RIVER PROTECTION PROJECT – WASTE TREATMENT PLANT

ENGINEERING SPECIFICATION

FOR

HLW Canister Grapple and Load Cells

Content applicable to ALARA?	☒ **Yes** ☐ **No**	**Quality Level**
ADR No. 24590-HLW-ADR-M-24-0011 24590-HLW-ADR-MH-25-0002	**Rev** 1 0	Q
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Revision History

Revision	Reason for Revision	Q Specification Revision Only Margin Reduced?		CM Only
		YES	NO	N/A
0	Issue for Purchase	N/A	N/A	N/A
		☐	☐	☐
		☐	☐	☐
		☐	☐	☐

Contents

Appendices

Tables

1 Scope

1.1 Project Description and Location

1.1.1 The Hanford Tank Waste Treatment and Immobilization Plant (WTP) is a complex of radioactive waste processing facilities that will be engineered, procured, and constructed by Bechtel National, Inc. (BNI) for the Department of Energy (DOE). The complex will immobilize waste that is contained in underground storage tanks at the Hanford Site. The facility will convert radioactive waste into solid glass through a process called vitrification. WTP will return vitrified waste products, intermediate waste, and secondary waste to DOE Hanford Field Office (HFO) custody.

1.1.2 The Hanford Site occupies an area of approximately 560 square miles and is located along the Columbia River, north of Richland, WA. The WTP Facility is being constructed at the east end of the 200 East Area of the Hanford Site. Benton, Franklin, and Grant counties surround the Hanford Site.

1.2 Equipment, Material, and Services Required

The High-Level Waste (HLW) Canister Grapples are mechanically actuated lifting devices, used for transporting Canisters within the HLW Facility. The Grapples are suspended from an overhead crane and attached to the hook with a lifting bail. Canisters are filled with vitrified waste. The load cell assembly is used to weigh the filled canisters.

1.2.1 This specification applies to the fabrication, assembly and testing of the Grapples and load cells for use in the HLW Facility. The SELLER is responsible for supplying the equipment identified in **Table 1-1.** The term SELLER refers to the seller and any parties subcontracted by the seller to complete any portion of the work. The BUYER is providing detailed equipment drawings (DED) for the Grapples and has performed all necessary analysis. The BUYER is also providing design proposal drawings (DPD) for the load cells. Refer to part 1 of the Purchase Order (PO) for a complete list of the PRODUCTS required. The term PRODUCTS includes equipment, services, and documentation to support the design and fabrication of equipment.

1.2.2 The Grapples are designated as Quality (Q) due to waste acceptance impacting (WAI) Performance requirements. For this reason, the quality assurance (QA) program for fabrication, assembly, testing, and supporting documentation shall be qualified under a DOE/RW-0333P, *Quality Assurance Requirements and Description* (QARD), quality assurance program (refer to Section 8.1.1). The requirements applicable to WAI are discussed in Section 3.5, WAI Requirements.

1.2.3 The load cells are designated as commercial material (CM) and must meet WAI Passive requirements. For this reason, the quality assurance (QA) program for design, fabrication, assembly, testing, and supporting documentation shall be qualified under DOE Order 414.1D contractor requirements document (CRD) Quality Assurance (refer to Section 8.1.2).

1.2.4 The SELLER shall provide the equipment/services identified in **Table 1-1** and, unless otherwise stated, any deliverables necessary to comply with the requirements identified in this specification.

Table 1-1 Required Equipment / Service

No.	Component Tag Number (CTN) 24590-HLW-	Description	HLW Room
1	N/A	HLW Grapple for Design Validation Testing[i]	N/A
2	N/A	Perform Design Validation Testing & Inspections[i]	N/A
3	FH-HDH-TOOL-00001	CANISTER DECONTAMINATION CAVE CANISTER GRAPPLE (CLEAN)	H-0133
4	FH-HDH-TOOL-00004	CANISTER DECONTAMINATION CAVE CANISTER GRAPPLE (DIRTY)	H-0133
5	FH-HEH-TOOL-00001	CANISTER GRAPPLE CANISTER STORAGE CAVE	H-0132
6	FH-HPH-TOOL-00001	THREE JAW GRAPPLE, CANISTER HANDLING CAVE, LOWER CRANE	H-0136
7	FH-HPH-TOOL-00018	THREE JAW GRAPPLE SPARE	NA
8	FH-HRH-TOOL-00002	MECHANICAL SEQUENCE GRAPPLE	H-0135A
9	FH-HSH-TOOL-00004	CANISTER GRAPPLE[ii]	H-0106 H-0117
10	FH-HPH-TOOL-00017	THREE JAW GRAPPLE, CANISTER HANDLING CAVE, UPPER CRANE	H-0136
11	N/A	Test Canister & Lids for testing	N/A
12	MH-HEH-MHAN-00013	Export Canister Grapple Load Cell	H-0132
13	MH-HEH-MHAN-00014	Export Canister Grapple Load Cell	H-0132

