloy 690, 2002, Publication Number SMC-079, Special Metals Corporation

Bibliography

1. Agarwal, DC, *Nickel and Nickel alloys*, In: Revie, WW, 2000. *Uhlig's Corrosion Handbook*, 2nd Edition, Wiley-Interscience, New York, NY 10158
2. Davis, JR (Ed), 1987, *Corrosion, Vol 13*, In "Metals Handbook", ASM International, Metals Park, OH 44073
3. Imrich, KJ, *Metallurgical Evaluation of an Inconel 690 Insert from a Radioactive Waste Glass Melter Pour Spout*, Westinghouse Savannah River Company, 1998.
4. Wright, IG, *High-Temperature Oxidation*, In: Davis, JR (Ed), 1987, *Corrosion, Vol 13*, In "Metals Handbook", ASM International, Metals Park, OH 44073

PLANT ITEM MATERIAL SELECTION DATA SHEET

OPERATING CONDITIONS

Materials Selection Data

Component (Name/ID) HMP-MLTR-00001&2 (note 1)
System HMP (HLW Melter Process System)

Chemicals	Unit	Normal Conditions	Maximum Flow Conditions
Oxygen	%	15	14.9
Chlorine	ppmv	trace	trace
Fluorine	ppmv	trace	trace
NO_x	ppmv	1230	6650
Sulfur Dioxide (SO_2)	ppmv	11	9
Ammonia (NH_3)	ppmv	181	436
Carbon Monoxide (CO)	ppmv	80	156
Carbon Dioxide	%	0.7	1.3
Particulate	ppmv	410	361
Hydrochloric Acid (HCl)	ppmv	3.5	26
Hydrofluoric Acid (HF)	ppmv	30	294
Water (H_2O)	%	27.7	27.2
Pressure	mbar	972	971
Temperature (Note 2)	°F		

Note 1: The compositions for the HOP system are used as a conservative limit.

Note 2: Cooling panel temperatures are expected to be the maximum average cooling water temperature. Operating temperature range for HLW panels is 130F to 135F. HLW maximum gas barrier temperature is 411°F at the lid (CCN120764).

PLANT ITEM MATERIAL SELECTION DATA SHEET

HOP-HEME-00001A/B & 2A/B (HLW)
Melter 1 & 2 High Efficiency Mist Eliminator (HEME)

- Design Temperature (°F)(max/min): 325/32
- Design Pressure (psig) (max/min): 15/FV
- Location: incell

ISSUED BY RPP-WTP PDC
INIT DATE

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on Sheet 5

Operating Modes Considered:

- The vessel is at pH < 2.5 at the normal operating temperature
- The vessel is at pH < 2.5 at boiling, ≈212°F
- The vessel cycles between wet conditions at 111°F and dry at 325°F

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00		X
316L (S31603)	1.18		X
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material: UNS N08367

Recommended Corrosion Allowance: 0.04 inch

Process & Operations Limitations:

- Develop a rinse/flush strategy
- Develop a lay-up procedure

STEVEN WAKEMAN VAIL
STATE OF WASHINGTON
39250
REGISTERED PROFESSIONAL ENGINEER
4/22/04
EXPIRES: 12/07/05

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

This bound document contains a total of 5 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
0	4/22/04	Issued for Permitting Use			

PLANT ITEM MATERIAL SELECTION DATA SHEET

Corrosion Considerations:

a General Corrosion
Hamner (1981) lists corrosion rates for 304 (and 304L) and 316 (and 316L) of less than about 1 mpy in dilute neutral salt solutions.

Conclusion:
The 300 series alloys are acceptable.

b Pitting Corrosion
Chloride is known to cause pitting in acid and neutral solutions. Normally the vessel is to operate at 111°F at a pH < 2.5. Berhardsson et al (1981) conclude 304L could be used, although 316L would provide additional safety. However, if the temperature can exceed 150°F, Phull et al (2000) imply that a 6% Mo alloy or the equivalent will be better even though the nominal halide concentrations are low. Allowing that the temperature can approach the design temperature and the vessel can cycle between wet and dry conditions, a more resistant alloy is required.

The presence of Hg in the waste stream suggests a 6% Mo with a low Cu content, such as AL6XN (UNS N08367), is preferred.

Conclusion:
A 6% Mo alloy is recommended.

c End Grain Corrosion
End grain corrosion only occurs in high acid conditions.

Conclusion:
Not expected in this system.

d Stress Corrosion Cracking
The exact amount of chloride required to cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, the environment, and also because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even as little as 10 ppm can lead to cracking under some conditions. The expected concentrations, about 1 ppm, at ambient temperature would not require anything more than 304L. However with the stated operating temperature, 316L is recommended. Because the HEME can be acid and cycle to dryness, a minimum of 6% Mo is recommended.

Conclusion:
With the stated conditions, a 6% Mo is recommended.

e Crevice Corrosion
See Pitting.

Conclusion:
See Pitting

f Corrosion at Welds
Weld corrosion is not expected to be a concern if proper welding procedures are followed.

Conclusion:
Not a concern.

PLANT ITEM MATERIAL SELECTION DATA SHEET

g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions are ideal for microbial growth – however food sources and sources of microbes are effectively non-existent.

Conclusion:
MIC is not considered a problem.

h Fatigue/Corrosion Fatigue
Corrosion fatigue not a problem because the 6% Mo alloy is sufficiently resistant for expected temperature cycles.

Conclusions
Not expected to be a concern

i Vapor Phase Corrosion
The vapor phase portion of the vessel is expected to be contacted with particles of waste from splashing. It is uncertain whether the region will be sufficiently washed to prevent solids deposits. A more pitting-resistant alloy such as a 6% Mo is recommended

Conclusion:
6% Mo alloy is recommended.

j Erosion
Velocities within the vessel are not expected to be a concern.

Conclusion:
Not expected to be a concern

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
No metal/metal contacting surfaces expected.

Conclusion:
Not a concern.

m Galvanic Corrosion
No dissimilar metals are present.

Conclusion:
Not a concern.

n Cavitation
None expected.

Conclusion:
Not a concern.

o Creep
The temperatures are too low to be a concern.

Conclusion:
Not applicable.

PLANT ITEM MATERIAL SELECTION DATA SHEET

References:

1. Berhardsson, S, R Mellstrom, and J Oredsson, 1981, *Properties of Two Highly corrosion Resistant Duplex Stainless Steels*, Paper 124, presented at Corrosion 81, NACE International, Houston, TX 77218
2. Hamner, NE, 1981, *Corrosion Data Survey*, Metals Section, 5th Ed, NACE International, Houston, TX 77218
3. Phull, BS, WL Mathay, & RW Ross, 2000, *Corrosion Resistance of Duplex and 4-6% Mo-Containing Stainless Steels in FGD Scrubber Absorber Slurry Environments*, Presented at Corrosion 2000, Orlando, FL, March 26-31, 2000, NACE International, Houston TX 77218.

Bibliography:

1. Davis, JR (Ed), 1987, *Corrosion, Vol 13*, In "Metals Handbook", ASM International, Metals Park, OH 44073
2. Davis, JR (Ed), 1994, *Stainless Steels*, In ASM Metals Handbook, ASM International, Metals Park, OH 44073
3. Jones, RH (Ed.), 1992, *Stress-Corrosion Cracking*, ASM International, Metals Park, OH 44073
4. Koch, GH, 1995, *Localized Corrosion in Halides Other Than Chlorides*, MTI Pub No. 41, Materials Technology Institute of the Chemical Process Industries, Inc, St Louis, MO 63141
5. Miles RE, 2001, Telecon to JR Divine, *LAW and HLW Gamma Radiation Exposures Estimates*, RPP-WTP, Richland, WA 99352
6. Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., New York, NY 10158
7. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158
8. Van Delinder, LS (Ed), 1984, *Corrosion Basics*, NACE International, Houston, TX 77084
9. Wilding, MW and BE Paige, 1976, *Survey on Corrosion of Metals and Alloys in Solutions Containing Nitric Acid*, ICP-1107, Idaho National Engineering Laboratory, Idaho Falls, ID

PLANT ITEM MATERIAL SELECTION DATA SHEET

OPERATING CONDITIONS

Material Selection Data Sheets for the HLW Vitrification Facility

Materials Selection Data

Component (Name/ID) High Efficiency Mist Eliminator HOP-HEME-00001A/B & 2A/B

System HLW-HOP

Operations

Chemicals	Unit	Cold Startup	Normal Operations	Contract Max.	Cleaning	Accident
		Note 1		Note 2	Note 3	Note 4
Aluminum	g/l		0.003			
Chloride	g/l		0.015			
Fluoride	g/l		0.015	1.1		
Iron	g/l					
Nitrate	g/l		0.0011			
Nitrite	g/l		0.0003			
Phosphate	g/l					
TOC*	g/l		0			
Sulfate	g/l		0.0003			
Undissolved solids	g/l		0.086			
Particle size/hardness	μm (##)					
Other ($NaMnO_4$, Hg, etc)	g/l		0.14	1.79 (Hg^{++})		
Carbonate	g/l		0			
pH	-		$\leq$ 2.5			
Dose rate, α, β/γ	Rad					
Temperature	°F		111.2			
Velocity	fps					
Vibration						
Time of exposure	#					

- % of total; ## - use Mho scale

Notes:
Note 1: Same as normal operation.
Note 2: Max. contract value mass balance, unreleased. Only values greater than normal operations are listed.
Note 3: H2O or $\leq$ 12.2M Nitric Acid for cleaning for 1 week for 5 yr for acid and 1 hr per year for water.
Solids are accumulated the same as those entering column dried on the HEME element.
Note 4: Assume same as normal operating conditions.

☐ Black Cell

☐ Flushing

* List expected organic species:
Use maximum of 2 significant figures

R10378686

PLANT ITEM MATERIAL SELECTION DATA SHEET

HOP-WESP-00001&2 (HLW)
MELTER 1 & 2 WET ELECTROSTATIC PRECIPITATOR (WESP)

- Design Temperature (°F)(max/min): 170/45
- Design Pressure (max/min): +1 atm/ -1 atm
- Location: out cell

ISSUED BY
RPP-WTP PDC

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on sheets 5 and 6

Operating Modes Considered:

- The vessel is acid, pH 2.4 to 2.6.
- Temperature up to 149 °F in the event the SBS loses cooling.

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00		X
316L (S31603)	1.18		X
6% Mo (N08367)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material: UNS N08367

Recommended Corrosion Allowance: 0.04 inch (includes 0.00 inch erosion allowance)

Process & Operations Limitations:

- Develop a rinse/flush strategy

MARK W. HOFFMANN
STATE OF WASHINGTON
0030952
REGISTERED
PROFESSIONAL ENGINEER
9/15/04
EXPIRES 12/10/04

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

This bound document contains a total of 6 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
	9/15/04				apkanagis
0		Issued for Permitting Use			

PLANT ITEM MATERIAL SELECTION DATA SHEET

Corrosion Considerations:

The WESP is used to collect radioactive aerosols from the SBS to extend the life of the downstream equipment filter media. Spray rings are provided above and below the internal tubes for vessel and tube flushing. Water and acid flushing capability can be used for WESP cleanout for decontamination and decommissioning. Acid flushing may be required non-routinely to prevent buildup of solids in the WESP.

a General Corrosion
At the stated concentrations and pH, the general corrosion rate is expected to be low, ≤ 1 mpy. In this system, during normal operation, either 304L or 316L would be acceptable.

Conclusion:
304L or 316L would be acceptable for the conditions stated.

b Pitting Corrosion
Chloride is known to cause pitting in acid and neutral solutions. Normally the vessel is to operate at 122°F at a pH of 2.4 to 2.6 but could approach pH 0 during acid flushing . Berhardsson et al (1981) conclude 304L or 316L could be used based on temperatures and concentrations. However, the temperature could approach 150 °F and data from Phull et al (2000) imply that with these conditions, a 6% Mo alloy or the equivalent will be needed during an off-normal event involving SBS cooling.

In addition, because of the high electrical potentials involved, the environment may be more oxidizing than is common. Consequently, a strongly pitting resistant alloy may be needed.

Further, there would be a tendency to pit if the vessel were filled with process water and left stagnant. The time to initiate would depend on the source of the water, being shorter for filtered river water and longer for DIW. Pitting has been observed in both cases, and is likely because residual chlorides are likely to remain. Pitting is less likely for the higher alloys such as a 6% Mo alloy.

Conclusion:
Based on the stated operating conditions, 316L is marginal and 6% Mo is recommended.

c End Grain Corrosion
End grain corrosion only occurs in high acid conditions.

Conclusion:
Not believed likely in this system.

d Stress Corrosion Cracking
The exact amount of chloride required to cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, the environment, and also because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even as little as 10 ppm can lead to cracking under some conditions. With the possible off-normal conditions and the tendency to concentrate salts, 6% Mo or better is recommended.

Conclusion:
For the normal stated operating environment, 316L is satisfactory. However, possible higher temperature off-normal conditions require a more resistant alloy.

e Crevice Corrosion
WESPs are known to accumulate solid deposits. Because the solids will probably contain halides, crevice corrosion will be likely. A 6% Mo is recommended. Also, see Pitting.

Conclusion:
A 6% Mo should be used.

f Corrosion at Welds
Corrosion at welds is not expected to be a concern.

Conclusion:
Not a concern.

g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions are not conducive to microbial growth – the average operating temperature is approximately correct but the pH is too acid. No process water is shown as entering the vessel.

Conclusion:
MIC is not considered a problem.

PLANT ITEM MATERIAL SELECTION DATA SHEET

h Fatigue/Corrosion Fatigue
Only minimal temperature cycling is expected. The presence of tubular internal components could be a concern but the vessel will be designed to accommodate any fatigue arising from the presence of the tubes during the design life of the equipment.

Conclusions
Not a concern.

i Vapor Phase Corrosion
The vapor phase portion of the vessel is expected to be contacted with particles of waste from splashing. Equipment is designed to allow the removal of solids as necessary.

Conclusion:
Not a concern.

j Erosion
Velocities within the vessel are relatively low.

Conclusion:
Not a concern.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
No metal/metal contacting surfaces expected.

Conclusion:
Not a concern.

m Galvanic Corrosion
No dissimilar metals are present.

Conclusion:
Not a concern.

n Cavitation
None expected.

Conclusion:
Not a concern.

o Creep
The temperatures are too low to be a concern.

Conclusion:
Not applicable.

p Inadvertent Addition of Nitric Acid
Equipment normally operates at a low pH and will be rinsed with nitric acid.

Conclusion:
Not applicable.

PLANT ITEM MATERIAL SELECTION DATA SHEET

References:

1 Berhardsson, S, R Mellstrom, and J Oredsson, 1981, *Properties of Two Highly corrosion Resistant Duplex Stainless Steels*, Paper 124, presented at Corrosion 81, NACE International, Houston, TX 77218
2. Phull, BS, WL Mathay, & RW Ross, 2000, *Corrosion Resistance of Duplex and 4-6% Mo-Containing Stainless Steels in FGD Scrubber Absorber Slurry Environments*, Presented at Corrosion 2000, Orlando, FL, March 26-31, 2000, NACE International, Houston TX 77218.

Bibliography:

1. Agarwal, DC, *Nickel and Nickel alloys*, In: Revie, WW, 2000. *Uhlig's Corrosion Handbook*, 2nd Edition, Wiley-Interscience, New York, NY 10158
2. Davis, JR (Ed), 1987, *Corrosion, Vol 13*, In "Metals Handbook", ASM International, Metals Park, OH 44073
3. Davis, JR (Ed), 1994, *Stainless Steels*, In ASM Metals Handbook, ASM International, Metals Park, OH 44073
4. Hamner, NE, 1981, *Corrosion Data Survey*, Metals Section, 5th Ed, NACE International, Houston, TX 77218
5. Jones, RH (Ed.), 1992, *Stress-Corrosion Cracking*, ASM International, Metals Park, OH 44073
6. Koch, GH, 1995, *Localized Corrosion in Halides Other Than Chlorides*, MTI Pub No. 41, Materials Technology Institute of the Chemical Process Industries, Inc, St Louis, MO 63141
7. Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., New York, NY 10158
8. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158
9. Van Delinder, LS (Ed), 1984, *Corrosion Basics*, NACE International, Houston, TX 77084

PLANT ITEM MATERIAL SELECTION DATA SHEET

OPERATING CONDITIONS

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Melter 1 & 2 wet electrostatic precipitators (HOP-WESP-00001, HOP-WESP-00002)

Facility HLW

In Black Cell? No

Chemicals	Unit[1]	Contract Maximum		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum Al+3	g/l	5.56E-04	6.85E-04			
Chloride	g/l	3.23E-02	4.23E-02			
Fluoride	g/l	1.37E-02	1.95E-02			
Iron	g/l	3.99E-03	2.21E-03			
Nitrate	g/l	1.52E-01	1.73E-01			
Nitrite	g/l					
Phosphate	g/l					
Sulfate	g/l					
Mercury Hg+3	g/l					
Carbonate	g/l					
Undissolved solids	wt %					
Other (NaMnO4, Pb,...)	g/l	9.2E-04	6.6E-04			
Other	g/l					
pH	N/A					Note 2
Temperature	°F					Note 3, Assumption 1

List of Organic Species:

Notes:

1. Concentrations less than 1x 10^{-4} g/l do not need to be reported; list values to two significant digits max
2. Average pH 2.4 to 2.6
3 T routine 122 °F (range not provided) condensate temperature

Assumptions

1. Temperature could rise as high as 149 °F in an off normal event involving SBS cooling

PLANT ITEM MATERIAL SELECTION DATA SHEET

5.4.10 Melter 1 and Melter 2 Wet Electrostatic Precipitators (HOP-WESP-00001, HOP-WESP-00002)

Routine Operations

A wet electrostatic precipitator (WESP) is a vessel assembly used to collect radioactive aerosols from the SBS to extend the life of downstream equipment filter media. The WESP internals consist of vertical tubes mounted on a tube sheet(s) connected to the vessel that serve as particle collection surfaces. Discharge rods extend from above each tube down through the tube center to the tube bottom. The discharge electrode array is supported by a conducting structure above the tubes and attached to the external power supply rods that extend through the pipes on the WESP top. Other WESP services such as gas inlet/outlet, demineralized flush water/nitric acid, instrumentation, and drains are provided through the vessel walls in the active services pipe area. Spray rings are provided in the vessel above and below the tubes for vessel and tube flushing. A gas flow distributor plate(s) is located below the tubes to ensure even gas flow through the tubes. The WESP drain is located in the vessel bottom and is routed to the SBS condensate receiver vessels (HOP-VSL-00903, HOP-VSL-00904). There is a remotely operated drain valve in the drain line located in the melter cave. The drain line is hydraulically sealed by the solution in the SBS condensate receiver vessel. The valve on the line is used to close the vessel for filling with nitric acid and flushing. Water and acid flushing capability can be used for WESP cleanout for decontamination and decommissioning. The offgas enters from the side, near the bottom of the vessel. A water atomizing nozzle is mounted on the gas inlet. The offgas flows through the distributor plate, through the tubes, and out through the outlet nozzle.

Non-Routine Operations that Could Affect Corrosion/Erosion

Acid flushing may be required periodically to prevent buildup of solids in the WESP.

R103786 85

PLANT ITEM MATERIAL SELECTION DATA SHEET

HOP-ADBR-00001A/B & 2A/B (HLW)
Activated Carbon Adsorber

- Design Temperature (°F): 275
- Design Pressure (in-WG): -82
- Location: outcell

ISSUED BY
RPP-WTP PDC

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on sheets 4 and 5

Options Considered:

- Equipment is maintainable.
- A preheater will be used to prevent condensation from forming in the activated carbon media during start-up or after replacement.

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00		X
316L (S31603)	1.18	X	
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material: 316 (max 0.030% C; dual certified)

Recommended Corrosion Allowance: NA

Process & Operations Limitations:

- None

MARK W. HOFFMANN
STATE OF WASHINGTON
0030952
REGISTERED
PROFESSIONAL ENGINEER
9/15/04
EXPIRES 12/10/04

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

This bound document contains a total of 5 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
0	9/15/04	Issued for Permitting Use			

PLANT ITEM MATERIAL SELECTION DATA SHEET

Corrosion Considerations:

The sulfur-impregnated activated carbon column removes volatile mercury compounds from the offgas at a mildly elevated temperature, 186 to 275 °F. During normal operation air atomized demineralized water is injected into the inlet piping to cool the offgas to operating temperature. The offgas humidity is maintained below 50 % relative such that the water does not condense in the column.

a General Corrosion
The anticipated dry-air conditions are not conductive to general corrosion and none is expected.

Conclusion
Either 304L or 316L would be satisfactory.

b Pitting Corrosion
Pitting corrosion will only be a concern if moisture is present. It is assumed that there will be no condensation in the unit. For safety, 316L is recommended.

Conclusion
At the stated operating conditions, pitting corrosion is not a significant concern. Recommend 316L.

c End Grain Corrosion
End grain corrosion only occurs in high acid conditions and is not a concern.

Conclusion:
Not a concern

d Stress Corrosion Cracking
At operations at the stated temperatures, stress corrosion cracking will only be a concern in the presence of moisture. It is assumed that there will be no condensation in the unit. Also see Pitting.

Conclusion
At the stated operating conditions, stress corrosion cracking is not a concern.

e Crevice Corrosion
Crevice corrosion will only be a concern if moisture is present. The offgas humidity is controlled so that there will be no condensation.

Conclusion
At the stated operating conditions, crevice corrosion is not a concern.

f Corrosion at Welds
Assuming dry air and proper welding procedures, corrosion at welds is not anticipated.

Conclusion
At the stated operating conditions, weld corrosion is not a concern.

g Microbiologically Induced Corrosion (MIC)
The stated operating conditions are not suitable for microbial growth.

Conclusion
At the stated operating conditions, MIC is not a concern.

h Fatigue/Corrosion Fatigue
Extreme temperature cycling or fluctuations are not expected.

Conclusion
At the expected operating conditions, corrosion fatigue is not a concern.

PLANT ITEM MATERIAL SELECTION DATA SHEET

i Vapor Phase Corrosion
Components essential consist entirely of vapor space so general corrosion comments apply.

Conclusion:
See comments under general corrosion.

j Erosion
The velocity and solids content are sufficiently low that erosion is not a concern.

Conclusion
Erosion is not a concern.

k Galling of Moving Surfaces
There are no unlubricated moving surfaces present.

Conclusion:
Galling is not a concern.

l Fretting/Wear
No metal/metal contacting surfaces are expected.

Conclusion:
Fretting is not a concern.

m Galvanic Corrosion
No significantly dissimilar metals are present nor is moisture assumed to be present.

Conclusion:
Galvanic corrosion is not a concern.

n Cavitation
Cavitation is not expected in an off-gas system

Conclusion:
Cavitation is not a concern.

o Creep
Stated operating temperatures are too low for creep to occur.

Conclusion
Creep is not a concern.

p. Inadvertent Addition of Nitric Acid
Addition of nitric acid to the offgas lines is not a plausible scenario.

Conclusion
Not applicable

PLANT ITEM MATERIAL SELECTION DATA SHEET

OPERATING CONDITIONS

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Activated carbon adsorber (HOP-ADBR-00001A/B, HOP-ADBR-00002A/B)

Facility HLW

In Black Cell? No

Chemicals	Unit[1]	Contract Maximum		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/m^3					
HCl	g/m^3					
HF	g/m^3		1.08E-04			
Iron	g/m^3					
NO	g/m^3	6.28E-01	6.52E-01			
NO2	g/m^3	1.71E-01	1.84E-01			
Phosphate	g/m^3					
SO2	g/m^3					
Mercury	g/m^3	2.50E-03	3.95E-03			
Carbonate	g/m^3					
Undissolved solids	wt %					
Other (NaMnO4, Pb,...)	g/m^3					
Other	g/m^3					
Humidity	%	41%	41%			
Temperature	°F					Note 2

List of Organic Species:

Notes:

1. Concentrations less than $1x\ 10^{-4}\ g/m^3$ do not need to be reported; list values to two significant digits max.
2. Tmin 186 °F, Tmax 250 °F.

Assumptions

PLANT ITEM MATERIAL SELECTION DATA SHEET

5.4.2 Activated Carbon Adsorber (HOP-ADBR-00001A/B, HOP-ADBR-00002A/B)

Routine Operations

The sulfur-impregnated activated carbon (AC) column removes volatile mercury compounds from the offgas at a mildly elevated temperature. The AC column consists of two sulfur-impregnated activated charcoal beds. Each bed is contained inside a vessel that is insulated. The piping and valving are arranged to operate the beds in series (normal), in parallel, or individually. Connections are provided on each vessel to load the AC through isolation valves from multiple lines using a manual gravity feed chute supplied from a feed hopper located above the vessel(s). Spent AC is removed from a bed by gravity draining through multiple line isolation valves and using a screw conveyor system to route the AC to a vessel for packaging. The second bed can continue operation during bed changeout. There is a system bypass line that can be manually activated. During normal operation air atomized demineralized water is injected into the inlet piping to cool the offgas to operating temperature. An automatically activated water deluge fire suppression system is provided for safety. The system is activated based on differential inlet to exit CO concentration. The offgas inlet isolation valve is automatically closed on system activation. A water overflow valve is automatically activated in each vessel in case of fire to prevent overfilling with water. A water drain system is also provided.

This equipment is operated at low humidity.

Non-Routine Operations that Could Affect Corrosion/Erosion

None identified.

R10378684

PLANT ITEM MATERIAL SELECTION DATA SHEET

HOP-SCO-00001 & HOP-SCO-00004 (HLW)
Thermal Catalytic Oxidizer

ISSUED BY
RPP-WTP PDC

- Inlet Temperature (°F) (nom/max): 330/330
- Operating Pressure (in-WG) (max/min): 80/-80
- Location: outcell

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on sheets 4 and 5

Operating Modes Considered:

- Assume off-normal conditions same as normal operations.

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00		X
316L (S31603)	1.18	X	
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material: 316 (max 0.030% C; dual certified)

Recommended Corrosion Allowance: 0.00 inch (includes 0.00 inch erosion allowance)

Process & Operations Limitations:

- None

MARK W. HOFFMANN
STATE OF WASHINGTON
0030952
REGISTERED PROFESSIONAL ENGINEER
9/15/04
EXPIRES 12/10/04

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

This bound document contains a total of 5 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
1	9/15/04	Issued for Permitting Use			
0	9/24/02	Issued For Permitting Use	DLA	JRD	MHoffmann

PLANT ITEM MATERIAL SELECTION DATA SHEET

Corrosion Considerations:

The thermal catalytic oxidizers oxidize organics to carbon dioxide, water, and possibly acid gases. The equipment operates at low relative humidity.

a General Corrosion
None anticipated.

Conclusion
304L is satisfactory.

b Pitting Corrosion
Pitting corrosion will only be a concern if column is allowed to cool with the formation of moisture.

Conclusion
At the stated operating conditions, pitting corrosion is not a significant concern, but 316L is recommended for its greater resistance to pitting.

c End Grain Corrosion
None anticipated.

d Stress Corrosion Cracking
Stress corrosion cracking will only be a concern if column is allowed to have multiple cooling cycles with the formation of liquid.

Conclusion
At the stated operating conditions, pitting corrosion is not a significant concern.

e Crevice Corrosion
Crevice corrosion will only be a concern if column is allowed to have multiple cooling cycles with the formation of liquid.

Conclusion
At the stated operating conditions, crevice corrosion is not a significant concern.

f Corrosion at Welds
None anticipated.

Conclusion
Not a concern.

g Microbiologically Induced Corrosion (MIC)
Conditions in this equipment are not conducive to MIC

Conclusion
Not a concern.

h Fatigue/Corrosion Fatigue
Equipment shall be designed to accommodate the expected fatigue cycles over the 40 year design life.

Conclusion
Not a concern.

i Vapor Phase Corrosion
Offgas equipment is essentially entirely vapor space. Comments under General Corrosion apply.

Conclusion
Not a concern.

PLANT ITEM MATERIAL SELECTION DATA SHEET

j Erosion
Velocities are not expected to be sufficient to cause concern.

Conclusion
Not a concern

k Galling of Moving Surfaces
None expected.

Conclusion
Not a concern.

l Fretting/Wear
None anticipated

Conclusion
Not a concern.

m Galvanic Corrosion
None anticipated.

Conclusion
Not a concern.

n Cavitation
None anticipated.

Conclusion
Not a concern.

o Creep
Creep is not a concern at these temperatures.

Conclusion
At the stated operating conditions, creep is not a concern.

p Inadvertent Addition of Nitric Acid
Introduction of nitric acid into the offgas stream is not a likely scenario.

Conclusion
Not applicable.

PLANT ITEM MATERIAL SELECTION DATA SHEET

OPERATING CONDITIONS

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Thermal catalytic oxidizer (HOP-SCO-00001, HOP-SCO-00004)

Facility HLW

In Black Cell? No

Chemicals	Unit[1]	Contract Maximum		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/m^3					
HCl	g/m^3					
HF	g/m^3					
Iron	g/m^3					
NO	g/m^3	2.92E-01	3.02E-01			
NO2	g/m^3	1.07E-01	1.16E-01			
Phosphate	g/m^3					
SO2	g/m^3					
Mercury	g/m^3					
Carbonate	g/m^3					
Undissolved solids	wt %					
Other (NaMnO4, Pb,...)	g/m^3					
Other	g/m^3					
Humidity	%	0.064%	0.061%			
Temperature	°F					Note 2

List of Organic Species:

Notes:

1 Concentrations less than 1x 10^{-4} g/m^3 do not need to be reported; list values to two significant digits max.
2. Tmin not provided, Tmax 330 °F

Assumptions

PLANT ITEM MATERIAL SELECTION DATA SHEET

5.4.8.3 Thermal Catalytic Oxidizer (HOP-SCO-00001, HOP-SCO-00004)

Routine Operations

The gas from the catalyst skid electric heater flows to the thermal catalytic oxidizer (TCO). The TCO oxidizes organics to carbon dioxide and water and possibly acid gases (depending on the presence of halogenated organics in the gas). The TCO operates at about the same temperature as the NO_x SCR. The TCO is placed in front of the NO_x SCR to take advantage of the decomposition reaction heat generation to maintain the NO_x SCR operating temperature, although little heat is generated. This arrangement also prevents the formation of NO_x in the TCO from the oxidation of ammonia used in the NO_x SCR. The TCO catalyst is likely to be a platinum-based material deposited on a substructure that is held in frames and is inserted and removed through access doors. This facilitates easy changeout.

This equipment is operated at low relative humidity.

R10378683

PLANT ITEM MATERIAL SELECTION DATA SHEET

HOP-SCR-00001 & HOP-SCR-00002 (HLW)
NOx Selective Catalytic Reducer

ISSUED BY
RPP-WTP PDC

- Inlet Temperature (°F) (max/normal): 330/330
- Design Pressure (in WG) (max/min): 80/-80
- Location: outcell

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on sheets 4 and 5

Operating Modes Considered:

- Normal operations up to a maximum temperature of 330 °F.

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00		X
316L (S31603)	1.18	X	
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material: 316 (max 0.030% C; dual certified)

Recommended Corrosion Allowance: 0.00 inch (includes 0.00 inch erosion allowance)

Process & Operations Limitations:

- Develop a procedure for equipment review and examination if temperature exceeds 900°F.

MARK W. HOFFMANN
STATE OF WASHINGTON
0030952
REGISTERED
PROFESSIONAL ENGINEER
9/15/04
EXPIRES 12/10/04

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

This bound document contains a total of 5 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
1	9/15/04	Issued for Permitting Use			
0	9/25/02	Issued For Permitting Use	DLA	JRD	MHoffmann

PLANT ITEM MATERIAL SELECTION DATA SHEET

Corrosion Considerations:

Column receives gas from thermal catalytic oxidizer and sends scrubbed gas to silver mordenite column. In the reducer, NO_X is reduced to nitrogen and water. This equipment normally operates at low relative humidity. Condensation is not expected during normal operations.

a General Corrosion
None anticipated.

Conclusion
304L is satisfactory.

b Pitting Corrosion
Pitting corrosion will only be a concern if column is allowed to cool below 225°F in the presence of moisture. Use 316L for safety.

Conclusion
At the stated operating conditions, pitting corrosion is not a concern. Recommend 316L.

c End Grain Corrosion
None anticipated.

d Stress Corrosion Cracking
Stress corrosion cracking will only be a concern if column is allowed to have multiple cooling cycles below 225°F in the presence of moisture.

Conclusion
At the stated operating conditions, pitting corrosion is not a concern.

e Crevice Corrosion
Crevice corrosion will only be a concern if column is allowed to cool below 225°F in the presence of moisture.

Conclusion
At the stated operating conditions, pitting corrosion is not a concern.

f Corrosion at Welds
None anticipated.

Conclusion
Not a concern.

g Microbiologically Induced Corrosion (MIC)
Conditions in this equipment are not conducive to MIC

Conclusion
Not a concern.

h Fatigue/Corrosion Fatigue
Equipment shall be designed to accommodate the expected fatigue cycles over the 40 year design life.

Conclusion
Not a concern.

i Vapor Phase Corrosion
Offgas equipment is essentially entirely vapor space. Comments under General Corrosion apply.

Conclusion
Not a concern.

PLANT ITEM MATERIAL SELECTION DATA SHEET

j Erosion
Velocities are not expected to be sufficient to cause concern.

Conclusion
Not a concern.

k Galling of Moving Surfaces
None expected.

Conclusion
Not a concern.

l Fretting/Wear
None anticipated.

Conclusion
Not a concern.

m Galvanic Corrosion
None anticipated.

Conclusion
Not a concern.

n Cavitation
None anticipated.

Conclusion
Not a concern.

o Creep
Creep is possible if off normal operation at or above 900°F is frequent.

Conclusion
At the stated operating conditions, creep is not a problem.

p Inadvertent Addition of Nitric Acid
Introduction of nitric acid into the offgas stream is not a likely scenario.

Conclusion
Not applicable.

PLANT ITEM MATERIAL SELECTION DATA SHEET

OPERATING CONDITIONS

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) NOx selective catalytic reducer (HOP-SCR-00001, HOP-SCR-00002)

Facility HLW

In Black Cell? No

Chemicals	Unit[1]	Contract Maximum		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/m^3					
HCl	g/m^3					
HF	g/m^3					
Iron	g/m^3					
NO	g/m^3	2.86E-01	2.97E-01			
NO2	g/m^3	1.05E-01	1.14E-01			
Phosphate	g/m^3					
SO2	g/m^3					
Mercury	g/m^3					
Carbonate	g/m^3					
Undissolved solids	wt %					
Other (NaMnO4, Pb,...)	g/m^3					
Other	g/m^3					Note 2
Humidity	%	0.067%	0.064%			
Temperature	°F					Note 3

List of Organic Species:

Notes:

1. Concentrations less than $1x\ 10^{-4}\ g/m^3$ do not need to be reported, list values to two significant digits max.
2. Anhydrous ammonia is injected into the SCR to aid in the conversion of NO_X
3. Tmin not provided, Tmax 330 °F.

Assumptions

PLANT ITEM MATERIAL SELECTION DATA SHEET

5.4.8.4 NO_x Selective Catalytic Oxidizer Reducer (HOP-SCR-00001, HOP-SCR-00002)

Routine Operations

The NO_x SCRs reduce (destroy) nitrogen oxides (NO_x) in the process offgas. Gas from the TCO flows into a chamber where the gas is mixed, due to the turbulent flow, with ammonia gas injected into the gas stream. The ammonia is added at a stoichiometric ratio of slightly more than 1 to ensure efficient reaction of about 95 %. The ammonia addition rate is controlled based on an in-stream analysis of the concentration and flow rate of the NO_x into the NO_x SCR. The ammonia slip needs to be controlled because ammonia is also an air pollutant. The offgas from the mixing chamber flows into the NO_x SCR catalyst bed at a temperature of about 750 °F where the reaction takes place. The inlet temperature is well above the temperature for ammonium nitrate formation (NH_4NO_3 decomposes above 410 °F). In the SCR, NO_x is reduced to nitrogen and water.

Non-Routine Operations that Could Affect Corrosion/Erosion

This equipment is operated at low relative humidity. Any extended facility shutdown mode that results in cessation of airflow thorough offgas system, resulting in condensation of effluent inside equipment, is not desirable.

R10192681

PLANT ITEM MATERIAL SELECTION DATA SHEET

HOP-ABS-00002 & 3 (HLW)
Silver Mordenite Column

- Design Temperature (°F): 330/59
- Design Pressure (psig) (max/min): +3/-3
- Location: outcell
- Anticipated 40 y radiation dose: gamma <<$2x10^8$ rad, alpha << $2x10^9$ rad

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on sheet 3

Operating Modes Considered:

- Off-normal conditions assume a 7X melter off-gas surge.
- Equipment is maintainable.
- Process conditions for HOP-ABS-00003 are identical to those for HOP-ABS-00002.

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00		X
316L (S31603)	1.18	X	
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material: 316 (max 0.030% C; dual certified)

Recommended Corrosion Allowance: NA

Process & Operations Limitations:

- Equipment will be visually examined for evidence of corrosion during the change-out of the cartridges.
- Develop start-up and shut-down procedure.

ISSUED BY
RPP-WTP PDC
MD 1/28/04
INIT DATE

STEVEN WAKEMAN VAIL
STATE OF WASHINGTON
39250
REGISTERED
PROFESSIONAL ENGINEER
1/26/04
EXPIRES: 12/07/05

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

This bound document contains a total of 3 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
1	1/26/04	Issued For Permitting Use		JRD	
0	9/25/02	Issued For Permitting Use	DLA	JRD	MHoffmann

PLANT ITEM MATERIAL SELECTION DATA SHEET

Corrosion Considerations:

a General Corrosion
None anticipated.

Conclusion
Either 304L or 316L would be satisfactory.

b Pitting Corrosion
Pitting corrosion will only be a concern if column is allowed to cool below 225°F in the presence of moisture. For safety, use 316L and develop a procedure to evaluate equipment following any such low temperature event.

Conclusion
At the stated operating conditions, pitting corrosion is not a significant concern. Recommend 316L.

c End Grain Corrosion
None anticipated.

d Stress Corrosion Cracking
Stress corrosion cracking will only be a concern if column is allowed to cool below 225°F in the presence of moisture. See Pitting.

Conclusion
At the stated operating conditions, stress corrosion cracking is not a concern.

e Crevice Corrosion
Crevice corrosion will only be a concern if column is allowed to cool below 225°F in the presence of moisture.

Conclusion
At the stated operating conditions, crevice corrosion is not a concern.

f Corrosion at Welds
None anticipated.

g Microbiologically Induced Corrosion (MIC)
None anticipated.

h Fatigue/Corrosion Fatigue
None anticipated.

i Vapor Phase Corrosion
None anticipated.

j Erosion
None anticipated.

k Galling of Moving Surfaces
None anticipated.

l Fretting/Wear
None anticipated.

m Galvanic Corrosion
None anticipated.

n Cavitation
None anticipated.

o Creep
Creep is not expected at stated operating conditions.

Conclusion
At the stated operating conditions, creep is not a problem.

PLANT ITEM MATERIAL SELECTION DATA SHEET

OPERATING CONDITIONS

Materials Selection Data

	Silver Mordenite Column
Component (Name/ID)	HOP-ABS-00002
System	HLW HOP

Operations

Chemicals	Unit	Cold Startup	Normal Operation	Standby/Idle	Cleaning	Accident
Aluminum	g/l	Note 2		Note 2	Note 3	Note 4
Chloride	g/l		4.0E-08			2.8E-07
Fluoride	g/l		5.9E-08			4.1E-07
Hydroxide	g/l					
Iron	g/l					
Nitrate	g/l		4.2E-05			3.0E-04
Nitrite	g/l					
Phosphate	g/l					
TOC[♀]	g/l					
Sulfate	g/l		1.5E-05			1.1E-04
Undissolved solids	g/l					
Particle size/hardness	μm (##)					
Other ($NaMnO_4$, Hg, etc)	g/l					
Carbonate	g/l					
pH	-					
Dose rate, α, β/γ (Note 1)	Bq/l		3.4E-9, 4.4E-5			2.4E-8, 3.1E-4
Temperature	°F	330	330	77		392
Velocity	fps					
Vibration						
Time of exposure	#					

- % of total; ## - use Mho scale

Assumptions: Column receives offgases from Catalyst Skid and sends it to the stack

Note 1: Excluding Tritium, Carbon-14, and Iodine-129.
Note 2: Assumes normal air at elevated temperatures.
Note 3: No cleaning operations required. Absorbtion cartridges are disposible.
Note 4: Accident assumes a 7X melter offgas surge.

Comments: Based on stream #HV243

☐ Black Cell

☐ Flushing

[♀] List expected organic species: _____
Use maximum of 2 significant figures

PLANT ITEM MATERIAL SELECTION DATA SHEET

HOP-HX-00002 & HOP-HX-00004 (HLW)
Silver Mordenite Preheater

- Design Inlet Temperature (°F) (hot side/cold side): 500/250
- Location: outcell

ISSUED BY
RDP-WTP PDC
INIT DATE

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on sheet 4

Operating Modes Considered:

- Equipment is maintainable.

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00		X
316L (S31603)	1.18	X	
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material: 316 (max 0.030% C; dual certified)

Recommended Corrosion Allowance: NA

Process & Operations Limitations:

- None

STEVEN WAKEMAN VAIL
STATE OF WASHINGTON
39250
REGISTERED PROFESSIONAL ENGINEER
4/21/04
EXPIRES: 12/07/05

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

This bound document contains a total of 4 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
0	4/21/04	Issued for Permitting Use			

PLANT ITEM MATERIAL SELECTION DATA SHEET

Corrosion Considerations:

a General Corrosion
The anticipated dry-air conditions are not conductive to general corrosion and none is expected.

Conclusion
Either 304L or 316L would be satisfactory.

b Pitting Corrosion
Pitting corrosion will only be a concern if moisture is present. It is assumed that there will be no condensation in the unit. For conservatism, 316L is recommended.

Conclusion
At the stated operating conditions, pitting corrosion is not a significant concern. Recommend 316L.

c End Grain Corrosion:
End grain corrosion only occurs in high acid conditions and is not a concern.

Conclusion:
Not a concern

d Stress Corrosion Cracking
At operations at the stated temperatures, stress corrosion cracking will only be a concern in the presence of moisture. It is assumed that there will be no condensation in the unit. Also see Pitting.

Conclusion
At the stated operating conditions, stress corrosion cracking is not a concern.

e Crevice Corrosion
Crevice corrosion will only be a concern if moisture is present. It is assumed that this will be prevented by the presence of a preheater.

Conclusion
At the stated operating conditions, crevice corrosion is not a concern.

f Corrosion at Welds
Assuming dry air and proper welding procedures, corrosion at welds is not anticipated.

Conclusion
At the stated operating conditions, weld corrosion is not a concern.

g Microbiologically Induced Corrosion (MIC)
The stated operating conditions are not suitable for microbial growth.

Conclusion
At the stated operating conditions, MIC is not a concern.

h Fatigue/Corrosion Fatigue
Extreme temperature cycling or fluctuations are not expected during normal operations. During the life of the equipment such fluctuation are expected to be very infrequent.

Conclusion
At the expected operating conditions, corrosion fatigue is not a concern.

PLANT ITEM MATERIAL SELECTION DATA SHEET

i Vapor Phase Corrosion
Components essentially consist entirely of vapor space so general corrosion comments apply.

Conclusion:
See comments under general corrosion.

j Erosion
The velocity and solids content are sufficiently low that erosion is not a concern.

Conclusion
Erosion is not a concern.

k Galling of Moving Surfaces
There are no unlubricated moving surfaces present.

Conclusion:
Galling is not a concern.

l Fretting/Wear
No metal/metal contacting surfaces are expected.

Conclusion:
Fretting is not a concern.

m Galvanic Corrosion
No significantly dissimilar metals are present nor is moisture assumed to be present.

Conclusion:
Galvanic corrosion is not a concern.

n Cavitation
Cavitation is not expected in an off-gas system

Conclusion:
Cavitation is not a concern.

o Creep
Creep is not expected at stated operating conditions.

Conclusion
At the stated operating conditions, creep is not a problem.

PLANT ITEM MATERIAL SELECTION DATA SHEET

OPERATING CONDITIONS

Materials Selection Data

Component (Name/ID) HOP-HX-00002 & 4

System HLW-HOP

Operations

Chemicals	Unit	Normal Case Conditions		Maximum Case Conditions	
		Cold Side	Hot Side	Cold Side	Hot Side
CO	ppmv	39.5	1.91	64.1	3.11
NO_X	ppmv	606	29.3	2,650	129
NH_3	ppmv	67.6	109	60.7	290
SO_2	ppmv	4.65E-02	2.26E-03	3.15E-02	1.53E-03
HCl	ppmv	3.76E-03	3.63E-06	2.27E-02	2.20E-05
HF	ppmv	2.17E-01	2.10E-04	1.77	1.72E-03
I_2	ppmv	2.86E-09	2.76E-12	1.26E-04	1.22E-07
Hg	ppmv	2.26E-05	2.18E-05	9.86E-04	9.55E-04
SVOC	ppmv	5.48	2.64E-01	0.45	2.16E-02
VOC	ppmv	9.56E-08	1.71E-09	0.21	3.84E-03
Particulate	ppmv	3.07E-11	4.58E-12	8.46E-11	1.99E-11
Temperature (in/out)	^oF	186/380	462/269	221/395	469/295

VESSEL/TANK MATERIAL SELECTION DATA SHEET

R10082250

HOP-VSL-00903 & HOP-VSL-00904 (HLW)
SBS Condensate Receiver Vessel

- Design Temperature, max/min (°F): 165/40
- Design Pressure, max/min (psig): 15/FV
- Location: incell
- Anticipated 40 y radiation dose: gamma ≈$2x10^8$ rad, alpha ≈ $2x10^9$ rad
- PJM Discharge Velocity (fps) (max): 32
- Drive Cycle: 25 %

Offspring items

HOP-PJM-00001 – HOP-PJM-00003
HOP-PJM-00007 – HOP-PJM-00011,
HOP-VSL-00101A/B, HOP-VSL-00004A/B
HOP-VSL-00905A/B – HOP-VSL-00906A/B
HOP-RFD-0001A/B – HOP-RFD-0004A/B

ISSUED BY
RPP-WTP PDC
INIT DATE 6/4/03

Operating conditions are as stated on sheet 5

Operating Modes Considered:

- normal operation at pH 1.3 (≈0.05M)
- vessel is at pH 1.3 and temperature reaches ≈165°F
- process conditions for HOP-VSL-00904 are identical to those for HOP-VSL-00903

Materials Considered:

Material (UNS No,)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00		X
316L (S31603)	1.18		X
6% Mo (N08367/N08926)	7.64		X
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material: UNS N06022

Recommended Corrosion Allowance: 0.08 inch

Process & Operations Limitations:

- maintain agitation during operation
- develop lay-up strategy

STEVEN WAKEMAN VAIL
STATE OF WASHINGTON
39250
REGISTERED PROFESSIONAL ENGINEER
EXPIRES: 12/07/03
5/31/03

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only

This bound document contains a total of 5 sheets.

Processed/Data Entry ☐ Copied/QA ☐ Scanned ☐ Filed ☐

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
2	5/31/03	Issued For Permitting Use	6/4/03	5-12-03	
1	1/8/03	Issued For Permitting Use	DLAdler	JRDivine	SWVail
0	9/25/02	Issued For Permitting Use	DLA	JRD	MWH

VESSEL/TANK MATERIAL SELECTION DATA SHEET

Corrosion Considerations:

a General Corrosion
Wilding and Paige (1976) have shown that in 5% nitric acid with 1000 ppm fluoride at 290°F, the corrosion rate of 304L can be kept as low as 5 mpy by the use of Al^{+++}. Additionally, Sedriks (1996) has noted with 10% (≈2N) nitric acid and 3,000 ppm fluoride at 158°F, the corrosion rate of 304L is over 4,000 mpy; C-22 or equivalent has a corrosion rate of about 75 mpy. The presence of Al^{+++} at the forecast ratio of Al^{+++}/F^- is expected to reduce the corrosion rate to near zero. However, because of the possibility of hot, though dilute, acid with a low Al^{+++}/F^- ratio, an alloy more corrosion resistant than the 300 series stainless steels, such as Hastelloy C-22 or equivalent, will be required.

Conclusion: Hastelloy C-22 or the equivalent is recommended to protect the vessel from off-normal conditions. Added protection by using a 0.08 inch corrosion allowance is recommended.

b Pitting Corrosion
Chloride is known to cause pitting in acid and neutral solutions. Normally the vessel is to operate at 122°F at a pH of 1.3. Extrapolating from Wilding & Paige (1976) data, it appears that 304L would not pit due to the presence of the nitric acid and excess nitrate. Berhardsson et al (1981) have similar conclusions based solely on concentrations. However, the temperature could approach boiling. Data from Phull et al (2000) imply that with these conditions, Hastelloy C-22 or equivalent will be needed as a minimum.

Further, if the vessel were filled with process water and left stagnant, there would be a tendency to pit. The time to initiate would depend on the source of the water, being shorter for filtered river water and longer for DIW. Pitting has been observed in both cases, and is likely because residual chlorides are likely to remain. Pitting is less likely for the higher alloys such as Hastelloy C-22 or equivalent.

Conclusion:
Hastelloy C-22 or the equivalent is recommended.

c End Grain Corrosion
End grain corrosion only occurs in hot concentrated oxidizing acid conditions.

Conclusion:
Not applicable to this system.

d Stress Corrosion Cracking
The exact amount of chloride required to cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, the environment, and also because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even as little as 10 ppm can lead to cracking under some conditions. For the normal operating conditions, 316L would be satisfactory. However, with the proposed off-normal conditions where there will be a tendency to concentrate salts, Hastelloy C-22 or equivalent is required.

Conclusion:
Because of the normal operating environment as well as that which can occur during off-normal conditions, the minimum alloy recommended is Hastelloy C-22 or equivalent.

e Crevice Corrosion
See Pitting.

Conclusion:
See Pitting

f Corrosion at Welds
The heat tint must be removed after construction if it is darker than straw yellow.

Conclusion:
Weld corrosion is not considered a problem for this system except as noted above.

VESSEL/TANK MATERIAL SELECTION DATA SHEET

g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions are not conducive to microbial growth – the average operating temperature is approximately correct but the pH is too acidic.

Conclusion:
MIC is not considered a problem.

h Fatigue/Corrosion Fatigue
Corrosion fatigue is expected to be a concern because of the frequent temperature cycles and the presence of vibration from the pulse jet mixers.

Conclusions
C-22 is anticipated to be sufficiently resistant for the design life.

i Vapor Phase Corrosion
The vapor phase portion of the vessel is expected to be splashed with particles of waste. The region shall be sufficiently washed to prevent solids deposits.

Conclusion:
Not expected to be a concern.

j Erosion
Velocities within the vessel are expected to be low. The presence of PJMs in the vessels will create higher velocities near the nozzles but this has been reviewed and the determination has been made that the standard 0.080-inch corrosion allowance is sufficient to offset any possible effects of erosion.

Conclusion:
Not expected to be a concern.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
No metal/metal contacting surfaces expected.

Conclusion:
Not expected to be a concern.

m Galvanic Corrosion
No dissimilar metals are present.

Conclusion:
Not expected to be a concern.

n Cavitation
None expected.

Conclusion:
Not believed to be of concern.

o Creep
The temperatures are too low to be a concern.

Conclusion:
Not applicable.

VESSEL/TANK MATERIAL SELECTION DATA SHEET

References:

1. Berhardsson, S, R Mellstrom, and J Oredsson, 1981, *Properties of Two Highly Corrosion Resistant Duplex Stainless Steels*, Paper 124, presented at Corrosion 81, NACE International, Houston, TX 77218
2. Phull, BS, WL Mathay, & RW Ross, 2000, *Corrosion Resistance of Duplex and 4-6% Mo-Containing Stainless Steels in FGD Scrubber Absorber Slurry Environments*, Presented at Corrosion 2000, Orlando, FL, March 26-31, 2000, NACE International, Houston TX 77218.
3. Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., New York, NY 10158
4. Wilding, MW and BE Paige, 1976, *Survey on Corrosion of Metals and Alloys in Solutions Containing Nitric Acid*, ICP-1107, Idaho National Engineering Laboratory, Idaho Falls, ID

Bibliography:

1. Agarwal, DC, *Nickel and Nickel alloys*, In: Revie, WW, 2000. *Uhlig's Corrosion Handbook*, 2nd Edition, Wiley-Interscience, New York, NY 10158
2. Davis, JR (Ed), 1987, *Corrosion, Vol 13*, In "Metals Handbook", ASM International, Metals Park, OH 44073
5. Davis, JR (Ed), 1994, *Stainless Steels*, In ASM Metals Handbook, ASM International, Metals Park, OH 44073
6. Hamner, NE, 1981, *Corrosion Data Survey*, Metals Section, 5th Ed, NACE International, Houston, TX 77218
3. Jones, RH (Ed.), 1992, *Stress-Corrosion Cracking*, ASM International, Metals Park, OH 44073
4. Koch, GH, 1995, *Localized Corrosion in Halides Other Than Chlorides*, MTI Pub No. 41, Materials Technology Institute of the Chemical Process Industries, Inc, St Louis, MO 63141
5. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158
6. Van Delinder, LS (Ed), 1984, *Corrosion Basics*, NACE International, Houston, TX 77084

VESSEL/TANK MATERIAL SELECTION DATA SHEET

OPERATING CONDITIONS

Materials Selection Data

Component (Name/ID) SBS Condensate Receiver Vessel/HOP-VSL-00903
System HLW - HOP

Operations

Chemicals	Unit	Cold Startup	Normal Operation	Standby/Idle	Cleaning	Accident
Aluminum	g/l	Note 3	0.23	Note 4	Note 5	
Chloride	g/l		0.01			
Fluoride	g/l		0.08			
Hydroxide	g/l		0			
Iron	g/l					
Nitrate	g/l		3.56			
Nitrite	g/l		0			
TOC[a]	g/l		0			
Sulfate	g/l		0.05			
Undissolved solids	g/l		3.61			
Particle size/hardness	µm (##)					
Other ($NaMnO_4$, etc)	g/l		0.4			
Carbonate	g/l		0			
pH (Note 1)	-		1.3			
Dose rate, α, β/γ (Note 2)	Bq/L		2.66E7, 7.37E10			
Temperature	°C		50			75, Note 6
Velocity	fps					
Vibration						
Time of exposure	#					

- % of total; ## - use Mho scale

Assumptions: Cannot be maintained during the 40 year design life

Notes
Note 1: Based on best engineering judgement.
Note 2: Excluding Tritium, Carbon-14 and Iodine-129.
Note 3: Assume same as for normal operation minus the radionuclides.
Note 4: Assumes same as normal operation.
Note 5: Assume Process H2O.
Note 6: Based on maximum SBS operating temperature (60C) + 15C allowance for off-normal event involving steam ejector use.

[X] Black Cell

[ ] Flushing Use maximum of 2 significant figures

MASTER DISTRIBUTION SCHEDULE

Document Number: 24590-HLW-N1D-HOP-P0009

Revision: 2

Name	MSIN	Controlled	Uncontrolled	Size						Comments
				8 ½ × 11 (A)	11 × 17 (B)	Drawings			As Is	
						C	D	E		
Mike O'Connor	MS4-A1		X						X	
Dan Pfluger	MS4-B2		X						X	
Phil Peistrup	MS4-C1		X						X	

Approver Steven Vail (*Print Name*) Steven Vail (*Signature*) 5/31/03 (*Date*)

R10306069

24590-HLW-N1D-HOP-P0010
Rev. 0

PLANT ITEM MATERIAL SELECTION DATA SHEET

HOP-SCB-00001/2 (HLW)
Melter 1 & 2 Submerged Bed Scrubber (SBS)

- Design Temperature (°F)(max/min): 237/41*
- Design Pressure (psig) (max/min): 15/-3.6
- Location: incell

ISSUED BY
RPP-WTP PDC
4/22/04
INIT DATE

* To consider upset conditions, the top head cover & top head flange shall be designed to 1250°F and 945° respectively.

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on sheet 5

Options Considered:

- Vessel is operating at pH 3 at the normal operating temperature.
- Vessel is at pH 3 at the maximum operating temperature, 140°F.
- The process conditions for Melter 2 are identical to those for Melter 1. Therefore, it is assumed that the conditions stated on attached Material Selection Data Sheet for HOP-SCB-00001 are applicable to HOP-SCB-00002 as well.

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00		X
316L (S31603)	1.18		X
6% Mo (N08367/N08926)	7.64		X
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material: UNS N06022

Packing can be an acid resistant ceramic such as Al_2O_3 or equivalent.

Recommended Corrosion Allowance: 0.08 inch

Process & Operations Limitations:

- Develop flushing/rinsing procedure for acid and water.
- Develop lay-up strategy.

STEVEN WAKEMAN VAIL
STATE OF WASHINGTON
39250
REGISTERED
PROFESSIONAL ENGINEER
4/21/04
EXPIRES: 12/07/05

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

This bound document contains a total of 5 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
0	4/21/04	Issued for Permitting Use			

PLANT ITEM MATERIAL SELECTION DATA SHEET

Corrosion Considerations:

It is assumed that upset conditions will be sufficiently infrequent as to not affect the corrosion behavior of the vessel to any significant degree.

a General Corrosion
Wilding and Paige (1976) have shown that in 5% nitric acid with 1000 ppm fluoride at 290°F, the corrosion rate of 304L can be kept as low as 5 mpy by the use of Al^{+++}. Additionally, Sedriks (1996) has noted with 10% (≈2N) nitric acid and 3,000 ppm fluoride at 158°F, the corrosion rate of 304L is over 4,000 mpy; C-22 has a corrosion rate of about 75 mpy. The presence of Al^{+++} at the forecast ratio of Al/F can reduce the corrosion rate to near zero, but there are regions in the system where there could be excess fluoride. Consequently, a more corrosion resistant alloy such as Hastelloy C-22 will be required.

The dissolution rate of the ceramic components in the proposed environment is unknown. However, data from Clark and Zoitos (1992) suggest Al_2O_3, SiC, and ZrO_2 ceramics will have little reactivity in the proposed solutions. The effect of fluoride and the varying temperatures is unclear but the uniform corrosion rate is expected to be larger.

Conclusion: Hastelloy C-22 or the equivalent is recommended to protect the regions in the scrubber that are exposed to excessive temperatures and concentrations. Added protection by using a 0.08 inch corrosion allowance is recommended. A high-fired alumina, silicon carbide (reaction bonded and with no free silicon), or zirconia are expected to be suitably resistant for the packing.

b Pitting Corrosion
Chloride is known to cause pitting of stainless steels and related alloys in acid and neutral solutions. Normally the vessel is to operate at 122°F at a pH of 3. Extrapolating from Wilding & Paige data (1976), it appears that 304L would not pit due to the presence of the nitric acid and excess nitrate. Berhardsson et al (1981) provide similar conclusions. However, the temperature could approach boiling and, in some locations, be superheated. Data from Phull et al (2000) imply that with these conditions, Hastelloy C-22 or equivalent will be needed as a minimum.

Further, if the vessel were filled with process water and left stagnant, there would be a tendency to pit. The time to initiate would depend on the source of the water, being shorter for filtered river water and longer for DIW. Pitting has been observed in both cases, and is likely because residual chlorides are likely to remain. Pitting is less likely for the higher alloys such as C-22.

Conclusion:
Hastelloy C-22 or equivalent is recommended.

c End Grain Corrosion
End grain corrosion only occurs in concentrated acid conditions.

Conclusion:
Not believed likely in this system.

d Stress Corrosion Cracking
The exact amount of chloride required to cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, the environment, and because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even as little as 10 ppm can lead to cracking under some conditions. For the proposed conditions, Hastelloy C-22 or equivalent is required because of its greater resistance to SCC.

Conclusion:
Because of the normal operating environment as well as that which can occur during off normal conditions, the minimum alloy recommended is Hastelloy C-22.

e Crevice Corrosion
See Pitting.

Conclusion:
See Pitting

f Corrosion at Welds
Corrosion at welds is not considered a problem in the proposed environment.

Conclusion:
Weld corrosion is not considered a problem.

g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions are not conducive to microbial growth. The average operating temperature is approximately correct, but the pH is too low. Further, the system is downstream of the main entry points of microbes and the air streams are heated to over 500°F.

Conclusion:
MIC is not considered a problem.

PLANT ITEM MATERIAL SELECTION DATA SHEET

h Fatigue/Corrosion Fatigue
Corrosion fatigue is not expected to be a concern. The pressures encountered are so low and the strength of the material is so comparatively high that corrosion fatigue is not a problem.

Conclusions
Not expected to be of concern.

i Vapor Phase Corrosion
The vapor phase portion of the vessel is expected to be contacted with particles of waste from splashing. It is suspected the region will be sufficiently washed to prevent solids deposits. C-22 is sufficiently resistant that no corrosion is expected in the vapor space.

Conclusion:
Not expected to be of concern.

j Erosion
Velocities within the vessel are unknown but are expected to be low.

Conclusion:
Not expected to be of concern.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
No metal/metal contacting surfaces expected.

Conclusion:
Not expected to be of concern.

m Galvanic Corrosion
No dissimilar metals are present.

Conclusion:
Not expected to be of concern.

n Cavitation
None expected.

Conclusion:
Not expected to be of concern.

o Creep
The temperatures are too low to be a concern.

Conclusion:
Not applicable.

PLANT ITEM MATERIAL SELECTION DATA SHEET

References:

1. Berhardsson, S, R Mellstrom, and J Oredsson, 1981, *Properties of Two Highly corrosion Resistant Duplex Stainless Steels*, Paper 124, presented at Corrosion 81, NACE International, Houston, TX 77218
2. Clark, DE & BK Zoitos (Editors), 1992, *Corrosion of Glass, Ceramics and Ceramic Superconductors*, Noyes Publications, Park Ridge, NJ 07656
3. Phull, BS, WL Mathay, & RW Ross, 2000, *Corrosion Resistance of Duplex and 4-6% Mo-Containing Stainless Steels in FGD Scrubber Absorber Slurry Environments*, Presented at Corrosion 2000, Orlando, FL, March 26-31, 2000, NACE International, Houston TX 77218.
4. Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., New York, NY 10158
5. Wilding, MW and BE Paige, 1976, *Survey on Corrosion of Metals and Alloys in Solutions Containing Nitric Acid*, ICP-1107, Idaho National Engineering Laboratory, Idaho Falls, ID

Bibliography:

1. Agarwal, DC, *Nickel and Nickel alloys*, In: Revie, WW, 2000. *Uhlig's Corrosion Handbook*, 2nd Edition, Wiley-Interscience, New York, NY 10158
2. Davis, JR (Ed), 1987, *Corrosion, Vol 13*, In "Metals Handbook", ASM International, Metals Park, OH 44073
3. Davis, JR (Ed), 1994, *Stainless Steels*, In ASM Metals Handbook, ASM International, Metals Park, OH 44073
4. Hamner, NE, 1981, *Corrosion Data Survey*, Metals Section, 5th Ed, NACE International, Houston, TX 77218
5. Jones, RH (Ed.), 1992, *Stress-Corrosion Cracking*, ASM International, Metals Park, OH 44073
6. Koch, GH, 1995, *Localized Corrosion in Halides Other Than Chlorides*, MTI Pub No. 41, Materials Technology Institute of the Chemical Process Industries, Inc, St Louis, MO 63141
7. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158
8. Van Delinder, LS (Ed), 1984, *Corrosion Basics*, NACE International, Houston, TX 77084

PLANT ITEM MATERIAL SELECTION DATA SHEET

OPERATING CONDITIONS

Material Selection Data Sheets for the HLW Vitrification Facility

Materials Selection Data

Component (Name/ID) HLW SBS HOP-SCB-00001/2

System HLW-HOP

Operations

Chemicals	Unit	Cold Startup	Normal Operation*	Contract Max.	Cleaning	Accident
		Note 1		Note 2	Note 3	
Aluminum	g/l		0.22			
Chloride	g/l		0.12	0.27		
Fluoride	g/l		0.17	1.3		
Hydroxide	g/l		0			
Iron	g/l					
Nitrate	g/l		2.2			
Nitrite	g/l		2.9E-05			
Phosphate	g/l					
TOC♦	g/l		6.4E-06			
Sulfate	g/l		0.61			
Undissolved solids	g/l		3			
Particle size/hardness	µm (##)					
Other (Na, etc)	g/l		1.5	2.73 (Hg^{++})		
Carbonate	g/l		0			
pH	-		3			
Dose rate, α, β/γ	Bq/L**		3.0E+6, 1.3E+10			
Temperature	°F		122			149 (Note 5)
Velocity	fps					
Vibration						
Time of exposure	#					

* Based on Stream #HV216

- % of total; ## - use Mho scale

Notes:

~~Note 1: Same as normal operations minus radionuclides and dose rate.~~

Note 2: Max. contract value mass balance, unreleased. Only values significantly different than normal operations are listed

Note 3: Can be Process H2O or ≤ 12.2 M HNO3 for 1 week every 5 years at temperature ≤212F, solids being flushed are projected to have compositions of dried melter feed and non routine flush of hot 19M NaOH may slightly dissolve SBS media.

Note 4: deleted

Note 5: Based on the maximum SBS operating temperature (122F) + 27F allowance or off normal event involving SBS cooling or steam ejector use.

♦ List expected organic species:
Use maximum of 2 significant figures

PLANT ITEM MATERIAL SELECTION DATA SHEET

R10422910

HSH-TK-00001 & 2 (HLW)
DECONTAMINATION TANK MELTER CAVE 1 AND 2

- Design Temperature (°F)(max/min)· 212/59
- Design Pressure (psig): vented
- Location· outcell

ISSUED BY
RPP-WTP PDC

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on sheet 5

Operating Modes Considered:

- The tank is expected to contain nitric acid up to 2 M Other chemicals may be used in the future requiring further evaluation.
- Evaluation based on the assumption that chlorides, including HCl, will not be added to the tank

Materials Considered:

Material	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0 23		X
304L	1 00		X
316L	1.18	X	
6% Mo	7.64	X	
Alloy 22	11.4	X	
Ti-2	10 1	X	

Recommended Material: 316L

Recommended Corrosion Allowance: 0.04 inch (includes 0.0 inch erosion allowance)

Process & Operations Limitations:

- None identified at this time

STEVEN WAKEMAN VAIL
STATE OF WASHINGTON
39250
REGISTERED
PROFESSIONAL ENGINEER
11/11/04
EXPIRES: 12/07/05

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only

This bound document contains a total of 5 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
0	4/6/04	Issued for Permitting Use			

PLANT ITEM MATERIAL SELECTION DATA SHEET

Corrosion Considerations:

a General Corrosion
Hamner (1981) lists a corrosion rate for 304 (and 304L) in 2 M HNO_3 of less than 2 mpy. Davis (1994) states the corrosion rate for 304L in 12% HNO_3 will be less than about 1 mpy up to about 212°F. 316L should have similar corrosion rates in similar conditions.

Conclusion:
At the proposed temperature range, either 304L or 316L is expected to be sufficiently resistant to the anticipated acid solution with a probable general corrosion rate of less than 1 mpy. A minimum corrosion allowance of 0.04 inch is recommended.

b Pitting Corrosion
At the concentrations and temperatures used, nitric acid will not pit 304L and 316L is more resistant than 304L.

Conclusion:
Pitting is not considered a problem for either 304L or 316L.

c End Grain Corrosion
End grain corrosion only occurs in metal with exposed end grains and in highly oxidizing acid conditions.

Conclusion:
Not expected in this system.

d Stress Corrosion Cracking
The exact amount of chloride required to stress corrosion crack stainless steel is unknown. In part this is because the amount varies with temperature, metal sensitization, the environment and because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even as little as 10 ppm can lead to cracking under some conditions. Generally, as seen in Sedriks (1996) and Davis (1994), stress corrosion cracking does not usually occur below about 140°F. Further, the use of "L" grade stainless reduces the opportunity for sensitization and, therefore, the likelihood of cracking. These tanks are not expected to have significant concentrations of chlorides present and the normal operating temperature should not be high enough to cause concern.

Conclusion:
The use of 304L and 316L are expected to be acceptable with 316L marginally better.

e Crevice Corrosion
See Pitting.

Conclusion:
See Pitting

f Corrosion at Welds
Weld corrosion is not considered a problem in the proposed environment.

Conclusion:
Weld corrosion is not considered a problem for this system.

g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions are not conducive to microbial growth.

Conclusion:
MIC is not considered a problem.

h Fatigue/Corrosion Fatigue
Corrosion fatigue is not expected to be a problem.

Conclusions
Not expected to be a concern.

PLANT ITEM MATERIAL SELECTION DATA SHEET

i Vapor Phase Corrosion
Not considered to be a concern.

Conclusion
Not a problem.

j Erosion
Velocities within the vessel are expected to be low

Conclusion·
Not expected to be of concern.

k Galling of Moving Surfaces
Tank contains remotely removable spray ring assembly Components have been designed to minimize the possibility of galling.

Conclusion·
Design of components is such as to eliminate concern.

l Fretting/Wear
Removable strainer basket is present. Components have been designed to minimize the possibility of fretting.

Conclusion.
Design of components is such as to eliminate concern.

m Galvanic Corrosion
No dissimilar metals are present.

Conclusion
Not applicable.

n Cavitation
None expected.

Conclusion.
Not believed to be of concern.

o Creep
The temperatures are too low to be a concern.

Conclusion.
Not applicable

p Inadvertent Addition of Nitric Acid
These tanks contain normally contain nitric acid.

Conclusion.
Not applicable.

PLANT ITEM MATERIAL SELECTION DATA SHEET

References:

1. Davis, JR (Ed), 1994, *Stainless Steels*, In ASM Metals Handbook, ASM International, Metals Park, OH 44073
2. Hamner, NE, 1981, *Corrosion Data Survey*, Metals Section, 5th Ed, NACE International, Houston, TX 77218
3. Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., New York, NY 10158

Bibliography:

1. Davis, JR (Ed), 1987, *Corrosion, Vol 13*, In "Metals Handbook", ASM International, Metals Park, OH 44073
2. Jones, RH (Ed), 1992, *Stress-Corrosion Cracking*, ASM International, Metals Park, OH 44073
3. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158

PLANT ITEM MATERIAL SELECTION DATA SHEET

OPERATING CONDITIONS

Component(s) (Name/ID #) DECONTAMINATION TANK MELTER CAVE 1 AND 2 (HSH-TK-00001/2)

Facility HLW

In Black Cell? No

Chemicals	Unit[1]	Contract Maximum		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l					
Chloride	g/l					
Fluoride	g/l					
Iron	g/l					
Nitrate	g/l					
Nitrite	g/l					
Phosphate	g/l					
Sulfate	g/l					
Mercury	g/l					
Carbonate	g/l					
Undissolved solids	wt %					
Other (NaMnO4, Pb,...)	g/l					
Other	g/l					
pH	N/A					Assumption 1
Temperature	°F					Assumption 2

List of Organic Species:

Notes:

1. Concentrations less than 1x 10^{-4} g/l do not need to be reported; list values to two significant digits max

Assumptions

1. Assume pH near 0
2. Tmin 59 °F, Tnorm 95 °F, Tmax 212 °F

PLANT ITEM MATERIAL SELECTION DATA SHEET

R10344401

RLD-VSL-00007 (HLW)
Acidic Waste Vessel

- Design Temperature (°F)(max/min): 168/40
- Design Pressure (psig) (max/min): 15/FV
- Location: incell
- PJM Discharge Velocity (fps): 26
- Drive Cycle: 25 %

Offspring items

RLD-PJM-00005 – RLD-PJM-00008
RLD-VSL-00015A/B, RLD-RFD-00162A/B

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on sheets 5 and 6

ISSUED BY
RPP-WTP PDC
INIT 8/16/04 DATE

Operating Modes Considered:

- Vessel is operating at pH 2 at the normal operating temperature.
- Waste is neutralized in vessel.
- The vessel is alkaline.
- Wash solutions could be 5M NaOH, 0.5M nitric acid or DIW.

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00		X
316L (S31603)	1.18		X
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material: UNS N08367 or N08926
Steam ejectors and piping: UNS N06022

The vessel head on the inside of the vessel under nozzles 7, 8, 29, 30, 36, and 37 shall have a band of Hastelloy C-276 clad layer a minimum of 4 inch wide surrounding the outer perimeter of the nozzle pipe.

Recommended Corrosion Allowance: 0.04 inch (includes 0.00 inch erosion allowance; localized protection is provided as necessary and is discussed elsewhere)

Process & Operations Limitations:

- Develop a lay-up strategy.
- Develop a rinsing/flushing strategy for acid and water.

STEVEN WAKEMAN VAIL
STATE OF WASHINGTON
39250
REGISTERED PROFESSIONAL ENGINEER
EXPIRES: 12/07/05
8/5/04

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

This bound document contains a total of 6 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
0	8/3/04	Issued for Permitting Use			

PLANT ITEM MATERIAL SELECTION DATA SHEET

Corrosion Considerations:

This vessel collects liquids from the SBS, the SBS condensate receiver vessel, and the waste neutralization vessel. The collected waste consists of SBS purge and WESP and HEME drainage. Sodium hydroxide is added to the vessel to adjust pH based on sample analysis.

a General Corrosion
Wilding and Paige (1976) have shown that in 5% nitric acid with 1000 ppm fluoride at 290°F, the corrosion rate of 304L can be kept as low as 5 mpy by the use of Al^{+++}. Additionally, Sedriks (1996) has noted with 10% (≈2N) nitric acid and 3,000 ppm fluoride at 158°F, the corrosion rate of 304L is over 4,000 mpy. Under the same conditions, a 6% Mo alloy has a corrosion rate of about 3 mpy and C-22 <2 mpy. Extrapolating acid concentration, fluoride concentration, and temperature, suggests the corrosion rate for 304L and 316L would be less than about 1 mpy and 6% Mo and C-22 are much less. The presence of Al^{+++} is expected to reduce the corrosion rate but it is in insufficient quantities to be highly effective. 304L or 316L will not be satisfactory at the listed conditions. A minimum of a 6% Mo alloy is needed.

Hamner (1981) lists a corrosion rate for 304 (and 304L) in NaOH of less than 20 mpy (500 μm/y) at 77°F. He shows 316 (and 316L) has a rate of less than 2 mpy up to 122°F and 50% NaOH. Sedriks (1996) states that the 300 series are acceptable in up to 50% NaOH at temperatures up to about 122°F or slightly above. The usual corrosion rate for 304L in pure NaOH will be less than about 0.1 mpy up to about 212°F though Sedriks states the data beyond about 122°F are incorrect due to oxidizer contaminants – such as contained in the waste. The corrosion rates of the higher nickel alloys are expected to be lower. In this system, 304L or 316L stainless steel will be acceptable during alkaline conditions.

Conclusion:
One of the 6% Mo alloys is expected to be the minimum required. The uniform corrosion rate of higher alloys will be smaller – it is assumed a corrosion allowance of 0.04 inch would be satisfactory for them.

b Pitting Corrosion
Chloride is known to cause pitting in acid and neutral solutions. Normally the vessel is to operate at about 138°F at a pH ranging from 2 to 14. Extrapolating from Wilding & Paige data (1976), it appears that 304L would not pit due to the presence of the nitric acid and excess nitrate. Berhardsson et al (1981) have similar conclusions based solely on concentrations. 316L will provide added protection should chlorides concentrate during operation, though at the maximum operating conditions a 6% Mo is recommended.

If the vessel were filled with process water and left stagnant, there would be a tendency to pit, more so with the 300 series than with 6% Mo alloys. The time to initiate would depend on the source of the water, being shorter for filtered river water and longer for DIW. Pitting has been observed in both cases, and is likely because residual chlorides are likely to remain.

Conclusion:
Based on the expected operating conditions, a 6% Mo is expected to be satisfactory.

c End Grain Corrosion
End grain corrosion only occurs in hot concentrated oxidizing acid conditions.

Conclusion:
Not believed likely in this system.

d Stress Corrosion Cracking
The exact amount of chloride required to cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, the environment, and also because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even as little as 10 ppm can lead to cracking under some conditions. Generally, as seen in Sedriks (1996) and Davis (1987), stress corrosion cracking does not usually occur below about 140°F for sensitized alloys. According to Koch (1995), the presence of fluoride exacerbates intergranular stress corrosion cracking. With the proposed normal conditions, a 6% Mo is expected to be the minimum acceptable.

Steam ejectors will be used to empty the vessel. A band of C-276 is needed in the high temperature zone of the dome to prevent cracking at the nozzle entry.

Conclusion:
For the normal operating environment, a 6% Mo alloy is required.

e Crevice Corrosion
With the stated operating conditions, a 6% Mo alloy would be the minimum acceptable. Also see Pitting.

Conclusion:
A 6% Mo alloy is recommended.

f Corrosion at Welds
It is expected that the heat tint will be removed during normal operation. NiCrMo-3 or similar filler metal should be used to avoid low-molybdenum areas in the welds.

Conclusion:
Weld corrosion is not considered a problem.

PLANT ITEM MATERIAL SELECTION DATA SHEET

g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions are not conducive to microbial growth – the temperature is approximately correct but the pH is too acid.

Conclusion:
MIC is not likely a problem.

h Fatigue/Corrosion Fatigue
Corrosion fatigue is a not expected to be a problem.

Conclusions
Not expected to be a concern.

i Vapor Phase Corrosion
The vapor phase portion of the vessel is expected to be contacted with particles of waste from splashing. Vessel is fitted with wash rings. Recommend more pitting resistant 6% Mo alloy.

Conclusion:
Vapor phase corrosion is not a concern.

j Erosion
Based on past experiments by Smith & Elmore (1992), the solids are soft and erosion is not expected to be a concern for the vessel wall. At least 0.090 inch of additional N08367 or N08926 should be provided as localized protection for the applicable portions of the bottom head to accommodate PJM discharge velocities of up to 9.4 m/s with solids concentrations of 1.2 wt% for 100 % operation. A maximum solids concentration of 1.2 wt% occurs during normal operations using contract maximums in the leach case.

The wear of the PJM nozzles can occur from flow for both the discharge and reflood cycles of operation. At least 0.075 inch of additional N08367 or N08926 should be provided on the inner surface of the PJM nozzle to accommodate wear due to PJM discharge and suction velocities with solids concentrations up to 1.2 wt% for 100 % operation.

Conclusion:
The recommended corrosion allowance provides sufficient protection for erosion of the vessel walls. Additional localized protection for the bottom head will accommodate PJM discharge velocities and for the PJM nozzles will accommodate PJM discharge and reflood velocities.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
No contacting surfaces expected.

Conclusion:
Not applicable.

m Galvanic Corrosion
For passive alloys there is negligible potential difference so galvanic corrosion is not a concern.

Conclusion:
Not expected to be a concern.

n Cavitation
None expected.

Conclusion:
Not believed to be of concern.

o Creep
The temperatures are too low to be a concern.

Conclusion:
Not applicable.

p Inadvertent Nitric Acid Addition
Vessel normally operates at low pH.

Conclusion:
Not applicable.

PLANT ITEM MATERIAL SELECTION DATA SHEET

References:

1. Berhardsson, S, R Mellstrom, and J Oredsson, 1981, *Properties of Two Highly corrosion Resistant Duplex Stainless Steels*, Paper 124, presented at Corrosion 81, NACE International, Houston, TX 77218
2. Davis, JR (Ed), 1987, *Corrosion, Vol 13*, In "Metals Handbook", ASM International, Metals Park, OH 44073
3. Hamner, NE, 1981, *Corrosion Data Survey*, Metals Section, 5th Ed, NACE International, Houston, TX 77218
4. Koch, GH, 1995, *Localized Corrosion in Halides Other Than Chlorides*, MTI Pub No. 41, Materials Technology Institute of the Chemical Process Industries, Inc, St Louis, MO 63141
5. Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., New York, NY 10158
6. Smith, HD and MR Elmore, 1992, *Corrosion Studies of Carbon Steel under Impinging Jets of Simulated Slurries of Neutralized Current Acid Waste (NCAW) and Neutralized Cladding Removal Waste (NCRW)*, PNL-7816, Pacific Northwest Laboratory, Richland, Washington.
7. Wilding, MW and BE Paige, 1976, *Survey on Corrosion of Metals and Alloys in Solutions Containing Nitric Acid*, ICP-1107, Idaho National Engineering Laboratory, Idaho Falls, ID

Bibliography:

1. Agarwal, DC, *Nickel and Nickel alloys*, In: Revie, WW, 2000. *Uhlig's Corrosion Handbook*, 2nd Edition, Wiley-Interscience, New York, NY 10158
2. Davis, JR (Ed), 1994, *Stainless Steels*, In ASM Metals Handbook, ASM International, Metals Park, OH 44073
3. Jones, RH (Ed.), 1992, *Stress-Corrosion Cracking*, ASM International, Metals Park, OH 44073
4. Phull, BS, WL Mathay, & RW Ross, 2000, *Corrosion Resistance of Duplex and 4-6% Mo-Containing Stainless Steels in FGD Scrubber Absorber Slurry Environments*, Presented at Corrosion 2000, Orlando, FL, March 26-31, 2000, NACE International, Houston TX 77218
5. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158
6. Van Delinder, LS (Ed), 1984, *Corrosion Basics*, NACE International, Houston, TX 77084

PLANT ITEM MATERIAL SELECTION DATA SHEET

OPERATING CONDITIONS

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Acidic waste vessel (RLD-VSL-00007)

Facility HLW

In Black Cell? yes

Chemicals	Unit[1]	Contract Maximum		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l	2.28E-01	2.77E-01			
Chloride	g/l	4.96E-01	7.42E-01			
Fluoride	g/l	3.05E-01	4.95E-01			
Iron	g/l	1.64E+00	8.94E-01			
Nitrate	g/l	2.54E+01	2.57E+01			
Nitrite	g/l					
Phosphate	g/l	1.18E-02	2.74E-02			
Sulfate	g/l					
Mercury	g/l	2.72E+00	3.12E+00			
Carbonate	g/l					
Undissolved solids	wt %	1.20%	1.07%			Note 4
Other (NaMnO4, Pb,...)	g/l	7.85E-02	4.25E-02			
Other	g/l					
pH	N/A					Note 3
Temperature	°F					Note 2

List of Organic Species:

Notes:

1. Concentrations less than 1x 10^{-4} g/l do not need to be reported; list values to two significant digits max.
2. Tmin 137°F, T normal 138 °F, Tmax 143 °F
3. pH 2 to 14. Receives various streams of differing pH but is neutralized before transfer.
4. Receives non-routine high solids from SBS

Assumptions

PLANT ITEM MATERIAL SELECTION DATA SHEET

5.6.5 Acidic Waste Vessel (RLD-VSL-00007)

Routine Operations

The acidic waste vessel (RLD-VSL-00007) is in a black cell and collects liquid from the SBS (HOP-SCB-00001/2), the SBS condensate receiver vessels (HOP-VSL-00903/904), and the waste neutralization vessel (HDH-VSL-00003). The collected waste consists of SBS purge, WESP and HEME drainage, and neutralized canister decontamination waste. The vessel receives transfers approximately once per day. The vessel contents are sampled for pH before being transferred to the PT vessel PWD-VSL-00043. The PJMs keep the vessel contents well mixed for a representative sample. Sodium hydroxide is added to the vessel based on the sample analysis and the mass of effluent in the vessel. The vessel transfers to the pretreatment vessel PWD-VSL-00043 approximately once every day. The process flow diagrams for the RLD system (24590-HLW-M5-V17T-P0007001 and 24590-HLW-M5-V17T-P0007002) illustrate the RLD vessels, associated equipment, and stream data.

Non-Routine Operations that Could Affect Corrosion/Erosion

Receives high solids from the SBS.

PLANT ITEM MATERIAL SELECTION DATA SHEET

RLD-BRKPT-00007 & RLD-BRKPT-00009 (HLW)
Acidic Wash Transfer Breakpot

R10342879

- Design Temperature (°F) (max/min): 368/40
- Design Pressure (psig) (internal/external): 15/FV
- Location: incell

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on sheet 5 and 6

ISSUED BY
RDP-WTP-PDC
8/5/04
INIT DATE

Operating Modes Considered:

- Normal operations

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00		X
316L (S31603)	1.18	X	
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material: 316 (max 0.030% C; dual certified)

Recommended Corrosion Allowance: 0.04 inch (includes 0.00 inch erosion allowance)

Process & Operations Limitations:

- Develop procedure for thoroughly flushing with water.

STEVEN WAKEMAN VAIL
STATE OF WASHINGTON
39250
REGISTERED PROFESSIONAL ENGINEER
8/5/04
EXPIRES: 12/07/05

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

This bound document contains a total of 6 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
0	7/15/04	Issued for Permitting Use			

PLANT ITEM MATERIAL SELECTION DATA SHEET

Corrosion Considerations:

Breakpots are normally empty and at ambient temperature. Steam is used for transfer and breakpots could see steam temperatures but such conditions will be of short duration. Breakpots will routinely transfer effluent from RLD-VSL-00007 and RLD-VSL-00008.

a General Corrosion
Wilding and Paige (1976) have shown that in 5% nitric acid with 1000 ppm fluoride at 290°F, the corrosion rate of 304L can be kept as low as 5 mpy by the use of Al^{+++}. Additionally, Sedriks (1996) has noted with 10% (≈2N) nitric acid and 3,000 ppm fluoride at 158°F, the corrosion rate of 304L is over 4,000 mpy. Extrapolating acid concentration, fluoride concentration, and temperature, suggests the corrosion rate for 304L and 316L would be less than about 1 mpy. The presence of Al^{+++} is expected to reduce the corrosion rate to near zero. It is probable that 304L or 316L would be satisfactory at the listed conditions. The less control of the acid conditions, the more consideration that will have to be given to more corrosion resistant alloys.

Conclusion:
304L and 316L are expected to be sufficiently resistant to the waste solution with a probable general corrosion rate of less than 1 mpy. The uniform corrosion rate of higher alloys will be smaller.

b Pitting Corrosion
Chloride is known to cause pitting in acid and neutral solutions. Normally the vessel is to be at ambient temperatures, with possible brief excursions to steam temperatures at transfer, at a pH ranging from 2 to 14, based on upstream vessels RLD-VSL-00007 and RLD-VSL-00008. Extrapolating from Wilding & Paige data (1976), it appears that 304L would not pit due to the presence of the excess nitrate. Berhardsson et al (1981) have similar conclusions based solely on concentrations. However, 316L will provide added protection against chloride concentrate during operation and is recommended.

Conclusion:
Based on the stated operating conditions, 316L is expected to be satisfactory.

c End Grain Corrosion
End grain corrosion occurs in hot concentrated acid conditions.

Conclusion:
Not believed likely in this system.

d Stress Corrosion Cracking
The exact amount of chloride required to cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, the environment, and also because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even as little as 10 ppm can lead to cracking under some conditions. Generally, as seen in Sedriks (1996) and Davis (1987), stress corrosion cracking does not usually occur below about 140°F for sensitized alloys. With the proposed normal conditions, 316L is recommended.

Conclusion:
For the stated operating environment, 316L is acceptable.

e Crevice Corrosion
Assuming no adherent deposits remain, and the stated operating conditions, 316L is acceptable. Also see Pitting.

Conclusion:
A minimum of 316L is recommended.

f Corrosion at Welds
Weld corrosion is not considered a problem in the proposed environment.

Conclusion:
Weld corrosion is not considered a problem for this system.

g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions are not conducive to microbial growth.

Conclusion:
MIC is not considered a problem.

h Fatigue/Corrosion Fatigue
Corrosion fatigue is a not expected to be a problem.

Conclusions
Not expected to be a concern.

PLANT ITEM MATERIAL SELECTION DATA SHEET

i Vapor Phase Corrosion
Vapor phase corrosion is not expected to be a concern. Further, the presence of wash rings indicates deposits can be prevented.

Conclusion:
Not expected to be a concern

j Erosion
Velocities within the vessel are expected to be low.

Conclusion:
Not a concern.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
No contacting surfaces expected.

Conclusion:
Not applicable.

m Galvanic Corrosion
No dissimilar metals are present.

Conclusion:
Not a concern.

n Cavitation
None expected.

Conclusion:
Not believed to be of concern.

o Creep
The temperatures are too low to be a concern.

Conclusion:
Not applicable.

p Inadvertent Nitric Acid Addition
Higher chloride contents and higher temperatures usually require higher alloy materials. Nitrate ions inhibit the pitting and crevice corrosion of stainless alloys. Furthermore, nitric acid passivates these alloys; therefore, lower pH values brought about by increases in the nitric acid content of process fluid will not cause higher corrosion rates for these alloys. The upset condition that was most likely to occur is lowering of the pH of the vessel content by inadvertent addition of 0.5 M nitric acid. Lowering of pH may make a chloride-containing solution more likely to cause pitting of stainless alloys. Increasing the nitric acid content of the process fluid adds more of the pitting-inhibiting nitrate ion to the process fluid. In addition, adding the nitric acid solution to the stream will dilute the chloride content of the process fluid.

Conclusion:
The recommended materials will be able to withstand a plausible inadvertent addition of 0.5 M nitric acid.

PLANT ITEM MATERIAL SELECTION DATA SHEET

References:

1. Berhardsson, S, R Mellstrom, and J Oredsson, 1981, *Properties of Two Highly corrosion Resistant Duplex Stainless Steels*, Paper 124, presented at Corrosion 81, NACE International, Houston, TX 77218
2. Davis, JR (Ed), 1987, *Corrosion, Vol 13*, In "Metals Handbook", ASM International, Metals Park, OH 44073
3. Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., New York, NY 10158
4. Wilding, MW and BE Paige, 1976, *Survey on Corrosion of Metals and Alloys in Solutions Containing Nitric Acid*, ICP-1107, Idaho National Engineering Laboratory, Idaho Falls, ID

Bibliography:

1. Davis, JR (Ed), 1994, *Stainless Steels*, In ASM Metals Handbook, ASM International, Metals Park, OH 44073
2. Hamner, NE, 1981, *Corrosion Data Survey*, Metals Section, 5th Ed, NACE International, Houston, TX 77218
3. Jones, RH (Ed.), 1992, *Stress-Corrosion Cracking*, ASM International, Metals Park, OH 44073
4. Koch, GH, 1995, *Localized Corrosion in Halides Other Than Chlorides*, MTI Pub No. 41, Materials Technology Institute of the Chemical Process Industries, Inc, St Louis, MO 63141
5. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158
6. Van Delinder, LS (Ed), 1984, *Corrosion Basics*, NACE International, Houston, TX 77084

PLANT ITEM MATERIAL SELECTION DATA SHEET

OPERATING CONDITIONS

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Acidic waste transfer breakpot
(RLD-BRKPT-00007, RLD-BRKPT-00009)

Facility HLW

In Black Cell? Yes

Chemicals	Unit[1]	Contract Maximum		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l	4.33E-02	6.84E-02			
Chloride	g/l	1.49E-01	1.82E-01			
Fluoride	g/l	9.19E-02	1.22E-01			
Iron	g/l	4.19E-01	3.23E-01			
Nitrate	g/l	2.54E+01	2.57E+01			
Nitrite	g/l					
Phosphate	g/l	2.28E-03	4.77E-03			
Sulfate	g/l					
Mercury	g/l	5.15E-01	7.66E-01			
Carbonate	g/l					
Undissolved solids	wt %	0.35%	0.37%			
Other (Pb)	g/l	1.47E-02	1.06E-02			
Other	g/l					
pH	N/A					
Temperature	°F					Note 2

List of Organic Species:

Notes:

1. Concentrations less than 1x 10^{-4} g/l do not need to be reported; list values to two significant digits max.
2. Streams entering breakpots use steam for transfer for short duration, but breakpots are normally empty.

Assumptions

PLANT ITEM MATERIAL SELECTION DATA SHEET

5.6.3 Acidic Waste Transfer Breakpot (RLD-BRKPT-00007, RDL-BRKPT-00009)

Routine Operations

Receives effluent from RLD-VSL-00007 and RLD-VSL-00008, and transfers to PWD-VSL-00043.

Non-Routine Operations that Could Affect Corrosion/Erosion

None identified.

PLANT ITEM MATERIAL SELECTION DATA SHEET

R10344403

RLD-VSL-00008 (HLW)
Plant Wash and Drains Vessel

- Design Temperature (°F)(Max/min): 165/40
- Design Pressure (psig) (Max/min): 15/FV
- Location: incell
- PJM Discharge Velocity (fps): 26
- Drive Cycle: 25 %

Offspring items

RLD-VSL-00016A/B, RLD-RFD-00163A/B
RLD-PJM-00001 -- RLD-PJM-00004

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on sheets 6 and 7

ISSUED BY RPP-WTP PDC INT DATE 8/5/04

Operating Modes Considered:

- The vessel is always alkaline, pH 10, at the normal operating temperature.
- Acid from canister decontamination is present without neutralization and halide concentrations are small.
- NaOH is present without neutralization.
- The vessel is filled with process water with only small quantities of other chemicals.

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00		X
316L (S31603)	1.18	X	
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material: 316 (max 0.030% C; dual certified)
Steam ejectors and piping: UNS N06022

The vessel head on the inside of the vessel under nozzles 21, 22, 23, and 24 shall have a band of Hastelloy C-276 clad layer a minimum of 4 inch wide surrounding the outer perimeter of the nozzle pipe.

Recommended Corrosion Allowance: 0.04 inch (includes 0.00 inch erosion allowance; localized protection is provided as necessary and is discussed elsewhere)

Process & Operations Limitations:

- Develop rinsing/flushing procedure.
- Develop lay-up strategy.

STEVEN WAKEMAN VAIL
STATE OF WASHINGTON
39250
REGISTERED PROFESSIONAL ENGINEER
8/5/04
EXPIRES: 12/07/05

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

This bound document contains a total of 7 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
0	8/3/04	Issued for Permitting Use			

PLANT ITEM MATERIAL SELECTION DATA SHEET

Corrosion Considerations:

Vessel collects all vessel, sump, and plant washes from C3 and C5 areas within the HLW vitrification as well as wash water from cell walls, equipment exterior surfaces, stainless steel cladding, and bulges. Sodium hydroxide is added to adjust pH as necessary.

a General Corrosion
Hamner (1981) lists the corrosion rate for 304 (and 304L) in NaOH to be less than about 20 mpy at 77°F and over 20 mpy at 122°F. He shows 316 (and 316L) has a rate of less than 2 mpy up to 122°F and 50% NaOH. Sedriks (1996) states that the 300 series are acceptable in up to 50% NaOH at temperatures up to about 122°F or slightly above. Indications are that in pH 8 water, the uniform corrosion rate is negligible even at the design temperature.

The only concern is that if the vessel can actually receive un-neutralized canister decontamination solutions, then it will depend on how long they are present. If excess decontamination acid is present, the fluoride concentration is expected to be small and the excessive HNO_3/HF corrosion rates are not expected. Excess Ce^{IV} may be present in acid but this is not expected to be a concern.

Conclusion:
304L or 316L is acceptable for normal operating conditions.

b Pitting Corrosion
It is thought that in alkaline solution chlorides are likely to promote pitting only in tight crevices. Koch (1995) is of the opinion that fluoride will have little effect in an alkaline media.

Normally the vessel is to operate at 86°F. This acceptable for 316L as long as there is no concentration of neutralized solutions.
No significant concentrations of pitting agents are expected, particularly considering the concentration of nitrate. 316L is recommended.

If the vessel were filled with process water and left stagnant, there would be a tendency to pit. The time to initiate would depend on the source of the water, being shorter for filtered river water and longer for DIW. Pitting has been observed in both cases, and is likely because residual chlorides are likely to remain.

Conclusion:
Localized corrosion, such as pitting, is common but is not expected to be a concern under the given conditions. 316L is considered acceptable.

c End Grain Corrosion
End grain corrosion only occurs in metal with exposed end grains and in hot concentrated acid conditions.

Conclusion:
Not believed likely in this system.

d Stress Corrosion Cracking
The exact amount of chloride required to cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, and the environment. But it is also unknown because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even as little as 10 ppm can lead to cracking under some conditions. Further, as seen in Sedriks (1996) and Davis (1987), stress corrosion cracking does not usually occur below about 140°F.

Steam ejectors will be used to empty the vessel. A band of C-276 is needed in the high temperature zone of the dome to prevent cracking at the nozzle entry.

Conclusion:
Because of the normal operating environment as well as that which can occur during off normal conditions, 316L is recommended. The steam ejector should be Hastelloy C-22 or equivalent.

e Crevice Corrosion
Solids content could lead to deposits on the bottom of the vessel. At the normal temperature, 316L will be sufficiently resistant to crevice corrosion. In addition, see Pitting.

Conclusion:
Under the stated operating conditions, 316L appears satisfactory.

f Corrosion at Welds
Corrosion at welds is not considered a problem in the proposed environment.

Conclusion:
Weld corrosion is not considered a problem for this system.

PLANT ITEM MATERIAL SELECTION DATA SHEET

g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions are conducive to microbial growth though in this part of the system microbial contaminants are not expected.

Conclusion:
MIC is not considered a problem.

h Fatigue/Corrosion Fatigue
Corrosion fatigue is a not expected to be a problem.

Conclusions
Not expected to be a concern.

i Vapor Phase Corrosion
The vapor phase portion of the vessel is expected to be contacted with particles of waste from splashing. It is unknown whether this will be sufficiently washed or whether residual acids or solids will be present. In the former case, 304L would be satisfactory. If particles or droplets remain on the surface, concentration of the salts is feasible and could lead to pitting. 316L is the minimum recommended.

Conclusion:
Not expected to be a concern, although 316L should be used.

j Erosion
Based on past experiments by Smith & Elmore (1992), the solids are soft and erosion is not expected to be a concern for the vessel wall. At least 0.051 inch of additional 316L stainless steel should be provided as localized protection for the applicable portions of the bottom head to accommodate PJM discharge velocities of up to 8.9 m/s with solids concentrations of 26 wt% for 10 % of the time and 0.029% for 90 % of the time during 100 % operation. A maximum solids concentration of 26-wt% occurs during non-routine operations using contract maximums in the leach case.

The wear of the PJM nozzles can occur from flow for both the discharge and reflood cycles of operation. At least 0.040 inch of additional 316L stainless steel should be provided on the inner surface of the PJM nozzle to accommodate wear due to PJM discharge and suction velocities with solids concentrations up to 26 wt% for 10 % of the time and 0.029 % for 90 % of the time during 100 % operation.

Conclusion:
The recommended corrosion allowance provides sufficient protection for erosion of the vessel walls. Additional localized protection for the bottom head will accommodate PJM discharge velocities and for the PJM nozzles will accommodate PJM discharge and reflood velocities.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
No contacting surfaces expected.

Conclusion:
Not applicable.

m Galvanic Corrosion
For passive alloys there is negligible potential difference so galvanic corrosion is not a concern.

Conclusion:
Not expected to be a concern.

n Cavitation
None expected.

Conclusion:
Not believed to be of concern.

o Creep
The temperatures are too low to be a concern.

Conclusion:
Not applicable.

PLANT ITEM MATERIAL SELECTION DATA SHEET

p Inadvertent Nitric Acid Addition

Higher chloride contents and higher temperatures usually require higher alloy materials. Nitrate ions inhibit the pitting and crevice corrosion of stainless alloys. Furthermore, nitric acid passivates these alloys; therefore, lower pH values brought about by increases in the nitric acid content of process fluid will not cause higher corrosion rates for these alloys. The upset condition that was most likely to occur is lowering of the pH of the vessel content by inadvertent addition of 0.5 M nitric acid. Lowering of pH may make a chloride-containing solution more likely to cause pitting of stainless alloys. Increasing the nitric acid content of the process fluid adds more of the pitting-inhibiting nitrate ion to the process fluid. In addition, adding the nitric acid solution to the stream will dilute the chloride content of the process fluid.

Conclusion:

The recommended materials will be able to withstand a plausible inadvertent addition of 0.5 M nitric acid.

PLANT ITEM MATERIAL SELECTION DATA SHEET

References:

1. Davis, JR (Ed), 1987, *Corrosion, Vol 13*, In "Metals Handbook", ASM International, Metals Park, OH 44073
2. Hamner, NE, 1981, *Corrosion Data Survey*, Metals Section, 5th Ed, NACE International, Houston, TX 77218
3. Koch, GH, 1995, *Localized Corrosion in Halides Other Than Chlorides*, MTI Pub No. 41, Materials Technology Institute of the Chemical Process Industries, Inc, St Louis, MO 63141
4. Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., New York, NY 10158
5. Smith, HD and MR Elmore, 1992, *Corrosion Studies of Carbon Steel under Impinging Jets of Simulated Slurries of Neutralized Current Acid Waste (NCAW) and Neutralized Cladding Removal Waste (NCRW)*, PNL-7816, Pacific Northwest Laboratory, Richland, Washington.

Bibliography:

1. Agarwal, DC, *Nickel and Nickel alloys*, In: Revie, WW, 2000. *Uhlig's Corrosion Handbook*, 2nd Edition, Wiley-Interscience, New York, NY 10158
2. Davis, JR (Ed), 1994, *Stainless Steels*, In ASM Metals Handbook, ASM International, Metals Park, OH 44073
3. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158
4. Van Delinder, LS (Ed), 1984, *Corrosion Basics*, NACE International, Houston, TX 77084

PLANT ITEM MATERIAL SELECTION DATA SHEET

OPERATING CONDITIONS

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Plant wash and drains vessel (RLD-VSL-00008)

Facility HLW

In Black Cell? Yes

Chemicals	Unit[1]	Contract Maximum		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l	1.23E-02		1.71E+01	5.31E+01	
Chloride	g/l	2.55E-04		5.29E-01	7.42E-01	
Fluoride	g/l	1.65E-04		6.30E-01	7.51E-01	
Iron	g/l	1.34E-01	1.43E-04	1.88E+02	1.27E+02	
Nitrate	g/l	2.56E-02	2.65E-02	3.15E+01	3.40E+01	
Nitrite	g/l	8.24E-04		2.92E+00	3.39E+00	
Phosphate	g/l	2.31E-03		4.34E+00	1.33E+01	
Sulfate	g/l	4.11E-04		1.13E+00	1.36E+00	
Mercury	g/l	9.33E-04		2.72E+00	3.12E+00	
Carbonate	g/l	2.27E-03		4.02E+00	5.03E+00	
Undissolved solids	wt %	0.029%		26%	23%	
Other (NaMnO4, Pb,...)	g/l	4.93E-03		6.91E+00	4.69E+00	
Other	g/l					
pH	N/A					Note 3
Temperature	°F					Note 2

List of Organic Species:

Notes:

1. Concentrations less than 1x 10^{-4} g/l do not need to be reported; list values to two significant digits max.
2. Tmin 59 °F, Tnorm 86 °F, Tmax140 °F
3. pH 8 to 12.6; Average pH 10

Assumptions

PLANT ITEM MATERIAL SELECTION DATA SHEET

5.6.6 Plant Wash and Drains Vessel (RLD-VSL-00008)

Routine Operations

The plant wash and drains vessel (RLD-VSL-00008) is in a black cell and collects all vessel, sump, and plant washes from C3 and C5 areas within the HLW vitrification building. Vessel RLD-VSL-00008 also collects wash water from cell walls, equipment exterior surfaces, stainless steel cladding, and bulges. These effluents enter RLD-VSL-00008 via wash effluent breakpots RLD-BRKPT-00001 and RLD-BRKPT-00003. The PJMs keep the vessel contents well mixed for a representative sample. Sodium hydroxide is added to the vessel based on the sample analysis and the mass of effluent in the vessel. The vessel receives intermittent flows, and transfers to pretreatment vessel PWD-VSL-00043 when the batch is full or at the operator's discretion.

Non-Routine Operations that Could Affect Corrosion/Erosion

None identified.

PLANT ITEM MATERIAL SELECTION DATA SHEET

R10342880

RLD-BRKPT-00004 (HLW)
Wash Effluent Breakpot

- Design Temperature (°F)(max/min): 368/40
- Design Pressure (psig) (internal/external): 15/FV
- Location: incell

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on sheets 5 and 6

Cannot be maintained/replaced during 40-year design life

Operating Modes Considered:

- Normal operation.

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00	X	
316L (S31603)	1.18	X	
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material: 304 (max 0.030% C; dual certified)

Recommended Corrosion Allowance: 0.04 inch (includes 0.00 inch erosion allowance)

Process & Operations Limitations:

- Develop rinsing/flushing procedure for acid and water.

STEVEN WAKEMAN VAIL
STATE OF WASHINGTON
39250
REGISTERED PROFESSIONAL ENGINEER
8/5/04
EXPIRES: 12/07/05

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

This bound document contains a total of 6 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
0	8/5/04	Issued for Permitting Use		apl	

PLANT ITEM MATERIAL SELECTION DATA SHEET

Corrosion Considerations:

The breakpot is normally empty and at ambient temperature. Steam is used for transfer and breakpot could see steam temperatures but such conditions will be of short duration. The breakpot transfers wash effluent from various vessels during non-routine operations.

a General Corrosion
In normal operation, the vessels will contain only plant wash. It is also possible that the vessel would be flushed with process wash solvent; this solvent may be water, acid, or caustic.

The uniform corrosion rate of the 300 series stainless steels in DIW at temperatures up to about boiling are generally considered to be small, <1 mpy. The corrosion rate for the stated normal operating conditions is expected to be similar.

Conclusion:
304L or 316L is expected to be sufficiently resistant to the waste solution with a probable general corrosion rate of less than 1 mpy.

b Pitting Corrosion
Chloride is known to cause pitting of stainless steels and related alloys in acid and neutral solutions. It is thought that in alkaline solutions chlorides are less likely to promote pitting except in tight crevices such as under deposits. Koch (1995) is of the opinion that fluoride will have little effect in an alkaline media.

Normally the breakpot will be at ambient temperature, assume approximately 70 °F. At this temperature, based on the work of Zapp (2000) and others, 304L stainless steel would be acceptable in the proposed conditions.

Conclusion:
Based on the stated conditions, 304L will be acceptable.

c End Grain Corrosion
End grain corrosion only occurs in metal with exposed end grains and in hot concentrated acid conditions.

Conclusion:
Not expected in this system.

d Stress Corrosion Cracking
The exact amount of chloride required to cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, the environment and also because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even as little as 10 ppm can lead to cracking under some conditions. Generally, as seen in Sedriks (1996) and Davis (1987), chloride stress corrosion cracking does not usually occur below about 140°F. With the assumed operating temperature and alkaline conditions, 304L is expected to be satisfactory.

Conclusion:
At the normal operating conditions, 304L stainless is acceptable.

e Crevice Corrosion
It is assumed that no long-term adherent deposits or other crevices are present. Therefore, 304L is acceptable. In addition, see Pitting.

Conclusion:
At the normal operating conditions, 304L stainless is acceptable.

f Corrosion at Welds
Weld corrosion is not considered a problem in the proposed environment.

Conclusion:
Weld corrosion is not considered a problem for this system.

g Microbiologically Induced Corrosion (MIC)
The normal operating conditions are not conducive to microbial growth.

Conclusion:
MIC is not considered a problem.

h Fatigue/Corrosion Fatigue
Corrosion fatigue is a not expected to be a problem.

Conclusions
Not expected to be a concern.

PLANT ITEM MATERIAL SELECTION DATA SHEET

i Vapor Phase Corrosion
Vapor phase corrosion is not expected to be a concern. Further, the presence of wash rings indicates deposits can be prevented.

Conclusion:
Not expected to be a concern

j Erosion
Velocities within the vessel are expected to be low.

Conclusion:
Not a concern.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
No contacting surfaces expected.

Conclusion:
Not applicable.

m Galvanic Corrosion
No significantly dissimilar metals are present.

Conclusion:
Not expected to be a concern.

n Cavitation
None expected.

Conclusion:
Not believed to be of concern.

o Creep
The temperatures are too low to be a concern.

Conclusion:
Not applicable.

p Inadvertent Nitric Acid Addition
Higher chloride contents and higher temperatures usually require higher alloy materials. Nitrate ions inhibit the pitting and crevice corrosion of stainless alloys. Furthermore, nitric acid passivates these alloys; therefore, lower pH values brought about by increases in the nitric acid content of process fluid will not cause higher corrosion rates for these alloys. The upset condition that was most likely to occur is lowering of the pH of the vessel content by inadvertent addition of 0.5 M nitric acid. Lowering of pH may make a chloride-containing solution more likely to cause pitting of stainless alloys. Increasing the nitric acid content of the process fluid adds more of the pitting-inhibiting nitrate ion to the process fluid. In addition, adding the nitric acid solution to the stream will dilute the chloride content of the process fluid.

Conclusion:
The recommended materials will be able to withstand a plausible inadvertent addition of 0.5 M nitric acid.

PLANT ITEM MATERIAL SELECTION DATA SHEET

References:

1. Davis, JR (Ed), 1987, *Corrosion, Vol 13*, In "Metals Handbook", ASM International, Metals Park, OH 44073
2. Koch, GH, 1995, *Localized Corrosion in Halides Other Than Chlorides*, MTI Pub No. 41, Materials Technology Institute of the Chemical Process Industries, Inc, St Louis, MO 63141
3. Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., New York, NY 10158
4. Zapp, PE, 2000, *Material Corrosion and Plate-Out Test of Types 304L and 316L Stainless Steel*, WSRC-TR-2000-00434, Savannah River Site, Aiken, SC

Bibliography:

1. Carpenter Technology, 1994. *Stainless Steels*, Reading, PA
2. Craig, BD, Editor, 1989, *Handbook of Corrosion Data*, ASM International, Metals Park, OH 44073
3. Davis, JR (Ed), 1994, *Stainless Steels*, In ASM Metals Handbook, ASM International, Metals Park, OH 44073
4. Hamner, NE, 1981, *Corrosion Data Survey*, Metals Section, 5th Ed, NACE International, Houston, TX 77218
5. Jones, RH (Ed.), 1992, *Stress-Corrosion Cracking*, ASM International, Metals Park, OH 44073
6. Kain, RM, 1990. *Crevice Corrosion Behavior Of Stainless Steel In Chloride And Sulfate Containing Waters*, CORROSION 90 Paper No 384. Las Vegas, NACE
7. Revie, WW, 2000. *Uhlig's Corrosion Handbook*, 2nd Edition, Wiley-Interscience, New York, NY 10158
8. Szklarska-Smialowska, Z, 1986. *Pitting Corrosion*, NACE, Houston TX
9. Theus, GJ and JR Cels, 1974, *Fluoride Induced Intergranular Stress corrosion Cracking of Sensitized Stainless Steel*, Corrosion Problems in Energy Conversion and Generation.
10. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158
11. Van Delinder, LS (Ed), 1984, *Corrosion Basics*, NACE International, Houston, TX 77084

PLANT ITEM MATERIAL SELECTION DATA SHEET

OPERATING CONDITIONS

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Plant wash and drains transfer breakpot (RLD-BRKPT-00004)

Facility HLW

In Black Cell? Yes

OPERATING CONDITIONS

Chemicals	Unit[1]	Contract Maximum		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l					
Chloride	g/l					
Fluoride	g/l					
Iron	g/l					
Nitrate	g/l					
Nitrite	g/l					
Phosphate	g/l					
Sulfate	g/l					
Mercury	g/l					
Carbonate	g/l					
Undissolved solids	wt %					
Other (NaMnO4, Pb,...)	g/l					
Other	g/l					
pH	N/A					
Temperature	°F					Note 2

List of Organic Species:

Notes:

1. Concentrations less than 1x 10^{-4} g/l do not need to be reported; list values to two significant digits max.
2. Streams entering breakpots use steam for transfer for short duration, but breakpots are normally empty.

Assumptions

PLANT ITEM MATERIAL SELECTION DATA SHEET

5.6.2 Plant Wash and Drains Transfer Breakpot (RLD-BRKPT-00004)

Routine Operations

Receives effluent from RLD-VSL-00008 and HCP-SUMP-00001 and transfers to PWD-VSL-00033.

Non-Routine Operations that Could Affect Corrosion/Erosion

Spill of reagent, etc. to a sump.

PLANT ITEM MATERIAL SELECTION DATA SHEET

R10344402

RLD-VSL-00002 (HLW)
Offgas Drains Collection Vessel

- Design Temperature (°F)(max/min): 167/40
- Design Pressure (psig) (internal/external): 15/FV
- Location: incell

ISSUED BY
RPP-WTP PDC
UNIT DATE

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on sheets 5 and 6

The solution is from vapor phase carry-over from HOP-HEME-00001A/B and HOP-HEME-00002A/B.

Not maintainable during the 40 y design life.

Operating Modes Considered:

- The vessel is pH ≈ 2.4 at the normal operating temperature.

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00		X
316L (S31603)	1.18	X	
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material: 316 (max 0.030% C; dual certified)

Recommended Corrosion Allowance: 0.04 inch (includes 0.00 inch erosion allowance)

Process & Operations Limitations:

- Develop rinsing/flushing procedure for acid and water.
- Develop lay-up strategy.

STEVEN WAKEMAN VAIL
STATE OF WASHINGTON
39250
REGISTERED PROFESSIONAL ENGINEER
8/5/04
EXPIRES: 12/07/05

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

This bound document contains a total of 6 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
0	8/5/04	Issued for Permitting Use		GPR	

PLANT ITEM MATERIAL SELECTION DATA SHEET

Corrosion Considerations:

This vessel receives little or no transfer of effluent during normal operation. It can receive condensate from the low points in the main offgas ductrs downstream of the HOP HEMEs (consider composition consistent with that of the HEMEs), decontamination effluent from HLW C5 drains, and plant wash for level makeup.

a General Corrosion
Hamner (1981) lists corrosion rates for 304 (and 304L) and 316 (and 316L) of less than about 1 mpy in dilute nitric acid solutions. Based on Uhlig (1948), little uniform corrosion is expected at these conditions. The stated solutions are compatible with the 300 series stainless steel.

Conclusion:
The 300 series alloys are expected to be acceptable.

b Pitting Corrosion
No significant concentrations of pitting agents are shown. Due to the possibility of the solution concentrating in the vessel, 316L is recommended.

Conclusion:
Pitting is not expected to be a concern. 316L is minimum recommended.

c End Grain Corrosion
End grain corrosion only occurs in highly oxidizing acid conditions.

Conclusion:
Not applicable.

d Stress Corrosion Cracking
The exact amount of chloride required to cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, and the environment but also because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even as little as 10 ppm can lead to cracking under some conditions. As seen in Sedriks (1996) and Davis (1987), stress corrosion cracking does not usually occur below about 140°F.

With wash lines available and expected temperature shown at 125°F, there should be minimal chance of cracking.

Conclusion:
Based on the normal operating environment, 316L is recommended.

e Crevice Corrosion
With the stated operating conditions, 316L is the minimum acceptable. Also see Pitting.

Conclusion:
See Pitting.

f Corrosion at Welds
Corrosion at welds is not considered a problem in the proposed environment.

Conclusion:
Weld corrosion is not considered a problem for this system.

g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions are conducive to microbial growth though in this part of the system microbial contaminants are not expected.

Conclusion:
MIC is not considered a problem.

PLANT ITEM MATERIAL SELECTION DATA SHEET

h Fatigue/Corrosion Fatigue
Corrosion fatigue is a not expected to be a concern.

Conclusions
Not expected to be a concern.

i Vapor Phase Corrosion
Not expected in this system.

Conclusion:
Not a concern.

j Erosion
Velocities are expected to be low.

Conclusion:
Not a concern.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
No contacting surfaces expected.

Conclusion:
Not applicable.

m Galvanic Corrosion
No dissimilar metals are present.

Conclusion:
Not expected to be a concern.

n Cavitation
None expected.

Conclusion:
Not believed to be of concern.

o Creep
The temperatures are too low to be a concern.

Conclusion:
Not applicable.

p Inadvertent Nitric Acid Addition
Vessel operates at low pH under normal conditions.

Conclusion:
Not applicable.

PLANT ITEM MATERIAL SELECTION DATA SHEET

References:

1. Davis, JR (Ed), 1987, *Corrosion, Vol 13*, In "Metals Handbook", ASM International, Metals Park, OH 44073
2. Hamner, NE, 1981, *Corrosion Data Survey*, Metals Section, 5th Ed, NACE International, Houston, TX 77218
3. Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., New York, NY 10158
4. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, Inc., New York, NY 10158

Bibliography:

1. Agarwal, DC, *Nickel and Nickel alloys*, In: Revie, WW, 2000. *Uhlig's Corrosion Handbook*, 2nd Edition, Wiley-Interscience, New York, NY 10158
2. Davis, JR (Ed), 1994, *Stainless Steels*, In ASM Metals Handbook, ASM International, Metals Park, OH 44073
3. Van Delinder, LS (Ed), 1984, *Corrosion Basics*, NACE International, Houston, TX 77084

PLANT ITEM MATERIAL SELECTION DATA SHEET

OPERATING CONDITIONS

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Offgas drains collection vessel (RLD-VSL-00002)

Facility HLW

In Black Cell? Yes

Chemicals	Unit[1]	Contract Maximum		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l	3.33E-04	3.17E-04			
Chloride	g/l	1.01E-02	1.72E-02			
Fluoride	g/l	5.71E-03	1.21E-02			
Iron	g/l	2.08E-03	7.67E-04			
Nitrate	g/l	1.13E+00	7.67E-01			
Nitrite	g/l					
Phosphate	g/l					
Sulfate	g/l					
Mercury	g/l	6.77E-01	5.78E-01			
Carbonate	g/l					
Undissolved solids	wt %	0.07%	0.06%			
Other (NaMnO4, Pb,...)	g/l					
Other	g/l					
pH	N/A					Note 2
Temperature	°F					Note 3

List of Organic Species:

Notes:

1. Concentrations less than 1x 10^{-4} g/l do not need to be reported; list values to two significant digits max.
2. pH $\leq$2.5 to 6.5, assumes condensate is worst case
3. Tmin 59 °F, Tnorm 125 °F, Tmax 141 °F

Assumptions

PLANT ITEM MATERIAL SELECTION DATA SHEET

5.6.4 Offgas Drains Collection Vessel (RLD-VSL-00002)

Routine Operations

The offgas drains collection vessel (RLD-VSL-00002) is in a black cell and receives little or no transfer of effluent during normal operation. Vessel RLD-VSL-00002 receives the following: condensate from the low points in the main offgas ducts downstream of the HEMEs (HOP-HEME-00001A/B and HOP-HEME-00002A/B); condensate from the pulse ventilation system header; and plant wash for level makeup to maintain hydraulic seal between the pulse jet ventilation system (PJV), the primary offgas system (HOP) and the C5 cell. The vessel contents are transferred to the plant wash and drains vessel RLD-VSL-00008. The drain lines must be dipped below the liquid level in the vessel to maintain a static water column in the drain line that will balance the pressure differential between the drain location and the vessel vent system. To ensure that the drain lines are below the liquid level, makeup water from the plant wash system will be added to the vessel to compensate for evaporation when condensation does not occur in the offgas system.

Non-Routine Operations that Could Affect Corrosion/Erosion

Receives highly acidic effluent from the HEME.

Attachment 51 – Appendix 10.10
High Level Waste Building
Critical Systems Equipment/Instrument List

Where information regarding treatment, management, and disposal of the radioactive source, byproduct material, and/or special nuclear components of mixed waste (as defined by the Atomic Energy Act of 1954, as amended) has been incorporated into this permit, it is not incorporated for the purpose of regulating the radiation hazards of such components under the authority of this permit and chapter 70.105 RCW. In the event of any conflict between Permit Condition III.10.A. and any statement relating to the regulation of source, special nuclear, and byproduct material contained in portions of the permit application that are incorporated into this permit, Permit Condition III.10.A. will prevail.

Additional appendices will be added to this appendix as new information is incorporated into this permit.

Drawings and Documents

Attachment 51 – Appendix 10.10

High Level Waste Building
Critical Systems Equipment/Instrument List

The following drawings have been incorporated into Appendix 10.10 and can be viewed at the Ecology Richland Office. **New drawings are in bold lettering**.

Drawing/Documents	**Description**
Rev 01-17-2007	**Room and Equipment List for EL.-21**
Rev 01-17-2007	**Room and Equipment List for EL. 0**
Rev 01-17-2007	**Room and Equipment List for EL. 37**
Rev 01-17-2007	**Room and Equipment List for EL. 58**
RESERVED	RESERVED

HLW Vitrification Facility
Room and Equipment List for El. 0'

Room	Room Description	Equipment Number	Equipment Description
MISCELLANEOUS UNITS			
H-A123	Secondary Offgas Oxidizer Room	HOP-SCO-00001	Thermal Catalytic Oxidizer (Skid HOP-SCO-00002)
		HOP-SCR-00001	NOx Selective Catalytic Reducer (Catalyst Skid HOP-SCO-00002)
		HOP-HTR-00001	Catalyst Skid Electric Heater (Catalyst Skid HOP-SCO-00002)
		HOP-HX-00001	Catalyst Skid Preheater (Catalyst Skid HOP-SCO-00002)
		HOP-SCO-00004	Thermal Catalytic Oxidizer (Catalyst Skid HOP-SCO-00003)
		HOP-SCR-00002	NOx Selective Catalytic Reducer (Skid HOP-SCO-00003)
		HOP-HTR-00007	Catalyst Skid Electric Heater (Catalyst Skid HOP-SCO-00003)
		HOP-HX-00003	Catalyst Skid Electric Preheater (Catalyst Skid HOP-SCO-00003)
		HOP-HX-00002	Silver Mordenite Preheater
		HOP-HX-00004	Silver Mordenite Preheater
		HOP-ADBR-00001A	Activated Carbon Adsorber
		HOP-ADBR-00001B	Activated Carbon Adsorber
		HOP-ADBR-00002A	Activated Carbon Adsorber
		HOP-ADBR-00002B	Activated Carbon Adsorber
CONTAINMENT BUILDINGS			
H-0136	Canister Handling Cave	HPH-SUMP-00001	Sump
		RLD-EJCTR-00029	Sump Ejector
		HPH-SUMP-00005	Sump
		RLD-EJCTR-00051	Sump Ejector
H-0133	Canister Swab and Monitoring Cave	N/A	Contains No Permitted Equipment
H-0126A/B H-B028	Drum Swabbing and Monitoring Area	N/A	Contains No Permitted Equipment

HLW Vitrification Facility
Room and Equipment List for El. 0'

Room	Room Description	Equipment Number	Equipment Description
H-0104	Filter Cave	HOP-HEPA-00001A	HEPA Filter
		HOP-HEPA-00001B	HEPA Filter
		HOP-HEPA-00002A	HEPA Filter
		HOP-HEPA-00002B	HEPA Filter
		HOP-HEPA-00007A	HEPA Filter
		HOP-HEPA-00007B	HEPA Filter
		HOP-HEPA-00008A	HEPA Filter
		HOP-HEPA-00008B	HEPA Filter
		PJV-HEPA-00004A	HEPA Filter
		PJV-HEPA-00004B	HEPA Filter
		PJV-HEPA-00005A	HEPA Filter
		PJV-HEPA-00005B	HEPA Filter
		HOP-HTR-00001B	HEPA Electric Preheater
		HOP-HTR-00002A	HEPA Electric Preheater
		HOP-HTR-00005A	HEPA Electric Preheater
		HOP-HTR-00005B	HEPA Electric Preheater
		PJV-HTR-00002	PJV Electric Preheater
CONTAINMENT BUILDINGS (WITH MISCELLANEOUS UNITS AND TANKS)			
H-0117	Melter Cave No. 1 (includes C3/C5 Airlock and Equipment Decontamination Pit)	HMP-MLTR-00001	Melter 1
		HOP-FCLR-00001	Film Cooler
		HOP-FCLR-00003	Film Cooler
		HSH-SUMP-00003	Sump

HLW Vitrification Facility
Room and Equipment List for El. 0'

Room	Room Description	Equipment Number	Equipment Description
		RLD-EJECTR-00171	Sump Ejector
		HOP-SCB-00001	Melter 1 Submerged Bed Scrubber
		HOP-HEME-00001A	Melter 1 High Efficiency Mist Eliminator
		HOP-HEME-00001B	Melter 1 High Efficiency Mist Eliminator
		HFP-VSL-00001	Melter 1 Feed Preparation Vessel
		HFP-VSL-00002	Melter 1 Feed Vessel
		HFP-SUMP-00002	Sump
		RLD-EJECTR-00172	Sump Ejector
H-0310A	Equipment Decontamination Pit	HSH-TK-00001	Melter 1 Decontamination Tank
		HSH-PMP-00001	Pump
		HSH-SUMP-00008	Sump
		RLD-EJCTR-00026	Sump Ejector
H-0116B	Melter Cave No. 1- C3/C5 Airlock	N/A	Contains No Permitted Equipment
H-0106	Melter Cave No. 2 (includes C3/C5 Airlock and Equipment Decontamination Pit)	HMP-MLTR-00002	Melter 2
		HOP-FCLR-00002	Film Cooler
		HOP-FCLR-00004	Film Cooler
		HSH-SUMP-00007	Sump
		RLD-EJECTR-00179	Sump Ejector
		HOP-SCB-00002	Melter 2 Submerged Bed Scrubber
		HOP-HEME-00002A	Melter 2 High Efficiency Mist Eliminator
		HOP-HEME-00002B	Melter 2 High Efficiency Mist Eliminator
		HFP-VSL-00005	Melter 2 Feed Preparation Vessel
		HFP-VSL-00006	Melter 2 Feed Vessel

HLW Vitrification Facility
Room and Equipment List for El. 0'

Room	Room Description	Equipment Number	Equipment Description
H-0304A		HFP-SUMP-00005	Sump
		RLD-EJECTR-00178	Sump Ejector
	Equipment Decontamination Pit	HSH-TK-00002	Melter 2 Decontamination Tank
		HSH-PMP-00002	Pump
		HSH-SUMP-00009	Sump
		RLD-EJCTR-00173	Sump Ejector
H-0105B	Melter Cave No. 2 - C3/C5 Airlock	N/A	Contains No Permitted Equipment
CONTAINER STORAGE AREAS			
H-0132	Canister Storage Cave	N/A	Contains No Permitted Equipment
H-0130	Loading Area	N/A	Contains No Permitted Equipment
HC0108/ 0109/0110	East Corridor El. 0'	N/A	Contains No Permitted Equipment

HLW Vitrification Facility
Room and Equipment List for El. -21'

Room	Room Description	Equipment Number	Equipment Description
MISCELLANEOUS UNITS			
H-B001B	Secondary Offgas	HOP-ABS-00002	Silver Mordenite Column
		HOP-ABS-00003	Silver Mordenite Column
H-B001C	Secondary Offgas Fan Room	HOP-FAN-00001A	Booster Extraction Fan
		HOP-FAN-00001B	Booster Extraction Fan
		HOP-FAN-00001C	Booster Extraction Fan
		HOP-FAN-00009A	Booster Extraction Fan
		HOP-FAN-00009B	Booster Extraction Fan
		HOP-FAN-00009C	Booster Extraction Fan
TANK SYSTEMS			
H-B005	SBS Drains Collection Cell No. 2	HOP-VSL-00904	Melter 2 SBS Condensate Receiver Vessel
		HOP-SUMP-00008	Sump
		RLD-EJCTR-00176A	Sump Ejector
		RLD-EJCTR-00176B	Sump Ejector
H-B014	Wet Process Cell (North)	RLD-VSL-00002	Offgas Drains Collection Vessel
		RLD-SUMP-00001	Sump
		RLD-EJCTR-00052A	Sump Ejector
		RLD-EJCTR-00052B	Sump Ejector
	Wet Process Cell (South)	RLD-VSL-00007	Acidic Waste Vessel
		RLD-VSL-00008	Plant Wash and Drains Vessel
		HCP-SUMP-00001	Sump

HLW Vitrification Facility
Room and Equipment List for El. -21'

Room	Room Description	Equipment Number	Equipment Description
		RLD-EJCTR-00049A	Sump Ejector
		RLD-EJCTR-00049B	Sump Ejector
		RLD-BRKPT-00004	Breakpot
		RLD-BRKPT-00007	Breakpot
		RLD-BRKPT-00009	Breakpot
H-B021	SBS Drain Collection Cell No. 1	HOP-VSL-00903	Melter 1 SBS Condensate Receiver Vessel
		HOP-SUMP-00003	Sump
		RLD-EJCTR-00053A	Sump Ejector
		RLD-EJCTR-00053B	Sump Ejector
H-B035	Canister Decon Cave	HDH-VSL-00002	Canister Decon Vessel 1
		HDH-VSL-00003	Waste Neutralization Vessel
		HDH-VSL-00004	Canister Decon Vessel 2
		HDH-SUMP-00003	Sump
		RLD-EJCTR-00054	Sump Ejector
H-B039B/	Canister Rinse Tunnel	HDH-VSL-00001	Canister Rinse Vessel
		HDH-SUMP-00001	Sump
		RLD-EJCTR-00055	Sump Ejector
H-B039A	Canister Rinse-Bogie Maintenance Room	HDH-SUMP-00002	Sump
		RLD-PMP-00023	Sump Pump
CONTAINMENT BUILDINGS			
H-B005A	Pour Tunnel No. 2	N/A	Contains No Permitted Equipment
H-B032	Pour Tunnel No. 1	N/A	Contains No Permitted Equipment

HLW Vitrification Facility
Room and Equipment List for El. 37'

Room	Room Description	Equipment Number	Equipment Description
MISCELLANEOUS UNITS			
H-0302	Active Services Cell - Melter No. 2	HOP-WESP-00002	Wet Electrostatic Precipitator
		HFP-SUMP-00004	Sump/Gravity Drain
H-0308	Active Services Cell - Melter No. 1	HOP-WESP-00001	Wet Electrostatic Precipitator
		HFP-SUMP-00001	Sump/Gravity Drain
CONTAINMENT BUILDING			
H-0311A/B	C3 Workshop	N/A	Contains No Permitted Equipment

HLW Vitrification Facility
Room and Equipment List for El. 58'

Room	Room Description	Equipment Number	Equipment Description
MISCELLANEOUS UNITS			
H-0429	Vessel Vent Exhaust Filter Room	HOP-FAN-00008A	Stack Extraction Fan
		HOP-FAN-00008B	Stack Extraction Fan
		HOP-FAN-00008C	Stack Extraction Fan
		HOP-FAN-00010A	Stack Extraction Fan
		HOP-FAN-00010B	Stack Extraction Fan
		HOP-FAN-00010C	Stack Extraction Fan
H-0424	Services Room	PJV-FAN-00002A	Pulse Jet Fan
		PJV-FAN-00002B	Pulse Jet Fan
CONTAINMENT BUILDING			
H-0410B/ H-0411	Waste Handling Area	N/A	Contains No Permitted Equipment

Attachment 51 – Appendix 10.11
High Level Waste Building
IQRPE Reports

Where information regarding treatment, management, and disposal of the radioactive source, byproduct material, and/or special nuclear components of mixed waste (as defined by the Atomic Energy Act of 1954, as amended) has been incorporated into this permit, it is not incorporated for the purpose of regulating the radiation hazards of such components under the authority of this permit and chapter 70.105 RCW. In the event of any conflict between Permit Condition III.10.A. and any statement relating to the regulation of source, special nuclear, and byproduct material contained in portions of the permit application that are incorporated into this permit, Permit Condition III.10.A. will prevail.

Additional appendices will be added to this appendix as new information is incorporated into this permit.

Drawings and Documents

Attachment 51 – Appendix 10.11
High Level Waste Building
IQRPE Reports

The following drawings have been incorporated into Appendix 10.11 and can be viewed at the Ecology Richland Office. **New drawings are in bold lettering**.

Drawings/Documents	Description
24590-101-SC-HXYG-0074-03-00003, Rev 00A	IQRPE Integrity Assessment Report for HOP-ABS-00002/3
24590-CM-HC4-HXYG-00138-01-00021, Rev 00B	IQRPE Integrity Assessment Report for HOP Miscellaneous Unit Sub-systems
24590-CM-HC4-HXYG-00138-01-08, Rev 00B	IQRPE Integrity Assessment Report for Below Grade Secondary Containment
24590-CM-HC4-HXYG-00138-01-11, Rev 00B	IQRPE Integrity Assessment Report for El. 0 Secondary Containment
24590-CM-HC4-HXYG-00138-01-15, Rev 00B	IQRPE Integrity Assessment Report for HLW Portion of Below Grade Transfer Lines, Secondary Containment, Ancillary Equipment, and Corrosion Assessment, Rev. 1
24590-CM-HC4-HXYG-00138-01-17, Rev 00A	IQRPE Integrity Assessment Report for HOP-VSL-00903/4
24590-CM-HC4-HXYG-00138-02-08, Rev 00B	IQRPE Integrity Assessment Report for El. -21 HOP Ancillary Equipment
24590-CM-HC4-HXYG-00138-02-00010, Rev 00A	IQRPE Integrity Assessment Reports PVV System Ancillary Equipment
24590-CM-HC4-HXYG-00138-02-00024, Rev 00A	IQRPE Integrity Assessment Report for HDH-VSL-00001/2/3/4
24590-CM-HC4-HXYG-00138-02-00025, Rev 00B	IQRPE Integrity Assessment Report for El. 0 to 58 HOP Ancillary Equipment
24590-CM-HC4-HXYG-00138-02-00026, Rev 00A	IQRPE Integrity Assessment Report for El. 0 HOP Miscellaneous Unit Subsystems
24590-CM-HC4-HXYG-00138-02-00030, Rev 00A	IQRPE Integrity Assessment Report for El. 0 HFP Ancillary Equipment
24590-CM-HC4-HXYG-00138-02-00042, Rev 00A	IQRPE Integrity Assessment Report for El. 37 Secondary Containment
24590-CM-HC4-HXYG-00138-02-00043, Rev 00A	IQRPE Integrity Assessment Report for RLD-VSL-00002/7/8
24590-CM-HC4-HXYG-00138-02-00044, Rev 00A	IQRPE Integrity Assessment Report for El. 21 RLD Ancillary Equipment
24590-CM-HC4-HXYG-00138-02-00048, Rev 00A	IQRPE Integrity Assessment Report for PJV Ancillary Equipment
24590-CM-HC4-HXYG-00138-02-00049, Rev 00A	IQRPE Integrity Assessment Report for PJV-HEPA-00004A/4B/5A/5B and PJV-HTR-00002
24590-CM-HC4-HXYG-00138-02-00050, Rev 00A	IQRPE Integrity Assessment Report for HSH-TK-00001/2
24590-CM-HXYG-00138-02-00055 Rev. 00A	IQRPE Integrity Assessment Report for HDH Ancillary Equipment
24590-CM-HC4-HXYG-00211 AREVA-IA-084, Rev 0	IQRPE Integrity Assessment Report for Melter Process HMP System Miscellaneous Treatment Unit
24590-CM-HC4-HXYG-00211 AREVA-IA-082, Rev 1	IQRPE Integrity Assessment Report for Melter Process HMP System Miscellaneous Treatment Unit Subsystem Equipment Ancillary Equipment
RESERVED	RESERVED

Bechtel National, Inc

Job No 24590

SUPPLIER DOCUMENT STATUS

1. [X] **Work may proceed.**
2. [ ] **Revise and resubmit. Work may proceed subject to resolution of indicated comments.**
3. [ ] **Revise and resubmit. Work may not proceed.**
4. [ ] **Review not required. Work may proceed.**

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations.

REVIEWED										EJNS 8/12

G-321 Document Category N/A
[From Supplement A to G-321-E (E) or G-321-V (V), as applicable, or "N/A" if SSRS is used]

Supersedes BNI Document No. N/A Rev. _____
[When applicable]

Accepted by DC Pfluger (Print Name) [signature] (Signature) 1/28/04 (Date)

Released by N/A (Print Name) _____ (Signature) _____ (Date)
[When applicable]

416 GP&S 7-03

24590-101-SC-HXYG-0074-03-00003

REV. 00A

SUBCONTRACT SUBMITTAL

R L0193003

COGEMA-IA-032, Rev. 0

IQRPE REVIEW -
HIGH LEVEL WASTE (HLW) BELOW GRADE MISCELLANEOUS THERMAL UNITS (HOP SYSTEM) SILVER MORDENITE COLUMNS HOP-ABS-00002 & -00003

"I, John T. Baxter have reviewed, and certified a portion of the design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by Department of Energy, Office of River Protection, Richland, Washington. My duties were independent review of the current design for the High-Level Waste (HLW) Below Grade Miscellaneous Thermal Units (HOP System) Silver Mordenite Columns HOP-ABS-00002 & -00003 as required by The Dangerous Waste Regulations, namely, WAC 173-303-640(3) applicable paragraphs, i.e., (a) through (g)."

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

The documentation reviewed indicate that the design intent fully satisfies the requirements of the WAC.

The attached review is six (6) sheets numbered one (1) through six (6).

RPP-WTP
RECEIVED
JAN 27 2004
BY PDC

JOHN T. BAXTER
STATE OF WASHINGTON
18978
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES: 10/28/04

John T. Baxter
Signature

01/26/2004
Date

24590-101-SC-HX9G-0074-03-00003, REV. 00A
1-27-04

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH LEVEL WASTE (HLW) BELOW GRADE MISCELLANEOUS THERMAL UNITS (HOP SYSTEM) SILVER MORDENITE COLUMNS HOP-ABS-00002 & -00003

COGEMA-IA-032
Rev. 0

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

Scope	Scope of this Integrity Assessment	This Integrity Assessment addresses the Silver Mordenite Columns, HOP-ABS-00002 & -00003 which are components of the HLW Melter 1/2 Secondary Offgas Treatement Systems (HOP). These adsorber columns are located in room H-B001B at elevation (-) 21'-0" in the High Level Waste Vitrification Building.
References	Drawings, Mechanical Systems Data Sheets, and System Description	24590-HLW-M5-V17T-P0004, Rev. 1, Process Flow Diagram HLW Vitrification Melter 1 Secondary Offgas Treatment (System HOP); 24590-HLW-M5-V17T-P20004, Rev. 0, Process Flow Diagram HLW Vitrification Melter 2 Secondary Offgas Treatment (System HOP); 24590-HLW-P1-P01T-P0001, Rev. 5 , HLW Vitrification Building General Arrangement Plan at EL. (-) 21'-0"; Mechanical Systems Data Sheet: Vessel, 24590-HLW-MKD-HOP-00014, Rev. 3, Melter 1 Silver Mordenite Column HOP-ABS-00002; Mechanical Systems Data Sheet: Vessel, 24590-HLW-MKD-HOP-00017, Rev. 3, Melter 2 Silver Mordenite Column HOP-ABS-00003; 24590-HLW-3YD-HOP-00001, Rev. 0, Systems Description for HLW Melter Offgas Treatment Process and Process Vessel Vent Extraction (HOP and PVV Systems); System Description Change Notice (SDCN) SDCN No. 24590-HLW-3YN-HOP-00001 for System Description No. 24590-HLW-3YD-HOP-00001, Rev. 0; SDCN No. 24590-HLW-3YN-HOP-00002 for System Description No. 24590-HLW-3YD-HOP-00001, Rev. 0; SDCN No. 24590-HLW-3YN-HOP-00003 for System Description No. 24590-HLW-3YD-HOP-00001, Rev. 0

Summary of Assessment

For each item of "Information Assessed" (i.e., Criteria) on the following pages, the items listed under "Source of Information" were reviewed and found to furnish adequate design controls and requirements to assure the design intent fully satisfies the WAC requirements.

	Information Assessed	Source of Information	Assessment
Design	Vessel design standards are appropriate and adequate for the vessel's intended use.	Drawings and Mechanical Systems Data Sheets listed above under references; 24590-HLW-3PS-MBT0-T0001, Rev. 4, Engineering Specification for Silver Mordenite Column Design and Fabrication; ASME AG-1-1997, Code on Nuclear Air and Gas Treatment; ASME AG-1a-2000, Addenda to ASME AG-1-1997, Code on Nuclear Air and Gas Treatment; ASME N509-1989, Nuclear Power Plant Air-Cleaning Units and Components; ASME Boiler & Pressure Vessel (B & PV) Code, Section VIII, Div. 1, Rules for Construction of Pressure Vessels	The HLW Silver Mordenite Columns (HOP-ABS-00002 & -00003) are components in the Melter 1/2 Secondary Offgas Treatment Systems (HOP). These columns are located in Room H-B001B at elevation (-) 21'-0" as shown on the HLW Vitrification Building General Arrangement Plan. They are accessible for maintenance. The Engineering Specification for Silver Mordenite Column Design and Fabrication requires that these columns be designed, fabricated, and tested in accordance with a consistent set of requirements taken from ASME AG-1-1997, ASME AG-1a-2000, and ASME N509-1989. Supplementary requirements are specified in the Engineering Specification for Silver Mordenite Column Design and Fabrication. The supplementary requirements include structural design requirements, positive material identification, fabrication tolerances, acceptable welding procedures for the silver mordenite column assemblies, welder qualifications and testing records, NDE inspections and records, and packaging, shipping, handling and storage requirements. The column housings pressure boundaries are to be designed in accordance with the ASME B & PV Code, Section VIII, Div. 1. The columns are identified as Quality Level (QL-2) and Seismic Category (SC-III) in the Mechanical Systems Data Sheets. These are adequate and acceptable design standards for the Silver Mordenite Columns..

	Information Assessed	Source of Information	Assessment
Design	If a non-standard vessel is to be used, the design calculations demonstrate sound engineering principles of construction.	Drawings and Mechanical Systems Data Sheets listed above under References	The HLW Silver Mordenite Columns (HOP-ABS-00002 & -00003) are components in the Melter 1/2 Secondary Offgas Treatment Systems (HOP). These columns are standard offgas treatment assemblies that are shop fabricated. The Mechanical Systems Data Sheets require that the ASME AG-1/1a and ASME Section VIII, Division 1 assemblies be delivered after design, fabrication, inspection, and testing. The Silver Mordenite Columns design standards are appropriate and adequate for the intended service.
	Vessel has adequate strength, after consideration of the corrosion allowance, to withstand the operating pressure, operating temperature, and seismic loads.	Drawings and Mechanical Systems Data Sheets listed above under references; 24590-HLW-3PS-MBT0-T0001, Rev. 4, Engineering Specification for Silver Mordenite Column Design and Fabrication; 24590-WTP-3PS-FB01-T0001, Rev. 0, Engineering Specification for Structural Design Loads for Seismic Category III and IV Equipment and Tanks; Uniform Building Code (UBC), 1997, International Conference of Building Officials	The Mechanical Systems Data Sheets identify the Silver Mordenite Columns operating pressure and temperature ranges, the materials selected for the columns shells and internal supports, the corrosion allowance(s), and the columns quality levels which determine the requirements for seismic design. The design specifications for the vessels require specific consideration of the operating pressures and temperatures and seismic loads in the design process. ASME Section VIII, Div. 1 requires that corrosion allowance material not be considered when evaluating the adequacy of vessel components for these loads at end of life. Detailed requirements for seismic design of the columns are furnished in the Engineering Specification for Structural Design Loads for Seismic Category III and IV Equipment and Tanks. Seismic design loads are taken from the UBC and Level C service limits are taken from ASME AG-1 and ASME, Section VIII, Div. 1. These codes and standards are adequate and appropriate for design of the Silver Mordenite Columns to withstand operating pressure and temperature loads and seismic loads for the specified design life while considering corrosion allowance.

	Information Assessed	Source of Information	Assessment
Foundation	Vessel foundation will maintain the load of a full vessel.	Drawings listed above under references; 24590-HLW-3PS-MBT0-T0001, Rev. 4, Engineering Specification for Silver Mordenite Column Design and Fabrication; 24590-WTP-DC-ST-01-001, Rev. 0, Structural Design Criteria	The Engineering Specification for Silver Mordenite Column Design and Fabrication requires that the Silver Mordenite Column Support Frames are to be designed in accordance with the provisions in the Structural Design Criteria. The codes and standards listed in the Structural Design Criteria are adequate and appropriate for design of the column support frames.
	If in an area subject to flooding, the vessel is anchored.	Drawings, System Description, and SDCNs listed above under references; 24590-HLW-3PS-MBT0-T0001, Rev. 4, Engineering Specification for Silver Mordenite Column Design and Fabrication	The HLW Silver Mordenite Columns (HOP-ABS-00002 & -00003) are components in the Melter 1/2 Secondary Offgas Treatment Systems (HOP). This system handles offgas vapors from the melters and process vessels ventilation. Cell H-B001B contains only components of this offgas system, therefore there are no local sources of liquids to flood the cell except for firewater from the sprinkler system. Design for flooding is not a required load case in the Engineering Specification for Silver Mordenite Column Design and Fabrication. The columns are anchored to provide for adequate seismic resistance.
	Vessel system will withstand the effects of frost heave.	Drawings listed above under references; 24590-WTP-DC-ST-01-001, Rev. 0, Structural Design Criteria	The Structural Design Criteria document requires that all structural foundations extend a distance below grade that exceeds the depth of the frost line in order to preclude frost heave. The frost line is 30 in. below grade. Therefore, the Silver Mordenite columns located in a below grade room in the HLW Vitrification Building are not subject to frost heave.

	Information Assessed	Source of Information	Assessment
Waste Characteristics	Characteristics of the waste to be stored or treated have been identified (ignitable, reactive, toxic, specific gravity, vapor pressure, flash point, storage temperature)	Mechanical Systems Data Sheets listed above under References; Plant Item Material Selection Data Sheet, 24590-HLW-N1D-HOP-P0006, Rev. 1, Silver Mordenite Column HOP-ABS-00002 & 3 (HLW); System Description and System Description Change Notices listed above under References	The Mechanical Systems Data Sheets present the offgas specific gravity, operating temperatures and pressures. The Plant Item Material Selection Data Sheet addresses the chemical composition of the offgas and the normal operation and potential accident temperatures to select appropriate Silver Mordenite Column materials and specify the corrosion allowance. The main safety function of the columns is to provide protection for the facility workers from the hazardous gases in the Melter 1/2 offgas systems. The System Description identifies that the offgas in the Silver Mordenite Columns is hazardous, but not ignitable or flammable. The columns are designed to remove gaseous I-129 and volatile forms of chlorine and fluorine from the offgas. The columns design is required to provide an intact housing pressure boundary during normal operations and during and after earthquake loads.
	Vessel is designed to store or treat the wastes with the characteristics defined above and any treatment reagents.	Plant Item Material Selection Data Sheet, 24590-HLW-N1D-HOP-P0006, Rev. 1, Silver Mordenite Column HOP-ABS-00002 & 3 (HLW); System Description and System Description Change Notices listed above under References	The Plant Item Material Selection Data Sheet demonstrates that the Silver Mordenite Columns are designed to process the Melter 1/2 offgas as discussed above. The System Description discusses normal and abnormal operations for the columns (HOP-ABS-00002 & 3). Additional reagents will not normally be added to the Silver Mordenite Columns during normal operations.
	The waste types are compatible with each other.	System Description and System Description Change Notices listed above under References; Drawings listed above under References	The System Description for the HLW Melter Offgas Treatment Process (HOP) System does not describe any operations where incompatible wastes are mixed in these Silver Mordenite Columns.

	Information Assessed	Source of Information	Assessment
Corrosion	Vessel material and protective coatings ensure the vessel structure is adequately protected form the corrosive effects of the waste stream and external environments (expected to not leak or fail for the design life of the system)	Drawings, System Description and System Description Change Notices listed above under References; Plant Item Material Selection Data Sheet, 24590-HLW-N1D-HOP-P0006, Rev. 1, Silver Mordenite Column HOP-ABS-00002 & 3 (HLW)	The Plant Item Material Selection Data Sheet reports selection of 316 stainless steel, maximum 0.030% Carbon, dual certified, hereinafter referred to as 316L stainless steel, to provide improved resistance to pitting corrosion, stress corrosion cracking, and crevice corrosion. The material recommendations from the Plant Item Material Selection Data Sheet have been adequately and appropriately incorporated into the Mechanical Systems Data Sheets for the Silver Mordenite Columns. A minimum thickness of 1/4 in. plate has been specified for the column shells.
	Corrosion allowance is adequate for the intended service life of the vessel.	Mechanical Systems Data Sheets listed above under references; Plant Item Material Selection Data Sheet, 24590-HLW-N1D-HOP-P0006, Rev. 1, Silver Mordenite Column HOP-ABS-00002 & 3 (HLW)	The bases for the Silver Mordenite Columns material selection and corrosion allowance is furnished in the Plant Item Material Selection Data Sheet. Selection of 316L stainless steel with a corrosion/erosion allowance of 0.04 in. for a service life of 40 years is adequate and appropriate. The material selections and corrosion allowances are carried forward to the Mechanical Systems Data Sheets consistently and correctly.
Pressure Relief	Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the vessel are exceeded.	Drawings listed above under references; System Description and System Description Change Notices listed above under References; Mechanical Systems Data Sheets listed above under references; Plant Item Material Selection Data Sheet, 24590-HLW-N1D-HOP-P0006, Rev. 1, Silver Mordenite Column HOP-ABS-00002 & 3 (HLW)	The System Description provides a discussion of the normal operating conditions for the HLW Melter Offgas Treatment Process (HOP System). The pressure limits for the Booster Extraction Fans (HOP-FAN-00001A/B/C & HOP-FAN-00009A/B/C) and the Stack Extraction Fans (HOP-FAN-00008A/B/C & HOP-FAN-00010A/B/C) are 60 in. water gage (about 2.2 psi) which is less than the internal and external design pressure of 3 psi listed on the Mechanical System Data Sheets for the Silver Mordenite Columns. Therefore, the columns are designed for pressures which are higher than the pressure capabilities of the offgas system extraction fans.

COGEMA ENGINEERING

RECEIVED
JAN 2 6 2004
BNI-Subcontracts

January 26, 2004

COGEMA-04-0028

D. J. Whiting
Bechtel National, Inc.
Waste Treatment Plant
2435 Stevens Center
Richland, Washington 99352

Dear Ms. Whiting:

BECHTEL NATIONAL, INC. CONTRACT NO. 24590-CM-HC4-HXYG-00138 - STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH LEVEL WASTE (HLW) BELOW GRADE MISCELLANEOUS THERMAL UNITS (HOP SYSTEM) SILVER MORDENITE COLUMNS HOP-ABS-00002 & -00003

The integrity assessment has been completed per the contract requirements and is enclosed for your use. The assessment found the design intent is sufficient to ensure the miscellaneous thermal unit(s) will be adequately designed and will have sufficient structural strength, compatibility with the waste(s) to be stored or treated, and corrosion protection to ensure that they will not collapse, rupture, or fail.

If you have any questions, please contact John Baxter on 372-3207, or via facsimile at (509) 372-0504.

Sincerely,

E. A. Nelson, Director
Engineering & Technology

jb

Enclosure

cc: D. C. Pfluger w/ Enclosure

2425 Stevens Center Place, Second Floor, Richland, Washington 99352 Tel· (509) 372-3572 - Fax· (509) 372-3169
COGEMA Engineering Corporation

24590-CM-HC4-HXYG-00138	- 01 - 00021	00B
PO/SCT	**Submittal**	**Rev**

Job No. 24590

Bechtel National, Inc.

SUPPLIER DOCUMENT STATUS

1. [X] **Work may proceed.**
2. [ ] **Revise and resubmit. Work may proceed subject to resolution of indicated comments.**
3. [ ] **Revise and resubmit. Work may not proceed.**
4. [ ] **Review not required. Work may proceed.**

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations.

REVIEWED EENS BJK

G-321 Document Category N/A
[From Supplement A to G-321-E (E) or G-321-V (V), as applicable, or "N/A" if SSRS is used]

Supersedes BNI Document No. N/A Rev. _____
[When applicable]

Accepted by DC Pflueger (Print Name) DC Pflueger (Signature) 10/4/04 (Date)

Released by N/A (Print Name) _____ (Signature) _____ (Date)
[When applicable]

TP0406_34 7-04

SUBCONTRACT SUBMITTAL

Best Available Copy

R10396363

COGEMA-IA-045, Rev. 2

IQRPE REVIEW – HIGH-LEVEL WASTE (HLW) FACILITY MELTER 1 & 2 OFFGAS TREATMENT PROCESS (HOP) SYSTEM MISCELLANEOUS TREATMENT UNIT SYSTEMS

"I, John T. Baxter, have reviewed, and certified a portion of the design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by Department of Energy, Office of River Protection, Richland, Washington. My duties were independent review of the current design for the High-Level Waste (HLW) Melter 1 & 2 Offgas Treatment Process (HOP) System Miscellaneous Treatment Unit Systems as required by the Dangerous Waste Regulations, namely, WAC 173-303-640(3) applicable paragraphs, i.e., (a) through (g)."

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

The documentation reviewed indicates that the design intent fully satisfies the requirements of the WAC.

The attached review is sixteen (16) pages numbered one (1) through sixteen (16).

JOHN T. BAXTER
STATE OF WASHINGTON
18978
REGISTERED
PROFESSIONAL ENGINEER

10/01/2004

EXPIRES: 10/28/04

John T. Baxter
Signature

10/01/2004
Date

24590-CM-HC4-HXYG-00138-01-00021 REV. 00B

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH-LEVEL WASTE (HLW) FACILITY MELTER 1 & 2 OFFGAS TREATMENT PROCESS (HOP) SYSTEM MISCELLANEOUS TREATMENT UNIT SYSTEMS

COGEMA-IA-045
REV. 2

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

Scope	Scope of this Integrity Assessment	This Integrity Assessment addresses Miscellaneous Treatment Unit Systems (MTUs) that are components of the HLW Melter 1 & 2 Primary and Secondary Offgas Treatments Systems (HOP). These MTUs include; Booster Extraction Fans, Stack Extraction Fans, Wet Electrostatic Precipitators, Activated Carbon Adsorbers and Catalyst Skids shown on the Process Flow Diagrams listed below under References.
References	Drawings, Material Requisition, Specification and Data Sheets	24590-HLW-M5-V17T-P0003, Rev. 0, Process Flow Diagram HLW Vit Primary Offgas Treatment (HOP System); 24590-HLW-M5-V17T-P0004, Rev. 1, Process Flow Diagram HLW Vitrification Melter 1 Secondary Offgas Treatment (System HOP); 24590-HLW-M5-V17T-P20003, Rev. 0, Process Flow Diagram HLW Vit Melter 2 Primary Offgas Treatment (HOP System); 24590-HLW-M5-V17T-P20004, Rev. 0, Process Flow Diagram HLW Vitrification Melter 2 Secondary Offgas Treatment (System HOP); Material Requisition No. 24590-QL-MRA-MACS-00002, Rev. 2, High Integrity Centrifugal Blowers QL2 (U6L9) (HV006) dated 8/31/04, MR Section 2 – Technical Specifications; 24590-WTP-3PS-MACS-T0004, Rev. 1, Engineering Specification for High Integrity Centrifugal Blowers; High-Pressure Centrifugal Blower Data Sheet:, 24590-HLW-MAD-HOP-00018, Rev. 1, HLW Offgas Booster Fan HOP-FAN-00001A/B/C & -00009A/B/C; High-Pressure Centrifugal Blower Data Sheet:, 24590-HLW-MAD-HOP-00038, Rev. 0, HLW Offgas Stack Extraction Fan HOP-FAN-00008/A/B/C & -00010A/B/C; Material Requisition No. 24590-QL-MRA-MKE0-00001, Rev. 5, Wet Electrostatic Precipitators (WESP) QL-1/2 (QOL5) (MLT001) (N085) dated 08/18/04, MR Section 2 – Technical Specifications; 24590-WTP-3PS-MKE0-T0001, Rev. 4, Engineering Specification for Wet Electrostatic Precipitators; Plant Item Material Selection Data Sheet 24590-HLW-N1D-HOP-P0002, Rev. 0, Melter 1 & 2 Wet Electrostatic Precipitator HOP-WESP-00001 & 2 (HLW);

References	Specifications, Material Requisitions and Data Sheets	Material Requisition No. 24590-QL-MRA-MBT0-00002, Rev. 3, Thermal Catalytic Oxidizers / Reducers (N073) (MS056) dated 5/17/04, MR Section 2 – Technical Specifications; 24590-WTP-3PS-MBTV-T0001, Rev. 0, Engineering Specification for Thermal Catalytic Oxidizers/Reducers; Plant Item Material Selection Data Sheet 24590-HLW-N1D-HOP-P0004, Rev. 1, Thermal Catalytic Oxidizer, HOP-SCO-00001 & HOP-SCO-00004 (HLW); Plant Item Material Selection Data Sheet 24590-HLW-N1D-HOP-P0005, Rev. 1, NOx Selective Catalytic Reducer, HOP-SCR-00001 & HOP-SCR-00002 (HLW); HLW Catalytic Oxidizer/Reducer Mechanical Data Sheet No. 24590-HLW-MKD-HOP-00019, Rev. 1, HLW Catalytic Oxidizer/Reducer HOP-SCO-00002; HLW Catalytic Oxidizer/Reducer Mechanical Data Sheet No. 24590-HLW-MKD-HOP-00020, Rev. 1, HLW Catalytic Oxidizer/Reducer HOP-SCO-00003; Material Requisition No. 24590-QL-MRA-MWK0-00001, Rev.1, Carbon Bed Adsorbers (MS002) (N151) dated 9/27/04, MR Section 2 – Technical Specifications; 24590-WTP-3PS-MWK0-T0001, Rev. 0, Engineering Specification for Activated Carbon Bed Adsorbers; Plant Item Material Selection Data Sheet 24590-HLW-N1D-HOP-P0003, Rev. 0, Activated Carbon Adsorber HOP-ADBR-00001A/B & 2A/B (HLW); Mechanical Data Sheet Activated Carbon Adsorber 24590-HLW-MVD-HOP-00015, Rev. 0, Activated Carbon Adsorbers HOP-ADBR-00001A/B; Mechanical Data Sheet Activated Carbon Adsorber 24590-HLW-MVD-HOP-00016, Rev. 0, Activated Carbon Adsorbers HOP-ADBR-00002A/B;

References	System Description	24590-HLW-3YD-HOP-00001, Rev. 0, Systems Description for HLW Melter Offgas Treatment Process and Process Vessel Vent Extraction (HOP and PVV Systems); System Description Change Notice (SDCN) SDCN No. 24590-HLW-3YN-HOP-00001 for System Description No. 24590-HLW-3YD-HOP-00001, Rev. 0; SDCN No. 24590-HLW-3YN-HOP-00002 for System Description No. 24590-HLW-3YD-HOP-00001, Rev. 0; SDCN No. 24590-HLW-3YN-HOP-00003 for System Description No. 24590-HLW-3YD-HOP-00001, Rev. 0; SDCN No. 24590-HLW-3YN-HOP-00004 for System Description No. 24590-HLW-3YD-HOP-00001, Rev. 0
Definitions	Nomenclature	Catalyst Skid: The catalyst skids are comprised of four components. These components are the Catalyst Skid Preheater, the Catalyst Skid Electric Heater, a Thermal Catalytic Oxidizer Unit and a Selective Catalytic Reducer. Additional information is available in the System Description.

Summary of Assessment

For each item of "Information Assessed" (i.e., Criteria) on the following pages, the items listed under "Source of Information" were reviewed and found to furnish adequate design controls and requirements to assure the design intent fully satisfies the Washington Administrative Code Dangerous Waste Regulations WAC 173-303 requirements.

	Information Assessed	Source of Information	Assessment
Design	Plant item design standards are appropriate and adequate for the plant item's intended use.	Drawings, System Description and High-Pressure Centrifugal Blower Data Sheets listed above under references; 24590-WTP-3PS-MACS-TP004, Rev. 1, Engineering Specification for High Integrity Centrifugal Blowers; ASME AG-1-1997, Code on Nuclear Air and Gas Treatment; ASME AG-1a-2000, Addenda to ASME AG-1-1997, Code on Nuclear Air and Gas Treatment	The Booster Extraction Fans (HOP-FAN-00001A/B/C & 9A/B/C) and Stack Extraction Fans (HOP-FAN -00008A/B/C & 10A/B/C) are components in the Melter 1/2 Offgas Treatment Systems (HOP). The Booster Extraction Fans are located in Room H-B001C at elevation (-) 21'-0" and the Stack Extraction Fans are located in Room H-0429 at elevation 58'-0" as noted on the Data Sheets. They are accessible for maintenance. The Engineering Specification for High Integrity Centrifugal Blowers requires that these fans be designed, fabricated, and tested in accordance with the requirements in ASME AG-1-1997 and ASME AG-1a-2000. Supplementary requirements are specified in the Engineering Specification for High Integrity Centrifugal Blowers. The supplementary requirements address design, materials, fabrication, inspection, testing, quality assurance, documentation and storage requirements. The fans are identified as Quality Level (QL-2) and Seismic Category (SC-III) in the High-Pressure Centrifugal Blower Data Sheets. These are adequate and acceptable design standards for the Booster and Stack Extraction Fans.
	If a non-standard plant item is to be used, the design calculations demonstrate sound engineering principles of construction.	Drawings and High-Pressure Centrifugal Blower Data Sheets listed above under References; 24590-WTP-3PS-MACS-TP004, Rev. 1, Engineering Specification for High Integrity Centrifugal Blowers	The Booster and Stack Extraction Fans are components in the Melter 1/2 Offgas Treatment Systems (HOP). These fans are standard offgas treatment assemblies that are shop fabricated. The Engineering Specification for High Integrity Centrifugal Blowers requires that the ASME AG-1/1a fan assemblies be delivered after design, fabrication, inspection, and testing. The Booster and Stack Extraction Fans design codes and standards are appropriate and adequate for the intended service.

	Information Assessed	Source of Information	Assessment
Design	Plant item has adequate strength, after consideration of the corrosion allowance, to withstand the operating pressure, operating temperature, and seismic loads.	Drawings and High-Pressure Centrifugal Blower Data Sheets listed above under references; 24590-WTP-3PS-MACS-TP004, Rev. 1, Engineering Specification for High Integrity Centrifugal Blowers; ASME AG-1-1997, Code on Nuclear Air and Gas Treatment; ASME AG-1a-2000, Addenda to ASME AG-1-1997, Code on Nuclear Air and Gas Treatment 24590-WTP-3PS-FB01-T0001, Rev. 1, Engineering Specification for Structural Design Loads for Seismic Category III and IV Equipment and Tanks; Uniform Building Code (UBC), 1997, International Conference of Building Officials	The High-Pressure Centrifugal Blower Data Sheets identify the Booster and Stack Extraction Fans operating pressure and temperature ranges, the materials selected for the fan housings, shafts, fan wheels and the mounting frame, the fans quality levels, and the requirements for seismic design. The Engineering Specification for High Integrity Centrifugal Blowers requires use of ASME AG-1/1a for design which provides for specific consideration of the operating pressures and temperatures and seismic loads in the design process. The Blower Data Sheets indicate that the fans all operate in "dry" conditions (non-condensing); therefore, a corrosion resistant material is specified for the fan housing and internal components, but no corrosion allowance is specified. Detailed requirements for seismic design of the fans are furnished in the Engineering Specification for Structural Design Loads for Seismic Category III and IV Equipment and Tanks. Seismic design loads are taken from the UBC. These codes and standards are adequate and appropriate for design of the Booster and Stack Extraction Fans to withstand operating pressure and temperature loads and seismic loads for the specified design life while considering corrosion resistance.
Foundation	Plant item foundation will maintain the load of a full vessel.	24590-WTP-3PS-MACS-TP004, Rev. 1, Engineering Specification for High Integrity Centrifugal Blowers; ASME AG-1-1997, Code on Nuclear Air and Gas Treatment; ASME AG-1a-2000, Addenda to ASME AG-1-1997, Code on Nuclear Air and Gas Treatment	The Engineering Specification for High Integrity Centrifugal Blowers requires use of ASME AG-1/1a for design of the Booster and Stack Extraction Fans. The ASME codes have adequate provisions to assure proper foundation support for the fans. These codes and standards are adequate and appropriate for design of the Booster and Stack Extraction Fans supports. The fans are furnished as package units with their drives on skid platforms for installation in the HLW Vitrification Building.

	Information Assessed	Source of Information	Assessment
Foundation	If in an area subject to flooding, the plant item is anchored.	Drawings, System Description listed above under references; 24590-WTP-3PS-MACS-TP004, Rev. 1, Engineering Specification for High Integrity Centrifugal Blowers	The Booster Extraction Fans (HOP-FAN-00001A/B/C & 9A/B/C) are components in the Melter 1/2 Secondary Offgas Treatment Systems (HOP). This system handles offgas vapors from the melters and process vessels ventilation. Cell H-B001C contains only components of this offgas system; therefore, there are no local sources of liquids to flood the cell except for firewater from the sprinkler system. A similar condition exists in Room H-0429 where the Stack Extraction Fans (HOP-FAN-00008A/B/C & 10A/B/C) are located. Design for flooding is not a required load case in the Engineering Specification for High Integrity Centrifugal Blowers. The fans are anchored to provide for adequate seismic resistance.
Frost Heave	Plant item system will withstand the effects of frost heave.	System Description listed above under references; 24590-WTP-DC-ST-01-001, Rev. 3, Structural Design Criteria	The Structural Design Criteria document requires that all structural foundations extend a distance below grade that exceeds the depth of the frost line in order to preclude frost heave. The frost line is 30 in. below grade. The HLW Vitrification Building foundations are not subject to frost heave, therefore, the Booster and Stack Extraction Fans, located in rooms inside the HLW Vitrification Building, are not subject to frost heave.

	Information Assessed	Source of Information	Assessment
Waste Characteristics	Characteristics of the waste to be stored or treated have been identified (ignitable, reactive, toxic, specific gravity, vapor pressure, flash point, storage temperature)	High-Pressure Centrifugal Blower Data Sheets listed above under References; 24590-WTP-PER-PR-03-002, Rev. 1, Toxic Vapors and Emissions from WTP Tank Systems and Miscellaneous Treatment Unit Systems; System Description listed above under References	The High-Pressure Centrifugal Blower Data Sheets present the offgas specific gravity, operating temperatures and pressures, and the chemical composition of hazardous materials in the offgas. The main safety function of the Booster Extraction Fans is to provide protection for the facility workers from the acutely or chronically toxic vapors and emissions in the Melter 1/2 offgas systems as discussed in the Toxic Vapors and Emissions from WTP Tank Systems and Miscellaneous Treatment Unit Systems document. The System Description identifies that the offgas in the fans is hazardous, but not ignitable or flammable. The fans' function during normal operations is to maintain flow of the offgas to the HLW Building Stack. The Booster and Stack Extraction Fans designs are required to provide an intact housing pressure boundary during normal operations, abnormal operations and during and after a design level earthquake.
	Plant item is designed to store or treat the wastes with the characteristics defined above and any treatment reagents.	High-Pressure Centrifugal Blower Data Sheets, System Description listed above under References	The High-Pressure Centrifugal Blower Data Sheets identify that the fans provide pressure head to maintain normal offgas flow. The System Description discusses normal and abnormal operations for the fans. Additional reagents will not normally be added to the Booster and Stack Extraction Fans process streams during normal operations.
Compatibility	The waste types are compatible with each other.	High-Pressure Centrifugal Blower Data Sheets, System Description listed above under References	The System Description for the HLW Melter Offgas Treatment Process (HOP) System does not describe any operations where incompatible wastes are mixed in the Booster and Stack Extraction Fans offgas streams. The offgas chemistries for both normal and abnormal operations were fully considered in the material selections for the fans.

	Information Assessed	Source of Information	Assessment
Corrosion	Plant item material and protective coatings ensure the vessel structure is adequately protected form the corrosive effects of the waste stream and external environments (expected to not leak or fail for the design life of the system)	Drawings, High-Pressure Centrifugal Blower Data Sheets and System Description listed above under References; ASME AG-1-1997, Code on Nuclear Air and Gas Treatment; ASME AG-1a-2000, Addenda to ASME AG-1-1997, Code on Nuclear Air and Gas Treatment	The High-Pressure Centrifugal Blower Data Sheets list 316L stainless steel as the preferred material for the fan housings, shafts, fan wheels and the mounting frame. The Data Sheets indicate that the fans all operate in "dry" conditions (non-condensing); therefore, a corrosion resistant material is specified for the fan housing and internal components, but no corrosion allowance is specified. ASME AG-1/1a do require mandatory consideration of corrosion/erosion in the design of these fans. The external environment for the fans will be dry air in rooms H-B001C and H-0429. Therefore, external corrosion is not a concern.
	Corrosion allowance is adequate for the intended service life of the plant item.	High-Pressure Centrifugal Blower Data Sheets listed above under references; 24590-WTP-3PS-MACS-TP004, Rev. 1, Engineering Specification for High Integrity Centrifugal Blowers; ASME AG-1-1997, Code on Nuclear Air and Gas Treatment; ASME AG-1a-2000, Addenda to ASME AG-1-1997, Code on Nuclear Air and Gas Treatment	The bases for the HLW Offgas Booster Fans material selection is furnished in the High-Pressure Centrifugal Blower Data Sheets. Selection of 316L stainless steel for a service life of 40 years is adequate and appropriate considering that the fans all operate in "dry" conditions (non-condensing). The Engineering Specification for High Integrity Centrifugal Blowers does not specify use of a corrosion allowance. However, the ASME AG-1/1a codes do require mandatory consideration of corrosion/erosion in the design of these fans.
Pressure Relief	Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the plant item are exceeded.	High-Pressure Centrifugal Blower Data Sheets; 24590-WTP-3PS-MACS-TP004, Rev. 1, Engineering Specification for High Integrity Centrifugal Blowers; ASME AG-1-1997, Code on Nuclear Air and Gas Treatment; ASME AG-1a-2000, Addenda to ASME AG-1-1997, Code on Nuclear Air and Gas Treatment	The High-Pressure Centrifugal Blower Data Sheets provide the design pressure and temperature conditions for the Booster Extraction Fans. The Engineering Specification for High Integrity Blowers and ASME AG-1/1a both require that the fan enclosures be designed for pressures that are a minimum of 125% of the highest pressure the fan can produce while retaining adequate code based design stress and deformation margins.

	Information Assessed	Source of Information	Assessment
Design	Plant item design standards are appropriate and adequate for the plant item's intended use.	Material Requisitions, Engineering Specifications and Mechanical Data Sheets listed above under References; 24590-WTP-3PS-MV00-T0001, Rev. 1, Engineering Specification for Pressure Vessel Design and Fabrication; ASME Boiler and Pressure Vessel (B&PV) Code, Section VIII, Division 1, Rules for Construction of Pressure Vessels, American Society of Mechanical Engineers; ASME AG-1-1997, Code on Nuclear Air and Gas Treatment; American Society of Mechanical Engineers; ASME AG-1a-2000, Addenda to ASME AG-1-1997, Code on Nuclear Air and Gas Treatment; American Society of Mechanical Engineers; ASME N509-1989, Nuclear Power Plant Air-Cleaning Units and Components, American Society of Mechanical Engineers	The Material Requisitions and the associated Engineering Specifications require use of the Engineering Specification for Pressure Vessel Design and Fabrication for the external pressure boundaries of the WESPs, the Catalytic Skid components and the Activated Carbon Bed Adsorbers. This specification requires that the MTU external pressure boundaries are to be designed to ASME B&PV Code, Section VIII, Division 1 rules. Additional supplementary requirements are specified in the specification for Pressure Vessel Design and Fabrication. These supplementary requirements address positive material identification, standard fabrication tolerances, acceptable welding procedures for the vessel and appurtenances, welder qualifications and testing records, NDE inspections and records, quality assurance requirements, and packaging, shipping, handling and storage requirements. The Engineering Specifications for Catalytic Oxidizers/Reducers and Activated Carbon Bed Adsorbers require that the ASME B&PV Code, Section VIII, Division 1 rules be supplemented with the ASME AG-1/1a and ASME N509 design requirements as appropriate for the design of the external pressure boundaries. The Material Requisitions and the Mechanical Data Sheets identify Seismic Categories and Quality Levels for each MTU: HOP-WESP-00001 & 2, Seismic Category (SC-III), Quality Level (QL-2); HOP-SCO-00002 & 3, Seismic Category (SC-III), Quality Level (QL-2); and HOP-ADBR-00001A/B & 2A/B, Seismic Category (SC-III), Quality Level (QL-2). These are adequate and acceptable codes and standards for design and fabrication of these HOP system MTUs.

	Information Assessed	Source of Information	Assessment
Design	If a non-standard plant item is to be used, the design calculations demonstrate sound engineering principles of construction.	Engineering Specifications listed above under References; 24590-WTP-3PS-MV00-T0001, Rev. 1, Engineering Specification for Pressure Vessel Design and Fabrication; ASME Boiler and Pressure Vessel (B&PV) Code, Section VIII, Division 1, Rules for Construction of Pressure Vessels, American Society of Mechanical Engineers; ASME AG-1-1997, Code on Nuclear Air and Gas Treatment; American Society of Mechanical Engineers; ASME AG-1a-2000, Addenda to ASME AG-1-1997, Code on Nuclear Air and Gas Treatment; American Society of Mechanical Engineers; ASME N509-1989, Nuclear Power Plant Air-Cleaning Units and Components, American Society of Mechanical Engineers	The Engineering Specification for Pressure Vessel Design and Fabrication requires that the HOP System WESP pressure vessels are to be designed and fabricated in accordance with the requirements of ASME B&PV Code, Section VIII, Division 1. The vessels are to be delivered after design, fabrication, inspection and testing with ASME U stamps and the vessels will be registered with the National Board. The Engineering Specifications for the Catalytic Oxidizer/Reducers and the Activated Carbon Adsorbers require that the external pressure boundaries of these MTUs be designed in accordance with the requirements of ASME B&PV Code, Section VIII, Division 1, supplemented by selected requirements from ASME AG-1/1a and ASME N509. Code stamps are not required for these MTUs. These are shop fabricated MTUs for melter offgas service in the HLW Facility.

	Information Assessed	Source of Information	Assessment
Design	Plant item has adequate strength, after consideration of the corrosion allowance, to withstand the operating pressure, operating temperature, and seismic loads.	Engineering Specifications listed above under References; 24590-WTP-3PS-MV00-T0001, Rev. 1, Engineering Specification for Pressure Vessel Design and Fabrication; ASME Boiler and Pressure Vessel (B&PV) Code, Section VIII, Division 1, Rules for Construction of Pressure Vessels, American Society of Mechanical Engineers; ASME AG-1-1997, Code on Nuclear Air and Gas Treatment; American Society of Mechanical Engineers; ASME AG-1a-2000, Addenda to ASME AG-1-1997, Code on Nuclear Air and Gas Treatment; American Society of Mechanical Engineers; ASME N509-1989, Nuclear Power Plant Air-Cleaning Units and Components, American Society of Mechanical Engineers; 24590-WTP-3PS-MV00-T0002, Rev. 1, Engineering Specification for Seismic Qualification Criteria for Pressure Vessels; 24590-WTP-3PS-FB01-T0001, Rev. 1, Engineering Specification for Structural Design Loads for Seismic Category III & IV Equipment and Tanks; UBC, 1997, Uniform Building Code, International Conference of Building Officials	The Material Requisitions and the associated Engineering Specifications require use of the Engineering Specification for Pressure Vessel Design and Fabrication for the external pressure boundaries of the WESPs, the Catalytic Skid components and the Activated Carbon Bed Adsorbers. This specification requires that the MTU external pressure boundaries are to be designed to ASME B&PV Code, Section VIII, Division 1 rules. This code requires specific consideration of the operating pressures, temperatures, seismic loads, and corrosion allowance in the design process. The Engineering Specifications for Catalytic Oxidizers/Reducers and Activated Carbon Bed Adsorbers require that the ASME B&PV Code, Section VIII, Division 1 rules be supplemented with the ASME AG-1/1a and ASME N509 design requirements as appropriate for the design of the external pressure boundaries for these MTUs. The Specifications and Mechanical Data Sheets identify the operating pressure and temperature ranges for each MTU, the materials selected in the corrosion report, the corrosion allowance, and the requirements for seismic qualification in the design. General seismic design criteria are specified in the Engineering Specification for Seismic Qualification Criteria for Pressure Vessels which are applicable to the WESPs design. All of the MTUs considered in this assessment are SC-III, as noted above. The Engineering Specification for Structural Design Loads for Seismic Category III & IV Equipment and Tanks provides detailed guidance for this seismic analysis which requires use of the seismic design requirements in the 1997 UBC. These are appropriate codes and criteria to ensure the HOP system MTUs have adequate strength at the end of their design lives.

	Information Assessed	Source of Information	Assessment
Foundation	Plant item foundation will maintain the load of a full vessel.	Material Requisitions, Engineering Specifications and Mechanical Data Sheets listed above under References; 24590-WTP-3PS-MV00-T0001, Rev. 1, Engineering Specification for Pressure Vessel Design and Fabrication; Specification Change Notice (SCN) No. 24590-WTP-3PN-MV00-00006 for Engineering Specification for Pressure Vessel Design and Fabrication; ASME AG-1-1997, Code on Nuclear Air and Gas Treatment; American Society of Mechanical Engineers; ASME AG-1a-2000, Addenda to ASME AG-1-1997, Code on Nuclear Air and Gas Treatment; American Society of Mechanical Engineers	The Engineering Specification for Wet Electrostatic Precipitators shows the WESPs supported on cylindrical skirts. The Engineering Specification for Pressure Vessel Design and Fabrication provides requirements that assure adequate vessel skirt foundation designs. The Catalytic Oxidizers/Reducers and the Activated Carbon Adsorbers are to be designed with support frames adequate for both shipping and installation. Design requirements for these support frames are specified in ASME AG-1/1a and ASME N509. These are adequate codes and standards to assure that the plant item foundations will support the MTUs under all required load conditions.
	If in an area subject to flooding, the plant item is anchored.	Material Requisitions, Engineering Specifications and Mechanical Data Sheets listed above under References;	The MTUs considered in this assessment are components in the Melter 1/2 Offgas Treatment Systems (HOP). These systems handle offgas vapors from the melters and process vessels ventilation. Cells where the Catalytic Oxidizers/Reducers and Activated Carbon Adsorbers are located contain only components of these offgas systems; therefore, there are no local sources of liquids to flood the rooms except for firewater from the sprinkler systems and the internal fire protection deluge system built into the Activated Carbon Adsorbers. Operation of the deluge system includes automatic provisions for overflow control to avoid flooding the room. The process cells where the WESPs are located contain no fire suppression systems. Design for flooding is not a required load case in the Engineering Specifications these MTUs. They are anchored to provide for adequate seismic resistance.

	Information Assessed	Source of Information	Assessment
Frost Heave	Plant item system will withstand the effects of frost heave.	System Description listed above under References; 24590-WTP-DC-ST-01-001, Rev. 3, Structural Design Criteria	The System Description identifies that the WESPs, Catalytic Oxidizers/Reducers, and Activated Carbon Adsorbers are located in cells and rooms at various locations in the HLW Vitrification Building. These rooms are supported by the HLW Building mat foundation. The Structural Design Criteria requires that all structural foundations extend into the surrounding soil below the frost line in order to preclude frost heave. The frost line is located 30 in. below finished grade. The mat foundation is not subject to frost heave, therefore the HOP system MTUs will not be subject to frost heave.
Waste Characteristics	Characteristics of the waste to be stored or treated have been identified (ignitable, reactive, toxic, specific gravity, vapor pressure, flash point, storage temperature)	Specifications, Data Sheets and System Description listed above under References; 24590-WTP-PER-PR-03-002, Rev. 1, Toxic Vapors and Emissions from WTP Tank Systems and Miscellaneous Treatment Unit Systems	The Specifications and Data Sheets present the offgas operating temperatures and pressures, relative humidity and the radiological and chemical composition of hazardous materials in the offgas. The main safety function of the WESPs, Catalytic Oxidizers/Reducers, and Activated Carbon Adsorbers is to provide confinement of the toxic vapors and emissions in the Melter 1/2 offgas systems to protect the facility workers as discussed in the Toxic Vapors and Emissions from WTP Tank Systems and Miscellaneous Treatment Unit Systems document. The System Description identifies that the offgas in these MTUs is hazardous, but not ignitable or flammable. The Activated Carbon Adsorber design includes an internal deluge system for fire suppression to control potential fires in the activated carbon filter media. The MTU designs are required to provide an intact external pressure boundary during normal operations, abnormal operations and during and after a design level earthquake.

	Information Assessed	Source of Information	Assessment
Waste Characteristics	Plant item is designed to store or treat the wastes with the characteristics defined above and any treatment reagents.	Specifications, Data Sheets and System Description listed above under References	The Specifications and Plant Item Material Selection Data Sheets show that the material selections for these MTUs take into account both normal and abnormal operations offgas waste characteristics. The material selections also address reagent use for cleaning and periodic maintenance of the MTUs.
Compatibility	The waste types are compatible with each other.	Specifications, Data Sheets and System Description listed above under References	The System Description for the HLW Melter Offgas Treatment Process (HOP) System does not describe any operations where incompatible wastes are mixed in the MTU offgas streams. The Specifications and Data Sheets show that offgas chemistries for both normal and abnormal operations were fully considered in the material selections for the MTUs.

	Information Assessed	Source of Information	Assessment
Corrosion	Plant item material and protective coatings ensure the vessel structure is adequately protected form the corrosive effects of the waste stream and external environments (expected to not leak or fail for the design life of the system).	Specifications, Data Sheets and System Description listed above under References; 24590-WTP-3PS-NN00-T0001, Rev. 0, Engineering Specification for Hot and Anti-Sweat Thermal Insulation	The Engineering Specification for Wet Electrostatic Precipitators lists UNS N08367 (AL6XN, 6% Mo Alloy) as the material of choice for the WESP vessel external pressure boundary and wetted internal metal components. The Plant Item Material Selection Data Sheets for the Catalytic Oxidizers/Reducers, and Activated Carbon Adsorbers list 316 stainless steel (maximum 0.030% Carbon, dual certified), hereinafter called 316L stainless steel, as the material of choice for the external pressure boundaries (housings). No corrosion allowance is requiredfor these items. The Engineering Specification for Activated Carbon Bed Adsorbers requires external insulation of the Carbon Bed Adsorber housings and connecting piping in accordance with the Engineering Specification for Hot and Anti-Sweat Thermal Insulation. The Material Data Sheets refer to ASTM C533 Calcium Silicate, Type I insulation materials. The Material Data Sheets for the Catalytic Oxidizers/Reducers list both Internal Ceramic Fiber block insulation for the housings and external insulation in accordance with the Engineering Specification for Hot and Anti-Sweat Thermal Insulation. These requirements assure that the MTUs will have adequate corrosion protection for the expected design life (40 years).

	Information Assessed	Source of Information	Assessment
Corrosion	Corrosion allowance is adequate for the intended service life of the plant item.	Specifications, Data Sheets and System Description listed above under References	The Engineering Specification for Wet Electrostatic Precipitators lists UNS N08367 (AL6XN, 6% Mo Alloy) as the material of choice for the WESP vessel external pressure boundary with a corrosion allowance of 0.04" for a 40 year service life. The Mechanical Data Sheets for the Activated Carbon Absorbers list 316L stainless steel as the material selected for the housing with no corrosion allowance as adequate for a 40 year service life. The Plant Item Material Selection Data Sheets for the Catalytic Oxidizers/Reducers lists 316L stainless steel as the material selection for the housings with no corrosion allowance as adequate for a 40 year service life.
Pressure Relief	Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the plant item are exceeded.	Specifications, Data Sheets and System Description listed above under References	The Engineering Specifications for these MTUs list design pressures for the vessels and housings that exceed the range of the normal and abnormal operating pressures for the Melter 1/2 Offgas Treatment Process System at each MTU location.

R10049219

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH LEVEL WASTE BELOW GRADE SECONDARY CONTAINMENT

COGEMA-IA-010
REV. 1

Bechtel Systems & Infrastructure, Inc.

JOB No. 24590

SUPPLIER DOCUMENT STATUS

1. ☒ WORK MAY PROCEED
2. ☐ REVISE AND RESUBMIT. WORK MAY PROCEED SUBJECT TO RESOLUTION OF INDICATED COMMENTS
3. ☐ REVISE AND RESUBMIT. WORK MAY NOT PROCEED
4. ☐ REVIEW NOT REQUIRED. WORK MAY PROCEED.

PERMISSION TO PROCEED DOES NOT CONSTITUTE ACCEPTANCE OR APPROVAL OF DESIGN DETAILS, CALCULATIONS, ANALYSES, TEST METHODS, OR MATERIALS DEVELOPED OR SELECTED BY THE SUPPLIER AND DOES NOT RELIEVE SUPPLIER FROM FULL COMPLIANCE WITH CONTRACTUAL OBLIGATIONS.

	M	P	ML	H	MH	E	C&I	CS&A	PD	PT	ESH
REVIEWED											

G-321 DOCUMENT CATEGORY
[From Supplement A to G-321-E (E) or G-321-V (V), as applicable]

RESPONSIBLE ENGINEER [signature] DATE 5/16/03

Processed/Data Entry ☒ Copied/QA ☒ Scanned ☐ Filed
5/16/03 5/16/03 5-20-03 5/19/03

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

5/16/03 5/16/03
Processed/Data Entry ☒ Copied/QA ☒ Scanned ☐ Filed
KS 5/16/03 KS 5/16/03 5/28/03

RPP-WTP RECEIVED
MAY 16 2003
BY PDC

24590-CM-HC4-HXYG-00138-01-08 Rev 00B

	Information Assessed	Y/N	Source of Information	Assessment
Scope	Scope of this Integrity Assessment	This integrity assessment addresses High Level Waste Facility Below Grade Secondary Containment between the elevations of (-) 21'-0" and (-) 9'-0". The specific cells considered in this assessment are: H-B005, H-B014, H-B021, H-B035, H-B039A and H-B039B.		
	Drawings	The drawings are the general arrangement plan at elevation (-) 21'-0" and associated sections. 24590-HLW-P1-P01T-P0001, Rev. 4, HLW VITRIFICATION BUILDING GENERAL ARRANGEMENT PLAN AT EL. (-) 21'-0"; 24590-HLW-P1-P01T-P0008, Rev. 5, HLW VITRIFICATION BUILDING GENERAL ARRANGEMENT SECTIONS A-A, B-B & C-C; 24590-HLW-P1-P01T-P0009, Rev. 4, HLW VITRIFICATION BUILDING GENERAL ARRANGEMENT SECTIONS D-D, E-E & F-F; 24590-HLW-P1-P01T-P0010, Rev. 4, HLW VITRIFICATION BUILDING GENERAL ARRANGEMENT SECTION G-G & H-H; 24590-HLW-P1-P01T-P0011, Rev. 5, HLW VITRIFICATION BUILDING GENERAL ARRANGEMENT SECTION J-J & K-K		
Foundation Design	Description of subsurface conditions and soil bearing capacity are adequate.	Y	24590-WTP-DC-ST-01-001, Rev. 0, Structural Design Criteria; 24590-BOF-3PS-CE01-T0001, Rev. 4, Engineering Specification for Excavation and Backfill; 24590-BOF-3PS-C000-T0001, Rev. 2, Engineering Specification for Material Testing Services; WTSC99-1036-42-17, RPP-WTP Geotechnical Investigation Final Report, Shannon & Wilson, 2000	The Structural Design Criteria adequately presents design guidance for both mat and spread footings based on the geotechnical site investigation for the facility (WTSC99-1036-42-17, Shannon & Wilson, 2000). Bearing capacity and settlement design parameters are furnished for the dense Hanford Upper and Lower Sand Units and Structural Fill. Use of the loose wind blown (dune) sands for foundations is precluded. The Excavation and Backfill specification provides structural backfill requirements based on the geotechnical report and adequate current codes and standards for selection, placing, and compacting structural backfill including testing of candidate fill materials and completed backfills. The Specification for Material Testing Services provides current adequate codes and standards for testing of candidate structural fill materials and in-situ testing of structural fills as they are constructed. The codes and standards are consistent with those called out in the Excavation and Backfill specification.

Best Available Copy

	Information Assessed	Y/N	Source of Information	Assessment
Foundation Design	Foundation design loads (including full tanks) and estimated settlement are adequately considered.	Y	24590-WTP-DC-ST-01-001, Rev. 0, Structural Design Criteria	The Structural Design Criteria uses current adequate standards to define design loads and load combinations (ASCE 7-98, ACI 318-99, ACI 349-01 and ACI 349R-01). Dead and Fluid loads are included in these loads and load combinations. Settlement design parameters are included in the Structural Design Criteria subsection on geotechnical design parameters and foundation design.
	Design calculation approach and design basis of footings with design standard references (e.g., ACI) are adequate.	Y	24590-WTP-DC-ST-01-001, Rev. 0, Structural Design Criteria	The Structural Design Criteria references current adequate design criteria for the design of concrete foundations and footings. ACI 318-99 is referenced for the strength design of commercial grade structures and ACI 349-01 and ACI 349R-01 are referenced for design of "safety" grade structures.
	Foundation material is compatible with the soil.	Y	24590-WTP-3PS-DB01-T0001, Rev. 1, Engineering Specification for Furnishing and Delivering Ready-Mix Concrete; 24590-BOF-3PS-C000-T0001, Rev. 2, Engineering Specification for Material Testing Services; 24590-WTP-DB-ENG-01-001, Rev. 0, Basis of Design	The specification for Furnishing and Delivering Ready-Mix Concrete provides adequate current requirements for the selection of coarse and fine aggregates and the procurement of cementitious materials. Adequate test procedures are provided in the Material Testing Services specification for testing candidate aggregates. Instructions for mixing and delivering Ready-Mix Concrete are adequate and current. As noted in the Basis of Design document (section 4.7), the water table lies about 200 feet below the deepest foundations so there is little reason to expect compatibility problems between the concrete foundations and the site soils.
	Foundation will withstand the effects of frost heave.	Y	24590-WTP-DC-ST-01-001, Rev. 0, Structural Design Criteria	The Structural Design Criteria includes adequate provisions to preclude frost heave in the section addressing lateral earth pressure loads. All foundations are required to extend into the soil more than 30 inches below finish grade to preclude frost heave. The frost line is 30 inches below finished grade.

3

Best Available Copy

	Information Assessed	Y/N	Source of Information	Assessment
Foundation Design	Seismic considerations have been adequately addressed.	Y	24590-WTP-PER-CSA-02-001, Rev. 3, Secondary Containment Design; 24590-WTP-DC-ST-01-001, Rev. 0, Structural Design Criteria; ACI 349, Code Requirements for Nuclear Safety-Related Concrete Structures; ASCE 4, Seismic Analysis of Safety Related Nuclear Structures and Commentary; ANSI/AISC N690, Specification for the Design, Fabrication and Erection of Steel Safety-Related Structures for Nuclear Facilities; AISC MO16-89, Manual of Steel Construction - Allowable Stress Design, Ninth Edition.	The Secondary Containment Design document provides a summary description of the Design Methodology, Materials, Loads, and Load Combinations (including seismic loads) for the HLW secondary containment components. The Structural Design Criteria provides detailed discipline specific codes and standards for the design of Seismic Category I and II (SC-I/II) HLW secondary containment foundations, structures, and liners by the design engineers. ACI-349-01 and ACI 349R-01 provide the design code and load combinations for design of the secondary containment reinforced concrete foundations and structures. ASCE 4-98 is used for guidance on seismic analysis of safety-related nuclear structures. Stainless steel liners for SC-I/II secondary containments are to be designed using ANSI/AISC N690 and the AISC code. Lateral force response spectra for design of SC-I/II secondary containments and liners are provided in the Structural Design Criteria for input to the overall building seismic analysis models. The seismic design codes and standards and lateral force requirements have been adequately addressed.
Compatibility & Strength	The stored waste is compatible with its Secondary Containment and leak detection hardware based on a detailed chemical and physical analysis of the wastes used and other information sources.	Y	24590-WTP-DB-ENG-01-001, Rev. 0, Basis of Design; 24590-WTP-PER-M-02-001, Rev. 2, Material Selections for Building Secondary Containment/Leak Detection; 24590-WTP-PER-CSA-02-001, Rev. 3, Secondary Containment Design; 24590-WTP-PER-J-02-001, Rev. 3, Leak Detection - Sump Level Measurement in Secondary Containment Systems	The Basis of Design states that cells and sumps are appropriately lined and any spills are removed and flushed within 24-hr or as timely as possible. Based on detailed analysis of the corrosive properties of expected waste process operations, the Material Selection report identifies appropriate corrosion resistant materials for Secondary Containment liners and coatings. The Secondary Containment Design report provides adequate typical construction details for liners including tank anchorage details, special protective coatings, sumps, and leak detection equipment to be used for Secondary Containment. Typical details are furnished for leak detection and sump level measurement systems equipment both in cell, and out of cell in the Leak Detection - Sump Level Measurement document.

Best Available Copy

	Information Assessed	Y/N	Source of Information	Assessment
Compatibility & Strength	The design shows that the Secondary Containment has sufficient strength and thickness to prevent failure owing to pressure gradients, static head during a release, physical contact with the waste, climatic conditions, and the stress of daily operations (e.g., vehicular traffic).	Y	24590-WTP-DB-ENG-01-001, Rev. 0, Basis of Design; 24590-WTP-PER-CSA-02-001, Rev. 2, Secondary Containment Design; 24590-HLW-P1-P01T-P0001, Rev. 4, HLW VITRIFICATION BUILDING GENERAL ARRANGEMENT PLAN AT EL. (-) 21'-0" and the associated Cross-Section drawings	These general requirements are stated as design goals in the Basis of Design document. The explicit design codes and standards and loads and load combinations for design are listed in the Secondary Containment Design requirements document. These requirements and codes and standards are adequate for the secondary containment design. Since the secondary containments being considered are located in cells inside the High Level Waste Vitrification Building rather than directly buried, pressure gradients and vehicular traffic are not applicable load cases. The drawings show the general arrangement of the secondary containment.
	The Secondary Containment system has sufficient strength in the presence of operational stresses from site-specific conditions (i.e., traffic, heavy equipment, precipitation, frost).	Y	24590-WTP-DB-ENG-01-001, Rev. 0, Basis of Design; 24590-WTP-PER-CSA-02-001, Rev. 3, Secondary Containment Design; 24590-WTP-3PS-NLLR-00002, Rev. 0, Engineering Specification for Furnishing, Detailing, Fabrication, Delivery and Installation of Stainless Steel Liner Plates; 24590-WTP-PER-M-02-001, Rev. 2, Material Selections for Building Secondary Containment/Leak Detection	The Secondary Containments being considered are installed below grade inside the High Level Waste Vitrification Building. Because they are located inside the building, precipitation and frost are not applicable load cases. The Secondary Containment Design document identifies the applicable load cases (operational stresses) from site specific conditions that must be considered in the design. The Engineering Specification for Furnishing Stainless Steel Liner Plates includes specific provisions for protection of and repair of completed liners during the construction process. The Material Selections for Building Secondary Containment report addresses the potential effects of operations conditions on liner coatings integrity and the associated maintenance requirements.