Notes:
i. Not required if performed by High Level Waste Mockup (HMF).
ii. HSH grapple is shared between melter caves.

1.2.5 For PRODUCTS related to equipment covered by this specification, the SELLER's scope of work includes, but is not limited to:

- Any special tools or equipment required for assembly, maintenance, installation, removal, and disassembly
- Fabrication
- Assembly
- Temporary equipment required for equipment testing
- Examinations and inspections, Design Validation Testing, and factory acceptance testing (FAT)

- Preparation of drawings and other technical supporting documents
- QA documents necessary for qualification under the QARD program (refer to Section 8.1.1)
- Preparation for shipping, including fabrication of any required shipping support frames, handling beams, and tie-down fixtures
- Shipping of equipment to BUYER facility
- Submittals as identified in this and accompanying specifications and as summarized in the MR and the PO.

1.2.6 All material, equipment, devices, and parts comprising the design specified herein shall be new and unused and of current manufacture and supplied by the SELLER.

1.2.7 The SELLER may subcontract any portion of the engineering, fabrication, manufacture, inspection, or testing, provided it meets the QA requirements of this specification (see Section 8). The SELLER is responsible for the completeness and quality of all deliverables.

1.3 Build Approach

1.3.1 Procurement Strategy

1.3.1.1 For BUYER, status of HLW Mockup facility (HMF) verification and validation of HMF canister grapple testing is a prerequisite for MR.

1.3.1.2 Although this is a Build to Print specification, SELLER is encouraged to share ideas / improvements with BUYER. We also solicit comments where criteria in this specification could be improved to result in a better product.

1.3.2 General

1.3.2.1 This specification is accompanied by DEDs and a DPD. Refer to **Table 2-2** for details on these documents.

1.3.2.2 Requirements on DEDs are mandatory dimensions or features that are necessary to ensure interface with other design features. DEDs are provided for the Grapples. The Grapples shall be build to print.

1.3.2.3 A DPD is an equipment-based drawing that demonstrates a BUYER proposed concept for the equipment that meets specific functional, performance and facility interface design constraints requirements. Selections of components depicted on the DPD is for proposal only. The design for the load cells is a proposal. The DPD can be identified by 'Design Proposal Drawing' being included in the document description.

1.3.2.4 Some of the information on the DPD consists of additional technical requirements and some conceptual information for a proposed design. Differentiation between technical requirements (mandatory) and conceptual design proposal information (non-mandatory) is discussed below.

1.3.2.5 Mandatory technical requirements and design constraints are typically indicated on the DPD by use of terms such as "shall", "required", "mandatory", "maximum", "minimum", or "not to exceed", or by the use of notes. Examples of mandatory technical requirements are dimensions and their associated tolerances, bounding location of center of gravity, and estimated weight not to exceed. Mandatory requirements are also invoked via requirements in the specification.

1.3.2.6 SELLER may propose design improvements, including alternate approaches and component selections. Design improvements shall result in benefits associated with safety, quality, reliability, fabrication/construction, installation, testing, maintenance/repair, performance, cost, or schedule.

1.3.2.7 The SELLER shall verify that all required information on the BUYER DPD is shown on the SELLER's drawings.

1.3.2.8 The SELLER shall coordinate significant non-mandatory changes with the BUYER.

1.3.2.9 The SELLER is responsible for all load cell design development including full validation of the proposed design. The final design shall incorporate all requirements of this specification and other referenced specifications.