Best Available Copy

	Information Assessed	Y/N	Source of Information	Assessment
Foundation Integrity	The Secondary Containment is properly supported by a foundation or base in order to prevent failure from settlement, compression, or uplift, including the residual effects of installation.	Y	24590-WTP-DC-ST-01-001, Rev. 0, Structural Design Criteria; 24590-WTP-PER-CSA-02-001, Rev. 3, Secondary Containment Design; 24590-HLW-P1-P01T-P0001, Rev. 4, HLW VITRIFICATION BUILDING GENERAL ARRANGEMENT PLAN AT EL. (-) 21'-0" and the associated Cross-Section drawings	These conditions are fully addressed in the Structural Design Criteria and the Secondary Containment Design document. The design requirements and codes and standards specified are adequate to satisfy these performance goals. The design and construction specifications adequately provide for proper foundation construction and installation of the Secondary Containment. The general arrangement plan drawing for elevation (-) 21'-0" and the associated cross-sections provide an adequate description of the Secondary Containment being considered.
	The placement, structural support, and type of material used for backfill around and below the Secondary Containment are appropriate.	Y	24590-BOF-3PS-CE01-T0001, Rev. 4, Engineering Specification for Excavation and Backfill; 24590-BOF-3PS-C000-T0001, Rev. 2, Engineering Specification for Material Testing Services	The Excavation and Backfill, and Material Testing specifications contain current adequate industry standards for selecting and testing fill materials, placing and compacting backfills, and testing not less than once each lift to assure adequate compaction. Requirements for testing and record keeping are current and adequate for both safety grade fills and commercial grade fills.
	The design or operation (e.g., diking & curbing) prevents run-on or infiltration of precipitation into the Secondary Containment system unless the collection system has sufficient excess capacity (25 yr rainfall) to contain the run-on precipitation.	Y	24590-WTP-DB-ENG-01-001, Rev. 0 Basis of Design; 24590-HLW-P1-P01T-P0001, Rev. 4, HLW VITRIFICATION BUILDING GENERAL ARRANGEMENT PLAN AT EL. (-) 21'-0" and the associated Cross-Section drawings	This requirement is specified in the Environmental section of the Basis of Design document. In addition, the secondary containment being reviewed is located inside the High Level Waste Vitrification Building where it is protected from precipitation as shown in the General Arrangement Plan and the associated Cross-Section drawings.

6

Best Available Copy

	Information Assessed	Y/N	Source of Information	Assessment
Liner System	The design includes an external moisture barrier or other means to prevent moisture from entering the cell.	Y	24590-HLW-P1-P01T-P0001, Rev. 4, HLW VITRIFICATION BUILDING GENERAL ARRANGEMENT PLAN AT EL. (-) 21'-0" and the associated Cross-Section drawings; 24590-WTP-DB-ENG-01-001, Rev. 0, Basis of Design	The Secondary Containment shown in the general arrangement plan at elevation (-) 21'-0" is inside the High Level Waste Vitrification Building which shields it from precipitation and surface water percolation. The ground water table is located about 200 feet below the floors of the cells at elevation (-) 21'-0" as noted in the Basis of Design.
	The containment area is free of cracks or gaps and the design discusses methods of their minimization.	Y	24590-WTP-PER-CSA-02-001, Rev. 3, Secondary Containment Design; 24590-WTP-3PS-NLLR-T0002, Rev. 0, Engineering Specification for Furnishing, Detailing, Fabrication, Delivery and Installation of Stainless Steel Liner Plates	The Secondary Containment Design document provides current adequate design requirements and codes and standards to design leak tight stainless steel liners for Secondary Containment. This report (CSA-02-001) includes appropriate details for installation of protective coating liners free of cracks and gaps. The procurement specification for design, fabrication and installation of stainless steel liners identifies construction processes that are adequate and appropriate for installation of the liners.
	The design has considered the compatibility of the concrete liner or coatings and waste and presents information on coatings planning to be used from the manufacturer addressing compatibility with the stored waste. The lining or coating must prevent the waste from migrating into the concrete.	Y	24590-WTP-PER-M-02-001, Rev. 2, Material Selections for Building Secondary Containment/Leak Detection; 24590-WTP-PER-CSA-02-001, Rev. 3, Secondary Containment Design	The Material Selection Study contains general information on the compatibility of planned Secondary Containment stainless steel liners and protective coatings with the waste. The Secondary Containment Design report provides standard details for liners and coatings that will adequately prevent migration of the waste into the concrete.
	Y = Yes N = No N/A = Not Applicable			

Best Available Copy

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH LEVEL WASTE BELOW GRADE SECONDARY CONTAINMENT

"I, John T. Baxter have reviewed, and certified a portion of the design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by Department of Energy, Office of River Protection, Richland, Washington. My duties were independent review of the current design for the High Level Waste Facility Below Grade Secondary Containment as required by The Dangerous Waste Regulations, namely, WAC 173-303-640(3) applicable paragraphs (i.e., (a) through (g))."

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

The documentation reviewed indicate that the design intent fully satisfies the requirements of the WAC.

The attached review is 6 sheets numbered 1 through 6.

JOHN T. BAXTER
STATE OF WASHINGTON
18978
REGISTERED
PROFESSIONAL ENGINEER

EXPIRES: 10 / 28 / 04

John T. Baxter 05/15/03

Signature Date

RECEIVED
MAY 15 2003
BNI-Subcontracts

COGEMA ENGINEERING

May 15, 2003

COGEMA-03-0160

T. A. O'Toole
Bechtel National, Inc.
Waste Treatment Plant
2435 Stevens Center
Richland, Washington 99352

Dear Ms. O'Toole:

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH LEVEL WASTE BELOW GRADE SECONDARY CONTAINMENT, REVISION 1

The integrity assessment has been completed per the contract requirements and is attached for your use. The assessment found the design intent is sufficient to ensure the foundations and secondary containments will be adequately designed and will have sufficient structural strength, compatibility with the waste(s) to be stored or treated, and corrosion protection to ensure that they will not collapse, rupture, or fail.

If you have any questions, please contact me at (509) 376-5445, or via facsimile at (509) 372-0504.

Sincerely,

K. V. Scott, Manager
Facilities, Structures & Components

kld

Attachment

cc: D. C. Pfluger w/ attachment

2425 Stevens Center Place, Second Floor, Richland, Washington 99352 Tel: (509) 372-3572 - Fax: (509) 372-3169
COGEMA Engineering Corporation

9

MASTER DISTRIBUTION SCHEDULE

Project Name: RPP-WTP

Document Distribution: 24590-CM-HC4-HXYG-00138

Document Number: **Revision:**

Insert rows as necessary ↑

Name	MSIN	Controlled	Uncontrolled	Size				Comments
				8 ½ x 11	11 x 17	Full	As Is	
Dan Pfluger	MS4-E2							LEAD REVIEWER
Brad Erlundson								Reviewer
Trisha O'Toole								Info

Insert rows as necessary ↑

DAN PFLUGER
Approver's Name (Print)

Approver's Signature

8/27/2002
Date

MASTER DISTRIBUTION SCHEDULE

Project Name: 24590-CM-HCY-HXY6-00138

Document Distribution:

Document Number: **Revision:**

Name	MSIN	Controlled	Uncontrolled	Size				Comments
				8 ½ x 11	11 x 17	Full	As Is	
Dan Pfluger	MS4-B2		X	X				Signed off sticker copy
Trisha O'Toole	MS9-B		X	X				Signed off sticker copy

Dan Pfluger
Approver's Name (Print)

Approver's Signature

10/1/02
Date

Job No. 24590

Bechtel National, Inc.

SUPPLIER DOCUMENT STATUS

1. [X] **Work may proceed.**
2. [ ] **Revise and resubmit. Work may proceed subject to resolution of indicated comments.**
3. [ ] **Revise and resubmit. Work may not proceed.**
4. [ ] **Review not required. Work may proceed.**

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations.

REVIEWED										EJNS BMS

G-321 Document Category N/A
[From Supplement A to G-321-E (E) or G-321-V (V), as applicable, or "N/A" if SSRS is used]

Supersedes BNI Document No. 24590-CM-HC4-HXYG-00138-01-11 Rev. NA
[When applicable]

Accepted by DC Pfanger (Print Name) DC Pfanger (Signature) 10/9/03 (Date)

Released by
[When applicable] Print Name Signature Date

416 GP&S 7-03

24590-CM-HC4-HXYG-00138-01-11
REV. 00B

SUBCONTRACT SUBMITTAL

10/13/03 10/16/03

(B) [X] Processed/Data Entry [X] Copied/QA [X] Scanned [ ] Filed

(A) YAE 10-9-03

(C) NC 10/15/03

R10129795

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH LEVEL WASTE FACILITY ELEVATION 0'-0" SECONDARY CONTAINMENT

"I, John T. Baxter have reviewed, and certified a portion of the design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by Department of Energy, Office of River Protection, Richland, Washington. My duties were independent review of the current design for the High Level Waste Facility Elevation 0'-0" Secondary Containment as required by The Dangerous Waste Regulations, namely, WAC 173-303-640(3) applicable paragraphs, i.e., (a) through (g)."

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

The documentation reviewed indicate that the design intent fully satisfies the requirements of the WAC.

The attached review is 7 sheets numbered 1 through 7.

RPP-WTP
RECEIVED
OCT 0 6 2003
BY PDC

10-6-03 10/8/03
Processed/ Data Entry | Copied/ QA | Scanned | Filed
(B) (A) 10-6-03
(C) KS 10/7/03

JOHN T. BAXTER
STATE OF WASHINGTON
18978
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES: 10/28/04

John T. Baxter 10/02/2003
Signature Date

24590-CM-~~HCH~~ HCH-HX46-00138-01-11, Rev. 00B
JAS 10-6-03

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH LEVEL WASTE FACILITY ELEVATION 0'-0" SECONDARY CONTAINMENT

COGEMA-IA-014
REV. 1

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

Scope	Scope of this Integrity Assessment	This integrity assessment addresses High Level Waste Facility 0'-0" Elevation Secondary Containment. Rooms are located at elevations between (-) 9'-0" and elevation 0'-0", and above, inside the High Level Waste Facility. The specific rooms considered in this assessment are: H-0116B, H-0117, H-0304A and H-0310A.
References	Drawings	The drawings are the general arrangement plan at elevation 0'-0" (FROM EL. -9'-0" TO EL. 8'-0", and above) and associated sections. 24590 HLW P1 P01T P0002, Rev. 2, HLW VITRIFICATION BUILDING GENERAL ARRANGEMENT PERMIT PLAN AT EL. 0'-0"; 24590 HLW P1 P01T P0008, Rev. 6, HLW VITRIFICATION BUILDING GENERAL ARRANGEMENT PERMIT SECTIONS A-A, B-B & C-C; 24590 HLW P1 P01T P0009, Rev. 5, HLW VITRIFICATION BUILDING GENERAL ARRANGEMENT PERMIT SECTIONS D-D, E-E & F-F; 24590 HLW P1 P01T P0010, Rev. 5, HLW VITRIFICATION BUILDING GENERAL ARRANGEMENT PERMIT SECTION G-G & SECTION H-H; 24590 HLW P1 P01T P0011, Rev. 6, HLW VITRIFICATION BUILDING GENERAL ARRANGEMENT PERMIT SECTION J-J & SECTION K-K

Summary of Assessment

For each item of "Information Assessed" (i.e., Criteria) on the following pages, the items listed under "Source of Information" were reviewed and found to furnish adequate design controls and requirements to assure the design intent fully satisfies the WAC requirements.

	Information Assessed	Source of Information	Assessment
Foundation Design	Description of subsurface conditions and soil bearing capacity are adequate.	24590-WTP-DC-ST-01-001, Rev. 1, Structural Design Criteria; 24590-BOF-3PS-CE01-T0001, Rev. 4, Engineering Specification for Excavation and Backfill; 24590-BOF-3PS-C000-T0001, Rev. 2, Engineering Specification for Material Testing Services	The Structural Design Criteria adequately presents design guidance for both mat and spread footings based on the geotechnical site investigation for the facility (H-1616-51, Shannon & Wilson, 2000). Bearing capacity and settlement design parameters are furnished for the dense Hanford Upper and Lower Sand Units and Structural Fill. Use of the loose wind blown (dune) sands for foundations is precluded. The Excavation and Backfill Specification provides structural backfill requirements based on the geotechnical report and adequate current codes and standards for selection, placing, and compacting structural backfill including testing of candidate fill materials and completed backfills. The Specification for Material Testing Services provides current adequate codes and standards for testing of candidate structural fill materials and in-situ testing of structural fills as they are constructed. The codes and standards are consistent with those called out in the Excavation and Backfill Specification.
	Foundation design loads (including full tanks) and estimated settlement are adequately considered.	24590-WTP-DC-ST-01-001, Rev. 1, Structural Design Criteria; ASCE 7-98, Minimum Design Loads for Buildings and Other Structures	The Structural Design Criteria uses current adequate standards to define design loads and load combinations (ASCE 7-98, ACI 349-01 and ACI 318-99). Dead and Fluid loads are included in these loads and load combinations. Settlement design parameters are included in the Structural Design Criteria subsection on geotechnical design parameters and foundation design.
	Design calculation approach and design basis of footings with design standard references (e.g., ACI) are adequate.	24590-WTP-DC-ST-01-001, Rev. 1, Structural Design Criteria; ACI 349, Code Requirements for Nuclear Safety-Related Concrete Structures; ACI 318-99, Building Code Requirements for Structural Concrete	The Structural Design Criteria references current adequate design criteria for the design of concrete foundations and footings. ACI 349-01 is referenced for design of "safety" grade structures and ACI 318-99 is referenced for the strength design of "commercial grade" structures.

	Information Assessed	Source of Information	Assessment
Foundation Design	Foundation material is compatible with the soil.	24590-WTP-3PS-DB01-T0001, Rev. 6, Engineering Specification for Furnishing and Delivering Ready-Mix Concrete; 24590-BOF-3PS-C000-T0001, Rev. 2, Engineering Specification for Material Testing Services; 24590-WTP-DB-ENG-01-001, Rev. 0, Basis of Design	The specification for Furnishing and Delivering Ready-Mix Concrete provides adequate current testing requirements for the selection of coarse and fine aggregates and the procurement of cementitious materials. Adequate test procedures are provided in the Material Testing Services specification for testing candidate aggregates for chemical reactivity. Instructions for mixing and delivering Ready-Mix Concrete are adequate and current. As noted in the Basis of Design document (section 4.7), the water table lies about 200 feet below the deepest foundations so there is little reason to expect compatibility problems between the concrete foundations and the site soils.
	Foundation will withstand the effects of frost heave	24590-WTP-DC-ST-01-001, Rev. 1, Structural Design Criteria	The Structural Design Criteria includes adequate provisions to preclude frost heave in the section addressing lateral earth pressure loads. All structural foundations are required to extend into the soil below the frost line to preclude frost heave. The frost line is 30 inches below finished grade. Therefore, the foundation will not be subjected to frost heave.
Seismic Design	Seismic considerations have been adequately addressed.	24590-WTP-PER-CSA-02-001, Rev. 3, Secondary Containment Design; 24590-WTP-DC-ST-01-001, Rev. 1, Structural Design Criteria; ANSI/AISC N690, Specification for the Design, Fabrication and Erection of Steel Safety-Related Structures for Nuclear Facilities; AISC MO16-89, Manual of Steel Construction - Allowable Stress Design, Ninth Edition; ASCE 4, Seismic Analysis of Safety Related Nuclear Structures and Commentary	The Secondary Containment Design document describes and provides references for the design methodology, materials, loads, and load combinations (including seismic loads) for the HLW Building secondary containment. The Structural Design Criteria provides detailed discipline specific codes and standards for the design of Seismic Category (SC-I/II) HLW secondary containment foundations and structures by the design engineers. ACI-349-01 and ACI 318-99 provide the design codes and load combinations for design of the secondary containment reinforced concrete foundations and structures. Structural steel components of the secondary containment structures and stainless steel liners are to be designed using ANSI/AISC N690 and the AISC Allowable Stress Design code. ASCE 4-98 is used for guidance on seismic analysis of safety-related nuclear structures. These codes and standards are adequate and acceptable for addressing seismic considerations.

	Information Assessed	Source of Information	Assessment
Compatibility	The stored waste is compatible with its Secondary Containment and leak detection hardware based on a detailed chemical and physical analysis of the wastes used and other information sources.	24590-WTP-DB-ENG-01-001, Rev. 0, Basis of Design; 24590-WTP-PER-M-02-001, Rev. 3, Material Selections for Building Secondary Containment/Leak Detection; 24590-WTP-PER-CSA-02-001, Rev. 3, Secondary Containment Design; 24590-WTP-PER-J-02-001, Rev. 4, Leak Detection - Sump Level Measurement in Secondary Containment Systems	The Basis of Design states that cells and sumps are appropriately lined and any spills are removed and flushed within 24-hr or as timely as possible. Based on detailed analysis of the corrosive properties of expected waste process operations and evaluation of potential leak scenarios, the Material Selection report identifies appropriate and adequate corrosion resistant materials for Secondary Containment liners, coatings, and leak detection hardware. The Secondary Containment Design report provides adequate typical construction details for liners including tank anchorage details, stainless steel liner details, special protective coatings, sumps, and leak detection equipment to be used for Secondary Containment. Typical details are furnished for leak detection and sump level measurement systems equipment both in cell, and out of cell in the Leak Detection - Sump Level Measurement specification.
Strength	The design shows that the Secondary Containment has sufficient strength and thickness to prevent failure owing to pressure gradients, static head during a release, physical contact with the waste, climatic conditions, and the stress of daily operations (e.g., vehicular traffic).	Drawings listed above under References; 24590-WTP-PER-CSA-02-001, Rev. 3, Secondary Containment Design; 24590-WTP-3PS-NLLR-T0002, Rev. 0, Engineering Specification for Furnishing, Detailing, Fabrication, Delivery and Installation of Stainless Steel Liner Plates; 24590-WTP-PER-M-02-001, Rev. 3, Material Selections for Building Secondary Containment/Leak Detection	Because the Secondary Containment being considered is installed inside the High Level Waste Vitrification Building as shown on the drawings, climatic conditions and vehicular traffic are not applicable load cases. The Secondary Containment Design requirements document identifies adequate and appropriate design codes and standards and all applicable load cases (operational stresses) from site specific conditions that must be considered in the design. The procurement subcontract specification for furnishing the stainless steel liner plates includes specific provisions for protection of completed liners during the construction process. Similar specifications for protection of coatings will be developed during the coating selection process. Factors to be considered during coating selection are adequately discussed in the Material Selections for Building Secondary Containment/Leak Detection document.

	Information Assessed	Source of Information	Assessment
Strength	The Secondary Containment system has sufficient strength in the presence of operational stresses from site-specific conditions (i.e., traffic, heavy equipment, precipitation, frost).	Drawings listed above under References; 24590-WTP-PER-CSA-02-001, Rev. 3, Secondary Containment Design; 24590-WTP-3PI-NLLR-00002, Rev. 0, Engineering Specification for Furnishing, Detailing, Fabrication, Delivery and Installation of Stainless Steel Liner Plates; 24590-WTP-PER-M-02-001, Rev. 3, Material Selections for Building Secondary Containment/Leak Detection	Because the Secondary Containment being considered is installed inside the High Level Waste Vitrification Building as shown on the drawings, traffic, heavy equipment, precipitation and frost are not applicable load cases. The Secondary Containment Design requirements document identifies adequate and appropriate design codes and standards and all applicable load cases (operational stresses) from site specific conditions that must be considered in the design. The procurement subcontract specification for furnishing the stainless steel liner plates includes specific provisions for protection of completed liners during the construction process. Similar specifications for protection of coatings will be developed during the coating selection process. Factors to be considered during coating selection are adequately discussed in the Material Selections for Building Secondary Containment document.
Foundation Integrity	The Secondary Containment is properly supported by a foundation or base in order to prevent failure from settlement, compression, or uplift, including the residual effects of installation.	Drawings listed above under References; 24590-WTP-DC-ST-01-001, Rev. 1, Structural Design Criteria; 24590-WTP-PER-CSA-02-001, Rev. 3, Secondary Containment Design	These conditions are fully addressed in the Structural Design Criteria and the Secondary Containment Design requirements documents. The design requirements and codes and standards specified are adequate to satisfy these performance goals. The procurement and construction specifications adequately provide for proper foundation construction and installation of the Secondary Containment. The General Arrangement Plan drawing and the associated Cross-Section drawings show the Secondary Containment boundaries.
	The placement, structural support, and type of material used for backfill around and below the Secondary Containment are appropriate.	24590-BOF-3PS-CE01-T0001, Rev. 4, Engineering Specification for Excavation and Backfill; 24590-BOF-3PS-C000-T0001, Rev. 2, Engineering Specification for Material Testing Services	The Excavation and Backfill and Material Testing specifications contain current adequate industry standards for selecting and testing fill materials, placing and compacting backfills, and testing not less than once each lift to assure adequate compaction. Requirements for testing and record keeping are current and adequate for both 'safety grade' fills and 'commercial grade' fills.

	Information Assessed	Source of Information	Assessment
Infiltration	The design or operation (e.g., diking & curbing) prevents run-on or infiltration of precipitation into the Secondary Containment system unless the collection system has sufficient excess capacity (25 yr rainfall) to contain the run-on precipitation.	24590-WTP-DB-ENG-01-001, Rev. 0 Basis of Design; Drawings listed above under References	This requirement is specified in the Basis of Design. Secondary containments being reviewed in this Integrity Assessment are all located inside the High Level Waste Vitrification Building where they are protected from precipitation as shown in the General Arrangement Plan and the associated Cross-Section drawings.
	The design includes an external moisture barrier or other means to prevent moisture from entering the cell.	Drawings listed above under References; 24590-WTP-DB-ENG-01-001, Rev. 0, Basis of Design	The Secondary Containments shown in the General Arrangement Plan at Elevation 0'-0" are inside the High Level Waste Vitrification Building which shields them from precipitation and surface water percolation. The ground water table is located about 200 feet below the floors of the cells at elevation 0'-0" as noted in the Basis of Design.
Liner System	The containment area is free of cracks or gaps and the design discusses methods of their minimization.	24590-WTP-PER-CSA-02-001, Rev. 3, Secondary Containment Design; 24590-WTP-3PS-NLLR-T0002, Rev. 0, Engineering Specification for Furnishing, Detailing, Fabrication, Delivery and Installation of Stainless Steel Liner Plates	The Secondary Containment Design requirements document provides adequate and appropriate codes and standards for design of leak tight stainless steel liners. This report (CSA-02-001) also includes appropriate details for design and installation of special protective coatings free of cracks and gaps. The procurement specification for design, fabrication and installation of stainless steel liners identifies construction and inspection processes that are adequate and appropriate for installation of the liners and minimizing cracks or gaps.

	Information Assessed	Source of Information	Assessment
Liner System	The design has considered the compatibility of the concrete liner or coatings and waste and presents information on coatings planning to be used from the manufacturer addressing compatibility with the stored waste. The lining or coating must prevent the waste from migrating into the concrete.	24590-WTP-PER-M-02-001, Rev. 3, Material Selections for Building Secondary Containment/Leak Detection; 24590-WTP-PER-CSA-02-001, Rev. 3, Secondary Containment Design	The Material Selections Study contains adequate and appropriate general information on the compatibility of planned Secondary Containment stainless steel liners and special protective coatings with the waste. The Secondary Containment Design report provides adequate and appropriate standard details for design and installation of liners and special protective coatings that will prevent migration of the waste into the concrete.

COGEMA ENGINEERING

RECEIVED
OCT 0 3 2003
BNI-Subcontracts

October 2, 2003

COGEMA-03-0294

D. J. Whiting
Bechtel National, Inc.
Waste Treatment Plant
2435 Stevens Center MS14-3B
Richland, Washington 99352

Dear Ms. Whiting:

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH LEVEL WASTE FACILITY ELEVATION 0'-0" SECONDARY CONTAINMENT, REV. 1

The integrity assessment has been completed per the contract requirements and is attached for your use. The assessment found the design intent is sufficient to ensure the foundations and secondary containments will be adequately designed and will have sufficient structural strength, compatibility with the waste(s) to be stored or treated, and corrosion protection to ensure that they will not collapse, rupture, or fail.

If you have any questions, please contact me at (509) 376-5445, or via facsimile at (509) 372-0504.

Sincerely,

K. V. Scott, Manager
Facilities, Structures & Components

jb

Attachment

cc: D. C. Pfluger w/ attachment

2425 Stevens Center Place, Second Floor, Richland, Washington 99352 Tel: (509) 372-3572 - Fax: (509) 372-3169
COGEMA Engineering Corporation

Job No. 24590

Bechtel National, Inc.

SUPPLIER DOCUMENT STATUS

1. [X] **Work may proceed.**
2. [ ] **Revise and resubmit. Work may proceed subject to resolution of indicated comments.**
3. [ ] **Revise and resubmit. Work may not proceed.**
4. [ ] **Review not required. Work may proceed.**

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations.

REVIEWED										

G-321 Document Category N/A
[From Supplement A to G-321-E (E) or G-321-V (V), as applicable, or "N/A" if SSRS is used]

Supersedes BNI Document No. 24590-CM-HC4-HXYG-00138-01-15 Rev. 00A
[When applicable]

Accepted by _____ Print Name _____ Signature _____ Date 1/20/04

Released by N/A
[When applicable] Print Name _____ Signature _____ Date _____

416 GP&S 7-03

24590-CM-HC4-HXYG-00138-01-15
REV. 00B

SUBCONTRACT SUBMITTAL

COGEMA ENGINEERING

RECEIVED
JAN 12 2004
BNI-Subcontracts

January 9, 2004

COGEMA-04-0003

D. J. Whiting
Bechtel National, Inc.
Waste Treatment Plant
2435 Stevens Center
Richland, Washington 99352

Dear Ms. Whiting:

STRUCTURAL INTEGRITY ASSESSMENT OF THE WTP BELOW GRADE WASTE TRANSFER LINES (SECONDARY CONTAINMENT, ANCILLARY EQUIPMENT, AND CORROSION ASSESSMENT), REVISION 1

The integrity assessment has been completed per the contract requirements and is attached for your use. The assessment found the design intent is sufficient to ensure the WTP Below Grade Waste Transfer Lines (Secondary Containment and Ancillary Equipment) will be adequately designed and that the WTP Below Grade Waste Transfer Lines (Secondary Containment and Ancillary Equipment) will have sufficient structural strength, compatibility with the waste(s) to be stored or treated, and corrosion protection to ensure that they will not collapse, rupture, or fail.

If you have any questions, please contact me at (509) 376-5445, or via facsimile at (509) 372-0504.

Sincerely,

K. V. Scott, Manager
Facilities, Structures & Components

kld

Attachment

cc: D. C. Pfluger MS4-E2 w/ attachment

2425 Stevens Center Place, Second Floor, Richland, Washington 99352 Tel: (509) 372-3572 - Fax: (509) 372-3169
COGEMA Engineering Corporation

R10190664

IQRPE REVIEW – WTP BELOW GRADE WASTE TRANSFER LINES (SECONDARY CONTAINMENT, ANCILLARY EQUIPMENT, AND CORROSION ASSESSMENT), REVISION 1

"I, John T. Baxter, have reviewed, and certified a portion of the design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by Department of Energy, Office of River Protection, Richland, Washington. My duties were independent review of the current design for the WTP Below Grade Waste Transfer Lines (Secondary Containment, Ancillary Equipment, and Corrosion Assessment) as required by the Dangerous Waste Regulations, namely, WAC 173-303-640(3) applicable paragraphs, i.e., (a) through (g)."

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

The documentation reviewed indicate that the design intent fully satisfies the requirements of the WAC.

The attached review is 10 sheets numbered 1 through 10.

JOHN T. BAXTER
STATE OF WASHINGTON
18978
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES: 10/28/04

John T. Baxter

Signature Date 01/09/2004

RPP-WTP
RECEIVED
JAN 13 2004
BY PDC

24590-CM-HC4-HXYG-00138-01-15 Rev.00B

STRUCTURAL INTEGRITY ASSESSMENT OF THE WTP BELOW GRADE WASTE TRANSFER LINES (SECONDARY CONTAINMENT, ANCILLARY EQUIPMENT, AND CORROSION ASSESSMENT), REVISION 1

COGEMA-IA-015
REV. 1

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

Scope	Scope of this Integrity Assessment	This integrity assessment addresses the WTP Below Grade Waste Transfer Lines shown on Plant Wash & Disposal System Underground Transfer Lines P&ID drawings 24590-PTF-M6-PWD-P0057 and 24590-PTF-M6-PWD-P0058 (exclusive of the RLD lines shown as "on hold" on drawing –P0058). It considers the ancillary equipment, secondary containment, and a corrosion assessment for each of these transfer lines. The interfacility portion of these lines are direct buried double-walled pipe transfer lines. These transfer lines are associated with several process systems. Independent Corrosion Expert (ICE) Report: Attachment A, Corrosion Integrity Assessment of Waste Transfer Pipelines in the Hanford Waste Treatment Plant, Corrosion Control Specialists, Kent, Washington, Dennis P. Helgeson, P.E., 4 pages, 08/11/03. Attachment B, Buried Pipeline and Ancillary Equipment vs Soil Environment Compatibility Report, Ibid., 6 pages, 08//11/03.

References	Drawings	24590-PTF-M6-PWD-P0057, Rev. 0, P&ID PLANT WASH & DISPOSAL SYSTEM UNDERGROUND TRANSFER LINES (Q); 24590-PTF-M6-PWD-P0058, Rev. 0, P&ID-PTF PLANT WASH & DISPOSAL SYSTEM UNDERGROUND TRANSFER LINES (Q); 24590-PTF-M6-PWD-P0002, Rev. 1, P&ID-PTF PLANT WASH & DISPOSAL SYSTEM EFFLUENT COLLECTION PWD-VSL-00033/00043/00044 (Q); 24590-HLW-M6-HCP-P0001, Rev. 0, P&ID-HLW Concentrate Receipt Process System Concentrate Receipt Vessel 1 (Q); 24590-HLW-M6-HCP-P0002, Rev. 0, P&ID-HLW Concentrate Receipt Process System Concentrate Receipt Vessel 2 (Q); 24590-HLW-M6-RLD-P0001, Rev. 0, P&ID-HLW Radioactive Liquid Waste Disposal System Active Effluent Collection (Q); 24590-HLW-M6-RLD-P0002, Rev. 0, P&ID-HLW Radioactive Liquid Waste Disposal System Plant Wash and Drains Vessel (Q); 24590-WTP-M6-50-P0001, Rev. 0, P&ID SYMBOLS AND LEGEND SHEET 1 OF 6; 24590-WTP-M6-50-P0002, Rev. 0, P&ID SYMBOLS AND LEGEND SHEET 2 OF 6; 24590-WTP-M6-50-P0003, Rev. 0, P&ID SYMBOLS AND LEGEND SHEET 3 OF 6; 24590-WTP-M6-50-P0004, Rev. 0, P&ID SYMBOLS AND LEGEND SHEET 4 OF 6; 24590-WTP-M6-50-P0005, Rev. 0, P&ID SYMBOLS AND LEGEND SHEET 5 OF 6; 24590-WTP-M6-50-P0006, Rev. 0, P&ID SYMBOLS AND LEGEND SHEET 6 OF 6

Summary of Assessment

For each item of "Information Assessed" (i.e., Criteria) on the following pages, the items listed under "Source of Information" were reviewed and found to furnish adequate design controls and requirements to assure the design intent fully satisfies the WAC requirements.

	Information Assessed	Source of Information	Discussion
Design	Ancillary equipment design standards are appropriate and adequate for the equipment's intended use.	24590-WTP-DC-PS-01-001, Rev 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; 24590-WTP-PER-PL-02-001, Rev. 3, Piping Material Class Description; 24590-WTP-3PS-PS02-T0001, Rev. 2, Engineering Specification for Shop Fabrication of Piping; 24590-WTP-3PN-PS-02-00008, Specification Change Notice to 24590-WTP-3PS-PS02-T0001, Rev. 2; 24590-PTF-M6-PWD-P0057, Rev. 0, P&ID Plant Wash and Disposal System Underground Transfer Lines (Q); 24590-PTF-M6-PWD-P0058, Rev. 0, P&ID Plant Wash and Disposal System Underground Transfer Lines (Q)	The Pipe Stress Design Criteria document identifies American Society of Mechanical Engineers (ASME) B31.3 Process Piping as the design code for both safety grade and commercial grade piping systems of the WTP. To satisfy more stringent seismic requirements, the design criteria includes methodology provided in the ASME Boiler & Pressure Vessel Code, Section III Rules for Construction of Nuclear Facility Components (ASME Section III) to supplement the design rules of ASME B31.3 code for analysis and design of safety grade piping. The Piping Material Class Description document identifies the design conditions including limiting pressure and temperature service conditions and the corrosion/erosion allowance for each Piping Material Class, the piping material and wall thickness, and the appropriate design code(s). The description for each class identifies the ancillary equipment requirements for pipe, fittings, flanges, valves, and gaskets for the service conditions in which they will be employed. The Material Classes for the transfer lines being considered are W62F, S32B, W31A, and W32A. All of the transfer lines considered here are double-walled pipe containing a 3 in. nominal pipe size stainless steel carrier pipe inside a 6 in. nominal pipe size carbon steel seamless encasement pipe. The transfer lines are identified on the P&ID drawings as Quality Level (QL-1) and Seismic Category (SC-1). These codes and standards are acceptable and adequate for the design of the double-walled transfer lines.
	If the ancillary equipment to be used is not built to a design standard, the design calculations demonstrate sound engineering principles of construction.	24590-WTP-DC-PS-01-001, Rev 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"	This item is Not Applicable because the ancillary equipment piping is to be designed in accordance with ASME B31.3 for all applicable load conditions and load combinations as noted above.

	Information Assessed	Source of Information	Discussion
Design	Ancillary equipment has adequate strength at the end of its design life to withstand the operating pressure, operating temperature, thermal expansion, and seismic loads. Equipment is protected against physical damage and excessive stress due to settlement, vibration, expansion, or contraction.	24590-WTP-DC-PS-01-001, Rev 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; 24590-WTP-PER-M-02-002, Rev 0, Materials for Ancillary Equipment 24590-WTP-PER-PL-02-001, Rev. 3, Piping Material Class Description; ME101, Linear Elastic Analysis of Piping, Version N6 software, Bechtel Corporation, Computer Services Library, 50 Beale St., San Francisco, California; 24590-WTP-VV-PS-01-001, Rev 1, Verification and Validation Report for ME101, Linear Elastic Analysis of Piping Version N6	The Pipe Stress Design Criteria document specifies the ASME B31.3 code to address operating pressure, operating temperature, thermal expansion/contraction, settlement or support displacements, corrosion, and vibration and seismic loads. Elements of the ASME B&PV Code, Section III (Subsection NC and Appendices F and N) are used to supplement the requirements of ASME B31.3 for seismic design of Seismic Category (SC-I/II) ancillary equipment. Details of the seismic design methods are discussed in the Pipe Stress Design Criteria document. The ME101Linear Elastic Analysis of Piping program is used for static and dynamic design analysis for the more complex ancillary equipment such as the underground transfer lines. The program has been verified and validated. The Piping Material Class Description document provides enveloping values for design pressure and temperature limits for the primary carrier pipes and the secondary encasement pipes for each pipe class. A bounding corrosion/erosion allowance is furnished for the primary pipe for each class. These codes and standards are adequate and appropriate to assure that the ancillary equipment has adequate strength at the end of design life.

	Information Assessed	Source of Information	Discussion
Supports	Ancillary equipment supports are adequately designed.	24590-WTP-PER-PS-02-001, Rev. 4, Ancillary Equipment Pipe Support Design; 24590-WTP-DC-PS-01-001, Rev 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; ME101, Linear Elastic Analysis of Piping, Version N6 software, Bechtel Corporation, Computer Services Library, 50 Beale St., San Francisco, California; 24590-WTP-VV-PS-01-001, Rev 1, Verification and Validation Report for ME101, Linear Elastic Analysis of Piping Version N6	Pipe supports for the primary transfer line inside the secondary containment pipe consist of small support plates and spacers installed between the exterior surface of the primary pipe and the inside surface of the secondary containment pipe. A standard set of typical details is provided in the Ancillary Equipment Pipe Support Design document. An adequate set of horizontal supports, guides, and pipe anchor typical details is furnished to the fabricator to allow production of the spools. Additional details are furnished for closure of encasements at field connections, installation of insulation with an outer wrapping and elbow assemblies. The final design evaluations for the pipe-in-pipe transfer lines will be accomplished with ME101 models that represent the primary and secondary pipes, internal supports, guides and anchors, the surrounding soil, and the final line routings (geometries). The Pipe Stress Design Criteria document is organized around the design requirements of ASME B31.3 Process Piping supplemented by ASME Section III, Division 1, Subsection NC and Appendices F and N requirements for seismic design analysis. For safety grade supports, design allowable stresses are based on allowables for normal loads as defined in ASME Section III, Division I. Analysis is by manual calculation or approved computer programs. These codes and standards are appropriate and adequate for mixed waste transfer lines over the range of conditions identified for these systems. Use of approved and validated computer programs to analyze piping designs is appropriate.
Connections	Seams and connections are adequately designed.	24590-WTP-PER-PS-02-001, Rev. 4, Ancillary Equipment Pipe Support Design; 24590-WTP-3PS-PS02-T0001, Rev. 2, Engineering Specification for Shop Fabrication of Piping; 24590-WTP-3PN-PS-02-00008, Specification Change Notice to 24590-WTP-3PS-PS02-T0001, Rev. 2	The Engineering Specification for Shop Fabrication of Piping shows that the double-walled transfer lines use welded butt joints for all connections. The transfer lines are Quality Level 1 (QL-1). Welding requirements are in accordance with ASME B31.3. Welder qualifications are in accordance with the ASME Boiler and Pressure Vessel Code (B&PV) Section IX, Welding and Brazing Qualifications. Nondestructive examinations are to be conducted in accordance with ASME B&PV Section V as specified in the Engineering Specification for Shop Fabrication of Piping, Appendix A. The Ancillary Equipment Pipe Support Design document shows examples of standard assemblies for the transfer lines and encasements. These are adequate and appropriate design and fabrication codes and standards for the ancillary equipment being evaluated.

	Information Assessed	Source of Information	Discussion
Frost Heave	The system will withstand the effects of frost heave.	24590-WTP-DC-ST-01-001, Rev. 1, Structural Design Criteria; 24590-WTP-DB-ENG-01-001, Rev. 1A, Basis of Design	The Structural Design Criteria identifies the frost line as being 30 in. below grade. The Civil, Structural, Architectural Basis of Design section requires that all underground pipes be installed with the top of pipe at least 30 in. below grade so that the pipes are not subject to frost heave.
Waste Characteristics	Characteristics of the waste to be stored or treated have been identified (ignitable, reactive, toxic, specific gravity, vapor pressure, flash point, temperature)	24590-WTP-PSAR-ESH-01-002-02, Rev. 1, Preliminary Safety Analysis Report to Support Construction Authorization; PT Facility Specific Information; 24590-WTP-DB-ENG-01-001, Rev. 1A, Basis of Design; 24590-PTF-PER-M-02-003, Rev. 1, Underground Pipe Protection; 24590-WTP-PER-PL-02-001, Rev. 3, Piping Material Class Description	Chapter 4 of the Preliminary Safety Analysis Report identifies the Important to Safety functions for the waste transfer lines. They are listed as maintaining structural integrity for their design life while resisting a high radiation environment, corrosive effects of the process streams, and the erosive nature of the suspended solids. In addition, the waste transfer lines must maintain structural integrity during and after a seismic event. The Underground Pipe Protection document and the Piping Material Class Description document provide the basis for the corrosion/erosion allowances and list the allowances for each pipe class. Flammable gas is not identified as a concern for the waste transfer lines. Transfer lines originating or terminating in source or downstream receiving tanks typically include a dip tube that terminates below the surface of the low level heel in each tank. The dip tubes isolate the lines from any potential flammable gas buildup in the tank vapor spaces. The Basis of Design document requires a facility wide grounding system to be in place, including process equipment, to control ignition sources. The design has included adequate and appropriate features to address the waste characteristics including pressure, temperature, corrosion, erosion and control of potential flammable gases in ancillary equipment.

	Information Assessed	Source of Information	Discussion
Waste Characteristics	Ancillary equipment is designed to handle the wastes with the characteristics defined above and any treatment reagents.	24590-WTP-DB-ENG-01-001, Rev. 1A, Basis of Design; 24590-PTF-PER-M-02-003, Rev. 1, Underground Pipe Protection	The Basis of Design requires that dangerous waste tank systems meet the requirements of WAC 173-303-640. The Underground Pipe Protection document discusses the rationale for material selection for the underground transfer lines. The primary lines from the Hanford Tank Farms are 304L stainless steel because they are used to transfer alkaline wastes to the WTP. The intraplant transfer lines in the WTP use primary lines of 316L stainless steel to provide for transferring less alkaline solutions. The primary pipelines will be flushed with inhibited water after each use for corrosion control. Carbon steel was selected for the secondary encasement lines. During normal operations, the annulus between the exterior of the primary pipelines and the interior of the encasement lines remains dry which limits corrosion. The carbon steel encasement lines have sufficient wall thickness to resist internal corrosion from a waste leak for a period of time adequate to detect the leak and allow for flushing of the secondary line. The exteriors of the secondary encasements for the intraplant transfer lines are protected with a cathodic protection system. The exteriors of the secondary encasements for the transfer lines from the Hanford Tank Farms are enclosed in closed-cell bonded foam insulation with a waterproof outer jacket of High Density Polyethylene to prevent exterior corrosion.

	Information Assessed	Source of Information	Discussion
Compatibility	The pH range of the waste, waste temperature and the corrosion behavior of the structural materials are adequately addressed. Ancillary equipment material and protective coatings ensure the ancillary equipment structure is adequately protected from the corrosive effects of the waste stream and external environments. The protection is sufficient to ensure the equipment will not leak or fail for the design life of the system.	See drawings listed above; 24590-PTF-PER-M-02-003, Rev. 1, Underground Pipe Protection; 24590-WTP-3YD-CPE-00001, Rev. C, System Description for Cathodic Protection; 24590-WTP-3PS-EQ00-T0002, Rev. 2, Engineering Specification for Cathodic Protection; Specification No. 24590-WTP-3PS-PX04-T0004, Rev. 0, Engineering Specification for Epoxy Coating of Stainless Steel Items that are Buried, Embedded or Insulated; Specification No. 24590-WTP-3PS-PX04-T0001, Rev. 0, Engineering Specification for Shop Applied Fusion Bonded Epoxy Coating for Underground Carbon Steel Pipe; Requisition Number: 24590-QL-MRA-PSO2-00008, Rev. 2, SECTION 2 - TECHNICAL SPECIFICATIONS	The Underground Pipe Protection report identifies that two grades of stainless steel have been selected for the underground transfer lines. The primary transfer lines from the Hanford Tank Farms are 304L stainless steel because they are used to transfer alkaline wastes to the WTP. The intraplant transfer lines in the WTP use primary lines of 316L stainless steel to provide for transferring less alkaline solutions. All primary transfer lines are to be flushed with inhibited water after each use. Secondary encasement lines are designed to be sufficiently internally corrosion resistant to provide leak protection from the time a primary leak starts until the leak has been detected and the transfer line has been isolated. The soil side of the secondary encasement lines is to be protected with cathodic protection in accordance with National Association of Corrosion Engineers (NACE) International Recommended Practices (except for the Waste Feed Receipt Process System transfer lines). A System Description document identifies the overall scope of the WTP Cathodic Protection System that will be applied to the waste transfer lines. Detailed specifications for design and construction are furnished in the Engineering Specification for Cathodic Protection. Transfer lines evaluated in this integrity assessment have carbon steel secondary encasements. An impressed current cathodic protection system is to be used to protect these secondaries from corrosion where they are buried. The specification for "Shop Applied Fusion Bonded Epoxy Coating" describes the epoxy coating that will be applied to the outside of the transfer lines to control current flow in the cathodic protection system. Consideration was given to service life and cumulative anticipated radiation exposure of candidate epoxy coatings during development of the specifications. The Waste Feed Receipt Process (FRP) System waste transfer lines are furnished with additional external corrosion protection by adding an external waterproof barrier to the lines in lieu of cathodic protection. This barrier consists of a 2 in. layer of sprayed or injected closed-cell polyurethane foam with an external jacket of extruded high density polyethylene (HDPE) pipe with a minimum thickness of 150 mils. The Technical Notes in the Material Requisition (MRA) require the foam to be fully bonded to the epoxy coating on the outside of the encasement pipe and fully bonded to the inside of the HDPE jacket. Independent Corrosion Expert (ICE) Report: The corrosion protection provisions for the transfer lines considered in this Integrity Assessment have been reviewed by an ICE, Mr. Dennis Helgeson, P.E. His reports are included as attachment A and B to this assessment.

	Information Assessed	Source of Information	Discussion
Corrosion Allowance	Corrosion allowance is adequate for the intended service life of the ancillary equipment.	24590-WTP-DB-ENG-01-001, Rev. 1A, Basis of Design; 24590-WTP-DC-PS-01-001, Rev 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; 24590-PTF-PER-M-02-003, Rev. 1, Underground Pipe Protection; 24590-WTP-PER-PL-02-001, Rev. 3, Piping Material Class Description	The required service life of 40 years for mechanical systems, e.g. piping, is identified in the Basis of Design. The Pipe Stress Design Criteria identifies ASME B31.3 as the design code for WTP piping. Consideration of corrosion, including corrosion allowance, is a mandatory requirement of ASME B31.3. The Underground Pipe Protection document identifies the choice of 304L and 316L stainless steel as conservative for the primary underground transfer lines which are free-draining, operated only periodically during transfers, and are flushed with inhibited water after each transfer. The corrosion/erosion allowances for underground transfer pipe classes S32B, W31A, W32A and W62F are listed in the Piping Material Class Description document.
Pressure Controls	Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the vessels are exceeded.	24590-WTP-DC-PS-01-001, Rev 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"	The Pipe Stress Design Criteria identifies ASME B31.3 as the design code for the ancillary equipment piping. ASME B31.3 requires provision be made to safely contain or relieve any pressure to which the piping may be subjected. ASME B31.3 piping not protected by a pressure relieving device, or that can be isolated from a pressure relieving device must be designed for at least the highest pressure that the system can develop. This requirement applies to the primary transfer lines. The transfer lines all terminate in dip tubes which are free-draining to the heels in the Pretreatment Building tanks. The maximum internal pressure is therefore limited by the design configuration.
	Maximum flows and any unusual operating stresses are identified	24590-PTF-M6-PWD-P0057, Rev. 0, P&ID Plant Wash and Disposal System Underground Transfer Lines (Q); 24590-PTF-M6-PWD-P0058, Rev. 0, P&ID Plant Wash and Disposal System Underground Transfer Lines (Q); 24590-WTP-PER-PL-02-001, Rev. 3, Piping Material Class Description	The expected flow paths for the ancillary equipment are identified on the reference P&ID drawings. As noted in the adjacent item above, ASME B31.3 requires piping to be designed for the highest pressure that a system can develop. The bounding maximum design temperature and pressure are listed for each piping material class in the Piping Material Class Description. ASME B31.3 and the associated standards are appropriate and adequate for the design of the transfer lines.

	Information Assessed	Source of Information	Discussion
Secondary Containment	Ancillary equipment is designed with secondary containment that is constructed of materials compatible with the waste and of sufficient strength to prevent failure (pressure gradients, waste, climatic conditions, daily operations), provided with a leak-detection system, and designed to drain and remove liquids.	24590-PTF-PER-M-02-003, Rev. 1, Underground Pipe Protection; 24590-WTP-DC-PS-01-001, Rev 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; 24590-WTP-PER-J-02-002, Rev. 1, Low Point Leak Detection in Secondary Containment Systems for Buried Co-Axial Transfer Lines; 24590-PTF-M6-PWD-P0057, Rev. 0, P&ID Plant Wash and Disposal System Underground Transfer Lines (Q); 24590-PTF-M6-PWD-P0058, Rev. 0, P&ID Plant Wash and Disposal System Underground Transfer Lines (Q); 24590-BOF-3PS-C000-T0002, Rev. 0, Engineering Specification for Excavation and Backfill of Underground Radioactive Waste Transfer Lines; 24590-BOF-3PS-CE01-T0001, Rev. 4, Engineering Specification for Excavation and Backfill	The 6 in. diameter carbon steel secondary encasement pipes shown on the P&IDs must be designed to ASME B31.3 as noted in the Pipe Stress Design Criteria. ASME B31.3 requires piping to be designed for superimposed dead loads such as the soil overburden for the buried transfer lines and potential vehicular loads. The Underground Pipe Protection document identifies that the secondary containments have sufficient corrosion endurance to assure that the secondary lines will not leak for a time period sufficient to detect a leaking primary and isolate the transfer line from service. The Excavation and Backfill specifications have specific provisions for the use of controlled density fills for backfilling trench excavations for outside buried piping. They also address granular pipe bedding material that conforms to ASTM D 422 and a proviso that controlled density fill conforming to the ASTM is also acceptable. Installation instructions are provided for installing bedding material to line and grade with dimensional tolerances for minimum and maximum bedding material installation and appropriate lift and compaction requirements. The installation of bedding materials is coordinated with the backfill and compaction requirements for subgrade preparation for roads and paved areas. Testing Procedures and Record Keeping procedures are defined for quality control testing of bedding installation as each lift is placed. The fill and compaction requirements for the installation of underground transfer lines are appropriate and adequate to assure that the lines will perform as designed. The P&IDs show that each transfer line has a low point drain and leak detection to identify primary line leaks. Details of the leak detection system are discussed in the Low Point Leak Detection in Secondary Containment Systems for Buried Co-Axial Transfer Lines document. Flushing capabilities are provided at the high point end of of each transfer line for removing leaked waste or accumulated liquid in the secondary lines by flushing to the low point drains.

ATTACHMENT A

CORROSION INTEGRITY ASSESSMENT OF WASTE TRANSFER PIPELINES IN THE HANFORD WASTE TREATMENT PLANT

Corrosion Control Specialist,
Dennis P. Helgeson, P.E.

(5 pages including coversheet)

C C S **Corrosion Control Specialists**

P.O. Box 5303
Kent, Washington 98064-5303
Phone (253) 520-3424 • Fax (253) 520-3425

CORROSION INTEGRITY ASSESSMENT OF

Waste Transfer Pipelines in the
Hanford Waste Treatment Plant
Owned/Operated by the U. S. Department of Energy
Office of River Protection, Richland Washington
per WAC 173-303-640(3)(a) through (g)

This corrosion certification is for the waste transfer pipelines at the Hanford Waste Treatment Plant Richland, Washington. The transfer pipelines included in this certification are shown on drawings 24590-PTF-M6-PWD-P0057 AND –P0058 with the exception of the two lines on hold (RLD-ZS-03382-F10A AND RLD-03383-F10A-03). This corrosion integrity assessment was conducted to identify components of the environment or the piping network that could lead to corrosion damage to the pipe that could lead to failure of the pipe. The assessment evaluated the corrosion protection measures taken to assure that they were correctly designed and compatible with the environment in which they are to operate. This assessment is provided as a subcontract from COGEMA Engineering. This assessment has considered:

A. CORROSION/CORROSION CONTROL STANDARDS, DESIGN STANDARDS AND ENGINEERING DOCUMENTS:

NFPA 70 - 1996	National Electrical Code (NEC)
NACE International RP-0169-1996	Recommended Practice. "Control of External Corrosion on Underground or Submerged Metallic Piping Systems"
WAC 173-303-640 - October 3, 2001"	Washington Administrative Code, Title 173, WAC Department of Ecology, Dangerous Waste Regulations for Tank Systems
NACE-RP-0274	High Voltage Electrical Inspection of Pipeline Coatings

Steel Structures Painting Council (SSPC)

SSPC-SPI	Solvent Cleaning
SSPC-SPIO	Near-White Blast Cleaning
SSPC-SP11	Power Tool Cleaning to Bare Metal
SSPC-VISI	Visual Standards for Abrasive Blast Cleaned Steel
SSPC-PA2	Measurement of Dry Paint Thickness with Magnetic Gauges

Bechtel Document	24590-WTP-DB-ENG-01-001, REV 0 – Basis for Design
NACE Publication	Corrosion Data Survey compiled by Norman E. Hamner – Metals Section

B PLANT DESIGN DOCUMENTS REVIEWED IN PREPARATION OF THE ASSESSMENT

24590-BOF-3PS-CE01-T0001, Rev. 4	Engineering Spec for Excavation and Backfill
24590-WTP-PER-J-02-002, Rev. 1	Low-Point Leak Detection in Secondary Containment Systems for Buried Co-Axial Transfer Lines
24590-PTF-PER-M-02-003, Rev. 1	Underground Pipe Protection
24590-WTP-PER-PS-02-001, Rev. 3	Ancillary Equipment Pipe Support Design
24590-WTP-PER-PL-02-001, Rev 2	Piping Material Class Description
24590-WTP-3PS-NWP0-T0001, Rev.1	Engineering Specification for General Welding and NDE Requirements for Supplier Fabricated Piping
24590-WTP-3PS-PB01-T0001, Rev. 0	Engineering Specification for Technical Supply Conditions for Pipe, Fittings, and Flanges
SCN NO. 24590-WTP-3PN-PB01-00001	Change Notice for the specification listed above
24590-WTP-3PS-PS02-T0001, Rev. 2	Engineering Specification for Shop Fabrication of Piping
SCN NO. 24590-WTP-3PN-PS-02-00008	Change Notice for the specification listed above
24590-WTP-3PS-PS02-T0002, Rev. 1	Engineering Specification for Cold Bending of Pipe
SCN NO. 24590-WTP-3PN-PS02-00010	Change Notice for the specification listed above
24590-WTP-3PS-PX04-TP001, Rev. 0	Specification for Shop Applied Fusion Bonded Epoxy Coating for Underground Carbon Steel Pipe
24590-WTP-3PS-PX04-T0004, Rev. 0	Engineering Specification for Epoxy Coating of Stainless Steel Items that Are Buried, Embedded or Insulated
24590-WTP-3PS-G000-T0001, Rev. 0	General Specification for Supplier Quality Assurance Program Requirements
24590-WTP-3PS-EQ00-T0002, Rev. 2	Engineering Specification for Cathodic Protection
24590-WTP-3YD-CPE-00001, Rev. C	System Description for Cathodic Protection
WTSC99-1036-42-17	RPP-WTP Geo-technical Investigation Final Report, Shannon & Wilson, 2000
24590-PTF-M6-PWD-P0057, Rev. 0	P&ID Plant Wash & Disposal System Underground Transfer Lines (Q)
24590-PTF-M6-PWD-P0058, Rev. 0	P&ID Plant Wash & Disposal System Underground Transfer Lines (Q)
24590-PTF-3YD-PWD-00001, Rev. 0	System Description for Plant Wash and Disposal System PWD and Radioactive Liquid Waste Disposal System RLD
24590-WTP-3PS-DB01-T0001, Rev. 6	Engineering specification for Furnishing and delivering Ready Mix Concrete
24590-BOF-3PS-C000-T0002, Rev. 0	Engineering Specification for Excavation and Backfill of Underground Radioactive Waste Transfer Lines
24590-PTF-M6-PWD-P0002, Rev. 1	P&ID Plant Wash & Disposal System Effluent Collection System PWD-VSL-00033/00043/00044
24590-BOF-C2-C12T-00002, Rev. 3	RPP-WTP General Arrangement Plan
24590-PTF-P1-P01T-P0011, Rev. 3	Pretreatment Facility General Arrangement Section E-E
24590-PTF-P1-P01T-P0008, Rev. 2	Pretreatment Facility General Arrangement Section B-B

C. CHARACTERISTICS OF THE SOILS SURROUNDING THE PIPELINES AND THE RATES OF CORROSION THAT MIGHT BE EXPECTED

See "Buried Pipeline and Ancillary Equipment vs. Soil Environment Compatibility Report for Buried Pipelines at River Protection Project – Waste Treatment Plant dated August 11, 2003 attached.

D. PLANNED CORROSION PROTECTION MEASURES:

1 Impressed current cathodic protection

2 Fusion bonded epoxy coating

3. Corrosion allowance included in pipe material specification.

OR

1 Isolation of the steel pipe from contact with the soil

2 Corrosion allowance included in pipe material specification.

E: COMMENTS:

COGEMA Engineering has provided all documents requested in completing this assessment. COGEMA personnel interviewed were fully responsive to all inquires about the subject pipelines, their operation, or the soil environment into which they are to be placed. Notwithstanding the statements or information contained herein, this assessment conducted by Corrosion Control Specialists is based on that data and information supplied by COGEMA.

F CERTIFICATION LIMITATIONS;

This certification is only for the identified pipe material, coating, and cathodic protection specified in the design documents reviewed. If the materials of construction change or if the planned operation or use is changed or if a significant structural change is made, a new assessment certification is required.

CORROSION INTEGRITY ASSESSMENT CERTIFICATION

I, Dennis Helgeson have reviewed, and certified a portion of a design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by the U. S. Department of Energy, Office of River Protection, Richland Washington. My duties, as an independent corrosion expert, were to review the design for the waste transfer piping inside the plant to determine if it was compatible with the soils at the site and would not fail as a result of corrosion damage, as required by the Dangerous Waste Regulations, namely, WAC 173-303-640(3) (a).

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

The undersigned is a registered professional engineer in the state of Washington.

Signature: Dennis R Helgen Date: 8/11/03

Company: Corrosion Control Specialists
P. O. Box 5303
Kent, WA 98064

Telephone: (253) 520-3424 Fax: (253) 520-3425

DENNIS R. HELGEN
STATE OF WASHINGTON
18231
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES 12/24/04

ATTACHMENT B

BURIED PIPELINE AND ANCILLARY EQUIPMENT vs. SOIL ENVI RONMENT COMPATIBILITY REPORT

Corrosion Control Specialist,
Dennis P. Helgeson, P.E.

(7 pages including coversheet)

C C S **Corrosion Control Specialists**

P.O. Box 5303
Kent, Washington 98064-5303
Phone (253) 520-3424 • Fax (253) 520-3425

BURIED PIPELINE AND ANCILLARY EQUIPMENT VS SOIL ENVIRONMENT COMPATIBILITY REPORT

for the
River Protection Project - Waste Treatment Plant
Hanford, Washington

The U.S. Department of Energy (DOE) plans to construct a dangerous waste Waste Treatment Plant (WTP) at their Hanford, Washington facility. Construction of the plant is part of the DOE River Protection Project. Mixed waste will be received, pretreated, and vitrified in three primary waste treatment facilities. Waste will be transferred into the WTP, between WTP waste treatment facilities, and out of the WTP in buried piping. That transfer piping is the subject of this compatibility report. This report addresses only pipelines that will have active cathodic protection.

This report is being prepared to assure compliance with the state of Washington Department of Ecology regulation described in WAC 173-303-640(3) and its guidance 94-114.

Pipeline Design

The buried transfer piping for the WTP will be a sloped coaxial system. The coaxial system for transfer of the waste is made up of a carrier pipe made of 316L stainless steel to contain the waste. That carrier pipe will run inside an encasement pipe that is made of carbon steel. The encasement pipe is a secondary containment system in the event of a leak from the carrier pipe. The encasement pipe also isolates the carrier pipe from corrosion by the surrounding soils. The encasement pipes are to be 6-inch diameter Schedule 40 carbon steel. The pipe will have a nominal wall thickness of 0.280 inches. A leak detection system is incorporated into the pipeline design to provide an alarm in the event of a leak. The exterior of the encasement pipe is to be coated with a factory applied fusion bonded epoxy (FBE). The FBE is a primary method of corrosion control by isolating the pipe from contact with the soil. Specifications for the coating and its application are described in Bechtel documents 24590-WTP-3PS-PX04-T0001, Rev 0 and 24590-WTP-3PS-PX04-T0004, Rev 0. The specification for the WTP recognizes that the FBE may not be 100 percent effective and calls for the installation of cathodic protection to

supplement it. Details of the Bechtel's plan for cathodic protection are described in their documents 24590-WTP-3PS-EQ00-T0002, Rev 2 and 24590-WTP-3YD-CPE-00001, Rev C.

The drawings 24590-PTF-M6-PWD-P0057 and –P0058 identify the transfer pipelines that are the subject of this report. All of the pipelines shown on these drawings are within the scope of this report with the exception of the two lines on hold (RLD-ZS-03383-F10-03 and RLD-ZS-03382-F10A-04) which are the effluent lines from the Waste Treatment Plant to the Hanford site disposal facilities, the LERF and ETF facilities. Also the three transfer lines from the Hanford Tank Farms to the Pretreatment Facility (FRP-PZ-01749-W62F-03, FRP-PZ-01750-W62F-03, and FRP-PZ-01751-W62F-03) are excluded from the cathodic protection engineering specification, and are therefore not the subjects of cathodic protection discussed in this report. This report considers the metallic pipe that makes up the transfer piping at the WTP. It does not address any FRP piping nor does it address any steel piping that is isolated from the soil environment by encasement in high-density polyethylene pipe.

The compatibility of the carrier pipe with the wastes being transferred inside it is not the subject of this report. That compatibility is the responsibility of others. Any corrosion that might occur in the annular air space between the carrier pipe and the encasement pipe should be minimal to nil but that compatibility evaluation is also the responsibility of others.

This report is to evaluate if the FBE coating and cathodic protection system make the encasement pipe compatible with the soils at the site.

A detailed description of the make up of the piping network at the WTP is described in the following Bechtel documents:

24590-BOF-3PS-CE0I-T0001, Rev. 4
24590-WTP-PER-J-02-002, Rev. 1
24590-PTF-PER-M-02-003, Rev. 1
24590-WTP-PER-PL-02-001, Rev. 2
24590-WTP-3PS-NWP0-T0001, Rev. 1
24590-WTP-3PS-PB01-T0001, Rev. 0
24590-WTP-3PS-PS02-T0001, Rev. 2
24590-WTP-3PS-PS02-T0002, Rev. 1
24590-WTP-3PS-G000-TP002, Rev. 1

Soil Environment

To evaluate the relative corrosion performance of different soils a number of properties of the soil are evaluated. The principal properties evaluated are outlined in WAC 173-303–640(3)(a)(iii)(A)(I-VIII) to include:

(I) Soil moisture content
(II) Soil pH
(III) Soil sulfides level

(IV) Soil resistivity
(V) Structure to Soil Potentials
(VI) Influence of nearby underground metallic structures
(VII) Existence of stray electric currents
(VIII) Existing corrosion protection methods

The moisture content of soils at the WTP site varies seasonally between 2-4 %. The pH of the soils recently measured at the site ranged from 5.84 to 7.94 with an average of 6.88. Sulfates and chlorides measured at the site were below detectable limits or below any threshold that would impact corrosion of carbon steel. In-situ soil resistivity ranged from 14,300 to 143,000 ohm-cm with an average of 61,300 ohm-cm. Laboratory testing indicated resistivity between 61,000 and over a million ohm-cm. In as much as this is a planned facility no structure to soil potentials have been recorded. The site for the WTP is near the 200 East area and evaluation of the nearby buried tanks are a consideration as well as any stray current that might result from cathodic protection of those tanks. Interaction between cathodic protection systems in the 200 East Area and cathodic protection systems at the WTP site would be a design consideration for waste transfer lines routed between the sites. A summary of all the soil properties is tabulated and discussed in the Shannon & Wilson Report WTSC99-1036-42-17.

Other Corrosion Considerations

The corrosion of steel in soils is an electrochemical process and not just chemical interaction of the soil with the metal. The electrochemical theory is that four elements are necessary for corrosion to occur. The four elements are anodes on the metal surface, cathodes on the metal surface, a metallic path between the anode and cathode (the metal itself) and an electrolyte (soil). This model of corrosion is referred to as a corrosion cell. If all four elements are present, direct current flows from the anode areas into the soils, through the soil and onto the cathode areas, and through the metal back to the anode. Anodes and cathodes occur on the metal surface caused by a wide variety of reasons including:

Alloying of the metals
Differential aeration of the soil
Different resistivity of the electrolyte
Cold working of metal surface
Coupling of two different metal in the electrolyte
Welded areas vs. un-welded areas of metal surface
Coated or un-coated areas of metal surface
Stray Current

Many of these conditions are present for the intra plant-piping network planned for this WTP site. The encasement pipe as specified is alloyed carbon steel creating the initial anode – cathodes cells. The FBE coating specified is an excellent coating and tight quality control is planned for factory application. However the coating will still have some holidays that go undetected and the coating will experience some undetected nicks and scrapes during installation. Additionally the piping will

be inter-tied with valves, pumps, leak detection probes, etc which will be made up of different metals creating galvanic couples. Moreover field coating of the weld joints cannot fully match the quality achieved at the factory. Further the piping in the plant may pass under roads or paved areas in one area while in other areas in may be under native soil. Areas under the paved areas will have reduced moisture content and a lower aeration content than the native soil areas. The encasement clearly will experience corrosion by interaction with the soil environment.

Discussion

The Table shown below was published as part of the National Association of Corrosion Engineers (NACE) Basic Corrosion Course. It is intended to be a guideline of possible corrosion in homogenous soil. Considering the soil conditions at the WTP described above, the soils would be classified as only progressively less corrosive to carbon steel.

Rough Indications of Soil
Corrosivity vs. Resistivity

Ohm-cm	Description
Below 500	Very corrosive
500-1,000	Corrosive
1,000-2,000	Moderately corrosive
2,000-10,000	Mildly corrosive
Above 10,000	Progressively less corrosive

If one uses it as a guide for the WTP, it suggests the WTP_would expect very little corrosion of buried metals at the site. However, since the resistivity at the site is not homogenous but rather is heterogeneous, the different corrosion cells created by different resistivities at the site will increase corrosion above that indicated by the above table.

A NACE publication "Corrosion Data Survey" has compiled empirical historical data on corrosion rates of carbon steel in various soil resistivities. From this information we find a range of corrosion rates for the resistivity at the WTP. Corrosion rates could be less than 2 mils per year to as high as 10 mils per year. If this relative guide were used we would expect serious damage from anywhere from 15 to 70 years. Since most of the resistivity data is well above the 10,000 ohm-cm level it more likely closer to the 70 years than 15. However this determination of corrosion rates is subjective based on the experience of the corrosion engineer. Neither use of this approach nor the table above provides a satisfactory way for determining compatibility of the piping network at the WTP site.

If it were known the metals were buried in a homogenous soil then laboratory testing could be conducted to determine a more objective prediction of corrosion rates. The laboratory approach would be to complete a linear polarization curve to determine the polarization resistance. Then, the data would be combined with the electrochemical constant and the surface area of the test sample in an equation that results in corrosion rates in mils per year. However nonuniform soils

are present at the site, thus precluding use of this approach. Moreover the pipelines on the site will be subjected to some increased corrosion as indicated by the other corrosion consideration noted above. The corrosion impact of these factors would be left out of any corrosion rate calculation.

The determination in this case as in most soils leaves the expected corrosion rates determination to a subjective determination of a corrosion engineer based on his experience. Even if a corrosion rate for the WTP site could be defined, the other information needed to determine the pipe-soil compatibility is the planned life of the pipelines. The amount of waste to be processed at the WTP and the time needed to process the waste are just estimates. Therefore with only a rough indication corrosion rate in these soils and a planned design life of 40 years for the_WTP corrosion mitigating measures are required to assure pipe-soil compatibility.

The methods available to mitigate corrosion cells include the following:

1. Remove or insulate the electrical path between anodes and cathodes
2. Change or treat the soil
3. Isolate the pipe from the soil.
4. Apply anodic or cathodic protection

The first two approaches are not practical for any buried piping network. The most common method of accomplishing the third approach is to apply a non-conductive coating to the pipeline surface. A good coating system effectively isolates nearly all the pipe from the soil. However pinholes and holidays may exist in most coatings and some metal will remain in contact with the soil. Some corrosion can be expected to continue. Anodic protection is impractical for a buried pipeline system A correctly designed and operated cathodic protection system will effectively mitigate all corrosion on the pipeline by sacrificing another material (anode) that is remote from the metal surface. With an effective cathodic protection system installed at the WTP, there wouldn't be any corrosion of the pipeline and it would be considered compatible with the soil.

Applying cathodic protection to a bare steel pipeline results in high installation cost and high operating expenses. Good engineering practice is to apply a coating to the pipeline and also install cathodic protection. The cost of installing and operating a cathodic protection system for a coated pipeline is 5% or less of that required for a bare pipe. The cathodic protection system for a coated pipeline is protecting just the pinholes or holidays in the coating that comes in contact with the soil. The WTP plan calls for this approach of applying cathodic protection to a coated piping network. This plan for the WTP piping is good engineering practice. The question remains is the coating system specified and the cathodic protection specified adequate to make the pipelines at the WTP compatible with the site soils?

The selection of FBE coating for the WTP is an excellent choice for this application because it is environmentally compatible with the soils and will provide an excellent barrier between the pipe and soil with the minimum of holidays. The FBE coating called out in the project specifications is of the highest quality. The specifications outlines excellent application procedures. The specification requires detailed inspection procedures for quality control for application of the

coating. Moreover the storage, handling and shipping procedures for the pipe in route to the WTP site should ensure the pipe is placed in the ground in excellent condition.

The cathodic protection system specification for the WTP requires the quality of all system components to be met with the national standards by the designer. It provides the designer with direction on what installation practices may be used at the site. It requires the designer establish quality assurance procedures for the design, procurement, and installation of the system. A cathodic protection system designed and installed in accordance with the specification will provide a system that will mitigate all corrosion of the pipelines at the WTP.

In my professional opinion that if the piping is coated with FBE in accordance with the specification and is cathodically protected in accordance with the specification the pipelines will be compatible with the soils at this WTP.

Dennis R. Helgeson, P. E.
Corrosion Specialists # 2736

8/11/03
Date

R10146457

RPP-WTP
RECEIVED
OCT 13 2003
BY PDC

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH LEVEL WASTE (HLW) BELOW GRADE MELTER OFFGAS TREATMENT PROCESS (HOP) VESSELS

COGEMA-IA-013, Rev. 1

BECHTEL

Job No. 24590

Bechtel National, Inc.

SUPPLIER DOCUMENT STATUS

1. [X] Work may proceed.
2. [ ] Revise and resubmit. Work may proceed subject to resolution of indicated comments.
3. [ ] Revise and resubmit. Work may not proceed.
4. [ ] Review not required. Work may proceed.

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations.

REVIEWED

G-321 Document Category N/A
[From Supplement A to G-321-E (E) or G-321-V (V), as applicable, or "N/A" if SSRS is used]

Supersedes BNI Document No. 24590-CM-HC4-HXYG-00138-01-12 Rev. 00A
[When applicable]

Accepted by DC Pflinger (Print Name) DC Pflinger (Signature) 10/14/03 (Date)

Released by [When applicable] Print Name Signature Date

416 GP&S 7-03

10/14/03
(B) [X] Processed/Data Entry [ ] Copied/QA [X] Scanned [ ] Filed
(A) KJ 10/14/03
(C) 10/14/03

10/13/03
(B) [X] Processed/Data Entry [ ] Copied/QA [X] Scanned [X] Filed
(A) KJ 10/13/03
(C) 10/13/03

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

24590-CM-HC4-HXYG-00138--01-17 Rev. 00A

1061

Scope	Scope of this Integrity Assessment	This Integrity Assessment addresses the Submerged Bed Scrubber (SBS) Condensate Receiver Vessels (HOP-VSL-00903 & HOP-VSL-00904). These vessels are located in rooms H-B021 and H-B005 respectively at elevation (-) 21'-0" in the High Level Waste Vitrification Building.
References	Drawings, Mechanical Data Sheets, and System Description	24590-HLW-MV-HOP-P0001, Rev. 1, Equipment Assembly SBS Condensate Receiver Vessel HOP-VSL-00903; 24590-HLW-MV-HOP-P0003, Rev. 0, Equipment Assembly Melter 2 SBS Condensate Receiver Vessel HOP-VSL-00904 (Q); 24590-HLW-M5-V17T-P0003, Rev. 0, Process Flow Diagram HLW Vit Primary Offgas Treatment (System HOP); 24590-HLW-M5-V17T-P20003, Rev. 0, Process Flow Diagram HLW Vit Melter 2 Primary Offgas Treatment (System HOP); 24590-HLW-P1-P01T-P0001, Rev. 5 , HLW Vitrification Building General Arrangement Plan at EL. (-) 21'-0"; Mechanical Systems Data Sheet: Vessel, 24590-HLW-MVD-HOP-P0001, Rev. 1, SBS Condensate Receiver Vessel HOP-VSL-00903; Mechanical Data Sheet: Vessel, 24590-HLW-MVD-HOP-P0012, Rev. 0, Melter 2 SBS Condensate Receiver Vessel HOP-VSL-00904; 24590-HLW-3YD-HOP-00001, Rev. 0, Systems Description for HLW Melter Offgas Treatment Process and Process Vessel Vent Extraction (HOP and PVV Systems); System Description Change Notice (SDCN) SDCN No. 24590-HLW-3YN-HOP-00001, Rev. 0, for System Description No. 24590-HLW-3YD-HOP-00001, Rev. 0; SDCN No. 24590-HLW-3YN-HOP-00002, Rev. 0, for System Description No. 24590-HLW-3YD-HOP-00001, Rev. 0

Summary of Assessment

For each item of "Information Assessed" (i.e., Criteria) on the following pages, the items listed under "Source of Information" were reviewed and found to furnish adequate design controls and requirements to assure the design intent fully satisfies the WAC requirements.

	Information Assessed	Source of Information	Assessment
Design	Vessel design standards are appropriate and adequate for the vessel's intended use.	Drawings and Mechanical Data Sheets listed above under references; 24590-WTP-3PS-MV00-TP001, Rev. 1, Engineering Specification for Pressure Vessel Design and Fabrication; 24590-WTP-3PS-MV00-TP003, Rev. 1, Engineering Specification for Pressure Vessel Fatigue Analysis; 24590-WTP-3PS-MVB2-T0001, Rev. 1, Engineering Specification for Welding of Pressure Vessels, Heat Exchangers and Boilers; 24590-WTP-3PS-G000-TP002, Rev. 1, Positive Material Identification (PMI); 24590-WTP-3PS-G000-T0001, Rev. 0, General Specification for Supplier Quality Assurance Program Requirements	The SBS Condensate Receiver Vessels (HOP-VSL-00903 and HOP-VSL-00904) and all tank appurtenances are to be designed to the ASME Section VIII, Division 1 rules which are appropriate for unfired pressure vessels operating with mixed waste solutions over the pressure and temperature range specified for these vessels. Supplementary requirements are specified in the Engineering Specification for Pressure Vessel Design and Fabrication. Supplementary requirements address pressure vessel fatigue analysis, positive material identification, fabrication tolerances, acceptable welding procedures for the vessel and appurtenances, welder qualifications and testing records, NDE inspections and records, and packaging, shipping, handling and storage requirements. Some of the vessel internal equipment is subject to cyclic loading. The pulse jet mixer fatigue design analysis is adequate. The fatigue design standards, ASME Section VIII, Division 2, are appropriate for components with a high number of load cycles. These are adequate and acceptable design standards. The SBS Condensate Receiver Vessels are vertical vessels with a 144" ID and a vertical length of 93" tangent line to tangent line supported on a cylindrical skirt. Top and bottom heads are 2:1 elliptical shells. The shell and skirt are specified to have a minimum thickness of 5/8 inch. The heads have a minimum thickness of 11/16 inch. Materials for the shell, heads and vessel internal equipment are a nickel chromium alloy Hastelloy C-22, or equal. The external appurtenances such as the vessel skirt and the cooling jackets on the shell and the lower head are to be SA-240 304L and 316L stainless steel respectively. The operating volume is to be about 8134 gallons and the total internal volume is to be about 9891 gallons.

	Information Assessed	Source of Information	Assessment
Design	If a non-standard vessel is to be used, the design calculations demonstrate sound engineering principles of construction.	Drawings and Mechanical Data Sheets listed above under References	The SBS Condensate Receiver Vessels (HOP-VSL-00903 and HOP-VSL-00904) are standard vessels that are shop fabricated. The Mechanical Data Sheets require that the ASME Section VIII, Division 1 vessels be delivered after design, fabrication, inspection and testing with ASME code stamps and that the vessels be nationally registered. They are shop fabricated vessels for liquid acidic condensate mixed waste service in the High Level Waste Building. The vessels' design standards are appropriate and adequate for the intended service.
	Vessel has adequate strength, after consideration of the corrosion allowance, to withstand the operating pressure, operating temperature, and seismic loads.	Drawings and Mechanical Data Sheets listed above under references; 24590-WTP-3PS-MV00-TP001, Rev. 1, Engineering Specification for Pressure Vessel Design and Fabrication; 24590-WTP-3PS-MV00-TP002, Rev. 1, Engineering Specification for Seismic Qualification Criteria for Pressure Vessels; 24590-WTP-3PS-SS90-T0001, Rev. 0, Engineering Specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks	The Mechanical Data Sheets identify each vessel's operating pressure and temperature ranges, the materials selected for each vessel, the corrosion allowance(s), and the vessel quality levels which determine the requirements for seismic design. The design specifications for the vessels require specific consideration of the operating pressures and temperatures and seismic loads in the design process. ASME Section VIII, Div. 1 requires that corrosion allowance material not be considered when evaluating the adequacy of vessel components for these loads at end of life. The Engineering Specification for Seismic Qualification Criteria for Pressure Vessels adopts ASME Section VIII, Div. 2 design rules to address seismic design and analysis of the vessel and vessel supports. Detailed requirements for seismic design of Seismic Category (SC-I/II) vessels are furnished in the specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks. These codes and standards are adequate and appropriate for design of the Condensate Receiver Vessels to withstand operating pressure and temperature loads and seismic loads for the specified design life while considering corrosion allowance.

	Information Assessed	Source of Information	Assessment
Foundation	Vessel foundation will maintain the load of a full vessel.	Drawings listed above under references; 24590-WTP-DB-ENG-01-001, Rev. 0, Basis of Design; 24590-WTP-3PS-MV00-TP001, Rev. 1, Engineering Specification for Pressure Vessel Design and Fabrication	The Engineering Specification for Pressure Vessel Design and Fabrication requires the use of ASME B&PV code, Section VIII, Division I for design of each vessels skirt. This code assures an adequate design for the vessel skirts. Chapter 14 of the Basis of Design document requires that vessel foundations design must be adequate to support the loads from full vessels.
	If in an area subject to flooding, the vessel is anchored.	24590-WTP-3PS-MV00-TP001, Rev. 1, Engineering Specification for Pressure Vessel Design and Fabrication	Buoyant forces of an empty vessel in a flooded room are a mandatory standard design load case in this specification for Pressure Vessel Design and Fabrication.
	Vessel system will withstand the effects of frost heave.	24590-WTP-DC-ST-01-001, Rev. 1, Structural Design Criteria	The Structural Design Criteria document requires that all structural foundations extend a distance below grade that exceeds the depth of the frost line in order to preclude frost heave. The frost line is 30 in. below grade. Therefore, the vessels are not subject to frost heave.
Waste Characteristics	Characteristics of the waste to be stored or treated have been identified (ignitable, reactive, toxic, specific gravity, vapor pressure, flash point, storage temperature)	Mechanical Data Sheets listed above under References; Vessel/ Tank Material Selection Data Sheet, 24590-HLW-N1D-HOP-P0009, Rev. 2, SBS Condensate Receiver Vessel, HOP-VSL-00903 & HOP-VSL-00904 (HLW); 24590-WTP-PSAR-ESH-01-002-04, Rev. 1, Preliminary Safety Analysis Report (PSAR) to Support Construction Authorization; HLW Facility Specific Information	The Mechanical Data Sheets present the waste specific gravity, storage temperatures and pressures. The Vessel/ Material Selection Data Sheets address the pH range and chemical composition of the waste to select appropriate vessel materials and specify the corrosion allowance. Other waste characteristics that are hazardous, such as ignitability, flash point, and toxicity are addressed by the Preliminary Safety Analysis Report for the HLW Facility as an integral part of the design process. The HOP vessels provide primary confinement of the waste during normal operations, abnormal operations and during and after a Design Basis Earthquake. The main safety function is confinement of the vessel waste contents during these conditions. The PSAR identifies that the HOP vessels are not a concern for hydrogen control. The vessels are grounded to control ignition sources.

	Information Assessed	Source of Information	Assessment
Waste Characteristics	Vessel is designed to store or treat the wastes with the characteristics defined above and any treatment reagents.	Vessel/ Tank Material Selection Data Sheet, 24590-HLW-N1D-HOP-P0009, Rev. 2, SBS Condensate Receiver Vessel, HOP-VSL-00903 & HOP-VSL-00904 (HLW); System Description and System Description Change Notices listed above under References	The Vessel/Tank Material Selection Data Sheet demonstrates that the vessel is designed to store the wastes discussed above. The System Description discusses normal and abnormal operations for the HOP vessels (HOP-VSL-00903 and HOP-VSL-00904). Reagents will not routinely be added to these vessels during normal operations.
	The waste types are compatible with each other.	System Description and System Description Change Notices listed above under References; Process Flow Diagrams listed above under References	The System Description for the HLW Melter Offgas Treatment Process (HOP) System does not describe any operations where incompatible wastes are mixed in these vessels for processing. The HOP vessels function primarily to collect acidic condensate generated by the Submerged Bed Scrubber, the Wet Electrostatic Precipitators, and the High Efficiency Mist Eliminators as shown on the Process Flow Diagrams.

	Information Assessed	Source of Information	Assessment
Corrosion Protection	Vessel material and protective coatings ensure the vessel structure is adequately protected form the corrosive effects of the waste stream and external environments (expected to not leak or fail for the design life of the system)	Drawings, System Description and System Description Change Notices listed above under References; Vessel/ Tank Material Selection Data Sheet, 24590-HLW-N1D-HOP-P0009, Rev. 2, SBS Condensate Receiver Vessel, HOP-VSL-00903 & HOP-VSL-00904 (HLW)	The Vessel/Tank Material Selection Data Sheet for HOP-VSL-00903 and HOP-VSL00904 selected the nickel chromium alloy Hastelloy C-22, or equal, to provide resistance to potential process upset conditions. Accident related steam ejector use might produce higher temperatures above the normal operating temperature of 122 °F, perhaps up to the boiling point of the waste. The higher temperatures in combination with the normal operations chemistry of the acidic melter offgas (pH = 1.3) preclude the use of less resistant materials. Continuous agitation is recommended under normal operations to help control pitting and stress corrosion cracking. The material recommendations from the Vessel/Tank Material Selection Data Sheet have been adequately and appropriately incorporated into the Mechanical Data Sheets for the HOP vessels. The vessels are equipped with internal wash rings for decontamination as shown on the drawings. The HOP vessels are not equipped with overflow lines; therefore, the inaccessible process cells in which they are located should remain dry during normal operations which will limit external corrosion of the vessels over the facility design life.
Corrosion Allowance	Corrosion allowance is adequate for the intended service life of the vessel.	Mechanical Data Sheets listed above under references; Vessel/ Tank Material Selection Data Sheet, 24590-HLW-N1D-HOP-P0009, Rev. 2, SBS Condensate Receiver Vessel, HOP-VSL-00903 & HOP-VSL-00904 (HLW)	The bases for the HOP vessels material selection and corrosion allowance is furnished in the Vessel/Tank Material Selection Data Sheet. Selection of the nickel chromium alloy Hastelloy C-22, or equal, with a corrosion/erosion allowance of 0.08 in. for a service life of 40 years is adequate and appropriate. The material selections and corrosion allowances are carried forward to the Mechanical Data Sheets consistently and correctly.

	Information Assessed	Source of Information	Assessment
Pressure Relief	Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the vessel are exceeded.	Process Flow Diagrams listed above under references; 24590-WTP-PSAR-ESH-01-002-04, Rev. 1, Preliminary Safety Analysis Report to Support Construction Authorization; HLW Facility Specific Information	The Condensate Receiver Vessels each operate in a series loop with the associated Submerged Bed Scrubber (SBS) for each melter train. The SBSs operated at a constant head continuously overflowing to the Condensate Receiver Vessels. The contents of the Condensate Receiver Vessels are continuously recycled back to the SBSs to provide agitation to mix the solids that tend to accumulate in the bottoms of the SBSs. When the Condensate Receiver Vessels become full, the bottoms liquid in the associated SBS is pumped off to the Acidic Waste Vessel (RLD-VSL-00007). The recycle stream from the Condensate Receiver Vessel empties the vessel as the SBS contents are transferred. The Process Flow Diagrams show that the HOP vessels are not equipped with overflow lines. They are, however, provided with redundant level indication and an interlock system that shuts off the melter feed on a high-high signal from either the SBS and/or the HOP vessel to stop the addition of more condensate to these vessels.

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH LEVEL WASTE (HLW) BELOW GRADE MELTER OFFGAS TREATMENT PROCESS (HOP) VESSELS, REV. 1

"I, John T. Baxter have reviewed, and certified a portion of the design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by Department of Energy, Office of River Protection, Richland, Washington. My duties were independent review of the current design for the High Level Waste (HLW) Below Grade Melter Offgas Treatment Process (HOP) Vessels as required by The Dangerous Waste Regulations, namely, WAC 173-303-640(3), applicable paragraphs, i.e., (a) through (g)."

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

The documentation reviewed indicate that the design intent fully satisfies the requirements of the WAC.

The attached review is 7 sheets numbered 1 through 7.

JOHN T. BAXTER
STATE OF WASHINGTON
18978
REGISTERED
PROFESSIONAL ENGINEER

EXPIRES: 10 / 28 / 04

John T. Baxter 10/13/2003

Signature Date

1603

COGEMA ENGINEERING

RECEIVED
OCT 13 2003
BNI-Subcontracts

October 13, 2003

COGEMA-03-0317

Daisy J. Whiting
Bechtel National, Inc.
Waste Treatment Plant
2435 Stevens Center
Richland, Washington 99352

Dear Ms. Whiting:

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH LEVEL WASTE (HLW) BELOW GRADE MELTER OFFGAS TREATMENT PROCESS (HOP) VESSELS, REVISION 1

The integrity assessment has been completed per the contract requirements and is enclosed for your use. The assessment found the design intent is sufficient to ensure the vessels will be adequately designed and will have sufficient structural strength, compatibility with the waste(s) to be stored or treated, and corrosion protection to ensure that they will not collapse, rupture, or fail.

If you have any questions, please contact me at (509) 376-5445, or via facsimile at (509) 372-0504.

Sincerely,

K V Scott

K. V. Scott, Manager
Facilities, Structures & Components

kld

Enclosure

cc: D. C. Pfluger w/ attachment

2003

2425 Stevens Center Place, Second Floor, Richland, Washington 99352 Tel: (509) 372-3572 - Fax: (509) 372-3169
COGEMA Engineering Corporation

24590-CM-HC4-HXYG-00138	- 02 - 00010	00A
PO/SCT	**Submittal**	**Rev**

Job No. 24590

Bechtel National, Inc.

SUPPLIER DOCUMENT STATUS

1. [X] **Work may proceed.**
2. [ ] **Revise and resubmit. Work may proceed subject to resolution of indicated comments.**
3. [ ] **Revise and resubmit. Work may not proceed.**
4. [ ] **Review not required. Work may proceed.**

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations.

REVIEWED									EJN

G-321 Document Category N/A
[From Supplement A to G-321-E (E) or G-321-V (V), as applicable, or "N/A" if SSRS is used]

Supersedes BNI Document No. N/A Rev. _____
[When applicable]

Accepted by DC Pfluger (Print Name) DC Pfluger (Signature) 10/27/04 (Date)

Released by N/A (Print Name) _____ (Signature) _____ (Date)
[When applicable]

TP0406_34 7-04

SUBCONTRACT SUBMITTAL

R10404415

IQRPE REVIEW
OF
THE HIGH-LEVEL WASTE (HLW) FACILITY
PROCESS VESSEL VENT EXTRACTION SYSTEM (PVV)
ANCILLARY EQUIPMENT

"I, Tarlok Hundal, have reviewed, and certified a portion of the design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by Department of Energy, Office of River Protection, Richland, Washington. My duties were independent review of the current design for the High-Level Waste (HLW) Facility Process Vessel Vent Extraction System (PVV) Ancillary Equipment as required by the Dangerous Waste Regulations, namely, WAC 173-303-640(3) applicable paragraphs, i.e., (a) through (g)."

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

The documentation reviewed indicates that the design intent fully satisfies the requirements of the WAC.

The attached review is nine (9) pages numbered one (1) through nine (9).

TARLOK SINGH HUNDAL
STATE OF WASHINGTON
20213
REGISTERED
PROFESSIONAL ENGINEER

EXPIRES: 02/15/06

Signature

10/25/04
Date

24590-CM-HC4-HXYG-00138-02-00010 Rev.00A

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH-LEVEL WASTE (HLW) FACILITY PROCESS VESSEL VENT EXTRACTION SYSTEM (PVV) ANCILLARY EQUIPMENT

COGEMA-IA-074
REV. 0

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

Scope	Scope of this Integrity Assessment	This Integrity Assessment includes the PVV ancillary equipment associated with various vessels, breakpots, siphon breaks, plant wash racks, and demisters located in HLW facility and as shown on the Drawings and as described in the System Description document listed in the References below.
References	Drawings and System Description	Drawings: 24590-HLW-M6-PVV-P0001, Rev. 0, P&ID – HLW Process Vessel Vent Exhaust System, Sheet 1 of 2; 24590-HLW-M6-PVV-P20001, Rev. 0, P&ID – HLW Process Vessel Vent Exhaust System Sheet 2 of 2; System Description: 24590-HLW-3YD-HOP-00001, Rev. 0, Systems Description for HLW Melter Offgas Treatment Process and Process Vessel Vent Extraction (HOP and PVV Systems)- including System Description Change Notice (SDCN) Nos. 24590-HLW-3YN-HOP-00001,-00002,-00003, and -00004, against Rev. 0.
Summary of Assessment		For each item of "Information Assessed" (i.e., Criteria) on the following pages, the items listed under "Source of Information" were reviewed and found to furnish adequate design controls and requirements to ensure the design intent fully satisfies the requirements of Washington Administrative Code, WAC-173-303-640, *Dangerous Waste Regulations* for Tank Systems.

	Information Assessed	Source of Information	Discussion
Design	Ancillary equipment design standards are appropriate and adequate for the equipment's intended use.	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev. 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; 24590-WTP-PSAR-ESH-01-002-04, Rev. 1a, Preliminary Safety Analysis Report (PSAR) to Support Construction Authorization: HLW Facility Specific Information.	The Pipe Stress Design Criteria document identifies ASME B31.3 as the design code for piping systems for the WTP. The P&ID drawings identify the varying Seismic Categories and Quality Levels of the ancillary equipment components. To ensure continued function during normal operations, abnormal operations, and during and after a Design Basis Earthquake, the design requirements for all various Seismic Categories (SC-I, II, III, and IV) are discussed in detail in the Pipe Stress Design Criteria document. The Quality Levels are discussed in the PSAR. The above listed design criteria, codes, and standards are acceptable and adequate for the design of the ancillary equipment for its intended use.
	If the ancillary equipment to be used is not built to a design standard, the design calculations demonstrate sound engineering principles of construction.	ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; 24590-WTP-DC-PS-01-001, Rev. 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria."	The ancillary equipment is built to design standards. The Pipe Stress Design Criteria document specifies that piping is to be designed in accordance with ASME B31.3 Code.

	Information Assessed	Source of Information	Discussion
Design	Ancillary equipment has adequate strength at the end of its design life to withstand the operating pressure, operating temperature, thermal expansion, and seismic loads. Equipment is protected against physical damage and excessive stress due to settlement, vibration, expansion, or contraction.	24590-WTP-DC-PS-01-001, Rev 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; ASME Boiler and Pressure Vessel Code, Section III, Rules for Construction of Nuclear Facility Components, Division 1, Code Case N-411, Subsection NC, Appendix N, and Appendix F, 1995; 24590-WTP-VV-PS-01-001, Rev. 2, Verification and Validation Report for ME101, Linear Elastic Analysis of Piping, Version N8; 24590-WTP-DB-ENG-01-001, Rev. 1B, Basis of Design; 24590-WTP-PER-M-02-002, Rev. 1, Materials for Ancillary Equipment; DOE-STD-1020-94, Natural Phenomenon Hazards Design Evaluation Criteria for Department of Energy Facilities (including Change Notice #1, January 1996); UBC, Uniform Building Code, 1997 Edition.	The Basis of Design document specifies that the mechanical equipment is to be designed for a nominal plant life of 40 years. The Materials for Ancillary Equipment document specifies that ancillary equipment downstream of a waste source vessel or miscellaneous plant items is to be constructed of the same or better material and with the same corrosion allowance as the source vessel or plant items, unless the service seen in the downstream line warrants a different material, corrosion allowance, or other modification. The Pipe Stress Design Criteria requires the use of the ASME B31.3 Code and DOE-STD-1020-94 Standard, for piping design. ASME B31.3 requires explicit consideration of operating pressure, operating temperature, thermal expansion and contraction, settlement, vibration, and corrosion allowance in the design of piping. ASME BPV Code, Section III, Code Case N-411, Subsection NC, Appendix N, and Appendix F, and the Uniform Building Code (UBC) are used to supplement the requirements of ASME B31.3 and DOE-STD-1020-94 for design as applicable to the appropriate Seismic Category of the ancillary equipment. Details of the seismic design methods are discussed in the Pipe Stress Design Criteria document. These are appropriate and adequate codes and standards to ensure that the ancillary equipment has adequate strength at the end of its design life to withstand all anticipated loads.

	Information Assessed	Source of Information	Discussion
Supports	Ancillary equipment supports are adequately designed.	Drawings listed above under References; 24590-WTP-DC-PS-01-002, Rev. 3, Pipe Support Design Criteria; 24590-WTP-PER-PS-02-001, Rev. 4, Ancillary Equipment Pipe Support Design; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; ASME Boiler and Pressure Vessel Code, Section III, Rules for Construction of Nuclear Facility Components, Division 1, Subsection NF and Appendix F, 1995; 24590-WTP-PL-PS-01-001, Rev. 1, Verification and Validation Test Plan for Bechtel's ME150 Pipe Support Family of Programs (PCFAPPS).	The Pipe Support Design Criteria considers all load types identified in ASME B31.3 and utilizes ASME Section III, Division 1, Subsection NF and Appendix F to supplement the requirements of ASME B31.3 for seismic design of SC-I/II and SC-III/IV pipe supports. Bounding load cases are passed to the pipe support designers from the results of the ancillary equipment piping stress analyses. Details of the seismic design methodology are discussed in the Pipe Support Design Criteria document. Analysis is by manual calculation and computer programs that have been tested and approved as discussed in the Verification and Validation Test Plan for Bechtel's ME150 Pipe Support Family of Programs. The Ancillary Equipment Pipe Support Design document shows examples of typical equipment supports. Ancillary equipment supports are to be designed in such a way that the heat transferred from supports to the building structure does not raise the building structure temperature to exceed 150°F for concrete and 200°F for steel. These are appropriate codes and standards for design of the PVV system ancillary equipment supports.

	Information Assessed	Source of Information	Discussion
Connections	Seams and connections are adequately designed.	24590-WTP-DB-ENG-01-001, Rev. 1B, Basis of Design; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; 24590-WTP-DC-PS-01-001, Rev. 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications; ASME/ANSI B16.5, 1988 Edition, Piping Flanges and Flanged Fittings.	The Basis of Design states that in-cell piping that is non-maintainable will be fully welded. The Pipe Stress Design Criteria document specifies the ASME B31.3 Process Piping design code for the piping systems. Welding is to be performed in accordance with the requirements of ASME B31.3 and the ASME B&PV Code, Section IX. Flange connections are to be designed in accordance with ANSI B16.5. These are appropriate codes and standards for design and fabrication of the PVV system ancillary equipment seams and connections.
Frost Heave	The system will withstand the effects of frost heave.	Drawings and System Description listed above under References; 24590-WTP-DC-ST-01-001, Rev. 4, Structural Design Criteria.	Structural Design Criteria requires that all structural foundations for outdoor equipment shall extend into the surrounding soil below the 30" frost line depth to preclude the frost heave. The ancillary equipment associated with the PVV system considered in this assessment is located in the inside interior of the HLW Facility. The majority of the HLW building foundation mat is at Elev. (-) 21'-0" level, therefore, the ancillary equipment is not subject to frost heave.

	Information Assessed	Source of Information	Discussion
Waste Characteristics	Characteristics of the waste to be stored or treated have been identified (ignitable, reactive, toxic, specific gravity, vapor pressure, flash point, temperature)	Drawings and System Description listed above under References; 24590-WTP-PER-PR-03-002, Rev. 1, Toxic Vapors and Emissions from WTP Tank Systems and Miscellaneous Treatment Unit Systems; 24590-WTP-PER-PR-03-001, Rev. 1, Prevention of Hydrogen Accumulation in WTP Tank Systems and Miscellaneous Treatment Unit Systems.	The PVV System Description identifies the only safety function for the PVV vessel offgas lines and headers shown on the P&ID drawings as providing primary confinement of the vessels offgases during normal operations, abnormal operations, and during and after a Design Basis seismic event. These functions are discussed with respect to vapors and emissions of acutely or chronically toxic (upon inhalation) extremely hazardous waste in the Toxic Vapors and Emissions document. Similar discussions are provided in the Prevention of Hydrogen Accumulation document with respect to ancillary equipment functions related to maintaining hydrogen concentrations below lower flammability limits during normal operations, abnormal operations and during and after a design level seismic event.
	Ancillary equipment is designed to handle the wastes with the characteristics defined above and any treatment reagents.	Drawings and System Description listed above under References; 24590-WTP-PER-M-02-002, Rev. 1, Materials for Ancillary Equipment; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description.	The System Description identifies that additional reagents are not added to the PVV system ancillary equipment during normal operations. The PVV system vessel offgas vent lines and headers provide for collection of vessel offgases from selected vessels and provide pathways to the melter offgas process treatment (HOP) system for treatment prior to release from the facility. The Materials for Ancillary Equipment document requires that the material selection and corrosion/erosion allowances for ancillary equipment in contact with the waste will be equal to or better than the material and corrosion allowance of the waste source vessels except as noted therein. The vessel offgas vent lines and headers are to be fabricated from 316L stainless steel or from UNS N08367 (6% Molybdenum stainless steel alloy, grade AL-6XN), as shown in the P&ID drawings and as identified in Piping Material Class Description document.