1.4 Acronyms/Definitions

ASME	American Society of Mechanical Engineers
ASNT	American Society for Nondestructive Testing
ASTM	American Society for Testing and Materials
AWS	American Welding Society
BNI	Bechtel National, Inc.
BUYER	Bechtel National, Inc.
Canister	HLW vitrification canister- stainless steel container containing molten waste/glass mixture
CM	Commercial Material (quality level)
CoC	certificate of compliance / conformance (Conformance for Q)
CTN	component tag number
CRD	contractor requirements document
CWI	certified weld inspector
DFHLW	Direct Feed high-level waste / High-Level Waste Facility
DED	detailed equipment drawing
DOE	Department of Energy
DPD	design proposal drawing
FAT	factory acceptance test
Grapple	HLW Canister Grapple- mechanically actuated lifting device used to transport Canisters
HDH	HLW canister decontamination handling system
HEH	HLW canister export handling system
HFO	Hanford Field Office
HLW	high-level waste / High-Level Waste Facility
HMF	High-Level Waste Mockup Facility
HPH	HLW canister pour handling system
HRH	HLW canister receipt handling system

HSH	HLW melter cave support handling system
IGRIP	Interactive Graphics Robot Instruction Program
MTR	Material test report
MR	material requisition
NDE	nondestructive examination
NIST	National Institute of Standards and Technology
PO	purchase order
PQR	procedure qualification record
PRODUCTS	equipment, services, and documentation to support the design and fabrication of equipment
Q	Quality (quality level)
QA	Quality Assurance
QAP	Quality Assurance Program
QARD	Quality Assurance Requirements and Description
SELLER	this is a comprehensive term and includes seller, vendor, contractor, subcontractor, supplier, sub-supplier, etc.
TLM	telemanipulator
WAI	waste acceptance impacting
WPS	welding procedure specification
WTP	Hanford Tank Waste Treatment and Immobilization Plant

1.5 Safety/Quality/Seismic Classifications

1.5.1 The classification for all equipment is covered by this specification as shown in **Table 1-2**.

Table 1-2 Equipment Classifications

Description	Safety Classification	Quality Classification	Seismic Category	WAI Designation
All Grapples	Non-Safety	Q[i]	SC-III	WAI-Performance WAI-Passive
Load Cells	Non-Safety	CM	SC-III	WAI-Passive

Notes:
i. WAI-Performance assigns Q quality classification. See section 8.1.

2 Applicable Documents

2.1 General Requirements

2.1.1 The following codes and standards are applicable to the extent cited within this specification. If the SELLER finds a conflict between this specification and other requirements, the SELLER shall obtain written resolution from BUYER prior to proceeding with any work. In general, when resolving conflicts, the following order of precedence shall apply:

- PO
- MR
- This Specification
- Detailed Equipment Drawings

- Engineering General Specifications referenced by this Specification (**Table 2-1**)
- Industry Codes and Standards
- Design Proposal Drawing

2.1.2 The applicable version of all codes and standards specified shall be in effect at time of contract award, unless otherwise noted. Use of any other edition, revision, or issue of codes and standards require BUYER's written approval prior to proceeding with any work. When specific chapters, sections, parts, or paragraphs are listed following a code or industry standard, only those chapters, sections, parts, or paragraphs of the document are applicable and shall be applied.

2.1.3 For codes and standards listed below, 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. When more than one code, standard, or reference document covers the same topic, the requirements for all must be met.

2.2 Federal & State Regulations

OSHA 29 CFR 1926.251	Rigging Equipment for Material Handling

2.3 Quality Assurance

DOE/RW-0333P	Quality Assurance Requirements and Description (QARD) (refer to Section 8.1.1)
DOE Order 414.1D	Quality Assurance

2.4 Industry Codes & Standards

All equipment shall be designed and manufactured in accordance with the applicable sections of the edition in effect at the time of award of the contract of the following standards unless noted otherwise.

2.4.1 American Society of Mechanical Engineers (ASME)

2.4.1.1 Design, Fabrication, Documentation, and Operation Standards

ASME B46.1	Surface Texture (Surface Roughness, Waviness, & Lay)
ASME BTH-1	Design of Below-the-Hook Lifting Devices
ASME B30.20	Below-the-Hook Lifting Devices

2.4.1.2 Fastener Standards

ASME B18.2.1	Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)
ASME B18.2.2	Nuts for General Applications: Machine Screw Nuts; and Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)

2.4.2 American Society for Nondestructive Testing (ASNT)

ASNT SNT-TC-1A	Personnel Qualification and Certification in Nondestructive Testing

2.4.3 American Society for Testing and Materials (ASTM)

2.4.3.1 Material Standards

ASTM A240/A240M	Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A564/564M	Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes

2.4.3.2 Fastener Standards

ASTM A354	Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other External Threaded Fasteners
ASTM A449	Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM F593	Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

2.4.4 American Welding Society (AWS)

AWS D1.1/D1.1M	Structural Welding Code
AWS D1.6/D1.6M	Structural Welding Code – Stainless Steel
AWS D9.1/D9.1M	Sheet Metal Welding Code
AWS D14.0/D14.0M	Machinery and Equipment Welding Specification
AWS QC1	Specification for AWS Certification of Welding Inspectors

2.4.5 National Electric Manufacturers Association (NEMA)

Not Used	

2.4.6 National Fire Protection Association (NFPA)

Not Used	

2.5 Engineering Specifications

The following is a list of WTP and HLW Specifications invoked by this specification:

Table 2-1 Engineering Specifications

Document Number	Title
24590-WTP-3PS-AFPS-T0001	Engineering Specification for Shop Applied Special Protective Coatings for Steel Items and Equipment
24590-WTP-3PS-G000-T0019	Engineering Specification for Acquisition of Commercial Items and Services for Use in Safety Applications at WTP
24590-WTP-3PS-G000-T0050	Engineering Specification for Supplier Documentation
24590-WTP-3PS-G000-T0053	Engineering Specification for QARD Supplier Quality Assurance Program Requirements
24590-WTP-3PS-G000-T0056	Engineering Specification for Packaging, Handling and Storage Requirements for HLW Equipment
24590-WTP-3PS-NW00-T0003	Engineering Specification for Chemical Requirements for Materials Used in Contact with Austenitic Stainless Steel and Nickel Based Alloys – For HLW and DFHLW
24590-WTP-3PS-SS00-T0002	Engineering Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel
24590-WTP-LIST-ESH-16-0001	Restricted Materials List Hanford Tank Waste Treatment and Immobilization Plant (WTP Project)

2.6 Drawings

2.6.1 Detailed Equipment Drawings

Table 2-2 Grapples (Build to Print)

Document Number	Title
24590-HLW-MX-30-00011001	HLW VITRIFICATION SYSTEM FABRICATION DRAWING GRAPPLE ASSEMBLY
24590-HLW-MX-30-00011002	HLW VITRIFICATION SYSTEM FABRICATION DRAWING GRAPPLE ASSEMBLY DETAILS
24590-HLW-MX-30-00011003	HLW VITRIFICATION SYSTEM FABRICATION DRAWING GRAPPLE ASSEMBLY OPERATION MODES
24590-HLW-MX-30-00011004	HLW VITRIFICATION SYSTEM FABRICATION DRAWING GRAPPLE ASSEMBLY CANISTER INTERACTION
24590-HLW-MX-30-00011005	HLW VITRIFICATION SYSTEM FABRICATION DRAWING GRAPPLE ASSEMBLY DETAILS
24590-HLW-MX-30-00011006	HLW VITRIFICATION SYSTEM FABRICATION DRAWING GRAPPLE ASSEMBLY DETAILS
24590-HLW-MX-30-00012001	HLW VITRIFICATION SYSTEM FABRICATION DRAWING GRAPPLE BASE ASSEMBLY