	Information Assessed	Source of Information	Discussion
Compatibility	The pH range of the waste, waste temperature and the corrosion behavior of the structural materials are adequately addressed. Ancillary equipment material and protective coatings ensure the ancillary equipment structure is adequately protected from the corrosive effects of the waste stream and external environments. The protection is sufficient to ensure the equipment will not leak or fail for the design life of the system.	System Description and listed above under References; 24590-WTP-DB-ENG-01-001, Rev.1B, Basis of Design; 24590-WTP-PER-M-02-002, Rev. 1, Materials for Ancillary Equipment; 24590-WTP-3PS-NN00-T0001, Rev 0, Engineering Specification for Hot and Anti-Sweat Thermal Insulation; Annual Book of ASTM Standards, American Society of Testing and Materials.	The Basis of Design identifies a service design life of 40 years for the ancillary equipment. All non-maintainable items will be designed to last the life of the facility. Detailed material selection (corrosion) analyses are conducted for each vessel and major components in the PVV system in the HLW facility during process design. The Materials for Ancillary Equipment document specifies that ancillary equipment downstream of a waste source vessel or miscellaneous plant items is to be constructed of the same or better material and with the same corrosion allowance as the source vessel or plant items, unless the service seen in the downstream line warrants a different material, corrosion allowance, or other modification. The Thermal Insulation specification requires that all insulating materials used on the outside of ancillary equipment be pre-approved for use on austenitic stainless steel in accordance with applicable ASTM procedures and tests to preclude external corrosion of ancillary equipment. Both internal and external corrosion has been considered for all ancillary equipment, therefore, the ancillary equipment will provide the expected design service life of 40 years.

	Information Assessed	Source of Information	Discussion
Corrosion Allowance	Corrosion allowance is adequate for the intended service life of the ancillary equipment.	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev. 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; 24590-WTP-DB-ENG-01-001, Rev. 1B, Basis of Design; 24590-WTP-PER-M-02-002, Rev. 1, Materials for Ancillary Equipment; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description.	The Pipe Stress Design Criteria document requires use of the ASME B31.3 Code for ancillary equipment design. Consideration of corrosion, including corrosion allowance, is a mandatory requirement of ASME B31.3. A required service design life of 40 years is identified in the Basis of Design for ancillary equipment located in inaccessible process cells. Detailed material selection (corrosion) analyses are conducted for each vessel and major components in the PVV system in the HLW Facility during process design. The Materials for Ancillary Equipment document specifies that ancillary equipment downstream of a waste source vessel or miscellaneous plant items is to be constructed of the same or better material and with the same corrosion allowance as the source vessel or plant items, unless the service seen in the downstream line warrants a different material, corrosion allowance, or other modification. Bounding corrosion allowances are listed for each piping material class in the Piping Material Class Description document. The corrosion/erosion allowance for the PVV system ancillary equipment is, 0.040 in. for the 316L stainless steel material and is 0.0425 in. for the UNS N08367 (6% Molybdenum stainless steel alloy, grade AL-6XN) material. The material and corrosion allowance are appropriate and adequate for the intended service life of the ancillary equipment.

	Information Assessed	Source of Information	Discussion
Strength	Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the vessels are exceeded.	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev. 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description.	The Pipe Stress Design Criteria document specifies use of ASME B31.3 as the design code for the WTP piping. ASME B31.3 requires provision be made to safely contain or relieve any pressure to which the piping may be subjected. ASME B31.3 piping not protected by a pressure relieving device, or that can be isolated from a pressure reliving device must be designed for at least the highest pressure that can be developed. Bounding pressure and temperature limits are listed for each of the piping material classes in the Piping Material Class Description document.
	Maximum flows and any unusual operating stresses are identified	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev. 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description.	The expected flow paths for the ancillary equipment are identified on the P&ID drawings. The Pipe Stress Design Criteria document specifies the ASME B31.3 code for piping design. This code requires piping to be designed to the highest pressure that can be developed in a piping system, assuring that maximum operating stresses remain within the code allowable values. The Piping Material Class Description document lists the bounding pressure and temperature limits for each piping material class.
Secondary Containment	Ancillary equipment is designed with secondary containment that is constructed of materials compatible with the waste and of sufficient strength to prevent failure (pressure gradients, waste, climatic conditions, daily operations), provided with a leak-detection system, and designed to drain and remove liquids.	Drawings and System Description listed above under References.	The ancillary equipment considered in this assessment is located in the process cells inside the HLW. Secondary containment for ancillary equipment within the cells is provided by the stainless steel liners plates and sumps and is outside the scope of this integrity assessment.

Job No. 24590

Bechtel National, Inc.

SUPPLIER DOCUMENT STATUS

1. [X] **Work may proceed.**
2. [ ] **Revise and resubmit. Work may proceed subject to resolution of indicated comments.**
3. [ ] **Revise and resubmit. Work may not proceed.**
4. [ ] **Review not required. Work may proceed.**

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations.

REVIEWED

G-321 Document Category N/A
[From Supplement A to G-321-E (E) or G-321-V (V), as applicable, or "N/A" if SSRS is used]

Supersedes BNI Document No. N/A Rev. _____
[When applicable]

Accepted by DC Pfluger [signature] 4/6/04
Print Name Signature Date

Released by N/A
[When applicable] Print Name Signature Date

416 GP&S 7-03

24590-CM-HC4-HXYG-00138-02-00024
REV. 00A

SUBCONTRACT SUBMITTAL

R10282424

COGEMA-IA-049, Rev. 0

IQRPE REVIEW -
HIGH LEVEL WASTE (HLW) CANISTER DECONTAMINATION HANDLING SYSTEM (HDH) VESSELS HDH-VSL-00001/-00002/-00003/-00004

"I, John T. Baxter have reviewed, and certified a portion of the design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by Department of Energy, Office of River Protection, Richland, Washington. My duties were independent review of the current design for the High Level Waste (HLW) Canister Decontamination Handling System (HDH) Vessels HDH-VSL-00001/-00002/-00003/-00004 as required by The Dangerous Waste Regulations, namely, WAC 173-303-640(3) applicable paragraphs, i.e., (a) through (g)."

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

The documentation reviewed indicate that the design intent fully satisfies the requirements of the WAC.

The attached review is twelve (12) pages numbered one (1) through twelve (12).

JOHN T. BAXTER
STATE OF WASHINGTON
18978
REGISTERED
PROFESSIONAL ENGINEER

04/06/04

EXPIRES: 10 / 28 / 04

John T. Baxter
Signature

04/06/2004
Date

24590-CM-HC4-HXYG-00138-02-00024, REV. 00A

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH LEVEL WASTE (HLW) CANISTER DECONTAMINATION HANDLING SYSTEM (HDH) VESSELS HDH-VSL-00001/-00002/-00003/-00004

COGEMA-IA-049
Rev. 0

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

Scope	Scope of this Integrity Assessment	The scope of this integrity assessment includes the High-Level Waste (HLW) Facility Canister Decontamination Handling System (HDH) Vessels HDH-VSL-00001/-00002/-00003/ and -00004. These vessels are components in the process system that removes smearable contamination from the exterior of HLW canisters after they have been filled and sealed.
References	Drawings, Material Requisition, Specifications and Mechanical Data Sheets	24590-HLW-P1-P01T-P0001, Rev. 5, HLW Vitrification Building General Arrangement Permit Plan at EL. (-) 21'-0"; 24590-HLW-P1-P01T-P0002, Rev. 2, HLW Vitrification Building General Arrangement Permit Plan at EL. 0'-0"; <u>HDH-VSL-00002 & -00004, Canister Decon Vessels</u> Material Requisition No. 24590-CM-MRA-MVA0-00007, Rev. 2, Pressure Vessels, Shop Fabricated, Titanium Small (CM) (N029) (MS012), MR Section 2 – Technical Specifications (Rev. 5, August 19, 2003); 24590-HLW-MV-HDH-00004, Rev. 1, Equipment Assembly Canister Decon Vessel 1 HDH-VSL-00002 Sheet 1 of 2; 24590-HLW-MV-HDH-00005, Rev. 1, Equipment Assembly Canister Decon Vessel 1 HDH-VSL-00002 Sheet 2 of 2; 24590-HLW-MV-HDH-00006, Rev. 0, Equipment Assembly Canister Decon Vessel 2 HDH-VSL-00004 Sheet 1 of 2; 24590-HLW-MV-HDH-00007, Rev. 0, Equipment Assembly Canister Decon Vessel 2 HDH-VSL-00004 Sheet 2 of 2; Mechanical Data Sheet: Vessel, 24590-HLW-MVD-HDH-00006, Rev. 1, Canister Decon Vessel 1 HDH-VSL-00002; Mechanical Data Sheet: Vessel, 24590-HLW-MVD-HDH-00012, Rev. 0, Canister Decon Vessel 2 HDH-VSL-00004; <u>HDH-VSL-00003, Waste Neutralization Vessel</u> Material Requisition No. 24590-CM-MRA-MVA0-00018, Rev. 1, Pressure Vessels, High Alloy, Shop Fabricated, Medium (N132) Off-gas (OCI), MR Section 2 – Technical Specifications (Rev. 5, August 19, 2003); 24590-HLW-MV-HDH-00003, Rev. 0, Equipment Assembly Waste Neutralization Vessel HDH-VSL-00003; Mechanical Data Sheet: Vessel, 24590-HLW-MVD-HDH-00003, Rev. 0, Waste Neutralization Vessel HDH-VSL-00003;

References	Drawings, Material Requisition, Specifications and System Description	HDH-VSL-00001, Canister Rinse Bogie Decon Vessel Material Requisition No. 24590-QL-MRA-MQTS-00002, Rev. 2, Bogies Special L/DS (HLW Rinse) (MH025) (VHL0), MR Section 2 – Technical Specifications (Rev. 5, August 19, 2003); 24590-HLW-3PS-MQR0-T0002, Rev. 2, Engineering Specification for HLW System HDH Canister Rinse Bogie; 24590-HLW-M0-HDH-00013, Rev. 2, HLW Vitrification System HDH Design Proposal Drawing Canister Rinse Bogie Arrangement; 24590-HLW-M0-HDH-00012001, Rev. 2, HLW Vitrification System HDH Design Proposal Drawing Canister Rinse Bogie; 24590-HLW-M0-HDH-00012002, Rev. 1, HLW Vitrification System HDH Design Proposal Drawing Canister Rinse Bogie; Mechanical Handling Data Sheet:, 24590-HLW-M0D-HDH-00029, Rev. 2, Canister Rinse Bogie Spool Piece; Mechanical Handling Data Sheet:, 24590-HLW-M0D-HDH-00030, Rev. 1, Canister Rinse Vessel Lid; Mechanical Systems Data Sheet: Vessel, 24590-HLW-MVD-HDH-00009, Rev. 0, Canister Rinse Bogie Decon Vessel HDH-VSL-00001; 24590-HLW-3YD-HDH-00002, Rev. 1, System Description for HLW System HDH Canister Decontamination Handling; System Description Change Notice (SDCN) No. 24590-HLW-3YN-HDH-00001, System Description for HLW System HDH Canister Decontamination Handling; 24590-HLW-3YD-HDH-00001, Rev. 0, Process System Description of HLW Canister Decontamination Handling System (HDH); SDCN No. 24590-HLW-3YN-HDH-00002, Process System Description of HLW Canister Decontamination Handling System (HDH)

Summary of Assessment

For each item of "Information Assessed" (i.e., Criteria) on the following pages, the items listed under "Source of Information" were reviewed and found to furnish adequate design controls and requirements to assure the design intent fully satisfies the WAC requirements.

	Information Assessed	Source of Information	Assessment
Design	Vessel design standards are appropriate and adequate for the vessel's intended use.	Drawings, Material Requisitions and Mechanical Data Sheets listed above under References; 24590-WTP-3PS-MV00-T0001, Rev. 1, Engineering Specification for Pressure Vessel Design and Fabrication; Specification Change Notice (SCN) No. 24590-WTP-3PN-MV00-00006 for Engineering Specification for Pressure Vessel Design and Fabrication; ASME Section VIII, Division 1, Rules for Construction of Pressure Vessels, American Society of Mechanical Engineers	The Material Requisitions require use of the Engineering Specification for Pressure Vessel Design and Fabrication for vessels HDH-VSL-00002/-00003/ and -00004. This specification requires that the vessels and all vessel appurtenances are to be designed to ASME Section VIII, Division 1 rules. Additional supplementary requirements are specified in the specification for Pressure Vessel Design and Fabrication. These supplementary requirements address pressure vessel fatigue analysis, positive material identification, standard fabrication tolerances, acceptable welding procedures for the vessel and appurtenances, welder qualifications and testing records, NDE inspections and records, quality assurance requirements, and packaging, shipping, handling and storage requirements. The Mechanical Data Sheets identify these HDH vessels as Commercial Grade, Seismic Category (SC-III) equipment. These are adequate and acceptable codes and standards for design and fabrication of these HDH system vessels.
	If a non-standard vessel is to be used, the design calculations demonstrate sound engineering principles of construction.	24590-WTP-3PS-MV00-T0001, Rev. 1, Engineering Specification for Pressure Vessel Design and Fabrication; Specification Change Notice (SCN) No. 24590-WTP-3PN-MV00-00006 for Engineering Specification for Pressure Vessel Design and Fabrication	The Engineering Specification for Pressure Vessel Design and Fabrication requires that the HDH System vessels, HDH-VSL-00002/-00003/ and -00004, are to be designed and fabricated in accordance with the requirements of ASME Section VIII, Division 1. The vessels are to be delivered after design, fabrication, inspection and testing. Only vessel HDH-VSL-00003 will be provided with an ASME U stamp and the vessel will be registered with the National Board. These are shop fabricated vessels for mixed waste service in the HLW Facility. The vessel design standards are appropriate and adequate for the vessels' intended uses.

	Information Assessed	Source of Information	Assessment
Design	Vessel has adequate strength, after consideration of the corrosion allowance, to withstand the operating pressure, operating temperature, and seismic loads.	Drawings, Material Requisitions and Mechanical Data Sheets listed above under References; 24590-WTP-3PS-MV00-T0001, Rev. 1, Engineering Specification for Pressure Vessel Design and Fabrication; Specification Change Notice (SCN) No. 24590-WTP-3PN-MV00-00006 for Engineering Specification for Pressure Vessel Design and Fabrication; 24590-WTP-3PS-MV00-T0002, Rev. 1, Engineering Specification for Seismic Qualification Criteria for Pressure Vessels (HDH-VSL-00002 & -00004); 24590-WTP-3PS-MV00-T0002, Rev. 2, Engineering Specification for Seismic Qualification Criteria for Pressure Vessels (HDH-VSL-00003); 24590-WTP-3PS-FB01-T0001, Rev. 1, Engineering Specification for Structural Design Loads for Seismic Category III & IV Equipment and Tanks; UBC, 1997, Uniform Building Code, International Conference of Building Officials	The Engineering Specification for Pressure Vessel Design and Fabrication requires that the HDH vessels are to be designed to ASME Section VIII, Division 1 rules. This code requires specific consideration of the operating pressures, temperatures, seismic loads, and corrosion allowance in the design process. Supplementary design criteria are specified in the Engineering Specifications for Seismic Qualification Criteria and Structural Design Loads for Seismic Category III & IV Equipment and Tanks to provide for the seismic design analysis. The Mechanical Data Sheets identify the operating pressure and temperature ranges for each vessel, the materials selected in the corrosion report, the corrosion allowance, and the requirements for seismic qualification in the design. The Mechanical Data Sheets indicate that vessels HDH-VSL-00002/-00003/ and -00004 are to be analyzed as Seismic Category (SC-III) vessels which requires use of the seismic design requirements in the 1997 UBC. These are appropriate codes and criteria to ensure the tanks have adequate strength at the end of their design lives.
Foundations	Vessel foundation will maintain the load of a full vessel.	Drawings listed above under References; 24590-WTP-3PS-MV00-T0001, Rev. 1, Engineering Specification for Pressure Vessel Design and Fabrication; Specification Change Notice (SCN) No. 24590-WTP-3PN-MV00-00006 for Engineering Specification for Pressure Vessel Design and Fabrication	The Equipment Assembly drawings show the support arrangements for each of the HDH vessels. Canister Decon Vessels, HDH-VSL-00002 & -00004, are supported by a support ring assembly near the top of the vessels, while the Waste Neutralization Vessel, HDH-VSL-00003, is provided with a cylindrical skirt. The Engineering Specification for Pressure Vessel Design and Fabrication requirements assure adequate vessel foundation designs.

	Information Assessed	Source of Information	Assessment
Foundations	If in an area subject to flooding, the vessel is anchored.	24590-WTP-3PS-MV00-T0001, Rev. 1, Engineering Specification for Pressure Vessel Design and Fabrication; Specification Change Notice (SCN) No. 24590-WTP-3PN-MV00-00006 for Engineering Specification for Pressure Vessel Design and Fabrication	Buoyant forces of an empty vessel in a flooded room are a mandatory standard design load case in the Engineering Specification for Pressure Vessel Design and Fabrication.
Frost Heave	Vessel system will withstand the effects of frost heave.	Drawings and System Description listed above under References 24590-WTP-DC-ST-01-001, Rev. 0, Structural Design Criteria	The System Description identifies that the HDH system vessels HDH-VSL-00002/-00003/ and -00004 are located in the Canister Decon Handling Cave, Room H-B035. The General Arrangement Plans at elevations (-) 21'-0" and 0'-0" show this room is supported by the HLW Building mat foundation. The Structural Design Criteria requires that all structural foundations extend into the surrounding soil below the frost line in order to preclude frost heave. The frost line is located 30 in. below finished grade. Therefore the HDH System vessels will not be subject to frost heave.
Waste Characteristics	Characteristics of the waste to be stored or treated have been identified (ignitable, reactive, toxic, specific gravity, vapor pressure, flash point, storage temperature)	Drawings, Mechanical Data Sheets and System Description listed above under References;	The System Description identifies that the HDH system vessels have no important to safety functions, therefore these vessels are not a concern for hydrogen generation, accumulation and flammability. The vessels are furnished with grounding lugs to control the discharge of static electricity as shown on the drawings. A fluidic agitator is provided in vessel HDH-VSL-00003 for mixing prior to transfers to homogenize the vessel contents as discussed in the System Description. All of the vessels are equipped with internal spray rings for decontamination.

	Information Assessed	Source of Information	Assessment
Waste Characteristics	Vessel is designed to store or treat the wastes with the characteristics defined above and any treatment reagents.	Mechanical Data Sheets and System Description listed above under References; Vessel/Tank Material Selection Data Sheet, 24590-HLW-N1D-HDH-P0003, Rev. 0, Canister Decon Vessel HDH-VSL-00002 & HDH-VSL-00004 (HLW); Vessel/Tank Material Selection Data Sheet, 24590-HLW-N1D-HDH-P0005, Rev. 0, Waste Neutralization Vessel HDH-VSL-00003 (HLW)	The HDH System Description document identifies that the Canister Decon Vessels normally operate with a a mixture of Nitric Acid and Cerium Nitrate at about 113 °F. This mixture was selected to lightly etch the exterior surface of the filled and sealed waste containers. The etch is followed by a spray wash with dilute nitric acid and then a second spray wash with deionized water The Vessel/Tank Material Selection Data Sheet recommended UNS R50400 (Ti-2) as an appropriate material for the Canister Decon Vessels that is resistant to this mixture and the spray wash solutions. The etch mixture and spray washes are drained into the Waste Neutralization Vessel as the decontamination operation is completed. The contents of vessel HDH-VSL-00003 are diluted and neutralized to pH 8 or above immediately after the last transfer in the decontamination cycle. The Vessel/Tank Material Selection Data Sheet for HDH-VSL-00003 recommended 304L stainless steel (maximum 0.030% Carbon, dual certified), which will hereinafter be referred to as 304L stainless steel, as an adequately corrosion resistant material.
	The waste types are compatible with each other.	System Description listed above under References	The HDH System Description document identifies that the only liquids used in vessels HDH-VSL-00002/-00003/ and -00004 are the Nitric Acid and Cerium Nitrate etching mixture and the spray washes which are neutralized when they are transferred to vessel HDH-VSL-00003. These wastes are compatible. No other wastes are used in these vessels.

	Information Assessed	Source of Information	Assessment
Corrosion	Vessel material and protective coatings ensure the vessel structure is adequately protected form the corrosive effects of the waste stream and external environments (expected to not leak or fail for the design life of the system)	Mechanical Data Sheets and System Description listed above under References; Vessel/Tank Material Selection Data Sheet, 24590-HLW-N1D-HDH-P0003, Rev. 0, Canister Decon Vessel HDH-VSL-00002 & HDH-VSL-00004 (HLW); Vessel/Tank Material Selection Data Sheet, 24590-HLW-N1D-HDH-P0005, Rev. 0, Waste Neutralization Vessel HDH-VSL-00003 (HLW)	The HDH system vessels HDH-VSL-00002/-00003/ and -00004 are located in the Canister Decon Cave at elevations (-) 16'-0" and 0'-0". Although the tanks and associated equipment are accessible for maintenance, the service design life is 40 years. The Vessel/Tank Material Selection Data Sheets for these vessels identify that UNS R50400 (Ti-2) material was selected for vessels HDH-VSL-00002 & -00004 to provide adequate corrosion protection against the Nitric Acid-Cerium Nitrate mixture used for final exterior decontamination of the filled and sealed HLW waste canisters. The data sheet for vessel HDH-VSL-00003 identifies that 304L stainless steel has been selected for this vessel. These material selections are adequate to provide the required 40 year service life for these vessels.
	Corrosion allowance is adequate for the intended service life of the vessel.	Drawings and Mechanical Data Sheets listed above under References; Vessel/Tank Material Selection Data Sheet, 24590-HLW-N1D-HDH-P0003, Rev. 0, Canister Decon Vessel HDH-VSL-00002 & HDH-VSL-00004 (HLW); Vessel/Tank Material Selection Data Sheet, 24590-HLW-N1D-HDH-P0005, Rev. 0, Waste Neutralization Vessel HDH-VSL-00003 (HLW)	The Vessel/Tank Material Selection Data Sheet for Canister Decon Vessels HDH-VLS-00002 & -00004 specifies a corrosion allowance of 0.040 inches for a 40 year design life based on selection of UNS R50400 (Ti-2) Titanium for use in this waste environment. The Material Selection Data Sheet for the Waste Neutralization Vessel HDH-VSL-00003 specifies a corrosion allowance of 0.040 inches for a 40 year design life based on selection of 304L stainless steel. These material selections and corrosion allowances assure an adequate service life for the vessels.
Pressure Relief	Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the vessel are exceeded.	Drawings and Process System Description listed above under References	The Process System Description identifies that vessels HDH-VSL-00002 & -00004 overflow to vessel HDH-VSL-00003. Vessel HDH-VSL-00003 overflows to the sump in room H-B035 at elevation (-) 16'-0". The Equipment Assembly drawings show that the overflow lines are larger than any of the other liquid conveying lines entering the vessels and therefore have adequate flow capacity to preclude overpressure.

	Information Assessed	Source of Information	Assessment
Design	Vessel design standards are appropriate and adequate for the vessel's intended use.	Drawings, Material Requisition and Mechanical Data Sheet listed above under References; 24590-HLW-3PS-MQR0-T0002, Rev. 2, Engineering Specification for HLW System HDH Canister Rinse Bogie; ASME Section VIII, Division 1, Rules for Construction of Pressure Vessels, American Society of Mechanical Engineers; ASME B31.3 – 1996, Process Piping, American Society of Mechanical Engineers	The Material Requisition requires use of The Engineering Specification for HLW System HDH Canister Rinse Bogie for the design and fabrication of vessel HDH-VSL-00001. This specification requires that the vessel is to be designed to ASME Section VIII, Division 1 rules. Ancillary piping inside and exterior to the vessel is to be designed to the requirements of ASME B31.3. The Mechanical Data Sheet identifies this HDH vessel as Commercial Grade, Seismic Category (SC-III) equipment. These are adequate and acceptable codes and standards for design and fabrication of this HDH system vessel.
	If a non-standard vessel is to be used, the design calculations demonstrate sound engineering principles of construction.	24590-HLW-3PS-MQR0-T0002, Rev. 2, Engineering Specification for HLW System HDH Canister Rinse Bogie	The Engineering Specification for HLW System HDH Canister Rinse Bogie requires that vessel HDH-VSL-00001 is to be designed and fabricated in accordance with the requirements of ASME Section VIII, Division 1. The vessel is to be delivered after design, fabrication, inspection and testing. A code stamp is not required for this vessel. This is a shop fabricated vessel that will be delivered as part of a mechanical equipment handling system for mixed waste service in the HLW Facility. The vessel design standards are appropriate and adequate for the vessels intended use.

	Information Assessed	Source of Information	Assessment
Design	Vessel has adequate strength, after consideration of the corrosion allowance, to withstand the operating pressure, operating temperature, and seismic loads.	Drawings and Mechanical Data Sheet listed above under References; 24590-HLW-3PS-MQR0-T0002, Rev. 2, Engineering Specification for HLW System HDH Canister Rinse Bogie; 24590-WTP-3PS-MV00-T0002, Rev. 0, Engineering Specification for Seismic Qualification Criteria for Pressure Vessels; 24590-WTP-3PS-FB01-T0001, Rev. 0, Engineering Specification for Structural Design Loads for Seismic Category III & IV Equipment and Tanks; UBC, 1997, Uniform Building Code, International Conference of Building Officials	The Engineering Specification for HLW System HDH Canister Rinse Bogie requires that the vessel is to be designed to ASME Section VIII, Division 1 rules. This code requires specific consideration of the operating pressures, temperatures, seismic loads, and corrosion allowance in the design process. Supplementary design criteria are specified in the Engineering Specifications for Seismic Qualification Criteria and Structural Design Loads for Seismic Category III & IV Equipment and Tanks to provide for the seismic design analysis. The Mechanical Data Sheet identifies the vessel operating pressure and temperature ranges and the requirements for seismic qualification in the design. The Mechanical Data Sheet indicates that vessel HDH-VSL-00001 is to be analyzed as a Seismic Category (SC-III) vessel which requires use of the seismic design requirements in the 1997 UBC. These are appropriate codes and standards to ensure the vessel has adequate strength at the end of it's design life.
Foundations	Vessel foundation will maintain the load of a full vessel.	Drawings listed above under References; 24590-HLW-3PS-MQR0-T0002, Rev. 2, Engineering Specification for HLW System HDH Canister Rinse Bogie	The Reference drawings show the support arrangements for the HDH vessel. The Canister Rinse Bogie Decon Vessel is supported by the frame structure of the Canister Rinse Bogie which travels on rails in a process tunnel. The drawings and the Engineering Specification for HLW System HDH Canister Rinse Bogie provide adequate design requirements to assure that the Canister Rinse Bogie can adequately support the Decon Vessel under all anticipated load conditions including that of a full vessel.
	If in an area subject to flooding, the vessel is anchored.	Mechanical Data Sheet listed above under References; 24590-HLW-3PS-MQR0-T0002, Rev. 2, Engineering Specification for HLW System HDH Canister Rinse Bogie	The Mechanical Data Sheet indicates that the maximum water inventory in the Canister Rinse Bogie Decon Vessel during operations is 360 gallons. This volume is insufficient to float the Decon Vessel. Therefore, the Engineering Specification for HLW System HDH Canister Rinse Bogie does not require design for this load condition.

	Information Assessed	Source of Information	Assessment
Frost Heave	Vessel system will withstand the effects of frost heave.	Drawings and System Description listed above under References 24590-WTP-DC-ST-01-001, Rev. 0, Structural Design Criteria	The Drawings show that the HDH system Canister Rinse Bogie including the Decon Vessel is located in the Canister Rinse Tunnel, room H-B039B. This tunnel is located on top of the HLW Building mat foundation. The Structural Design Criteria requires that all structural foundations extend into the surrounding soil below the frost line in order to preclude frost heave. The frost line is located 30 in. below finished grade. Therefore the HDH System Canister Rinse Bogie will not be subject to frost heave.
Waste Characteristics	Characteristics of the waste to be stored or treated have been identified (ignitable, reactive, toxic, specific gravity, vapor pressure, flash point, storage temperature)	Drawings and System Description listed above under References;	The System Description identifies that the rinse water used in vessel HDH-VSL-00001 is low pressure deionized water. Therefore, the vessel contents are water and incidental loose contamination that washes off the filled and sealed HLW canisters. There are no flammability or ignitability concerns. Vessel HDH-VSL-00001 is an open top container. During rinse operations, the vessel is aligned below the Canister Rinse Bogie Spool Piece which is mounted on the ceiling of the Canister Rinse Tunnel. An inflatable seal is used to provide a leak-tight interface between top of the Canister Rinse Bogie Decon Vessel and the Spool Piece prior to conducting the rinse operation.
	Vessel is designed to store or treat the wastes with the characteristics defined above and any treatment reagents.	Drawings, Mechanical Data Sheet, Mechanical Handling Data Sheets and System Description listed above under References; Vessel/Tank Material Selection Data Sheet, 24590-HLW-N1D-HDH-P0007, Rev. 0, Canister Rinse Bogie Decon Vessel HDH-VSL-00001 (HLW)	The HDH System Description document identifies that the Canister Rinse Bogie Decon Vessel normally operates with a rinse of deionized water at a temperature of about 68 °F. This rinse is used to remove loose surface contamination on the exterior surface of the filled and sealed waste containers. The Vessel/Tank Material Selection Data Sheet recommended 316L (maximum 0.030% Carbon, dual certified) stainless steel as an appropriate material for this vessel. This material is hereinafter referred to as 316L stainless steel. The Mechanical Handling Data Sheets for the Canister Rinse Bogie Spool Piece and the Canister Rinse Vessel Lid specify the use of 304L stainless steel for these components.

	Information Assessed	Source of Information	Assessment
Waste Char.	The waste types are compatible with each other.	System Description listed above under References	The HDH System Description document identifies that the only liquid used in vessel HDH-VSL-00001 is deionized water. Therefore, waste compatibility is not a concern.
Corrosion	Vessel material and protective coatings ensure the vessel structure is adequately protected form the corrosive effects of the waste stream and external environments (expected to not leak or fail for the design life of the system)	Mechanical Data Sheet and System Description listed above under References; Vessel/Tank Material Selection Data Sheet, 24590-HLW-N1D-HDH-P0007, Rev. 0, Canister Rinse Bogie Decon Vessel HDH-VSL-00001 (HLW)	The HDH system vessel HDH-VSL-00001 is located in the Canister Rinse Tunnel at elevation (-) 16'-6". Although the vessel and associated equipment is accessible for maintenance, the service design life is 40 years. The Vessel/Tank Material Selection Data Sheet for this vessel identifies that 316L stainless steel was selected for this vessel to provide appropriate corrosion resistance to the rinse water. The Mechanical Handling Data Sheets for the Canister Rinse Bogie Spool Piece and the Canister Rinse Vessel Lid specify the use of 304L stainless steel for these components. These material selections are adequate to provide the required 40 year service life for this vessel.
Corrosion Allowance	Corrosion allowance is adequate for the intended service life of the vessel.	Drawings, Mechanical Data Sheet and Mechanical Handling Data Sheets listed above under References; Vessel/Tank Material Selection Data Sheet, 24590-HLW-N1D-HDH-P0007, Rev. 0, Canister Rinse Bogie Decon Vessel HDH-VSL-00001 (HLW)	The Vessel/Tank Material Selection Data Sheet for vessel HDH-VSL-00001 specifies a corrosion allowance of 0.040 inches for a 40 year design life based on selection of 316L stainless steel for use in this waste environment. The material selection and corrosion allowance is consistently carried forward in the design to the Mechanical Data Sheet. The Mechanical Handling Data Sheets for the Canister Rinse Bogie Spool Piece and the Canister Rinse Vessel Lid specify the use of 304L stainless steel for these components, but do not specify corrosion allowances.

	Information Assessed	Source of Information	Assessment
Pressure Relief	Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the vessel are exceeded.	Drawings and Process System Description listed above under References	The Process System Description identifies that vessel HDH-VSL-00001 overflows to the sump in room H-B039B at elevation (-) 16'-6". The pressurization or overflow of the vessel can be relieved through the vent and the inflatable seal. During normal operations, the rinse water volume in the bottom of the Canister Rinse Bogie Decon Vessel is about 200 gallons. The vessel is equipped with redundant high level indication instrumentation.

24590-CM-HC4-HXYG-00138	- 02 - 00025	00B
PO/SCT	**Submittal**	**Rev**

Job No. 24590

Bechtel National, Inc.

SUPPLIER DOCUMENT STATUS

1. [X] **Work may proceed.**
2. [ ] **Revise and resubmit. Work may proceed subject to resolution of indicated comments.**
3. [ ] **Revise and resubmit. Work may not proceed.**
4. [ ] **Review not required. Work may proceed.**

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations.

REVIEWED									

G-321 Document Category N/A
[From Supplement A to G-321-E (E) or G-321-V (V), as applicable, or "N/A" if SSRS is used]

Supersedes BNI Document No. N/A Rev. _____
[When applicable]

Accepted by DC Pflinger DC Pflinger 9/8/04
Print Name Signature Date

Released by N/A
[When applicable] Print Name Signature Date

TP0406_34 7-04

SUBCONTRACT SUBMITTAL

Best Available Copy

R10375550

IQRPE REVIEW
OF
HIGH-LEVEL WASTE (HLW) FACILITY HLW MELTER OFFGAS TREATMENT PROCESS (HOP) SYSTEM ELEVATIONS 0'-0" TO 58'-0" MISCELLANEOUS TREATMENT UNITS (MTUS) ANCILLARY EQUIPMENT
(COGEMA-IA-050, REV. 1)

"I, John T. Baxter, have reviewed, and certified a portion of the design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by Department of Energy, Office of River Protection, Richland, Washington. My duties were independent review of the current design for the High-Level Waste (HLW) Facility HLW Melter Offgas Treatment Process (HOP) System Elevations 0'-0" to 58'-0" Miscellaneous Treatment Units (MTUs) Ancillary Equipment as required by the Dangerous Waste Regulations, namely, WAC 173-303-640(3) applicable paragraphs, i.e., (a) through (g)."

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

The documentation reviewed indicates that the design intent fully satisfies the requirements of the WAC.

The attached review is eleven (11) pages numbered one (1) through eleven (11).

JOHN T. BAXTER
STATE OF WASHINGTON
18978
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES: 10/28/04

09/07/2004

John T. Baxter
Signature

09/07/2004
Date

24590-CM-HC4-HXYG-00188-02-00025 REV.00B

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH-LEVEL WASTE (HLW) FACILITY HLW MELTER OFFGAS TREATMENT PROCESS (HOP) SYSTEM ELEVATIONS 0'-0" TO 58'-0" MISCELLANEOUS TREATMENT UNITS (MTUS) ANCILLARY EQUIPMENT (COGEMA-IA-050, REV. 1)

COGEMA-IA-050
REV. 1

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

Scope	Scope of this Integrity Assessment	This integrity assessment includes ancillary equipment shown on the P&ID drawings listed below under References.
References	Drawings	24590-HLW-M5-V17T-P0003, Rev. 0, Process Flow Diagram HLW Vit Primary Offgas Treatment (System HOP); 24590-HLW-M5-V17T-P20003, Rev. 0, Process Flow Diagram HLW Vit Melter 2 Primary Offgas Treatment (System HOP); 24590-HLW-M6-HOP-P0001, Rev. 0, P&ID - HLW Melter Offgas System Melter 1 Primary Offgas Scrubber; 24590-HLW-M6-HOP-P20001, Rev. 0, P&ID - HLW Melter Offgas System Melter 2 Primary Offgas Scrubber; 24590-HLW-M6-HOP-P0002, Rev. 0, P&ID-HLW Melter Offgas System Melter 1 Primary Offgas WESP; 24590-HLW-M6-HOP-P20002, Rev. 0, P&ID-HLW Melter Offgas System Melter 2 Primary Offgas WESP; 24590-HLW-M6-HOP-P0009, Rev. 0, P&ID-HLW Melter Offgas System Melter 1 Primary Offgas HEME; 24590-HLW-M6-HOP-P20009, Rev. 0, P&ID-HLW Melter Offgas System Melter 2 Primary Offgas HEME; 24590-HLW-M6-HOP-P0010, Rev. 0, P&ID-HLW Melter Offgas System Melter 1 Primary Offgas HEPA Filters; 24590-HLW-M6-HOP-P20010, Rev. 0, P&ID-HLW Melter Offgas System Melter 2 Primary Offgas HEPA Filters;

References	System Description	24590-HLW-3YD-HOP-00001, Rev. 0, Systems Description for HLW Melter Offgas Treatment Process and Process Vessel Vent Extraction (HOP and PVV Systems); System Description Change Notice (SDCN), SDCN NO. 24590-HLW-3YN-HOP-00001 for System Description Number 24590-HLW-3YD-HOP-00001, Rev. 0, Systems Description for HLW Melter Offgas Treatment Process and Process Vessel Vent Extraction (HOP and PVV Systems); SDCN NO. 24590-HLW-3YN-HOP-00002 for Systems Description for HLW Melter Offgas Treatment Process and Process Vessel Vent Extraction (HOP and PVV Systems) SDCN NO. 24590-HLW-3YN-HOP-00003 for Systems Description for HLW Melter Offgas Treatment Process and Process Vessel Vent Extraction (HOP and PVV Systems); SDCN NO. 24590-HLW-3YN-HOP-00004 for Systems Description for HLW Melter Offgas Treatment Process and Process Vessel Vent Extraction (HOP and PVV Systems)

Summary of Assessment

For each item of "Information Assessed" (i.e., Criteria) on the following pages, the items listed under "Source of Information" were reviewed and found to furnish adequate design controls and requirements to assure the design intent fully satisfies the WAC requirements.

	Information Assessed	Source of Information	Discussion
Design	Ancillary equipment design standards are appropriate and adequate for the equipment's intended use.	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; 24590-WTP-PSAR-ESH-01-002-04, Rev. 1a, Preliminary Safety Analysis Report (PSAR) to Support Construction Authorization; HLW Facility Specific Information	The Pipe Stress Design Criteria document identifies ASME B31.3 as the design code for piping and ancillary equipment systems of the WTP. Seismic Categories and Quality Levels vary among the ancillary equipment components. The PSAR identifies that the Primary Offgas Treatment System ductwork has a safety design significant function to provide confinement of hazardous melter offgas to protect the public, co-located workers, and facility workers. Most of the ancillary equipment is Seismic Category (SC-III) and Quality Level (QL-2) so that it can provide the confinement function during normal operations as discussed in the PSAR. The Seismic Categories and Quality Levels are explained in detail in the Pipe Stress Design Criteria document. These codes and standards are acceptable and adequate for the design of the ancillary equipment for the intended service.
	If the ancillary equipment to be used is not built to a design standard, the design calculations demonstrate sound engineering principles of construction.	24590-WTP-DC-PS-01-001, Rev 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"	The ancillary equipment is built to design standards. The Pipe Stress Design Criteria document specifies that piping is to be designed in accordance with ASME B31.3.

	Information Assessed	Source of Information	Discussion
Design	Ancillary equipment has adequate strength at the end of its design life to withstand the operating pressure, operating temperature, thermal expansion, and seismic loads. Equipment is protected against physical damage and excessive stress due to settlement, vibration, expansion, or contraction.	24590-WTP-DC-PS-01-001, Rev 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; Uniform Building Code (UBC), 1997 Edition, International Conference of Building Officials; ASME Boiler and Pressure Vessel Code, Section III, Rules for Construction of Nuclear Facility Components, Division 1, Subsection NC, Appendix N and Appendix F, 1995; 24590-WTP-VV-PS-01-001, Rev. 2, Verification and Validation Test Plan/Test Report for ME101, Linear Elastic Analysis of Piping, Version N8	The Pipe Stress Design Criteria document requires the use of the ASME B31.3 Code for piping design. ASME B31.3 requires explicit consideration of many loadings including operating pressure, operating temperature, thermal expansion/contraction, settlement, vibration, and corrosion allowance in the design of piping. Elements of the ASME B&PV Code, Section III, Division 1, Subsection NC and Appendix F, and the Uniform Building Code (UBC) are used to supplement the requirements of ASME B31.3 for seismic design of SC-III/SC-IV piping. Details of the seismic design methods are discussed in the Pipe Stress Design Criteria document. Design is by hand calculations and computer codes that have been tested and approved as discussed in the Verification and Validation Test Plan/Test Report for ME101, Linear Elastic Analysis of Piping, Version N8. These are adequate and appropriate codes and standards to ensure that the ancillary equipment will have adequate strength at end of design life to withstand all anticipated loadings.

	Information Assessed	Source of Information	Discussion
Supports	Ancillary equipment supports are adequately designed.	Drawings - see references above; 24590-WTP-DC-PS-01-002, Rev 3, Pipe Support Design Criteria; 24590-WTP-PER-PS-02-001, Rev. 4, Ancillary Equipment Pipe Support Design; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; ASME Boiler and Pressure Vessel Code, Section III, Rules for Construction of Nuclear Facility Components, Division 1, Subsection NF and Appendix F, 1995; 24590-WTP-PL-PS-01-001, Rev 1, Verification and Validation Test Plan for Bechtel's ME150 Pipe Support Family of Programs (PCFAPPS)	The Pipe Support Design Criteria considers all load types identified in ASME B31.3 and utilizes ASME Section III, Division 1, Subsection NF and Appendix F to supplement the requirements of ASME B31.3 for seismic design of SC-I/II and SC-III/IV pipe supports. Bounding load cases are passed to the pipe support designers from the results of the ancillary equipment piping stress analyses. Details of the seismic design methodology are discussed in the Pipe Support Design Criteria document. Analysis is by manual calculation and computer programs that have been tested and approved as discussed in the Verification and Validation Test Plan for Bechtel's ME150 Pipe Support Family of Programs (PCFAPPS). The Ancillary Equipment Pipe Support Design document shows examples of typical equipment supports. These are appropriate codes and standards for design of the Primary HOP system MTUs ancillary equipment supports. Ancillary equipment supports are to be designed to allow a minimum of heat to be transferred to the building structures (building structures not to exceed 150 deg F for concrete and 200 deg F for steel). Design standards for vessel internal equipment supports are discussed in the integrity assessment for the HOP system vessels.

	Information Assessed	Source of Information	Discussion
Connections	Seams and connections are adequately designed.	24590-WTP-DB-ENG-01-001, Rev 1B, Basis of Design; 24590-WTP-DC-PS-01-001, Rev. 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications; ASME/ANSI B16.5, 1988 Edition, Piping Flanges and Flanged Fittings; 24590-WTP-3PS-PF00-T0001, Rev. 2, Engineering Specification for Process Jumper Fabrication for PT and HLW	The Basis of Design states that in-cell piping that is non-maintainable will be fully welded. The Pipe Stress Design Criteria document specifies the ASME B31.3 Process Piping design code for the piping systems. Welding is to be performed in accordance with the requirements of ASME B31.3 and the ASME B&PV Code, Section IX. Flange connections are to be designed in accordance with ANSI B16.5. HOP system ancillary equipment is located in the Melter Caves and surrounding process cells to provide for remote maintenance. Remote connection jumpers are designed and fabricated in accordance with the Engineering Specification for Process Jumper Fabrication. These are appropriate codes and standards for design and fabrication of the HOP system ancillary equipment seams and connections.
Frost Heave	The system will withstand the effects of frost heave.	System Description and SDCNs listed above under References; 24590-WTP-DC-ST-01-001, Rev. 3, Structural Design Criteria	The ancillary equipment associated with the HOP system considered in this assessment is located in the Melter Caves, a Filter Cave, Active Service Duct Areas, and a Secondary Offgas Room inside the HLW Facility. The Structural Design Criteria requires that all structural foundations shall extend into the surrounding soil below the frost line to preclude frost heave. The frost line is 30 in. below grade. The HLW building foundations are not subject to frost heave; therefore, the ancillary equipment located inside the building is not subject to frost heave.

	Information Assessed	Source of Information	Discussion
Waste Characteristics	Characteristics of the waste to be stored or treated have been identified (ignitable, reactive, toxic, specific gravity, vapor pressure, flash point, temperature)	System Description listed above under References; 24590-WTP-PER-PR-03-002, Rev. 1, Toxic Vapors and Emissions from WTP Tank Systems and Miscellaneous Treatment Unit Systems	The HOP System Description identifies the only important to safety function for the HOP System Miscellaneous Treatment Units ancillary equipment is confinement of hazardous melter offgas to protect the public, co-located workers, and facility workers. This function is required during normal operations. This function is discussed in more detail in the Toxic Vapors and Emissions from WTP Systems and Miscellaneous Treatment Unit Systems document. Ancillary equipment shown on drawings 24590-HLW-M6-HOP-P0001, -P20001, -P0002, -P20002, -P0009 and –P20009 handle acidic offgas and offgas condensate. As discussed in the System Description, by the time the offgas reaches the Primary Offgas System HEPA filters (HEPAs) it is brought above the dew point by the preheaters and contains relatively small quantities of acid gases, toxic vapors (primarily NOx) and radioactive particulates.
	Ancillary equipment is designed to handle the wastes with the characteristics defined above and any treatment reagents.	24590-WTP-PER-M-02-002, Rev 1, Materials for Ancillary Equipment; System Description and SDCNs listed above under References; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description	The System Description indicates that the Primary HOP system Submerged Bed Scrubbers, WESPs, and HEMEs process wet melter offgas containing acids. Additional reagents are not added to this system during normal operations. The Materials for Ancillary Equipment document requires that the material selection and corrosion/erosion allowances for ancillary equipment in contact with the waste will be equal to or better than the material and corrosion allowance of the waste source vessels except as noted therein. The System Description indicates that the HEMEs are cleaned at intervals using deionized water sprays. Both the WESPs and the HEMEs can be filled with dilute nitric acid to enhance removal of solids. These soak solutions are disposed to the SBS Condensate Receiver Vessels.

	Information Assessed	Source of Information	Discussion
Compatibility	The pH range of the waste, waste temperature and the corrosion behavior of the structural materials are adequately addressed. Ancillary equipment material and protective coatings ensure the ancillary equipment structure is adequately protected from the corrosive effects of the waste stream and external environments. The protection is sufficient to ensure the equipment will not leak or fail for the design life of the system.	Drawings, System Description and SDCNs listed above under References; 24590-WTP-DB-ENG-01-001, Rev 1B, Basis of Design; 24590-WTP-PER-M-02-002, Rev 1, Materials for Ancillary Equipment; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description	The Basis of Design identifies a service design life of 40 years for the ancillary equipment. All non-maintainable items will be designed to last the life of the facility. Detailed material selection (corrosion) analyses are conducted for each vessel and major components in the melter offgas systems in the HLW facility during process design. The Materials for Ancillary Equipment document requires that the material selection and corrosion/erosion allowances for ancillary equipment in contact with the waste will be equal to or better than the material and corrosion allowance of the waste source vessels and melter offgas system components. Ancillary equipment associated with the HLW melters and the SBSs are to be fabricated from Hastelloy C-22 (UNS N06022) which is highly resistant to the acid offgas and offgas condensate. Ancillary equipment associated with the WESPs and HEMEs is to be fabricated from AL6XN 6% Mo stainless steel (UNS N08367) which has more resistance to acids than 316L stainless steel, but less than Hastelloy C-22. The concentration of acid in the offgas at the HEMEs is much lower than that at the SBSs. Ancillary equipment associated with the Primary Offgas HEPAs is to be fabricated with 316L stainless steel from the intake duct at the preheater to the exhaust line. Offgas in the HEPAs is maintained above the dew point by the preheater. Corrosion allowances are considered for all ancillary equipment, therefore, the ancillary equipment will provide the expected design service life.

	Information Assessed	Source of Information	Discussion
Corrosion Allowance	Corrosion allowance is adequate for the intended service life of the ancillary equipment.	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev. 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; 24590-WTP-DB-ENG-01-001, Rev 1B, Basis of Design; 24590-WTP-PER-M-02-002, Rev 1, Materials for Ancillary Equipment; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description	The Pipe Stress Design Criteria document requires use of the ASME B31.3 Code for ancillary equipment design. Consideration of corrosion, including corrosion allowance, is a mandatory requirement of ASME B31.3. A required service design life of 40 years is identified in the Basis of Design for ancillary equipment located in inaccessible process cells. Detailed material selection (corrosion) analyses are conducted for each vessel and major components in the melter offgas systems in the HLW Facility during process design. The Materials for Ancillary Equipment document requires that downstream ancillary equipment is to be constructed of equal or better materials than the source vessel and with the same corrosion allowance as the source vessel except as noted therein. Bounding corrosion allowances are listed for each piping material class in the Piping Material Class Description document. The corrosion allowance for Hastelloy C-22 ancillary equipment is 0.040 in. The corrosion allowance for AL-6XN 6% Mo stainless steel is 0.0425 in. and the corrosion/erosion allowance for the 316L stainless steel ancillary equipment is 0.040 in. These corrosion allowances are adequate to provide the intended service life.

	Information Assessed	Source of Information	Discussion
Strength	Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the vessels are exceeded.	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev. 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description	The Pipe Stress Design Criteria document specifies use of ASME B31.3 as the design code for the WTP piping. ASME B31.3 requires provision be made to safely contain or relieve any pressure to which the piping may be subjected. ASME B31.3 piping not protected by a pressure relieving device, or that can be isolated from a pressure reliving device must be designed for at least the highest pressure that can be developed. Bounding pressure and temperature limits are listed for each of the piping material classes in the Piping Material Class Description document. The offgas ductwork considered in this assessment operates slightly below atmospheric pressure.
	Maximum flows and any unusual operating stresses are identified	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description	The expected flow paths for the ancillary equipment are identified on the P&IDs. The Pipe Stress Design Criteria document specifies the ASME B31.3 code for piping design. This code requires piping to be designed to the highest pressure that can be developed in a piping system assuring that maximum operating stresses remain within code allowables. The Piping Material Class Description document lists the bounding pressure and temperature limits for each piping material class.

	Information Assessed	Source of Information	Discussion
Secondary Containment	Ancillary equipment is designed with secondary containment that is constructed of materials compatible with the waste and of sufficient strength to prevent failure (pressure gradients, waste, climatic conditions, daily operations), provided with a leak-detection system, and designed to drain and remove liquids.	Drawings, System Description and SDCNs listed above under References	The ancillary equipment considered in this assessment is located in Melter Caves, a Filter Cave, Active Service Duct Areas, and a Secondary Offgas Room inside the HLW Facility. Secondary containment for ancillary equipment within the caves and rooms is provided by the liners and sumps within these areas as appropriate, which are outside the scope of this integrity assessment.

Job No. 24590

Bechtel National, Inc.

SUPPLIER DOCUMENT STATUS

1. ☑ **Work may proceed.**
2. ☐ **Revise and resubmit. Work may proceed subject to resolution of indicated comments.**
3. ☐ **Revise and resubmit. Work may not proceed.**
4. ☐ **Review not required. Work may proceed.**

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations.

REVIEWED									

G-321 Document Category N/A
[From Supplement A to G-321-E (E) or G-321-V (V), as applicable, or "N/A" if SSRS is used]

Supersedes BNI Document No. N/A Rev. _____
[When applicable]

Accepted by Lisa Ham (Print Name) _____ (Signature) 4/27/04 (Date)

Released by N/A (Print Name) _____ (Signature) _____ (Date)
[When applicable]

416 GP&S 7-03

24590-CM-HC4-HXYG-00138-02-00026
REV. 00A

SUBCONTRACT SUBMITTAL

R10307330

IQRPE REVIEW
OF
THE HIGH LEVEL WASTE (HLW) FACILITY EL 0'-0" MELTER OFFGAS TREATMENT PROCESS SYSTEM (HOP) MISCELLANEOUS TREATMENT UNITS

"I, Fred Porter, have reviewed, and certified a portion of the design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by Department of Energy, Office of River Protection, Richland, Washington. My duties were independent review of the current design for the High Level Waste (HLW) Facility EL 0'-0" Melter Offgas Treatment Process System (HOP) Miscellaneous Treatment Units as required by the Dangerous Waste Regulations, namely, WAC 173-303-640(3) (applicable paragraphs (i.e., (a) through (g)."

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

The documentation reviewed indicates that the design intent fully satisfies the requirements of the WAC.

The attached review is 9 pages numbered 1 through 9.

FRED E. PORTER
STATE OF WASHINGTON
11689
REGISTERED
PROFESSIONAL ENGINEER

Expires on 12/8/05

Signature

APRIL 27, 2004
Date

24590-CM-HC4-HXYG-00138-02-00026, REV. 00A

Best Available Copy

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH LEVEL WASTE (HLW) FACILITY EL 0'-0" MELTER OFFGAS TREATMENT PROCESS SYSTEM (HOP) MISCELLANEOUS TREATMENT UNITS

COGEMA-IA-052

REV. 0

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

Scope	Scope of this Integrity Assessment	The scope of this integrity assessment includes Melter 1/2 Primary Offgas Treatment Process System (HOP) Submerged Bed Scrubbers (SBS) HOP-SCB-00001/2, High Efficiency Mist Eliminators (HEME) HOP-HEME-00001A/1B/2A/2B, HEPA Preheaters HOP-HTR-00001B/2A/5A/5B, HEPA Filters HOP-HEPA-00001A/2A/1B/2B/7A/8A/7B/8B and Secondary Offgas Process System Plate Heat Exchangers HOP-HX-00002/4.
References	Drawings, Mechanical Systems Data Sheets, Mechanical Data Sheets, Plant Item Material Selection Data Sheets, Engineering Specifications, System Description and System Description Change Notices.	Drawing:24590-HLW-M5-V17T-P0003, Rev. 0, Process Flow Diagram HLW Vitrification Melter 1 Primary Offgas Treatment (System HOP) ; Drawing:24590-HLW-M5-V17T-P20003, Rev. 0, Process Flow Diagram HLW Vitrification Melter 2 Primary Offgas Treatment (System HOP); Drawing:24590-HLW-M5-V17T-P0004, Rev. 1, Process Flow Diagram HLW Vitrification Melter 1 Secondary Offgas Treatment (System HOP) ; Drawing:24590-HLW-M5-V17T-P20004, Rev.0, Process Flow Diagram HLW Vitrification Melter 2 Secondary Offgas Treatment (System HOP) ; Drawing:24590-HLW-P1-P01T-P0002, Rev. 2, HLW Vitrification Building General Arrangement Plan at EL. 0'-0"; Drawing:24590-HLW-P1-P01T-P0008, Rev. 6, HLW Vitrification Building General Arrangement Sections A-A, B-B & C-C; Drawing:24590-HLW-P1-P01T-P0009, Rev. 5, HLW Vitrification Building General Arrangement Sections D-D,E-E & F-F; Drawing:24590-HLW-P1-P01T-P0010, Rev. 5, HLW Vitrification Building General Arrangement Sections G-G & H-H; Drawing:24590-HLW-P1-P01T-P0011, Rev. 6, HLW Vitrification Building General Arrangement Sections J-J & K-K; Drawing 24590-HLW-MK-HOP-00001001,1002,1003,1004, Rev. 1, Equipment Assembly HLW Submerged Bed Scrubber HOP-SCB-00001 (Q) & -00002 (Q) Sheets 1 thru 4 ; Drawing 24590-HLW-MV-HOP-00002001,2002,2003, Rev.0, Equipment Assembly HLW Primary Offgas HEME, HOP-HEME-00001A/B (Q) & -00002A/B Sheets 1 thru 3 ; Plant Item Material Selection Data Sheet: 24590-HLW-N1D-HOP-P0010, Rev. 0, Melter 1&2 Submerged Bed Scrubber (SBS) HOP-SCB-00001/2 (HLW); Plant Item Material Selection Data Sheet: 24590-HLW-N1D-HOP-P0001, Rev. 0, Melter 1&2 High Efficiency Mist Eliminator (HEME) HOP-HEME-00001A/1B/2A/2B (HLW); Plant Item Material Selection Data Sheet: 24590-HLW-N1D-HOP-P0007, Rev. 0, Silver Mordenite Preheater (Plate Heat Exchanger) HOP-HX-00002 & HOP- HX-00004 (HLW);

References	Drawings, Mechanical Systems Data Sheets, Mechanical Data Sheets, Plant Item Material Selection Data Sheets, Engineering Specifications, System Description and System Description Change Notices.(continued from above)	Mechanical Systems Data Sheet: SBS, 24590-HLW-MKD-HOP-00016, Rev. 1, HLW Submerged Bed Scrubbers HOP-SCB-00001/2 ; Mechanical Data Sheet: HEME, 24590-HLW-MVD-HOP-00007, Rev. 0, HLW Primary Offgas HEME HOP-HEME-00001A/1B/2A/2B ; Mechanical Data Sheet: HEPA Preheater, 24590-HLW-MED-HOP-00013, Rev. B, HEPA Preheaters HOP-HTR-00001B/2A/5A/5B ; Remote-Change HEPA Filter Housing Data Sheet: 24590-HLW-MAD-HOP-P0010 thru 017, Rev. 0, HEPA Filters HOP-HEPA-00001A/2A/1B/2B/7A/8A/7B/8B ; Mechanical Data Sheet: Plate Heat Exchanger, 24590-HLW-MED-HOP-00012, Rev. D, Plate Heat Exchanger HOP-HX-00002 ; Mechanical Data Sheet: Plate Heat Exchanger, 24590-HLW-MED-HOP-00017, Rev. C, Plate Heat Exchanger HOP-HX-00004 ; Engineering Specification for Pressure Vessel Design and Fabrication (SBS & HEME), 24590-WTP-3PS-MV00-T0001 ; Engineering Specification for HEPA Filter Preheaters: 24590-HLW-3PS-MEE0-T0001, Rev. A ; Engineering Specification for HEPA Filters: 24590-WTP-3PS-MKH0-TP002, Rev. 0 ; System Description for HLW Melter Offgas Treatment Process and Process Vent Extraction (HOP and PVV Systems); 24590-HLW-3YD-HOP-00001, Rev. 0 ; System Description Change Notices for System Description No. 24590-HLW-3YD-HOP-00001, Rev. 0: SDCN No. 24590-HLW-3YN-HOP-00001 ; SDCN No. 24590-HLW-3YN-HOP-00002 ; SDCN No. 24590-HLW-3YN-HOP-00003 ; SDCN No. 24590-HLW-3YN-HOP-00004 ;

Summary of Assessment

For each item of "Information Assessed" (i.e., Criteria) on the following pages, the items listed under "Source of Information" were reviewed and found to furnish adequate design controls and requirements to assure the design intent fully satisfies the WAC requirements.

	Information Assessed	Source of Information	Assessment
Design	Plant Item design standards are appropriate and adequate for the vessel's intended use.	Drawings, Mechanical Systems Data Sheets, Mechanical Data Sheets, Plant Item Material Selection Data Sheets and Engineering Specifications listed above under references; ASME AG-1-1997, Code on Nuclear Air and Gas Treatment; ASME AG-1a-2000, Addenda to ASME AG-1-1997, Code on Nuclear Air and Gas Treatment; ASME N509-1989, Nuclear Power Plant Air-Cleaning Units and Components; ASME Boiler & Pressure Vessel (B & PV) Code, Section VIII, Div. 1, Rules for Construction of Pressure Vessels.	Submerged Bed Scrubbers (HOP-SCB-00001/2), High Efficiency Mist Eliminators (HOP-HEME-00001A/1B/-2A/2B), HEPA Preheaters (HOP-HTR-00001B/2A/5A/5B) and HEPA Filters (HOP-HEPA-00001A/2A/1B/2B/7A/8A/7B/8B) are components of the Melter 1/2 Primary Offgas Treatment System (HOP). The Plate Heat Exchangers (HOP-HX-00002/4) are components of the Melter 1/2 Secondary Offgas Treatment System (HOP). Miscellaneous Treatment Units (MTUs) located in C5/R5 Remote Operating Areas include: Submerged Bed Scrubber (SBS) HOP-SCB-00001 and High Efficiency Mist Eliminators (HEME) HOP-HEME-00001A/1B located in Melter 1 Cave H-0117 as shown on HLW Vitrification Building General Arrangement Plan At EL. 0'-0" and Elevations At Section D-D & J-J; Submerged Bed Scrubber (SBS) HOP-SCB-00002 and High Efficiency Mist Eliminators (HEME) HOP-HEME-00002A/2B located in Melter 2 Cave H-0106 as shown on HLW Vitrification Building General Arrangement Plan At EL. 0'-0" and Elevation At Section J-J; HEPA Filter Preheaters HOP-HTR-00001B/2A/5A/5B and HEPA Filters HOP-HEPA-00001A/2A/1B/2B/7A/8A/7B/8B located in Filter Cave H-0104 as shown on HLW Vitrification Building General Arrangement Plan At EL 0'-0" and Elevations at Sections A-A, J-J & K-K. MTUs located in C3/R3 Contact Maintenance Areas include: Plate Heat Exchangers HOP-HX-00002/4 located in Room H-A123 as shown on HLW Vitrification Building Arrangement Plan At EL.0'-0"and Elevation at Section H-H. The Engineering Specifications for Design and Fabrication of MTUs in the Primary and Secondary Offgas Treatment Systems requires that these units be designed, fabricated, and tested in accordance with a consistent set of requirements taken from ASME AG-1-1997, ASME AG-1a-2000 and ASME N509-1989.

	Information Assessed	Source of Information	Assessment
Design	Plant Item design standards are appropriate and adequate for the Plant Item's intended use. (continued from above)	See items listed above.	The pressure containment boundaries are to be designed in accordance to ASME B & PV Code, Section VIII, Div. 1. Supplementary requirements are specified in Engineering Specifications and Mechanical Data Sheets for the MTUs. The supplementary requirements include structural design requirements, positive material identification, fabrication tolerances, welding procedures, welder qualifications and testing records, NDE inspections and records, shipping, handling and storage requirements. The MTUs are identified as Quality Level (QL-2) and Seismic Category (SC-I/SC-II/SC-III) in the Mechanical System Data Sheets and Specifications. These design requirements are appropriate for pressure vessels operating over the pressure and temperature ranges specified for these vessels.
	If a non-standard Plant Item is to be used, the design calculations demonstrate sound engineering principles of construction.	Mechanical Systems Data Sheets and Engineering Specifications listed above under References ; ASME AG-1-1997,Code on Nuclear Air and Gas Treatment ; ASME AG-1a-2000, Addenda to ASME AG-1-1997, Code on Nuclear Air and Gas Treatment ; ASMS Boiler & Pressure (B & PV) Code, Section VIII, Div. I, Rules for Construction of Pressure Vessels.	The MTUs in the Primary and Secondary Offgas Systems (HOP) noted above are standard offgas treatment assemblies that are shop fabricated. The Mechanical Systems Data Sheets and Specifications require that the ASME AG-1/1a and ASME B & PV Code, Section VIII, Div. 1 assemblies be delivered after design, fabrication, inspection, and testing. Design standards for the MTUs are appropriate and adequate for the intended service.

	Information Assessed	Source of Information	Assessment
Design	Plant Item has adequate strength, after consideration of the corrosion allowance, to withstand the operating pressure, operating temperature, and seismic loads.	Drawings, Mechanical Systems Data Sheets and Engineering Specifications listed above under references ; 24590-WTP-3PS-SS90-T0001, Rev. 0, Engineering Specification for Seismic Category 1 / II Equipment and Tanks ; 24590-WTP-3PS-FB01-T0001, Rev. 0, Engineering Specification for Structural Design Loads for Seismic Category III and IV Equipment and Tanks ; ASME Boiler & Pressure Vessel (B & PV) Code, Section VIII, Div. 1, Rules for Construction of Pressure Vessels ; ASME AG-1-1997, Code on Nuclear Air and Gas Treatment ; ASME AG-1a-2000, Addenda to ASME AG-1-1997, Code on Nuclear Air and Gas Treatment ; Uniform Building Code (UBC), 1997, International Conference of Building Officials.	The Mechanical Systems Data Sheets for MTUs identify the operating pressure and temperature ranges, the materials selected for the MTU shells and internal supports, the corrosion allowance(s), and the quality levels which determine the requirements for seismic design. The Engineering Specifications for the MTUs require specific consideration of the operating pressures and temperatures and seismic loads in the design process. ASME B & PV Code, Section VIII, Div. 1 requires that corrosion allowance material not be considered when evaluating the adequacy of MTU components for these loads at end of life. Detailed requirements for seismic design of the MTUs are furnished in the Engineering Specifications for Structural Design Loads for Seismic Category I/II and III and IV Equipment and Tanks. Seismic design loads are taken from the UBC and Level C service limits are taken from ASME AG-1 and ASME B & PV Code, Section VIII, Div. 1. These codes and standards are adequate and appropriate for design of the MTUs to withstand operating pressure and temperature loads and seismic loads for the specified design life while considering corrosion allowance.
Foundation	MTU foundation will maintain the load of a full MTU.	Drawings, Mechanical Data Sheets and Engineering Specifications listed above under references; ASME Boiler & Pressure Vessel (B & PV) Code, Section VIII, Div. 1, Rules for Construction of Pressure Vessels; 24590-WTP-DC-ST-01-001, Rev. 2, Structural Design Criteria	Design and Fabrication of MTUs that require Support Frames are to be in accordance with the Mechanical Data Sheets and the Structural Design Criteria. MTUs that utilize support skirts are designed in accordance with the requirements of the ASME B&PV Code, Section VIII. The codes and standards listed in the Mechanical Data Sheets and the Engineering Specifications are adequate and appropriate for design of the MTU support frames.

	Information Assessed	Source of Information	Assessment
Foundation	If in an area subject to flooding, the Plant Item is anchored.	Drawings, Mechanical System Data Sheets, Engineering Specifications, System Descriptions, and System Description Change Notices listed above under references ; ASME Boiler & Pressure Vessel (B & PV) Code, Section VIII, Div. I, Rules for Construction of Pressure Vessels ; ASME AG-1-1997, Code on Nuclear Air and Gas Treatment ; ASME AG-1a- 2000, Addenda to ASME AG-1-1997, Code on Nuclear Air and Gas Treatment ; Uniform Building Code (UBC), 1997, International Conference of Building Officials.	Primary Offgas System SBS and HEME Treatment Units located in Melter 1 Cave (H-0117) and Melter 2 Cave (H-0106) are a part of the Melter Offgas Treatment System (HOP). The Melter 1/2 Caves are lined and have sumps which will contain and allow removal of liquids. These MTUs are designed for a flood load case in accordance with their Engineering Specifications. HEPA Preheaters and HEPA Filters are located in HEPA Filter Cave (H-0104) and are components in the Melter 1/2 Primary Offgas Treatment System (HOP). These units receive offgas from SBS and HEME. HEPA Filter Cave (H-0104) MTUs do not contain liquids, therefore there are no local sources of liquids to flood the cell. Design for flooding is not a required load case in HEPA Preheater and HEPA Filter design and fabrication. Secondary Offgas System Treatment Units, Plate Heat Exchangers, are located in Room H-A123. These MTUs are gas/gas heat exchangers. They receive offgas from HEPA filters in the Primary Offgas System and offgas from the Silver Mordenite Column in the Secondary Offgas System. Room H-A123 contains only offgas system components, therefore there are no local sources of liquid to flood the room except for water from the sprinkler system. Design for flooding is not a required load case in the Plate Heat Exchanger Engineering Specification.
Frost Heave	Plant Item system will withstand the effects of frost heave.	Drawings listed above under references; 24590-WTP-DC-ST-01-001, Rev. 0, Structural Design Criteria	The Structural Design Criteria document requires that all structural foundations extend a distance below grade that exceeds the 30 in. depth of the frost line in order to preclude frost heave. Primary and Secondary Offgas System MTUs are located in the HLW Vitrification Building at EL. 0'-0" which is not subject to frost heave, therefore the MTUs are not subject to frost heave.

	Information Assessed	Source of Information	Assessment
Waste Characteristics	Characteristics of the waste to be stored or treated have been identified (ignitable, reactive, toxic, specific gravity, vapor pressure, flash point, storage temperature)	Mechanical Systems Data Sheets, Plant Item Material Selection Data Sheets, System Descriptions and System Description Change Notices listed above under References	The Mechanical Systems Data Sheets present the offgas specific gravity, operating temperatures and pressures. The Plant Item Material Selection Data Sheets address the chemical composition of the offgas and the normal operation and potential accident temperatures to select appropriate MTU materials and specify the corrosion allowance. The main safety function of the MTUs is to provide protection for the facility workers from the hazardous gases in the Melter 1/2 offgas Systems.The System Description identifies that the offgas in the MTUs is hazardous, but not ignitable or flammable. Primary Offgas System treatment includes: Removal of radioactive particulate and reduction of offgas temperatures in the SBS, removal of radioactive aerosols in the HEME, Preheat Offgas prior to HEPA filtration, provide particulate removal with HEPA filtration, and deliver Primary Offgas to the gas/gas counter-current flow Plate Heat Exchangers in the Secondary Offgas System. MTU vessel design is required to provide an intact housing pressure boundary during normal and abnormal operations and during and after design level seismic events.
	Plant Item is designed to store or treat the wastes with the characteristics defined above and any treatment reagents.	Plant Item Material Selection Data Sheet, Engineering Specifications, System Description and System Description Change Notices listed above under References	The Plant Item Material Selection Data Sheets and Engineering Specifications demonstrate that the MTUs are designed to process the Melter 1/2 Primary and Secondary offgas as discussed above. The System Descriptions discusses normal and abnormal operating conditions for Treatment Units in the offgas systems.
Compatibility	The waste types are compatible with each other.	Drawings, System Description and System Description Change Notices listed above under References;	The System Description for the HLW Melter Offgas Treatment Process (HOP) System does not describe any operations where incompatible wastes are mixed in these Treatment Units.

	Information Assessed	Source of Information	Assessment
Corrosion	Plant Item material and protective coatings ensure the plant item structure is adequately protected form the corrosive effects of the waste stream and external environments (expected to not leak or fail for the design life of the system)	Mechanical Systems Data Sheets, Mechanical Data Sheets, Engineering Specifications and Plant Item Material Selection Data Sheets listed above under References; ASME AG-1-1997, Code on Nuclear Air and Gas Treatment; ASME AG1a-2000, Addenda to ASNE AG-1-1997 Code on Nuclear Air and Gas Treatment.	The Plant Item Material Selection Data Sheet for Melter 1&2 Submerged Bed Scrubbers (SBS) recommends selection of UNS N06022, hereinafter referred to as Alloy 22, to provide improved resistance to pitting corrosion, stress corrosion cracking, and crevice corrosion. The Plant Item Material Selection Data Sheet for Melter 1&2 High Efficiency Mist Eliminators (HEME) recommends selection of UNS No. N08367, hereinafter referred to as AL6XN 6 % Mo, to provide improved resistance to pitting, stress corrosion cracking, crevice corrosion, and vapor phase corrosion. The Mechanical Data Sheet for HEPA Filter Preheaters recommends selection of Type 316L stainless steel for Plenum and Element Pockets, and Carbon Steel for Shield Plate and Mounting Frame materials, in accordance with the Engineering Specification for HEPA Filter Preheaters. The Engineering Specification for HEPA Filters specifies materials of construction shall conform to ASME AG-1,Section FC, Article 3000 with Type 304L stainless steel for HEPA Filter case material. The Plant Item Material Selection Data Sheet for Plate Heat Exchangers (Silver Mordenite Preheater) recommends selection of 316 (max 0.030% C; dual certified), hereinafter referred to as 316L (S31603), to provide improved resistance to pitting. The material recommendations from the Plant Item Material Selection Data Sheets have been adequately and appropriately incorporated into the Mechanical Systems Data Sheets for the specified MTUs.

	Information Assessed	Source of Information	Assessment
Corrosion Allowance	Corrosion allowance is adequate for the intended service life of the plant item.	Mechanical Systems Data Sheets, Mechanical Data Sheets, Engineering Specifications and Plant Item Material Selection Data Sheets listed above under references.	The basis for material selection and corrosion allowance is furnished in the Mechanical System Data Sheets, Mechanical Data Sheets, Engineering Specifications and Plant Item Material Selection Data Sheets for the following MTUs: Submerged Bed Scrubber (SBS); Material Alloy 22 with a corrosion allowance of 0.080 in. High Efficiency Mist Eliminator (HEME); Material AL6XN 6% Mo with a corrosion allowance of 0.040 in. HEPA Filter Preheater Plenum and Element Pocket; Material 304-L with 0.04 corrosion allowance. HEPA Filter Case; Material 304-L with no corrosion allowance Specified. Plate Heat Exchanger; Material 316L (S31603) with no corrosion allowance. Corrosion allowances for a service life of 40 years are adequate and appropriate.
Pressure Relief	Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the plant items are exceeded.	Drawings, Mechanical Systems Data Sheets, Plant Item Material Selection Data Sheets, System Description and System Description Change Notices listed above under references;	The System Description provides a discussion of the normal operating conditions for the HLW Melter Offgas Treatment Process (HOP System) which is less than the internal and external design pressures listed on the Mechanical System Data Sheets for Treatment Units in the Primary and Secondary Offgas Systems. Therefore, the MTUs are designed for pressures which are higher than the pressure capabilities of the offgas system extraction fans.

Job No 24590

Bechtel National, Inc.

SUPPLIER DOCUMENT STATUS

1. [X] **Work may proceed.**
2. [ ] **Revise and resubmit. Work may proceed subject to resolution of indicated comments.**
3. [ ] **Revise and resubmit. Work may not proceed.**
4. [ ] **Review not required. Work may proceed.**

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations.

REVIEWED										
										EPS 8/12

G-321 Document Category N/A
[From Supplement A to G-321-E (E) of G-321-V (V), as applicable, or "N/A" if SSRS is used]

Supersedes BNI Document No. N/A Rev. _____
[When applicable]

Accepted by T.C Pfluger (Print Name) T.C Pfluger (Signature) 5/14/04 (Date)

Released by N/A (Print Name) _____ (Signature) _____ (Date)
[When applicable]

416 GP&S 7-03

24590-CM-HC4-HXYG-00138-02-00030

REV. 00A

SUBCONTRACT SUBMITTAL

R10312197

COGEMA-IA-051, Rev. 1

IQRPE REVIEW –
HIGH LEVEL WASTE (HLW) FACILITY ELEVATION 0'-0" HLW MELTER FEED (HFP) SYSTEM ANCILLARY EQUIPMENT

"I, Douglas W. Hendrickson, have reviewed, and certified a portion of the design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by Department of Energy, Office of River Protection, Richland, Washington. My duties were independent review of the current design for the High Level Waste (HLW) Facility Elevation 0'-0" HLW Melter Feed (HFP) System Ancillary Equipment as required by the Dangerous Waste Regulations, namely, WAC 173-303-640(3) applicable paragraphs, i.e., (a) through (g)."

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

The documentation reviewed indicate that the design intent fully satisfies the requirements of the WAC.

The attached review is ten (10) pages numbered one (1) through ten (10).

DOUGLAS W. HENDRICKSON
STATE OF WASHINGTON
33907
REGISTERED PROFESSIONAL ENGINEER
13 May 2004

EXPIRES 6-10-2005

Signature P.E.

13 May 2004
Date

24590-CM-HC4-HXYG-00138-02-00030, REV. 00A

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH LEVEL WASTE (HLW) FACILITY ELEVATION 0'-0" HLW MELTER FEED (HFP) SYSTEM ANCILLARY EQUIPMENT

COGEMA-IA-051
REV. 1

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

Scope	Scope of this Integrity Assessment	This integrity assessment includes: a. Ancillary equipment associated with the HLW Melter Feed Process System Melter Feed Preparation Vessel HFP-VSL-00001 as shown on drawing 24590-HLW-M6-HFP-P0001, Rev. 0 b. Ancillary equipment associated with the HLW Melter Feed Process System Melter Feed Vessel HFP-VSL-00002 as shown on drawing 24590-HLW-M6-HFP-P0002, Rev. 0 c. Ancillary equipment associated with the HLW Melter Feed Process System Melter Feed Preparation Vessel HFP-VSL-00005 (Melter 2) as shown on drawing 24590-HLW-M6-HFP-P20001, Rev. 0 d. Ancillary equipment associated with the HLW Melter Feed Process System Melter Feed Vessel HFP-VSL-00006 (Melter 2) as shown on drawing 24590-HLW-M6-HFP-P20002, Rev. 0
References	Drawings and System Description	24590-HLW-3YD-HFP-00001, Rev. 0, System Description for HLW Melter Feed (System HFP); System Description Change Notices (SDCNs) Nos. 24590-HLW-3YN-HFP-00001 and 24590-HLW-3YN-HFP-00002 for System Description Number 24590-HLW-3YD-HFP-00001, Rev. 0; 24590-HLW-M5-V17T-P0001, Rev. 2, Process Flow Diagram HLW Receipt & Feed Preparations (System HCP, GFR, & HFP); 24590-HLW-M6-HFP-P0001, Rev. 0, P&ID – HLW Melter Feed Process System Melter Feed Preparation Vessel HFP-VSL-00001 (Q); 24590-HLW-M6-HFP-P0002, Rev. 0, P&ID – HLW Melter Feed Process System Melter Feed Vessel HFP-VSL-00002 (Q); 24590-HLW-M6-HFP-P20001, Rev. 0, P&ID – HLW Melter Feed Process System Melter Feed Preparation Vessel HFP-VSL-00005 (Melter 2) (Q); 24590-HLW-M6-HFP-P20002, Rev. 0, P&ID – HLW Melter Feed Process System Melter Feed Vessel HFP-VSL-00006 (Melter 2) (Q)

Summary of Assessment

For each item of "Information Assessed" (i.e., Criteria) on the following pages, the items listed under "Source of Information" were reviewed and found to furnish adequate design controls and requirements to assure the design intent fully satisfies the WAC requirements.

Design	Ancillary equipment design standards are appropriate and adequate for the equipment's intended use.	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; 24590-WTP-PSAR-ESH-01-002-04, Rev. 1A, Preliminary Safety Analysis Report (PSAR) to Support Construction Authorization; HLW Facility Specific Information	The Pipe Stress Design Criteria document identifies ASME B31.3 as the design code for piping systems of the WTP. Seismic Categories and Quality Levels vary among the ancillary equipment components. For example, the radar guide tube shown on P&ID drawing no. 24590-HLW-M6-HFP-P0001 is Seismic Category (SC-1) and Quality Level (QL-1) to ensure continued function during normal operations, abnormal operations, and during and after a Design Basis Earthquake. Much of the ancillary equipment is Seismic Category (SC-II) and Quality Level (QL-2) as noted for example on P&ID drawing no. 24590-HLW-M6-HFP-P0001. Hydrogen mitigation portions of the ancillary equipment are SDC and will be SC-I and QL-1, including the vessel vent line and overflow line. The Seismic Categories are explained in detail in the Pipe Stress Design Criteria document. Quality Levels are discussed in the PSAR. These codes and standards are acceptable and adequate for the design of the ancillary equipment for the intended service.
	If the ancillary equipment to be used is not built to a design standard, the design calculations demonstrate sound engineering principles of construction.	24590-WTP-DC-PS-01-001, Rev 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"	The ancillary equipment is built to design standards. The Pipe Stress Design Criteria document specifies that piping is to be designed in accordance with ASME B31.3.

Design	Ancillary equipment has adequate strength at the end of its design life to withstand the operating pressure, operating temperature, thermal expansion, and seismic loads. Equipment is protected against physical damage and excessive stress due to settlement, vibration, expansion, or contraction.	24590-WTP-DC-PS-01-001, Rev 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; Uniform Building Code (UBC), 1997 Edition, International Conference of Building Officials; ASME Boiler and Pressure Vessel Code, Section III, Rules for Construction of Nuclear Facility Components, Division 1, Subsection NC, Appendix N and Appendix F, 1995; 24590-WTP-VV-PS-01-001, Rev. 2, Verification and Validation Report for ME101, Linear Elastic Analysis of Piping, Version N8	The Pipe Stress Design Criteria document requires the use of the ASME B31.3 Code for piping design. ASME B31.3 requires explicit consideration of many loadings including operating pressure, operating temperature, thermal expansion/contraction, settlement, vibration, and corrosion allowance in the design of piping. Elements of the ASME B&PV Code, Section III, Division 1, Subsection NC, Appendix N and Appendix F are used to supplement the requirements of ASME B31.3 for seismic design of SC-I/SC-II piping. Although applicable elsewhere, ASME B&PV Code, Section III, Division 1, Subsection NC and Appendix F, and the Uniform Building Code (UBC) are not used to supplement the requirements of ASME B31.3 for seismic design of SC-III/SC-IV piping for this ancillary equipment as none is SC-III/SC-IV. Details of the seismic design methods are discussed in the Pipe Stress Design Criteria document. Design is by hand calculations and computer codes that have been tested and approved as discussed in the Verification and Validation Report for ME101, Linear Elastic Analysis of Piping, Version N8. These are adequate and appropriate codes and standards to ensure that the ancillary equipment will have adequate strength at end of design life to withstand all anticipated loadings.

Supports	Ancillary equipment supports are adequately designed.	Drawings - see references above; 24590-WTP-DC-PS-01-002, Rev 2, Pipe Support Design Criteria; 24590-WTP-PER-PS-02-001, Rev. 4, Ancillary Equipment Pipe Support Design; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; ASME Boiler and Pressure Vessel Code, Section III, Rules for Construction of Nuclear Facility Components, Division 1, Subsection NF and Appendix F, 1995; 24590-WTP-PL-PS-01-001, Rev 1, Verification and Validation Test Plan for Bechtel's ME150 Pipe Support Family of Programs (PCFAPPS)	The Pipe Support Design Criteria considers all load types identified in ASME B31.3 and utilizes ASME Section III, Division 1, Subsection NF and Appendix F to supplement the requirements of ASME B31.3 for seismic design of SC-I/II and SC-III/IV pipe supports. Bounding load cases are passed to the pipe support designers from the results of the ancillary equipment piping stress analyses. Details of the seismic design methodology are discussed in the Pipe Support Design Criteria document. Analysis is by manual calculation and computer programs that have been tested and approved as discussed in the Verification and Validation Test Plan for Bechtel's ME150 Pipe Support Family of Programs (PCFAPPS). The Ancillary Equipment Pipe Support Design document shows examples of typical equipment supports. These are appropriate codes and standards for design of the HFP system ancillary equipment supports. Ancillary equipment supports are to be designed to allow a minimum of heat to be transferred to the building structures (building structures not to exceed 150 °F for concrete and 200 °F for steel). Design standards for vessel internal equipment supports are discussed in the integrity assessment for the HFP system vessels.

Connections	Seams and connections are adequately designed.	24590-WTP-DB-ENG-01-001, Rev 1A, Basis of Design; 24590-WTP-DC-PS-01-001, Rev. 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications; ASME/ANSI B16.5, 1988 Edition, Piping Flanges and Flanged Fittings; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description	The Basis of Design states that in-cell piping that is non-maintainable will be fully welded. The Pipe Stress Design Criteria document specifies the ASME B31.3 Process Piping design code for the piping systems. Welding is to be performed in accordance with the requirements of ASME B31.3 and the ASME B&PV Code, Section IX. Flange connections are to be designed in accordance with ANSI B16.5 as called out by piping material class. These are appropriate codes and standards for design and fabrication of the HFP system ancillary equipment.
Supports	The system will withstand the effects of frost heave.	System Description and SDCNs listed above under References; 24590-WTP-DC-ST-01-001, Rev. 2, Structural Design Criteria	The ancillary equipment associated with the HFP system considered in this assessment is located in above grade process cells inside the HLW Facility. The Structural Design Criteria requires that all structural foundations shall extend into the surrounding soil below the frost line to preclude frost heave. The frost line is 30 in. below grade. The HLW building foundations are not subject to frost heave; therefore, the ancillary equipment located inside the building is not subject to frost heave.

Waste Characteristics	Characteristics of the waste to be stored or treated have been identified (ignitable, reactive, toxic, specific gravity, vapor pressure, flash point, temperature)	24590-WTP-PSAR-ESH-01-002-04, Rev. 1A, Preliminary Safety Analysis Report (PSAR) to Support Construction Authorization; HLW Facility Specific Information; System Description, SDCNs, and Process Flow Diagram listed above under References; 24590-WTP-PER-PR-03-002, Rev. 1, Toxic Vapors and Emissions from WTP Tank Systems and Miscellaneous Treatment Unit Systems; 24590-WTP-PER-PR-03-001, Rev. 1, Prevention of Hydrogen Accumulation in WTP Tank Systems and Miscellaneous Treatment Unit Systems.	24590-WTP-PER-PR-03-002 provides discussion of confinement and control methods for the toxic vapor and emission characteristics. The PSAR, a reference to 24590-WTP-PER-PR-03-002, provides a summary of potential hazardous conditions associated with each HLW vessel and the associated ancillary equipment. Design provisions for control of these hazards are listed in the PSAR, the System Descriptions and 24590-WTP-PER-PR-03-002. The HFP System Description identifies the only safety functions for ancillary equipment are to stop all transfers into the vessel at a liquid level set point, providing primary confinement of the wastes during normal operations, upset conditions and during and after a SC-III Design Basis Seismic Event, and providing sufficient agitation to prevent hydrogen accumulation/storage in the waste. Ancillary equipment associated with the Melter Feed Preparation and Melter Feed Vessels (HFP-VSL-00001 and -00002 for Melter 1 and -00005 and -00006 for Melter 2, respectively) handle caustic slurries or vessel ventilation gases. This caustic waste is received, blended with glass forming chemicals and slurry pumped as shown on the Process Flow Diagram. 24590-WTP-PER-PR-03-001 describes approaches to minimizing hydrogen accumulation including application of mechanical agitation of solids, transfer pumps, sparge rings, and ITS power and air for these four vessels. The primary function of the ancillary equipment associated with the HFP System is to provide a primary pressure and fluid boundary to protect facility workers from the hazardous materials in the vessel transfer streams and vessel ventilation stream.

Waste Characteristics	Ancillary equipment is designed to handle the wastes with the characteristics defined above and any treatment reagents.	24590-WTP-PER-M-02-002, Rev 1, Materials for Ancillary Equipment; System Description and SDCNs listed above under References; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description	The System Description indicates that the HFP system Melter Feed Preparation and Melter Feed Vessels collect caustic waste and slurries of waste and glass forming chemicals from the concentrate receipt vessels (CRV system) and Glass Former Reagent (GFR) system as well as demister wash-down from the vessel ventilation duct. Additional reagents are not added to this system during normal operations although pumps provide recirculatory sampling capability. The Materials for Ancillary Equipment document requires that the material selection and corrosion/erosion allowances for ancillary equipment in contact with the waste will be equal to or better than the material and corrosion allowance of the waste source vessels except as noted therein. The HFP vessels and nozzles are fabricated of 316L stainless steel with the exception that the ejector nozzles are specified as Hastelloy C-22. The Piping Material Class Description lists 316L stainless steel as the material selection for the HFP system ancillary equipment. Reagents (other than glass formers) are not normally added to the HFP system ancillary equipment during normal operations.

Compatibility	The pH range of the waste, waste temperature and the corrosion behavior of the structural materials are adequately addressed. Ancillary equipment material and protective coatings ensure the ancillary equipment structure is adequately protected from the corrosive effects of the waste stream and external environments. The protection is sufficient to ensure the equipment will not leak or fail for the design life of the system.	System Description and SDCNs listed above under References; 24590-WTP-DB-ENG-01-001, Rev 1A, Basis of Design; 24590-WTP-PER-M-02-002, Rev 1, Materials for Ancillary Equipment; 24590-WTP-3PS-NN00-T0001, Rev 0, Engineering Specification for Hot and Anti-Sweat Thermal Insulation	The Basis of Design identifies a service design life of 40 years for the ancillary equipment. All non-maintainable items will be designed to last the life of the facility. Detailed material selection (corrosion) analyses are conducted for each vessel and major components in the melter feed and melter feed preparation system in the HLW facility during process design. The Materials for Ancillary Equipment document requires that the material selection and corrosion/erosion allowances for ancillary equipment in contact with the waste will be equal to or better than the material and corrosion allowance of the waste source vessels except as noted therein. The Thermal Insulation specification requires that all insulating materials used on the outside of ancillary equipment be pre-approved for use on austenitic stainless steel in accordance with applicable ASTM procedures and tests to preclude external corrosion of ancillary equipment. Corrosion allowances are considered for all ancillary equipment, therefore, the ancillary equipment will provide the expected design service life.

Corrosion Allowance	Corrosion allowance is adequate for the intended service life of the ancillary equipment.	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev. 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; 24590-WTP-DB-ENG-01-001, Rev 1A, Basis of Design; 24590-WTP-PER-M-02-002, Rev 1, Materials for Ancillary Equipment; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description	The Pipe Stress Design Criteria document requires use of the ASME B31.3 Code for ancillary equipment design. Consideration of corrosion, including corrosion allowance, is a mandatory requirement of ASME B31.3. A required service design life of 40 years is identified in the Basis of Design for ancillary equipment located in inaccessible process cells. Detailed material selection (corrosion) analyses are conducted for each vessel and major components in the HFP systems in the HLW Facility during process design. The Materials for Ancillary Equipment document requires that downstream ancillary equipment is to be constructed of equal or better materials than the source vessel, and with the same corrosion allowance as the source vessel except as noted therein. Bounding corrosion allowances are listed for each piping material class in the Piping Material Class Description document and are adequate for the intended service life of the ancillary equipment. The corrosion/erosion allowance for the 316L stainless steel HFP system ancillary equipment is 0.0937 in. for caustic waste transfer lines and 0.040 in. for radar guide tubes and the vessel vent.
Strength	Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the vessels are exceeded.	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev. 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description	The Pipe Stress Design Criteria document specifies use of ASME B31.3 as the design code for the WTP piping. ASME B31.3 requires provision be made to safely contain or relieve any pressure to which the piping may be subjected. ASME B31.3 piping not protected by a pressure relieving device, or that can be isolated from a pressure reliving device must be designed for at least the highest pressure that can be developed. Bounding pressure and temperature limits are listed for each of the piping material classes in the Piping Material Class Description document.

	Maximum flows and any unusual operating stresses are identified	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description	The expected flow paths for the ancillary equipment are identified on the P&ID drawings. The Pipe Stress Design Criteria document specifies the ASME B31.3 code for piping design. This code requires piping to be designed to the highest pressure that can be developed in a piping system assuring that maximum operating stresses remain within code allowables. The Piping Material Class Description document lists the bounding pressure and temperature limits for each piping material class.
Secondary Containment	Ancillary equipment is designed with secondary containment that is constructed of materials compatible with the waste and of sufficient strength to prevent failure (pressure gradients, waste, climatic conditions, daily operations), provided with a leak-detection system, and designed to drain and remove liquids.	Drawings, System Description and SDCNs listed above under References	The ancillary equipment considered in this assessment is located in above grade melter caves inside the HLW Facility. Secondary containment for ancillary equipment within the cells is provided by the liners and sumps as appropriate and is outside the scope of this integrity assessment.

Job No 24590

Bechtel National, Inc

SUPPLIER DOCUMENT STATUS

1. [X] **Work may proceed.**
2. [ ] **Revise and resubmit. Work may proceed subject to resolution of indicated comments.**
3. [ ] **Revise and resubmit. Work may not proceed.**
4. [ ] **Review not required. Work may proceed.**

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations.

REVIEWED										EWS

G-321 Document Category N/A
[From Supplement A to G-321-E (E) or G-321-V (V), as applicable, or "N/A" if SSRS is used]

Supersedes BNI Document No N/A Rev
[When applicable]

Accepted by DCPflugor DCPflugor 8/10/04
Print Name Signature Date

Released by N/A
[When applicable] Print Name Signature Date

416 GP&S 7-03

24590-CM-HC4-HXYG-00138-02-00042

REV. 00A

PURCHASE ORDER SUBMITTAL

R10360318

IQRPE REVIEW OF THE HIGH-LEVEL WASTE (HLW) FACILITY ELEVATION 37'-0" SECONDARY CONTAINMENT

"I, John T. Baxter, have reviewed, and certified a portion of the design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by Department of Energy, Office of River Protection, Richland, Washington. My duties were independent review of the current design for the High-Level Waste (HLW) Facility Elevation 37'-0" Secondary Containment as required by the Dangerous Waste Regulations, namely, WAC 173-303-640(3) applicable paragraphs, i.e., (a) through (g)."

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

The documentation reviewed indicates that the design intent fully satisfies the requirements of the WAC.

The attached review is six (6) pages numbered one (1) through six (6).

JOHN T. BAXTER
STATE OF WASHINGTON
18978
REGISTERED PROFESSIONAL ENGINEER
EXPIRES: 10/28/04

08/06/04

24590-CM-HC4-HXYG-00138-02-00042, REV. 00A

John T. Baxter
Signature

08/06/2004
Date

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH-LEVEL WASTE (HLW) FACILITY ELEVATION 37'-0" SECONDARY CONTAINMENT

COGEMA-IA-067

REV. 0

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

Scope	Scope of this Integrity Assessment	This integrity assessment addresses the High-Level Waste (HLW) Facility Secondary Containment at Elevation 37'-0". The specific rooms considered in this assessment are: H-0302 and H-0308.
References	Drawings	The drawings are the general arrangement plan at elevation 37'-0" and associated section. 24590-HLW- P1- P01T- P0004, Rev. 0, HLW Vitrification Building General Arrangement (Permit) Plan at EL. 37 '-0"; 24590-HLW- P1- P01T- P0011, Rev. 7, HLW Vitrification Building General Arrangement (Permit) Section J-J & K-K

Summary of Assessment

For each item of "Information Assessed" (i.e., Criteria) on the following pages, the items listed under "Source of Information" were reviewed and found to furnish adequate design controls and requirements to assure the design intent fully satisfies the WAC requirements.

	Information Assessed	Source of Information	Assessment
Foundation Design	Description of subsurface conditions and soil bearing capacity are adequate.	24590-WTP-DC-ST-01-001, Rev. 3, Structural Design Criteria; 24590-BOF-3PS-CE01-T0001, Rev. 5, Engineering Specification for Excavation and Backfill; 24590-BOF-3PS-C000-T0001, Rev. 3, Engineering Specification for Material Testing Services	The Structural Design Criteria adequately presents design guidance for both mat and spread footings based on the geotechnical site investigation for the facility, (WTSC99-1036-42-17, Shannon & Wilson, 2000). Bearing capacity and settlement design parameters are furnished for the dense Hanford Upper and Lower Sand Units and Structural Fill. Use of the loose wind blown (dune) sands for foundations is precluded. The Excavation and Backfill Specification provides structural backfill requirements based on the geotechnical report and adequate current codes and standards for selection, placing, and compacting structural backfill including testing of candidate fill materials and completed backfills. The Specification for Material Testing Services provides current adequate codes and standards for testing of candidate structural fill materials and in-situ testing of structural fills as they are constructed. The codes and standards are consistent with those called out in the Excavation and Backfill Specification.
	Foundation design loads (including full tanks) and estimated settlement are adequately considered.	24590-WTP-DC-ST-01-001, Rev. 3, Structural Design Criteria; ASCE 7-98, Minimum Design Loads for Buildings and Other Structures	The Structural Design Criteria uses current adequate standards to define design loads and load combinations (ASCE 7-98, ACI 349-01 and ACI 318-99). Dead and Fluid loads are included in these loads and load combinations. Settlement design parameters are included in the Structural Design Criteria subsection on geotechnical design parameters and foundation design.
	Design calculation approach and design basis of footings with design standard references (e.g., ACI) are adequate.	24590-WTP-DC-ST-01-001, Rev. 3, Structural Design Criteria; ACI 349-01, Code Requirements for Nuclear Safety-Related Concrete Structures; ACI 318-99, Building Code Requirements for Structural Concrete	The Structural Design Criteria references current adequate design criteria for the design of concrete foundations and footings. ACI 349-01 is referenced for design of "safety" grade structures and ACI 318-99 is referenced for the strength design of "commercial" grade structures.

	Information Assessed	Source of Information	Assessment
Foundation Design	Foundation material is compatible with the soil.	24590-WTP-3PS-DB01-T0001, Rev. 6, Engineering Specification for Furnishing and Delivering Ready-Mix Concrete; 24590-BOF-3PS-C000-T0001, Rev. 3, Engineering Specification for Material Testing Services; 24590-WTP-DB-ENG-01-001, Rev. 1B, Basis of Design	The specification for Furnishing and Delivering Ready-Mix Concrete provides adequate current testing requirements for the selection of coarse and fine aggregates and the procurement of cementitious materials. Adequate test procedures are provided in the Material Testing Services specification for testing candidate aggregates for chemical reactivity. Instructions for mixing and delivering Ready-Mix Concrete are adequate and current. As noted in the Basis of Design document (section 4.7), the water table lies about 200 feet below the building's deepest foundations so there is little reason to expect compatibility problems between the concrete foundations and the site soils.
	Foundation will withstand the effects of frost heave	24590-WTP-DC-ST-01-001, Rev. 3, Structural Design Criteria	The Structural Design Criteria includes adequate provisions to preclude frost heave in the section addressing lateral earth pressure loads. All structural foundations are required to extend into the soil below the frost line to preclude frost heave. The frost line is 30 inches below finished grade. Therefore, the foundation will not be subjected to frost heave.
Seismic Design	Seismic considerations have been adequately addressed.	24590-WTP-PER-CSA-02-001, Rev. 4, Secondary Containment Design; 24590-WTP-DC-ST-01-001, Rev. 3, Structural Design Criteria; ANSI/AISC N690, Specification for the Design, Fabrication and Erection of Steel Safety-Related Structures for Nuclear Facilities; AISC MO16-89, Manual of Steel Construction - Allowable Stress Design, Ninth Edition; ASCE 4-98, Seismic Analysis of Safety Related Nuclear Structures and Commentary, American Society of Civil Engineers	The Secondary Containment Design document describes and provides references for the design methodology, materials, loads, and load combinations (including seismic loads) for the HLW Building secondary containment. The Structural Design Criteria provides detailed discipline specific codes and standards for the design of Seismic Category (SC-I/II) HLW secondary containment foundations and structures by the design engineers. ACI-349-01 and ACI 318-99 provide the design codes and load combinations for design of the secondary containment reinforced concrete foundations and structures. Structural steel components of the secondary containment structures and stainless steel liners are to be designed using ANSI/AISC N690 and the AISC Allowable Stress Design code as applicable. ASCE 4-98 is used for guidance on seismic analysis of safety-related nuclear structures. These codes and standards are adequate and acceptable for addressing seismic considerations.