Document Number	Title
24590-HLW-MX-30-00012002	HLW VITRIFICATION SYSTEM FABRICATION DRAWING GRAPPLE BASE ASSEMBLY CENTER BASE TUBE DETAIL
24590-HLW-MX-30-00012003	HLW VITRIFICATION SYSTEM FABRICATION DRAWING GRAPPLE BASE ASSEMBLY BASE GUIDE FOOT DETAIL
24590-HLW-MX-30-00012004	HLW VITRIFICATION SYSTEM FABRICATION DRAWING GRAPPLE BASE ASSEMBLY BASE PLATE DETAIL
24590-HLW-MX-30-00012005	HLW VITRIFICATION SYSTEM FABRICATION DRAWING GRAPPLE BASE ASSEMBLY DETAILS
24590-HLW-MX-30-00013001	HLW VITRIFICATION SYSTEM FABRICATION DRAWING UPPER SLIDING TUBE
24590-HLW-MX-30-00013002	HLW VITRIFICATION SYSTEM FABRICATION DRAWING UPPER SLIDING TUBE DETAIL
24590-HLW-MX-30-00013003	HLW VITRIFICATION SYSTEM FABRICATION DRAWING UPPER SLIDING TUBE LINKAGE ATTACHMENT LUG
24590-HLW-MX-30-00014001	HLW VITRIFICATION SYSTEM FABRICATION DRAWING UPPER LIFTING FRAME
24590-HLW-MX-30-00014002	HLW VITRIFICATION SYSTEM FABRICATION DRAWING UPPER LIFTING FRAME MOUNT PLATE
24590-HLW-MX-30-00014003	HLW VITRIFICATION SYSTEM FABRICATION DRAWING UPPER LIFTING FRAME CENTER TUBE
24590-HLW-MX-30-00014004	HLW VITRIFICATION SYSTEM FABRICATION DRAWING UPPER LIFTING FRAME UPPER LIFTING ARM ATTACHMENT PLATES
24590-HLW-MX-30-00014005	HLW VITRIFICATION SYSTEM FABRICATION DRAWING UPPER LIFTING FRAME UPPER POSITION INDICATOR BUSING BUNG
24590-HLW-MX-30-00015001	HLW VITRIFICATION SYSTEM FABRICATION DRAWING LIFTING ARM ASSEMBLY
24590-HLW-MX-30-00015002	HLW VITRIFICATION SYSTEM FABRICATION DRAWING LIFTING ARM ASSEMBLY LIFTING ARM PLATE DETAIL
24590-HLW-MX-30-00015003	HLW VITRIFICATION SYSTEM FABRICATION DRAWING LIFTING ARM ASSEMBLY LIFTING ARM TOOTH DETAIL
24590-HLW-MX-30-00016001	HLW VITRIFICATION SYSTEM FABRICATION DRAWING CANISTER POSITION INDICATOR
24590-HLW-MX-30-00016002	HLW VITRIFICATION SYSTEM FABRICATION DRAWING CANISTER POSITION INDICATOR ROD DETAIL
24590-HLW-MX-30-00016003	HLW VITRIFICATION SYSTEM FABRICATION DRAWING CANISTER POSITION INDICATOR TOP DETAIL
24590-HLW-MX-30-00017001	HLW VITRIFICATION SYSTEM FABRICATION DRAWING LIFTING ARM LINKAGE
24590-HLW-MX-30-00018001	HLW VITRIFICATION SYSTEM FABRICATION DRAWING CAM FOLLOWER ASSEMBLY
24590-HLW-MX-30-00018002	HLW VITRIFICATION SYSTEM FABRICATION DRAWING CAM FOLLOWER ASSEMBLY CAM FOLLOWER HOUSING DETAIL
24590-HLW-MX-30-00018003	HLW VITRIFICATION SYSTEM FABRICATION DRAWING CAM FOLLOWER ASSEMBLY CAM FOLLOWER DETAIL

Document Number	Title
24590-HLW-MX-30-00018004	HLW VITRIFICATION SYSTEM FABRICATION DRAWING CAM FOLLOWER ASSEMBLY CAM FOLLOWER WASHER DETAIL
24590-HLW-MX-30-00019001	HLW VITRIFICATION SYSTEM FABRICATION DRAWING VERTICAL CAM SHAFT ASSEMBLY
24590-HLW-MX-30-00019002	HLW VITRIFICATION SYSTEM FABRICATION DRAWING VERTICAL CAM SHAFT ASSEMBLY CAM SHAFT
24590-HLW-MX-30-00019003	HLW VITRIFICATION SYSTEM FABRICATION DRAWING VERTICAL CAM SHAFT ASSEMBLY CAM LAYOUT - FLAT DEVELOPMENT
24590-HLW-MX-30-00019004	HLW VITRIFICATION SYSTEM FABRICATION DRAWING VERTICAL CAM SHAFT ASSEMBLY CAM KEY
24590-HLW-MX-30-00020001	HLW VITRIFICATION SYSTEM FABRICATION DRAWING LIFTING SHACKLE ASSEMBLY
24590-HLW-MX-30-00020002	HLW VITRIFICATION SYSTEM FABRICATION DRAWING LIFTING SHACKLE ASSEMBLY LIFTING SHACKLE ATTACHMENT LUG DETAIL
24590-HLW-MX-30-00020003	HLW VITRIFICATION SYSTEM FABRICATION DRAWING LIFTING SHACKLE ASSEMBLY HOOK ATTACHMENT SHACKLE DETAIL
24590-HLW-MX-30-00020004	HLW VITRIFICATION SYSTEM FABRICATION DRAWING LIFTING SHACKLE ASSEMBLY SHACKLE PIN DETAIL
24590-HLW-MX-30-00021001	HLW VITRIFICATION SYSTEM FABRICATION DRAWING GRAPPLE DECON DEFLECTION SHIELD WELDMENT
24590-HLW-MX-30-00021002	HLW VITRIFICATION SYSTEM FABRICATION DRAWING GRAPPLE DECON DEFLECTION SHIELD WELDMENT SIDE PLATE DETAIL
24590-HLW-MX-30-00021003	HLW VITRIFICATION SYSTEM FABRICATION DRAWING GRAPPLE DECON DEFLECTION SHIELD WELDMENT TOP PLATE DETAIL
24590-HLW-MX-30-00022001	HLW VITRIFICATION SYSTEM FABRICATION DRAWING STATUS INDICATOR ASSEMBLY
24590-HLW-MX-30-00022002	HLW VITRIFICATION SYSTEM FABRICATION DRAWING STATUS INDICATOR ASSEMBLY GEAR BODY BOTTOM PLATE DETAILS
24590-HLW-MX-30-00022003	HLW VITRIFICATION SYSTEM FABRICATION DRAWING STATUS INDICATOR ASSEMBLY GEAR BODY TOP PLATE DETAILS
24590-HLW-MX-30-00022004	HLW VITRIFICATION SYSTEM FABRICATION DRAWING STATUS INDICATOR ASSEMBLY HOUSING COVER DETAILS
24590-HLW-MX-30-00022005	HLW VITRIFICATION SYSTEM FABRICATION DRAWING STATUS INDICATOR ASSEMBLY IDLER GEAR - LONG DETAILS
24590-HLW-MX-30-00022006	HLW VITRIFICATION SYSTEM FABRICATION DRAWING STATUS INDICATOR ASSEMBLY IDLER GEAR - SHORT DETAILS

Document Number	Title
24590-HLW-MX-30-00022007	HLW VITRIFICATION SYSTEM FABRICATION DRAWING STATUS INDICATOR ASSEMBLY INDICATOR CYLINDER DETAILS
24590-HLW-MX-30-00023001	HLW VITRIFICATION SYSTEM FABRICATION DRAWING LIFTING ARM POSITION INDICATOR
24590-HLW-MX-30-00023002	HLW VITRIFICATION SYSTEM FABRICATION DRAWING LIFTING ARM POSITION INDICATOR LIFTING ARM ROD
24590-HLW-MX-30-00023003	HLW VITRIFICATION SYSTEM FABRICATION DRAWING LIFTING ARM POSITION INDICATOR TOP DETAIL
24590-HLW-MX-30-00025001	HLW VITRIFICATION SYSTEM FABRICATION DRAWING GRAPPLE ASSEMBLY SPACER ROD
24590-HLW-MX-30-00027001	HLW VITRIFICATION SYSTEM FABRICATION DRAWING DRIVE GEAR
24590-HLW-MX-30-00028001	HLW VITRIFICATION SYSTEM FABRICATION DRAWING GRAPPLE LABEL

2.6.2 Design Proposal Drawing

Table 2-3 Load Cells (Proposal)

Document Number	Title
24590-HLW-M0-HEH-00031001	HLW VITRIFICATION SYSTEM HEH DESIGN PROPOSAL DRAWING CANISTER GRAPPLE LOAD CELL ASSEMBLY

2.6.3 Reference Drawings

Table 2-4 Reference Drawings (Sorted by Canister Sequence)

Document Number	Title	Relevant Equipment
24590-HLW-MX-30-00010001[i]	HLW Vitrification Canister Assembly Drawing (3/8" Wall)	HLW Vitrification Canister & Lids
24590-HLW-MX-30-00010002[i]	HLW Vitrification Canister Detail Drawing (3/8" Wall)	
24590-HLW-MX-30-00010003[i]	HLW Vitrification Canister Weldment Drawing (3/8" Wall)	
24590-HLW-MX-30-00010004[i]	HLW Vitrification Canister Lid Detail Drawing (3/8" Wall)	
24590-HLW-MX-30-00010005[i]	HLW Vitrification Canister Lid Welding Drawing (3/8" Wall)	
24590-QL-POA-FH00-00001-03-00001	HLW Canister Grapple - Grapple Stand Arrangement	Grapple Stands HDH-MHAN-00004 HDH-MHAN-00013 HDH-MHAN-00014 HEH-MHAN-00004