	Information Assessed	Source of Information	Assessment
Compatibility	The stored waste is compatible with its Secondary Containment and leak detection hardware based on a detailed chemical and physical analysis of the wastes used and other information sources.	Drawings listed above under References; 24590-WTP-DB-ENG-01-001, Rev. 1B, Basis of Design; 24590-WTP-PER-M-02-001, Rev. 3, Material Selections for Building Secondary Containment/Leak Detection; 24590-WTP-PER-CSA-02-001, Rev.4, Secondary Containment Design 24590-HLW-PER-M-02-001, Rev. 3, HLW Facility Sump Data	The Basis of Design states that cells and sumps are appropriately lined and any spills are removed and flushed within 24-hrs or as timely as possible. Secondary Containment design for cells at elevation 37'-0" includes stainless steel liners with sumps. Based on detailed analysis of the corrosive properties of expected waste process operations and evaluation of potential leak scenarios, the Material Selection report identifies appropriate and adequate corrosion resistant materials requirements for Secondary Containment liners. The Secondary Containment Design report provides adequate typical construction details for liners and sumps to be used for Secondary Containment. Sump information for the HLW Vitrification Building is summarized in the HLW Facility Sump Data document.
Strength	The design shows that the Secondary Containment has sufficient strength and thickness to prevent failure owing to pressure gradients, static head during a release, physical contact with the waste, climatic conditions, and the stress of daily operations (e.g., vehicular traffic).	Drawings listed above under References; 24590-WTP-PER-CSA-02-001, Rev. 4, Secondary Containment Design; 24590-WTP-PER-M-02-001, Rev. 3, Material Selections for Building Secondary Containment/Leak Detection	Because the Secondary Containment being considered is installed inside the HLW Facility Building as shown on the drawings, climatic conditions and vehicular traffic are not applicable load cases. The Secondary Containment Design requirements document identifies adequate and appropriate design codes and standards and all applicable load cases (operational stresses) from site specific conditions that must be considered in the design of the secondary containment liners and sumps.
	The Secondary Containment system has sufficient strength in the presence of operational stresses from site-specific conditions (i.e., traffic, heavy equipment, precipitation, frost).	Drawings listed above under References; 24590-WTP-PER-CSA-02-001, Rev.4, Secondary Containment Design; 24590-WTP-PER-M-02-001, Rev. 3, Material Selections for Building Secondary Containment/Leak Detection	Because the Secondary Containment being considered is installed inside the HLW Facility Building as shown on the drawings, traffic, heavy equipment, precipitation and frost are not applicable load cases. The Secondary Containment Design requirements document identifies adequate and appropriate design codes and standards and all applicable load cases (operational stresses) from site specific conditions that must be considered in the design of the secondary containment liners.

	Information Assessed	Source of Information	Assessment
Foundation Integrity	The Secondary Containment is properly supported by a foundation or base in order to prevent failure from settlement, compression, or uplift, including the residual effects of installation.	Drawings listed above under References; 24590-WTP-DC-ST-01-001, Rev. 3, Structural Design Criteria; 24590-WTP-PER-CSA-02-001, Rev. 4, Secondary Containment Design	These conditions are fully addressed in the Structural Design Criteria and the Secondary Containment Design requirements documents. The design requirements and codes and standards specified are adequate to satisfy these performance goals. The procurement and construction specifications adequately provide for proper foundation construction and installation of the Secondary Containment. The General Arrangement Plan drawing and the associated Cross-Section drawings show the Secondary Containment boundaries.
	The placement, structural support, and type of material used for backfill around and below the Secondary Containment are appropriate.	24590-BOF-3PS-CE01-T0001, Rev. 5, Engineering Specification for Excavation and Backfill; 24590-BOF-3PS-C000-T0001, Rev. 3, Engineering Specification for Material Testing Services	The Excavation and Backfill and Material Testing specifications contain current adequate industry standards for selecting and testing fill materials, placing and compacting backfills, and testing not less than once each lift to assure adequate compaction. Requirements for testing and record keeping are current and adequate for both "safety" grade fills and "commercial" grade fills. Provisions for Controlled Density Fills have recently been incorporated into these standards to provide for additional construction flexibility when approved by Engineering.
Infiltration	The design or operation (e.g., diking & curbing) prevents run-on or infiltration of precipitation into the Secondary Containment system unless the collection system has sufficient excess capacity (25 yr rainfall) to contain the run-on precipitation.	24590-WTP-DB-ENG-01-001, Rev. 1B, Basis of Design; Drawings listed above under References	This requirement is specified in the Basis of Design. Secondary containments being reviewed in this Integrity Assessment are all located inside the HLW Facility Building where they are protected from precipitation as shown in the General Arrangement Plan and the associated Cross-Section drawings.

	Information Assessed	Source of Information	Assessment
Infiltration	The design includes an external moisture barrier or other means to prevent moisture from entering the cell.	24590-WTP-DB-ENG-01-001, Rev. 1B, Basis of Design; Drawings listed above under References	The Secondary Containments shown in the General Arrangement Plan at Elevation 37"-0" are inside the HLW Vitrification Building which shields them from precipitation and surface water percolation. The ground water table is located about 200 feet below the building's deepest foundations as noted in the Basis of Design.
Liner System	The containment area is free of cracks or gaps and the design discusses methods of their minimization.	24590-WTP-PER-CSA-02-001, Rev. 4, Secondary Containment Design; 24590-WTP-3PS-NLLR-T0002, Rev. 1, Engineering Specification for Furnishing, Detailing, Fabrication, Delivery and Installation of Stainless Steel Liner Plates	The Secondary Containment Design requirements document provides adequate and appropriate codes and standards for design of leak-tight liners. This report (CSA-02-001) includes appropriate details for design and installation of stainless steel liners and sumps free of cracks and gaps. The procurement specification for design, fabrication and installation of stainless steel liners identifies construction and inspection processes that are adequate and appropriate for installation of the liners to assure they are free from cracks and gaps.
	The design has considered the compatibility of the concrete liner or coatings and waste and presents information on coatings planning to be used from the manufacturer addressing compatibility with the stored waste. The lining or coating must prevent the waste from migrating into the concrete.	24590-WTP-PER-M-02-001, Rev. 3, Material Selections for Building Secondary Containment/Leak Detection; 24590-WTP-PER-CSA-02-001, Rev. 4, Secondary Containment Design; 24590-WTP-3PS-NLLR-T0002, Rev. 1, Engineering Specification for Furnishing, Detailing, Fabrication, Delivery and Installation of Stainless Steel Liner Plates	The Material Selections for Building Secondary Containment/Leak Detection study contains adequate and appropriate general information on the compatibility of planned Secondary Containment liners with the waste. The Secondary Containment Design report provides adequate and appropriate standard details for design and installation of stainless steel liners and sumps. The procurement specification for design, fabrication and installation of stainless steel liners identifies construction and inspection processes that are adequate and appropriate for installation of the liners to preclude waste migration into the concrete.

Job No 24590

Bechtel National, Inc.

SUPPLIER DOCUMENT STATUS

1. [X] **Work may proceed.**
2. [ ] **Revise and resubmit. Work may proceed subject to resolution of indicated comments.**
3. [ ] **Revise and resubmit. Work may not proceed.**
4. [ ] **Review not required. Work may proceed.**

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations

REVIEWED										EWS
										JC

G-321 Document Category N/A
[From Supplement A to G-321-E (E) or G-321-V (V), as applicable, or "N/A" if SSRS is used]

Supersedes BNI Document No. N/A Rev
[When applicable]

Accepted by DC Pfluger (Print Name) DC Pfluger (Signature) 8/10/04 (Date)

Released by N/A (Print Name) (Signature) (Date)
[When applicable]

416 GP&S 7-03

24590-CM-HC4-HXYG-00138-02-00043
REV. 00A

SUBCONTRACT SUBMITTAL

R10360853

COGEMA-IA-068, Rev. 0

IQRPE REVIEW
OF
HIGH-LEVEL WASTE (HLW) FACILITY RADIOACTIVE LIQUID WASTE DISPOSAL SYSTEM (RLD) VESSELS RLD-VSL-00002, -00007 & -00008

"I, John T. Baxter have reviewed, and certified a portion of the design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by Department of Energy, Office of River Protection, Richland, Washington. My duties were independent review of the current design for the High-Level Waste (HLW) Facility Radioactive Liquid Waste Disposal System (RLD) Vessels RLD-VSL-00002, -00007 & -00008 as required by The Dangerous Waste Regulations, namely, WAC 173-303-640(3) applicable paragraphs, i.e., (a) through (g)."

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

The documentation reviewed indicates that the design intent fully satisfies the requirements of the WAC.

The attached review is nine (9) pages numbered one (1) through nine (9).

08/09/04

JOHN T. BAXTER
STATE OF WASHINGTON
18978
REGISTERED
PROFESSIONAL ENGINEER

EXPIRES: 10/28/04

John T. Baxter — 08/09/2004

Signature — Date

24590-CM-HC4-HXYG-00138-02-00043, REV. 00A

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH-LEVEL WASTE (HLW) FACILITY RADIOACTIVE LIQUID WASTE DISPOSAL SYSTEM (RLD) VESSELS RLD-VSL-00002, -00007 & -00008

COGEMA-IA-068
Rev. 0

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

Scope	Scope of this Integrity Assessment	The scope of this integrity assessment includes the High-Level Waste (HLW) Radioactive Liquid Waste Disposal System (RLD) Vessels RLD-VSL-00002/-00007/ and -00008. These vessels are components in the liquid waste disposal system that receives radioactive effluents from the process operations in the HLW Building.
References	Drawings, Material Requisitions, and Mechanical Systems Data Sheets	24590-HLW-P1-P01T-P0001, Rev. 5, HLW Vitrification Building General Arrangement (Permit) Plan at El. - 21'-0"; 24590-HLW-P1-P01T-P0002, Rev. 2, HLW Vitrification Building General Arrangement (Permit) Plan at El. 0'-0"; Material Requisition No. 24590-CM-MRA-MVA0-00018, Rev. 1, Pressure Vessels, High Alloy, Shop Fabricated, Medium (N132) Off-gas (OCI), Section 2 – Technical Specifications (Rev. 5, August 19, 2003), including Supplement –S0001 and –S00002; 24590-HLW-MV-RLD-00002, Rev. 0, Equipment Assembly HLW Offgas Drains Collection Vessel RLD-VSL-00002; Mechanical Systems Data Sheet: Vessel, 24590-HLW-MVD-RLD-00008, Rev. 1, HLW Offgas Drains Collection Vessel RLD-VSL-00002; Plant Item Material Selection Data Sheet, 24590-HLW-N1D-RLD-P0013, Rev. 0, Offgas Drains Collection Vessel RLD-VSL-00002 (HLW); Material Requisition No. 24590-QL-MRG-MVA0-00002, Rev. 1, Pressure Vessels, Shop Fabricated, Medium (VXLR), MR Section 2 – Technical Specifications (September 29, 2003), including Supplement – S0004; 24590-HLW-MV-RLD-00003, Rev. 1, Equipment Assembly Acidic Waste Vessel RLD-VSL-00007; 24590-HLW-MV-RLD-00004, Rev. 1, Equipment Assembly Plant Wash and Drains Vessel RLD-VSL-00008;

References	Mechanical Systems Data Sheets, Plant Item Material Selection Data Sheets and System Descriptions	Mechanical Systems Data Sheet: Vessel, 24590-HLW-MVD-RLD-00005, Rev. 2, Acidic Waste Vessel RLD-VSL-00007; Mechanical Systems Data Sheet: Vessel, 24590-HLW-MVD-RLD-00007, Rev. 2, Plant Wash and Drains Vessel RLD-VSL-00008; Plant Item Material Selection Data Sheet, 24590-HLW-N1D-RLD-P0001, Rev. 0, Acidic Waste Vessel RLD-VSL-00007 (HLW); Plant Item Material Selection Data Sheet, 24590-HLW-N1D-RLD-P0006, Rev. 0, Plant Wash and Drains Vessel RLD-VSL-00008 (HLW); 24590-HLW-3YD-RLD-00001, Rev. 0, System Description for HLW Radioactive Liquid Waste Disposal (System RLD); System Description Change Notice (SDCN) No. 24590-HLW-3YN-RLD-00001 for 24590-HLW-3YD-RLD-00001, Rev. 0; SDCN No. 24590-HLW-3YN-RLD-00002 for 24590-HLW-3YD-RLD-00001, Rev. 0; SDCN No. 24590-HLW-3YN-RLD-00003 for 24590-HLW-3YD-RLD-00001, Rev. 0

Summary of Assessment

For each item of "Information Assessed" (i.e., Criteria) on the following pages, the items listed under "Source of Information" were reviewed and found to furnish adequate design controls and requirements to assure the design intent fully satisfies the WAC requirements.

	Information Assessed	Source of Information	Assessment
Design	Vessel design standards are appropriate and adequate for the vessel's intended use.	Drawings, Material Requisitions and Mechanical Systems Data Sheets listed above under References; 24590-WTP-3PS-MV00-T0001, Rev. 1, Engineering Specification for Pressure Vessel Design and Fabrication; Specification Change Notice (SCN) No. 24590-WTP-3PN-MV00-00006 for Engineering Specification for Pressure Vessel Design and Fabrication; 24590-WTP-3PS-MV00-T0003, Rev. 1, Engineering Specification for Pressure Vessel Fatigue Analysis; ASME Boiler and Pressure Vessel (B&PV) Code, Section VIII, Division 1, Rules for Construction of Pressure Vessels, American Society of Mechanical Engineers; ASME Boiler and Pressure Vessel (B&PV) Code, Section VIII, Division 2, Alternative Rules, American Society of Mechanical Engineers	The Material Requisitions require use of the Engineering Specification for Pressure Vessel Design and Fabrication for vessels RLD-VSL-00002/-00007/ and -00008. This specification requires that the vessels and all vessel appurtenances are to be designed to ASME B&PV Code, Section VIII, Division 1 rules. Additional supplementary requirements are specified in the specification for Pressure Vessel Design and Fabrication. These supplementary requirements address pressure vessel fatigue analysis, positive material identification, standard fabrication tolerances, acceptable welding procedures for the vessel and appurtenances, welder qualifications and testing records, NDE inspections and records, quality assurance requirements, and packaging, shipping, handling and storage requirements. Two of the vessels have internal equipment (RLD-VSL-00007 & -00008) that is subject to cyclic loading, e.g., pulse jet mixers and charge vessels. The Engineering Specification for Pressure Vessel Fatigue Analysis requires use of the fatigue design standards in ASME B&PV Code, Section VIII, Division 2, which are appropriate for components with a high number of load cycles. The Mechanical Data Sheets identify Seismic Categories and Quality Levels for each vessel: RLD-VSL-00007, Seismic Category (SC-II), Quality Level (QL-2); RLD-VSL-00008, Seismic Category (SC-I), Quality Level (QL-1); and RLD-VSL-00002, Seismic Category (SC-III), Quality Level (CM)(Commercial Materials). Seismic Categories and Quality Levels are explained in the Engineering Specification for Pressure Vessel Design and Fabrication. These are adequate and acceptable codes and standards for design and fabrication of these RLD system vessels.

	Information Assessed	Source of Information	Assessment
Design	If a non-standard vessel is to be used, the design calculations demonstrate sound engineering principles of construction.	24590-WTP-3PS-MV00-T0001, Rev. 1, Engineering Specification for Pressure Vessel Design and Fabrication; Specification Change Notice (SCN) No. 24590-WTP-3PN-MV00-00006 for Engineering Specification for Pressure Vessel Design and Fabrication	The Engineering Specification for Pressure Vessel Design and Fabrication requires that the RLD System vessels RLD-VSL-00002/-00007/ and -00008, are to be designed and fabricated in accordance with the requirements of ASME B&PV Code, Section VIII, Division 1. The vessels are to be delivered after design, fabrication, inspection and testing with ASME U stamps and the vessels will be registered with the National Board. These are shop fabricated vessels for mixed waste service in the HLW Facility.

	Information Assessed	Source of Information	Assessment
Design	Vessel has adequate strength, after consideration of the corrosion allowance, to withstand the operating pressure, operating temperature, and seismic loads.	Drawings, Material Requisitions and Mechanical Systems Data Sheets listed above under References; 24590-WTP-3PS-MV00-T0001, Rev. 1, Engineering Specification for Pressure Vessel Design and Fabrication; Specification Change Notice (SCN) No. 24590-WTP-3PN-MV00-00006 for Engineering Specification for Pressure Vessel Design and Fabrication; 24590-WTP-3PS-MV00-T0002, Engineering Specification for Seismic Qualification Criteria for Pressure Vessels (Rev. 1, RLD-VSL-00002)(Rev. 2, RLD-VLS-00007 & -00008); 24590-WTP-3PS-SS90-T0001, Rev. 0, Engineering Specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks; 24590-WTP-3PS-FB01-T0001, Rev. 1, Engineering Specification for Structural Design Loads for Seismic Category III & IV Equipment and Tanks; UBC, 1997, Uniform Building Code, International Conference of Building Officials	The Engineering Specification for Pressure Vessel Design and Fabrication requires that the RLD vessels are to be designed to ASME B&PV Code, Section VIII, Division 1 rules. This code requires specific consideration of the operating pressures, temperatures, seismic loads, and corrosion allowance in the design process. Supplementary general design criteria are specified in the Engineering Specification for Seismic Qualification Criteria for Pressure Vessels. The Mechanical Systems Data Sheets identify the operating pressure and temperature ranges for each vessel, the materials selected in the corrosion report, the corrosion allowance, and the requirements for seismic qualification in the design. The Mechanical Systems Data Sheets indicate that vessels RLD-VSL-00007/ and -00008 are to be analyzed as SC-I/II vessels. The Engineering Specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks provides detailed guidance for the seismic analyses. The Data Sheet indicates the RLD-VSL-00002 is to be analyzed as a SC-III vessel. The Engineering Specification for Structural Design Loads for Seismic Category III & IV Equipment and Tanks provides detailed guidance for this seismic analysis which requires use of the seismic design requirements in the 1997 UBC. These are appropriate codes and criteria to ensure the tanks have adequate strength at the end of their design lives.
Foundations	Vessel foundation will maintain the load of a full vessel.	Drawings listed above under References; 24590-WTP-3PS-MV00-T0001, Rev. 1, Engineering Specification for Pressure Vessel Design and Fabrication; Specification Change Notice (SCN) No. 24590-WTP-3PN-MV00-00006 for Engineering Specification for Pressure Vessel Design and Fabrication	The Equipment Assembly drawings show the support arrangements for each of the RLD vessels. All the vessels are provided with cylindrical skirts. The Engineering Specification for Pressure Vessel Design and Fabrication provides requirements that assure adequate vessel skirt foundation designs.

	Information Assessed	Source of Information	Assessment
Foundations	If in an area subject to flooding, the vessel is anchored.	24590-WTP-3PS-MV00-T0001, Rev. 1, Engineering Specification for Pressure Vessel Design and Fabrication; Specification Change Notice (SCN) No. 24590-WTP-3PN-MV00-00006 for Engineering Specification for Pressure Vessel Design and Fabrication	Buoyant forces of an empty vessel in a flooded room are a mandatory standard design load case in the Engineering Specification for Pressure Vessel Design and Fabrication.
Frost Heave	Vessel system will withstand the effects of frost heave.	Drawings and System Description listed above under References 24590-WTP-DC-ST-01-001, Rev. 3, Structural Design Criteria	The System Description identifies that the RLD system vessels RLD-VSL-00002/-00007/ and -00008 are located in the Wet Process Cell at elevation (-) 21'-0". This room is supported by the HLW Building mat foundation. The Structural Design Criteria requires that all structural foundations extend into the surrounding soil below the frost line in order to preclude frost heave. The frost line is located 30 in. below finished grade. Therefore the RLD system vessels will not be subject to frost heave.

	Information Assessed	Source of Information	Assessment
Waste Characteristics	Characteristics of the waste to be stored or treated have been identified (ignitable, reactive, toxic, specific gravity, vapor pressure, flash point, storage temperature)	Drawings, Mechanical Systems Data Sheets and System Description listed above under References; 24590-WTP-PER-PR-03-002, Rev. 1, Toxic Vapors and Emissions from WTP Tank Systems and Miscellaneous Treatment Unit Systems; 24590-WTP-PER-PR-03-001, Rev. 1, Prevention of Hydrogen Accumulation in WTP Tank Systems and Miscellaneous Treatment Unit Systems	The System Description describes the characteristics of the waste handled in each of the RLD system vessels. The primary functions of all the tanks are confinement of the waste during normal operations, abnormal operations, and during and after a design level seismic event as discussed in the Toxic Vapors and Emissions from WTP Tank Systems document. RLD-VSL-00002 receives effluent condensate from low point drains in the primary offgas lines downstream from the High Efficiency Mist Eliminators (HEMEs). This waste contains no solids and the pH may range from about 2.5 to 6.5. The Acidic Waste Vessel, RLD-VSL-00007, will receive melter offgas condensate and particulates from the Submerged Bed Scrubbers (SBS), the SBS condensate receiver vessels, the wet electrostatic precipitators (WESPs) and the HEMEs. This waste is normally acidic with a pH of about 2. Waste in this tank is neutralized with the addition of NaOH to a pH of about 14 prior to transfers to the Pretreatment Facility. Wastes handled in RLD-VSL-00002 & -00007 are not a concern for flammability or ignitability. The Plant Wash and Drains Vessel, RLD-VSL-00008, collects vessel overflows, sump drains, wash water from cells, and fire protection water with a pH of about 8 to 13. RLD-VSL-00008 is provided with hydrogen mitigation and purge mixing systems as discussed in the Prevention of Hydrogen Accumulation in WTP Tank Systems document. The vessels are furnished with grounding lugs to control the discharge of static electricity as shown on the drawings. All of the vessels are equipped with internal wash rings for decontamination.

	Information Assessed	Source of Information	Assessment
Waste Characteristics	Vessel is designed to store or treat the wastes with the characteristics defined above and any treatment reagents.	Mechanical Systems Data Sheets, Plant Item Material Selection Data Sheets and System Description listed above under References	The System Description document describes the normal waste operations for the RLD system vessels. The Offgas Drains Collection Vessel, RLD-VSL-00002, doesn't receive any treatment reagents. The Plant Item Material Selection Data Sheet for this vessel lists 316 stainless steel, (maximum 0.030% Carbon; dual certified), hereinafter referred to as 316L stainless steel, as the appropriate material choice for this vessel. The Acidic Waste Vessel, RLD-VSL-00007, normally operates with acidic melter offgas condensate waste. This tank receives NaOH to neutralize the acidic waste prior to transfers to the Pretreatment Facility. The Plant Item Material Selection Data Sheet for this vessel lists UNS N08367/N08926, hereinafter referred to as 6% Mo, as an appropriate material choice for this vessel. The Data Sheet indicates that steam ejectors and piping in this vessel will be Hastelloy C-22 (UNS N06022) material for additional corrosion resistance. The Plant Wash and Drains Vessel, RLD-VSL-00008 normally receives neutral to slightly caustic washes from C3/C5 area drains and sumps. NaOH is added to this tank to adjust the pH prior to transfers to the Pretreatment Facility. The Plant Item Material Selection Data Sheet for this vessel lists 316L stainless steel as the appropriate material choice for this vessel. The Data Sheet indicates that steam ejectors and piping will be Hastelloy C-22 (UNS N06022) material for additional corrosion resistance.
	The waste types are compatible with each other.	System Description listed above under References	The RLD System Description document identifies that the only liquids used in vessels RLD-VSL-00002/-00007/ and -00008 are the wastes described above and NaOH reagent. These wastes are compatible and the vessel material selections consider both the waste characteristics and the reagent characteristics.

	Information Assessed	Source of Information	Assessment
Corrosion	Vessel material and protective coatings ensure the vessel structure is adequately protected form the corrosive effects of the waste stream and external environments (expected to not leak or fail for the design life of the system)	Mechanical Systems Data Sheets, Plant Item Material Selection Data Sheets and System Descriptions listed above under References	The Plant Item Material Selection Data Sheet for RLD-VSL-00002 lists 316L stainless steel as the appropriate material choice for this vessel for a 40 year service life. The Plant Item Material Selection Data Sheet for RLD-VSL-00007 lists 6% Mo as an appropriate material choice for this vessel for a 40 year service life. The Plant Item Material Selection Data Sheet for RLD-VSL-00008 lists 316L stainless steel as the appropriate material choice for this vessel for a 40 year service life. The material selections all provide for a corrosion allowance. These material selections are adequate to provide the required 40 year service life for these vessels.
	Corrosion allowance is adequate for the intended service life of the vessel.	Drawings, Mechanical Systems Data Sheets and Plant Item Material Selection Data Sheets listed above under References	The Plant Item Material Selection Data Sheet for RLD-VSL-00002 lists 316L stainless steel as the appropriate material choice for this vessel with a 0.040 in. corrosion allowance for a 40 year service life. The Plant Item Material Selection Data Sheet for RLD-VSL-00007 lists 6% Mo as an appropriate material choice for this vessel with a 0.040 in. corrosion allowance for a 40 year service life. The Plant Item Material Selection Data Sheet for RLD-VSL-00008 lists 316L stainless steel as the appropriate material choice for this vessel with a 0.040 in. corrosion allowance for a 40 year service life. These material selections and corrosion allowances assure an adequate service life for the vessels.
Pressure Relief	Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the vessel are exceeded.	Drawings and System Description listed above under References	The System Description identifies that vessels RLD-VSL-00002 & -00008 overflow to the sump in the Wet Process Cell. Vessel RLD-VSL-00007 overflows to RLD-VSL-00008. The Equipment Assembly drawings show that the overflow lines are larger than any of the other liquid conveying lines entering the vessels and therefore have adequate flow capacity to preclude overpressure.

Job No 24590

Bechtel National, Inc

SUPPLIER DOCUMENT STATUS

1. [X] **Work may proceed.**
2. [ ] **Revise and resubmit. Work may proceed subject to resolution of indicated comments.**
3. [ ] **Revise and resubmit. Work may not proceed.**
4. [ ] **Review not required. Work may proceed.**

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations

REVIEWED										EWS

G-321 Document Category N/A
[From Supplement A to G-321-E (E) or G-321-V (V), as applicable, or "N/A" if SSRS is used]

Supersedes BNI Document No N/A Rev _____
[When applicable]

Accepted by T C Pfluger (Print Name) [signature] (Signature) 8/11/04 (Date)

Released by N/A (Print Name) _____ (Signature) _____ (Date)
[When applicable]

416 GP&S 7-03

24590-CM-HC4-HXYG-00138-02-00044
REV. 00A

SUBCONTRACT SUBMITTAL

R10361301

IQRPE REVIEW
OF
HIGH-LEVEL WASTE (HLW) FACILITY ELEVATION -21'-0" HLW RADIOACTIVE LIQUID WASTE DISPOSAL (RLD) SYSTEM ANCILLARY EQUIPMENT

"I, John T. Baxter, have reviewed, and certified a portion of the design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by Department of Energy, Office of River Protection, Richland, Washington. My duties were independent review of the current design for the High-Level Waste (HLW) Facility Elevation -21'-0" HLW Radioactive Liquid Waste Disposal (RLD) System Ancillary Equipment as required by the Dangerous Waste Regulations, namely, WAC 173-303-640(3) applicable paragraphs, i.e., (a) through (g)."

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

The documentation reviewed indicates that the design intent fully satisfies the requirements of the WAC.

The attached review is eleven (11) pages numbered one (1) through eleven (11).

08/11/04

JOHN T. BAXTER
STATE OF WASHINGTON
18978
REGISTERED
PROFESSIONAL ENGINEER

EXPIRES: 10/28/04

24590-CM-HC4-HXYG-00138-02-00044, REV. 00A

John T. Baxter
Signature

08/11/2004
Date

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH-LEVEL WASTE (HLW) FACILITY ELEVATION -21'-0" HLW RADIOACTIVE LIQUID WASTE DISPOSAL (RLD) SYSTEM ANCILLARY EQUIPMENT

COGEMA-IA-069
REV. 0

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

Scope	Scope of this Integrity Assessment	This integrity assessment includes the ancillary equipment shown on the P&ID drawings listed below:
References	Drawings – P&ID	24590-HLW-M6-RLD-P0001, Rev. 1, P&ID – HLW Radioactive Liquid Waste Disposal System Active Effluent Collection; 24590-HLW-M6-RLD-P0002, Rev. 1, P&ID – HLW Radioactive Liquid Waste Disposal System Plant Wash & Drains Vessel; 24590-HLW-M6-RLD-P0003, Rev. 0, P&ID – HLW Radioactive Liquid Waste Disposal System Decontamination Tank & Sumps; 24590-HLW-M6-RLD-P0004, Rev. 0, P&ID – HLW Radioactive Liquid Waste Disposal System Miscellaneous Sumps; 24590-HLW-M6-RLD-P0006, Rev. 0, P&ID – HLW Radioactive Liquid Waste Disposal System Fluidics Air Rack RLD-RK-00023; 24590-HLW-M6-RLD-P0007, Rev. 0, P&ID – HLW Radioactive Liquid Waste Disposal System Fluidics Air Rack RLD-RK-00024 (Q); 24590-HLW-M6-RLD-P0008, Rev. 0, P&ID – HLW Radioactive Liquid Waste Disposal System Miscellaneous Sumps; 24590-HLW-M6-RLD-P0014, Rev. 0, P&ID – HLW Radioactive Liquid Waste Disposal System Offgas Drains Collection Vessel; 24590-HLW-M6-RLD-P0015, Rev. 0, P&ID – HLW Radioactive Liquid Waste Disposal System Miscellaneous Sumps; 24590-HLW-M6-RLD-P0016, Rev. 0, P&ID – HLW Radioactive Liquid Waste Disposal System Miscellaneous Sumps; 24590-HLW-M6-RLD-P0017, Rev. 0, P&ID – HLW Radioactive Liquid Waste Disposal System Miscellaneous Sumps; 24590-HLW-M6-RLD-P20003, Rev. 0, P&ID – HLW Radioactive Liquid Waste Disposal System Decontamination Tank & Sumps - Melter 2; 24590-HLW-M6-RLD-P20004, Rev. 0, P&ID – HLW Radioactive Liquid Waste Disposal System Miscellaneous Sumps - Melter 2; 24590-HLW-M6-RLD-P20005, Rev. 0, P&ID – HLW Radioactive Liquid Waste Disposal System Miscellaneous Sumps - Melter 2

References	System Description and System Description Change Notices	24590-HLW-3YD-RLD-00001, Rev. 0, System Description for HLW Radioactive Liquid Waste Disposal (System RLD); 24590-HLW-3YN-RLD-00001, System Description Change Notice (SDCN) for 24590-HLW-3YD-RLD-00001, Rev. 0; 24590-HLW-3YN-RLD-00002, SDCN for 24590-HLW-3YD-RLD-00001, Rev. 0; 24590-HLW-3YN-RLD-00003, SDCN for 24590-HLW-3YD-RLD-00001, Rev. 0
	Plant Item Material Selection Data Sheets and Mechanical Systems Data Sheets	24590-HLW-N1D-RLD-P0002, Rev. 0, Plant Item Material Selection Data Sheet, RLD-BKPT-00007 & RLD-BKPT-00009 (HLW) Acidic Wash Transfer Breakpot; 24590-HLW-N1D-RLD-P0009, Rev. 0, Plant Item Material Selection Data Sheet, RLD-BRKPT-00004 (HLW) Wash Effluent Breakpot;
	Drawings – PFD	24590-HLW-M5-V17T-P0007001, Rev. 1, Process Flow Diagram HLW Vitrification Liquid Waste Effluent (System RLD) (Sheet 1); 24590-HLW-M5-V17T-P0007002, Rev. 1, Process Flow Diagram HLW Vitrification Liquid Waste Effluent (System RLD) (Sheet 2)

Summary of Assessment

For each item of "Information Assessed" (i.e., Criteria) on the following pages, the items listed under "Source of Information" were reviewed and found to furnish adequate design controls and requirements to assure the design intent fully satisfies the WAC requirements.

Information Assessed		Source of Information	Assessment
Design	Ancillary equipment design standards are appropriate and adequate for the equipment's intended use.	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev. 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; 24590-WTP-PSAR-ESH-01-002-04, Rev. 1A, Preliminary Safety Analysis Report (PSAR) to Support Construction Authorization; HLW Facility Specific Information	The Pipe Stress Design Criteria document identifies ASME B31.3 as the design code for piping systems of the WTP. Seismic Categories and Quality Levels vary among the ancillary equipment components. Ancillary equipment shown on the P&ID drawings ranges from Seismic Category (SC-I), Quality Level (QL-1) to Seismic Category (SC-III), Quality Level (CM) (Commercial Material). Much of the ancillary equipment is Seismic Category (SC-II) and Quality Level (QL-2) as noted for example on P&ID drawing no. 24590-HLW-M6-RLD-P0001 prior to entry into wallbox RLD-WBOX-00090. The Seismic Categories are explained in detail in the Pipe Stress Design Criteria document. Quality Levels are discussed in the PSAR. These codes and standards are acceptable and adequate for the design of the ancillary equipment for the intended service.
	If the ancillary equipment to be used is not built to a design standard, the design calculations demonstrate sound engineering principles of construction.	24590-WTP-DC-PS-01-001, Rev. 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers	The ancillary equipment is built to design standards. The Pipe Stress Design Criteria document specifies that piping is to be designed in accordance with ASME B31.3.

Information Assessed		Source of Information	Assessment
Design	Ancillary equipment has adequate strength at the end of its design life to withstand the operating pressure, operating temperature, thermal expansion, and seismic loads. Equipment is protected against physical damage and excessive stress due to settlement, vibration, expansion, or contraction.	24590-WTP-DC-PS-01-001, Rev. 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; Uniform Building Code (UBC), 1997 Edition, International Conference of Building Officials; ASME Boiler and Pressure Vessel Code, Section III, Rules for Construction of Nuclear Facility Components, Division 1, Subsection NC, Appendix N and Appendix F, 1995; 24590-WTP-VV-PS-01-001, Rev. 2, Verification and Validation Report for ME101, Linear Elastic Analysis of Piping, Version N8	The Pipe Stress Design Criteria document requires the use of the ASME B31.3 Code for piping design. ASME B31.3 requires explicit consideration of many loadings including operating pressure, operating temperature, thermal expansion/contraction, settlement, vibration, and corrosion allowance in the design of piping. Elements of the ASME B&PV Code, Section III, Division 1, Subsection NC, Appendix N and Appendix F are used to supplement the requirements of ASME B31.3 for seismic design of SC-I/SC-II piping. ASME B&PV Code, Section III, Division 1, Subsection NC and Appendix F, and the Uniform Building Code (UBC) are used to supplement the requirements of ASME B31.3 for seismic design of SC-III/SC-IV piping. Details of the seismic design methods are discussed in the Pipe Stress Design Criteria document. Design is by hand calculations and computer codes that have been tested and approved as discussed in the Verification and Validation Report for ME101, Linear Elastic Analysis of Piping, Version N8. These are adequate and appropriate codes and standards to ensure that the ancillary equipment will have adequate strength at end of design life to withstand all anticipated loadings.

Information Assessed		Source of Information	Assessment
Supports	Ancillary equipment supports are adequately designed.	Drawings - see references above; 24590-WTP-DC-PS-01-002, Rev 2, Pipe Support Design Criteria; 24590-WTP-PER-PS-02-001, Rev. 4, Ancillary Equipment Pipe Support Design; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; ASME Boiler and Pressure Vessel Code, Section III, Rules for Construction of Nuclear Facility Components, Division 1, Subsection NF and Appendix F, 1995; 24590-WTP-PL-PS-01-001, Rev 1, Verification and Validation Test Plan for Bechtel's ME150 Pipe Support Family of Programs (PCFAPPS)	The Pipe Support Design Criteria considers all load types identified in ASME B31.3 and utilizes ASME Section III, Division 1, Subsection NF and Appendix F to supplement the requirements of ASME B31.3 for seismic design of SC-I/II and SC-III/IV pipe supports. Bounding load cases are passed to the pipe support designers from the results of the ancillary equipment piping stress analyses. Details of the seismic design methodology are discussed in the Pipe Support Design Criteria document. Analysis is by manual calculation and computer programs that have been tested and approved as discussed in the Verification and Validation Test Plan for Bechtel's ME150 Pipe Support Family of Programs (PCFAPPS). The Ancillary Equipment Pipe Support Design document shows examples of typical equipment supports. These are appropriate codes and standards for design of the RLD system ancillary equipment supports. Ancillary equipment supports are to be designed to allow a minimum of heat to be transferred to the building structures (building structures not to exceed 150 °F for concrete and 200 °F for steel). Design standards for vessel internal equipment supports are discussed in the integrity assessment for the RLD system vessels.

Information Assessed		Source of Information	Assessment
Connections	Seams and connections are adequately designed.	24590-WTP-DB-ENG-01-001, Rev 1B, Basis of Design; 24590-WTP-DC-PS-01-001, Rev. 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications; ASME/ANSI B16.5, 1988 Edition, Piping Flanges and Flanged Fittings; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description	The Basis of Design states that in-cell piping that is non-maintainable will be fully welded. The Pipe Stress Design Criteria document specifies the ASME B31.3 Process Piping design code for the piping systems. Welding is to be performed in accordance with the requirements of ASME B31.3 and the ASME B&PV Code, Section IX. Flange connections are to be designed in accordance with ANSI B16.5 as called out by piping material class. These are appropriate codes and standards for design and fabrication of the RLD system ancillary equipment.
Supports	The system will withstand the effects of frost heave.	System Description listed above under References; 24590-WTP-DC-ST-01-001, Rev. 3, Structural Design Criteria	The ancillary equipment associated with the RLD system considered in this assessment is located in above and below grade process cells and caves inside the HLW Facility. The Structural Design Criteria requires that all structural foundations shall extend into the surrounding soil below the frost line to preclude frost heave. The frost line is 30 in. below grade. The HLW building foundations are not subject to frost heave; therefore, the ancillary equipment located inside the building is not subject to frost heave.

Information Assessed		Source of Information	Assessment
Waste Characteristics	Characteristics of the waste to be stored or treated have been identified (ignitable, reactive, toxic, specific gravity, vapor pressure, flash point, temperature)	24590-WTP-PER-PR-03-002, Rev. 1, Toxic Vapors and Emissions from WTP Tank Systems and Miscellaneous Treatment Unit Systems; System Description and Process Flow Diagrams listed above under References	24590-WTP-PER-PR-03-002 provides discussion of confinement and control methods for the toxic vapor and emission characteristics. Design provisions for control of potential hazardous conditions associated with each HLW vessel and the associated ancillary equipment are listed in the System Description and 24590-WTP-PER-PR-03-002. The RLD System Description identifies the safety functions for ancillary equipment as to provide primary confinement of the wastes (Safety Design Class for RLD-VSL-00008 and Safety Design Significant for RLD-VSL-00007). Ancillary equipment associated with the Acidic Waste Vessel handles acidic and caustic liquids or vessel ventilation gases. Ancillary equipment associated with the Plant Wash and Drains Vessel handles caustic liquids or vessel ventilation gases. Ancillary equipment associated with the Offgas Drains Vessel handles caustic liquids or vessel ventilation gases.

Information Assessed		Source of Information	Assessment
Waste Characteristics	Ancillary equipment is designed to handle the wastes with the characteristics defined above and any treatment reagents.	24590-WTP-PER-M-02-002, Rev 1, Materials for Ancillary Equipment; System Description listed above under References; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description; Plant Item Material Selection Data Sheets listed above under References.	The System Description indicates that the RLD system vessels RLD-VSL-00007, -00008, and -00002 collect acidic waste, plant wash and drains (caustic), and offgas drain liquids, respectively, from the submerged bed scrubbers, wet electrostatic precipitator, high efficiency mist eliminator, and various plant, vessel, and sump washes and miscellaneous radioactive drains. The Materials for Ancillary Equipment document requires that the material selection and corrosion/erosion allowances for ancillary equipment in contact with the waste will be equal to or better than the material and corrosion allowance of the waste source vessels except as noted therein. The RLD vessels and nozzles are fabricated of 316L stainless steel with the exception of vessel RLD-VSL-00007 with a shell and nozzles of AL-6XN (6% Mo) due to the acidic nature of the materials handled within this vessel. The Piping Material Class Description lists 316L stainless steel as the material selection for most of the RLD system ancillary equipment. Acidic process inflows to RLD-VSL-00007 from the SBS and SBS condensate receiver vessels are in Hastelloy C-22 piping, while all other process lines to and from this vessel are AL-6XN except for breakpot overflows fabricated of 316L. Reagents are normally added to the RLD system ancillary equipment during normal operations to neutralize acids in RLD-VSL-00007. Breakpots RLD-BRKPT-00007 & -00009 are to be fabricated of 316L while RLD-BRKPT-00004 is to be 304L Stainless Steel. These material specifications indicate that the ancillary equipment is designed to handle the identified wastes.

Information Assessed		Source of Information	Assessment
Compatibility	The pH range of the waste, waste temperature and the corrosion behavior of the structural materials are adequately addressed. Ancillary equipment material and protective coatings ensure the ancillary equipment structure is adequately protected from the corrosive effects of the waste stream and external environments. The protection is sufficient to ensure the equipment will not leak or fail for the design life of the system.	System Description and Plant Item Material Selection Data Sheets listed above under References; 24590-WTP-DB-ENG-01-001, Rev 1B, Basis of Design; 24590-WTP-PER-M-02-002, Rev 1, Materials for Ancillary Equipment; 24590-WTP-3PS-NN00-T0001, Rev 0, Engineering Specification for Hot and Anti-Sweat Thermal Insulation	The Basis of Design identifies a service design life of 40 years for the ancillary equipment. All non-maintainable items will be designed to last the life of the facility. Detailed material selection (corrosion) analyses are conducted for each vessel and major components in the radioactive liquid waste disposal system in the HLW facility during process design. The Materials for Ancillary Equipment document requires that the material selection and corrosion/erosion allowances for ancillary equipment in contact with the waste will be equal to or better than the material and corrosion allowance of the waste source vessels except as noted therein. The Thermal Insulation specification requires that all insulating materials used on the outside of ancillary equipment be pre-approved for use on austenitic stainless steel in accordance with applicable ASTM procedures and tests to preclude external corrosion of ancillary equipment. Corrosion allowances are considered for all ancillary equipment, therefore, the ancillary equipment will provide the expected design service life.

Information Assessed		Source of Information	Assessment
Corrosion Allowance	Corrosion allowance is adequate for the intended service life of the ancillary equipment.	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev. 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; 24590-WTP-DB-ENG-01-001, Rev 1B, Basis of Design; 24590-WTP-PER-M-02-002, Rev 1, Materials for Ancillary Equipment; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description	The Pipe Stress Design Criteria document requires use of the ASME B31.3 Code for ancillary equipment design. Consideration of corrosion, including corrosion allowance, is a mandatory requirement of ASME B31.3. A required service design life of 40 years is identified in the Basis of Design for ancillary equipment located in inaccessible process cells. Detailed material selection (corrosion) analyses are conducted for each vessel and major components in the RLD systems in the HLW Facility during process design. The Materials for Ancillary Equipment document requires that downstream ancillary equipment is to be constructed of equal or better materials than the source vessel and with the same corrosion allowance as the source vessel, except as noted therein. Bounding corrosion allowances are listed for each piping material class in the Piping Material Class Description document and are adequate for the intended service life of the ancillary equipment.
Strength	Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the vessels are exceeded.	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev. 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description	The Pipe Stress Design Criteria document specifies use of ASME B31.3 as the design code for the WTP piping. ASME B31.3 requires provision be made to safely contain or relieve any pressure to which the piping may be subjected. ASME B31.3 piping not protected by a pressure relieving device, or that can be isolated from a pressure reliving device must be designed for at least the highest pressure that can be developed. Bounding pressure and temperature limits are listed for each of the piping material classes in the Piping Material Class Description document.

Information Assessed		Source of Information	Assessment
Strength	Maximum flows and any unusual operating stresses are identified	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev. 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description	The expected flow paths for the ancillary equipment are identified on the P&ID drawings. The Pipe Stress Design Criteria document specifies the ASME B31.3 code for piping design. This code requires piping to be designed to the highest pressure that can be developed in a piping system assuring that maximum operating stresses remain within code allowables. The Piping Material Class Description document lists the bounding pressure and temperature limits for each piping material class.
Secondary Containment	Ancillary equipment is designed with secondary containment that is constructed of materials compatible with the waste and of sufficient strength to prevent failure (pressure gradients, waste, climatic conditions, daily operations), provided with a leak-detection system, and designed to drain and remove liquids.	Drawings and System Description listed above under References	The ancillary equipment considered in this assessment is located in above and below grade process cells and caves inside the HLW Facility. Secondary containment for ancillary equipment within the cells and caves is provided by the liners and sumps in these areas, as appropriate, and is considered to be outside the scope of this integrity assessment.

R10402826

COGEMA-IA-073, Rev. 0

IQRPE REVIEW
OF THE
HIGH LEVEL WASTE FACILITY (HLW) PULSE JET VENTILATION SYSTEM (PJV) MISCELLANEOUS TREATMENT UNIT SUBSYSTEM ANCILLARY EQUIPMENT

"I, Fred E. Porter, have reviewed, and certified a portion of the design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by Department of Energy, Office of River Protection, Richland, Washington. My duties were independent review High Level Waste Facility (HLW) Pulse Jet Ventilation System (PJV) Miscellaneous Treatment Unit Subsystem Ancillary Equipment as required by the Dangerous Waste Regulations, namely, WAC 173-303-640(3) applicable paragraphs, i.e., (a) through (g)."

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

The documentation reviewed indicates that the design intent fully satisfies the requirements of the WAC.

The attached review is nine (9) pages numbered one (1) through nine (9).

Bechtel National, Inc.

Job No 24590

SUPPLIER DOCUMENT STATUS

1. [X] **Work may proceed.**
2. [ ] **Revise and resubmit. Work may proceed subject to resolution of indicated comments.**
3. [ ] **Revise and resubmit. Work may not proceed.**
4. [ ] **Review not required. Work may proceed.**

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations

REVIEWED

G-321 Document Category N/A
[From Supplement A to G-321-E (E) or G-321-V (V), as applicable, or "N/A" if SSRS is used]

Supersedes BNI Document No. N/A Rev
[When applicable]

Accepted by DCPflager (Print Name) (Signature) 10/2/04 (Date)

Released by N/A (Print Name) (Signature) (Date)
[When applicable]

416 GP&S 7-03

EXPIRES 12-06-05

Signature

10-15-2004
Date

24590-CM-HC4-HXYG-00138-02-00048 Rev 00A

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH LEVEL WASTE FACILITY (HLW) PULSE JET VENTILATION SYSTEM (PJV) MISCELLANEOUS TREATMENT UNIT SUBSYSTEM ANCILLARY EQUIPMENT

COGEMA-IA-073
REV. 0

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

Scope	Scope of this Integrity Assessment	This Integrity Assessment reviews miscellaneous treatment unit subsystem ancillary equipment located in the HLW Pulse Jet Ventilation System (PJV) as shown on P&ID drawings 24590-HLW-M6-PJV-P0001/P0002, Process Flow Diagram Drawing 24590-HLW-M5-V17T-P0005, and as defined in the System Description for the HLW Pulse Jet Ventilation System.
References	Drawings and System Description	Drawings: 24590-HLW-M6-PJV-P0001, Rev. 0, P&ID - HLW Pulse Jet Ventilation System Collection & Conditioning; 24590-HLW-M6-PJV-P0002, Rev. 0, P&ID - HLW Pulse Jet Ventilation System Filtration & Monitoring; 24590-HLW-M5-V17T-P0005, Rev. 0, Process Flow Diagram HLW Nitrification Pulse Jet Ventilation Treatment (System PJV); System Description: 24590-HLW-3YD-PJV-00001, Rev. 0, System Description for the HLW Pulse Jet Ventilation System (System PJV); System Description Change Notice (SDCN): SDCN No. 24590-HLW-3YN-PJV-00001 for System Description No.24590-HLW-3YD-PJV-00001, Rev. 0.
Summary of Assessment		For each item of "Information Assessed" (i.e., Criteria) on the following pages, the items listed under "Source of Information" were reviewed and found to furnish adequate design controls and requirements to ensure the design intent fully satisfies the requirements of Washington Administrative Code, WAC-173-303-640, *Dangerous Waste Regulations* for Tank Systems.

	Information Assessed	Source of Information	Discussion
Design	Ancillary equipment design standards are appropriate and adequate for the equipment's intended use.	Drawings and System Description listed above under References; 24590-WTP-DC-PS-01-001, Rev. 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; 24590-WTP-PSAR-ESH-01-002-04, Rev.1a, Preliminary Safety Analysis Report to Support Construction Authorization; HLW Facility Specific Information.	The Preliminary Safety Analysis Report to Support Construction Authorization; HLW Facility Specific Information document, and the System Description for the HLW Pulse Jet Ventilation System (System PJV) document identify design codes and quality levels for piping, ductwork and ancillary equipment for the PJV system. The Waste Treatment Plant (WTP) pipe stress design criteria document identifies ASME B31.3 as the design code for piping systems. The P&ID drawings identify the varying Seismic Categories and Quality Levels of the ancillary equipment components. To ensure continued function during normal operations, abnormal operations, and during and after a Design Basis Earthquake, the design requirements for all various Seismic Categories (SC-I, II, III, and IV) are discussed in detail in the Pipe Stress Design Criteria document. The above listed design criteria, codes, and standards are acceptable and adequate for the design of the ancillary equipment for its intended use.
	If the ancillary equipment to be used is not built to a design standard, the design calculations demonstrate sound engineering principles of construction.	ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; 24590-WTP-DC-PS-01-001, Rev. 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria."	The ancillary equipment is built to design standards. The Pipe Stress Design Criteria document specifies that piping is to be designed in accordance with ASME B31.3 Code.

	Information Assessed	Source of Information	Discussion
Design	Ancillary equipment has adequate strength at the end of its design life to withstand the operating pressure, operating temperature, thermal expansion, and seismic loads. Equipment is protected against physical damage and excessive stress due to settlement, vibration, expansion, or contraction.	24590-WTP-DC-PS-01-001, Rev 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; ASME Boiler and Pressure Vessel Code, Section III, Rules for Construction of Nuclear Facility Components, Division 1, Code Case N-411, Subsection NC, Appendix N, and Appendix F, 1995; 24590-WTP-VV-PS-01-001, Rev. 2, Verification and Validation Report for ME101, Linear Elastic Analysis of Piping, Version N8; 24590-WTP-DB-ENG-01-001, Rev. 1B, Basis of Design; 24590-WTP-PER-M-02-002, Rev. 1, Materials for Ancillary Equipment; DOE-STD-1020-94, Natural Phenomenon Hazards Design Evaluation Criteria for Department of Energy Facilities (including Change Notice #1, January 1996); UBC, Uniform Building Code, 1997 Edition.	The Basis of Design document specifies that mechanical equipment is to be designed for a nominal plant life of 40 years. The Materials for Ancillary Equipment document specifies that ancillary equipment downstream of a waste source vessel or miscellaneous plant items is to be constructed of the same or better material and with the same corrosion allowance as the source vessel or plant items, unless the service seen in the downstream line warrants a different material, corrosion allowance, or other modification. The Pipe Stress Design Criteria requires the use of the ASME B31.3 Code and DOE-STD-1020-94 Standard, for piping design. ASME B31.3 requires explicit consideration of operating pressure, operating temperature, thermal expansion and contraction, settlement, vibration, and corrosion allowance in the design of piping. ASME B&PV Code, Section III, Code Case N-411, Subsection NC, Appendix N, and Appendix F, and the Uniform Building Code (UBC) are used to supplement the requirements of ASME B31.3 and DOE-STD-1020-94 for design as applicable to the appropriate Seismic Category of the ancillary equipment. Details of the piping seismic analysis methods are discussed in the Pipe Stress Design criteria document. These are appropriate and adequate codes and standards to ensure that the ancillary equipment has adequate strength at the end of its design life to withstand all anticipated loads.

	Information Assessed	Source of Information	Discussion
Supports	Ancillary equipment supports are adequately designed.	24590-WTP-DC-PS-01-002, Rev. 2, Pipe Support Design Criteria; 24590-WTP-PER-PS-02-001, Rev. 4, Ancillary Equipment Pipe Support Design; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; ASME Boiler and Pressure Vessel Code, Section III, Rules for Construction of Nuclear Facility Components, Division 1, Subsection NF and Appendix F, 1995; 24590-WTP-PL-PS-01-001, Rev. 1, Verification and Validation Test Plan for Bechtel's ME150 Pipe Support Family of Programs (PCFAPPS).	The Pipe Support Design Criteria considers all load types identified in ASME B31.3 and utilizes ASME B&PV Code, Section III, Division 1, Subsection NF and Appendix F to supplement the requirements of ASME B31.3 for seismic design of SC-I/II and SC-III/IV pipe supports. Bounding load cases are passed to the pipe support designers from the results of the ancillary equipment piping stress analyses. Details of the seismic design methodology are discussed in the Pipe Support Design Criteria document. Analysis is by manual calculation and computer programs that have been tested and approved as discussed in the Verification and Validation Test Plan for Bechtel's ME150 Pipe Support Family of Programs. The Ancillary Equipment Pipe Support Design document shows examples of typical equipment supports. Ancillary equipment supports are to be designed in such a way that the heat transferred from supports to the building structure does not raise the building structure temperature to exceed 150°F for concrete and 200°F for steel. These are appropriate codes and standards for design of the PJV system ancillary equipment supports.
Connections	Seams and connections are adequately designed.	24590-WTP-DB-ENG-01-001, Rev. 1B, Basis of Design; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; 24590-WTP-DC-PS-01-001, Rev. 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications; ASME/ANSI B16.5, 1988 Edition, Piping Flanges and Flanged Fittings.	The Basis of Design states that in-cell piping that is non-maintainable will be fully welded. The Pipe Stress Design Criteria document specifies the ASME B31.3 Process Piping design code for the piping systems. Welding is to be performed in accordance with the requirements of ASME B31.3 and the ASME B&PV Code, Section IX. Flange connections are to be designed in accordance with ANSI B16.5. These are appropriate codes and standards for design and fabrication of the PJV system ancillary equipment seams and connections.

	Information Assessed	Source of Information	Discussion
Frost Heave	The system will withstand the effects of frost heave.	Drawings and System Description listed above under References; 24590-WTP-DC-ST-01-001, Rev. 3, Structural Design Criteria.	The ancillary equipment associated with the PJV system considered in this assessment begins at the outlet from the fluidics equipment headers and is routed underneath the drum transfer tunnel at an elevation of -10 feet to the pulse vent system HEPA Filter cave at an elevation of 0 feet and on to pulse vent system exhaust fans at elevation 58 feet inside the HLW facility. The Structural Design Criteria requires that all structural foundations shall extend into the surrounding soil below the frost line to preclude frost heave. The frost depth line is 30 in. below grade. The HLW building foundation mat is a thick concrete slab, is not subject to frost heave; therefore, the ancillary equipment located inside the building is not subject to frost heave either.
Waste Characteristics	Characteristics of the waste to be stored or treated have been identified (ignitable, reactive, toxic, specific gravity, vapor pressure, flash point, temperature)	Drawings and System Description listed above under References; 24590-WTP-PER-03-002, Rev. 1, Toxic Vapors and Emissions from WTP Tank Systems and Miscellaneous Treatment Unit Systems; 24590-WTP-PER-03-001, Rev. 1, Prevention of Hydrogen Accumulation in WTP Tank Systems and Miscellaneous Treatment Unit Systems.	The PJV System Description identifies the safety function of the pulse ventilation treatment system shown on the P&ID drawings as maintaining air flow from the pulse jet mixers during normal operations, abnormal operations and during and after a Design Basis seismic event. These functions are discussed with respect to vapors and emissions of acutely or chronically toxic (upon inhalation) extremely hazardous waste in the Toxic Vapors and Emissions document. Similar discussions are provided in the Prevention of Hydrogen Accumulation document with respect to ancillary equipment functions related to maintaining hydrogen concentrations below lower flammability limits during normal operations, abnormal operations and during and after a design level seismic event.

	Information Assessed	Source of Information	Discussion
Waste Characteristics	Ancillary equipment is designed to handle the wastes with the characteristics defined above and any treatment reagents.	Drawings and System Description listed above under References; 24590-WTP-PER-M-02-002, Rev. 1, Materials for Ancillary Equipment; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description.	The System Description identifies that additional reagents are not added to the PJV system during normal operations. The PJV system will collect, contain, filter, monitor and discharge exhaust air from fluidics devices, and prevent release of contaminants to controlled spaces. There is a potential for aerosol condensation forming in the piping system and hydrogen accumulation in the pulse jet mixers (PJM's). The P&ID drawings show a drain line at the low point in the system to remove condensate. The exhaust fans operate continuously to ensure that hydrogen will not accumulate in the fluidic devices and ancillary equipment. The Materials for Ancillary Equipment document requires that the material selection and corrosion/erosion allowances for ancillary equipment in contact with the PJV system offgas will be equal to or better than the material and corrosion allowance of the waste source vessels except as noted therein. PJV ancillary system components are to be fabricated of 316L stainless steel as shown in the Piping Material Class Description document for piping class S11Z specified on the P&ID drawings.

	Information Assessed	Source of Information	Discussion
Compatibility	The pH range of the waste, waste temperature and the corrosion behavior of the structural materials are adequately addressed. Ancillary equipment material and protective coatings ensure the ancillary equipment structure is adequately protected from the corrosive effects of the waste stream and external environments. The protection is sufficient to ensure the equipment will not leak or fail for the design life of the system.	24590-WTP-DB-ENG-01-001, Rev.1B, Basis of Design; 24590-WTP-PER-M-02-002, Rev. 1, Materials for Ancillary Equipment; .	The Basis of Design identifies a service design life of 40 years for the ancillary equipment. All non-maintainable items will be designed to last the life of the facility. Detailed material selection (corrosion) analyses are conducted for piping, ductwork and ancillary equipment in the PJV system during process design. The Materials for Ancillary Equipment document requires that the material selection and corrosion/erosion allowances for ancillary equipment in contact with the offgas will be equal to or better than the material and corrosion allowance of the HLW fluidics equipment, except as noted therein. Both internal and external corrosion has been considered for all ancillary equipment, therefore, the ancillary equipment will provide the expected design service life.

	Information Assessed	Source of Information	Discussion
Corrosion Allowance	Corrosion allowance is adequate for the intended service life of the ancillary equipment.	24590-WTP-DC-PS-01-001, Rev. 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; 24590-WTP-DB-ENG-01-001, Rev. 1B, Basis of Design; 24590-WTP-PER-M-02-002, Rev. 1, Materials for Ancillary Equipment; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers.	The Pipe Stress Design Criteria document requires use of the ASME B31.3 Code for ancillary equipment design. Consideration of corrosion, including corrosion allowance, is a mandatory requirement of ASME B31.3. A required service design life of 40 years is identified in the Basis of Design for ancillary equipment located in inaccessible process cells. Detailed material selection (corrosion) analyses are conducted for each ancillary equipment component in the PJV system during process design. The Materials for Ancillary Equipment document requires that downstream ancillary equipment is to be constructed of equal or better material than the source HLW fluidics equipment and with the same corrosion allowance, except as noted therein. Bounding corrosion allowances are listed for each piping material class in the Piping Material Class Description document. The corrosion/erosion allowance for the 316L stainless steel PJV system ancillary equipment is 0.040 in. The material and corrosion allowance are appropriate and adequate for the intended service life of the ancillary equipment.
Strength	Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the vessels are exceeded.	24590-WTP-DC-PS-01-001, Rev. 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers.	The Pipe Stress Design Criteria document specifies use of ASME B31.3 as the design code for the PJV piping. ASME B31.3 requires provision be made to safely contain or relieve any pressure to which the piping may be subjected. ASME B31.3 piping not protected by a pressure relieving device, or that can be isolated from a pressure reliving device must be designed for at least the highest pressure that can be developed. Bounding pressure and temperature limits are listed for each of the piping material classes in the Piping Material Class Description document.

	Information Assessed	Source of Information	Discussion
Strength	Maximum flows and any unusual operating stresses are identified	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev. 3, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers.	The expected flow paths for the ancillary equipment are identified on the P&ID drawing. The Pipe Stress Design Criteria document specifies the ASME B31.3 code for piping design. This code requires piping to be designed to the highest pressure that can be developed in a piping system, assuring that maximum operating stresses remain within code allowables. The Piping Material Class Description document lists the bounding pressure and temperature limits for each piping material class.
Secondary Containment	Ancillary equipment is designed with secondary containment that is constructed of materials compatible with the waste and of sufficient strength to prevent failure (pressure gradients, waste, climatic conditions, daily operations), provided with a leak-detection system, and designed to drain and remove liquids.	Drawings and System Description listed above under References.	The ancillary equipment considered in this assessment is located in the inaccessible process cells inside the HLW. Secondary containment for ancillary equipment within the cells is provided by the stainless steel liners plates and sumps and is outside the scope of this integrity assessment.

24590-CM-HC4-HXYG-00138	- 02 - 00049	00A
PO/SCT	**Submittal**	**Rev**

Job No. 24590

Bechtel National, Inc.

SUPPLIER DOCUMENT STATUS

1. [X] **Work may proceed.**
2. [ ] **Revise and resubmit. Work may proceed subject to resolution of indicated comments.**
3. [ ] **Revise and resubmit. Work may not proceed.**
4. [ ] **Review not required. Work may proceed.**

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations.

REVIEWED EJS RHL

G-321 Document Category N/A
[From Supplement A to G-321-E (E) or G-321-V (V), as applicable, or "N/A" if SSRS is used]

Supersedes BNI Document No. N/A Rev. _____
[When applicable]

Accepted by DC Pflinger (Print Name) [signature] (Signature) 11/9/04 (Date)

Released by N/A (Print Name) _____ (Signature) _____ (Date)
[When applicable]

TP0406_34 7-04

SUBCONTRACT SUBMITTAL

R10422808

IQRPE REVIEW
OF
THE HIGH-LEVEL WASTE FACILITY PULSE JET VENTILATION SYSTEM MISCELLANEOUS TREATMENT UNITS (MTUs): PJV HEPA FILTERS (PJV-HEPA-00004A/B & -00005A/B) AND PJV HEPA FILTER PREHEATER (PJV-HTR-00002)

"I, Tarlok S. Hundal, have reviewed and certified a portion of the design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by Department of Energy, Office of River Protection, Richland, Washington. My duties were independent review of the current design for the Miscellaneous Treatment Units: PJV HEPA Filters (PJV-HEPA-00004A/B & 00005A/B) and PJV HEPA Filter Preheater (PJV-HTR-00002) as required by the Dangerous Waste Regulations, namely, WAC 173-303-640(3) applicable paragraphs, i.e., (a) through (g)."

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

The documentation reviewed indicates that the design intent fully satisfies the requirements of the WAC.

The attached review is thirteen (13) pages numbered one (1) through thirteen (13).

TARLOK SINGH HUNDAL
STATE OF WASHINGTON
20213
REGISTERED
PROFESSIONAL ENGINEER

EXPIRES: 02/15/06

Signature

11-09-04
Date

24590-CM-HC4-HXYG-00138-02-00049 Rev 00A

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH-LEVEL WASTE FACILITY PULSE JET VENTILATION SYSTEM MISCELLANEOUS TREATMENT UNITS (MTUs): PJV HEPA FILTERS (PJV-HEPA-00004A/B & -00005A/B) AND PJV HEPA FILTER PREHEATER (PJV-HTR-00002)

COGEMA-IA-075
REV. 0

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

Scope	Scope of this Integrity Assessment	This Integrity Assessment addresses the Miscellaneous Treatment Units (MTUs) that are components of the HLW Facility Pulse Jet Ventilation System (PJV). These MTUs are: 1. Four PJV System HEPA Filters (PJV-HEPA-00004A/B & -00005A/B) - pages 3 thru 8. 2. One PJV System HEPA Filter Preheater (PJV-HTR-00002) - pages 9 thru 13.
References	Data Sheets, Mechanical Data Sheet, and System Description	Data Sheets: 24590-HLW-MAD-PJV-00004, Rev. 4, Remote-Change HEPA Filter Housing Data Sheet (PJV-HEPA-00004A); 24590-HLW-MAD-PJV-00005, Rev. 4, Remote-Change HEPA Filter Housing Data Sheet (PJV-HEPA-00005A); 24590-HLW-MAD-PJV-00006, Rev. 4, Remote-Change HEPA Filter Housing Data Sheet (PJV-HEPA-00004B); 24590-HLW-MAD-PJV-00007, Rev. 4, Remote-Change HEPA Filter Housing Data Sheet (PJV-HEPA-00005B). Mechanical Data Sheet: 24590-HLW-MED-PJV-00002, Rev. 0, Pulse Ventilation HEPA Electric Preheater (PJV-HTR-00002). System Description: 24590-HLW-3YD-PJV-00001, Rev. 0, System Description for the HLW Pulse Jet Ventilation System (PJV), including System Description Change Notice (SDCN) SDCN Nos. 24590-HLW-3YN-PJV-00001 & -00002.
Summary of Assessment		For each item of "Information Assessed" (i.e., Criteria) on the following pages, the items listed under "Source of Information" were reviewed and found to furnish adequate design controls and requirements to ensure the design intent fully satisfies the requirements of Washington Administrative Code, WAC-173-303-640, *Dangerous Waste Regulations* for Tank Systems.

References	Material Requisitions, Specifications, and Drawings.	Material Requisitions (MRs): 24590-QL-MRA-MKH0-00002, Rev. 1, Remote Change HEPA Filter Housings QL-1 (U6L3), MR Section 2 – Technical Specifications (Rev. 2, November 26,2002) including Supplement –S0001; 24590-QL-MRA-MEE0-00001, Rev. 1, Heaters, Electric (Offgas Heaters) (MS071) (N075), MR Section 2 – Technical Specifications (Rev. 5, August 19, 2003) including Supplement –S0001. The following Specifications with their appropriate number and revision (including specification change notices) are included in the above listed Material Requisitions: Engineering Specification for Pressure Vessel Design and Fabrication; Engineering Specification for Seismic Qualification Criteria for Pressure Vessels; General Specification for Supplier Quality Assurance Program Requirements; Engineering Specification for Positive Material Identification (PMI); General Specification for Packaging, Shipping, Handling, and Storage Requirements; Engineering Specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks; Engineering Specification for Structural Design Loads for Seismic Category III/IV Equipment and Tanks; Engineering Specification for Hot and Anti-Sweat Thermal Insulation; Engineering Specification for HEPA Filter Preheaters; Engineering Specification for HEPA Filters; Engineering Specification for Remote Change HEPA Filter Housings. Drawings: 24590-HLW-P1-P01T-P0002, Rev. 3, HLW Vitrification Building general Arrangement (Permit) Plan at El. 0'-0"; 24590-HLW-P1-P01T-P0008, Rev. 7, HLW Vitrification Building general Arrangement (Permit) Sections A-A, B-B, and C-C; 24590-HLW-M5-V17T-P0005, Rev. 0, Process Flow Diagram HLW Vitrification Pulse Jet Ventilation Treatment (PJV); 24590-HLW-M6-PJV-P0001, Rev. 0, P&ID – HLW Pulse Jet Ventilation System Collection & Conditioning; 24590-HLW-M6-PJV-P0002, Rev. 0, P&ID – HLW Pulse Jet Ventilation System Filtration & Monitoring.

	Information Assessed	Source of Information	Assessment
Design	Plant item design standards are appropriate and adequate for the plant item's intended use.	Specifications, Drawings, System Description, and Data Sheets listed above under References; ASME AG-1a-2000, Addenda to and ASME AG-1-1997, Code on Nuclear Air and Gas Treatment, American Society of Mechanical Engineers.	The HLW Pulse Vent HEPA Filters are components in the HLW Facility Pulse Jet Ventilation System (PJV). The HLW Pulse Vent HEPA Filters are located in room H-0104 at Elevation 0'-0" as shown on the drawings and as noted on the data sheets. They are accessible for maintenance. The Engineering Specifications for Remote Change HEPA Filter Housings require that these HEPA Filters be designed, fabricated, and tested in accordance with the requirements in ASME AG-1-1997 and ASME AG-1a-2000. Supplementary requirements are specified in both of the Engineering Specifications. The supplementary requirements address design, materials, fabrication, inspection, testing, quality assurance, documentation, and storage requirements. The HEPA Filters are identified as Quality Level QL-1 and Seismic Category SC-I on the data sheets. These are adequate and acceptable design standards for the HLW Pulse Vent HEPA Filters.
	If a non-standard plant item is to be used, the design calculations demonstrate sound engineering principles of construction.	Specifications, Drawings, and Data Sheets listed above under References.	The HLW Pulse Vent HEPA Filters are components in the HLW Facility Pulse Jet Ventilation System (PJV). These HEPA Filters are standard offgas treatment assemblies that are shop fabricated. Engineering Specifications require that the ASME AG-1/1a HEPA Filter assemblies be delivered after design, fabrication, inspection, and testing. The HLW Pulse Vent HEPA Filters design codes and standards are appropriate and adequate for the intended service.

Information Assessed		Source of Information	Assessment
Design	Plant item has adequate strength, after consideration of the corrosion allowance, to withstand the operating pressure, operating temperature, and seismic loads.	Specifications, Drawings, and Data Sheets listed above under References; ASME AG-1a-2000, Addenda to and ASME AG-1-1997, Code on Nuclear Air and Gas Treatment, American Society of Mechanical Engineers.	The HLW Pulse Vent HEPA Filters data sheets identify the HEPA Filters operating pressure and temperature ranges, the materials selected for the HEPA Filters, the MTU quality levels, and the requirements for seismic design. The Engineering Specification for Remote Change HEPA Filter Housings requires the use of ASME AG-1/1a for design which provides for specific consideration of the operating pressures, temperatures, seismic loads and corrosion allowance in the design process. The data sheets indicate that the HEPA Filters operate in "dry" conditions (non-condensing); therefore, a corrosion resistant material is specified for the HEPA Filters, but no corrosion allowance is specified. Detailed requirements for seismic design of the HEPA Filters are furnished in the Engineering Specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks. These codes and standards are adequate and appropriate for design of the HLW Pulse Vent HEPA Filters to withstand operating pressure and temperature loads and seismic loads for the specified design life while considering corrosion resistance.
Foundation	Plant item foundation will maintain the load of a full vessel.	Specifications listed above under References; ASME AG-1a-2000, Addenda to and ASME AG-1-1997, Code on Nuclear Air and Gas Treatment, American Society of Mechanical Engineers.	The Engineering Specification for Remote Change HEPA Filter Housings requires that these HEPA Filters be designed, fabricated, and tested in accordance with the requirements in ASME AG-1/1a. These ASME codes and associated standards have adequate provisions to assure proper design of the HLW Pulse Vent HEPA Filters supports. The HEPA Filters are furnished as package units on skid platforms for installation in the HLW Vitrification Building.

	Information Assessed	Source of Information	Assessment
Foundation	If in an area subject to flooding, the plant item is anchored.	Specifications, Drawings, Data Sheets, and System Description listed above under References.	The HLW Pulse Vent HEPA Filters are components in the HLW Facility Pulse Jet Ventilation System (PJV). This system handles offgas vapors and aerosols from the process vessels pulse jet (fluidics) mixing equipment. The HEPA Filters are located in filter cave H-0104 as shown on the data sheets. This process area contains only components of the HLW facility offgas systems; therefore, there are no local sources of liquids to flood the room and there is no firewater sprinkler system in Filter Cave H-0104. Design for flooding is not a required load case in the Engineering Specification for Remote Change HEPA Filter Housings. The HEPA Filters are anchored to provide for adequate seismic resistance.
Frost Heave	Plant item system will withstand the effects of frost heave.	System Description listed above under References; 24590-WTP-DC-ST-01-001, Rev. 3, Structural Design Criteria.	The Structural Design Criteria requires that all structural foundations extend a distance below grade that exceeds the depth of the frost line in order to preclude frost heave. The frost line is 30 in. below grade. The HLW Vitrification Building mat foundation is not subject to frost heave, therefore, the HLW Pulse Vent HEPA Filters, located inside the HLW Vitrification Building, are not subject to frost heave.

	Information Assessed	Source of Information	Assessment
Waste Characteristics	Characteristics of the waste to be stored or treated have been identified (ignitable, reactive, toxic, specific gravity, vapor pressure, flash point, storage temperature)	Material Requisitions, Data Sheets, and System Description listed above under References; 24590-WTP-PER-PR-03-002, Rev. 1, Toxic Vapors and Emissions from WTP Tank Systems and Miscellaneous Treatment Unit Systems; 24590-WTP-PER-PR-03-001, Rev. 1, Prevention of Hydrogen Accumulation in WTP Tank Systems And Miscellaneous Treatment Unit Systems; 24590-WTP-SED-ENS-03-002-04, Rev. 0e, Safety Envelope Document; HLW Facility Specific Information.	The HLW Pulse Vent HEPA Filters material requisitions and data sheets list the offgas specific gravity, operating temperatures and pressures, and the chemical composition of hazardous materials in the offgas for design inputs. The main safety function of the HEPA Filters is to provide protection for the public, co-located workers and facility workers from the acutely or chronically toxic vapors and emissions during normal and abnormal operations. This is discussed in the Toxic Vapors and Emissions from WTP Tank Systems and Miscellaneous Treatment Unit Systems document. The Prevention of Hydrogen Accumulation in WTP Tank Systems And Miscellaneous Treatment Unit Systems document describes that the MTUs in the HLW facility are not expected to generate hydrogen gas. The HEPA Filters function during normal and abnormal operations to maintain flow of the offgas to the HLW Building Stack. The HLW Pulse Vent MTUs and the associated ductwork perform a safety function to provide an intact housing pressure boundary during normal operations, abnormal operations and during and after a Design Basis Earthquake (DBE) as discussed in the Safety Envelope Document. This function assures operation of the Pulse Jet Mixers for hydrogen control in HLW Facility process vessels after a DBE.
	Plant item is designed to store or treat the wastes with the characteristics defined above and any treatment reagents.	Data Sheets and System Description listed above under References.	The HLW Pulse Vent HEPA Filters data sheets identify that the HEPA Filters provide filtration and pressure head to maintain normal offgas flow. The System Description discusses normal and abnormal operations for the HEPA Filters. Additional reagents will not normally be added to the PJV System offgas streams during normal and abnormal operations.

	Information Assessed	Source of Information	Assessment
Compatibility	The waste types are compatible with each other.	Data Sheets and System Description listed above under References.	The System Description for the HLW Pulse Jet Ventilation System (PJV) does not describe any operations where incompatible wastes are mixed in the PJV System offgas streams. The offgas chemistries for both normal and abnormal operations were fully considered in the material selections for the HEPA Filters as shown on the data sheets.
Corrosion	Plant item material and protective coatings ensure the vessel structure is adequately protected form the corrosive effects of the waste stream and external environments (expected to not leak or fail for the design life of the system)	Drawings, Data Sheets, and System Description listed above under References; ASME AG-1a-2000, Addenda to and ASME AG-1-1997, Code on Nuclear Air and Gas Treatment, American Society of Mechanical Engineers.	The HLW Pulse Vent HEPA Filters data sheets list 304L stainless steel as the preferred material the HEPA Filters pressure boundaries and internals. The data sheets indicate that the HEPA Filters operate in "dry" conditions (non-condensing); therefore, a corrosion resistant material is specified for the housings and internal components, but no corrosion allowance is specified. ASME AG-1/1a do require mandatory consideration of corrosion/erosion in the design of these MTUs. The external environment for the HEPA Filters will be dry air in room H-0104. Therefore, external corrosion is not a concern.
Corrosion Allowance	Corrosion allowance is adequate for the intended service life of the plant item.	Specifications and Data Sheets listed above under References; ASME AG-1a-2000, Addenda to and ASME AG-1-1997, Code on Nuclear Air and Gas Treatment, American Society of Mechanical Engineers.	The basis for the HLW Pulse Vent HEPA Filters material selections is furnished in the data sheets. Selection of 304L stainless steel for a service life of 40 years is adequate and appropriate considering that the HEP Filters operate in "dry" conditions (non-condensing). The Engineering Specification for Remote Change HEPA Filter Housings does not specify use of a corrosion allowance. However, the ASME AG-1/1a codes do require mandatory consideration of corrosion/erosion in the design of these HEPA Filters. The external environment for the HEPA Filters will be dry air in room H-0104. Therefore, external corrosion is not a concern.

	Information Assessed	Source of Information	Assessment
Pressure Relief	Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the plant item are exceeded.	Specifications and Data Sheets listed above under References; ASME AG-1a-2000, Addenda to and ASME AG-1-1997, Code on Nuclear Air and Gas Treatment, American Society of Mechanical Engineers.	The HLW Pulse Vent HEPA Filters data sheets provide the design pressure and temperature conditions for the HEPA Filters. The Engineering Specification for Remote Change HEPA Filter Housings requires the HEPA pressure boundary to be designed for a minimum of 150% of the Maximum Operating Pressure while retaining adequate code based design and deformation margins. This requirement is correctly carried into the data sheets.

Information Assessed		Source of Information	Assessment
Design	Plant item design standards are appropriate and adequate for the plant item's intended use.	Material Requisition, Specifications, and Mechanical Data Sheets listed above under References; ASME Boiler and Pressure Vessel (B&PV) Code, Section VIII, Division 1, Rules for Construction of Pressure Vessels, American Society of Mechanical Engineers; ASME AG-1a-2000, Addenda to and ASME AG-1-1997, Code on Nuclear Air and Gas Treatment; American Society of Mechanical Engineers; 24590-WTP-3DP-G04T-00905, Rev. 3, Determination of Quality Levels. (BNI RPP-WTP, Engineering Department Project Instructions.)	The Engineering Specification for HEPA Filter Preheaters requires use of the Engineering Specification for Pressure Vessel Design and Fabrication for the external pressure boundary of the HLW HEPA Filter Preheater. This specification requires that the external pressure boundary is to be designed to ASME B&PV Code, Section VIII, Division 1 rules supplemented with elements of the ASME AG-1/1a codes. Additional supplementary requirements are specified in the specification for Pressure Vessel Design and Fabrication. These supplementary requirements address positive material identification, standard fabrication tolerances, acceptable welding procedures for the vessel and appurtenances, welder qualifications and testing records, NDE inspections and records, quality assurance requirements, and packaging, shipping, handling and storage requirements. The Mechanical Data Sheet identifies the external pressure boundary of the HLW HEPA Filter Preheater as Quality Level (QL-1) and Seismic Category (SC-I). Quality Levels are explained in the Determination of Quality Levels and Seismic Categories are explained in the Engineering Specification for Pressure Vessel Design and Fabrication. These are adequate and acceptable codes and standards for design and fabrication of the HLW HEPA Filter Preheater.
	If a non-standard plant item is to be used, the design calculations demonstrate sound engineering principles of construction.	Specifications listed above under References; ASME Boiler and Pressure Vessel (B&PV) Code, Section VIII, Division 1, Rules for Construction of Pressure Vessels, American Society of Mechanical Engineers.	The Engineering Specification for HEPA Filter Preheaters requires that the HLW HEPA Filter Preheater is to be designed and fabricated in accordance with the requirements of ASME B&PV Code, Section VIII, Division 1 supplemented by ASME AG-1/1a. The preheater is to be delivered after design, fabrication, inspection and testing. A code stamp is not required for this MTU. This is a shop fabricated MTU for PJV System offgas service in the HLW Facility.

Information Assessed		Source of Information	Assessment
Design	Plant item has adequate strength, after consideration of the corrosion allowance, to withstand the operating pressure, operating temperature, and seismic loads.	Specifications and Mechanical Data Sheet listed above under References; ASME Boiler and Pressure Vessel (B&PV) Code, Section VIII, Division 1, Rules for Construction of Pressure Vessels, American Society of Mechanical Engineers; ASME AG-1a-2000, Addenda to and ASME AG-1-1997, Code on Nuclear Air and Gas Treatment, American Society of Mechanical Engineers.	The Engineering Specification for HEPA Filter Preheaters requires use of the Engineering Specification for Pressure Vessel Design and Fabrication for the external pressure boundary of the HLW HEPA Filter Preheater. This specification requires that the external pressure boundary is to be designed to ASME B&PV Code, Section VIII, Division 1 rules supplemented with elements of the ASME AG-1/1a codes. These codes require specific consideration of the operating pressures, temperatures, seismic loads, and corrosion allowance in the design process. The Mechanical Data Sheet identifies the operating pressure and temperature range for the HLW HEPA Filter Preheater, the materials selected for the process conditions, the corrosion allowance, and the requirements for seismic qualification in the design. The HLW HEPA Filter Preheater pressure boundary is Seismic Category SC-I. The Engineering Specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks provides detailed guidance for seismic analysis of this MTU. These are adequate and appropriate codes and standards to ensure the HLW HEPA Filter Preheater has adequate strength at the end of its design life for all anticipated loading conditions.
Foundation	Plant item foundation will maintain the load of a full vessel.	Material Requisition, Specifications, and Mechanical Data Sheet listed above under References; ACI 349, Code Requirements for Nuclear Safety Related Concrete Structures (ACI 349-01)/and Commentary (ACI 349R-01), American Concrete Institute; AISC N690-1994, Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities, American Institute of Steel Construction.	The Engineering Specification for HEPA Filter Preheaters requires use of the Engineering Specification for Pressure Vessel Design and Fabrication which provides requirements that assure adequate equipment foundation designs. The Mechanical Data Sheet provides a sketch showing the envelope available for installation of the HLW HEPA Filter Preheater in the shield wall inside the HLW Facility. The Material Requisition includes the cast-in-place steel penetration frame for the concrete wall that supports the HEPA preheater. This frame is designed in accordance with the provisions of ACI 349 and AISC N690. These codes and standards and dimensional data are appropriate and adequate to assure that the foundation design is acceptable.

Information Assessed		Source of Information	Assessment
Foundation	If in an area subject to flooding, the plant item is anchored.	Specifications and Mechanical Data Sheet listed above under References.	The HLW HEPA Filter Preheater is to be installed in an exterior shield wall of filter cave H-0104 as shown in the sketch in the Mechanical Data Sheet. The equipment in filter cave H-0104 is comprised of remote handled HEPA filtration units for several offgas systems in the HLW Facility. There are no local sources of liquids to flood the filter cave room. Design for flooding is not a required load case in the Engineering Specification for HEPA Filter Preheaters. The preheater is anchored to provide for adequate seismic resistance.
Frost Heave	Plant item system will withstand the effects of frost heave.	System Description listed above under References; 24590-WTP-DC-ST-01-001, Rev. 3, Structural Design Criteria.	The HLW HEPA Filter Preheater is installed in an exterior shield wall of filter cave H-0104 in the HLW Vitrification Building. This room is supported by the HLW Building mat foundation. The Structural Design Criteria requires that all structural foundations extend into the surrounding soil below the frost line in order to preclude frost heave. The frost line is located 30 in. below finished grade. The HLW Building mat foundation is not subject to frost heave, therefore the HLW HEPA Filter Preheater will not be subject to frost heave.
Waste Characteristics	Characteristics of the waste to be stored or treated have been identified (ignitable, reactive, toxic, specific gravity, vapor pressure, flash point, storage temperature)	Mechanical Data Sheet and System Description listed above under References; 24590-WTP-PER-PR-03-002, Rev. 1, Toxic Vapors and Emissions from WTP Tank Systems and Miscellaneous Treatment Unit Systems.	The Mechanical Data Sheet lists the offgas operating temperatures and pressures, relative humidity and the radiological and chemical composition of hazardous materials in the offgas. The main safety functions of the HLW HEPA Filter Preheater are to provide confinement of the toxic vapors and aerosols in the PJV System offgas and to raise the offgas temperature above the dew point to protect the HEPA filters. These functions are discussed in the Toxic Vapors and Emissions from WTP Tank Systems and Miscellaneous Treatment Unit Systems document. The HLW HEPA Filter Preheater is also required to provide an intact external pressure boundary during normal operations, abnormal operations and during and after a Design Basis Earthquake as discussed in the System Description.

Information Assessed		Source of Information	Assessment
Waste Characteristics	Plant item is designed to store or treat the wastes with the characteristics defined above and any treatment reagents.	Mechanical Data Sheet and System Description listed above under References.	The Mechanical Data Sheet shows that the material selection for the HLW HEPA Filter Preheater takes into account both normal and abnormal operations waste characteristics. The System Description discussions of normal and abnormal operations do not identify any reagents that would normally be added to the PJV system offgas stream.
Compatibility	The waste types are compatible with each other.	Mechanical Data Sheet and System Description listed above under References.	The System Description for the HLW Pulse Jet Ventilation System (PJV) does not describe any operations where incompatible wastes are mixed in the PJV offgas streams. The Mechanical Data Sheet shows that offgas chemistries for both normal and abnormal operations were fully considered in the material selections for the HLW HEPA Filter Preheater.

Information Assessed		Source of Information	Assessment
Corrosion	Plant item material and protective coatings ensure the vessel structure is adequately protected form the corrosive effects of the waste stream and external environments (expected to not leak or fail for the design life of the system).	Specifications, Mechanical Data Sheet, and System Description listed above under References.	The Mechanical Data Sheet for the HLW HEPA Filter Preheater identifies 304 stainless steel (maximum 0.030% Carbon, dual certified), hereinafter called 304L stainless steel, as the material of choice for the external pressure boundary (housing). The pockets where the electric heating elements are installed are part of the external pressure boundary and they require additional corrosion resistance. Therefore, 316 stainless steel (maximum 0.030% Carbon, dual certified), hereinafter called 316L stainless steel, is specified for these pockets. The Engineering Specification for HEPA Filter Preheaters requires external insulation of the HLW HEPA Filter Preheater housing and connecting piping in accordance with the Engineering Specification for Hot and Anti-Sweat Thermal Insulation. The Specification for HEPA Filter Preheaters also requires that the maximum temperature of the concrete wall surface in contact with the Preheater not to be exceeded 100° F. These requirements assure that the HLW HEPA Filter Preheater will have adequate corrosion protection for the expected design life (40 years).
Corrosion Allowance	Corrosion allowance is adequate for the intended service life of the plant item.	Mechanical Data Sheet listed above under References	The Mechanical Data Sheet for the HLW HEPA Filter Preheater lists 304L stainless steel as the material selected for the external pressure boundary augmented by 316L stainless steel for the electrical heater pockets. A corrosion allowance of 0.040 in. is selected as adequate for a 40 year service life.
Pressure Relief	Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the plant item are exceeded.	Mechanical Data Sheet listed above under References	The Mechanical Data Sheet for the HLW HEPA Filter Preheater lists a minimum design pressure of (-) 10 psig at 32° F and a maximum design pressure of (+) 25 psig at 212° F for the external pressure boundary. Normal operating pressure for the PJV offgas system is listed as about 13.7 psia. Therefore, the design has adequate margins.

24590-CM-HC4-HXYG-00138	- 02 - 00050	00A
PO/SCT	**Submittal**	**Rev**

Job No. 24590

Bechtel National, Inc.

SUPPLIER DOCUMENT STATUS

1. [X] **Work may proceed.**
2. [ ] **Revise and resubmit. Work may proceed subject to resolution of indicated comments.**
3. [ ] **Revise and resubmit. Work may not proceed.**
4. [ ] **Review not required. Work may proceed.**

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations.

REVIEWED

G-321 Document Category N/A
[From Supplement A to G-321-E (E) or G-321-V (V), as applicable, or "N/A" if SSRS is used]

Supersedes BNI Document No. N/A Rev. _____
[When applicable]

Accepted by D C Affinger (Print Name) (Signature) 11/16/04 (Date)

Released by N/A
[When applicable] Print Name Signature Date

TP0406_34 7-04

SUBCONTRACT SUBMITTAL

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH LEVEL WASTE (HLW) MELTER CAVE SUPPORT HANDLING SYSTEM (HSH) DECONTAMINATION TANKS (HSH-TK-00001/2)

COGEMA-IA-076
REV. 0

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

R10424844

IQRPE REVIEW
OF
THE HIGH LEVEL WASTE (HLW)
MELTER CAVE SUPPORT HANDLING SYSTEM (HSH)
DECONTAMINATION TANKS (HSH-TK-00001/2)

"I, Tarlok S. Hundal, have reviewed and certified a portion of the design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by Department of Energy, Office of River Protection, Richland, Washington. My duties were independent review of the current design for the High Level Waste (HLW) Melter Cave Support Handling System (HSH) Decontamination Tanks (HSH-TK-00001/2) as required by the Washington Administrative Code, *Dangerous Waste Regulations*, Section WAC 173-303-640(3) (a) through (g) applicable components."

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

The documentation reviewed indicates that the design intent fully satisfies the requirements of the WAC.

The attached review is six (6) pages numbered one (1) through six (6).

TARLOK SINGH HUNDAL
STATE OF WASHINGTON
20213
REGISTERED
PROFESSIONAL ENGINEER

EXPIRES: 02/15/06

Signature

11-12-04
Date

24590-CM-HC4-HXYG-00138-02-00050 REV. 00A

Scope	Scope of this Integrity Assessment	This Integrity Assessment includes two HSH system Decontamination Tanks (HSH-TK-00001/2) located in room H-0310A and room H-0304A, respectively, in the HLW Vitrification Building:
References	Specifications, Drawings	The following Specifications with their respective revision and specification change notices are listed directly in the Material Requisition No. 24590-CM-MRA-HDYR-00001, Rev. 3 or are indirectly embedded in the specification listed in this MR: 24590-WTP-3PS-MV00-T0001, Engineering Specification for Pressure Vessel Design and Fabrication; 24590-WTP-3PS-G000-T0001, General Specification for Supplier Quality Assurance Program Requirements; 24590-WTP-3PS-G000-T0002, Engineering Specification for Positive Material Identification (PMI); 24590-WTP-3PS-G000-T0003, General Specification for Packaging, Shipping, Handling, and Storage Requirements; 24590-WTP-3PS-FB01-T0001, Engineering Specification for Structural Design Loads for Seismic Category III/IV Equipment and Tanks; 24590-WTP-3PS-HD00-T0001, Engineering Specification for Maintenance Decontamination Equipment; 24590-WTP-3PS-MTSS-T0001, Engineering Specification for Tank Welding; 24590-WTP-3PS-SS00-T0002, Engineering Specification for Welding of Structural Stainless Steel and Welding of Carbon Steel to Stainless Steel; 24590-WTP-3PS-P000-T0001, Engineering Specification for Piping Material Classes. Drawings: 24590-HLW-M0-HSH-00071, Rev. 0, HLW Vitrification System HSH Melter Caves 1 & 2 Design Proposal Drawing Decontamination Tank Assembly; 24590-HLW-M0-HSH-00072, Rev. 1, HLW Vitrification System HSH Design Proposal Drawing Decontamination Tank; 24590-HLW-M0-HSH-00075, Rev. 1, HLW Vitrification System HSH Design Proposal Drawing Decontamination Tank Process Flow Diagram; 24590-HLW-P1-P01T-P0002, Rev. 3, HLW Vitrification Building General Arrangement (Permit) Plan at EL. 0'-0"; 24590-HLW-P1-P01T-P0008, Rev. 7, HLW Vitrification Building General Arrangement (Permit) Sections A-A, B-B, and C-C; 24590-HLW-P1-P01T-P0009, Rev. 6, HLW Vitrification Building General Arrangement (Permit) Sections D-D, E-E, and F-F; 24590-HLW-P1-P01T-P0011, Rev. 7, HLW Vitrification Building General Arrangement (Permit) Sections J-J & K-K.
Summary of Assessment		For each item of "Information Assessed" (i.e., Criteria) on the following pages, the items listed under "Source of Information" were reviewed and found to furnish adequate design controls and requirements to ensure the design intent fully satisfies the requirements of Washington Administrative Code, WAC-173-303-640, *Dangerous Waste Regulations* for Tank Systems.

	Information Assessed	Source of Information	Assessment
Design	Tank design standards are appropriate and adequate for the tank's intended use.	Specifications listed under Material Requisition and Drawings listed above under References; American Petroleum Institute standard API 620, Design and Construction of Large, Welded, Low- Pressure Storage Tanks, 10th Edition; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers.	The Engineering Specification for Maintenance Decontamination Equipment requires the HSH system Decontamination Tanks, HSH-TK-00001/00002, to be designed and fabricated in accordance with API 620 standard and Specification for Tank Welding and their appurtenances to be designed per Specification for Pressure Vessel Design and Fabrication requirements. The tanks are not to be stamped. The Quality Level of the tanks is CM (commercial), safety class is RRC (risk reduction class), and Seismic Criteria is SC-III. The associated pipes are to be designed per ASME B31.3 and Specification for Piping Material Classes. Supplementary requirements are specified in the Engineering Specification for Pressure Vessel Design and Fabrication. The above standards, codes, and specifications provide requirements for tank analysis, positive material identification, lifting attachment design, equipment drop evaluation, fabrication tolerances, acceptable welding procedures for the tanks and appurtenances, welder qualifications and testing records, NDE inspections and records, and lifting, packaging, shipping, handling and storage requirements. These are adequate and acceptable design standards for the intended use of the tanks. These tanks are vertical with a 72 in. ID cylinder by 218 in. high, from bottom to top with a conical bottom and an open top. The tanks are built with 1/2" minimum thick plate and are supported on four legs which in turn are supported from and anchored to the concrete floor. Material for the tanks and appurtenances is 316L stainless steel.
	If a non-standard tank is to be used, the design calculations demonstrate sound engineering principles of construction.	Specifications listed under Material Requisition and Drawings listed above under References.	The HSH Decontamination Tanks, HSH-TK-00001/00002 are standard API 620 tanks. The Specification for Maintenance Decontamination Equipment requires that these tanks be delivered after design, fabrication, inspection, and testing. Supplemental design information is provided by the reference documents listed in the Source of Information column for utilizing sound engineering principles of construction of the tanks.

	Information Assessed	Source of Information	Assessment
Design	Tank has adequate strength, after consideration of the corrosion allowance, to withstand the operating pressure, operating temperature, and seismic loads.	Specifications listed under Material Requisition and Drawings listed above under References; American Petroleum Institute standard API 620, Design and Construction of Large, Welded, Low-Pressure Storage Tanks, 10th Edition.	The Specification for Maintenance Decontamination Equipment identifies the tanks' operating pressure and temperature ranges, the materials selected for the tanks, the corrosion allowance, and the tank quality level and seismic category which determine the requirements for seismic design. The Specification for Maintenance Decontamination Equipment requires specific consideration of the operating pressures and temperatures and seismic loads in the design process. API 620 states that when corrosion is expected on any part of the tank including its appurtenances, additional metal thickness in excess of design computations shall be provided and shall be at least equal to the expected corrosion loss during the desired life of the tank. API 620 also addresses seismic design and analysis of the tanks. Detailed supplemental requirements for seismic load determination are furnished in the Specification for Seismic Category III/IV Equipment and Tanks. These codes, standards, and specifications are adequate and appropriate for the design of the HSH tanks to withstand operating pressure and temperature loads and seismic loads for the specified design life.

	Information Assessed	Source of Information	Assessment
Foundation	Tank foundation will maintain the load of a full tank.	Specifications listed under Material Requisition above under References; AISC Manual of Steel Construction, 9th Edition, American Institute of Steel Construction; 24590-WTP-DB-ENG-01-001, Rev. 1B, Basis of Design.	The Engineering Specification for Pressure Vessel Design and Fabrication requires the use of AISC Manual of Steel Construction for the design of the tank supports. This code ensures an adequate design for the tank supports. Chapter 14 of the Basis of Design document requires that the tank foundation design must be adequate to support the loads from the full tank.
	If in an area subject to flooding, the tank is anchored.	Specifications listed under Material Requisition under References.	The Specification for Maintenance Decontamination Equipment requires the supports and anchors to be designed to secure a buoyant tank in case the tank is empty and fully submerged.
	Tank system will withstand the effects of frost heave.	24590-WTP-DB-ENG-01-001, Rev. 1B, Basis of Design.	The Basis of Design document requires that all structural foundations for outdoor equipment extend a distance below grade that exceeds the 30" depth of the frost line. These tanks are located inside/interior of the building floor at grade-level, therefore, the tank foundations are not subject to the frost heave effects.

	Information Assessed	Source of Information	Assessment
Waste Characteristics	Characteristics of the waste to be stored or treated have been identified (ignitable, reactive, toxic, specific gravity, vapor pressure, flash point, storage temperature)	Plant Item Material Selection Data Sheet, 24590-HLW-N1D-HSH-P0001, Rev. 0, HSH-TK-00001/00002 (HLW) Decontamination Tank Melter Cave 1 and 2; 24590-WTP-PER-PR-03-002, Rev. 1, Toxic Vapors and Emissions from WTP Tank Systems and Miscellaneous Treatment Unit Systems; 24590-WTP-PER-PR-03-001, Rev. 1, Prevention of Hydrogen Accumulation in WTP Tank Systems and Miscellaneous Treatment Unit Systems.	The Plant Item Material Selection Data Sheet addresses the pH range and chemical composition of the waste to select appropriate tank materials and specify the corrosion allowance. Waste characteristics that are hazardous, such as ignitability, reactivity, and toxicity are appropriately addressed in the Toxic Vapors and Emissions document and Prevention of Hydrogen Accumulation document. These two documents do not specifically list these HSH tanks to exhibit any hazardous characteristics. The HSH tanks provide primary confinement of the waste during normal operations, abnormal operations, and during and after a Design Basis Earthquake. The tanks are expected to contain nitric acid up to 2M. Other chemicals may be used in the future, requiring further evaluation. The present evaluation has assumed that chlorides, including HCl, will not be added to the tanks.
	Tank is designed to store or treat the wastes with the characteristics defined above and any treatment reagents.	Specifications listed under Material Requisition under References; Plant Item Material Selection Data Sheet, 24590-HLW-N1D-HSH-P0001, Rev. 0, HSH-TK-00001/00002 (HLW) Decontamination Tank Melter Cave 1 and 2.	The Specification for Maintenance Decontamination Equipment states that decontamination chemicals will be injected along with neutralizing reagents. The Plant Item Material Selection Data Sheet demonstrates that the tanks are to be designed to process the wastes discussed above. The fluids from the tanks are pumped to a radioactive waste disposal system for further processing.
	The waste types are compatible with each other.	Specifications listed under Material Requisition under References; Plant Item Material Selection Data Sheet, 24590-HLW-N1D-HSH-P0001, Rev. 0, HSH-TK-00001/00002 (HLW) Decontamination Tank Melter Cave 1 and 2.	The decontamination entails the removal of unwanted radioactive fixed and loose contaminants using various mechanical and chemical methods. The primary function of these Decontamination Tanks is to decontaminate large equipment using liquid spray or blasting methods. The Plant Item Material Selection Data Sheet or the Specification for Maintenance Decontamination Equipment did not describe or identify where any incompatible liquids or chemicals are mixed in the decontamination process.