Document Number	Title	Relevant Equipment
		HPH-MHAN-00001 HSH-MHAN-00006[i]
24590-CM-POA-MJKH-00002-01-00015	5 Ton Monorail Electric Wire Rope Hoist General Arrangement	HRH-HST-00001
24590-QL-POA-MJKG-00002-08-00896	6 Ton T/R Crane Number 2797 - Hook and Nut Details	HPH-CRN-00001
24590-QL-POA-MJKG-00002-08-00791	6 Ton T/R Crane Number 2796 - Hook and Nut Details	HPH-CRN-00002
24590-QL-POA-MJKG-00002-08-01834	25 Ton T/R Crane Number 2795 Hook and Nut Details	HSH-CRN-00001
24590-QL-POA-MJKG-00002-08-00583	6 Ton T/R Crane Number 2798 Hook and Nut Details	HDH-CRN-00005
24590-QL-POA-MQTS-00002-01-148	Canister Rinse Bogie Assembly, Drawing NO. A051862A	HDH-TRLY-00003
24590-QL-POA-MQTS-00002-01-127	Decontamination Vessel Assembly	HDH-VSL-00001
24590-CM-POA-MVA0-00008-02-00001	Canister Decontamination Vessel 1 24590-HLW-MV-HDH-VSL-00002	HDH-VSL-00002
24590-CM-POA-MVA0-00008-02-00010	Canister Decontamination Vessel 2 24590-HLW-MV-HDH-VSL-00004	HDH-VSL-00004
24590-QL-POA-MJKG-00002-08-01003	6 Ton T/R Crane Number 2799 Hook and Nut Details	HEH-CRN-00003
24590-WTP-ICD-MG-01-014	ICD 14 - Interface Control Document For Immobilized High-Level Waste	NA
	TLM	
24590-HLW-M0-HSH-00083	Design Proposal Drawing MSM Hand/Tool Adapter	N/A
24590-WTP-M0-10-00014	WTP Vitrification System Design Proposal Drawing MSM Manipulator Dimension	N/A

Notes:
i. Provide to SELLER for Test Canister & Lids.

3 Design Requirements

3.1 Functional & Mechanical Requirements (Buyer's Use)

3.1.1 The HLW Grapples are all identical.

3.1.2 The HLW Grapples shall provide a hands-free interface between the overhead crane and all configurations of the HLW Canisters.

- The HLW Grapple shall be capable of being remotely connected or disconnected from the crane hooks (including Load Cell Hook) without external assistance.
- The Grapples shall be capable of being remotely engaged and disengaged from their designated load without external assistance.

3.1.3 The Grapple interface with the crane is designed to allow the Grapple to be centered, such that it hangs vertically, within two degrees, under its own weight.

3.1.4 The HLW Grapple shall be capable of being remotely engaged and disengaged from a Canister that is standing on its base with the Canister centerline within five (5) degrees of vertical. The Grapple shall be capable of engaging and disengaging the Canister without assistance when the Canister is in its normal upright orientation. The Grapple shall be capable of aligning itself and engaging the Canister flange when lowered such that the Grapple vertical centerline is within one inch of the Canister centerline.

3.1.5 The Grapples shall maintain secure attachment of the load while operating from the overhead crane. Maximum crane operating speed is 60 ft/min.

3.1.6 Each Grapple shall include an indexing feature that requires two fully lowered set-downs to disengage the load. The indexing feature shall be designed to prevent an inadvertent release of the suspended load during handling.

a) Unloaded Grapple, ready for operation (normally open)
b) Grapple lowered onto load (open condition)
c) Grapple lift (operates closing condition)
d) Grapple first set-down (closed condition)
e) Grapple raised (closed condition)
f) Grapple second set-down (operates opening condition)

3.1.7 The Grapple designs provides clearly visible indicators for the operator to confirm HLW Grapple status.

3.1.8 The Grapple is designed such that it is not possible to lift the load unless it is fully engaged.

3.1.9 The HLW Grapple shall be capable of engaging and disengaging the Canister flange within a right-circular cylindrical cavity with a maximum diameter of 62.5 cm.[1]

3.1.10 Each Grapple shall be equipped with manual release pins to disengage the Grapple from the load if the normal disengagement mechanism fails. The manual release pins shall be suitable for actuation by a telemanipulator (TLM); the maximum pulling force required to actuate the emergency release shall not exceed 50 lbf. The manual release pins are not expected to be operated inside casks or vessels.