	Information Assessed	Source of Information	Assessment
Corrosion Protection	Tank material and protective coatings ensure the tank structure is adequately protected from the corrosive effects of the waste stream and external environments (expected to not leak or fail for the design life of the system)	Drawings and Specifications listed above under References; Plant Item Material Selection Data Sheet, 24590-HLW-N1D-HSH-P0001, Rev. 0, HSH-TK-00001/00002 (HLW) Decontamination Tank Melter Cave 1 and 2.	The Plant Item Material Selection Data Sheet shows that the HSH Decontamination Tanks, HSH-TK-00001/00002 normally operate at atmospheric pressure, a nearly zero pH value, and at a temperature of 95°F. The Specification for Maintenance Decontamination Equipment specifies the tanks to be designed for a temperature of 240°F. Decontamination liquids are considered to contain nitric acid up to 2M. The tanks assembly drawings show the material as 316 L stainless steel and corrosion allowance of 0.125 in. The HSH tanks are located in the HLW rooms H-0310A and H-0304A. These rooms are equipped with sumps to pump out any accumulation of liquid in them. Therefore, the rooms' environment should remain dry during normal operations which will limit external corrosion of the tanks over the facility design life.
Corrosion Allowance	Corrosion allowance is adequate for the intended service life of the tank.	Drawings listed above under References; Plant Item Material Selection Data Sheet, 24590-HLW-N1D-HSH-P0001, Rev. 0, HSH-TK-00001/00002 (HLW) Decontamination Tank Melter Cave 1 and 2.	The bases for the HFP tanks' material selection and the minimum recommended corrosion allowance are furnished in the Plant Item Material Selection Data Sheet. The 316 L stainless steel material to be used and 0.125 in. corrosion allowance required for the tanks are shown on the drawings for the tank assembly. Selection of material and corrosion allowance is adequate and appropriate for the 40 year service life.
Pressure Relief	Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the tank are exceeded.	Drawings listed above under References.	The HSH Decontamination Tanks, HSH-TK-00001/00002 are designed to overflow through a 4" diameter unrestricted line, as shown on the drawings, which will prevent their over pressurization.

R10571126

COGEMA-IA-081, Rev. 0

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH LEVEL WASTE (HLW) CANISTER DECONTAMINATION HANDLING SYSTEM (HDH) ANCILLARY EQUIPMENT

BECHTEL

Job No 24590

Bechtel National, Inc

SUPPLIER DOCUMENT STATUS

1. [X] **Work may proceed.**
2. [ ] **Revise and resubmit. Work may proceed subject to resolution of indicated comments.**
3. [ ] **Revise and resubmit. Work may not proceed.**
4. [ ] **Review not required. Work may proceed.**

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations.

REVIEWED									

G-321 Document Category N/A
[From Supplement A to G-321-E (E) or G-321-V (V), as applicable, or "N/A" if SSRS is used]

Supersedes BNI Document No. _____ Rev _____
[When applicable]

Accepted by M. W. Hoffmann (Print Name) _____ (Signature) 5/19/05 (Date)

Released by _____ (Print Name) _____ (Signature) _____ (Date)
[When applicable]

416 GP&S 7-03

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

24590-CM-HC4-HXYG-00138-02-00055 Rev 00A

IQRPE REVIEW
OF
THE HIGH LEVEL WASTE (HLW) CANISTER DECONTAMINATION HANDLING SYSTEM (HDH) ANCILLARY EQUIPMENT

"I, Tarlok Hundal have reviewed, and certified a portion of the design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by Department of Energy, Office of River Protection, Richland, Washington. My duties were independent review of the current design for the High Level Waste (HLW) Canister Decontamination Handling System (HDH) Ancillary Equipment as required by the Washington Administrative Code, *Dangerous Waste Regulations*, Section WAC-173-303-640(3) (a) through (g) applicable components."

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

The documentation reviewed indicates that the design fully satisfies the requirements of the WAC.

The attached review is seven (7) pages numbered one (1) through seven (7).

TARLOK SINGH HUNDAL
STATE OF WASHINGTON
20213
REGISTERED
PROFESSIONAL ENGINEER

EXPIRES: 02/15/06

T S Hundal
Signature

5/13/05
Date

Scope	Scope of this Integrity Assessment	This Integrity Assessment addresses ancillary equipment associated with the High Level Waste (HLW) Canister Decontamination Handling System (HDH) vessels located in the south east corner of the HLW facility. The ancillary equipment associated with these vessels is shown on P&ID drawings 24590-HLW-M6-HDH-P0001, -P0002, and -P20001. This includes the ancillary equipment associated with the following HDH vessels : (1) One Canister Rinse Bogie Decon Vessel (HDH-VSL-00001) located at Elevation (-) 16'-6" in Room H-B039B; a secondary containment structure. (2) Two Canister Decon Vessels (HDH-VSL-00002/4) and one Waste Neutralization Vessel (HDH-VSL-00003), all located at Elevation (-) 16'-0" in Room H-B035; a secondary containment structure. Ancillary equipment located inside the HLW (HDH) system vessels is addressed separately in the Integrity Assessments for these plant items.
References	Drawings and System Description	Drawings: 24590-HLW-P1-P01T-P0001, Rev. 6, HLW Vitrification Building General Arrangement (Permit) Plan at El.(-)21'- 0"; 24590-HLW-P1-P01T-P0002, Rev. 3, HLW Vitrification Building General Arrangement (Permit) Plan at El. 0'- 0"; 24590-HLW-P1-P01T-P0009, Rev. 6, HLW Vitrification Building General Arrangement (Permit) Sections D-D, E-E & F-F; 24590-HLW-P1-P01T-P0010, Rev. 6, HLW Vitrification Building General Arrangement (Permit) Section G-G & H-H; 24590-HLW-M6-HDH-P0001, Rev. 1, P&ID –HLW Canister Decontamination Handling System; 24590-HLW-M6-HDH-P0002, Rev. 1, P&ID – HLW Canister Decontamination Handling System; 24590-HLW-M6-HDH-P20001, Rev. 1, P&ID – HLW Canister Decontamination Handling System; 24590-HLW-M5-V17T-P0006, Rev. 2, P&ID –Process Flow Diagram HLW Canister Decon (System HDH). 24590-QL-POA-MQTS-00002-01-86, Rev. 000C, Decontamination Vessel Pump Assembly (HDH-PMP-00001); 24590-HLW-P3-HDH-WS00010001, Rev. 0, HLW Vitrification Isometric (Line No. HDH-WS-00010-T11A-1); 24590-HLW-P3-HDH-ZT00008001, Rev. 0, HLW Vitrification Isometric (Line No. HDH-ZT-00008-S11P-1); 24590-HLW-P3-HDH-PA00003001, Rev. 1, HLW Vitrification Isometric (Line No. HDH-PA-00003-T11A-3); 24590-HLW-P3-HDH-DB00007001, Rev. A, HLW Vitrification Isometric (Line No. HDH-DB-00007-T11A-1); 24590-HLW-P3-HDH-PA00007001, Rev. A, HLW Vitrification Isometric (Line No. HDH-PA-00007-S11F-2); 24590-HLW-HDH-H00013, Rev. 0, Pipe Support Drawing; 24590-HLW-HDH-H00015, Rev. 0, Pipe Support Drawing; 24590-HLW-HDH-H30050, Rev. 0, Pipe Support Drawing; 24590-HLW-HDH-H20004, Rev. 0, Pipe Support Drawing; 24590-HLW-HDH-H30003, Rev. 0, Pipe Support Drawing. System Description: 24590-HLW-3YD-HDH-00002, Rev. 2, System Description for HLW System Canister Decontamination Handling.
Summary of Assessment		For each item of "Information Assessed" (i.e., Criteria) on the following pages, the items listed under "Source of Information" were reviewed and found to furnish adequate design controls and requirements to ensure that the design fully satisfies the requirements of Washington Administrative Code, WAC-173-303-640, *Dangerous Waste Regulations* for Tank Systems.

Information Assessed		Source of Information	Assessment
Design	Ancillary equipment design standards are appropriate and adequate for the equipment's intended use.	Drawings and System Description listed above under References; 24590-WTP-DC-PS-01-001, Rev. 4, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria;" ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers.	The Pipe Stress Design Criteria identifies ASME B31.3 as the design code for piping systems of the WTP. The Process System Description document states that the HDH system does not have any important to safety function. Drawings show that the ancillary equipment is of commercial quality grade and is Seismic Category SC-III. The Pipe Stress Design Criteria document provides a detailed discussion of seismic categories. The codes and standards used are acceptable and adequate for the design of the ancillary piping for the intended service.
	If the ancillary equipment to be used is not built to a design standard, the design calculations demonstrate sound engineering principles of construction.	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev. 4, Pipe Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; 24590-WTP-3DP-G04T-00906, Rev. 2, Isometric Drawings and Associated Calculations.	The ancillary equipment are designed and built to the design standards and codes. The Pipe Stress Design Criteria specifies that piping is to be designed in accordance with ASME B31.3 Code. The review of the sample isometric drawings listed in References and of the design process and controls described in Isometric Drawings and Associated Calculations document provides adequate assurance that HDH ancillary equipment are properly designed, installed, and verified to meet the requirements of the applicable design criteria established for the project. The documentation reviewed demonstrates that sound design engineering principles are used for the design and construction.

Information Assessed		Source of Information	Assessment
Design	Ancillary equipment has adequate strength at the end of its design life to withstand the operating pressure, operating temperature, thermal expansion, and seismic loads. Equipment is protected against physical damage and excessive stress due to settlement, vibration, expansion, or contraction.	24590-WTP-DC-PS-01-001, Rev. 4, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria;" ASME Boiler and Pressure Vessel Code, Section III, Division 1, Rules for Construction of Nuclear Power Plant Components, American Society of Mechanical Engineers, 1995; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; Uniform Building Code (UBC), 1997; 24590-WTP-PER-M-02-002, Rev. 1, Materials for Ancillary Equipment.	The Pipe Stress Design Criteria requires the use of the ASME B31.3 Code for process piping design. ASME B31.3 requires explicit consideration of operating pressure, operating temperature, thermal expansion/contraction, settlement, vibration, and corrosion allowance in the design of piping. ASME Section III, Subsection NC and Appendix F, and the Uniform Building Code (UBC) are used to supplement the requirements of ASME B31.3 for seismic design of Seismic Category (SC-III/IV) ancillary equipment. Details of the seismic design methods are discussed in the Pipe Stress Design Criteria document. These are appropriate and adequate codes and standards to assure that the ancillary equipment has adequate strength at the end of its design life to withstand all anticipated loads.

Information Assessed		Source of Information	Assessment
Supports	Ancillary equipment supports are adequately designed.	Drawings listed above under References; 24590-WTP-DC-PS-01-002, Rev. 3, Pipe Support Design Criteria; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; ASME Boiler and Pressure Vessel Code, Section III, Division 1, Rules for Construction of Nuclear Power Plant Components, American Society of Mechanical Engineers, 1995; Uniform Building Code (UBC), 1997; 24590-WTP-PER-PS-02-001, Rev. 4, Ancillary Equipment Pipe Support Design; 24590-WTP-PL-PS-01-001, Rev 1, Verification and Validation Test Plan for Bechtel's ME150 Pipe Support Family of Programs (PCFAPPS). 24590-QL-POA-MQTS-00002-02-10, Rev. 00B, Stress Analysis of Decontamination Pump Support Frame; 24590-WTP-3DP-G04T-00906, Rev. 2, Isometric Drawings and Associated Calculations.	The Pipe Support Design Criteria document considers all loadings identified in ASME B31.3 and utilizes ASME BPV Code, Section III, Division 1, Subsection NF and Appendix F and UBC, to supplement the requirements of ASME B31.3 for seismic design of Seismic Category (SC-III/IV) pipe supports. Bounding load cases are passed to the pipe support designers from the results of the ancillary equipment piping stress analyses. Details of the seismic design methodology are discussed in the Pipe Support Design Criteria document. Examples of typical ancillary equipment supports are shown in the Ancillary Equipment Pipe Support Design document. Analysis is by manual calculation or approved computer programs that have been verified and validated. These are appropriate codes and standards for design of ancillary equipment supports for the HDH system. Ancillary equipment supports are to be designed to allow a minimum of heat to be transferred to the building structures. The temperature of the building structures is not to exceed 150°F for concrete and 200°F for steel. The review of the sample isometric drawings, support calculations, and drawings and that of the design process and controls described in Isometric Drawings and Associated Calculations document provides sufficient assurance that HDH ancillary equipment supports are adequately designed, installed, and verified to meet the requirements of the applicable design criteria established for the project.
	The system will withstand the effects of frost heave.	Drawings listed above under References; 24590-WTP-DC-ST-01-001, Rev. 6, Structural Design Criteria.	The HDH ancillary equipment system considered in this assessment is located inside the process cells at Elevation (-) 16'-0", in the HLW facility. The Structural Design Criteria requires that all structural foundations shall extend into the surrounding soil below the frost line to preclude frost heave. The HLW facility structural foundations are well below the grade elevation, therefore, the HDH system is not subjected to any frost heave effects.

Information Assessed		Source of Information	Assessment
Connections	Seams and connections are adequately designed.	24590-WTP-DC-PS-01-001, Rev. 4, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria;" ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; ASME B16.5, Piping Flanges and Flanged Fittings, American Society of Mechanical Engineers; ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications, American Society of Mechanical Engineers.	The Pipe Stress Design Criteria specifies the ASME B31.3 Process Piping design code for the piping systems. Welding is to be performed in accordance with the requirements of ASME B31.3 and the ASME B&PV Code, Section IX. ASME B16.5 is specified for flange designs. These are appropriate codes and standards for design and fabrication of the HDH System ancillary equipment.
Waste Characteristics	Characteristics of the waste to be stored or treated have been identified (ignitable, reactive, toxic, specific gravity, vapor pressure, flash point, temperature)	System Description listed above under References; 24590-WTP-PER-PR-03-001, Rev. 1, Prevention of Hydrogen Accumulation in WTP Tank Systems and Miscellaneous Treatment Unit Systems; 24590-WTP-PER-PR-03-002, Rev. 2, Toxic Vapors and Emissions from WTP Tank Systems and Miscellaneous Treatment Unit Systems.	The HDH System Description states that the Canister Rinse Bogie Decon Vessel (HDH-VSL-00001), Canister Decontamination Vessels (HDH-VSL-00002/4), and Waste Neutralization Vessel (HDH-VSL-00003) have no important to safety functions. The primary function of the HDH ancillary equipment is containment of the radioactive decontamination fluids. The Prevention of Hydrogen Accumulation in WTP Tank Systems and Miscellaneous Treatment Unit Systems document indicates that flammable or explosive concentrations of hydrogen are not expected in the HLW facility systems ancillary equipment. Similarly, the Toxic Vapors and Emissions from WTP Tank Systems and Miscellaneous Treatment Unit Systems document provides a summary of the HLW facility ancillary equipment design features that provide for confinement and treatment of chronically toxic vapors and emissions during normal operations, abnormal operations, and during and after a Design Basis seismic event.
	Ancillary equipment is designed to handle the wastes with the characteristics defined above and any treatment reagents.	System Description listed above under References; 24590-WTP-PER-M-02-002, Rev. 1, Materials for Ancillary Equipment.	The Materials for Ancillary Equipment document specifies that ancillary equipment materials that contact the waste are to be equal to or better than those of the upstream source vessels. The System Description states that compatible reagents (Nitric Acid from tank NAR-TK-00001, Ceric Nitrate from tank HDH-TK-00002, and Hydrogen Peroxide from tank HDH-TK-00003) are added to the HDH vessels during normal operations.

	Information Assessed	Source of Information	Assessment
Compatibility	The pH range of the waste, waste temperature and the corrosion behavior of the structural materials are adequately addressed. Ancillary equipment material and protective coatings ensure the ancillary equipment structure is adequately protected from the corrosive effects of the waste stream and external environments. The protection is sufficient to ensure the equipment will not leak or fail for the design life of the system.	24590-WTP-DB-ENG-01-001, Rev. 1C, Basis of Design; 24590-WTP-PER-M-02-002, Rev. 1, Materials for Ancillary Equipment; 24590-WTP-3PS-NN00-T0001, Rev. 0, Engineering Specification for Hot and Anti-Sweat Thermal Insulation.	The Basis of Design document identifies a service design life of 40 years for the ancillary equipment. Detailed materials selection (corrosion) evaluations are conducted for each vessel in the HLW facility during process design to assure a 40 year service life. The Materials for Ancillary Equipment document requires that the material selection and corrosion/erosion allowances for ancillary equipment in contact with the waste will be equal to or better than the material and corrosion allowance of the waste source vessel. The Thermal Insulation specification requires that all insulating materials used on the outside of ancillary equipment be pre-approved for use on austenitic stainless steel in accordance with applicable ASTM standards and tests to preclude external corrosion of ancillary equipment. Therefore, the ancillary equipment will provide the expected design service life.
Corrosion Allowance	Corrosion allowance is adequate for the intended service life of the ancillary equipment.	System Description listed above under References; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; 24590-WTP-PER-M-02-002, Rev. 1, Materials for Ancillary Equipment; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description. 24590-WTP-DB-ENG-01-001, Rev. 1C, Basis of Design;	ASME B31.3 is the design code for the WTP piping. Consideration of corrosion, including corrosion allowance, is a mandatory requirement of ASME B31.3. A required service life of 40 years is identified in the Basis of Design for ancillary equipment. Detailed materials selection (corrosion) evaluations are conducted for each vessel in the HLW facility during process design to assure a 40 year service life. The Materials for Ancillary Equipment document requires that downstream ancillary equipment is to be constructed of equal or better materials, and with the same corrosion allowance as the source vessel. Corrosion/Erosion allowances are listed for the ancillary equipment (each piping class and associated valves, fittings, etc.) in the Piping Material Class Description document.

	Information Assessed	Source of Information	Discussion
Strength	Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the vessels are exceeded.	24590-WTP-DC-PS-01-001, Rev. 4, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria;" ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers.	The Pipe Stress Design Criteria document specifies ASME B31.3 as the design code for the WTP piping. ASME B31.3 requires provision be made to safely contain or relieve any pressure to which the piping may be subjected. ASME B31.3 piping not protected by a pressure relieving device, or that can be isolated from a pressure reliving device must be designed for at least the highest pressure that can be developed.
	Maximum flows and any unusual operating stresses are identified	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev. 4, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria;" ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description.	The expected flow paths for the ancillary equipment are identified on the P&ID drawings. The Pipe Stress Design Criteria specifies the ASME B31.3 code for piping design. This code requires piping to be designed to the highest pressure that can be developed in a piping system assuring that maximum operating stresses remain within code allowables. Piping material classes are shown on the P&ID drawings, embedded in the item numbers for each ancillary equipment component. The Piping Material Class Description document lists the bounding pressure and temperature limits for each piping material class.
Secondary Containment	Ancillary equipment is designed with secondary containment that is constructed of materials compatible with the waste and of sufficient strength to prevent failure (pressure gradients, waste, climatic conditions, daily operations), provided with a leak-detection system, and designed to drain and remove liquids.	Drawings listed above under References.	The ancillary equipment considered in this assessment is located in Rooms H-B039B and H-B035, within the HLW building. These HLW rooms or cells are secondary containment concrete structures provided with stainless steel liner plates and sumps (HDH-SUMP-00001/3), as shown on the general arrangement drawings, which are outside the scope of this integrity assessment. The assessment of the secondary containment structures is conducted in a separate document.

Job No. 24590

Bechtel National, Inc.

SUPPLIER DOCUMENT STATUS

1. [X] **Work may proceed.**
2. [ ] **Revise and resubmit. Work may proceed subject to resolution of indicated comments.**
3. [ ] **Revise and resubmit. Work may not proceed.**
4. [ ] **Review not required. Work may proceed.**

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations.

REVIEWED									

G-321 Document Category N/A
[From Supplement A to G-321-E (E) or G-321-Y (V), as applicable, or "N/A" if SSRS is used]

Supersedes BNI Document No. N/A Rev. _____
[When applicable]

Accepted by D.C. Pfluger (Print Name) D C Pfluger (Signature) 4/2/04 (Date)

Released by N/A (Print Name) _____ (Signature) _____ (Date)
[When applicable]

416 GP&S 7-03

24590-CM-HC4-HXYG-00138-02-08
REV. 00B

SUBCONTRACT SUBMITTAL

Best Available Copy

R10281663

COGEMA-IA-028, Rev. 1

IQRPE REVIEW –
HIGH LEVEL WASTE (HLW) FACILITY ELEVATION (-) 21'-0" HLW MELTER OFFGAS TREATMENT PROCESS (HOP) SYSTEM ANCILLARY EQUIPMENT FOR MISCELLANEOUS TREATMENT UNITS AND VESSELS

"I, John T. Baxter, have reviewed, and certified a portion of the design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by Department of Energy, Office of River Protection, Richland, Washington. My duties were independent review of the current design for the High Level Waste (HLW) Facility Elevation (-) 21'-0" HLW Melter Offgas Treatment Process (HOP) System Ancillary Equipment for Miscellaneous Treatment Units and Vessels as required by the Dangerous Waste Regulations, namely, WAC 173-303-640(3) applicable paragraphs, i.e., (a) through (g)."

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

The documentation reviewed indicate that the design intent fully satisfies the requirements of the WAC.

The attached review is ten (10) sheets numbered one (1) through ten (10).

JOHN T. BAXTER
STATE OF WASHINGTON
18978
REGISTERED
PROFESSIONAL ENGINEER

EXPIRES: 10/28/04

John T. Baxter — 04/02/2004

Signature — Date

24590-CM-HC4-HXYG-00138-02-08, REV. 00B

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH LEVEL WASTE (HLW) FACILITY ELEVATION (-) 21'-0" HLW MELTER OFFGAS TREATMENT PROCESS (HOP) SYSTEM ANCILLARY EQUIPMENT FOR MISCELLANEOUS TREATMENT UNITS AND VESSELS

COGEMA-IA-028
REV. 1

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

Scope	Scope of this Integrity Assessment	This integrity assessment includes: a. Ancillary equipment associated with the HLW Melter Offgas System Melter 1 Primary Offgas Scrubber (Q) Condensate Vessel as shown on drawing No. 24590-HLW-M6-HOP-P0006, Rev. 1; b. Ancillary equipment associated with the HLW Melter Offgas System Melter 2 Primary Offgas Scrubber (Q) Condensate Vessel as shown on drawing No. 24590-HLW-M6-HOP-P20006, Rev. 0 ; c. Ancillary equipment associated with the HLW Melter 1 Offgas Fluidic Air Rack HOP-RK-00025 (Q) shown on drawing 24590-HLW-M6-HOP-P0004, Rev. 1; d. Ancillary equipment associated with the HLW Melter 2 Offgas Fluidic Air Rack HOP-RK-00048 (Q) shown on drawing 24590-HLW-M6-HOP-P20004, Rev. 0; e. Ancillary equipment associated with the HLW Offgas Booster Fans (HOP-FAN-00001A/B/C shown on drawing 24590-HLW-M6-HOP-P0003, Rev. 0; f. Ancillary equipment associated with the Silver Mordenite Column (HOP-ABS-00002) shown on drawing 24590-HLW-M6-HOP-P0008, Rev. 0; g. Ancillary equipment associated with the HLW Offgas Booster Fans (HOP-FAN-00009A/B/C shown on drawing 24590-HLW-M6-HOP-P20003, Rev. 0; h. Ancillary equipment associated with the Silver Mordenite Column (HOP-ABS-00003) shown on drawing 24590-HLW-M6-HOP-P20008, Rev. 0

References	Drawings and System Description	24590-HLW-M5-V17T-P0003, Rev. 0, Process Flow Diagram HLW Vit Primary Offgas Treatment (System HOP); 24590-HLW-M5-V17T-P20003, Rev. 0, Process Flow Diagram HLW Vit Melter 2 Primary Offgas Treatment (System HOP); 24590-HLW-M6-HOP-P0006, Rev. 1, P&ID - HLW Melter Offgas System Melter 1 Primary Offgas Scrubber (Q) Condensate Vessel; 24590-HLW-M6-HOP-P20006, Rev. 0, P&ID - HLW Melter Offgas System Melter 2 Primary Offgas Scrubber (Q) Condensate Vessel; 24590-HLW-M6-HOP-P0004, Rev. 1, P&ID - HLW Melter 1 Offgas Fluidic Air Rack HOP-RK-00025 (Q); 24590-HLW-M6-HOP-P20004, Rev. 0, P&ID - HLW Melter 2 Offgas Fluidic Air Rack HOP-RK-00048; 24590-HLW-M6-HOP-P0003, Rev. 0, P&ID-HLW Melter Offgas System Melter 1 Secondary Offgas Treatment Sheet 1 of 2; 24590-HLW-M6-HOP-P0008, Rev. 0, P&ID-HLW Melter Offgas System Melter 1 Secondary Offgas Treatment Sheet 2 of 2; 24590-HLW-M6-HOP-P20003, Rev. 0, P&ID-HLW Melter Offgas System Melter 2 Secondary Offgas Treatment Sheet 1 of 2; 24590-HLW-M6-HOP-P20008, Rev. 0, P&ID-HLW Melter Offgas System Melter 2 Secondary Offgas Treatment Sheet 2 of 2; 24590-HLW-3YD-HOP-00001, Rev. 0, Systems Description for HLW Melter Offgas Treatment Process and Process Vessel Vent Extraction (HOP and PVV Systems); System Description Change Notice (SDCN), SDCN NO. 24590-HLW-3YN-HOP-00001 for System Description Number 24590-HLW-3YD-HOP-00001, Rev. 0, Systems Description for HLW Melter Offgas Treatment Process and Process Vessel Vent Extraction (HOP and PVV Systems); SDCN NO. 24590-HLW-3YN-HOP-00002 for System Description Number 24590-HLW-3YD-HOP-00001, Rev. 0; SDCN NO. 24590-HLW-3YN-HOP-00003 for System Description Number 24590-HLW-3YD-HOP-00001, Rev. 0; SDCN NO. 24590-HLW-3YN-HOP-00004 for System Description Number 24590-HLW-3YD-HOP-00001, Rev. 0

Summary of Assessment

For each item of "Information Assessed" (i.e., Criteria) on the following pages, the items listed under "Source of Information" were reviewed and found to furnish adequate design controls and requirements to assure the design intent fully satisfies the WAC requirements.

	Information Assessed	Source of Information	Discussion
Design	Ancillary equipment design standards are appropriate and adequate for the equipment's intended use.	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; 24590-WTP-PSAR-ESH-01-002-04, Rev. 1a, Preliminary Safety Analysis Report (PSAR) to Support Construction Authorization; HLW Facility Specific Information	The Pipe Stress Design Criteria document identifies ASME B31.3 as the design code for piping systems of the WTP. Seismic Categories and Quality Levels vary among the ancillary equipment components. For example, the Pulse Jet Vent line shown on P&ID drawing no. 24590-HLW-M6-HOP-P0004 is Seismic Category (SC-1) and Quality Level (QL-1) to ensure continued function during normal operations, abnormal operations, and during and after a Design Basis Earthquake. Much of the ancillary equipment is Seismic Category (SC-III) and Quality Level (QL-2) as noted for example on P&ID drawing no. 24590-HLW-M6-HOP-P0006. The Seismic Categories are explained in detail in the Pipe Stress Design Criteria document. Quality Levels are discussed in the PSAR. These codes and standards are acceptable and adequate for the design of the ancillary equipment for the intended service.
	If the ancillary equipment to be used is not built to a design standard, the design calculations demonstrate sound engineering principles of construction.	24590-WTP-DC-PS-01-001, Rev 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"	The ancillary equipment is built to design standards. The Pipe Stress Design Criteria document specifies that piping is to be designed in accordance with ASME B31.3.

	Information Assessed	Source of Information	Discussion
Design	Ancillary equipment has adequate strength at the end of its design life to withstand the operating pressure, operating temperature, thermal expansion, and seismic loads. Equipment is protected against physical damage and excessive stress due to settlement, vibration, expansion, or contraction.	24590-WTP-DC-PS-01-001, Rev 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; Uniform Building Code (UBC), 1997 Edition, International Conference of Building Officials; ASME Boiler and Pressure Vessel Code, Section III, Rules for Construction of Nuclear Facility Components, Division 1, Subsection NC, Appendix N and Appendix F, 1995; 24590-WTP-VV-PS-01-001, Rev. 2, Verification and Validation Report for ME101, Linear Elastic Analysis of Piping, Version N8	The Pipe Stress Design Criteria document requires the use of the ASME B31.3 Code for piping design. ASME B31.3 requires explicit consideration of many loadings including operating pressure, operating temperature, thermal expansion/contraction, settlement, vibration, and corrosion allowance in the design of piping. Elements of the ASME B&PV Code, Section III, Division 1, Subsection NC, Appendix N and Appendix F are used to supplement the requirements of ASME B31.3 for seismic design of SC-I/SC-II piping. Similarly, ASME B&PV Code, Section III, Division 1, Subsection NC and Appendix F, and the Uniform Building Code (UBC) are used to supplement the requirements of ASME B31.3 for seismic design of SC-III/SC-IV piping. Details of the seismic design methods are discussed in the Pipe Stress Design Criteria document. Design is by hand calculations and computer codes that have been tested and approved as discussed in the Verification and Validation Report for ME101, Linear Elastic Analysis of Piping, Version N8. These are adequate and appropriate codes and standards to ensure that the ancillary equipment will have adequate strength at end of design life to withstand all anticipated loadings.

	Information Assessed	Source of Information	Discussion
Supports	Ancillary equipment supports are adequately designed.	Drawings - see references above; 24590-WTP-DC-PS-01-002, Rev 2, Pipe Support Design Criteria; 24590-WTP-PER-PS-02-001, Rev. 4, Ancillary Equipment Pipe Support Design; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; ASME Boiler and Pressure Vessel Code, Section III, Rules for Construction of Nuclear Facility Components, Division 1, Subsection NF and Appendix F, 1995; 24590-WTP-PL-PS-01-001, Rev 1, Verification and Validation Test Plan for Bechtel's ME150 Pipe Support Family of Programs (PCFAPPS)	The Pipe Support Design Criteria considers all load types identified in ASME B31.3 and utilizes ASME Section III, Division 1, Subsection NF and Appendix F to supplement the requirements of ASME B31.3 for seismic design of SC-I/II and SC-III/IV pipe supports. Bounding load cases are passed to the pipe support designers from the results of the ancillary equipment piping stress analyses. Details of the seismic design methodology are discussed in the Pipe Support Design Criteria document. Analysis is by manual calculation and computer programs that have been tested and approved as discussed in the Verification and Validation Test Plan for Bechtel's ME150 Pipe Support Family of Programs (PCFAPPS). The Ancillary Equipment Pipe Support Design document shows examples of typical equipment supports. These are appropriate codes and standards for design of the HOP system ancillary equipment supports. Ancillary equipment supports are to be designed to allow a minimum of heat to be transferred to the building structures (building structures not to exceed 150 deg F for concrete and 200 deg F for steel). Design standards for vessel internal equipment supports are discussed in the integrity assessment for the HOP system vessels.
Connections	Seams and connections are adequately designed.	24590-WTP-DB-ENG-01-001, Rev 1A, Basis of Design; 24590-WTP-DC-PS-01-001, Rev. 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications; ASME/ANSI B16.5, 1988 Edition, Piping Flanges and Flanged Fittings	The Basis of Design states that in-cell piping that is non-maintainable will be fully welded. The Pipe Stress Design Criteria document specifies the ASME B31.3 Process Piping design code for the piping systems. Welding is to be performed in accordance with the requirements of ASME B31.3 and the ASME B&PV Code, Section IX. Flange connections are to be designed in accordance with ANSI B16.5. These are appropriate codes and standards for design and fabrication of the HOP system ancillary equipment.

	Information Assessed	Source of Information	Discussion
Supports	The system will withstand the effects of frost heave.	System Description and SDCNs listed above under References; 24590-WTP-DC-ST-01-001, Rev. 2, Structural Design Criteria	The ancillary equipment associated with the HOP system considered in this assessment is located in below grade process cells inside the HLW Facility. The Structural Design Criteria requires that all structural foundations shall extend into the surrounding soil below the frost line to preclude frost heave. The frost line is 30 in. below grade. The HLW building foundations are not subject to frost heave; therefore, the ancillary equipment located inside the building is not subject to frost heave.
Waste Characteristics	Characteristics of the waste to be stored or treated have been identified (ignitable, reactive, toxic, specific gravity, vapor pressure, flash point, temperature)	24590-WTP-PSAR-ESH-01-002-04, Rev. 1a, Preliminary Safety Analysis Report (PSAR) to Support Construction Authorization; HLW Facility Specific Information; System Description and SDCNs listed above under References	The PSAR provides a summary of potential hazardous conditions associated with each HLW vessel and the associated ancillary equipment. Design provisions for control of these hazards are listed in the PSAR and the individual System Descriptions. The HOP System Description identifies the only safety function for ancillary equipment as providing primary confinement of the wastes during normal operations, upset conditions and during and after a SC-III Design Basis Seismic Event. Ancillary equipment associated with the Submerged Bed Scrubber (SBS) Condensate Receiver Vessels (HOP-VSL-00903 and HOP-VSL-00904) handles an acidic condensate. This condensate is collected from the offgas system Submerged Bed Scrubbers, Wet Electrostatic Precipitators and High Efficiency Mist Eliminators as shown on the Process Flow Diagrams. The primary function of the ancillary equipment associated with the HOP System is to provide a primary pressure boundary to protect facility workers from the hazardous materials in the melter offgas streams.

	Information Assessed	Source of Information	Discussion
Waste Characteristics	Ancillary equipment is designed to handle the wastes with the characteristics defined above and any treatment reagents.	24590-WTP-PER-M-02-002, Rev 1, Materials for Ancillary Equipment; System Description and SDCNs listed above under References; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description	The System Description indicates that the HOP system SBS Condensate Receiver Vessels collect acidic condensate from the offgas system Submerged Bed Scrubbers, Wet Electrostatic Precipitators and High Efficiency Mist Eliminators as shown on the Process Flow Diagrams. Additional reagents are not added to this system during normal operations. The Materials for Ancillary Equipment document requires that the material selection and corrosion/erosion allowances for ancillary equipment in contact with the waste will be equal to or better than the material and corrosion allowance of the waste source vessels except as noted therein. The Piping Material Class Description lists 316L stainless steel as the material selection for the melter offgas system ancillary equipment. Reagents are not normally added to the melter offgas system ancillary equipment during normal operations.

	Information Assessed	Source of Information	Discussion
Compatibility	The pH range of the waste, waste temperature and the corrosion behavior of the structural materials are adequately addressed. Ancillary equipment material and protective coatings ensure the ancillary equipment structure is adequately protected from the corrosive effects of the waste stream and external environments. The protection is sufficient to ensure the equipment will not leak or fail for the design life of the system.	System Description and SDCNs listed above under References; 24590-WTP-DB-ENG-01-001, Rev 1A, Basis of Design; 24590-WTP-PER-M-02-002, Rev 1, Materials for Ancillary Equipment; 24590-WTP-3PS-NN00-T0001, Rev 0, Engineering Specification for Hot and Anti-Sweat Thermal Insulation	The Basis of Design identifies a service design life of 40 years for the ancillary equipment. All non-maintainable items will be designed to last the life of the facility. Detailed material selection (corrosion) analyses are conducted for each vessel and major components in the melter offgas systems in the HLW facility during process design. The Materials for Ancillary Equipment document requires that the material selection and corrosion/erosion allowances for ancillary equipment in contact with the waste will be equal to or better than the material and corrosion allowance of the waste source vessels and melter offgas system components except as noted therein. The Thermal Insulation specification requires that all insulating materials used on the outside of ancillary equipment be pre-approved for use on austenitic stainless steel in accordance with applicable ASTM procedures and tests to preclude external corrosion of ancillary equipment. Corrosion allowances are considered for all ancillary equipment, therefore, the ancillary equipment will provide the expected design service life.

	Information Assessed	Source of Information	Discussion
Corrosion Allowance	Corrosion allowance is adequate for the intended service life of the ancillary equipment.	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev. 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; 24590-WTP-DB-ENG-01-001, Rev 1A, Basis of Design; 24590-WTP-PER-M-02-002, Rev 1, Materials for Ancillary Equipment; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description	The Pipe Stress Design Criteria document requires use of the ASME B31.3 Code for ancillary equipment design. Consideration of corrosion, including corrosion allowance, is a mandatory requirement of ASME B31.3. A required service design life of 40 years is identified in the Basis of Design for ancillary equipment located in inaccessible process cells. Detailed material selection (corrosion) analyses are conducted for each vessel and major components in the melter offgas systems in the HLW Facility during process design. The Materials for Ancillary Equipment document requires that downstream ancillary equipment is to be constructed of equal or better materials than the source vessel, and with the same corrosion allowance as the source vessel except as noted therein. Bounding corrosion allowances are listed for each piping material class in the Piping Material Class Description document. The corrosion/erosion allowance for the 316L stainless steel melter offgas system ancillary equipment is 0.040 in.
Strength	Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the vessels are exceeded.	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev. 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description	The Pipe Stress Design Criteria document specifies use of ASME B31.3 as the design code for the WTP piping. ASME B31.3 requires provision be made to safely contain or relieve any pressure to which the piping may be subjected. ASME B31.3 piping not protected by a pressure relieving device, or that can be isolated from a pressure reliving device must be designed for at least the highest pressure that can be developed. Bounding pressure and temperature limits are listed for each of the piping material classes in the Piping Material Class Description document.

	Information Assessed	Source of Information	Discussion
	Maximum flows and any unusual operating stresses are identified	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; 24590-WTP-PER-PL-02-001, Rev. 5, Piping Material Class Description	The expected flow paths for the ancillary equipment are identified on the P&ID drawings. The Pipe Stress Design Criteria document specifies the ASME B31.3 code for piping design. This code requires piping to be designed to the highest pressure that can be developed in a piping system assuring that maximum operating stresses remain within code allowables. The Piping Material Class Description document lists the bounding pressure and temperature limits for each piping material class.
Secondary Containment	Ancillary equipment is designed with secondary containment that is constructed of materials compatible with the waste and of sufficient strength to prevent failure (pressure gradients, waste, climatic conditions, daily operations), provided with a leak-detection system, and designed to drain and remove liquids.	Drawings, System Description and SDCNs listed above under References	The ancillary equipment considered in this assessment is located in inaccessible below grade process cells and the secondary offgas room inside the HLW Facility. Secondary containment for ancillary equipment within the cells is provided by the liners and sumps as appropriate and is outside the scope of this integrity assessment.

R10681732

AREVA

RPP-WTP
RECEIVED
MAY 2 2 2006
BY PDC

CCN: 139505

AREVA-06-044

Ms. Anne Weldon
Subcontracts
Bechtel National, Inc.
2435 Stevens Center Place
Richland, Washington 99352

May 9, 2006

Dear Ms. Weldon:

BECHTEL NATIONAL, INC. CONTRACT NO. 24590-CM-HC4-HXYG-00211 - STRUCTURAL INTEGRITY ASSESSMENT OF HIGH LEVEL WASTE (HLW) MELTER PROCESS SYSTEM (HMP) MISCELLANEOUS TREATMENT UNITS (MTUs) SUBSYSTEM EQUIPMENT ANCILLARY EQUIPMENT (COGEMA-IA-082, REV. 1)

The integrity assessment of the subject ancillary equipment has been completed per the contract requirements and is enclosed for your use. The assessment found that the design is sufficient to ensure that the ancillary equipment are adequately designed and have sufficient structural strength, compatibility with the waste(s) to be processed/stored/treated, and corrosion protection to ensure that they will not collapse, rupture, or fail.

If you have any questions, please contact Tarlok Hundal at (509) 373-4438, or via facsimile at (509) 372-0504.

Sincerely,

M. D. Rickenbach, Director
Engineering & Services
AREVA NC Inc.
Richland

llm

Enclosure

cc: D. C. Pfluger M.1.I104 w/ enclosure(2)

COGEMA, INC.
2425 Stevens Center Place, Second Floor, Richland, Washington 99354 - P.O. Box 840, Richland, Washington 99352
Tel.: 509 372 8256 - Fax: 509 372 3169 - www.areva.com

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH LEVEL WASTE (HLW) MELTER PROCESS SYSTEM (HMP) MISCELLANEOUS TREATMENT UNITS (MTUs) SUBSYSTEM EQUIPMENT ANCILLARY EQUIPMENT

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

IQRPE REVIEW
OF
THE HIGH LEVEL WASTE (HLW) MELTER PROCESS SYSTEM (HMP) MISCELLANEOUS TREATMENT UNITS (MTUs) SUBSYSTEM EQUIPMENT ANCILLARY EQUIPMENT

"I, Tarlok Hundal have reviewed, and certified a portion of the design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by Department of Energy, Office of River Protection, Richland, Washington. My duties were independent review of the current design for the High Level Waste (HLW) Melter Process System (HMP) Miscellaneous Treatment Units (MTUs) Subsystem Equipment Ancillary Equipment as required by the Washington Administrative Code, *Dangerous Waste Regulations*, Section WAC-173-303-640(3) (a) through (g) applicable components."

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

The documentation reviewed indicates that the design fully satisfies the requirements of the WAC.

The attached review is nine (9) pages numbered one (1) through nine (9).

TARLOK SINGH HUNDAL
STATE OF WASHINGTON
20213
REGISTERED
PROFESSIONAL ENGINEER

EXPIRES: 02/15/08

Signature

5/9/06
Date

Scope	Scope of this Integrity Assessment	This Integrity Assessment addresses the MTUs ancillary equipment associated with the HLW Melter Process System (HMP) two Melters (HMP-MLTR-00001 and -00002) located in Rooms H-0117 and H-0106, respectively, at Elevation 3'-0" of the HLW facility. The MTUs ancillary equipment associated with these two Melters are shown on the P&ID drawings 24590-HLW-M6-HMP-P0001, -P0002, -P0003, -P0004,-P0006, -P0007, -P0008, -P0013, -P0014, -P20001, -P20002, -P20003, -P20004, -P20006, -P20007, -P20008, -P20013, and -P20014.
Summary of Assessment		For each item of "Information Assessed" (i.e., Criteria) on the following pages, the items listed under "Source of Information" were reviewed and found to furnish adequate design requirements and controls to ensure that the design fully satisfies the requirements of Washington Administrative Code, WAC-173-303-640, *Dangerous Waste Regulations* for Tank Systems.

References	Drawings and System Description	Drawings: 24590-HLW-P1-P01T-00001, Rev. 6, HLW Vitrification Building General Arrangement (Permit) Plan at El.(-)21'- 0"; 24590-HLW-P1-P01T-00002, Rev. 5, HLW Vitrification Building General Arrangement (Permit) Plan at El. 0'- 0"; 24590-HLW-P1-P01T-00005, Rev. 4, HLW Vitrification Building General Arrangement (Permit) Plan at El. 58'- 0"; 24590-HLW-P1-P01T-00009, Rev. 10, HLW Vitrification Building General Arrangement (Permit) Sections D-D, E-E & F-F; 24590-HLW-P1-P01T-00010, Rev. 10, HLW Vitrification Building General Arrangement (Permit) Section G-G & H-H; 24590-HLW-M6-HMP-P0001, Rev. 1, P&ID –HLW Melter 1 System Feed and Agitation; 24590-HLW-M6-HMP-P0002, Rev. 1, P&ID –HLW Melter 1 System Film Cooler and Offgas Connection; 24590-HLW-M6-HMP-P0003, Rev. 0, P&ID –Melter Process System HLW Melter 1 Cooling System; 24590-HLW-M6-HMP-P0004, Rev. 0, P&ID –HLW Melter 1 Electrode Air Cooling and Joule Heating; 24590-HLW-M6-HMP-P0006, Rev. 1, P&ID –HLW Melter 1 System East Discharge Heaters and Airlift; 24590-HLW-M6-HMP-P0007, Rev. 1, P&ID –HLW Melter 1 System West Discharge Heaters and Airlift; 24590-HLW-M6-HMP-P0008, Rev. 1, P&ID –HLW Melter Process System Melter 1 Gas Pour & Monitoring Instrumentation; 24590-HLW-M6-HMP-P0013, Rev. 1, P&ID –HLW Melter 1 System Pressure, Density and Level Detection; 24590-HLW-M6-HMP-P0014, Rev. 0, P&ID –Melter Process System HLW Melter 1 Cooling System; 24590-HLW-M6-HMP-P20001, Rev. 1, P&ID –HLW Melter 2 System Feed and Agitation; 24590-HLW-M6-HMP-P20002, Rev. 1, P&ID –HLW Melter 2 System Film Cooler and Offgas Connection; 24590-HLW-M6-HMP-P20003, Rev. 0, P&ID –Melter Process System HLW Melter 2 Cooling System; 24590-HLW-M6-HMP-P20004, Rev. 0, P&ID –HLW Melter 2 Electrode Air Cooling and Joule Heating; 24590-HLW-M6-HMP-P20006, Rev. 1, P&ID –HLW Melter 2 System East Discharge Heaters and Airlift; 24590-HLW-M6-HMP-P20007, Rev. 1, P&ID –HLW Melter 2 System West Discharge Heaters and Airlift; 24590-HLW-M6-HMP-P20008, Rev. 1, P&ID –HLW Melter Process System Melter 2 Gas Pour & Monitoring Instrumentation; 24590-HLW-M6-HMP-P20013, Rev. 1, P&ID –HLW Melter 2 System Pressure, Density and Level Detection; 24590-HLW-M6-HMP-P20014, Rev. 0, P&ID –Melter Process System HLW Melter 2 Cooling System; 24590-HLW-M5-V17T-P0002, Rev. 1, Process Flow Diagram HLW Vitrification Melter 1 (Systems HMP and HOP); 24590-HLW-M5-V17T-P20002, Rev. 1, Process Flow Diagram HLW Vitrification Melter 2 (Systems HMP and HOP). 24590-HLW-P3-HMP-GL02011001, Rev. 0, HLW Vitrification Isometric (Line No. HMP-GL-02011-S11B-0.5); 24590-HLW-P3-HMP-GL02011002, Rev. 0, HLW Vitrification Isometric (Line No. HMP-GL-02011-S11B-0.5); 24590-HLW-P3-HMP-GL02011003, Rev. 0, HLW Vitrification Isometric (Line No. HMP-GL-02011-S10A-0.5); 24590-HLW-P3-HMP-GA02041001, Rev. 0, HLW Vitrification Isometric (Line No. HMP-GA-02041-S11B-0.5); 24590-HLW-P3-HMP-GA02041002, Rev. 0, HLW Vitrification Isometric (Line No. HMP-GA-02041-S11B-0.5); 24590-HLW-P3-HMP-GA02041003, Rev. 0, HLW Vitrification Isometric (Line No. HMP-GA-02041-S10A-0.5); 24590-HLW-P3-HMP-GA02050001, Rev. 0, HLW Vitrification Isometric (Line No. HMP-GA-02050-S11B-0.5). 24590-HLW-HMP-H30500, Rev. 0, Pipe Support Drawing; 24590-HLW-HMP-H30501, Rev. 0, Pipe Support Drawing; 24590-HLW-HMP-H30502, Rev. 0, Pipe Support Drawing; 24590-HLW-HMP-H30503, Rev. 0, Pipe Support Drawing; 24590-HLW-HMP-H30504, Rev. 0, Pipe Support Drawing. System Description: 24590-HLW-3YD-HMP-00001, Rev. 1, System Description for HLW Melter Process System (HMP).

	Information Assessed	Source of Information	Assessment
Design	Ancillary equipment design standards are appropriate and adequate for the equipment's intended use.	Drawings and System Description listed above under References; 24590-WTP-DC-PS-01-001, Rev. 4, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria;" ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; 24590-WTP-3DP-G04T-00905, Rev. 7, Determination of Quality Levels.	The Pipe Stress Design Criteria identifies ASME B31.3 as the design code for piping systems of the WTP. The Process System Description document states that the HMP system does not have any important to safety function. Drawings show that the ancillary equipment is of QL-1, QL-2 or commercial quality grade and is Seismic Category SC-I, SC-II, SC-III, or SC-IV. Determination of Quality Levels document and Pipe Stress Design Criteria document provide detailed discussion of quality grades and seismic categories, respectively. The codes and standards used are acceptable and adequate for the design of the ancillary piping for the intended service.
	If the ancillary equipment to be used is not built to a design standard, the design calculations demonstrate sound engineering principles of construction.	Drawings and listed above under References; 24590-WTP-DC-PS-01-001, Rev. 4, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria"; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; 24590-HLW-PHC-HMP-00100, Rev. D, RPP-WTP Pipe Support Calculation for HMP System (non-analyzed piping); 24590-WTP-3DP-G04T-00906, Rev. 4, Isometric Drawings and Associated Calculations; 24590-WTP-3DP-G04B-00037, Rev. 10, Engineering Calculations.	The ancillary equipment is built to design standards. The Pipe Stress Design Criteria specifies that piping is to be designed in accordance with ASME B31.3 Code. The review of the sample isometric and pipe support drawings listed in the References, Pipe Support Calculation, and of the design process and controls described in Isometric Drawings and Associated Calculations, and Engineering Calculations documents provides adequate assurance that HMP ancillary equipment are properly designed, installed, and verified to meet the requirements of the applicable design criteria established for the project. The review of the aforementioned documents demonstrates that sound design engineering principles are used for the design and construction.

Information Assessed		Source of Information	Assessment
Design	Ancillary equipment has adequate strength at the end of its design life to withstand the operating pressure, operating temperature, thermal expansion, and seismic loads. Equipment is protected against physical damage and excessive stress due to settlement, vibration, expansion, or contraction.	24590-WTP-DC-PS-01-001, Rev. 4, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria;" ASME Boiler and Pressure Vessel Code, Section III, Division 1, Rules for Construction of Nuclear Power Plant Components, American Society of Mechanical Engineers, 1995; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; Uniform Building Code (UBC), 1997; 24590-WTP-PER-M-02-002, Rev. 1, Materials for Ancillary Equipment.	The Pipe Stress Design Criteria requires the use of the ASME B31.3 Code for process piping design. ASME B31.3 requires explicit consideration of operating pressure, operating temperature, thermal expansion/contraction, settlement, vibration, and corrosion allowance in the design of piping. For the seismic design of Seismic Category (SC-I/II/III/IV) ancillary equipment, applicable ASME Section III, Subsection NC and Appendix F and Appendix N, or Uniform Building Code (UBC) are used to supplement the requirements of ASME B31.3. Details of the seismic design methods are discussed in the Pipe Stress Design Criteria document. These are appropriate and adequate codes and standards to assure that the ancillary equipment has adequate strength at the end of its design life to withstand all anticipated loads.

Information Assessed		Source of Information	Assessment
Supports	Ancillary equipment supports are adequately designed.	Drawings listed above under References; 24590-WTP-DC-PS-01-002, Rev. 3, Pipe Support Design Criteria; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; ASME Boiler and Pressure Vessel Code, Section III, Division 1, Rules for Construction of Nuclear Power Plant Components, American Society of Mechanical Engineers, 1995; Uniform Building Code (UBC), 1997; 24590-WTP-PER-PS-02-001, Rev. 4, Ancillary Equipment Pipe Support Design; 24590-WTP-PL-PS-01-001, Rev. 1, Verification and Validation Test Plan for Bechtel's ME150 Pipe Support Family of Programs (PCFAPPS); 24590-HLW-PHC-HMP-00100, Rev. D, RPP-WTP Pipe Support Calculation for HMP System (non-analyzed piping); 24590-WTP-3DP-G04T-00906, Rev. 4, Isometric Drawings and Associated Calculations; 24590-WTP-3DP-G04B-00037, Rev. 10, Engineering Calculations.	The Pipe Support Design Criteria document considers all loadings identified in ASME B31.3 and utilizes ASME B&PV Code, Section III, Division 1, Subsection NF and Appendix F or UBC, to supplement the requirements of ASME B31.3 for seismic design of Seismic Category (SC-I/IIIII/IV) pipe supports. Bounding load cases are passed to the pipe support designers from the results of the ancillary equipment piping stress analyses. Details of the seismic design methodology are discussed in the Pipe Support Design Criteria document. Examples of typical ancillary equipment supports are shown in the Ancillary Equipment Pipe Support Design document. Analysis is by manual calculation or approved computer programs that have been verified and validated. These are appropriate codes and standards for design of ancillary equipment supports for the HMP system. Ancillary equipment supports are to be designed to allow a minimum of heat to be transferred to the building structures. The temperature of the building structures is not to exceed 150°F for concrete and 200°F for steel. The review of the sample isometric drawings, pipe support drawings, Pipe Support Calculations, and that of the design process and controls described in Isometric Drawings and Associated Calculations, and Engineering Calculation documents provides sufficient assurance that HMP ancillary equipment supports are adequately designed, installed, and verified to meet the requirements of the applicable design criteria established for the project.
	The system will withstand the effects of frost heave.	Drawings listed above under References; 24590-WTP-DC-ST-01-001, Rev. 11, Structural Design Criteria.	The Structural Design Criteria requires that all outdoor equipment structural foundations shall extend into the surrounding soil below the 30" frost line to preclude frost heave. The HMP ancillary equipment system considered in this assessment is located inside the HLW facility. The HLW facility structural foundations are well below the grade elevation, therefore, the HMP system is not subjected to any frost heave effects.

Information Assessed		Source of Information	Assessment
Connections	Seams and connections are adequately designed.	24590-WTP-DC-PS-01-001, Rev. 4, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria;" ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; ASME B16.5, Piping Flanges and Flanged Fittings, American Society of Mechanical Engineers; ASME Boiler and Pressure Vessel Code (B&PV), Section IX, Welding and Brazing Qualifications, American Society of Mechanical Engineers.	The Pipe Stress Design Criteria specifies the ASME B31.3 Process Piping design code for the piping systems. Welding is to be performed in accordance with the requirements of ASME B31.3 and the ASME B&PV Code, Section IX. ASME B16.5 is specified for flange designs. These are appropriate codes and standards for design and fabrication of the HMP System ancillary equipment.
Waste Characteristics	Characteristics of the waste to be stored or treated have been identified (ignitable, reactive, toxic, specific gravity, vapor pressure, flash point, temperature)	System Description listed above under References; 24590-WTP-PER-PR-03-001, Rev. 1, Prevention of Hydrogen Accumulation in WTP Tank Systems and Miscellaneous Treatment Unit Systems; 24590-WTP-PER-PR-03-002, Rev. 2, Toxic Vapors and Emissions from WTP Tank Systems and Miscellaneous Treatment Unit Systems.	The Prevention of Hydrogen Accumulation in WTP Tank Systems and Miscellaneous Treatment Unit System and System Description documents indicate that flammable or explosive concentrations of hydrogen are not expected in the HLW facility systems ancillary equipment. Similarly, the Toxic Vapors and Emissions from WTP Tank Systems and Miscellaneous Treatment Unit Systems document provides a summary of the HLW facility ancillary equipment design features that provide for confinement and treatment of chronically toxic vapors and emissions during normal operations, abnormal operations, and during and after a Design Basis seismic event.
	Ancillary equipment is designed to handle the wastes with the characteristics defined above and any treatment reagents.	24590-WTP-PER-M-02-002, Rev. 1, Materials for Ancillary Equipment.	The Materials for Ancillary Equipment document specifies that ancillary equipment materials that contact the waste are to be equal to or better than those of the upstream source vessels. Selection of proper material for the HMP piping and equipment ensures that the ancillary equipment is appropriately designed to handle the waste.

Information Assessed		Source of Information	Assessment
Compatibility	The pH range of the waste, waste temperature and the corrosion behavior of the structural materials are adequately addressed. Ancillary equipment material and protective coatings ensure the ancillary equipment structure is adequately protected from the corrosive effects of the waste stream and external environments. The protection is sufficient to ensure the equipment will not leak or fail for the design life of the system.	24590-WTP-DB-ENG-01-001, Rev. 1F, Basis of Design; 24590-WTP-PER-M-02-002, Rev. 1, Materials for Ancillary Equipment; 24590-WTP-3PS-NN00-T0001, Rev. 1, Engineering Specification for Thermal Insulation for Mechanical Systems; ASTM Annual Book of ASTM Standards, American Society of Testing and Materials.	The Basis of Design document identifies a service design life of 40 years for the ancillary equipment. Detailed materials selection (corrosion) evaluations are conducted for each vessel in the HLW facility during process design to assure a 40-year service life. The Materials for Ancillary Equipment document requires that the material selection and corrosion/erosion allowances for ancillary equipment in contact with the waste will be equal to or better than the material and corrosion allowance of the waste source vessel. The Thermal Insulation specification requires that all insulating materials used on the outside of ancillary equipment be pre-approved for use on austenitic stainless steel in accordance with applicable ASTM standards and tests to preclude external corrosion of ancillary equipment. Therefore, the ancillary equipment will provide the expected design service life.
Corrosion Allowance	Corrosion allowance is adequate for the intended service life of the ancillary equipment.	System Description listed above under References; ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; 24590-WTP-DC-PS-01-001, Rev. 4, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria;" 24590-WTP-DB-ENG-01-001, Rev. 1F, Basis of Design; 24590-WTP-PER-M-02-002, Rev. 1, Materials for Ancillary Equipment; 24590-WTP-PER-PL-02-001, Rev. 6, Piping Material Class Description.	ASME B31.3 is the design code for the WTP piping. Consideration of corrosion, including corrosion allowance, is a mandatory requirement of ASME B31.3 and is appropriately supplemented in the Pipe Stress Design Criteria document. A required service life of 40 years is identified in the Basis of Design for ancillary equipment. Detailed materials selection (corrosion) evaluations are conducted for each vessel in the HLW facility during process design to ensure a 40-year service life. The Materials for Ancillary Equipment document requires that downstream ancillary equipment is to be constructed of equal or better materials, and with the same corrosion allowance as the source vessel. Corrosion/Erosion allowances are listed for the ancillary equipment (each piping class and associated valves, fittings, etc.) in the Piping Material Class Description document.

Information Assessed		Source of Information	Assessment
Pressure Controls	Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the vessels are exceeded.	24590-WTP-DC-PS-01-001, Rev. 4, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria;" ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers.	The Pipe Stress Design Criteria document specifies ASME B31.3 as the design code for the WTP piping. ASME B31.3 requires provision be made to safely contain or relieve any pressure to which the piping may be subjected. ASME B31.3 piping not protected by a pressure relieving device, or that can be isolated from a pressure reliving device must be designed for at least the highest pressure that can be developed.
Pressure Controls	Maximum flows and any unusual operating stresses are identified	Drawings listed above under References; 24590-WTP-DC-PS-01-001, Rev. 4, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria;" ASME B31.3 Code, Process Piping, 1996 Edition, American Society of Mechanical Engineers; 24590-WTP-3PS-P000-T0001, Rev. 5, Engineering Specification for Piping Material Classes General Description and Summary; 24590-WTP-PER-PL-02-001, Rev. 6, Piping Material Class Description; 24590-WTP-3DP-G04T-00906, Rev. 4, Isometric Drawings and Associated Calculations; 24590-WTP-3DP-G04B-00037, Rev. 10, Engineering Calculations.	The expected flow paths for the ancillary equipment are identified on the P&ID drawings. The Pipe Stress Design Criteria specifies the ASME B31.3 code for piping design. This code requires piping to be designed to the highest pressure that can be developed in a piping system assuring that maximum operating stresses remain within code allowables. Piping material classes are shown on the P&ID drawings, embedded in the item numbers for each ancillary equipment component. Each ancillary equipment is designed for the highest anticipated temperature and pressure values which are also within the bounding maximum design temperature and pressure values listed for each piping material class in the Piping Material Class General Description document. ASME B31.3 and the associated standards are appropriate and adequate for the design of the ancillary equipment. Furthermore, the fabrication or isometric drawings released for construction by Bechtel National, Inc. (BNI), and the design process and controls described in the Isometric Drawings and Associated Calculations, and Engineering Calculations documents provides adequate assurance that subject ancillary equipment are properly designed, installed, and verified to meet the requirements identified in the applicable design criteria established for the project.

Information Assessed		Source of Information	Assessment
Secondary Containment	Ancillary equipment is designed with secondary containment that is constructed of materials compatible with the waste and of sufficient strength to prevent failure (pressure gradients, waste, climatic conditions, daily operations), provided with a leak-detection system, and designed to drain and remove liquids.	Drawings listed above under References; 24590-HLW-PER-M-02-001, Rev. 3, HLW Facility Sump Data.	The ancillary equipment considered in this assessment is located in C5/R5 areas (Room H-0117 and H-0106) within the HLW building. These HLW rooms are secondary containment concrete structures provided with stainless steel liner plates and sumps (HSH-SUMP-00003/7), as shown on the general arrangement drawings and in Sump Data document, which are outside the scope of this integrity assessment. The assessment of the secondary containment structures is conducted in a separate document.

Master Distribution Schedule for WTP Project Subcontract Management Group

SUBMITTAL TRANSMITTAL: ☐ First Submittal ☐ Re-Submittal ☐ QVRP Package
☐ No Review Required ☐ No Review Required Re-Submittal ☐ Submittal Supplement

CORRESPONDENCE: ☒ With Attachment ☐ W/O Attachment (letter only)
☐ Fax as Original (Letter Only) ☐ Fax as Original (With Attachment)

☐ Pre-Award/Award Package ☐ Executed Change Order Package
☐ Executed Amendment Package ☐ Back Charge

Subcontract Number:	24590-CM-HC4-HXYG-00211
Subcontract Title:	Tank Integrity Design Assessments by IQRPE
Subcontractor Name:	AREVA NC, Inc.
Subcontract Administrator:	Anne Weldon

PDC Document Number	Rev	Document Title	Rev
139505	0	AREVA -AI-082, Rev. 1	

INCOMING DISTRIBUTION

Name	MSIN/ E-mail	Original	Copy	Copy of cover sheet / transmittal only	Primary File Index	Alternate File Index	Assigned Action or Remarks
PDC	MS9-A	X		B.8			Please rush for permitting
Dan Pfluger	MS5-I		x				
Barbara Dubiel	MS4-D2		x				
Anne Weldon	MS14-3A		X				

OUTGOING DISTRIBUTION FOR RETURNED STATUSED STICKER SUBMITTALS

Name	MSIN/ E-mail	Original	Copy	Copy of cover sheet / transmittal only	Primary File Index	File Index Alternate	Assigned Action or Remarks
PDC	MS9-A	X					

R10681733

RPP-WTP
RECEIVED
MAY 2 2 2006
BY PDC

AREVA

CCN: 139504

AREVA-06-045

Ms. Anne Weldon
Subcontracts
Bechtel National, Inc.
2435 Stevens Center Place
Richland, Washington 99352

May 9, 2006

Dear Ms. Weldon:

BECHTEL NATIONAL, INC. CONTRACT NO. 24590-CM-HC4-HXYG-00211 - STRUCTURAL INTEGRITY ASSESSMENT OF HIGH LEVEL WASTE (HLW) MELTER PROCESS SYSTEM (HMP) MISCELLANEOUS TREATMENT UNITS (MTUs) (AREVA-IA-084, REV. 0)

The integrity assessment of the subject Miscellaneous Treatment Units (MTUs) has been completed per the contract requirements and is enclosed for your use. The assessment found that the design is sufficient to ensure that the MTUs are adequately designed and have sufficient structural strength, compatibility with the waste(s) to be processed/ stored/treated, and corrosion protection to ensure that they will not collapse, rupture, or fail.

If you have any questions, please feel free to contact me at (509) 376-8020

Sincerely,

M. D. Rickenbach, Director
Engineering & Services
AREVA NC Inc.
Richland

llm

Enclosure

cc: D. C. Pfluger M.1.I104 w/enclosure (2)

COGEMA, INC.
2425 Stevens Center Place, Second Floor, Richland, Washington 99354 - P.O. Box 840, Richland, Washington 99352
Tel : 509 372 8256 - Fax: 509 372 3169 - www.areva.com

IQRPE REVIEW
OF
THE HIGH LEVEL WASTE (HLW) MELTER PROCESS SYSTEM (HMP) MISCELLANEOUS TREATMENT UNITS (MTUs)

"I, Fred Porter, have reviewed, and certified a portion of the design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by Department of Energy, Office of River Protection, Richland, Washington. My duties were independent review of the current design for the High Level Waste (HLW) Melter Process System (HMP) Miscellaneous Treatment Units (MTUs) as required by the Washington Administrative Code, *Dangerous Waste Regulations*, Section WAC-173-303-640(3) (a) through (g) applicable components."

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

The documentation reviewed indicates that the design fully satisfies the requirements of the WAC.

The attached review is ten (10) pages numbered one (1) through ten (10).

FRED E. PORTER
STATE OF WASHINGTON
11689
REGISTERED
PROFESSIONAL ENGINEER

EXPIRES: 12-08-2007

Signature

5-09-2006
Date

STRUCTURAL INTEGRITY ASSESSMENT OF THE HIGH LEVEL WASTE (HLW) MELTER PROCESS SYSTEM (HMP) MISCELLANEOUS TREATMENT UNITS (MTUs)

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

Scope	Scope of this Integrity Assessment.	The HLW Melter Process System (HMP) is comprised of two HLW melters, each with the same design. Also included in the HMP are the pour spouts that are attached to the discharge chambers (2) of each melter. Melter 1 is located in HLW building cave H-0117 and Melter 2 is in cave H-0106, as shown on HLW Vitrification Building General Arrangement Plan at EL. 0'-0". This Integrity Assessment reviews the HLW Melter Process System (HMP) melter design and compatibility with ancillary process systems interfacing with the melters as shown on: Process Flow Diagram Drawings 24590-HLW-M5-V17T-P0002, -P20002; P&ID drawings 24590-HLW-M6-HMP-P0001, -P0002, -P0003, -P0004, -P0006, -P0007, -P0008, -P0013, -P0014, -P20001, -P20002, -P20003, -P20004, -P20006, -P20007, -P20008, -P20013, -P20014; and as defined in the System Description for HLW Melter Process System (HMP).
Summary of Assessment		For each item of "Information Assessed" (i.e., Criteria) on the following pages, the items listed under "Source of Information" were reviewed and found to furnish adequate design controls and requirements to ensure the design fully satisfies the requirements of Washington Administrative Code, WAC-173-303-640, *Dangerous Waste Regulations* for Tank Systems.

References	Drawings and System Description.	Drawings: 24590-HLW-P1-P01T-00002, Rev. 5, HLW Vitrification Building General Arrangement Plan at EL. 0'-0"; 24590-HLW-M5-VI7T-P0002, Rev. 1, Process Flow Diagram HLW Vitrification Melter 1 (Systems HMP and HOP); 24590-HLW-M5-V17T-P20002, Rev.1, Process Flow Diagram HLW Vitrificatiion Melter 2 (Systems HMP and HOP); 24590-HLW-M6-HMP-P0001, Rev. 1, P&ID - HLW Melter 1 System Feed and Agitation; 24590-HLW-M6-HMP-P0002, Rev. 1, P&ID - HLW Melter 1 System Film Cooler and Offgas Connection; 24590-HLW-M6-HMP-P0003, Rev. 0, P&ID - HLW Melter Process System HLW Melter 1 Cooling System; 24590-HLW-M6-HMP-P0004, Rev. 0, P&ID - HLW Melter 1 Electrode Air Cooling and Joule Heating; 24590-HLW-M6-HMP-P0006, Rev. 1, P&ID - HLW Melter 1 System East Discharge Heaters and Airlift; 24590-HLW-M6-HMP-P0007, Rev. 1, P&ID - HLW Melter 1 System West Discharge Heaters and Airlift; 24590-HLW-M6-HMP-P0008, Rev. 1, P&ID - HLW Melter Process System Melter 1 Glass Pour & Monitoring Instrumentation; 24590-HLW-M6-HMP-P0013, Rev. 1, P&ID - HLW Melter 1 System Pressure, Density and Level Detection; 24590-HLW-M6-HMP-P0014, Rev. 0, P&ID - HLW Melter Process System HLW Melter 1 Cooling System; 24590-HLW-M6-HMP-P20001, Rev. 1, P&ID - HLW Melter 2 System Feed and Agitation; 24590-HLW-M6-HMP-P20002, Rev. 1, P&ID - HLW Melter 2 System Film Cooler and Offgas Connection; 24590-HLW-M6-HMP-P20003, Rev. 0, P&ID - HLW Melter Process System HLW Melter 2 Cooling System; 24590-HLW-M6-HMP-P20004, Rev. 0, P&ID - HLW Melter 2 Electrode Air Cooling and Joule Heating; 24590-HLW-M6-HMP-P20006, Rev. 1, P&ID - HLW Melter 2 System East Discharge Heaters and Airlift; 24590-HLW-M6-HMP-P20007, Rev. 1, P&ID - HLW Melter 2 System West Discharge Heaters and Airlift; 24590-HLW-M6-HMP-P20008, Rev. 1, P&ID - HLW Melter Process System Melter 2 Glass Pour & Monitoring Instrumentation; 24590-HLW-M6-HMP-P20013, Rev. 1, P&ID - HLW Melter 2 System Pressure, Density and Level Detection; 24590-HLW-M6-HMP-P20014, Rev. 0, P&ID - HLW Melter Process System HLW Melter 2 Cooling System. System Description: 24590-HLW-3YD-HMP-00001, Rev. 1, System Description for HLW Melter Process System (HMP).

Design	Melter design standards are appropriate and adequate for the equipment's intended use.	24590-HLW-3PS-AE00-T0001, Rev. 3, Engineering Specification for High Level Waste Melters; 24590-WTP-DC-ST-01-001, Rev. 11, Structural Design Criteria; 24590-WTP-SED-ENS-03-002-04, Rev 0H, Safety Envelope Document; HLW Facility Specific Information (SED); ASME B31.3, Chemical Plant and Petroleum Refinery Piping (1996); ASME Boiler and Pressure Vessel Code, Section III, Division 1, Subsection NC, Appendices N and F, Rules for Construction of Nuclear Power Plant Components (2001); ASME Boiler and Pressure Vessel Code, Section VIII, (2001). .	Melters 1 and 2 are vendor supplied equipment. The melters are designed to meet performance requirements specified in the Engineering Specification for High Level Waste Melters for all phases of melter life, including assembly, transport, startup, commissioning and maintenance. Structural design of the melters is in accordance with the Structural Design Criteria Document for seismic category SC-II structures, systems and components (SSCs) referenced in the Engineering Specification Document. The melters are not required to operate after a seismic event. However, the category SC-II shell and restraints containing the molten glass pool will maintain structural integrity and remain in place to preclude potential impacts to SC-I items referenced in the Safety Envelope Document. Provisions to avoid stress problems associated with thermal growth of the melter as it expands in relation to ancillary equipment has been considered in the design. Melter cooling water piping, feed piping, offgas piping and pour flanges are designed in accordance with ASME B31.3. Piping seismic design is in accordance with ASME B&PV Code Section III, appendices N and F. Melter cooling water system panels located on the external surface of the ceramic refractory containing the glass pool are designed in accordance with ASME B&PV Code Section VIII.

Design	Melter design compatibility with ancillary systems.	Drawings and System Description listed above under References; ASME B31.3, Chemical Plant and Petroleum Refinery Piping (1966); ASME Boiler and Pressure Vessel Code, Section III, Division 1, Subsection NC, Appendices N and F, Rules for Construction of Nuclear Power Plant Components (2001); 24590-WTP-3PS-J000-T0001, Rev. 1, Melter Systems C&I Work Specification; 24590-HLW-3YD-HOP-00001, Rev. 1, System Description for HLW Melter Offgas Treatment Process and Process Vessel Vent Extraction (HOP and PVV Systems).	Melters are supplied as packaged units with provisions for interface connections with ancillary systems listed in the System Description Document and shown on the P&ID drawings. Ancillary process systems interfacing with melters include: HLW Melter Feed Process System (HFP), HLW Melter Offgas Treatment Process System (HOP), and HLW Canister Pour Handling System (HPH). The melter design provides nozzles for jumpers from connecting ancillary piping systems. Melter piping and nozzle design is compatible with ASME B31.3 and ASME B&PV Code Section III design requirements of ancillary piping systems. Melter offgas is routed to the HLW Melter Offgas Treatment Process System (HOP) as defined in the System Description for HLW Melter Offgas Treatment Document. The ancillary HOP system scrubbers and coolers reduce melter offgas temperature and minimize solids disposition in the downstream offgas system. Controls and Instrumentation for specific melter-related functional requirements are specified in the Melter Systems C&I Work Specification. Purge air is supplied to the melter for continuous bubbler and air lift lance operation in the glass pool and for intermittent uses in the plenum.

Design	Melter design is adequate to maintain operating requirements during design life.	24590-HLW-3PS-AE00-T0001, Rev 3, Engineering Specification for High Level Waste Melters; 24590-WTP-DB-ENG-01-001, Rev. 1F, Basis of Design; 24590-WTP-SRD-ESH-01-001-02, Rev.31, Safety Requirements Document, Volume II.	The Basis of Design Document for the HLW facility specifies the facility is expected to operate for 40 years. The Engineering Specification for High Level Waste Melters specifies the melter, excluding consumable SSCs, shall have a minimum 5 year design life. The melter design life is applicable to all non-maintainable melter components, which includes refractory, electrodes, discharge dam and trough, cooling panels, and all structural and containment steelwork. Melter consumable components are designed to be removed and replaced remotely. Components requiring replacement during the design life of the melter are designed for ease of remote replacement and disposal. Where required, installed spare capacity is provided. Melters are designed and installed to allow for replacement after end-of-life or failure. The melter design and installation permits appropriate periodic inspection and testing in accordance with Safety Requirements Document, Volume II (SRD).
Design	Melter is adequately designed. For structural and seismic loads.	24590-HLW-3PS-AE00-T0001, Rev. 3, Engineering Specification for High Level Waste Melters; 24590-WTP-DC-ST-01-001, Rev. 11, Structural Design Criteria; 24590-WTP-RPT-ST-01-002, Rev. 3, Seismic Analysis and Design Approach.	Seismic design for the melters is in accordance with the Seismic Analysis and Design Approach document for SC-II structures, systems, and components as referenced in the Engineering Specification for High Level Waste Melters. Melter structural design is in accordance with Structural Design Criteria Document for seismic category II structures.

Connections	Melter Seams and connections are adequately designed.	24590-HLW-3PS-AE00-T0001, Rev. 3, Engineering Specification for High Level Waste Melters; ASME B31.3, Chemical Plant and Petroleum Refinery Piping (1996); ASME Boiler and Pressure Vessel Code, Section III, Division 1, Subsection NC, Appendices N and F, Rules for Construction of Nuclear Facility Components (2001). .	The Engineering Specification for High Level Waste Melters requires in-cell piping that is non-maintainable to be fully welded. The melter nozzle connections at the interface with ancillary piping system Jumpers are maintainable and are not welded connections. Melter piping and nozzle interface connections are compatible with ancillary piping design codes ASME B31.3 and ASME B&PV, Section III. The melter design provides in-leakage through engineered openings in some lid components. There is also incidental air in-leakage into the melter plenum. Air in-leakage to the melter plenum comes directly from the HLW cave. Each melter is connected to a dedicated offgas system that maintains a slight vacuum in the melter plenum.
Frost Heave	The Melter Process System will withstand the effects of frost heave.	24590-WTP-DC-ST-01-001, Rev.11, Structural Design Criteria.	The Structural Design Criteria requires that all structural foundations shall extend into the surrounding soil below the frost line to preclude frost heave. The frost depth line is 30 in. below grade. The HLW building foundation is at elevation -21"-0"and is not subject to frost heave. The HLW Melter Process System is located in caves within the HLW building at elevation 0'-0".

Waste Characteristics	Characteristics of the waste to be stored or treated have been identified.	Drawings and System Description listed above under References; 24590-HLW-3PS-AE00-T0001, Rev. 3, Engineering Specification for High Level Waste Melters; 24590-WTP-DB-ENG-01-001, Rev. 1F, Basis of Design.	The Basis of Design describes the characteristics of the waste to be treated and waste product to be stored. The HMP System Description provides a melter process overview listing the range of physical properties of HLW molten glass which is further defined in the Engineering Specification for High Level Waste Melters. The System Description Document describes facility interfaces, waste characteristics and production flow rates. Process systems that interface with the HLW Melter Process System (HMP) are shown on the P&ID drawings. The constituents of the HLW concentrate undergo chemical reactions, convert to their respective oxides, and dissolve in the molten glass.

Waste Handling Functions	Melters are designed to handle wastes with the characteristics defined above.	Drawings and System Description listed above under References; 24590-HLW-3YD-HOP-00001, Rev. 1, System Description for HLW Melter Offgas Treatment Process and Process Vessel Vent Extraction (HOP and PVV Systems).	The System Description Document defines the functions of the HMP system as the following; receive HLW concentrate and additives, vitrify HLW concentrate and additives, contain glass pool, deliver glass, confine hazardous emissions and report system conditions. The melters are designed to produce molten glass formed from HLW concentrate and glass former additives with the characteristics defined above. The glass pool is contained using heat-resisting ceramic bricks called refractory, backed up with an exterior metal structure with cooling panels. The panels provide cooling to freeze the glass within the refractory brick seams. The melters deliver molten glass to stainless steel canisters. The molten material is then allowed to cool, forming a borosilicate glass waste form. Immobilized High Level Waste (IHLW) is the resulting product (glass plus canister). The system works with the HLW Melter Offgas Treatment System (HOP) to direct melter emissions to offgas treatment processes. The functions of the ancillary systems servicing the HMP System are defined in the System Description Document and shown on the P&ID drawings.
Compatibility	The selection of materials adequately addresses the operating environment.	24590-HLW-3PS-AE00-T0001, Rev. 3, Engineering Specification for High Level Waste Melters; 24590-HLW-N1D-HMP-P0001, Rev. 0, Plant Item Material Selection Data Sheet.	The Engineering Specification for High Level Waste Melters specifies each melter, excluding consumable components, shall have a minimum 5 year design life. Materials of construction provided in accordance with the Engineering Specification Document and Plant Item Material Selection Data Sheets are able to withstand the radioactive, thermal, and corrosive environment caused by the melter feed, molten glass, and offgasses. The selection of materials and structural design of melters fabricated in accordance with the Engineering Specification Document are compatible with the melter operating environment for the required design life.

Corrosion Allowance	Corrosion allowance is adequate for the intended service life of the miscellaneous treatment units.	24590-HLW-3PS-AE00-T0001, Rev. 3, Engineering Specification for High Level Waste Melters.	The Engineering Specification for High Level Waste Melters specifies materials selected to withstand the corrosive melter operating environment for the service life of melter SSC's. Corrosion monitoring capability during operations is not required. The Engineering Specification for High Level Waste Melters considers environmental, durability, corrosion and erosion factors during materials selection. Factors evaluated include: surface finish, chemical resistance, radiation resistance, pressure effects (cyclical), temperature effects, hardness and fatigue.
Strength	Pressure controls are designed to ensure pressure relief if normal operating pressures in the melters are exceeded.	Drawings and System Description listed above under References; 24590-WTP-SED-ENS-03-002-04, Rev. 0H, Safety Envelope Document; HLW Facility Specific In formation (SED).	The System Description Document states the system shall provide instrumentation to detect rises in pressure in the melter plenum and provide an actuating signal to the associated interlocks that follow when the melter plenum pressure reaches a predetermined value. The melter plenum pressure interlocks will stop feed to the melter and film cooler injection air on receiving an actuation signal from the melter pressure instrumentation. Redundant pressure measurement shown on the P&ID drawings is provided for the melter plenum in accordance with requirements of the Safety Envelope Document.
Strength	Maximum flows and any unusual operating stresses are identified	Drawings and System Description listed above under References; 24590-101-TSA-W000-0010-407-577, Rev, NA, HLW Melter FMEA Report.	The System Description Document section, Action on Faults and Mal-Operation, discusses selected failure modes and recovery responses for the HLW Melter Process System. A component- by- component detailed analysis can be found in the HLW Melter Failure Modes and Effects Analysis (FMEA) Document.

Secondary Containment	Containment and confinement requirements for high level wastes.	Drawings and System Description listed above under References; ASME Boiler and Pressure Vessel Code, Section VIII, (2001); 24590-WTP-SRD-ESH-01-001-02, Rev.31, Safety Requirements Document, Volume II.	High level wastes containment and confinement requirements in terms of configuration, interfaces, instrumentation, control and reliability is provided as defined in the HMP System Description Document. Confinement reliability factors for HMP structures, systems and components are in accordance with Safety Requirements Document, Volume II, for QL-2 requirements. The HMP melters use a refractory package to contain the molten glass. The refractory package consists of glass pool refractory and plenum refractory. The refractory package is designed to serve as a mechanical, thermal, and electrical barrier between the molten glass inside the shell and the external metal shell. The refractory package is contained within a metal structure with cooling panel assemblies on three sides and the bottom of the melter, which provide bulk containment and melter cooling. The metal containment shell / cooling water panels are designed and fabricated in accordance with ASME B&PV Section VIII. The caves that house the melter installations have protective liners and provide secondary containment for the HMP melter process system. Ventilation systems and offgas systems are provided to control radiological and chemical material releases and the generation of flammable and explosive gases during normal and accident conditions. Each melter is connected to a dedicated offgas system through to the stack, as shown on the P&ID drawings. Instrumentation is provided to detect and control rises in offgas pressure in the melter plenum.

Master Distribution Schedule for WTP Project Subcontract Management Group

SUBMITTAL TRANSMITTAL: ☐ First Submittal ☐ Re-Submittal ☐ QVRP Package
☐ No Review Required ☐ No Review Required Re-Submittal ☐ Submittal Supplement

CORRESPONDENCE: ☒ With Attachment ☐ W/O Attachment (letter only)
☐ Fax as Original (Letter Only) ☐ Fax as Original (With Attachment)

☐ Pre-Award/Award Package ☐ Executed Change Order Package
☐ Executed Amendment Package ☐ Back Charge

Subcontract Number:	24590-CM-HC4-HXYG-00211
Subcontract Title:	Tank Integrity Design Assessments by IQRPE
Subcontractor Name:	AREVA NC, Inc.
Subcontract Administrator:	Anne Weldon

PDC Document Number	Rev	Document Title	Rev
139504	0	AREVA -AI-084, Rev. 0	

INCOMING DISTRIBUTION

Name	MSIN/ E-mail	Original	Copy	Copy of cover sheet / transmittal only	Primary File Index	Alternate File Index	Assigned Action or Remarks
PDC	MS9-A	X		B.8			Please rush for permitting
Dan Pfluger	MS5-I		x				
Barbara Dubiel	MS4-D2		x				
Anne Weldon	MS4-3A		X				

OUTGOING DISTRIBUTION FOR RETURNED STATUSED STICKER SUBMITTALS

Name	MSIN/ E-mail	Original	Copy	Copy of cover sheet / transmittal only	Primary File Index	File Index Alternate	Assigned Action or Remarks
PDC	MS9-A	X					

Attachment 51 – Appendix 10.13
High Level Waste Building
Instrument Control Logic and Narrative Descriptions

Where information regarding treatment, management, and disposal of the radioactive source, byproduct material, and/or special nuclear components of mixed waste (as defined by the Atomic Energy Act of 1954, as amended) has been incorporated into this permit, it is not incorporated for the purpose of regulating the radiation hazards of such components under the authority of this permit and chapter 70.105 RCW. In the event of any conflict between Permit Condition III.10.A. and any statement relating to the regulation of source, special nuclear, and byproduct material contained in portions of the permit application that are incorporated into this permit, Permit Condition III.10.A. will prevail.

Additional appendices will be added to this appendix as new information is incorporated into this permit.

Drawings and Documents

Attachment 51 – Appendix 10.13

High Level Waste Building
Instrument Control Logic and Narrative Descriptions

The following drawings have been incorporated into Appendix 10.13 and can be viewed at the Ecology Richland Office. **New drawings are in bold lettering.**

Drawing/Document Number	**Description**
24590-HLW-PER-J-02-001, Rev 2	System Logic Description for HOP and PVV Systems
24590-HLW-PER-J-02-002, Rev 1	System Logic Description for HDH System
24590-HLW-PER-J-02-003, Rev 0	System Logic Description for RLD System
24590-HLW-PER-J-04-0001, Rev 0	System Logic Description for HFP System
24590-HLW-PER-J-04-0002, Rev 0	System Logic Description for PJV System
24590-HLW-PER-J-04-0003, Rev 0	System Logic Description for HSH System
RESERVED	RESERVED

R10274716

ISSUED BY
RPP-WTP PDC
INIT DATE

Document title: **System Logic Description for High-Level Waste Facility - Melter Offgas Treatment Process and Process Vessel Vent Extraction (HOP and PVV) Systems**

Contract number: DE-AC27-01RV14136

Department: Controls and Instrumentation

Author(s): Anthony L. Coulam

Principal author signature: Anthony L. Coulam

Document number: 24590-HLW-PER-J-02-001, Rev 2

Checked by: Robert O. Frink

Checker signature: Robert O. Frink

Date of issue: 25 MARCH 2004

Issue status: Issued for Permitting Use

Approved by: Stephen E. Anderson

Approver's position: C&I Discipline Engineering Manager

Approver signature: S. E. Anderson

MARK A. FRIEDRICH
STATE OF WASHINGTON
32426
REGISTERED
PROFESSIONAL ENGINEER
Mark A. Friedrich
3-25-04
EXPIRES: 08/31/04

This bound document contains a total of 18 sheets

River Protection Project
Waste Treatment Plant
2435 Stevens Center Place
Richland, WA 99352
United States of America
Tel: 509 371 2000

Notice

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the US Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

History Sheet

Rev	Date	Reason for revision	Revised by
0	29 October 2002	Issued for permitting use	N McAdams
1	04 December 2003	Major revision, issued for permitting use	A Coulam
2	25 MARCH 2004	Issued for permitting use	A Coulam

Contents

Notice ii
History Sheet iii
Glossary vii
1 Introduction 1
2 Applicable Documents 1
3 Description 2
3.1 Melter 1 and 2 Submerged Bed Scrubbers (SBS) 2
3.2 Melter 1 and 2 SBS Condensate Receiver Vessels 3
3.3 Melter 1 and 2 Wet Electrostatic Precipitators (WESP) 3
3.4 Melter 1 and 2 High Efficiency Mist Eliminators (HEME) 4
3.5 Melter 1 and 2 High Efficiency Particulate Air (HEPA) Filters 4
3.6 Process Vessel Vent Extraction (PVV) System 4

Tables

Table 1 Associated ITS Instruments for Melter 1 and 2 Submerged Bed Scrubbers (SBS) 5
Table 2 Associated ITS Instruments for Melter 1 and 2 SBS Condensate Receiver Vessels 5
Table 3 Associated Instruments for Melter 1 and 2 Wet Electrostatic Precipitators (WESP) 5
Table 4 Associated Instruments for Melter 1 and 2 High Efficiency Mist Eliminators (HEME) 5
Table 5 Associated Instruments for Melter 1 and 2 High Efficiency Particulate Air (HEPA) Filters 5

Figures

Figure 1 Typical ITS Level Measurement For Melter 1 And 2 Submerged Bed Scrubbers 7
Figure 2 Typical ITS Level Measurement For Melter 1 And 2 SBS Condensate Receiver Vessels 8
Figure 3 Typical Level Measurement For Melter 1 And 2 Wet Electrostatic Precipitators (WESP) 9
Figure 4 Typical Level Measurement For Melter 1 And 2 High Efficiency Mist Eliminators (HEME) 10

Figure 5 Typical Pressure Differential Measurement For Melter 1 And 2 High Efficiency Particulate Air (HEPA) Filters 11

Acronyms and Abbreviations

Reference the piping and instrumentation diagrams (P&IDs) symbols and legend sheets as listed in the Applicable Documents section, for acronyms and abbreviations used in the figures.

AI	analog input
HEME	high efficiency mist eliminator
HLW	high level waste
HOP	melter offgas treatment process system
ITS	important to safety
LAH	level alarm high
LAHH	level alarm high high
LI	level indicator
LSH	level switch high
LSHH	level switch high high
LT	level transmitter
P&ID	piping and instrumentation diagram
PDAH	pressure differential alarm high
PDSH	pressure differential switch high
PVV	process vessel vent extraction system
RFD	reverse flow diverter
RLD	radioactive liquid waste disposal system
SBS	submerged bed scrubber
VSL	vessel
WESP	wet electrostatic precipitator
WTP	Hanford Tank Waste Treatment and Immobilization Plant

Glossary

Batch control	This term refers to control activities and control functions that provide an ordered set of processing activities to complete a batch process.
Batch process	A batch process leads to the production of a finite quantity of material by subjecting quantities of input material to an ordered set of processing activities over a finite period using one or more pieces of equipment.
Control system	This term refers to electronic processors that perform regulatory and logic control functions necessary for normal operation of the plant.
Exception handling	This term refers to those functions that deal with plant or process contingencies and other events that occur outside the normal or desired behavior of batch control.
High level	This term refers to a notification in the control system that is activated when the high level setpoint of the vessel has been reached.
High-high level	This term refers to a notification in the control system that is activated when the high-high level setpoint of the vessel has been reached.
Interlock	Predetermined system equipment connections so that action of one part of the system affects the action of another part of the system.
Low level	This term refers to a notification in the control system that is activated when the low level setpoint of the vessel has been reached.
Low-low level	This term refers to a notification in the control system that is activated when the low-low level setpoint of the vessel has been reached.

1 Introduction

This document describes the instrument control logic for dangerous waste vessels and ancillary equipment associated with the high-level waste (HLW) facility melter offgas treatment process (HOP) and process vessel vent extraction (PVV) systems as they pertain to the dangerous waste permit.

2 Applicable Documents

24590-WTP-M6-50-P0001, *P&ID Symbols and Legend Sheet 1 of 6*

24590-WTP-M6-50-P0002, *P&ID Symbols and Legend Sheet 2 of 6*

24590-WTP-M6-50-P0003, *P&ID Symbols and Legend Sheet 3 of 6*

24590-WTP-M6-50-P0004, *P&ID Symbols and Legend Sheet 4 of 6*

24590-WTP-M6-50-P0005, *P&ID Symbols and Legend Sheet 5 of 6*

24590-WTP-M6-50-P0006, *P&ID Symbols and Legend Sheet 6 of 6*

24590-HLW-M6-HOP-P0001, *P&ID-HLW Melter Offgas System Melter 1 Primary Offgas Scrubber*

24590-HLW-M6-HOP-P0002, *P&ID-HLW Melter Offgas System Melter 1 Primary Offgas WESP*

24590-HLW-M6-HOP-P0004, *P&ID-HLW Melter 1 Offgas Fluidic Air Rack HOP-RK-00025 (Q)*

24590-HLW-M6-HOP-P0006, *P&ID-HLW Melter Offgas System Melter 1 Primary Offgas Scrubber (Q) Condensate Vessel*

24590-HLW-M6-HOP-P0009, *P&ID-HLW Melter Offgas System Melter 1 Primary Offgas HEME*

24590-HLW-M6-HOP-P0010, *P&ID-HLW Melter Offgas System Melter 1 Primary Offgas HEPA Filters*

24590-HLW-M6-HOP-P20001, *P&ID-HLW Melter Offgas System Melter 2 Primary Offgas Scrubber*

24590-HLW-M6-HOP-P20002, *P&ID-HLW Melter Offgas System Melter 2 Primary Offgas WESP*

24590-HLW-M6-HOP-P20004, *P&ID-HLW Melter 2 Offgas Fluidic Air Rack HOP-RK-00048*

24590-HLW-M6-HOP-P20006, *P&ID-HLW Melter Offgas System Melter 2 Primary Offgas Scrubber Condensate Vessel*

24590-HLW-M6-HOP-P20009, *P&ID-HLW Melter Offgas System Melter 2 Primary Offgas HEME*

24590-HLW-M6-HOP-P20010, *P&ID-HLW Melter Offgas System Melter 2 Primary Offgas HEPA Filters*

24590-HLW-M6-PVV-P0001, *P&ID-HLW Process Vessel Vent Extraction System*

24590-HLW-M6-PVV-P20001, *P&ID-HLW Melter 2 Process Vessel Vent Extraction System*

24590-HLW-3YD-HOP-00001, *Systems Description for HLW Melter Offgas Treatment Process and Process Vessel Vent Extraction (HOP and PVV Systems)*

3 Description

The HLW HOP system plant items and ancillary equipment included in the dangerous waste permit are the following:

- HOP-SCB-00001 melter 1 submerged bed scrubber (SBS)
- HOP-SCB-00002 melter 2 submerged bed scrubber (SBS)
- HOP-VSL-00903 SBS condensate receiver vessel
- HOP-VSL-00904 melter 2 SBS condensate receiver vessel
- HOP-WESP-00001 melter 1 wet electrostatic precipitator (WESP)
- HOP-WESP-00002 melter 2 wet electrostatic precipitator (WESP)
- HOP-HEME-00001A melter 1 high efficiency mist eliminator (HEME)
- HOP-HEME-00001B melter 1 high efficiency mist eliminator (HEME)
- HOP-HEME-00002A melter 2 high efficiency mist eliminator (HEME)
- HOP-HEME-00002B melter 2 high efficiency mist eliminator (HEME)
- HOP-HEPA-00001A primary offgas HEPA filter
- HOP-HEPA-00002A primary offgas HEPA filter
- HOP-HEPA-00001B primary offgas HEPA filter
- HOP-HEPA-00002B primary offgas HEPA filter
- HOP-HEPA-00007A primary offgas HEPA filter, melter 2
- HOP-HEPA-00008A primary offgas HEPA filter, melter 2
- HOP-HEPA-00007B primary offgas HEPA filter, melter 2
- HOP-HEPA-00008B primary offgas HEPA filter, melter 2

The HLW PVV system does not contain any plant items or ancillary equipment included in the dangerous waste permit.

3.1 Melter 1 and 2 Submerged Bed Scrubbers (SBS)

The offgas from the HLW melters with film cooler and pressure control air is transferred via the primary offgas jumpers for further cooling and treatment in the submerged bed scrubbers (SBS) (HOP-SCB-00001 and HOP-SCB-00002). Each SBS removes particulates and cools the offgas to a desired discharge temperature by quenching the offgas with a solution and transferring the heat out using cooling coils and cooling jacket. The SBS levels are controlled by overflows into the SBS condensate receiver vessels (HOP-VSL-00903 and HOP-VSL-00904). There is redundant safety system level detection within the SBSs so that high-high liquid levels can be detected and the corresponding melter feed, reverse flow diverters (RFDs) in the SBS condensate receiver vessel and all controlled feeds into the SBS can be terminated. The scrubbed offgas discharges through the top of the SBSs for further treatment. Agitation

in the SBSs is maintained by solution jets powered by RFDs located in the SBS condensate receiver vessels. The agitation maintains the solids in the SBSs tank bottom in suspension so that solid slurry can be periodically removed by air jet activated siphon lines that draw slurry through the suction square to the acidic waste vessel (RLD-VSL-00007). Condensate is circulated between the SBS and the SBS condensate receiver vessel by pumping the solution using the RFDs.

The SBS liquid levels are maintained at nominal levels by fixed overflows to the SBS condensate receiver vessels. Condensate and particulates are removed from the systems by regular operational batch transfers from the SBSs to the acidic waste vessel (RLD-VSL-00007). Transfers maintain the SBS condensate receiver vessels within the acceptable operating range. When the operator initiates the transfer-out sequence, the control system will verify that instruments, utilities, and equipment associated with the transfer are within operational parameters. If any of the monitored parameters are not within the specified limits during the transfer, the control system will switch to exception handling logic. The control system alarms or notifies the operator upon reaching the high, high-high, low, or low-low liquid levels.

When the levels are no longer within the normal operating range, interlocks in the programmable protection system overrides operation to control high-high liquid level conditions. Figure 1 shows the interlocks for the important to safety (ITS) level instruments in Table 1, which are associated with the SBSs.

3.2 Melter 1 and 2 SBS Condensate Receiver Vessels

The SBS condensate receiver vessels (HOP-VSL-00903 and HOP-VSL-00904) receive the condensate overflows from the SBSs, drainage from the wet electrostatic precipitators (WESP), and drainage from the high-efficiency mist eliminators (HEME). To help minimize the buildup of solids in the bottom of the SBSs, solution jets powered by RFDs in the SBS condensate receiver vessels are used to agitate the solution at the bottom of the SBSs. The agitation maintains the solids in the tank bottoms suspended so that they can be periodically removed by air jet activated siphon lines that draw slurry through the suction square in the SBSs to the acidic waste vessel (RLD-VSL-00007). Condensate is continuously circulated between the SBS condensate receiver vessels and the SBSs with the RFDs. Like the SBSs, there is redundant safety system level detection within the SBS condensate receiver vessels so that high-high liquid levels can be detected and the corresponding melter feed, water sprays to the WESP and HEME and all controlled feeds into the SBS condensate receiver vessel can be terminated. Because the SBSs operate at a constant level, the condensate builds up in the SBS condensate receiver vessels. The operator will initiate a liquid waste transfer from the SBS to the acidic waste vessel (RLD-VSL-00007) to maintain the SBS condensate receiver vessel within the acceptable operating range. The control system alarms or notifies the operator upon reaching the high, high-high, low or low-low liquid levels.

When the levels are no longer within the normal operating range, interlocks in the programmable protection system overrides operation to control high-high liquid level conditions. Figure 2 shows the interlocks for the ITS level instruments in Table 2, which are associated with the SBS condensate receiver vessels.

3.3 Melter 1 and 2 Wet Electrostatic Precipitators (WESP)

The SBSs offgas are routed to the corresponding WESPs (HOP-WESP-00001 and HOP-WESP-00002) for removal of aerosols and particulates down to a submicron size. The WESPs house vertical tubes, which act as positive electrodes. Each of these tubes also has a single negatively charged electrode, which runs down the centerline. The strong electric field, generated by the discharge electrode, generates

electrons that apply a negative charge to the offgas particles (corona effect). The negatively charged particles are then attracted to the positively charged tube walls. The collected particles are partially washed from the tube wall by entrained condensate that also collects on the inner tube wall. The solids are periodically washed from the tubes using water sprays from above the tubes. The water and collected particulates drains into the SBS condensate receiver vessels.

The WESPs will not be expected to have liquid level accumulation during normal operations. Figure 3 shows the indication for the level instruments in Table 3, which are associated with the WESPs. If liquid starts to accumulate in the WESPs during normal operations, the liquid level indication will alert the operator.

3.4 Melter 1 and 2 High Efficiency Mist Eliminators (HEME)

The purpose of the HEMEs (HOP-HEME-00001A, HOP-HEME-00001B, HOP-HEME-00002A, and HOP-HEME-00002B) is to further remove aerosols from the HLW melter offgas and the vessel ventilation air, and to reduce the solids-loading rate on the HEPA filters. As the offgas passes through the HEMEs, the liquid droplets and other aerosols in the offgas interact and adhere to the filaments by surface tension. The droplets agglomerate and eventually acquire enough mass to gravity flow to the bottom of the unit and drain into the SBS condensate receiver vessels. As the condensate flows down through the filter bed, a washing action is generated that will help wash and dissolve collected solids from the filter elements.

The HEMEs will not be expected to have liquid level accumulation during normal operations. Figure 4 shows the indication for the level instruments in Table 4, which are associated with the HEMEs. The liquid level indication will alert the operator that liquid is accumulating in the HEMEs.

3.5 Melter 1 and 2 High Efficiency Particulate Air (HEPA) Filters

The purpose of the high efficiency particulate air (HEPA) filters is to provide high efficiency submicron particulate removal. The HEPA filters will be periodically tested for particulate removal efficiency to validate performance. Figure 5 shows the indication for the pressure differential instruments in Table 5, which are associated with the HEPA filters.

3.6 Process Vessel Vent Extraction (PVV) System

The process vessel vent (PVV) system provides a vacuum on connected tanks relative to the tanks surroundings. The header is connected in the melter cave to the primary offgas system between the WESP and HEME, which provides the vacuum source. There is no figure or table associated with this system.

Table 1 Associated ITS Instruments for Melter 1 and 2 Submerged Bed Scrubbers (SBS)

Instrument Number	Associated Vessel	Description
HOP-LT-0104	HOP-SCB-00001	Safety control level
HOP-LT-0130	HOP-SCB-00001	Redundant safety control level
HOP-LT-2104	HOP-SCB-00002	Safety control level
HOP-LT-2130	HOP-SCB-00002	Redundant safety control level

Table 2 Associated ITS Instruments for Melter 1 and 2 SBS Condensate Receiver Vessels

Instrument Number	Associated Vessel	Description
HOP-LT-0110	HOP-VSL-00903	Safety control level
HOP-LT-0136	HOP-VSL-00903	Redundant safety control level
HOP-LT-2110	HOP-VSL-00904	Safety control level
HOP-LT-2136	HOP-VSL-00904	Redundant safety control level

Table 3 Associated Instruments for Melter 1 and 2 Wet Electrostatic Precipitators (WESP)

Instrument Number	Associated Vessel	Description
HOP-LT-0208	HOP-WESP-00001	Level
HOP-LT-2208	HOP-WESP-00002	Level

Table 4 Associated Instruments for Melter 1 and 2 High Efficiency Mist Eliminators (HEME)

Instrument Number	Associated Vessel	Description
HOP-LT-0216	HOP-HEME-00001A	Level
HOP-LT-0229	HOP-HEME-00001B	Level
HOP-LT-2216	HOP-HEME-00002A	Level
HOP-LT-2229	HOP-HEME-00002B	Level

Table 5 Associated Instruments for Melter 1 and 2 High Efficiency Particulate Air (HEPA) Filters

Instrument Number	Associated Vessel	Description
HOP-PDT-0222	HOP-HEPA-00001A	Pressure differential
HOP-PDT-0223	HOP-HEPA-00002A	Pressure differential
HOP-PDT-0235	HOP-HEPA-00001B	Pressure differential
HOP-PDT-0236	HOP-HEPA-00002B	Pressure differential
HOP-PDT-2222	HOP-HEPA-00007A	Pressure differential
HOP-PDT-2223	HOP-HEPA-00008A	Pressure differential

HOP-PDT-2235	HOP-HEPA-00007B	Pressure differential
HOP-PDT-2236	HOP-HEPA-00008B	Pressure differential

Figure 1 **Typical ITS Level Measurement For Melter 1 And 2 Submerged Bed Scrubbers**

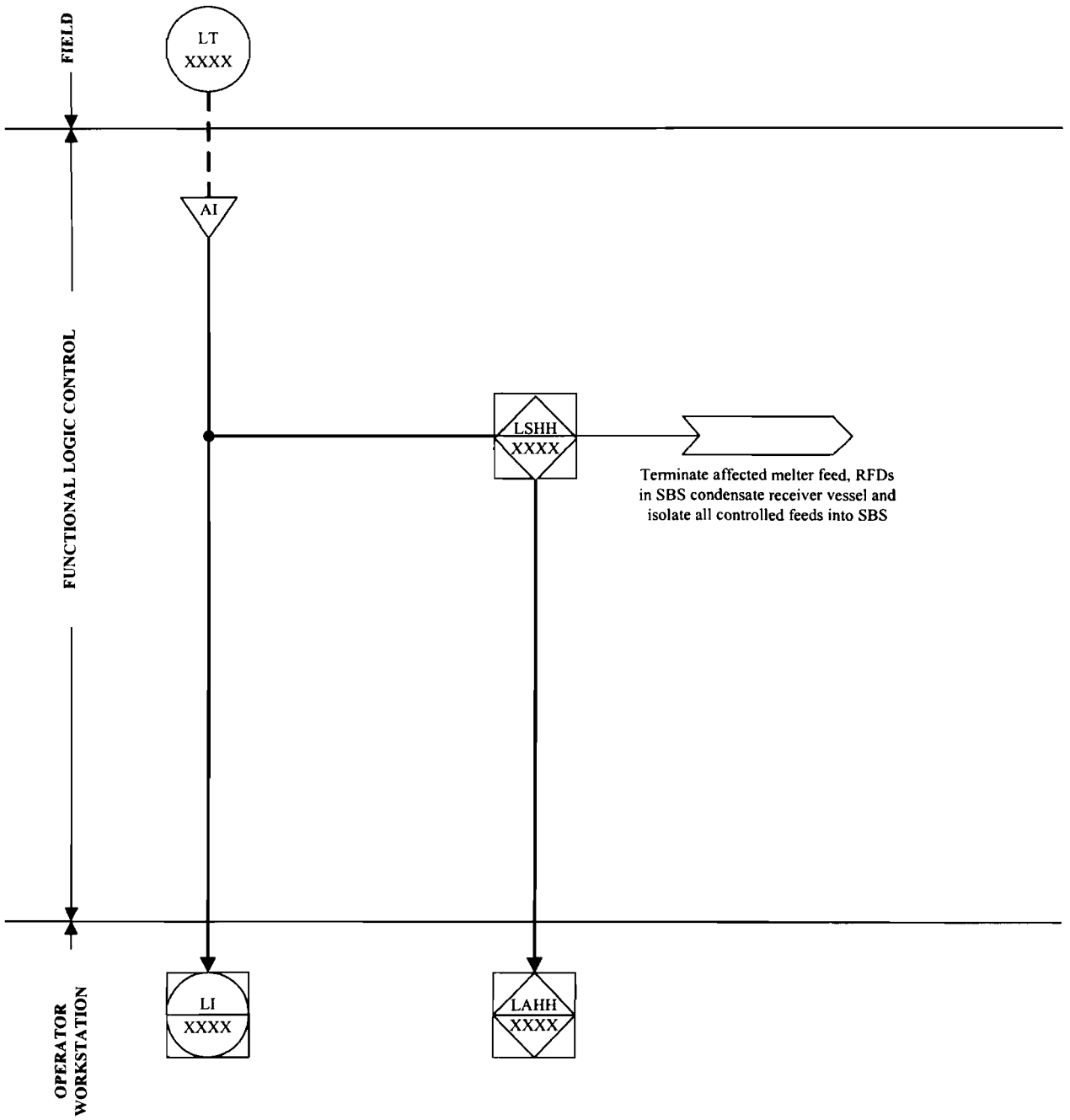


Figure 2 **Typical ITS Level Measurement For Melter 1 And 2 SBS Condensate Receiver Vessels**

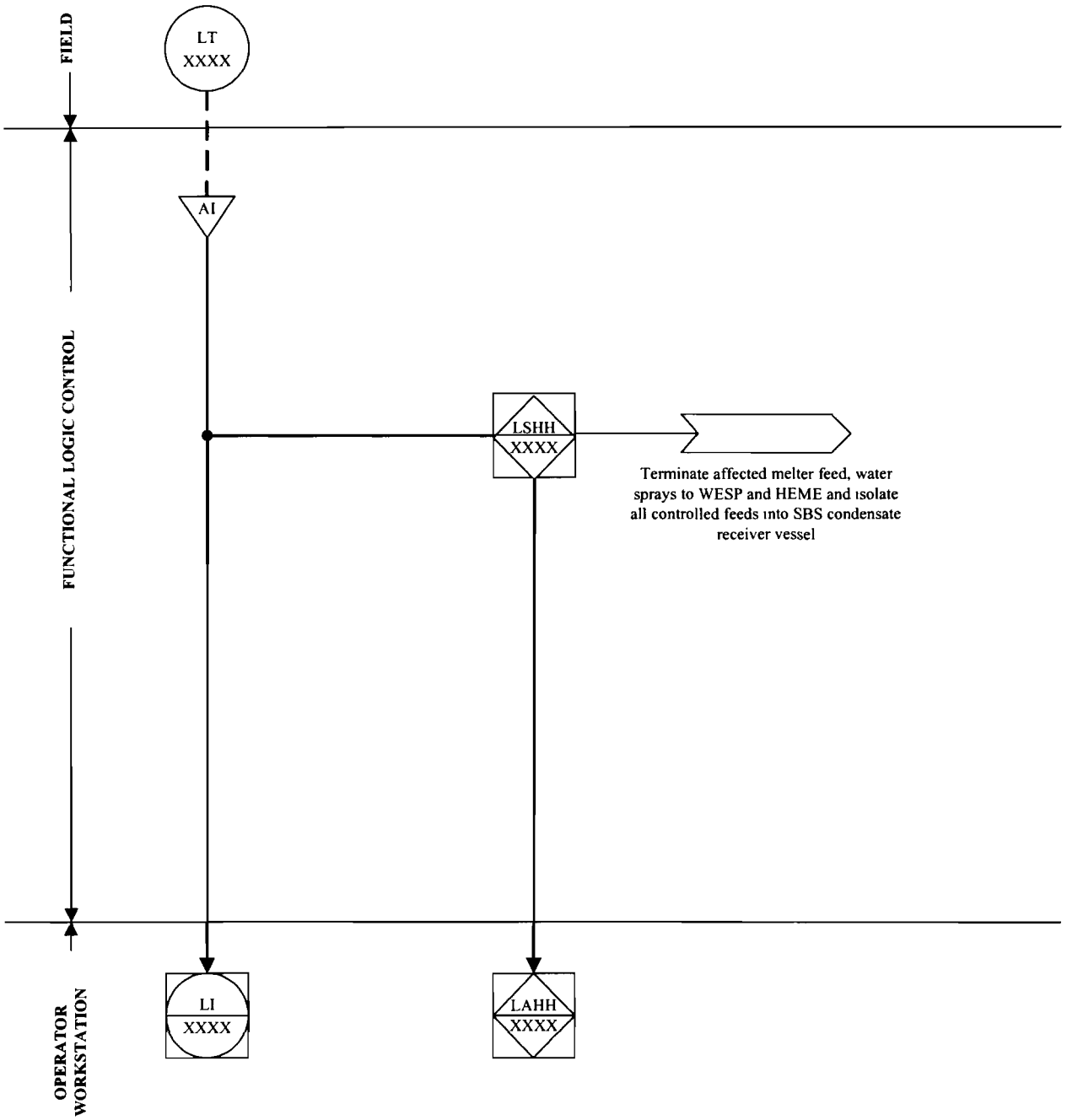


Figure 3 **Typical Level Measurement For Melter 1 And 2 Wet Electrostatic Precipitators (WESP)**

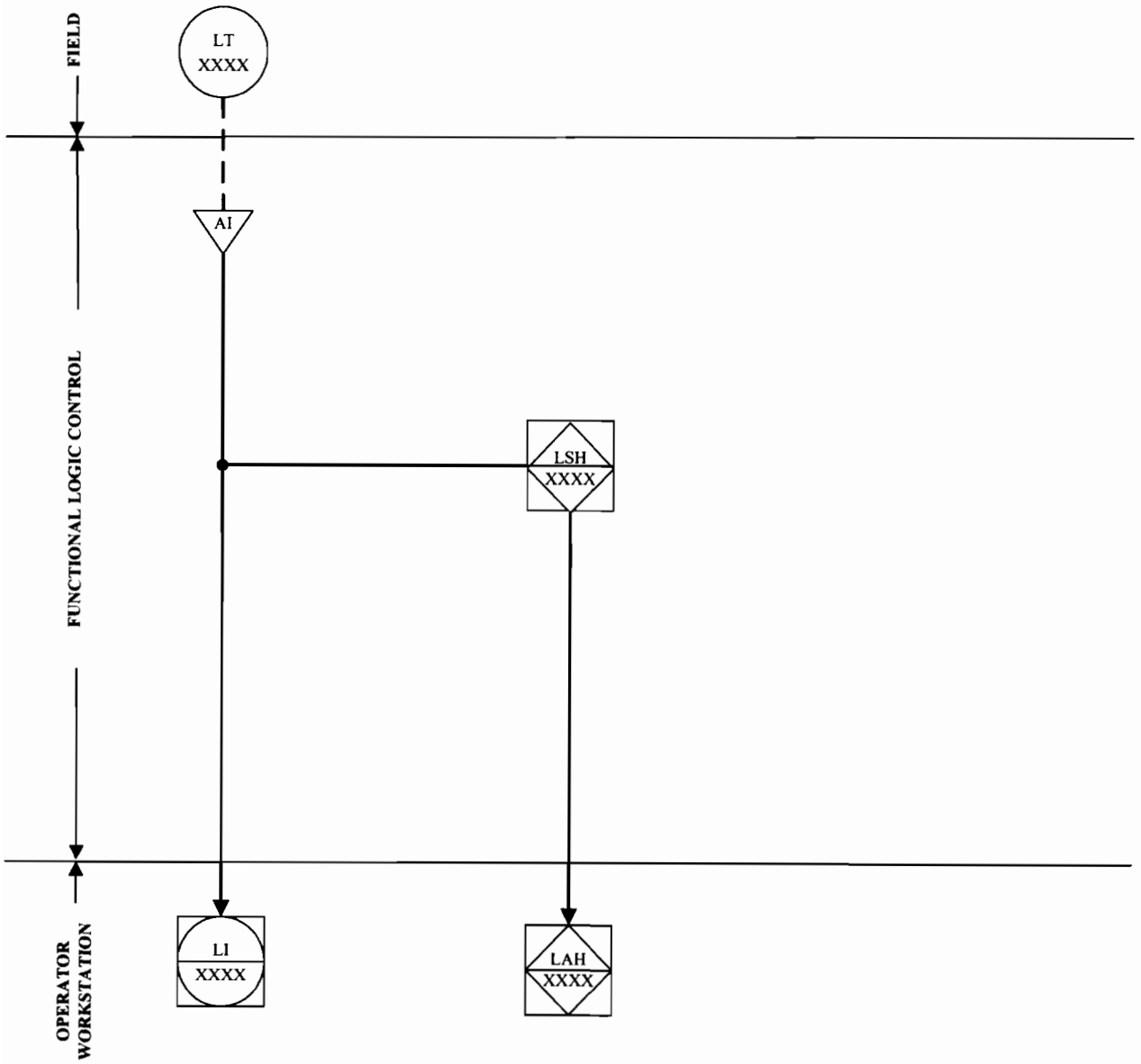


Figure 4 **Typical Level Measurement For Melter 1 And 2 High Efficiency Mist Eliminators (HEME)**

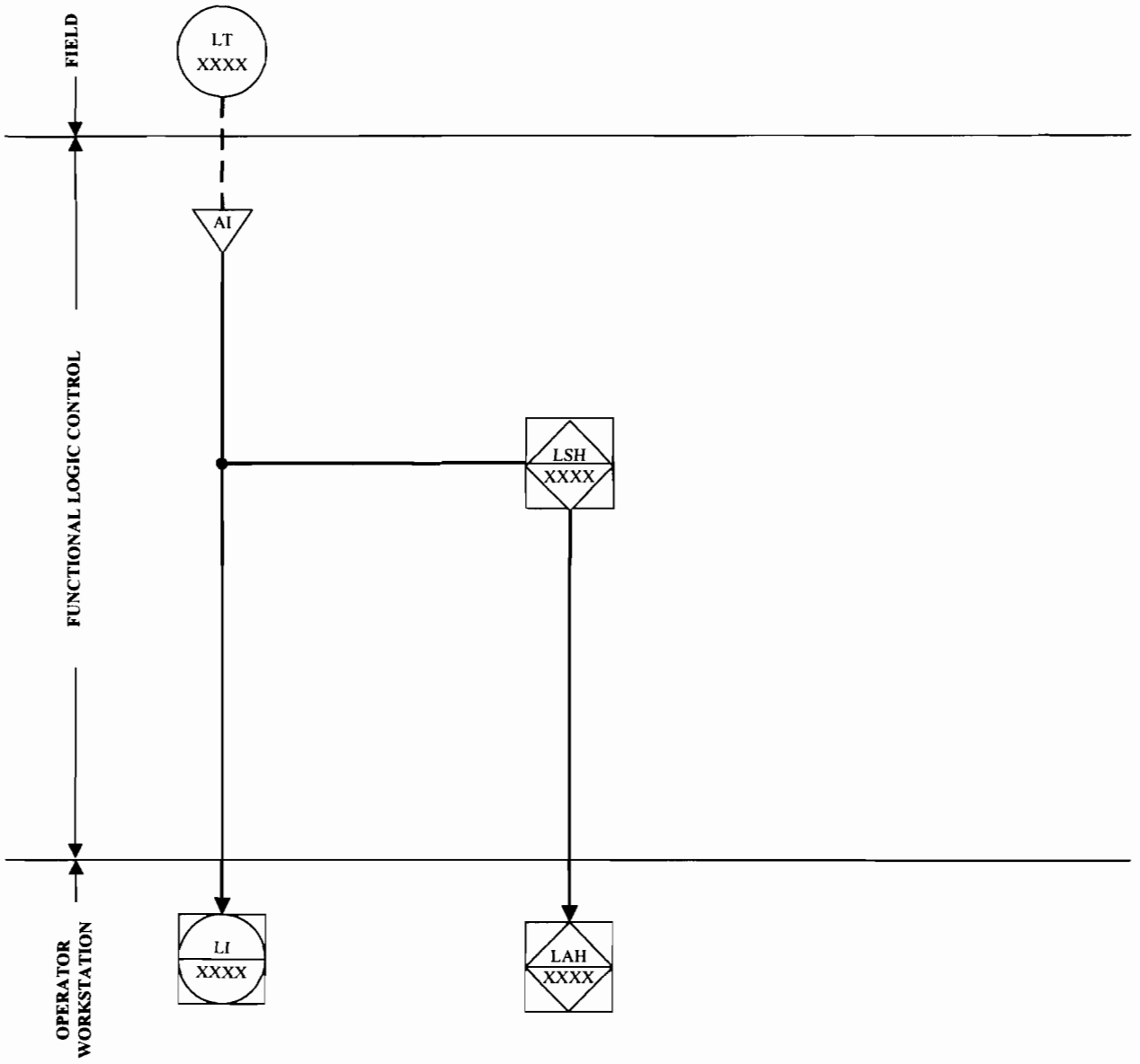
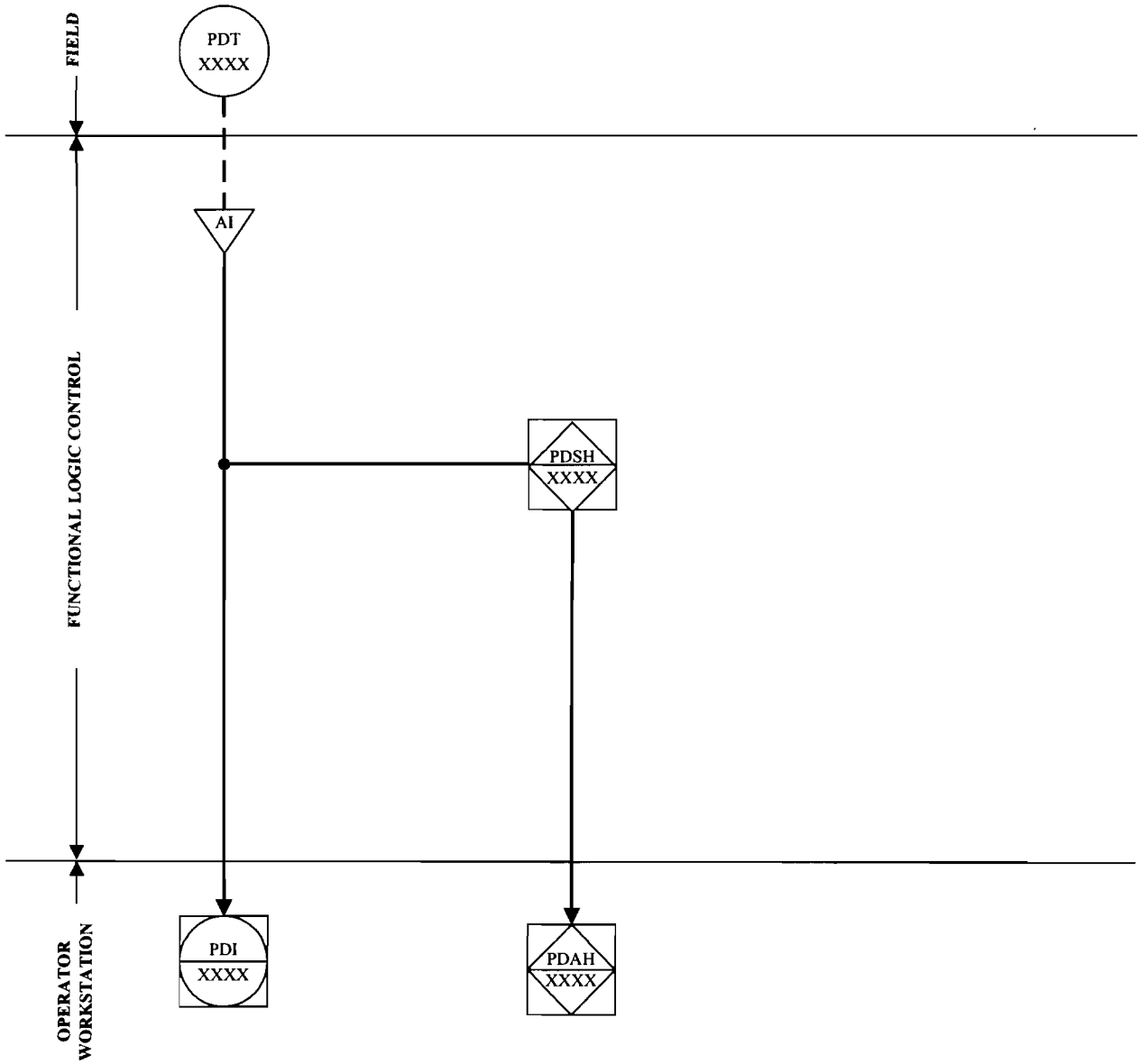


Figure 5 **Typical Pressure Differential Measurement For Melter 1 And 2 High Efficiency Particulate Air (HEPA) Filters**



R10202234

ISSUED BY
BPP-WTP PDC
INIT DATE 2/10/04

Document title: **System Logic Description for High Level Waste Facility - Canister Decontamination Handling (HDH) System**

Contract number: DE-AC27-01RV14136

Department: Controls and Instrumentation

Author(s): M Dingeldein and M Friedrich

Principal author signature:

Document number: 24590-HLW-PER-J-02-002, Rev 1

Checked by: H Webber

Checker signature:

Date of issue: Date of issue 2/10/04

Issue status: Issued for Permitting Use

Approved by: S Anderson for SE Anderson

Approver's position: C&I Engineering Manager

Approver signature:

MARK A. FRIEDRICH
STATE OF WASHINGTON
32426
REGISTERED
PROFESSIONAL ENGINEER
2-9-04
EXPIRES: 08/31/2004

This bound document contains a total of 13 pages

River Protection Project
Waste Treatment Plant
2435 Stevens Center Place
Richland, WA 99352
United States of America
Tel: 509 371 2000

Notice

Please note that source, special nuclear, and byproduct materials, as defined in the *Atomic Energy Act of 1954* (AEA), are regulated at the US Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that, pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

History Sheet

Rev	Date	Reason for revision	Revised by
0	10/29/02	Issued for Permitting Use	KDS
1	2/6/04	Major revision, Issued for Permitting Use	MDD

Contents

Notice ii

Acronyms v

Glossary vi

1 Introduction 1

2 Applicable Documents 1

3 Description 1

3.1 Rinse Tunnel Canister Rinse Vessel (HDH-VSL-00001) and Bogie Decontamination Canister Pump (HDH-PMP-00001) 2

3.2 Canister Decontamination Vessel 1 (HDH-VSL-00002) and Vessel 2 (HDH-VSL-00004) 2

3.3 Waste Neutralization Vessel (HDH-VSL-00003) 3

Tables

Table 1 Associated Instruments for HLW canister decontamination vessel 1 (HDH-VSL-00002) and HLW canister decontamination vessel 2 (HDH-VSL-00004) 4

Figures

Figure 1 Level Control for Rinse Tunnel Canister Rinse Vessel (HDH-VSL-00001) and Bogie Decontamination Canister Pump (HDH-PMP-00001) 5

Figure 2 Level Control for Canister Decontamination Vessel 1 (HDH-VSL-00002) and Canister Decontamination Vessel 2 (HDH-VSL-00004) 6

Figure 3 Level Control for Waste Neutralization Vessel (HDH-VSL-00003) 7

Acronyms

Reference the piping and instrumentation diagrams (P&IDs) symbols and legend sheets as listed in the Applicable Documents section, for acronyms and abbreviations used in the figures.

AEA	*Atomic Energy Act of 1954*
AI	analog input
DI	density indicator where in circle in square, discrete input where in triangle
DT	density transmitter
DOE	US Department of Energy
HDH	canister decontamination handling system
HLW	high-level waste
LAH	level alarm high
LAHH	level alarm high-high
LI	level indicator
LSH	level switch high
LSHH	level switch high-high
LSL	level switch low
LT	level transmitter
P&ID	piping and instrumentation diagram
WTP	Hanford Tank Waste Treatment and Immobilization Plant
PMP	pump
PWD	plant wash and disposal system
VSL	vessel

Glossary

control system	This term refers to electronic processors that perform regulatory and logic control functions necessary for normal operation of the plant.
local operator interface	This term refers to the interfaces at the cave faces where the operator will control the system.
interlock	Predetermined system equipment connection so that action of one part of the system affects the actions of another part of the system.
low-level control point	This term refers to a notification in the control system that is activated when the low level set point of the vessel has been reached.
high-level control point	This term refers to a notification in the control system that is activated when the high level set point of the vessel has been reached.
high-high level control point	This term refers to a notification in the control system that is activated when the high-high level set point of the vessel has been reached.
level signal	This term refers to information from an instrument measuring the height of fluid in a vessel.

1 Introduction

This document describes the instrument control logic for dangerous waste tanks and ancillary equipment for the canister decontamination handling (HDH) system within the high-level waste (HLW) facility as it pertains to the dangerous waste permit.

2 Applicable Documents

24590-HLW-3YD-HDH-00001, *Process System Description of HLW Canister Decontamination Handling System (HDH).*

24590-HLW-M6-HDH-P0001, *P&ID-HLW Canister Decontamination Handling System.*

24590-HLW-M6-HDH-P0002, *P&ID-HLW Canister Decontamination Handling System.*

24590-HLW-M6-HDH-P20001, *P&ID-HLW Canister Decontamination Handling System.*

24590-WTP-M6-50-P0001, *P&ID Symbols and Legend Sheet 1 of 6.*

24590-WTP-M6-50-P0002, *P&ID Symbols and Legend Sheet 2 of 6.*

24590-WTP-M6-50-P0003, *P&ID Symbols and Legend Sheet 3 of 6.*

24590-WTP-M6-50-P0004, *P&ID Symbols and Legend Sheet 4 of 6.*

24590-WTP-M6-50-P0005, *P&ID Symbols and Legend Sheet 5 of 6.*

24590-WTP-M6-50-P0006, *P&ID Symbols and Legend Sheet 6 of 6.*

3 Description

The tank and ancillary equipment associated with dangerous waste management within the HLW HDH process system are the following:

- HDH-VSL-00001 rinse tunnel canister rinse vessel
- HDH-VSL-00002 canister decontamination vessel 1
- HDH-VSL-00003 waste neutralization vessel
- HDH-VSL-00004 canister decontamination vessel 2
- HDH-PMP-00001 bogie decontamination canister pump

3.1 Rinse Tunnel Canister Rinse Vessel (HDH-VSL-00001) and Bogie Decontamination Canister Pump (HDH-PMP-00001)

The HDH system function is to decontaminate HLW canisters. The canisters are transferred from the HLW canister handling cave to the rinse tunnel canister rinse vessel (HDH-VSL-00001) after the lids are welded. The rinse tunnel canister rinse vessel (HDH-VSL-00001) is where the decontamination sequence starts. To prevent overflow, the rinse tunnel canister rinse vessel (HDH-VSL-00001) is equipped with a level transmitter.

When the operator is notified that the rinse tunnel canister rinse vessel (HDH-VSL-00001) is ready to rinse the canister, the operator will initiate the "rinse" sequence within the control system. When initiated, the control system verifies that all instruments, utilities, and equipment associated with the "rinse" cycle are within operational parameters. After all instrumentation is verified, demineralized water is sprayed on the canister and the control system starts the bogie decontamination canister pump (HDH-PMP-00001). The rinse is stopped by the control system when the level in the rinse tunnel canister rinse vessel (HDH-VSL-00001) reaches its high-high level control point, a specified volume has been sprayed on the canister, or the waste neutralization vessel (HDH-VSL-00003) reaches its high-level control point. After the "rinse" cycle is complete and the rinse tunnel canister rinse vessel (HDH-VSL-00001) low-level control point has been reached, the control system will notify the operator through the local operator interface that the rinsed canister can be transferred to one of the canister decontamination vessels (HDH-VSL-00002 or HDH-VSL-00004).

If the tank level is outside the normal operating range due to an abnormality, interlocks along with alarms within the control system prevent an overflow condition. Figure 1 shows the interlocks and alarms for the level instrument associated with the rinse tunnel canister rinse vessel (HDH-VSL-00001). Figure 1 also shows the level control logic for the bogie decontamination canister pump (HDH-PMP-00001). To prevent overflows and loss of primary containment, the control system alarms at high level values. The level signal can activate an interlock or alarm within the control system. Upon receiving the high alarm level signal, the control system indicates a high alarm to the operator and starts the bogie decon canister pump (HDH-PMP-00001). On a high-high alarm, the control system automatically stops all transfers into the rinse tunnel canister rinse vessel (HDH-VSL-00001) and alerts the operator.

3.2 Canister Decontamination Vessel 1 (HDH-VSL-00002) and Vessel 2 (HDH-VSL-00004)

When the water rinse cycle is complete in the rinse tunnel canister rinse vessel (HDH-VSL-00001), the canister is transferred to one of the canister decontamination vessels (HDH-VSL-00002 or HDH-VSL-00004) to be decontaminated with a cerium nitrate bath. Either of the canister decontamination vessels (HDH-VSL-00002 or HDH-VSL-00004) can perform the decontamination process. The canister decontamination vessels (HDH-VSL-00002 or HDH-VSL-00004) receive incoming transfers from the cerium^{4+} addition tank (HDH-TK-00002), and the nitric acid dilution and distribution tank (NAR-TK-00001). Transfers between these tanks and vessels will be measured and verified by the HLW control system. The canister decontamination vessels (HDH-VSL-00002 or HDH-VSL-00004) are limited by the control system to one transfer at a time, whether it be in or out of the vessel. The density of the liquid in the canister decontamination vessel (HDH-VSL-00002 or HDH-VSL-00004) is measured and used to accurately determine the level of liquid in the vessel.

The vessel is empty when it receives the canister. The operator will initiate the transfer-in sequence when the vessel has received the canister and is able to receive decontamination fluids. The controls for

transferring both nitric acid and cerium nitrate are the same, but they are initiated at different times. When the transfer-in sequence is initiated, the control system will verify that all instruments, utilities, and equipment associated with the transfer are within operational parameters. Specific volumes of nitric acid from the nitric acid dilution and distribution tank (NAR-TK-00001) and cerium4+ from the cerium 4+ addition tank (HDH-TK-00002) will be added to the canister decontamination vessel (HDH-VSL-00002 or HDH-VSL-00004). The transfer will be stopped by the control system when either the level in the canister decontamination vessel (HDH-VSL-00002 or HDH-VSL-00004) reaches its high control point or the level in the nitric acid dilution and distribution tank (NAR-TK-00001) reaches its low-level control point. When the transfer is stopped and the specified time for the canister to remain in the chemical bath has been reached, the control system will notify the operator through the local operator interface that the contents of the canister decontamination vessel (HDH-VSL-00002 or HDH-VSL-00004) are ready to be transferred.

The operator will initiate the transfer-out sequence within the control system. Upon sequence initiation, the control system verifies that all instruments, utilities, and equipment associated with the transfer are within operational parameters. The transfer is stopped by the control system when the level in the canister decontamination vessel (HDH-VSL-00002 or HDH-VSL-00004) reaches its low-level control point, a specified volume has been transferred, or the waste neutralization vessel (HDH-VSL-00003) reaches its high-level control point. When the low-level control point has been reached and the transfer is stopped, the control system will notify the operator through the plant control system interface that the canister decontamination vessel (HDH-VSL-00002 or HDH-VSL-00004) is empty and ready for the next step in the decontamination process.

If the vessel levels are outside the normal operating range due to an abnormality, interlocks along with alarms within the control system prevent an overflow condition. Figure 2 shows the interlocks and alarms for the level instrument associated with the canister decontamination vessels (HDH-VSL-00002 or HDH-VSL-00004). Table 1 shows the level instruments associated with the canister decontamination vessels (HDH-VSL-00002 or HDH-VSL-00004). To prevent overflows and loss of primary containment, the control system alarms at two different high values. Upon reaching the high alarm level, the control system indicates a high alarm to the operator and stops incoming transfers. On a high-high alarm, the control system automatically stops all transfers within the HDH system and alerts the operator.

3.3 Waste Neutralization Vessel (HDH-VSL-00003)

The waste neutralization vessel (HDH-VSL-00003) functions as the effluent collection and neutralization vessel for the HLW HDH System. The waste neutralization vessel (HDH-VSL-00003) is capable of receiving all the contents of all the vessels within the HDH system. The transfer is stopped by the control system when the level in the waste neutralization vessel (HDH-VSL-00003) reaches its high-level control point or a specified volume has been transferred. Once the transfer is stopped, the control system will notify the operator through the local operator interface that contents of the waste neutralization vessel (HDH-VSL-00003) are ready to be neutralized and transferred.

The operator will initiate the transfer-out sequence within the control system. When initiated, the control system verifies that all instruments, utilities, and equipment associated with the transfer are within operational parameters. The transfer is stopped by the control system either when the level in the waste neutralization vessel (HDH-VSL-00003) reaches its low-level control point, a specified volume has been transferred, or the acidic waste vessel (RLD-VSL-00007) reaches its high-level control point. Once the low-level control point has been reached and the transfer is stopped, the control system will notify the

operator through the plant control system interface that the waste neutralization vessel (HDH-VSL-00003) is ready to receive effluent.

If the level is outside the normal operating range due to an abnormality, interlocks along with alarms within the control system prevent an overflow condition. Figure 3 shows the interlocks and alarms for the level instrument associated with the waste neutralization vessel (HDH-VSL-00003). To prevent overflows and loss of primary containment, the control system alarms at two different high values. Upon reaching the high alarm level, the control system indicates a high alarm to the operator and stops incoming transfers. On a high-high alarm, the control system automatically stops all transfers within the HDH system and alerts the operator.

Table 1 Associated Instruments for HLW canister decontamination vessel 1 (HDH-VSL-00002) and HLW canister decontamination vessel 2 (HDH-VSL-00004)

Instrument Tag Number	Associated Vessel	Description
HDH-LT-0118	HDH-VSL-00002	level control
HDH-DT-0117	HDH-VSL-00002	density
HDH-LT-0218	HDH-VSL-00004	level control
HDH-DT-0217	HDH-VSL-00004	density

Figure 1 **Level Control for Rinse Tunnel Canister Rinse Vessel (HDH-VSL-00001) and Bogie Decontamination Canister Pump (HDH-PMP-00001)**

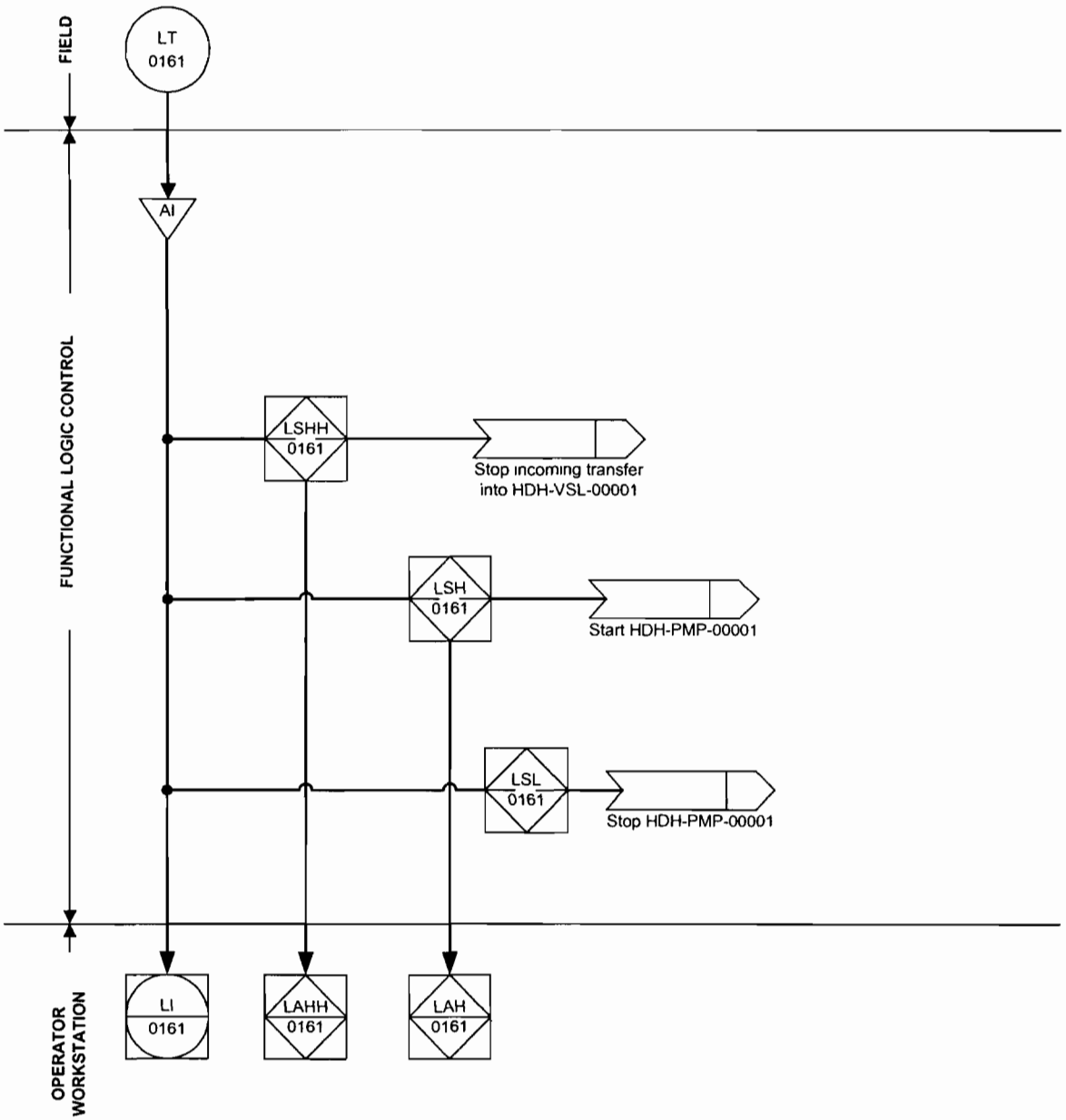


Figure 2 **Level Control for Canister Decontamination Vessel 1 (HDH-VSL-00002) and Canister Decontamination Vessel 2 (HDH-VSL-00004)**

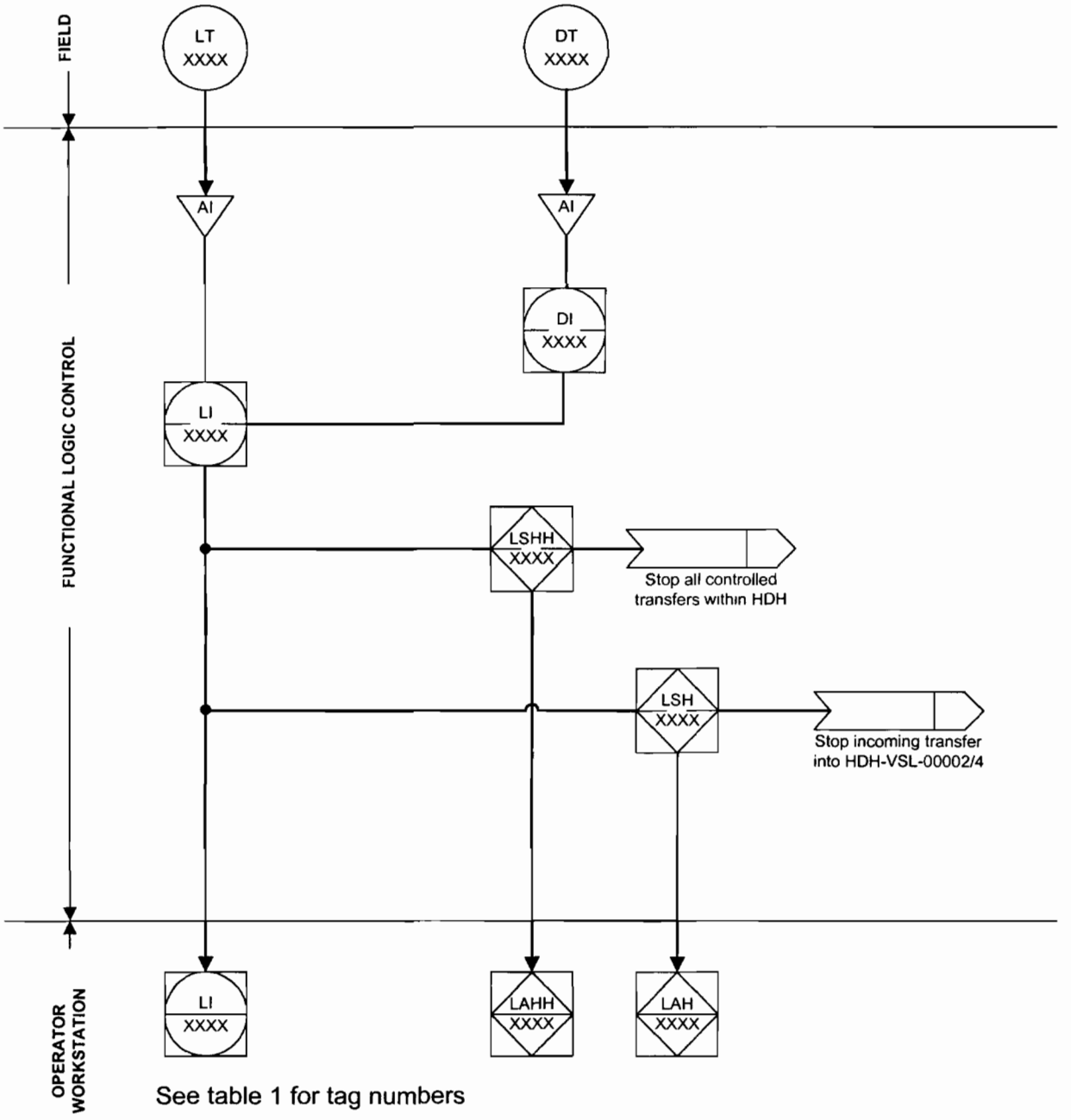
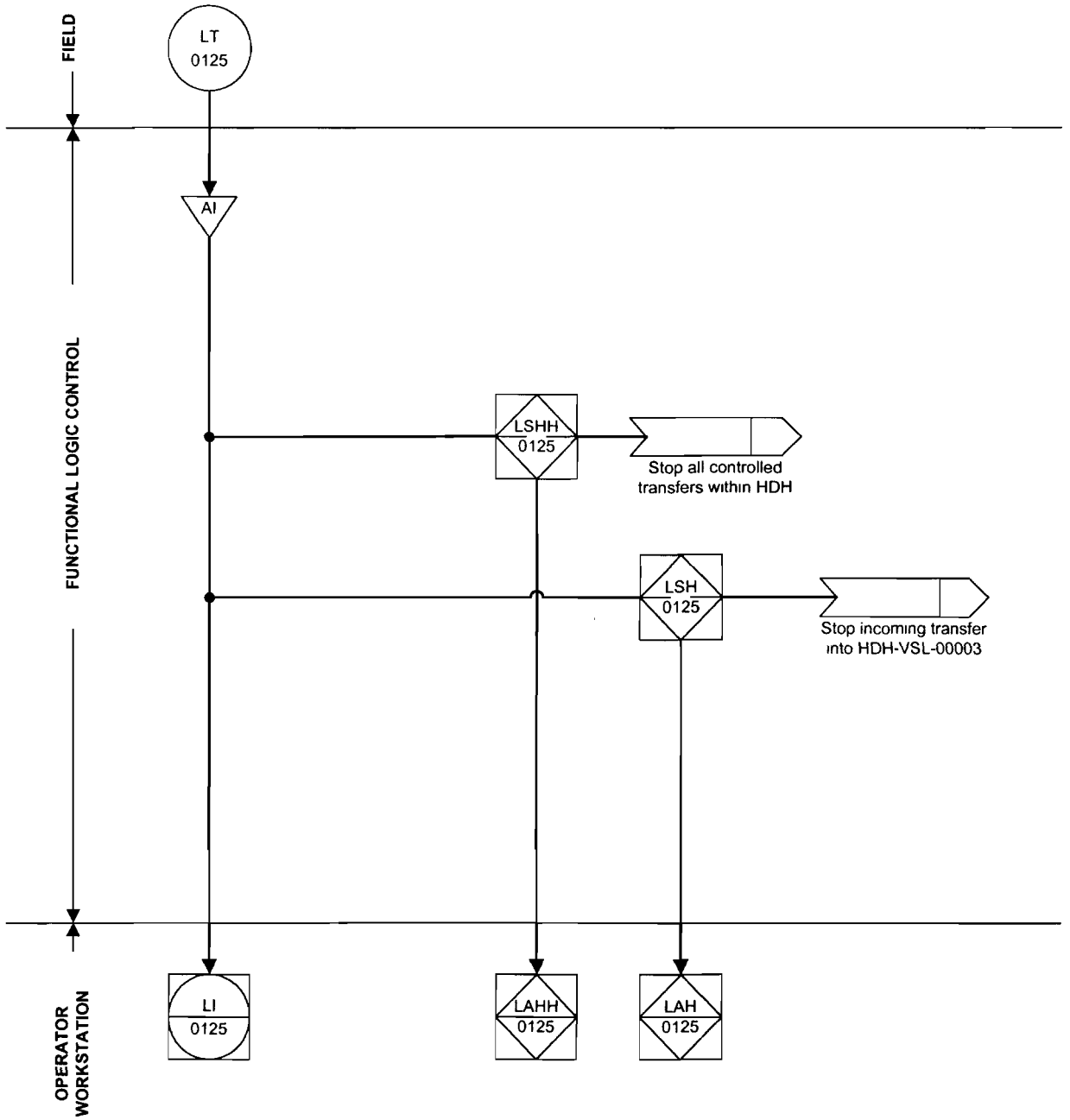


Figure 3 **Level Control for Waste Neutralization Vessel (HDH-VSL-00003)**



ISSUED
RPP-WTP
7/22/04
INIT DATE

R10337917

Document title: **System Logic Description for High-Level Waste Facility - Radioactive Liquid Waste Disposal System**

Contract number: DE-AC27-01RV14136

Department: Controls and Instrumentation

Author(s): R Frink

Principal author signature: R. Frink

Document number: 24590-HLW-PER-J-02-003, Rev 0

Checked by: A Coulam

Checker signature: Anthony L. Coulam

Date of issue: 21 July 04

Issue status: Issued for Permitting Use

Approved by: S. E. Anderson

Approver's position: C&I Discipline Engr Mgr

Approver signature: S. E. Anderson

MARK A. FRIEDRICH
STATE OF WASHINGTON
32426
REGISTERED
PROFESSIONAL ENGINEER

Mark A. Friedrich 7-15-04

EXPIRES: 08/31/04

This bound document contains a total of 15 sheets

River Protection Project
Waste Treatment Plant
2435 Stevens Center Place
Richland, WA 99352
United States of America
Tel: 509 371 2000

Notice

Please note that source, special nuclear, and byproduct materials, as defined in the *Atomic Energy Act of 1954* (AEA), are regulated at the US Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

History Sheet

Rev	Date	Reason for revision	Revised by
0	21 July 04	Issued for permitting use	R Frink

Contents

Notice ii
History Sheet iii
Acronyms and Abbreviations v
Glossary vi
1 Introduction 1
2 Applicable Documents 1
3 Description 2
3.1 System Requirements 2
3.2 Acidic Waste Vessel 3
3.3 The Plant Wash and Drains Vessel 3
3.4 The Offgas Drains Collection Vessel 4
3.5 Sumps 4

Tables

Table 1 Associated Instruments for HLW Acidic Waste Vessel (RLD-VSL-00007), Plant Wash and Drains Vessel (RLD-VSL-00008), and Offgas Drains Collection Vessel (RLD-VSL-00002) 5
Table 2 Associated Instruments for HLW Facility Sumps 6

Figures

Figure 1 Typical Level Measurement for the HLW Acidic Waste Vessel (RLD-VSL-00007) and the Plant Wash and Drains Vessel (RLD-VSL-00008) 7
Figure 2 Typical Level Measurement for Offgas Drains Collection Vessel (RLD-VSL-00002) 8
Figure 3 Typical Level Measurement for HLW Facility Sumps 9

Acronyms and Abbreviations

Reference the *P&ID Symbols and Legend Sheets*, as listed in the Applicable Documents section, for acronyms and abbreviations employed on the attached figures.

AEA	*Atomic Energy Act of 1954*
AI	analog input
DOE	US Department of Energy
HLW	high-level waste
HCP	HLW concentrate receipt process system
HDH	HLW canister decontamination handling system
HFP	HLW melter feed process system
HOP	HLW melter offgas treatment process system
HSH	HLW melter cave support handling system
LAH	level alarm high
LAHH	level alarm high-high
LI	level indicator
LOL	lower operating limit
LSH	level switch high
LSHH	level switch high-high
LT	level transmitter
P&ID	piping and instrumentation diagram
RLD	radioactive liquid waste disposal system
SDS	safety design significant
UOL	upper operating limit
VSL	vessel
WAC	Washington Administrative Code
WTP	Hanford Tank Waste Treatment and Immobilization Plant

Glossary

Control system	This term refers to the electronic processors that perform regulatory and logic control functions necessary for normal operation of the plant.
High level	This term refers to a notification in the control system that is activated when the high level setpoint of the vessel has been reached.
High-high level	This term refers to a notification in the control system that is activated when the high-high level setpoint of the vessel has been reached.
Interlock	Predetermined system equipment connections so that action of one part of the system affects the action of another part of the system.
LOL	Lower operating limit - A low level set point used to stop a transfer-out batch operation from the vessel under normal plant operations.
Transfer-in	Coordinates the effluent transfer into vessel by setting the appropriate valve alignment and facility communication.
Transfer-out	Coordinates the effluent transfer out of a vessel by setting the appropriate valve alignment and facility communication.
UOL	Upper operating limit - A high-level set point used to stop a transfer-in batch operation to the vessel under normal plant operation.

1 Introduction

This document describes the instrument control logic for the ancillary equipment in the radioactive liquid waste disposal system (RLD) within the high-level waste (HLW) facility associated with dangerous waste permit.

2 Applicable Documents

24590-HLW-M6-RLD-P0001, *P&ID-HLW Radioactive Liquid Waste Disposal System Active Effluent Collection.*

24590-HLW-M6-RLD-P0002, *P&ID - HLW Radioactive Liquid Waste Disposal System Plant Wash & Drains Vessel.*

24590-HLW-M6-RLD-P0003, *P&ID - HLW Radioactive Liquid Waste Disposal System Decontamination Tank & Sumps.*

24590-HLW-M6-RLD-P0004, *P&ID - HLW Radioactive Liquid Waste Disposal System Miscellaneous Sumps.*

24590-HLW-M6-RLD-P0006, *P&ID - HLW Radioactive Liquid Waste Disposal System Fluidics Air Rack RLD-RK-00023.*

24590-HLW-M6-RLD-P0007, *P&ID - HLW Radioactive Liquid Waste Disposal System Fluidics Air Rack RLD-RK-00024.*

24590-HLW-M6-RLD-P0008, *P&ID - HLW Radioactive Liquid Waste Disposal System Miscellaneous Sumps.*

24590-HLW-M6-RLD-P0014, *P&I - HLW Radioactive Liquid Waste Disposal System Offgas Drains Collection Vessel .*

24590-HLW-M6-RLD-P0015, *P&ID - HLW Radioactive Liquid Waste Disposal System Miscellaneous Sumps.*

24590-HLW-M6-RLD-P0016, *P&ID - HLW Radioactive Liquid Waste Disposal System Miscellaneous Sumps.*

24590-HLW-M6-RLD-P0017, *P&ID - HLW Radioactive Liquid Waste Disposal System Miscellaneous Sumps.*

24590-HLW-M6-RLD-P20003, *P&ID - HLW Radioactive Liquid Waste Disposal System Decontamination Tank & Sumps - Melter 2.*

24590-HLW-M6-RLD-P20004, *P&ID - HLW Radioactive Liquid Waste Disposal System Miscellaneous Sumps Melter 2.*

24590-HLW-M6-RLD-P20005, *P&ID - HLW Radioactive Liquid Waste Disposal System Miscellaneous Sumps Melter 2.*

24590-HLW-3YD-RLD-00001, *System Description for HLW Radioactive Liquid Waste Disposal (System RLD).*

WAC 173-303. "Dangerous Waste Characteristics", *Dangerous Waste Regulations. Washington Administration Code, as amended.*

3 Description

3.1 System Requirements

Radioactive liquid waste disposal (RLD) system sumps, in some cases, are not tagged with the RLD system. Sumps that are not tagged with the RLD system are tagged per the associated equipment within a facility room. Dangerous waste sump level measurement instruments that are all within the RLD system sumps are numbered with the RLD system designator. Vessels and the ancillary equipment associated with dangerous waste management that are within the HLW RLD system, but numbered per the facility room, are listed by tag number below.

HLW Sump PIN	HLW room number	Room Name	level measurement type
HCP-SUMP-00001	H-B014	wet process cell	radar
HDH-SUMP-00001	H-B039B	canister rinse tunnel	radar
HDH-SUMP-00002	H-B039A	canister rinse-bogie maintenance	radar
HDH-SUMP-00003	H-B035	canister decon cave	radar
HFP-SUMP-00002	H-0117	melter cave no. 1	radar
HFP-SUMP-00005	H-0106	melter cave no. 2	radar
HOP-SUMP-00003	H-B021	SBS drain collection cell no. 1	radar
HOP-SUMP-00008	H-B005	SBS drain collection cell no. 2	radar
HPH-SUMP-00001	H-0136	canister handling cave	radar
HPH-SUMP-00005	H-0136	canister handling cave	radar
HSH-SUMP-00003	H-0117	melter cave no. 1	bubbler
HSH-SUMP-00007	H-0106	melter cave no. 2	bubbler
HSH-SUMP-00008	H-0310A	melter no. 1 equipment decon pit	radar
HSH-SUMP-00009	H-0304A	melter no. 2 equipment decon pit	radar
RLD-SUMP-00001	H-B014	wet process cell	radar
HFP-SUMP-00001	H-0308	active services cell melter no. 1	none, drains to vessel RLD-VSL-00008
HFP-SUMP-00004	H-0302	active services cell melter no. 2	none, drains to vessel RLD-VSL-00008
RLD-VSL-00002	H-B014	wet process cell	radar
RLD-VSL-00007	H-B014	wet process cell	radar

HLW Sump PIN	HLW room number	Room Name	level measurement type
RLD-VSL-00008	H-B014	wet process cell	radar

3.2 Acidic Waste Vessel

The acidic waste vessel (RLD-VSL-00007) is used to store, process, and transfer acidic waste. For waste management reliability, transfers between vessels will be controlled by the control system for each vessel involved in the transfer. The acidic waste vessel (RLD-VSL-00007) is limited, by the control system, to one vessel volume transfer in or out at a time.

When the acidic waste vessel (RLD-VSL-00007) can receive effluent, the operator initiates the transfer-in sequence. The transfer-in sequence is monitored by the control system and stopped when the level in the acidic waste vessel (RLD-VSL-00007) reaches the upper operating limit (UOL), the specified transfer amount has been received, or the vessel transferring effluent to the acidic waste vessel (RLD-VSL-00007) reaches its lower operating limit (LOL). When the transfer is stopped by the control system, the operator is alerted. The effluent is sampled and tested, then the transfer-in sequence is completed. Based on the test results, the effluent is neutralized and prepared for transfer out.

When the effluent in the acidic waste vessel (RLD-VSL-00007) has been treated, the operator initiates the transfer-out sequence. The transfer-out sequence is stopped by the control system when the level in the acidic waste vessel (RLD-VSL-00007) reaches the LOL, the specified transfer amount has been transferred, or the receiving vessel reaches its UOL. When the transfer-out sequence is complete, the control system will alert the operator that the acidic waste vessel (RLD-VSL-00007) is ready to receive effluent.

Table 1 shows the level instruments associated with the acidic waste vessel (RLD-VSL-00007). Figure 1 shows the typical control system (UOL and LOL) for the level instruments associated with the acidic waste vessel (RLD-VSL-00007) level control. Two independent level signals can activate the control system to automatically stop transfer into or out of the acidic waste vessel (RLD-VSL-00007). The level limit, UOL, will alert the operator if level goes above the normal desired control range. If the vessel level is at level alarm high-high (LAHH) due to an abnormality, the vessel control system automatically stops transfer into the acidic waste vessel (RLD-VSL-00007) and alarms to alert the operator of the vessel level condition.

3.3 The Plant Wash and Drains Vessel

The plant wash and drains vessel (RLD-VSL-00008) is used to store, process, and transfer plant wash and drains effluent. Waste transfers between vessels will be measured and verified by the control system for the vessels involved in the transfer. The control system limits fluid transfer to one vessel volume transfer at a time.

The plant wash and drains vessel (RLD-VSL-00008) receives effluent intermittently from various systems and transfers from the offgas drains collection vessel (RLD-VSL-00002). When the plant wash and drains vessel (RLD-VSL-00008) is ready to receive effluent, the operator will initiate the transfer-in sequence. The transfer is monitored by the control system and stopped when the level in the plant wash and drains vessel (RLD-VSL-00008) reaches its UOL, the specified transfer amount has been received, or

the transferring vessel has reached its LOL. When the transfer is stopped by the control system, the operator is alerted.

When the transfer is complete, the effluent will be sampled and tested. Based on the results of this testing, the effluent will be neutralized and prepared for transfer. The operator will initiate the transfer-out sequence. The control system will stop the transfer when the plant wash and drains vessel (RLD-VSL-00008) reaches its LOL, the specified amount of effluent has been transferred, or the receiving vessel reaches its UOL.

Table 1 shows the level instruments associated with the plant wash and drains vessel (RLD-VSL-00008). Figure 1 shows the typical control system (UOL and LOL) for the level instruments associated with the plant wash and drains vessel (RLD-VSL-00008). Two independent level signals can activate the control system to automatically stop transfer into or out of the plant wash and drains vessel (RLD-VSL-00008). The UOL will alert the operator if level goes above the normal desired control range. If the effluent level is at LAHH due to an abnormality, the vessel control system automatically stops transfer into the plant wash and drains vessel (RLD-VSL-00008) and alarms to alert the operator of the vessel level condition.

3.4 The Offgas Drains Collection Vessel

The offgas drains collection vessel (RLD-VSL-00002) receives condensate from the low points in the offgas ducts. Little to no effluent is received during normal operation. When the offgas drains collection vessel (RLD-VSL-00002) reaches its UOL, the control system will alert the operator through the plant control system interface.

When notified by the control system, the operator will initiate a transfer-out sequence. The transfer is stopped by the control system when the effluent level in the offgas drains collection vessel (RLD-VSL-00002) reaches its LOL, the effluent level in the plant wash and drains vessel (RLD-VSL-00008) reaches its UOL, or the specified transfer amount has been transferred. If the effluent level in the offgas drains collection vessel (RLD-VSL-00002) goes below the LOL, the control system will alert the operator to initiate a procedure to add the appropriate amount of water to put the fluid at the LOL.

If the effluent level rises above the normal operating range due to an abnormality, the LAHH interlock, along with alarms within the control system, will alert the operator of a possible overflow condition and stop the transfer of effluent into the offgas drains collection vessel (RLD-VSL-00002). Table 1 shows the level instruments associated with the offgas drains collection vessel (RLD-VSL-00002). Figure 2 shows the interlock and alarms system for the level instruments associated with the offgas drains collection vessel (RLD-VSL-00002). The control system will alarm at two high values. Each level signal can activate an interlock or alarm in the control system to alert the operator.

3.5 Sumps

All sumps for dangerous waste systems are designed for secondary containment during abnormal operating instances. Sump alarms may be caused by abnormal conditions, such as system leaks or overflows. Sump level transmitters will alarm when the sump fluid level reaches the high level to trigger operator investigation and action.

Table 2 shows the level instruments associated with the sumps. Figure 3 shows the alarm setting for the level instruments associated with each sump within the HLW facility.

Table 1 **Associated Instruments for HLW Acidic Waste Vessel (RLD-VSL-00007), Plant Wash and Drains Vessel (RLD-VSL-00008), and Offgas Drains Collection Vessel (RLD-VSL-00002)**

Instrument Tag Number	Associated Vessel	Description
RLD-LT-3153	RLD-VSL-00007	SDS level measurement sensor
RLD-LT-3154	RLD-VSL-00007	SDS level measurement sensor
RLD-LT-3241	RLD-VSL-00008	SDS level measurement sensor
RLD-LT-3242	RLD-VSL-00008	SDS level measurement sensor
RLD-LT-3024	RLD-VSL-00002	normal level measurement senor
RLD-LT-3027	RLD-VSL-00002	normal level measurement sensor

Table 2 Associated Instruments for HLW Facility Sumps

Instrument Tag Number	Sump	Description
RLD-LT-3014	HCP-SUMP-00001	level measurement sensor
RLD-LT-3215	RLD-SUMP-00001	level measurement sensor
RLD-LT-3413	HDH-SUMP-00003	level measurement sensor
RLD-LT-3102	HOP-SUMP-00003	level measurement sensor
RLD-LT-3416	HDH-SUMP-00001	level measurement sensor
RLD-LT-3172	HOP-SUMP-00008	level measurement sensor
RLD-LT-3411	HPH-SUMP-00001	level measurement sensor
RLD-LT-3403	HPH-SUMP-00005	level measurement sensor
RLD-LT-3803	HFP-SUMP-00002	level measurement sensor
RLD-LT-3805	HSH-SUMP-00003	level measurement sensor
RLD-LT-3853	HFP-SUMP-00005	level measurement sensor
RLD-LT-3333	HSH-SUMP-00008	level measurement sensor
RLD-LT-3855	HSH-SUMP-00007	level measurement sensor
RLD-LT-3383	HSH-SUMP-00009	level measurement sensor
RLD-LT-3418	HDH-SUMP-00002	level measurement sensor

Figure 1 Typical Level Measurement for the HLW Acidic Waste Vessel (RLD-VSL-00007) and the Plant Wash and Drains Vessel (RLD-VSL-00008)

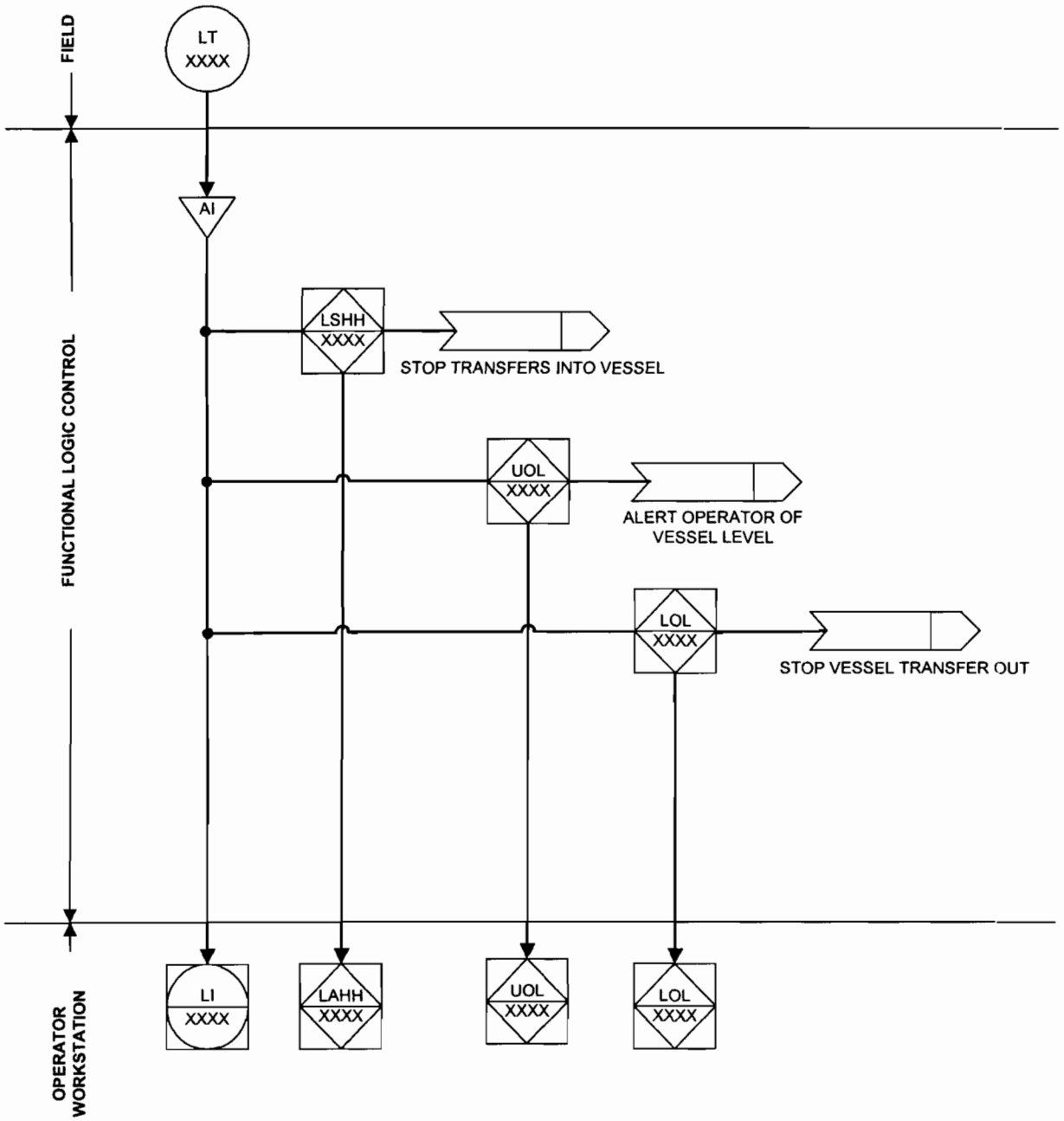


Figure 2 Typical Level Measurement for Offgas Drains Collection Vessel (RLD-VSL-00002)

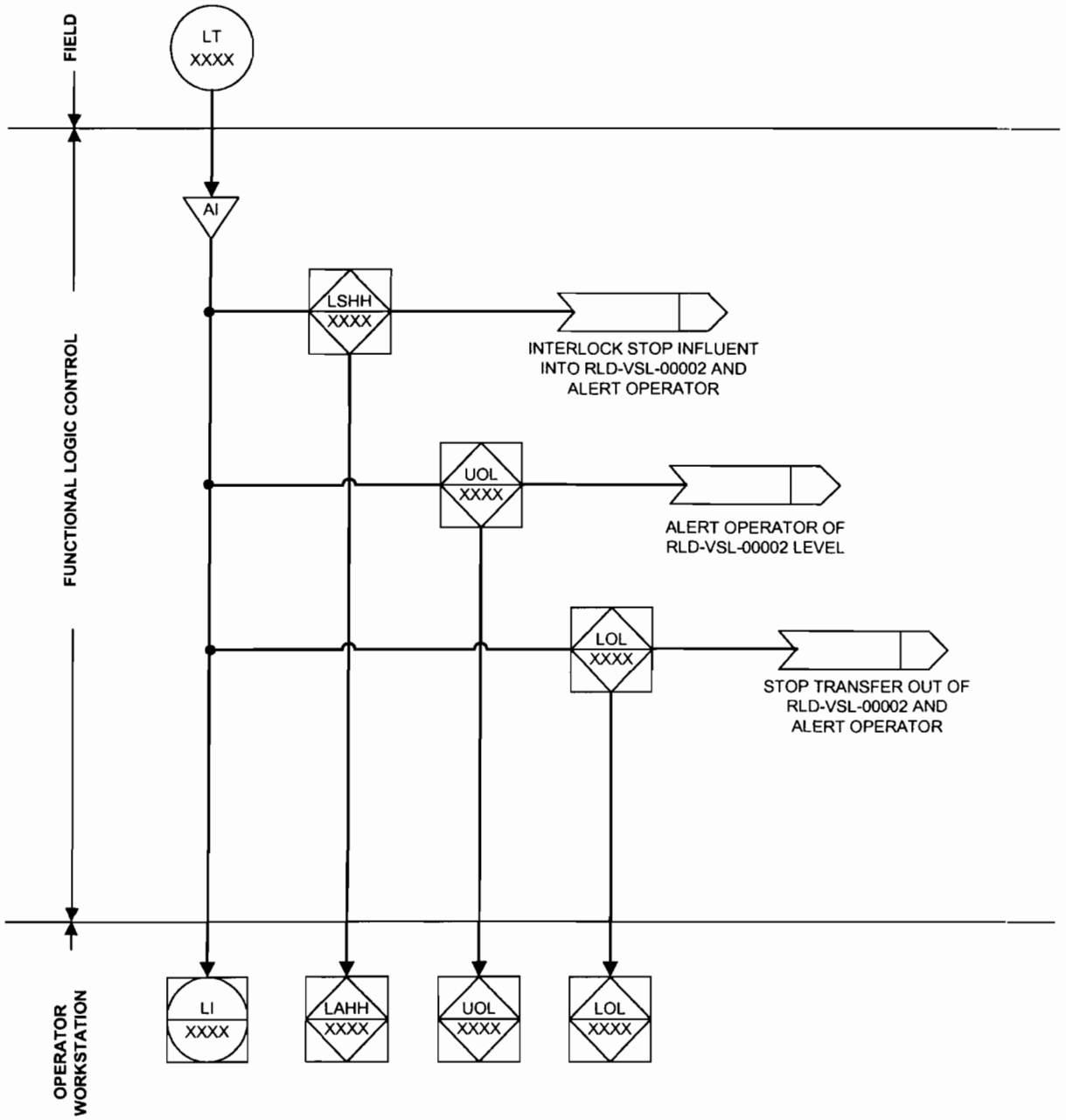
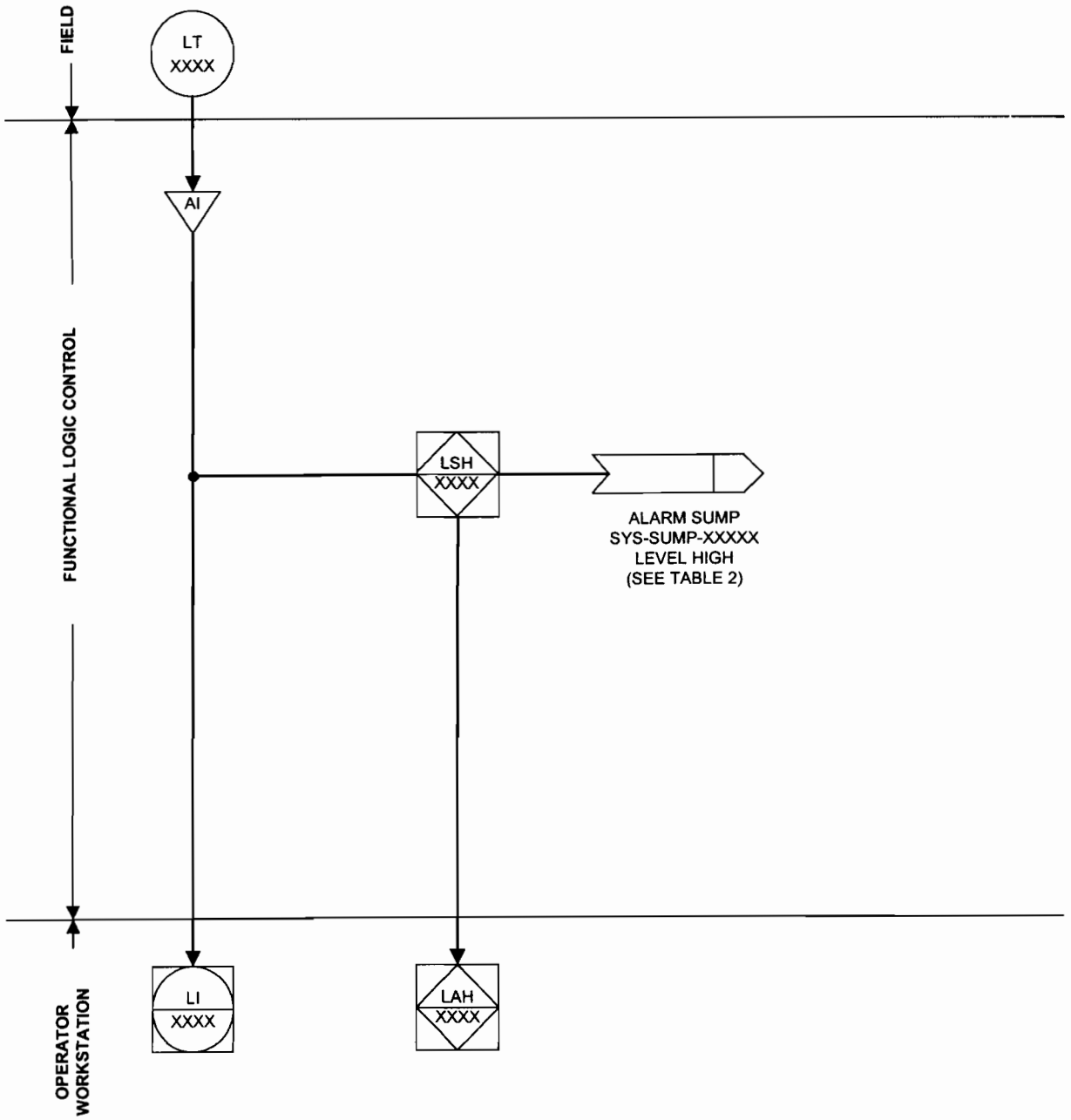


Figure 3 Typical Level Measurement for HLW Facility Sumps



R10308873

ISSUED BY
RPP-WTP PDC
TSM 5/4/04
INIT DATE

Document title: **System Logic Description for High-Level Waste Facility - Melter Feed (HFP) System**

Contract number: DE-AC27-01RV14136

Department: Controls and Instrumentation

Author(s): Henry Webber

Principal author signature: Henry Webber

Document number: 24590-HLW-PER-J-04-0001, Rev 0

Checked by: Kevin D. Smith

Checker signature:

Date of issue: 30 April 2004

Issue status: Issued for Permitting Use

Approved by: Steve Anderson

Approver's position: C&I Discipline Engineering Manager

Approver signature: S. E. Anderson

HENRY CLINTON WEBBER
STATE OF WASHINGTON
39756
REGISTERED
PROFESSIONAL ENGINEER

Henry Clinton Webber

EXPIRES 5-29-04

This bound document contains a total of 8 sheets

River Protection Project
Waste Treatment Plant
2435 Stevens Center Place
Richland, WA 99352
United States of America
Tel: 509 371 2000

Notice

Please note that source, special nuclear and byproduct materials, as defined in the *Atomic Energy Act of 1954* (AEA), are regulated at the US Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

History Sheet

Rev	Date	Reason for revision	Revised by
0	30 April 2004	Issued for permitting use	H Webber

Contents

Notice ii
History Sheet iii
Glossary v
1 Introduction 1
2 Applicable Documents 1
3 Description 1
3.1 Melters 1 and 2 Melter Feed Preparation Vessels 2
3.2 Melters 1 and 2 Melter Feed Vessels 2

Tables

Table 1 Associated Instruments for Melters 1 and 2 Melter Feed Preparation Vessels 2
Table 2 Associated Instruments for Melters 1 and 2 Melter Feed Vessels 2

Figures

Figure 1 Typical Level Measurement for Melter Feed Preparation Vessels and Melter Feed Vessels 3

Glossary

Batch control	This term refers to control activities and control functions that provide an ordered set of processing activities to complete a batch process.
Batch process	A batch process leads to the production of a finite quantity of material by subjecting quantities of input material to an ordered set of processing activities over a finite period using one or more pieces of equipment.
Control system	This term refers to electronic processors that perform regulatory and logic control functions necessary for normal operation of the plant.
Exception handling	This term refers to those functions that deal with plant or process contingencies and other events that occur outside the normal or desired behavior of batch control.
High level	This term refers to a notification in the control system that is activated when the high level setpoint of the vessel has been reached.
High-high level	This term refers to a notification in the control system that is activated when the high-high level setpoint of the vessel has been reached.
Interlock	Predetermined system equipment connections so that action of one part of the system affects the action of another part of the system.
Low level	This term refers to a notification in the control system that is activated when the low level setpoint of the vessel has been reached.
Low-low level	This term refers to a notification in the control system that is activated when the low-low level setpoint of the vessel has been reached.

1 Introduction

This document describes the instrument control logic for dangerous waste vessels and ancillary equipment associated with the high level waste (HLW) facility melter feed process (HFP) system as they pertain to the dangerous waste permit.

2 Applicable Documents

24590-WTP-M6-50-P0001, *P&ID Symbols and Legend Sheet 1 of 6*

24590-WTP-M6-50-P0002, *P&ID Symbols and Legend Sheet 2 of 6*

24590-WTP-M6-50-P0003, *P&ID Symbols and Legend Sheet 3 of 6*

24590-WTP-M6-50-P0004, *P&ID Symbols and Legend Sheet 4 of 6*

24590-WTP-M6-50-P0005, *P&ID Symbols and Legend Sheet 5 of 6*

24590-WTP-M6-50-P0006, *P&ID Symbols and Legend Sheet 6 of 6*

24590-HLW-M6-HFP-P0001, *P&ID - HLW Melter Feed Process System Melter Feed Preparation Vessel HFP-VSL-00001 (Q)*

24590-HLW-M6-HFP-P0002, *P&ID - HLW Melter Feed Process System Melter Feed Vessel HFP-VSL-00002 (Q)*

24590-HLW-M6-HFP-P20001, *P&ID - HLW Melter Feed Process System Melter Feed Preparation Vessel HFP-VSL-00005 (Melter 2) (Q)*

24590-HLW-M6-HFP-P20002, *P&ID - HLW Melter Feed Process System Melter Feed Vessel HFP-VSL-00006 (Melter 2) (Q)*

24590-HLW-3YD-HFP-00001, *System Description for HLW Melter Feed (System HFP)*

3 Description

The HLW HFP system vessels and ancillary equipment included in the dangerous waste permit are the following:

- HFP-VSL-00001 melter 1 feed preparation vessel
- HFP-VSL-00002 melter 1 feed vessel
- HFP-VSL-00005 melter 2 feed preparation vessel
- HFP-VSL-00006 melter 2 feed vessel

3.1 Melters 1 and 2 Melter Feed Preparation Vessels

The melter feed preparation vessels (HFP-VSL-00001 and HFP-VSL-00005) receive waste concentrate from the HLW concentrate receipt system, mix it with glass formers from the HLW glass formers system, sample the resulting slurry, then transfer the slurry to the corresponding melter feed vessels. Each vessel is equipped with an agitator to keep the contents mixed, two mechanical pumps to pump the slurry to the sampling system or the melter feed vessel, and a steam-powered ejector that allows the contents to be transferred to the radioactive liquid waste disposal (RLD) system. Level instrumentation consists of a radar level transmitter. Table 1 lists the level transmitters.

Before any transfer into the melter feed preparation vessel, the available volume is checked by the control system. If it is not sufficient to receive the planned transfer, the operation does not begin. At all times, a high-high level interlock is active to stop all controlled streams coming into the vessel. An alarm alerts the operator that the interlock has activated. See Figure 1.

3.2 Melters 1 and 2 Melter Feed Vessels

The melter feed vessels (HFP-VSL-00002 and HFP-VSL-00006) receive waste slurry from the melter feed preparation vessels in batches and transfer the material to the corresponding melters in a continuous feed. The vessel transfers feed to the melter until a low-level setpoint is reached. While the feed to the melter continues, a new batch is transferred from the melter feed preparation vessel. This cycle continues as long as the melter is receiving feed. Each vessel is equipped with an agitator to keep the contents mixed, two air displacement slurry pumps to transfer slurry to the melter, one mechanical pump for sampling, and a steam-powered ejector that allows the contents to be transferred to the RLD system. Level instrumentation consists of a radar level transmitter. Table 2 lists the level transmitters.

Before any transfer into the melter feed vessel, the available volume is checked by the control system. If it is not sufficient to receive the planned transfer, the operation does not begin. At all times, a high-high level interlock is active to stop all controlled streams coming into the vessel. An alarm alerts the operator that the interlock has activated. See Figure 1.

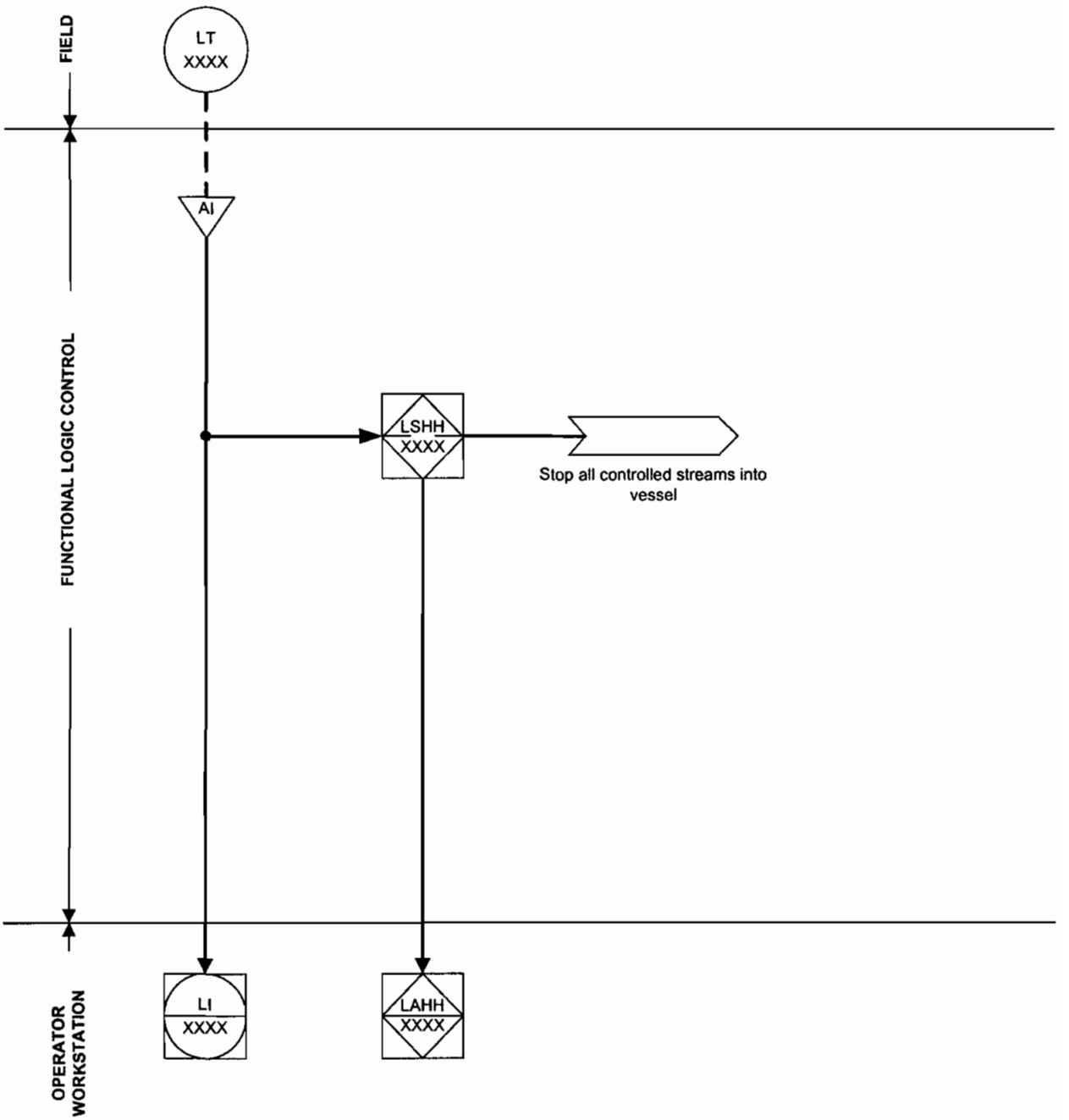
Table 1 Associated Instruments for Melters 1 and 2 Melter Feed Preparation Vessels

Instrument Number	Associated Vessel	Description
HFP-LT-0050	HFP-VSL-00001	Radar level transmitter
HFP-LT-2050	HFP-VSL-00005	Radar level transmitter

Table 2 Associated Instruments for Melters 1 and 2 Melter Feed Vessels

Instrument Number	Associated Vessel	Description
HFP-LT-0047	HFP-VSL-00002	Radar level transmitter
HFP-LT-2047	HFP-VSL-00006	Radar level transmitter

Figure 1 **Typical Level Measurement for Melter Feed Preparation Vessels and Melter Feed Vessels**



AI	analog input
LAHH	level alarm high high
LI	level indicator
LSHH	level switch high high
LT	level transmitter

R10382884

ISSUED BY
RPP-WTP PDC

Document title: **System Logic Description for High-Level Waste Facility - Pulse Jet Ventilation System**

Contract number: DE-AC27-01RV14136

Department: Controls and Instrumentation

Author(s): R Frink

Principal author signature: Robert O. Frink

Document number: 24590-HLW-PER-J-04-0002, Rev 0

Checked by: A Coulam

Checker signature: Anthony L. Coulam

Date of issue: 23 Sept 04

Issue status: Issued for Permitting Use

Approved by: S. E. Anderson

Approver's position: C & I Discipline Engineering Manager

Approver signature: S. E. Anderson

MARK A. FRIEDRICH
STATE OF WASHINGTON
32426
REGISTERED
PROFESSIONAL ENGINEER

Mark A. Friedrich 9-23-04

EXPIRES 08/31/06

This bound document contains a total of 9 sheets

River Protection Project
Waste Treatment Plant
2435 Stevens Center Place
Richland, WA 99352
United States of America
Tel: 509 371 2000

Notice

Please note that source, special nuclear, and byproduct materials, as defined in the *Atomic Energy Act of 1954* (AEA), are regulated at the US Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

History Sheet

Rev	Date	Reason for revision	Revised by
0	23Sept 04	Issued for permitting use	R Frink

Contents

Notice ii
History Sheet iii
Acronyms and Abbreviations v
Glossary vi
1 Introduction 1
2 Applicable Documents 1
3 Description 1
3.1 Function 1
3.2 High Efficiency Particulate Air (HEPA) Filter System 2

Tables

Table 1. Associated Instrument Sensors for HLW PJV High Efficiency Particulate Air (HEPA) Filters 2

Figures

Figure 1. Typical Pressure Differential Measurement for PJV High Efficiency Particulate Air (HEPA) Filters 3

Acronyms and Abbreviations

Reference the *P&ID Symbols and Legend Sheets*, as listed in the Applicable Documents section, for acronyms and abbreviations employed on the attached figures.

AEA	*Atomic Energy Act of 1954*
AI	analog input
ASD	adjustable speed drive
ASX	autosampling system
DOE	US Department of Energy
HLW	high-level waste
JPP	jet pump pair
PJV	pulse jet ventilation system
PDI	pressure differential indicator
PDT	pressure differential transmitter
P&ID	piping and instrumentation diagram
SS	safety significant
VSL	vessel
WAC	Washington Administrative Code
WTP	Hanford Tank Waste Treatment and Immobilization Plant

Glossary

Control system	This term refers to the electronic processors that perform regulatory and logic control functions necessary for normal operation of the plant.
feed forward control	Anticipatory control which tries to predict the effect on one part of the system due to a change in another and takes action to reduce the consequences to minimize the disturbances after they have occurred.
Pressure differential high	This term refers to a notification in the control system that is activated when high differential pressure setpoint has been reached.
Transfer-out	Coordinates the transfer out of a vessel by setting the appropriate valve alignment and facility communication.

1 Introduction

This document describes the instrument control logic for the ancillary equipment in the pulse jet ventilation system (PJV) within the high-level waste (HLW) facility associated with the dangerous waste permit.

2 Applicable Documents

24590-HLW-M6-PJV-P0001, *P&ID-HLW Pulse Jet Ventilation System.*

24590-HLW-M6-PJV-P0002, *P&ID - HLW Pulse Jet Ventilation Treatment System.*

WAC 173-303, *Dangerous Waste Regulations. Washington Administration Code, as amended.*

24590-HLW-3YD-PJV-00001, *System Description for HLW Pulse Jet Ventilation System (System PJV).*

3 Description

The HLW PJV system plant items included in the dangerous waste permit are:

- PJV-HTR-00002 Pulse ventilation HEPA pre-heater
- PJV-HEPA-00004A PJV system HEPA Filter (primary)
- PJV-HEPA-00004B PJV system HEPA Filter (standby primary)
- PJV-HEPA-00005A PJV system HEPA Filter (secondary)
- PJV-HEPA-00005B PJV system HEPA Filter (standby secondary)
- PJV-FAN-00002A Pulse vent extraction fan
- PJV-FAN-00002B Pulse vent extraction fan

3.1 Function

Fluidic equipment is used for waste treatment operation to mix liquids and slurries in process vessels. Types of fluidics equipment include pulse jet mixers (PJM), transfer reverse flow diverters (RFD), and sampling RFDs. The PJMs mix fluids within a vessel; RFDs transfer process fluid out of a vessel, and sampling RFDs transfer process fluid to the autosampling system (ASX). Fluidics equipment exhaust produces emissions, as part of its normal operation, that must be contained and treated before discharge.

Fluidic equipment PJMs and RFDs use compressed air to force a vessel's process liquid to be mixed using the PJM or transfer out of a vessel via a RFD. Exhaust from the fluidic equipment into the PJV header is drawn through the PJV system electric pre-heater and high efficiency particulate air (HEPA) filter by a fan prior to emission discharge to the atmosphere through a dedicated PJV system stack.

The intent of the process control system is to maintain a vacuum in the PJV system relative to the surrounding cave. Pressure in the PJV system must be monitored to ensure that the system pressure

remains negative with respect to ambient pressure and ensures that the pressure limits for the PJV system are not exceeded.

Fluidic equipment creates flow rates of emissions, which vary over the various fluidics operation cycles. The total emissions flow rate varies depending on how the fluidics cycles combine at a particular time and the number of fluidics equipment operating at a particular time.

To control pressure limits, system pressure measurement is a feed forward signal to control exhaust fan speed, via the adjustable speed drive (ASD). The exhaust fan maintains the PJV system under a vacuum while emissions are discharged into the system from the fluidics equipment. The PJV fans, one operating and one in standby, draw emissions through the pre-heater, HEPA filters, and out to the atmosphere via a dedicated exhaust stack.

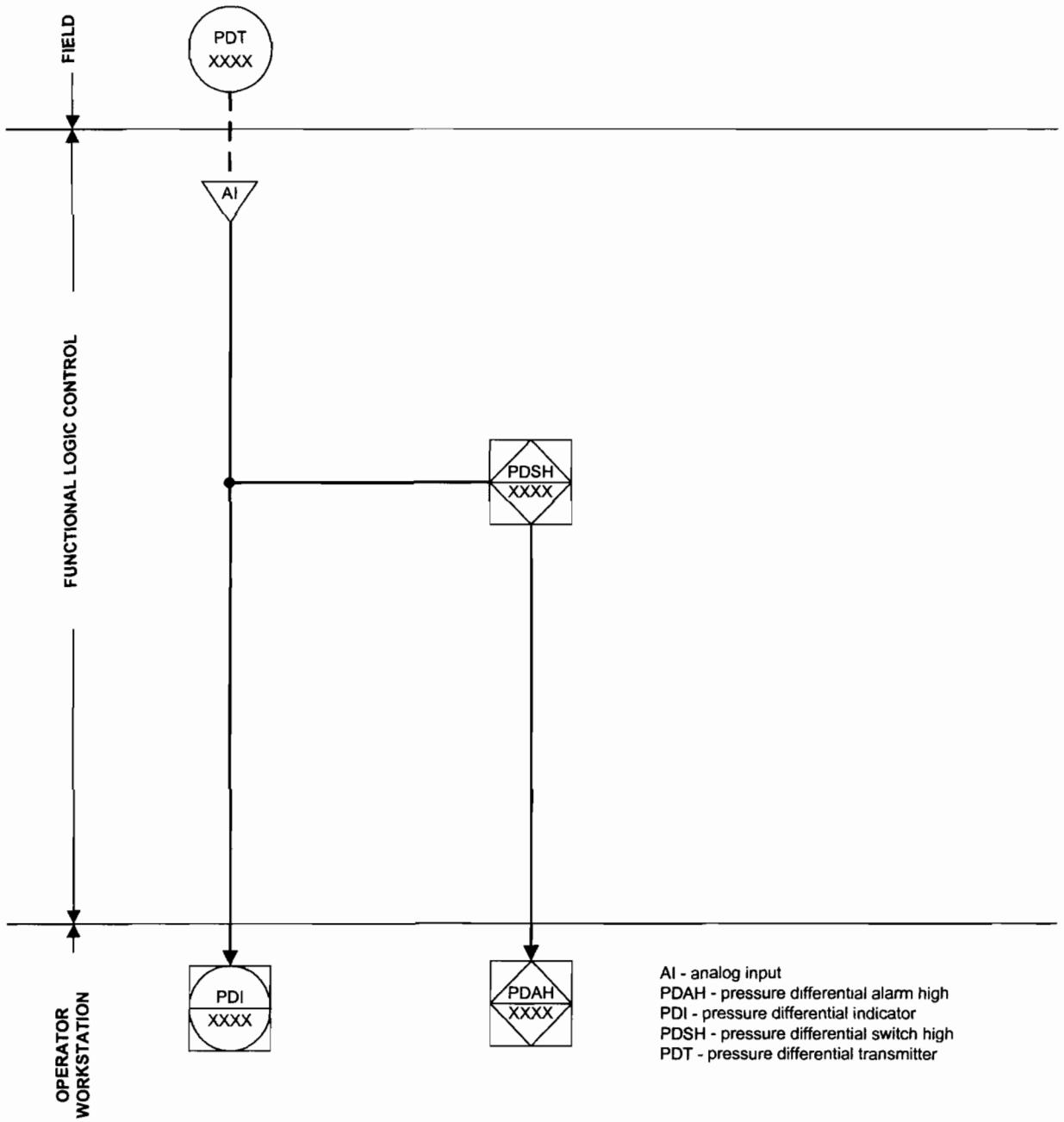
3.2 High Efficiency Particulate Air (HEPA) Filter System

The purpose of the HEPA filters is to provide high efficiency submicron particulate removal. The HEPA filters will be periodically tested for particulate removal efficiency to validate performance. Figure 1 shows the typical pressure differential instrument function and tag numbers listed in Table 1, which are associated with the HEPA filters.

Table 1. Associated Instrument Sensors for HLW PJV High Efficiency Particulate Air (HEPA) Filters

Instrument Tag Number	Associated Equipment	Description
PJV-PDT-3005	PJV-HEPA-00004A	pressure differential sensor
PJV-PDT-3006	PJV-HEPA-00005A	pressure differential sensor
PJV-PDT-3007	PJV-HEPA-00004B	pressure differential sensor
PJV-PDT-3008	PJV-HEPA-00005B	pressure differential sensor

Figure 1. Typical Pressure Differential Measurement for PJV High Efficiency Particulate Air (HEPA) Filters



ISSUED BY
RPP-WTP PDC

R10405644

Document title: **System Logic Description for High-Level Waste Facility - Melter Cave Support Handling System Decontamination Tank**

Contract number: DE-AC27-01RV14136

Department: Controls and Instrumentation

Author(s): R. O. Frink

Principal author signature: Robert O. Frink

Document number: 24590-HLW-PER-J-04-0003, Rev 0

Checked by: A. L. Coulam

Checker signature: Anthony L. Coulam

Date of issue: 26 Oct 04

Issue status: Issued for Permitting Use

Approved by: S. E. Anderson

Approver's position: C& I Discipline Engineering Manager

Approver signature: S. E. Anderson

ROBERT OSCAR FRINK
STATE OF WASHINGTON
36041
REGISTERED
PROFESSIONAL ENGINEER
Robert O. Frink
EXPIRES: 03-31-06

This bound document contains a total of 10 sheets

River Protection Project
Waste Treatment Plant
2435 Stevens Center Place
Richland, WA 99352
United States of America
Tel: 509 371 2000

Notice

Please note that source, special nuclear, and byproduct materials, as defined in the *Atomic Energy Act of 1954* (AEA), are regulated at the US Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

History Sheet

Rev	Date	Reason for revision	Revised by
0	10-26-04	Issued for permitting use	R Frink

Contents

Notice ii
History Sheet iii
Acronyms and Abbreviations v
Glossary vi
1 Introduction 1
2 Applicable Documents 1
3 Description 1
3.1 System 1
3.2 Transfer Control Logic 1

Tables

Table 1 Instruments for HLW HSH Decontamination Tank (HSH-TK-00001), Melter 1 and Decontamination Tank (HSH-TK-00002), Melter 2 3

Figures

Figure 1 Typical Level Measurement for HLW HSH Decontamination Tank HSH-TK-00001) for Melter 1 and Decontamination Tank (HSH-TK-00002) for Melter 2. 4

Acronyms and Abbreviations

Reference the *P&ID Symbols and Legend Sheets*, as listed in the Applicable Documents section, for acronyms and abbreviations employed on the attached figures.

AEA	*Atomic Energy Act of 1954*
AI	analog input
Decon	decontamination
DOE	US Department of Energy
HLW	high-level waste
HSH	HLW melter cave support handling system
LAH	level alarm high
LAHH	level alarm high-high
LI	level indicator
LOL	lower operating limit
LSH	level switch high
LSHH	level switch high-high
LT	level transmitter
P&ID	piping and instrumentation diagram
RLD	radioactive liquid waste disposal system
TK	tank
UOL	upper operating limit
WAC	Washington Administrative Code
WTP	Hanford Tank Waste Treatment and Immobilization Plant

Glossary

Control system	This term refers to the electronic processors that perform regulatory and logic control functions necessary for normal operation of the plant.
High level	This term refers to a notification in the control system that is activated when the high level setpoint of the vessel has been reached.
High-high level	This term refers to a notification in the control system that is activated when the high-high level setpoint of the vessel has been reached.
Interlock	Predetermined system equipment connections so that action of one part of the system affects the action of another part of the system.
LOL	Lower operating limit - A low level set point used to stop a transfer-out batch operation from the vessel under normal plant operations.
Transfer-in	Coordinates the effluent transfer into a vessel by setting the appropriate valve alignment and facility communication.
Transfer-out	Coordinates the effluent transfer out of a vessel by setting the appropriate valve alignment and facility communication.
UOL	Upper operating limit - A high level set point used to stop a transfer-in batch operation to the vessel under normal plant operation.

1 Introduction

This document describes the instrument control logic for the high-level waste (HLW) facility decontamination tanks within the melter cave support handling system associated with the dangerous waste permit.

2 Applicable Documents

24590-HLW-M6-RLD-P0003, *P&ID - HLW Radioactive Liquid Waste Disposal System Decontamination Tank & Sumps.*

24590-HLW-M6-RLD-P20003, *P&ID - HLW Radioactive Liquid Waste Disposal System Decontamination Tank & Sumps - Melter 2.*

24590-HLW-PER-J-02-003, *System Logic Description for HLW Facility Radioactive Liquid Waste Disposal System.*

WAC 173-303, *Dangerous Waste Regulations. Washington Administration Code, as amended.*

3 Description

3.1 System

The radioactive liquid waste disposal (RLD) system is the receipt system for the HLW melter support handling system (HSH) decontamination tank liquid. Instruments for the decontamination tank level and density are tagged with the RLD system tag numbers. Decontamination tank level measurement will not always be based on water pressure differential. The tank headspace is considered a constant pressure and the density of the liquid will be variable. Tank liquid density changes are used to sense and compensate the tank level measurement. Density compensation is via a calculation within the control system.

The decontamination tanks control system instruments have tag numbers with the HSH system designator. The ancillary equipments in the dangerous waste permit are:

- HSH-TK-00001 decontamination tank melter cave 1
- HSH-TK-00002 decontamination tank melter cave 2

3.2 Transfer Control Logic

The decontamination tanks (HSH-TK-00001 or HSH-TK-00002) are used to decontaminate equipment prior to hands on repair. Liquid waste may be periodically transferred from the HSH decontamination tanks (HSH-TK-00001 or HSH-TK-00002) to the RLD plant wash and drains vessel (RLD-VSL-00008). Liquid waste transfers between the decontamination tanks (HSH-TK-00001 or HSH-TK-00002) and the RLD plant wash and drains vessel (RLD-VSL-00008) will be controlled by the control system. Level instrumentation and control to prevent overfill of the RLD receipt vessel are provided in System Logic

Description for High Level Waste Facility - Radioactivity Liquid Waste Disposal System. Transfers will be limited to one decontamination tank volume transfer from one of the two decontamination tanks at a time.

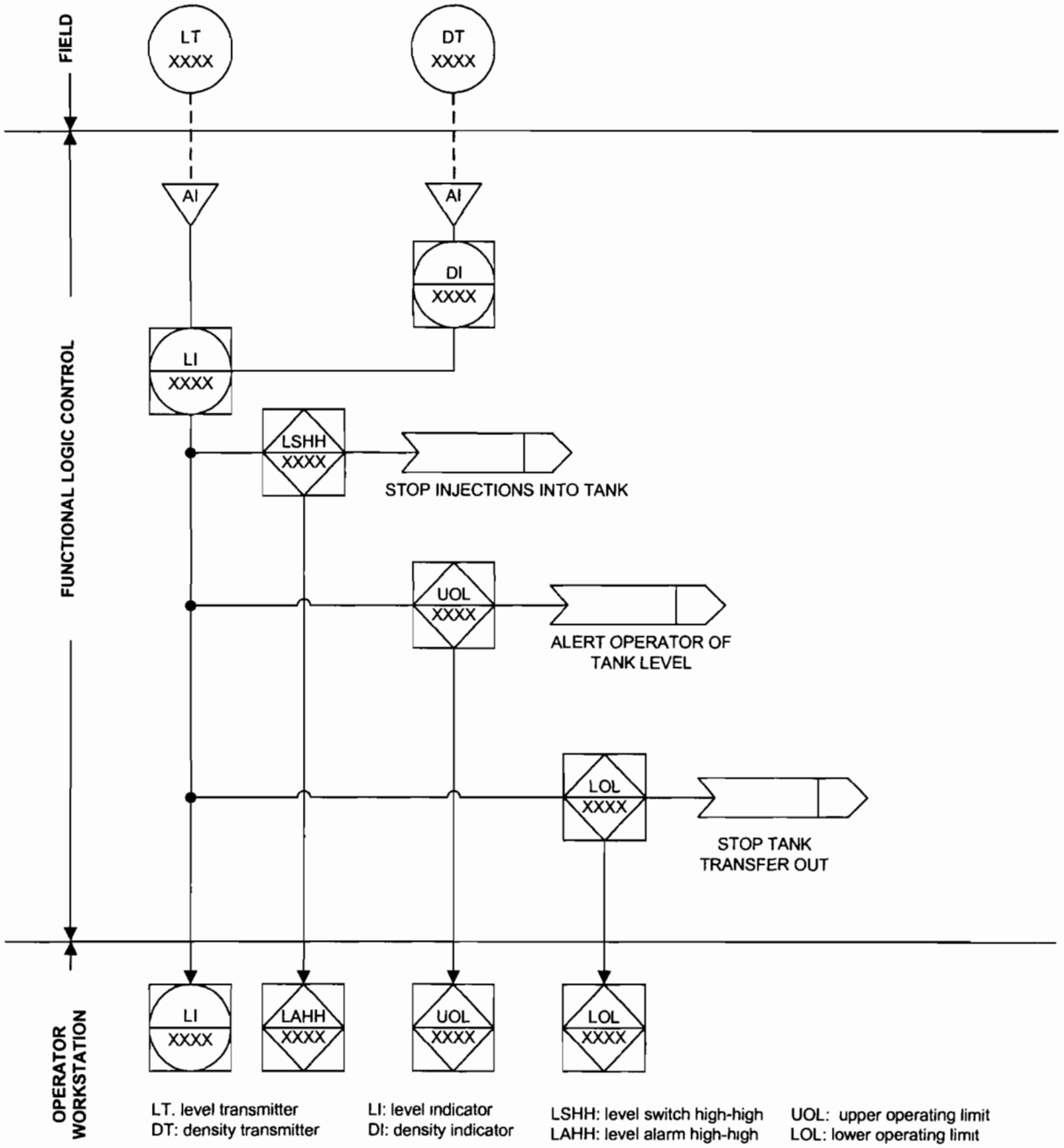
When a decontamination tank for melter 1 (HSH-TK-00001) or for melter 2 (HSH-TK-00002) is available to transfer waste effluent out of a decontamination tank, the operator initiates the transfer-out sequence. The transfer-out sequence is stopped by the control system when the level in the decontamination tank (HSH-TK-00001 or HSH-TK-00002) reaches the lower operating limit (LOL), the specified transfer amount has been transferred, or the receiving vessel reaches its upper operating limit (UOL). When the transfer-out sequence is complete, the control system will alert the operator that the transfer is complete.

Table 1 shows the level and density instruments associated with the decontamination tanks (HSH-TK-00001 and HSH-TK-00002). Figure 1 shows the typical control system (UOL and LOL) for the level instruments associated with the decontamination tanks (HSH-TK-00001 and HSH-TK-00002). The decontamination tank effluent will be transferred out when equipment decontamination is completed. The decontamination tank level signal will alert the operator if level goes above the normal desired control range. A level alarm high-high (LAHH) can activate the control system to automatically stop the fluid being added to the decontamination tank that is in use.

Table 1 Instruments for HLW HSH Decontamination Tank (HSH-TK-00001), Melter 1 and Decontamination Tank (HSH-TK-00002), Melter 2.

Instrument Tag Number	Associated Vessel	Description
RLD-DT-3329	HSH-TK-00001	density measurement sensor
RLD-LT-3307	HSH-TK-00001	level measurement sensor
RLD-DT-3379	HSH-TK-00002	density measurement sensor
RLD-LT-3357	HSH-TK-00002	level measurement senor

Figure 1 Typical Level Measurement for HLW HSH Decontamination Tank HSH-TK-00001) for Melter 1 and Decontamination Tank (HSH-TK-00002) for Melter 2.



Attachment 51 – Appendix 10.18
High Level Waste Building
Operating Documents

Where information regarding treatment, management, and disposal of the radioactive source, byproduct material, and/or special nuclear components of mixed waste (as defined by the Atomic Energy Act of 1954, as amended) has been incorporated into this permit, it is not incorporated for the purpose of regulating the radiation hazards of such components under the authority of this permit and chapter 70.105 RCW. In the event of any conflict between Permit Condition III.10.A. and any statement relating to the regulation of source, special nuclear, and byproduct material contained in portions of the permit application that are incorporated into this permit, Permit Condition III.10.A. will prevail.

Additional appendices will be added to this appendix as new information is incorporated into this permit.

Drawings and Documents

Attachment 51 – Appendix 10.18
High Level Waste Building
Operating Documents

The following drawings have been incorporated into Appendix 10.18 and can be viewed at the Ecology Richland Office. See Appendix 7.18 for operating documents common to the Pretreatment, LAW, HLW, and Laboratory buildings. **New drawings are in bold lettering.**

Drawing/Document Number	**Description**
24590-HLW-PER-PR-03-001, Rev 0	Description of HLW Vitrification System Bypass Events
24590-HLW-PER-M-04-002, Rev 2	Leak Detection Capability in the HLW Facility
24590-HLW-PER-M-04-0001, Rev 0	HLW Facility Removal Capability
RESERVED	RESERVED

R10457443

ISSUED BY
RPP-WTP PDC

Document title: **HLW Facility Waste Removal Capability**

Contract number: DE-AC27-01RV14136

Department: Mechanical Systems

Author(s): K. Chandrasekaran

Principal author signature: K. Chandrasekaran

Document number: 24590-HLW-PER-M-04-0001, Rev 0

Checked by: Jagdish Rewari

Checker signature: J Rewari

Date of issue: 13 January 2005

Issue status: Issued for Permitting Use

Approved by: J. Schneider

Approver's position: HLW Area Project Engineering Manager

Approver signature: John F. Schneider

ERIC B. ISERN
STATE OF WASHINGTON
33449
REGISTERED
PROFESSIONAL ENGINEER
1/13/05
EXPIRES: 07/28/05

This bound document contains a total of 18 sheets

River Protection Project
Waste Treatment Plant
2435 Stevens Center Place
Richland, WA 99354
United States of America
Tel: 509 371 2000

Notice

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the US Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

History Sheet

Rev	Date	Reason for revision	Revised by
0	1/12/05	Issued For Permitting Use	K. Chandrasekaran

Contents

Notice ii
History Sheet iii
Acronyms v
1 Summary 1
2 Objective 3
3 Description 4
4 Assumptions 4
5 Analysis 4
5.1 Sumps Located at Elevation -21 Ft 4
5.2 Sumps Located at Elevation 0 Ft 6
5.3 Sumps and Pump/Ejectors Data 6
6 Sump Removal Rates 7
7 Bounding Calculations 8
7.1 Wet Process Cell - South (Room H-B014) / -21 Ft Elevation 8
7.2 Wet Process Cell - North (Room H-B014) / -21 Ft Elevation 9
7.3 Canister Decon Cave (Room H-B035) / -16 Ft Elevation 9
7.4 Canister Rinse Tunnel (Room H-B039B) / -16.5 Ft Elevation 10
7.5 Canister Rinse-Bogie Maintenance (Room H-B039A) / -16 Ft Elevation 10
7.6 SBS Drain Collection Cell No 1 (Room H-B021) / -21 Ft Elevation 11
7.7 SBS Drain Collection Cell No 2 (Room H-B005) / -21 Ft Elevation 11
7.8 Melter Cave No 1 (Room H-0117) / 3 Ft Elevation 11
7.9 Melter 1 Equipment Decontamination Pit (Room H-0310A) / 0 Ft Elevation 12
7.10 Melter Cave No 2 (Room H-0106) / 3 Ft Elevation 12
7.11 Melter 2 Equipment Decontamination Pit (Room H-0304A) / 0 Ft Elevation 13
8 References 13

Acronyms

AEA Atomic Energy Act of 1954

BNI Bechtel National, Inc.

DWP Dangerous Waste Permit

HCP HLW concentrate receipt process system

HDH HLW canister decontamination system

HEME high efficiency mist eliminator

HFP HLW melter feed process system

HLW high-level waste

HOP melter offgas treatment process system

HPH HLW canister pour handling system

HSH HLW meleter cave support handling system

RLD radioactive liquid waste disposal system

SBS submerged bed scrubber

TK tank

VSL Vessel

WAC *Washington Administrative code*

1 Summary

The High Level Waste (HLW) facility must satisfy the waste removal criteria of Washington Administrative Code (WAC) 173-303-640(4) and Dangerous Waste Permit (DWP) Number WA7890008967, Permit Condition III.10.E.9.e.iii and III.10.J.5.e.iii for HLW vitrification facility Sub-systems and tanks, hereafter called regulated plant items, secondary containment areas. This report evaluates the capability for removing, within 24 hours, leaked waste that may accumulate within the regulated secondary containment areas in the HLW facility.

The secondary containment areas located at different elevations of the HLW facility are provided with sumps. These sumps are lined with 6 % molybdenum stainless steel liner material and equipped with radar or bubbler-type level detectors and have either ejectors or pumps.

Waste removal capability is estimated for the regulated plant items secondary containment areas listed as follows:

1. Wet Process Cell - South (Room H-B014) / -21 Ft Elevation
   The flooding volume in this area includes the total volume of the largest vessel (one of the HLW Concentrate Receipt Vessels, HCP-VSL-00001/ 00002 *). There are no fire sprinklers provided in this cell.

   * Note: The HLW Concentrate Receipt Vessels have been deleted from design, however, for the purpose of this report these vessels represent bounding volume consideration for this cell.

2. Wet Process Cell - North (Room H-B014) / -21 Ft Elevation
   The flooding volume in this area includes the total volume of the Offgas Drains Collection Vessel (RLD-VSL-00002). This cell has no fire protection sprinklers.

3. Canister Decon Cave (Room H-B035) / -16 Ft Elevation
   The flooding volume in this area includes 110 % of the maximum operating volume of the Waste Neutralization Vessel (HDH-VSL-00003). This room has no fire protection sprinklers.

4. Canister Rinse Tunnel (Room H-B039B) / -16.5 Ft Elevation
   The flooding volume in this area includes 110 % of the maximum operating volume of the Rinse Tunnel Canister Rinse Vessel (HDH-VSL-00001) and a firewater volume.

5. Canister Rinse-Bogie Maintenance (Room H-B039A) / -16 Ft Elevation
   The flooding volume in this area includes 110 % of the maximum operating volume of the Rinse Tunnel Canister Rinse Vessel (HDH-VSL-00001) and a firewater volume.

6. SBS Drain Collection Cell No 1 (Room H-B021) / -21 Ft Elevation
   The flooding volume in this area includes 110 % of the maximum operating volume of SBS Condensate Receiver Vessel (HOP-VSL-00903). This room has no fire protection sprinklers.

7. SBS Drain Collection Cell No 2 (Room H-B005) / -21 Ft Elevation
   The flooding volume in this area includes 110 % of the maximum operating volume of SBS Condensate Receiver Vessel (HOP-VSL-00904). This room has no fire protection sprinklers.

8. Melter Cave No 1 - South (Room H-0117) / 3 Ft Elevation
   The flooding volume in this area includes 110 % of the maximum operating volume of the Melter 1 Feed Vessel (HFP-VSL-00002). This room has no fire protection sprinklers.

9. Melter 1 Equipment Decontamination Pit (Room H-0310A) / 0 Ft Elevation
   The flooding volume in this area includes 110 % of the maximum operating volume of Decontamination Tank Melter Cave 1 (HSH-TK-00001). This room has no fire protection sprinklers.

10. Melter Cave No 2 - South (Room H-0106) / 3 Ft Elevation
    The flooding volume in this area includes 110 % of the maximum operating volume of the Melter 2 Feed Vessel (HFP-VSL-00006). This room has no fire protection sprinklers.

11. Melter 2 Equipment Decontamination Pit (Room H-0304A) / 0 Ft Elevation
    The flooding volume in this area includes 110 % of the maximum operating volume of Decontamination Tank Melter Cave 2 (HSH-TK-00002). This room has no fire protection sprinklers.

The results of the evaluation of waste removal capacity for each of the secondary containment areas is summarized as follows:

1. Wet Process Cell - South (Room H-B014) / -21 Ft Elevation
   Waste removal is achieved by the operation of one steam ejector in sump HCP-SUMP-00001. Total containment area waste removal capability is 14.0 hours.

2. Wet Process Cell - North (Room H-B014) / -21 Ft Elevation
   Waste removal is achieved by the operation of one steam ejector in sump RLD-SUMP-00001. Total containment area waste removal capability is 0.2 hours.

3. Canister Decon Cave (Room H-B035) / -16 Ft Elevation
   Waste removal is achieved by the operation of one steam ejector in sump HDH-SUMP-00003. Total containment area waste removal capability is 3.8 hours.

4. Canister Rinse Tunnel (Room H-B039B) / -16.5 Ft Elevation
   Waste removal is achieved by the operation of one steam ejector in sump HDH-SUMP-00001. Total containment area waste removal capability is 4.3 hours.

5. Canister Rinse-Bogie Maintenance (Room H-B039A) / -16 Ft Elevation
   Waste removal is achieved by the operation of one pump in sump HDH-SUMP-00002. Total containment area waste removal capability is 5.0 hours.

6. SBS Drain Collection Cell No 1 (Room H-B021) / -21 Ft Elevation
   Waste removal is achieved by the operation of one steam ejector in sump HOP-SUMP-00003. Total containment area waste removal capability is 7.7 hours.

7. SBS Drain Collection Cell No 2 (Room H-B005) / -21 Ft Elevation
   Waste removal is achieved by the operation of one steam ejector in sump HOP-SUMP-00008. Total containment area waste removal capability is 7.7 hours.

8. Melter Cave No 1 - South (Room H-0117) / 3 Ft Elevation

Waste removal is achieved by the operation of one steam ejector operating in sump HFP-SUMP-00002. Total containment area waste removal capability is 6.0 hours.

9. Melter 1 Equipment Decontamination Pit (Room H-0310A) / 0 Ft Elevation
   Waste removal is achieved by the operation of one steam ejector in sump HSH-SUMP-00008. Total containment area waste removal capability is 3.1 hours.

10. Melter Cave No 2 - South (Room H-0106) / 3 Ft Elevation
    Waste removal is achieved by the operation of one steam ejector in sump HFP-SUMP-00005. Total containment area waste removal capability is 6.0 hours.

11. Melter 2 Equipment Decontamination Pit (Room H-0304A) / 0 Ft Elevation
    Waste removal is achieved by the operation of one steam ejector in sump HSH-SUMP-00009. Total containment area waste removal capability is 3.1 hours.

These values range from 0.2 to 14.0 hours and are within the 24-hour period required by Chapter 173-303 WAC and stipulated by DWP Conditions III.10.E.9.e.iii and III.10.J.5.e.iii. These values are based on consideration of the maximum operating volume of a single vessel in its respective secondary containment area, plus the maximum anticipated volume of firewater (if applicable) that is postulated to accumulate in these cells and a design allowance of 5 % of flood volume to account for other auxiliary components (piping and equipment) in the room.

2 Objective

The purpose of this report is to estimate and document the waste removal capabilities for the HLW facility secondary containment areas associated with regulated plant items.

The HLW Facility must satisfy the waste removal criteria of Chapter 173-303 WAC and DWP Conditions III.10.E.9.e.iii and III.10.J.5.e.iii for secondary containment systems. This report evaluates the capability for removing, within 24 hours, leaked waste that may accumulate within the regulated process cells within the facility.

Excluded from the scope of this report are:

- Secondary containment areas that do not include regulated plant items, such as Canister Handling Cave. The sumps located in Canister Handling Cave (Room H-0136), HPH-SUM-00001 and HPH-SUMP-00005, have not been included in the waste removal analysis because the Canister Handling Cave does not house regulated plant items but has only ancillary equipment (piping). However, each of these sumps is provided with an ejector, which is capable of removing 36,000 gallons of leaked waste over 24 hours period at the rate of 25 gpm.

- Secondary containment areas that house HLW melters, such as Central containment areas in Melter Cave 1 and 2. The sumps located in the Melter Cave - Central (Rooms H-0106 and H-0117), HSH-SUMP-00003 and HSH-SUMP-00007, have not been included in the waste removal analysis because the Melter Cave- Central does not house regulated plant items that contain liquids, but has only ancillary equipment (piping). However, each of these sumps is provided with an ejector, which is capable of removing 36,000 gallons of leaked waste over 24 hours period at the rate of 25 gpm.

3 Description

The regulatory requirements for the regulated plant items containment areas are included in WAC 173-303-640(4), Tank Systems, Containment and Detection of Releases (Reference 1). The regulatory requirements are stated as follows:

> "(b) Secondary containment must be:
>
> > ...designed or operated to drain and remove leaks, spills, or precipitation... from the secondary containment system within 24 hours or in as timely a manner as is possible ..." [WAC 173-303-640(4)(c)(iv)].

In addition, the Waste Treatment Plant DWP (Reference 2), Permit Conditions III.10.E.9.e.iii and III.10.J.5.e.iii require submittal of:

> "Detailed operational plans and descriptions, demonstrating that spilled or leaked waste and accumulated liquids can be removed from the secondary containment system within twenty-four (24) hours." [WAC 173-303-806(4)(c)(vii)].

4 Assumptions

Assumptions used in this evaluation of the HLW facility waste removal capabilities are listed as follows.

1. Nominal design flow rates for ejectors and sump pumps are used to estimate waste removal rates. Purchased equipment will have capacities equal to or exceeding the nominal design flow rates.

2. Operator response times needed for activating transfer ejectors or sump pumps or time required for manual alignment of valves and pump priming are negligible and ignored for the purposes of this evaluation.

3. The capacity to receive and store leaks removed from secondary containment areas is assumed to be available. Adequate space is available in PTF vessels to contain the total estimated flooding volume from a leak in RLD-VSL-00008. For postulated leaks from other tanks, adequate space is available in RLD-VSL-00008 to contain the total estimated flooding volume for a single event, or can be made available in RLD-VSL-00008 by pumping from it to PTF. Delays associated with drawing down liquid level in RLD-VSL-00008 to create adequate space, and delays associated with sampling, analysis, and waste neutralization prior to initiating waste transfers to PTF, are not considered. If the leak cannot be removed from the secondary containment areas within the 24 hours, Ecology will be notified and actions taken as required under the permit conditions III.10.E.5.j and III.10.J.1.a.xxiv.

5 Analysis

5.1 Sumps Located at Elevation -21 Ft

The Wet Process Cell floor area (H-B014) is divided into two sections; the north and south. Each of these two sections is provided with a sump at -21 ft elevation.

5.1.1 Wet Process Cell South

The south section accommodates the Acidic Waste Vessel (RLD-VSL-00007) and Plant Wash and Drain Vessel (RLD-VSL-00008). The maximum flooding volume scenario is the failure of the largest vessel in the containment area. The Wet Process Cell (South) sump HCP-SUMP-00001 is provided with level detector and two emptying ejectors. The ejectors transfer the sump contents to Plant Wash and Drain Vessel (RLD-VSL-00008) or Pretreatment Facility (PTF). If the capacity of the Plant Wash and Drains Vessel (HLW-VSL-00008) is exceeded or failure of the vessel occurs, the excess flows into sump HCP-SUMP-00001. The redundant ejector transfers the waste to breakpot, RLD-BRKPT-00004, from where it is transferred by gravity to PTF. The maximum postulated flood considered is the total volume of one of the HLW Concentrate Receipt Vessels released to the containment. The HLW Concentrate Receipt Vessels have been deleted from design, however, for the purpose of this report, these vessels represent bounding volume consideration for this cell.

5.1.2 Wet Process Cell North

The Offgas Drain Collection Vessel (RLD-VSL-00002) is located in the north section of the Wet Process Cell. The postulated maximum flood volume is the total volume of this vessel. The Wet Process cell (North) sump RLD-SUMP-00001 is provided with level detector and two emptying ejectors. The ejectors transfer the sump contents to Plant Wash and Drain Vessel (RLD-VSL-00008).

5.1.3 Canister Decon Cave

There are three vessels located in the Canister Decon Cave (H-B035): Canister Decon Vessel 1 and 2 (HDH-VSL-00002 and HDH-VSL-00004) and Waste Neutralization Vessel (HDH-VSL-00003). Any leakages from the Canister Decon Vessel 1 (HDH-VSL-00002), Canister Decon Vessel 2 (HDH-VSL-00004), and Waste Neutralization Vessel (HDH-VSL-00003) flow into sump HDH-SUMP-00003 located in the Canister Decon Cave at -16 ft elevation. This sump is provided with level detector and an ejector. The ejector transfers the sump contents to Plant Wash and Drain Vessel (RLD-VSL-00008).

5.1.4 Canister Rinse Tunnel

The Rinse Tunnel Canister Rinse Vessel (HDH-VSL-00001) is located in the Canister Rinse Tunnel (H-B039B). The maximum volume that could be released into the room H-B039B upon vessel failure is 110 % of the maximum operating volume of Rinse Tunnel Canister Rinse Vessel. The Rinse Tunnel Canister Rinse-Bogie Maintenance Room and Canister Rinse Tunnel are interconnected and the flooding overflows from one room into the other room. Since the flood volume of the Canister Rinse-Bogie Maintenance Room is larger than Canister Rinse Tunnel, the flood volume of Canister Rinse-Bogie Maintenance Room is the postulated maximum flood volume for Canister Rinse Tunnel. Sump HDH-SUMP-00001 is located in this room at -16.5 ft elevation and is provided with level detector and an ejector. The ejector transfers the sump contents to Plant Wash and Drain Vessel (RLD-VSL-00008).

5.1.5 Canister Rinse-Bogie Maintenance Room

The Rinse Tunnel Canister Rinse Vessel (HDH-VSL-00001) could be moved on a bogie into the Canister Rinse Rinse-Bogie Maintenance Room (H-B039A). In the event of vessel failure, flooding could occur in the room. The maximum volume that could be released into the room H-B039A upon vessel failure is 110 % of the maximum operating volume of Rinse Tunnel Canister Rinse Vessel. Sump HDH-SUMP-00002 is located in this room at -16 ft elevation and is provided with level detector and a pump. The pump transfers the sump contents to Plant Wash and Drain Vessel (RLD-VSL-00008).

5.1.6 SBS Drain Collection Cell No 1

SBS Condensate Receiver Vessel, HOP-VSL-00903 and sump HOP-SUMP-00003 are located in this cell (H-B021). Any leakage from the SBS Condensate Receiver Vessel (HOP-VSL-00903) flows into sump HOP-SUMP-00003. This sump also receives waste, through gravity floor drain from the secondary containment for the Melter 1 Submerged Bed Scrubber (SBS) and Melter 1 High Efficiency Mist Eliminators (HEMEs). This sump is located at -21 ft elevation and is provided with level detector and two ejectors. The ejectors transfer the sump contents to Plant Wash and Drain Vessel (RLD-VSL-00008).

5.1.7 SBS Drain Collection Cell No 2

SBS Condensate Receiver Vessel, HOP-VSL-00904 and sump HOP-SUMP-00008 are located in this cell (H-B005). Any leakage from the SBS Condensate Receiver Vessel (HOP-VSL-00904) flows into sump HOP-SUMP-00008. This sump also receives waste, through gravity floor drain from the secondary containment for the Melter 2 SBS and Melter 2 HEMEs. This sump is located at -21 ft elevation and is provided with level detector and two ejectors. The ejectors transfer the sump contents to Plant Wash and Drain Vessel (RLD-VSL-00008).

5.2 Sumps Located at Elevation 0 Ft

5.2.1 Sumps Located in the Melter Cave No 1

Sump HFP-SUMP-00002 is located at 5 ft elevation in the south section of the cell (H-0117). If the capacity of the Melter 1 Feed Preparation Vessel (HFP-VSL-00001) or Melter 1 Feed Vessel (HFP-VSL-00002) is exceeded, the vessel overflows into this sump. Any leakages from these vessels also flow into this sump. The sump is provided with level detector and an ejector. The ejector transfers the sump contents to Plant Wash and Drain Vessel (RLD-VSL-00008).

5.2.2 Melter 1 Decontamination Pit

Sump HSH-SUMP-00008 is located at 0 ft elevation in the Melter 1 Equipment Decontamination Pit (H-0310A). If the capacity of the Decontamination Tank Melter Cave 1 (HSH-TK-00001) is exceeded, the excess overflows into this sump. This sump is provided with level detector and an ejector. The ejector transfers the sump contents to Plant Wash and Drain Vessel (RLD-VSL-00008).

5.2.3 Sumps Located in the Melter Cave No 2

Sump HFP-SUMP-00005 is located at 5 ft elevation in the south section of the cell (H-0106). If the capacity of the Melter 2 Feed Preparation Vessel (HFP-VSL-00005) or Melter 2 Feed Vessel (HFP-VSL-00006) is exceeded, the vessel overflows into this sump. Any leakages from these vessels also flow into this sump. This sump is provided with level detector and an ejector. The ejector transfers the sump contents to Plant Wash and Drain Vessel (RLD-VSL-00008).

5.2.4 Melter 2 Decontamination Pit

Sump HSH-SUMP-00009 is located at 0 ft elevation in the Melter 2 Equipment Decontamination Pit (H-0304A). If the capacity of the Decontamination Tank Melter Cave 2 (HSH-TK-00002) is exceeded, the excess overflows into this sump. This sump is provided with level detector and an ejector. The ejector transfers the sump contents to Plant Wash and Drain Vessel (RLD-VSL-00008).

5.3 Sumps Located at Elevation 37 Ft

Sump HFP-SUMP-00001 is located at 37 ft elevation in the active service cell Melter 1 (H-0308). Any leakage from the Melter 1 wet electrostatic precipitator, HOP-WESP-00001, flows into this sump. Sump HFP-SUMP-00004 is located at 37 ft elevation in the active service cell Melter 2 (H-0302). Any leakage from the Melter 2 wet electrostatic precipitator, HOP-WESP-00002, flows into this sump. The leakages collected in these sumps drain by gravity into the Plant Wash and Drains Vessel (RLD-VSL-00008). If the maximum operating volume of the wet electrostatic precipitator were to leak into this sump, it would gravity drain into RLD-VSL-00008 in less than an hour. Therefore, the sumps HFP-SUMP-00001 and HFP-SUMP-00004 are not included in the below analysis.

5.4 Sumps and Pump/Ejectors Data

The sumps and pump/ejectors data are summarized in the following table.

Room No.	Sump Number	Ejector/ Pump Number	Ejector/Pump Design Flowrate (gpm)
H-B014	HCP-SUMP-00001	RLD-EJCTR-00049A/B	25
H-B014	RLD-SUMP-00001	RLD-EJCTR-00052A/B	25
H-B035	HDH-SUMP-00003	RLD-EJCTR-00054	25
H-B039B	HDH-SUMP-00001	RLD-EJCTR-00055	25
H-B039A	HDH-SUMP-00002	RLD-PMP-00023	25
H-B021	HOP-SUMP-00003	RLD-EJCTR-00053A/B	25
H-B005	HOP-SUMP-00008	RLD-EJCTR-00176A/B	25
H-0117	HFP-SUMP-00002	RLD-EJCTR-00172	25
H-0310A	HSH-SUMP-00008	RLD-EJCTR-00026	25
H-0106	HFP-SUMP-00005	RLD-EJCTR-00178	25
H-0304A	HSH-SUMP-00009	RLD-EJCTR-00173	25

6 Sump Removal Rates

The results of this evaluation are compiled in the following table based on calculations provided in Section 7.

HLW Facility Waste Removal Capability Over 24 Hours

Containment Area Elevation (ft)	Containment Area Room Number	Sump Number	Sump Waste Removal Capacity, (US gal/h)	Largest Vessel in Containment Area (Vessel Number and Maximum Volume)[1]	Largest Vessel Waste Removal Capability, h	Fire Water Volume[2]. (US gal)	Fire Water Removal Capability, h	Total Flooding Volume,[2] including Design Allowance (US gal)	Total Containment Area Waste Removal Capability (h)
-21	H-B014 (South)	HCP-SUMP-00001	1,500	HCP-VSL-00001, 20,061 gal	13.4	Not Applicable	Not Applicable	21,064	14.0

Containment Area Elevation (ft)	Containment Area Room Number	Sump Number	Sump Waste Removal Capacity, (US gal/h)	Largest Vessel in Containment Area (Vessel Number and Maximum Volume)[1]	Largest Vessel Waste Removal Capability, h	Fire Water Volume[2]. (US gal)	Fire Water Removal Capability, h	Total Flooding Volume,[2] including Design Allowance (US gal)	Total Containment Area Waste Removal Capability (h)
-21	H-B014 (North)	RLD-SUMP-00001	1,500	RLD-VSL-00002, 344 gal	0.2	Not Applicable	Not Applicable	359	0.2
-16	H-B035	HDH-SUMP-00003	1,500	HDH-VSL-00003, 5,356 gal	3.6	Not Applicable	Not Applicable	5,625	3.8
-16.5	H-B039B	HDH-SUMP-00001	1,500	HDH-VSL-00001, 3,949 gal	2.6	2,228	1.5	6,485	4.3
-16	H-B039A	HDH-SUMP-00002	1,500	HDH-VSL-00001, 3,949 gal	2.6	3,168	2.1	7,480	5.0
-21	H-B021	HOP-SUMP-00003	1,500	HOP-VSL-00903, 10,936gal	7.3	Not Applicable	Not Applicable	11,482	7.7
-21	H-B005	HOP-SUMP-00008	1,500	HOP-VSL-00904, 10,936gal	7.3	Not Applicable	Not Applicable	11,482	7.7
3	H-0117	HFP-SUMP-00002	1,500	HFP-VSL-00002, 8,512 gal	5.7	Not Applicable	Not Applicable	8,939	6.0
0	H-0310A	HSH-SUMP-00008	1,500	HSH-TK-00001, 4,361 gal	2.9	Not Applicable	Not Applicable	4,578	3.1
3	H-0106	HFP-SUMP-00005	1,500	HFP-VSL-00006, 8,512 gal	5.7	Not Applicable	Not Applicable	8,939	6.0
0	H-0304A	HSH-SUMP-00009	1,500	HSH-TK-00002, 4,361 gal	2.9	Not Applicable	Not Applicable	4,578	3.1

[1] 110 % of maximum operating volume or total volume of the vessel which ever is larger.
[2] Fire water volume and total volume derived from flooding volume reports (Ref. 3)

7 Bounding Calculations

Waste removal capability is estimated for eleven secondary containment areas with regulated plant items based on the bounding calculation presented in this section. The eleven secondary containment areas and their location in the HLW Facility are listed as follows:

1. Wet Process Cell - South (Room H-B014) / -21 Ft Elevation
2. Wet Process Cell - North (Room H-B014) / -21 Ft Elevation
3. Canister Decon Cave (Room H-B035) / -16 Ft Elevation
4. Canister Rinse Tunnel (Room H-B039B) / -16.5 Ft Elevation
5. Canister Rinse-Bogie Maintenance (Room H-B039A) / -16 Ft Elevation
6. SBS Drain Collection Cell No 1 (Room H-B021) / -21 Ft Elevation
7. SBS Drain Collection Cell No 2 (Room H-B005) / -21 Ft Elevation
8. Melter Cave No 1 - South (Room H-0117) / 3 Ft Elevation
9. Melter No 1 Equipment Decontamination Pit (Room H-0310A) / 0 Ft Elevation
10. Melter Cave No 2 - South (Room H-0106) / 3 Ft Elevation
11. Melter No 2 Equipment Decontamination Pit (Room H-0304A) / 0 Ft Elevation

7.1 Wet Process Cell - South (Room H-B014) / -21 Ft Elevation

The Wet Process Cell-South secondary containment area has one sump. The sump is provided with two 100 % capacity ejectors; only one of the two ejectors is operated for removing waste.

Flooding volume is derived from the flooding volume report (Reference 3) and is based on the total volume of the largest vessel within this containment area, which is one of the HLW Concentrate Receipt Vessels (HCP-VSL-00001/00002). It is to be noted that the HLW Concentrate Receipt Vessels are deleted from the design. However, for the purpose of this report, the vessels are left in for bounding flooding volume consideration. Fire sprinklers are not provided in this area, and there is no contribution from other areas in this regard. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume.

Maximum flooding volume = 21,064 gal
Ejector capacity = 25 gpm / ejector
Ejector capacity = 25 gpm x 60 min/hr = 1,500 gal/hr

The waste removal capability is calculated by dividing the maximum flooding volume by the ejector capacity.

Waste removal capability = 21,064 gallons/1,500 gal/hr = 14.0 hours

7.2 Wet Process Cell - North (Room H-B014) / -21 Ft Elevation

The Wet Process Cell -North secondary containment area has one sump. The sump is provided with two 100 % capacity ejectors; only one of the two ejectors is operated for removing waste.

Flooding volume is derived from the flooding volume report (Reference 3) and is based on the total volume of Offgas Drain Collection Vessel (RLD-VSL-00002). Fire sprinklers are not provided in this area, and there is no contribution from other areas in this regard. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume.

Maximum flooding volume = 359 gal

Ejector capacity = 25 gpm / ejector
Ejector capacity = 25 gpm x 60 min/hr = 1,500 gal/hr

The waste removal capability is calculated by dividing the maximum flooding volume by the ejector capacity.

Waste removal capability = 359 gallons/1,500 gal/hr = 0.2 hours

7.3 Canister Decon Cave (Room H-B035) / -16 Ft Elevation

The Canister Decon Cave secondary containment area has one sump provided with a single ejector.

Flooding volume is derived from the flooding volume report (Reference 3) and is based on 110 % of the maximum operating volume of the largest vessel in this area, which is Waste Neutralization Vessel

(HDH-VSL-00003). Fire sprinklers are not provided in this room. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume.

110 % of the maximum operating volume of vessel = 5,356 gal
Maximum flooding volume = 5,625 gal

Ejector capacity = 25 gpm
Ejector capacity = 25 gpm x 60 min/hr = 1,500 gal/hr

The waste removal capability is calculated by dividing the maximum flooding volume by the ejector capacity.

Waste removal capability = 5,625 gallons/1,500 gal/hr = 3.8 hours

7.4 Canister Rinse Tunnel (Room H-B039B) / -16.5 Ft Elevation

The Canister Rinse Tunnel secondary containment area has one sump provided with a single ejector.

Flooding volume is derived from the flooding volume report (Reference 3) and is based on 110 % of the maximum operating volume of Rinse Tunnel Canister Rinse Vessel (HDH-VSL-00001). Fire sprinklers are provided in this area. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume.

110 % of the maximum operating volume of vessel = 3,949 gal
Fire water volume = 2,228 gal
Maximum flooding volume = 6,485 gal

Ejector capacity = 25 gpm / ejector
Ejector capacity = 25 gpm x 60 min/hr = 1,500 gal/hr

The waste removal capability is calculated by dividing the maximum flooding volume by the ejector capacity.

Waste removal capability = 6,485 gallons/1,500 gal/hr = 4.3 hours

7.5 Canister Rinse-Bogie Maintenance (Room H-B039A) / -16 Ft Elevation

The Canister Rinse-Bogie Maintenance secondary containment area has one sump provided with a single pump.

Flooding volume is derived from the flooding volume report (Reference 3) and is based on 110 % of the maximum operating volume of Rinse Tunnel Canister Rinse Vessel (HDH-VSL-00001). Fire sprinklers are provided in this area. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume.

110 % of the maximum operating volume of vessel = 3,949 gal
Fire water volume = 3,168 gal
Maximum flooding volume = 7,480 gal

Pump capacity = 25 gpm
Pump capacity = 25 gpm x 60 min/hr = 1,500 gal/hr

The waste removal capability is calculated by dividing the maximum flooding volume by the pump capacity.

Waste removal capability = 7,480 gallons/1,500 gal/hr = 5 hours

7.6 SBS Drain Collection Cell No 1 (Room H-B021) / -21 Ft Elevation

The SBS Drain Collection Cell No 1 secondary containment area has one sump. The sump is provided with two 100 % capacity ejectors; only one of the two ejectors is operated for removing waste.

Flooding volume is derived from the flooding volume report (Reference 3) and is based on 110 % of the maximum operating volume of SBS Condensate Receiver Vessel (HOP- VSL-00903). Fire sprinklers are not provided in this area, and there is no contribution from other areas in this regard. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume.

110 % of the maximum operating volume of vessel = 10,936 gal
Maximum flooding volume = 11,482 gal

Ejector capacity = 25 gpm / ejector
Ejector capacity = 25 gpm x 60 min/hr = 1,500 gal/hr

The waste removal capability is calculated by dividing the maximum flooding volume by the ejector capacity.
Waste removal capability = 11,482 gallons/1,500 gal/hr = 7.7 hours

7.7 SBS Drain Collection Cell No 2 (Room H-B005) / -21 Ft Elevation

The SBS Drain Collection Cell No 2 secondary containment area has one sump. The sump is provided with two 100 % capacity ejectors; only one of the two ejectors is operated for removing waste.

Flooding volume is derived from the flooding volume report (Reference 3) and is based on 110 % of the maximum operating volume of SBS Condensate Receiver Vessel (HOP- VSL-00904). Fire sprinklers are not provided in this area, and there is no contribution from other areas in this regard. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume.

110 % of the maximum operating volume of vessel = 10,936 gal
Maximum flooding volume = 11,482 gal

Ejector capacity = 25 gpm / ejector
Ejector capacity = 25 gpm x 60 min/hr = 1,500 gal/hr

The waste removal capability is calculated by dividing the maximum flooding volume by the ejector capacity.

Waste removal capability = 11,482 gallons/1,500 gal/hr = 7.7 hours

7.8 Melter Cave No 1 (Room H-0117) / 3 Ft Elevation

The Melter Cave No 1 (south) secondary containment area has one sump provided with a single ejector.

Flooding volume is derived from the flooding volume report (Reference 3) and is based on 110 % of the maximum operating volume of the largest vessel in this area, which is Melter 1 Feed Vessel (HFP-VSL-00002). Fire sprinklers are not provided in this room. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume.

110 % of the maximum operating volume of vessel = 8,512 gal
Maximum flooding volume = 8,939 gal

Ejector capacity = 25 gpm
Ejector capacity = 25 gpm x 60 min/hr = 1,500 gal/hr

The waste removal capability is calculated by dividing the maximum flooding volume by the ejector capacity.

Waste removal capability = 8,939 gallons/1,500 gal/hr = 6.0 hours

7.9 Melter 1 Equipment Decontamination Pit (Room H-0310A) / 0 Ft Elevation

The Melter 1 Equipment Decontamination Pit secondary containment area has one sump provided with a single ejector.

Flooding volume is derived from the flooding volume report (Reference 3) and is based on 110 % of the maximum operating volume of the largest vessel in this area, which is Decontamination Tank Melter Cave No 1 (HSH-TK-00001). Fire sprinklers are not provided in this room. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume.

110 % of the maximum operating volume of tank = 4,361 gal
Maximum flooding volume = 4,578 gal

Ejector capacity = 25 gpm
Ejector capacity = 25 gpm x 60 min/hr = 1,500 gal/hr

The waste removal capability is calculated by dividing the maximum flooding volume by the ejector capacity.

Waste removal capability = 4,578 gallons/1,500 gal/hr = 3.1 hours

7.10 Melter Cave No 2 (Room H-0106) / 3 Ft Elevation

The Melter Cave No 2 (south) secondary containment area has one sump provided with a single ejector.

Flooding volume is derived from the flooding volume report (Reference 3) and is based on 110 % of the maximum operating volume of the largest vessel in this area, which is Melter 2 Feed Vessel (HFP-VSL-

00006). Fire sprinklers are not provided in this room. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume.

110 % of the maximum operating volume of vessel = 8,512 gal
Maximum flooding volume = 8,939 gal

Ejector capacity = 25 gpm
Ejector capacity = 25 gpm x 60 min/hr = 1,500 gal/hr

The waste removal capability is calculated by dividing the maximum flooding volume by the ejector capacity.
Waste removal capability = 8,939 gallons/1,500 gal/hr = 6.0 hours

7.11 Melter 2 Equipment Decontamination Pit (Room H-0304A) / 0 Ft Elevation

The Melter 2 Equipment Decontamination Pit secondary containment area has one sump provided with a single ejector.

Flooding volume is derived from the flooding volume report (Reference 3) and is based on 110 % of the maximum operating volume of the largest vessel in this area, which is Decontamination Tank Melter Cave 2 (HSH-TK-00001). Fire sprinklers are not provided in this room. To account for other auxiliary components (piping and equipment) in the room, a design allowance of 5 % is applied to the flood volume.

110 % of the maximum operating volume of tank = 4,361 gal
Maximum flooding volume = 4,578 gal

Ejector capacity = 25 gpm
Ejector capacity = 25 gpm x 60 min/hr = 1,500 gal/hr

The waste removal capability is calculated by dividing the maximum flooding volume by the ejector capacity.

Waste removal capability = 4,578 gallons/1,500 gal/hr = 3.1 hours

8 References

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

2. Dangerous Waste Permit, Permit Number WA7890008967, *Dangerous Waste Portion of the Hanford Facility Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of dangerous waste,* Chapter 10 and Attachment 51, "Waste Treatment and Immobilization Plant".

3. 24590-HLW-PER-M-02-003, Rev.3, *Flooding Volume for the HLW Facility, August 3, 2004.*

4. 24590-HLW-PER-M-02-001, Rev.3, *HLW Facility Sump Data, August 3, 2004.*

ISSUED BY
RPP-WTP PDC

R10505948

Document title: **Leak Detection Capability in the HLW Facility**

Contract number: DE-AC27-01RV14136

Department: Mechanical Systems

Author(s): Y. Nurdogan

Principal author signature:

Document number: 24590-HLW-PER-M-04-002, Rev 2

Checked by: J. Rewari

Checker signature:

Date of issue: March 2005

Issue status: Issued for Permitting Use

Approved by: J. Schneider

Approver's position: Area Project Engineering Manager

Approver signature:

ERIC B. ISERN
STATE OF WASHINGTON
33449
REGISTERED
PROFESSIONAL ENGINEER
3/14/05
EXPIRES: 07/28/05

This bound document contains a total of 17 sheets

River Protection Project
Waste Treatment Plant
2435 Stevens Center Place
Richland, WA 99354
United States of America
Tel: 509 371 2000

Notice

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the US Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

History Sheet

Rev	Date	Reason for revision	Revised by
0	01/27/05	Issued for Permitting Use	K. Chandrasekaran
1	03/09/05	Completely Revised according to the WTP Style Manual. Revisions bars are not shown.	Y. Nurdogan
2	03/14/05	Re-issued with PE certification.	Y. Nurdogan

Contents

Notice ii
History Sheet iii
Acronyms v
1 Summary 1
2 Objective 1
3 Description 2
4 Assumptions 2
4.1 Inputs 2
4.2 Assumptions 3
5 Analysis 3
6 Detectable Leak Rates 4
7 Calculations 5
7.1 Methodology 5
7.2 Calculations 8
8 References 12
8.1 Project Documents 12
8.2 Codes and Standards 12
8.3 Other Documents 12

Acronyms

AEA	Atomic Energy Act of 1954
BNI	Bechtel National, Incorporated
CGS	centimeter gram second units of measurement
DOE	US Department of Energy
DWP	Dangerous Waste Permit
HCP	HLW concentrate receipt process system
HDH	HLW canister decontamination handling system
HFP	HLW melter feed process system
HLW	high-level waste
HOP	melter offgas treatment process system
HPH	HLW canister pour handling system
HSH	HLW melter cave support handling system
RLD	radioactive liquid waste disposal system
WAC	Washington Administrative Code
WTP	Hanford Tank Waste Treatment and Immobilization Plant

1 Summary

The High Level Waste (HLW) facility secondary containment sumps must satisfy the leak detection criteria of the Washington Administrative Code (WAC) and the Hanford Tank Waste Treatment and Immobilization Plant (WTP) Dangerous Waste Permit (DWP), Permit Conditions III.10.E.9.e.ii and III.10.J.5.e.ii for secondary containment systems. This report evaluates the minimum leak rates that the cell and cave sumps can detect within 24 hours.

The HLW facility contains 15 secondary containment sumps. Six of them are rectangular and the remaining nine are round sumps. These sumps are evaluated in this report. Leaks from vessels or piping within the cells and caves will flow along the floor and collect in a sump and be detected with level instrumentation. All sumps are dry type, that is, the sumps are dry unless there is a leak that reaches the sump. All round sumps are the same size (30 in. O.D. by 18 in. deep). All the rectangular sumps are the same size (31.5 in. long by 25.5 in. wide by 16 in. deep). All sumps, except the Melter Cave 1 and 2 central sumps (HSH-SUMP-00003 and HSH-SUMP-00007), are provided with radar type leak detection. The Melter Cave 1 and 2 central sump uses conventional pneumatic bubblers and a level transmitter to detect leaks.

The minimum leak flow rate that can be detected in 24 hours is calculated by estimating the volumes of two components of the leak: 1) the minimum detectable quantity of liquid in the sump and 2) the volume associated with the leak "rivulet" formed as the leak flows along the floor to the sump. Water is used as the standard fluid for estimating leak rates. The detectable volume of the leak in the sump is related to size and geometry of the sump and the location and sensitivity of the leak detection instrumentation. The volume associated with the leak rivulet is related to the slope of the floor and the flow rate of the leak.

Minimum 24-hour detectable leak rates are evaluated for each sump in the HLW facility. The leak detection rate varies with the travel distance of the leak. The longer the travel distance, the greater is the 24-hour leak detection rate. The bounding case for the smaller 30-inch diameter sumps (HCP-SUMP-00001) indicates a maximum leak travel distance of 82 ft. The calculated minimum 24-hour leak detection rate for this sump is 0.021 gal/hr. Leak detection rates for the remaining 30-inch diameter sumps range from 0.018 to 0.020 gal/hr.

For the larger rectangular sumps (HSH-SUMP-00003 and HSH-SUMP-00007) located in the melter cave, the maximum leak travel distance is 88 ft. The minimum 24-hour leak detection rate for these sumps is 0.207 gal/hr. Leak detection rate for the remaining rectangular sumps ranges from 0.060 to 0.061 gal/hr.

2 Objective

The objective of this report is to document the minimum flow rate that can be detected within a 24-hour period for potential leaks collected in the HLW facility secondary containment area sumps. The scope of this report includes:

- Leaks from inaccessible vessels, equipment, and piping containing DWP regulated waste that flows by gravity directly to sumps containing leak detection instrumentation.
- Leaks that flow by gravity to floor drains that are routed to another cell that contains a sump with leak detection instrumentation.

The scope does not include leaks collected in drain systems that flow to vessels or tanks and leaks detected by routine visual inspection are not in scope.

3 Description

The HLW facility secondary containment area sumps must satisfy the leak detection criteria of the WAC and the DWP conditions for tank and miscellaneous units secondary containment systems.

The regulatory requirements for leak detection are contained in WAC-173-303-640 (4), Tank Systems, Containment and Detection of Releases and are stated as follows:

"(b)Secondary Containment systems must be:

(ii) Capable of detecting and collecting releases and accumulated liquids until the collected material is removed.

(c) To meet the requirements of (b) of this subsection, secondary containment systems must be at a minimum:

(iii) Provided with a leak detection system that is designed and operated so that it will detect the failure of either the primary or secondary containment structure or the presence of any release of dangerous waste or accumulated liquid in the secondary containment system within twenty-four hours, or at the earliest practicable time if the owner or operator can demonstrate to the department that the existing detection technologies or site conditions will not allow detection of a release within twenty-four hours."

In addition, the WTP DWP (WA 7890008967), Conditions III.10.E.9.e.ii and III.10.J.5.e.ii requires submittal of:

"Detailed plans and descriptions, demonstrating the leak detection system is operated so that it will detect the failure of either the primary or secondary containment structure or the presence of any release of dangerous and/or mixed waste, or accumulated liquid in the secondary containment system within twenty-four (24) hours. Detection of a leak of at least 0.1 gallons per hour within twenty-four (24) hours is defined as being able to detect a leak within twenty-four (24) hours. Any exceptions to this criteria must be approved by Ecology [WAC 173-303-640(4)(c)(iii), WAC 173-303-806(4)(c)(vii)]"

4 Assumptions

4.1 Inputs

1. Sump type, leak detection type, and nominal sump dimensions are derived from "Sump Data for HLW Facility" (24590-HLW-PER-M-02-001, Table 1).
2. The stainless steel liners in the vessel cells and caves are sloped at a minimum slope of 1:100 (1%) to direct potential leakage in these areas to their respective sump.
3. The selection of rectangular sumps and their design is largely governed by the physical layout and associated constraints. The Melter Cave Central rectangular sumps (HSH-SUMP-00003 and HSH-SUMP-00007) are located at the center of drainage trenches; sumps have same width as trenches to achieve better flow into sump and to minimize dead spots for flow. The physical design of these sumps is largely dictated by minimum volume requirements, containment of

equipment, instrument lines and pipes, constructability, common design and configuration of melter rails in the Melter Cave. Radar level detection is not feasible for Melter Cave Central sumps, as the radar guide tube path would require several turns and bends to avoid physical constraints.

4.2 Assumptions

1. The following group of assumptions was derived from agreements between BNI, DOE, and the Department of Ecology.
    a. The liquid leaking is water at a temperature of 100 °F.
    b. The leak is at a constant rate over the twenty-four hour period.
    c. The leak is assumed to occur at the farthest point from the sump.
    d. No evaporation will occur.
    e. The liquid does not foam in the sumps.
    f. Hold-up is defined as wetting of the surface.
    g. Level detection instruments will be properly installed and calibrated upon installation. Periodic, normal maintenance and calibration will be performed on level instruments during operation of the facility and the instruments will be maintained in an operable condition.
2. The furthest point from the sump is assumed to be bounded by the furthest corner of the cell, which contains the sump. The flow path for each cell is conservatively considered to be along the straight walls rather than diagonally across the cell.
3. There will be no hold-up of the leakage on its way to the floor due to obstructions. The floors of the facility are properly sloped so that the leakage will flow into the low-point sumps and cause a level increase in sump. Obstructions in the flow path that may cause deviation from an idealized flow path, but do not cause temporary accumulation of liquid, may be neglected.
4. The floor is uniform (no undulations or low spots) and the flow path is in straight lines (no meandering flow).
5. Radar leak detection is stated by the radar instrument supplier to be accurate within $\pm$10 mm, i.e., the minimum level of water in the sump must rise to at least 10 mm before it is detected by the radar instrument. The radar guide tube is located 1/2 inch from the bottom of the sump. It is not necessary for the liquid level to be within the guide tube before the radar will detect it. Because the bottom of the round sump is dished (it is formed from an ellipsoidal head), and the radar guide tube is offset from the center of the sump by about 4 inches, the level as measured from the center of the sump must rise slightly higher in the sump to be within the radar's 10 mm detection specification. Therefore, for conservatism, it is assumed that the detectable level in the round sump is one inch from the bottom of the sump measured in the center. However, for rectangular sumps, it is assumed that the detectable level in the sump is 10 mm from the bottom of the sump.
6. The pneumatic bubbler leak detection instrument in the melter cave rectangular sump uses a 1/2-inch Schedule 40 pipe dip pipe with a straight end (not slanted). The bottom of the dip pipe is located 1/4 inch from the bottom of the sump. The leak detection instrumentation includes a pneumatic level transmitter that can detect a level that is 1 inch above the bottom of the dip tube. Therefore, added to the 1/4-inch dip tube clearance, the liquid must rise to a total depth in the sump of at least 1.25 inches before it can be detected.

5 Analysis

The HLW facility contains 15 secondary containment sumps. All round sumps are the same size (30 in. O.D. by 18 in. deep). All the rectangular sumps are same size, 31.5 in. long by 25.5 in. wide by 16 in.

deep. All sumps except the Melter Cave 1 and 2 central sumps (HSH-SUMP-00003 and HSH-SUMP-00007) are provided with radar type leak detection. The Melter Cave 1 and 2 central sumps use conventional pneumatic bubblers and level transmitter to detect leaks.

Leaks of vessels or piping within the cells will flow along the floor and will be collected in a sump and detected with level instrumentation.

6 Detectable Leak Rates

Minimum 24-hour leak detection rates are evaluated for each sump in the HLW facility. The leak detection rate varies with the travel distance of the leak, the sump size and leak detection instrument type. Longer the travel distance, the greater is the 24-hour leak detection rate. The bounding case for the smaller 30-inch diameter sumps (HCP-SUMP-00001) indicates a maximum leak travel distance of 82 ft. The minimum 24-hour leak detection rate for this sump is 0.021 gal/hr. Leak detection rates for the remaining eight 30-inch diameter sumps range from 0.018 to 0.020 gal/hr.

For the larger rectangular sumps (HSH-SUMP-00003 and HSH-SUMP-00007) located in the melter cave, the maximum leak travel distance is 88 ft. The minimum 24-hour leak detection rate for this sump is 0.207 gal/hr. Leak detection rate for the remaining four rectangular sumps range from 0.060 to 0.061 gal/hr.

Results of the evaluation for all HLW facility sumps are provided in Table 6.1 below.

Table 6.1 Minimum Leak Detection Rates for HLW Facility Sumps

Sump Number	Max. Leak Travel Distance	Volume of Leak to Reach Sump	Volume of Leak for Detection in Sump	Total Volume of Leak Detectable in 24 hours	24-Hour Leak Rate Detected (rounded)
	ft	gal	gal	gal	gal/hr
HCP-SUMP-00001	82	0.134	0.380	0.514	0.02
RLD-SUMP-00001	35	0.049	0.380	0.429	0.02
HDH-SUMP-00003	33	0.095	0.380	0.475	0.02
HDH-SUMP-00001	61	0.089	0.380	0.469	0.02
HDH-SUMP-00002	57	0.046	0.380	0.426	0.02
HOP-SUMP-00003	32	0.045	0.380	0.425	0.02
HOP-SUMP-00008	32	0.045	0.380	0.425	0.02
HFP-SUMP-00002	45	0.095	1.370	1.465	0.06
HSH-SUMP-00008	30	0.062	1.370	1.432	0.06
HFP-SUMP-00005	45	0.095	1.370	1.465	0.06
HSH-SUMP-00009	30	0.062	1.370	1.432	0.06
HSH-SUMP-00003	88	0.629	4.350	4.979	0.21
HSH-SUMP-00007	88	0.629	4.350	4.979	0.21
HPH-SUMP-00001	36	0.050	0.380	0.430	0.02
HPH-SUMP-00005	63	0.098	0.380	0.478	0.02

7 Calculations

7.1 Methodology

The minimum leak flow rate that can be detected in 24 hours is calculated by estimating the volumes of two components of the leak:

1. The minimum detectable quantity of liquid in the sump, V_s (in gallons)
2. The volume associated with the leak "rivulet" as the leak flows along the floor to the sump, V_r (in gallons)

The total volume of the leak: $V_t = V_r + V_s$

The minimum detectable flow rate: $Q = V_t/24$ in gal/hr

7.1.1 Minimum Detectable Volume in the Sump

7.1.1.1 Round Sumps

The round sumps are nominally 30 inches in diameter and about 18 inches in depth. The round sumps are formed from 30-inch Schedule 10S pipe with an I.D.of 29.376 inches. The bottom consists of a 2:1 ellipsoidal head.

The minimum detectable volume in the sump is determined using the following formula that relates depth in the ellipsoidal head to volume (24590-WTP-GPG-019, p 5).

$$V_s = \pi D h^2 \left[1 - \frac{4h}{3D} \right]$$

Where:
- V_s: volume based on the liquid level h, in^3
- h: height of liquid in the sump, in.
- D: sump inside diameter, in.
- V_s: in^3 is then converted to gallons.

7.1.1.2 Rectangular Sump

The rectangular sump size is 31.5 in. long by 25.5 in. wide by 16 in. deep (24590-HLW-PER-M-02-001, Table 1). The minimum detectable volume in the sump is

$$V_s = L \times W \times h$$

Where:
- L: length, in
- W: width, in.
- h: depth of liquid in sump, in.
- V_s: in^3 is then converted to gallons.

7.1.2 Wetted Volume For Flow of Liquid Across the Floor of the Cell

When a liquid flows down an inclined surface at a low rate, separate rivulets form instead of a continuous film (Towell and Rothfeld 1966, p 972). The hydrodynamics of rivulet flow have been empirically measured and mathematically modeled (Towell and Rothfeld 1966, p 972-980). The relationships provided in this reference are used to estimate the wetted volume for flow across the cell floor. In this reference, steady state theoretical solutions are developed for the laminar flow based on the reduced form of the Navier-Stokes equations using special boundary conditions that include contact angle (angle formed by the edge of the rivulet and the surface) and relations between the pressure inside and outside the curved interface. First the shape of the interface and the velocity profile in the rivulet is obtained. Then, a relationship between the rivulet width and the flow rate is produced by an integration of the velocity profile. This relationship equation contains the surface inclination (slope), contact angle of the liquid on the surface, and the fluid properties: viscosity, density and interfacial surface tension. In simpler terms, this analysis considers that the flow rate is a balance of gravitational forces, which drive the flow, and viscous forces, which resist the flow.

Experimental measurements consisting of rivulet width measurements as a function of rivulet flow rate were conducted for a variety of liquids including water. The data were then checked against the models and found to be in good agreement (Towell and Rothfeld 1966, p 979).

For the range of flow rates of interest in this calculation, the solution to the flow equations can be simplified by considering the rivulet as a relatively wide and flat rectangular shape (Towell and Rothfeld 1966, p 972). For this shape of rivulet, the maximum flow depth, Y_0 is given by:

$$Y_0 = 2\sin \theta/2 \qquad \text{Equation 1}$$

Where:

Y_o: maximum flow depth, cm

θ: contact angle (angle formed at the edge of the rivulet where it contacts the surface)

The width of the rivulet, l, is determined by Equation 27 (Towell and Rothfeld 1966, p 975) as follows:

$$\frac{\mu Q \tan\alpha}{l\gamma}\sqrt{\frac{\rho g \sin\alpha}{\gamma}} = \frac{8}{3}\sin^3\theta/2 \qquad \text{Equation 2}$$

Where:

α: angle of inclination between the surface and vertical (90^0 - slope in degrees)

γ: interfacial surface tension, dynes/cm = g/sec^2

μ: viscosity, g/cm sec

θ: contact angle (measured from the surface), degrees

ρ: density of liquid, g/cm^3

l: rivulet width, cm

Q: flow rate, cm^3/sec

g: acceleration of gravity, cm/sec^2

Note that CGS units are used in this calculation for consistency with the reference. The volume and flow rate results then are converted to English units.

Rearranging and solving for l gives:

$$l = \frac{3\mu Q \tan\alpha}{8\gamma\left(\sin^3\theta/2\right)}\sqrt{\frac{\rho g \sin\alpha}{\gamma}} \qquad \text{Equation 3}$$

The contact angle, θ, is unknown, but according to Table 2 (Towell and Rothfeld 1966, p 978), at a flow rate of 6.2 cm^3/min (~ 0.1 gal/hr), the contact angles ranging from 9 to 12 degrees were measured experimentally. At lower flow rates, the measured contact angle varied from 3 to 8 degrees but did not show proportionality to flow rate possibly due to varying shape of the rivulet and/or the slope of the surface. Low contact angles applied in equations 1 and 3 yield results of disproportionately wide and shallow rivulets (l is very large compared to Y_0). In the experiments, rivulet width varied up to a maximum of about 4 cm with most of the widths in the range of 0.4 to 3 cm for the smallest incline tested. Rivulet widths below 3 cm correspond to a contact angle of about 6 degrees. Below 6 degrees, widths increase greatly and at contact angles of 4 degrees and lower, the solution does not converge. Therefore, for purposes of this calculation, for flow rates < 0.05 gal/hr, contact angles between 6 degrees and 12 degrees are considered bounding, with the lower of the two angles yielding the highest flow rate. For flow rates of 0.1 gal/hr and higher, a range of 9 degrees to 12 degrees is used; 9 degrees yields the highest flow rate needed for detection in 24 hours, so it is the most conservative.

The remainder of the calculation procedure is now iterative by performing the following steps:

Step 1 - Assume a contact angle and assume a starting flow rate, Q.

Step 2 - Calculate the volume of the rivulet.

Since the rivulet is approximated as rectangular, the cross-sectional area of the rivulet, A, in cm^2:

$A = Y_0 l$

The total volume of the rivulet, V_r, in cm^3:

$V_r = A$ x flow path length (in cm)

V_r is then converted to gallons by dividing by 3,785 cm^3/gal.

Step 3 - Calculate a total volume of liquid leaked in 24 hours.

Add the rivulet volume, V_r, (in gallons) to the volume of liquid leaked in the sump to get V_t, the total volume of liquid leaked in a 24-hour period.

$V_t = V_s + V_r$

Step 4 - Calculate an adjusted total 24-hour flow rate.

$Q_{adj} = V_t / 24$

This new adjusted Q takes the total volume of liquid into account whereas the starting Q only considered the volume of liquid in the sump. Therefore, $Q_{adj,}$ may differ from the initial guess for Q if the volume of the rivulet is significant relative to the volume of the sump, so an iterative trial and error is performed by setting the new trial $Q = Q_{adj}$ from the first trial. This is continued until the starting Q matches the final Q_{adj} (i.e., the iteration converges).

7.2 Calculations

7.2.1 Calculation for the Longest Leak Travel Distance for the Sumps

The maximum leak travel distances for each sump in the facility is derived from the cell dimensions and sump locations as provided in the facility general arrangement drawings (24590-HLW-P1-P01T-P0001 and 24590-HLW-P1-P01T-P0002). As indicated in Assumption 2, the maximum leak travel distance is computed by summing the distance along the walls from the furthest corner of the cell, i.e., adding the north-south wall distance to the east-west wall distance. A summary of distance data for each sump is provided in Table 7.1.

Table 7.1 Maximum Leak Distances for Each Sump

Elev. (ft)	Room Number	Room Name	Sump Number	Sump Type	Sump Location in Cell	N-S Distance (ft)	E-W Distance (ft)	Total Distance (ft)
-21	H-B014	Wet Process Cell - South	HCP-SUMP-00001	Round	W wall	64	18	82
-21	H-B014	Wet Process Cell - North	RLD-SUMP-00001	Round	SE corner	17	18	35
-16	H-B035	Canister Decon Cave	HDH-SUMP-00003	Round	NE corner	21.5	11	33
-16.5	H-B039B	Canister Rinse Tunnel	HDH-SUMP-00001	Round	S wall	11.3	49.3	61
-16	H-B039A	Bogie Maintenance Room	HDH-SUMP-00002	Round	SW corner	34	23.3	57
-21	H-B021	SBS Drain Collection Cell No. 1	HOP-SUMP-00003	Round	NW corner	14.8	17	32
-21	H-B005	SBS Drain Collection Cell No. 2	HOP-SUMP-00008	Round	NW corner	14.8	17	32
3	H-0117	Melter Cave No.1	HFP-SUMP-00002	Rectangular	N wall	14.75	30.5	45
0	H-0310A	Melter 1 Equipment Decon Pit	HSH-SUMP-00008	Rectangular	North	9.5	20	30
3	H-0106	Melter Cave No. 2	HFP-SUMP-00005	Rectangular	N wall	14.75	30.5	45
0	H-0304A	Melter 2 Equipment Decon Pit	HSH-SUMP-00009	Rectangular	North	9.5	20	30
3	H-0117	Melter Cave No. 1	HSH-SUMP-00003	Rectangular	Center	54.1	33	88
3	H-0106	Melter Cave No. 2	HSH-SUMP-00007	Rectangular	Center	54.1	33	88
-3	H-0136	Canister Handling Cave	HPH-SUMP-00001	Round	NE corner	17.8	17.3	36
-3	H-0136	Canister Handling Cave	HPH-SUMP-00005	Round	SW corner	45.3	17.3	63

7.2.2 Calculation for the Round Sump

Based on the estimate of travel distances for leaks in each cell, the longest leak flow distance to any round sump was determined to be 82 ft for sump HCP-SUMP-00001 in the Wet Process Cell-South. The calculation for this bounding case is provided below.

7.2.2.1 Minimum Detectable Volume in the Sump

Minimum detectable volume is determined using the following equation (24590-WTP-GPG-M-019, p 5):

$$V_s = \pi D h^2 \left[1 - \frac{4h}{3D} \right]$$

Where:
D: 29.376 in (I.D. of a 30-inch Schedule 10S pipe)
h: 1 inch (Assumption 5)

$$V_s = \pi (29.376\,in)(1\,in)^2 \left[1 - \frac{4(1\,in)}{3(29.376\,in)} \right]$$

V_s = 88.1 in^3

Multiply by 0.00433 to convert in^3 to gallons.

V_s = 0.38 gal

7.2.2.2 Wetted Volume For Flow of Liquid Across the Floor of the Cell

Based on the methodology described in Section 7.1.2 (CCN 101514), the bounding contact angle, θ, is assumed to be 6°.

Using Equation 1 in Section 7.1.2, the depth of the rivulet, Y_0, is calculated

$$Y_0 = 2\sin(\theta/2)$$

$$Y_0 = 2\sin(6\text{ deg}/2)$$

Y_o = 0.105 cm

Next, the width of the rivulet is calculated using Equation 3 in Section 7.1.2.

$$l = \frac{3\mu Q \tan\alpha}{8\gamma(\sin^3\theta/2)} \sqrt{\frac{\rho g \sin\alpha}{\gamma}}$$

For water at 100°F and a floor slope of 1%, the following values can be used in this equation (CCN 101514, Attachment 1):

α: [90°- 0.01(90°)] = 89.1 degrees

γ: 69.9 dynes/cm = 69.9 g/sec^2

μ: 1 cP = 0.01 g/cm sec (viscosity of water at 100°F is lower than 1 cP, but this value is used to be conservative).

ρ: 1.0 g/cm^3 (density of water at 100°F is slightly lower than 1.0 g/cm^3, but this value is used to be conservative).

g: 980.7 cm/sec^2

The remainder of the calculation procedure is now iterative by performing the following steps:

Step 1 - Assume a starting flow rate, Q, and calculate the rivulet width, l

As a first guess for Q, use the sump volume $V_s/24$ = 0.38 gal/24 hr = 0.016 gal/hr = 0.017 cm^3/sec

$$l = \frac{3(0.01\ g/cm\sec)(0.017\,cm^3/\sec)\tan 89.1\deg}{8(69.9g/\sec^2)\left(\sin^3(6\deg/2)\right)}\sqrt{\frac{(1g/cm^3)(980.7\,cm/\sec^2)\sin 89.1\deg}{(69.9\ g/\sec^2)}}$$

l = 1.47 cm

Step 2 - Calculate the volume of the rivulet.

Since the rivulet is approximated as rectangular, the cross-sectional area, A, of the rivulet is:

$A = Y_0\, l$

A = 0.105 cm x 1.47 cm = 0.154 cm^2

The total volume of the rivulet, in cm^3, is V_r

$V_r = A$ x flow path length, cm

Path length = 82 ft x 30.48 cm/ft = 2,499 cm

V_r = (0.154 cm^2)(2499 cm) = 384.9 cm^3

V_r is then converted to gallons by dividing by 3,785 cm^3/gal.

V_r = 0.10 gal

Step 3 - Calculate a total volume of liquid collected in 24 hours.

Add the rivulet volume, V_r, (in gallons) to the volume of liquid collected in the sump to get V_t, the total volume of liquid leaked in a 24-hour period.

$$V_t = V_s + V_r$$

$$V_t = (0.38\ gal\ + 0.10\,gal) = 0.48\,gal$$

Step 4 - Calculate an adjusted total 24-hour flow rate.

$Q_{adj} = V_t/24$

Q_{adj} = (0.48 gal/24 hr) = 0.02 gal/hr

The initial guess for Q was 0.016 gal/hr so an iterative trial and error is performed until the starting Q matches the final Q_{adj} (i.e., the iteration converges).

When the iterations converge, the flow rate is:

Q = 0.021 gal/hr.

This is rounded to one significant figure:

Q = 0.02 gal/hr

7.2.3 Calculation for the Rectangular Sump

7.2.3.1 Minimum Detectable Volume in the Sump

Minimum detectable volume of the rectangular sump is determined as follows:

V_s = L x W x h

Where:
L: 31.5 in.
W: 25.5 in.
H: 1.25 in. (Assumption 6)

V_s = (31.5 in)(25.5 in)(1.25 in) = 1004 in^3 = 4.35 gal

7.2.3.2 Wetted Volume For Flow of Liquid Across the Floor of the Cell

The same calculation process as performed in Section 7.2.1.2 is used to calculate the wetted volume for flow of liquid across the floor of the cell. All input parameters are the same except:

- The longest flow path length to the sump is 116 ft.
- Contact angle is 9 degrees and starting flow rate for the iterations is 4.35 gal/24 hr = 0.181 gal/hr.

Q is iterated until convergence is achieved. At convergence, the following are determined:

L: 5.94 cm
Y_0: 0.16 cm
A: 0.93 cm^2
V_r: 0.87 gal
V_t: 5.22 gal
Q: 0.217 gal/hr

Q value would be 0.2 gal/hr after rounding to one significant figure.

7.2.4 Minimum Leak Flow Rates for the Remaining Sumps

Calculations for the remaining 13 sumps in the HLW facility are performed using the same methodology described in Section 7.1 The only variable is the leak travel distance to the sump. The results are summarized in Table 6.1.

8 References

8.1 Project Documents

24590-HLW-PER-M-02-001, Rev. 3, *HLW Facility Sump Data.*

24590-HLW-P1-P01T-P0001, Rev. 6, *HLW Vitrification Building General Arrangement Plan at El. -21 ft - 0 in.*

24590-HLW-P1-P01T-P0002, Rev. 3, *HLW Vitrification Building General Arrangement Plan at El. 0 ft - 0 in.*

24590-WTP-GPG-M-019, Rev 1, *Mechanical Systems Design Guide: Vessel Sizing.*

CCN 101514, *24-Hour Leak Detection.*

8.2 Codes and Standards

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

WA 7890008967. Dangerous Waste Permit. *Dangerous Waste Portion of the Hanford Facility Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste,* Chapter 10 and Attachment 51. Waste Treatment and Immobilization Plant.

8.3 Other Documents

Towell, G.D and Rothfeld, L.B. 1966. "Hydrodynamics of Rivulet Flow", *AIChE Journal,* Vol. 12, No. 5, Pages 972-980.

R10192640

ISSUED BY
RPP-WTP PDC
INIT DATE

Document title: **Description of HLW Vitrification System Bypass Events**

Contract number: DE-AC27-01RV14136

Department: Process Engineering/Melter Systems

Author(s): Jim Rouse

Principal author signature:

Document number: 24590-HLW-PER-PR-03-001, Rev 0

Checked by: Rich Peters

Checker signature:

Date of issue: January 23, 2004

Issue status: Initial Issue

Approved by: Jeff Pullen

Approver's position: HLW Area Discipline Supervisor

Approver signature:

JAMES K. ROUSE
STATE OF WASHINGTON
33910
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES: 3/5/04

This bound document contains a total of 12 pages

River Protection Project
Waste Treatment Plant
2435 Stevens Center Place
Richland, WA 99352
United States of America
Tel: 509 371 2000

Best Available Copy

Notice

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the US Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

History Sheet

Rev	Date	Reason for revision	Revised by
0	January 22, 2004	Issued For Permitting Use	Jim Rouse

Contents

Notice ii

History Sheet iii

Acronyms and Abbreviations v

1 Introduction 1

2 Applicable Documents 1

3 System Summary 1

- **3.1 Primary Melter Offgas Treatment System** 2
- **3.2 Secondary Offgas Treatment System** 3
- **3.3 Vessel Ventilation System (System PVV)** 3

4 Description of Bypass Events 3

- **4.1 Offgas Standby Jumper** 4
- **4.2 Melter Pressure Relief Device** 4
- **4.3 Submerged Bed Scrubber Maintenance Bypass** 5
- **4.4 HEME/HEPA Trains** 5
- **4.5 Activated Carbon Column Bypass** 5
- **4.6 Secondary Offgas Bypass** 6

Attachment 1 HLW Melter Offgas System 7

Acronyms and Abbreviations

ABS	Absorber
ADBR	Adsorber
AEA	*Atomic Energy Act*
Cl	Chloride
DOE	Department of Energy
F	Fluoride
FCLR	Film Cooler
HEME	High Efficiency Mist Eliminator
HEPA	High Efficiency Particulate Air
HLW	High Level Waste
HOP	HLW Melter Offgas System
HTR	Heater
HX	Heat Exchanger
MTG/d	Metric Tons per Day
NO_x	Nitrous Oxides
PVV	Process Vessel Vent
SBS	Submerged Bed Scrubber
SCO	Selective Catalytic Oxidizer
SCR	Selective Catalytic Reducer
SVOC	Semi-Volatile Organic Compound
VOC	Volatile Organic Compound
VSL	Vessel
WESP	Wet Electrostatic Precipitator
WTP	Waste Treatment Plant

1 Introduction

The HLW Vitrification Facility has been designed to vitrify mixed waste in a joule-heated ceramic melter and treat the resulting offgas in a manner that protects human health and the environment. Bypasses are designed into the HLW Vitrification Facility offgas system to:

- allow maintenance of air pollution control equipment without stopping melter ventilation,
- maintain a ventilation path to the facility stack, and
- prevent and/or minimize melter pressurization.

This document describes these potential HLW Vitrification Facility bypass events.

2 Applicable Documents

Process Flow Diagrams associated with the HLW melter offgas system are:

- 24590-HLW-M5-V17T-P0002, *Process Flow Diagram - HLW Vitrification - Melter 1 (System HMP)*
- 24590-HLW-M5-V17T-P0003, *Process Flow Diagram - HLW Vit Melter 1 - Primary Offgas Treatment (System HOP)*
- 24590-HLW-M5-V17T-P0004, *Process Flow Diagram - HLW Vitrification - Melter 1 - Secondary Offgas Treatment (System HOP)*
- 24590-HLW-M5-V17T-P20002, *Process Flow Diagram - HLW Vitrification - Melter 2 (System HMP)*
- 24590-HLW-M5-V17T-P20003, *Process Flow Diagram - HLW Vit Melter 2 - Primary Offgas Treatment (System HOP)*
- 24590-HLW-M5-V17T-P20004, *Process Flow Diagram - HLW Vitrification - Melter 2 - Secondary Offgas Treatment (System HOP)*

Additional process information can be obtained within 24590-HLW-3YD-HOP-00001, *Systems Description for HLW Melter Offgas Treatment Process and Process Vessel Vent Extraction (HOP and PVV Systems).*

3 System Summary

The HLW Facility contains two identical offgas treatment systems, one for each of the two HLW Melters. Both offgas systems contain three process sub-systems. These sub-systems are designed for specific purposes and use "best available control" technologies. These systems are defined as follows:

- Primary Melter Offgas Treatment System
  - Film Cooler (HOP-FCLR-00001/2)
  - Melter Pressure Control Subsystem
    - Melter pressure controls/instrumentation
    - Main offgas line
    - Standby offgas line

    - Maintenance bypass line
  - Submerged Bed Scrubber (SBS) (HOP-SCB-00001/2)
  - SBS Condensate Receiver Vessel (HOP-VSL-00903/904)
  - Wet Electrostatic Precipitator (WESP) (HOP-WESP-00001/2)
  - High Efficiency Mist Eliminators (HEMEs) (HOP-HEME-00001A/B and 2A/B)
  - HEPA Filter Electric Preheaters (HOP-HTR-00002A/1B/5A/5B)
  - High Efficiency Particulate Air (HEPA) Filters (HOP-HEPA-00001A/1B/2A/2B/7A/7B/8A/8B)
- Secondary Offgas Treatment System
  - Booster Extraction Fans (HOP-FAN-00001A/1B/1C/8A/8B/8C)
  - Activated Carbon Column (sulfur impregnated) (HOP-ADBR-00001A/1B/2A/2B)
  - Silver Mordenite Preheater (HOP-HX-00002/4)
  - Silver Mordenite Column (HOP-ABS-00002/3)
  - Catalyst Skid (HOP-SCO-00002/3)
    - Catalyst Skid Preheater (HOP-HX-00001/3)
    - Catalyst Skid Electric Heater (HOP-HTR-00001/7)
    - Thermal Catalytic Oxidizer (TCO) (HOP-SCO-00001/4)
    - NO_x Selective Catalytic Reducer (SCR) (HOP-SCR-00001/2)
  - Stack Extraction Fans (HOP-FAN-00009A/9B/9C/10A/10B/10C)
- Vessel Ventilation System (System PVV)

The following sections describe the three process offgas treatment systems components and their related process operations. A sketch of the HLW melter offgas system is included as Attachment 1.

3.1 Primary Melter Offgas Treatment System

The offgas treatment system is able to handle a melter capacity of 3.0 MTG/d. The primary offgas treatment system is designed to control the melter pressure, remove heat from the melter offgas to permit appropriate operation of the down-stream equipment, and remove particulates. The system, in conjunction with the fans, is designed to accommodate intermittent offgas surges with seven times (7X) the normal steam generation.

All HLW primary offgas equipment, except filter media, is designed for the life of the facility. The HEME and HEPA filter elements are designed for remote change-out as required.

A pair of HEME/HEPA filter trains will be provided for the HLW melter. One set of HEME/HEPA filters will be in operation while the parallel system is on standby or being maintained. A HEME/HEPA filter set is activated or taken off-line by opening or closing the appropriate inlet valves. The inlet valves will be located in the melter cave with the HEMEs. Isolation valves are also located in the filter cave that can be used for HEPA filter isolation to permit filter media replacement. These isolation and switching valves are remotely maintainable.

3.2 Secondary Offgas Treatment System

The combined primary and vessel ventilation offgas stream is discharged to the secondary offgas treatment system. The secondary offgas system will treat the combined offgas so that it is acceptable for release to the HLW vitrification facility stack. Specifically, the secondary offgas treatment system will remove iodine-129, volatile organic compounds (VOC), NO_x, and volatile halides (i.e. Cl and F) as required, to meet the WTP's air discharge requirements. The system will also be designed to limit potential catalyst poisons from reaching the VOC treatment unit.

The secondary offgas system also contains extraction fans (booster and stack) to provide the motive force to ventilate the system and maintain a vacuum within the HLW melter plenum. It also includes two heat recovery heat exchangers and an electric heater for offgas heating and cooling as appropriate.

The primary offgas treatment system is designed to remove sufficient radionuclides such that the secondary offgas treatment system can be contact or semi-remotely maintained.

3.3 Vessel Ventilation System (System PVV)

The vessel ventilation offgas system will maintain the various HLW process vessels under a slight vacuum relative to the cave to prevent cave contamination. Vessels (such as the melter feed preparation vessel and melter feed vessel) containing slurries with high solids content will be equipped with flushable demisters for aerosol removal. The vessel vent system will not receive any offgas generated from reverse flow diverter pumps and pulse jet agitator operations. The composition of the ventilation air is primarily air with slight chemical and radioactive particulate contamination. No significant acid gas or organic contamination is anticipated for the vessel ventilation offgas.

The vessel ventilation air is combined with the melter offgas prior to entering the HEMEs. The combined offgas streams are treated together in the remaining sections of the primary and secondary offgas treatment systems. A pressure control valve is used to balance the pressure between the vessel ventilation system and the primary offgas treatment systems.

4 Description of Bypass Events

The HLW Offgas system (HOP) has the following alternate flow paths that the melter offgas could be diverted to during certain upset or off-normal (i.e., maintenance) events:

- Offgas Standby Jumper
- Melter Pressure Relief Valve
- Submerged Bed Scrubber Maintenance Bypass
- HEME/HEPA Trains
- Activated Carbon Unit Bypass
- Secondary Offgas Bypass

The following sections provide a process description of each alternate flow path, what causes them to be activated, level of abatement when activated, and melter feeding/cold cap condition required for activation:

4.1 Offgas Standby Jumper

The standby offgas line supplements control of the melter plenum pressure under high offgas surge situations or if there is a blockage in the main offgas line to the submerged bed scrubber. The melter plenum pressure is controlled at a sufficient vacuum set point relative to the melter cave to avoid contamination release to the melter cave, prevent inadvertent glass pour, and prevent damage from occurring to the primary treatment system. This is accomplished by providing an alternate path by way of the standby offgas line for melter offgas. The standby offgas line is identical in size to the primary offgas line and runs parallel to the primary line from the melter to the submerged bed scrubber.

The standby line will normally be isolated from the offgas via a fast-acting valve. At a low vacuum set point, this valve will automatically open, providing an additional or alternative (if the primary is restricted) path for the melter offgas to flow. The standby offgas pipe extends to the bottom of the submerged bed scrubber packed bed, identical to the primary pipe. Thus, during melter surges the cross-sectional area available for offgas flow effectively doubles, decreasing the pressure drop between the melter and the submerged bed scrubber and helping to reestablish normal melter vacuum. In case of pluggage in the primary offgas pipe between the melter and the submerged bed scrubber, the standby system would also activate, allowing melter pressure control to continue. Once the cause of the standby system being activated is rectified, the valve would be closed by operator initiation, returning all of the melter offgas to the primary offgas film cooler and offgas pipe. An air purge will be used to keep the standby offgas line clean and prevent blocking.

The standby offgas jumper is automatically activated based on the melter plenum vacuum via a pressure control interlock. Activation of the standby jumper is most likely to occur under melter feeding conditions and during an upset condition (i.e., melter surge). No loss of offgas abatement occurs upon activation of the standby jumper since the offgas is routed to the same destination (i.e., the SBS) as the primary offgas jumper.

4.2 Melter Pressure Relief Device

In the unlikely event that an offgas surge exceeds the capacity of the melter offgas pressure control system, a pressure relief device is provided to vent the melter gases to the melter cave. These gases would be filtered by the C5 filter system.

The melter pressure relief device is a pressure-activated flapper valve that is mounted on the standby offgas jumper. It is mechanically designed to automatically open when the melter plenum reaches a predetermined "positive" pressure relative to the melter cave. The melter will begin venting to the melter cave once the plenum pressure exceeds the melter cave pressure. The primary purpose of this valve is to prevent the melter from over-pressurizing to such a degree that it pushes glass out of the melter pour spouts. The pressure relief valve automatically closes when the melter plenum pressure falls back below its set point.

Activation of the pressure relief valve is most likely to occur under melter feeding conditions and during a significant upset condition (i.e., valve misalignment, large melter surge, loss of extraction fan operation, etc.). Melter offgas vented into the melter cave would bypass all offgas treatment steps, but would be treated by the C5 ventilation HEPA filters. Except for extreme scenarios, offgas release to the melter cave would not be expected to continue for more than a few seconds to a minute. Through a combination of injected air minimization, melter feed termination, and increased fan speed, the melter offgas pressure control system is designed to compensate for upset conditions and automatically restore the melter plenum to vacuum. The HOP extraction fans can be operated via backup generators in case of loss of

offsite power. They are also operated in a 50% fashion whereby each extraction fan set (booster and stack) has two operation fans with a unique backup fan. In the event of single fan failure in either fan set, the remaining operational "50%" fan allows continued melter ventilation while the standby fan is started and ramps up to operational speeds.

4.3 Submerged Bed Scrubber Maintenance Bypass

The maintenance bypass line is located between the melter and the HEME inlet. It is used to provide an alternate melter ventilation path when maintenance is required on the film cooler, main/standby offgas jumper, the submerged bed scrubber, or on the WESP. The maintenance bypass line would only be opened after the melter has been placed in an idling state (no melter feeding and no cold cap present). The line contains a remotely operated valve, a cooling air supply, and a water spray quenching system. The cooling air partially cools the melter offgas from about 1800°F to about 1000°F. The water spray quenches the offgas from about 1000°F to about 150°F. The cooling air supply also normally provides an air purge when the line is not activated to prevent solids from accumulating in the inlet.

When activated, the submerged bed scrubber maintenance bypass diverts the melter offgas around two of the four particulate removal steps (i.e., submerged bed scrubber and WESP) in the primary offgas system. However, given that the melter is idled and no cold cap is present, the particulate load in the idled offgas would be minimal. The diverted offgas would still be treated by the HEME and HEPA filters which have a combined particulate removal efficiency that significantly exceeds the submerged bed scrubber /WESP combination. Idled melter offgas that is diverted through the maintenance bypass will have a significantly reduced particulate contamination after only HEME/HEPA treatment compared to what is discharged during normal melter feeding operations and abatement by the SBS, WESP, HEME, and HEPA combination. Operation of the SBS maintenance bypass for extended periods (days to weeks) would be expected while maintenance activities are performed.

4.4 HEME/HEPA Trains

A pair of HEME/HEPA filter trains will be provided for the HLW melter offgas treatment. One set of HEME/HEPA filters will be in operation while the parallel system is on standby or being maintained. Parallel filter trains are provided so that filter maintenance does not impact facility throughput and to provide a backup system in case of component failure in the primary train. Filter maintenance can consist of HEME filter flushing, HEME/HEPA filter media replacement, and/or maintenance of other related components. A HEME/HEPA filter set will be activated or taken off-line by opening or closing the appropriate remotely actuated inlet valves. The inlet valves will be located in the melter cave with the HEMEs. Isolation valves are also located in the filter cave that can be used for HEPA filter isolation only to permit filter media replacement.

When the melter offgas is diverted through either HEME/HEPA filter train, no loss of abatement efficiency occurs since each train contains identical treatment units. Either train can be used during melter feeding operations or to treat idled melter offgas that is diverted through the SBS maintenance bypass.

4.5 Activated Carbon Column Bypass

The activated carbon column is used to remove mercury compounds from the HLW melter offgas. The unit consists of two sulfur impregnated activated carbon beds that will alternate in a lead/lag series arrangement so that the unit has 100% availability. When the lead bed reaches breakthrough, the offgas is

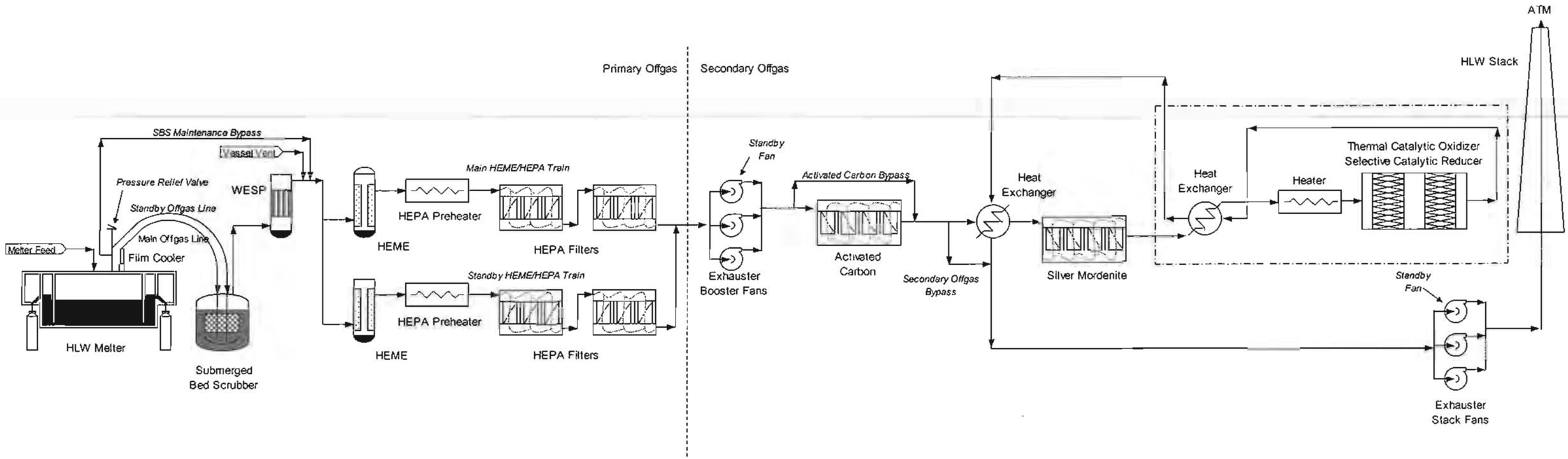
switched to the lag bed for treatment while the lead bed is independently isolated and the spent media replaced. The fresh media/bed is then "valved" back into the offgas stream as the new lag bed.

The overall unit is equipped with a manual bypass that would allow the offgas to bypass the treatment unit if opened. However, the bypass will not be used during normal operations. At least one of the activated carbon beds would always be online for offgas treatment, even if the melter were idled.

4.6 Secondary Offgas Bypass

Other than the activated carbon column, the HLW secondary offgas system also is equipped with a silver mordenite column for iodine/halide removal, a catalyst skid for NO_x and VOC/SVOC destruction, and a gas heat exchanger for heat recovery. Both the silver mordenite column and the catalyst skid will require eventual media change-out. This will require the units to be bypassed from the melter ventilation path. Therefore, the system is equipped with a "secondary offgas" manual bypass that diverts the melter offgas from the activated carbon column discharge directly to the stack extraction fans and the facility stack. This bypass would only be activated after the melter is fully idled and all cold cap remnants have dissipated. (NOTE: The activated carbon column is <u>not</u> bypassed upon activation of the secondary offgas bypass.)

When required, the secondary offgas bypass would be used for several days to weeks to allow sufficient time for media change-out and/or other maintenance activities on the silver mordenite column, catalyst skid, and/or silver mordenite preheater. Although the abatement function of these units would cease while they are bypassed for maintenance, the realized stack emissions are estimated to contain less iodine/halides, NO_x, and VOC/SVOCs than during normal melter feed operations. This is because the melter will be idled and no cold cap will be present in the melter.

Attachment 1

HLW Melter Offgas System