3.1.11 The HLW Grapples are designed to securely lift and transport either an empty, partially filled, or full HLW Canister (Canister), as well as an open and a lidded Canister (with primary or secondary lid).

3.1.12 For specific Canister interface requirements, refer to **Table 3-1** of this Specification.

3.1.13 The Grapple design incorporates features, such as rounded corners and smooth surfaces, to minimize marking or scratching to the Canister. For this specification, defects, such as pits or scratches, **less than** 0.010 in. deep do not require rework.[2]

3.1.14 After the HLW grapple is positively engaged with the canister, the HLW Grapple shall fail safe (fingers in closed position).

3.1.15 Each HLW Grapple shall have a rated capacity of 10,000 lbs. Each Grapple shall be clearly marked with its rated capacity.

3.1.16 The HLW Grapple finger contact-areas are designed such that stresses produced in the flange of the Canister, due to Grapple engagement, do not exceed 1/3 yield strength of the Canister flange material at 600 °F.

3.2 Modular Construction (Buyer's Use)

3.2.1 Modular construction was considered in the detail design.

3.3 Performance (Buyer's Use)

3.3.1 Design Life

3.3.1.1 Equipment is designed to operate for a period of 40 years. It is recognized that some components may not have a design life of 40 years. These components are designed to facilitate remote maintenance and are designed for at least a 5-year operating life.

3.3.1.2 Maintenance was considered in the detail design.

3.4 Environmental Conditions (Buyer's Use)

3.4.1.1 All Grapples are designed to operate under the following normal environmental conditions:

a) Ambient temperature range of 50°F to 113°F. [3]
b) Humidity range of 6% to 73% [4]
c) Maximum gamma radiological dose rate of 2.59E+06 mrad/hr.[5]

3.4.1.2 HLW Grapples are designed for a finger contact with HLW Canister Flange of 600°F. [6]

3.5 WAI Requirements (Seller Use)

WAI Requirements are provided in 24590-HLW-RPT-PR-01-001 and are depicted below. Acceptance criteria will be identified in the FAT and Verification and Validation testing for maximum diameter.

3.5.1 WAI Performance Grapple[7] Requirements (QARD-Q)

a) Grapple design is capable of being remotely engaged and disengaged from the flange.
b) When attached to a suitable hoist, and when engaged with the flange, Grapple design is capable of raising and lowering a standard canistered waste form in a vertical direction
c) Grapple design is capable of engaging and disengaging the canister flange within a right circular cylindrical cavity with a maximum diameter of 62.5 cm.
d) Grapple is designed to prevent an inadvertent release of a suspended (standard) canistered waste form when the grapple is engaged with the flange.

3.5.2 WAI Passive Requirements

3.5.2.1 WAI Passive Grapple Requirements

a) The Grapple design includes passive, fixed alignment guides that assist in locating the Grapple on the canister flange. The guides are profiled and have a smooth surface finish to reduce scratches to a minimum.
b) The use of liquid lubricants in the Grapple design is minimized.
c) The use of paint in the Grapple design is minimized.

3.5.2.2 WAI Passive Load Cell[8] Requirements (CM)

3.5.2.3 The load cells shall be designed to operate under the following environmental conditions:

a) The load cell shall be suitable for the application for which it's proposed:
    a. Maximum load
    b. Accuracy
b) The load cell shall be suitable for the room environment:
    a. Ambient temperature range of 59°F to 95°F. [9]
    b. Humidity range of 6% to 73%
    c. Maximum gamma radiological dose rate of 2.59E+06 mrad/hr.[10]

3.6 Interface Requirements (Buyer's Use)

3.6.1 Interface with WTP Cranes (Buyer's Use)

3.6.1.1 The HLW Grapples are installed/uninstalled by using the Canister Handling Cave Crane(s). For this process to occur the lifting bail must be installed onto the assembly.

3.6.1.2 Grapple design of lifting points meet the crane hook design. See **Table 3-2** for drawing of Canister Handling Cave Crane hook design.

3.6.1.3 The limiting dimensions and weights identified on detailed equipment drawings ensure that the HLW Grapples are within the crane/actuator's capacity, hook's travel limits, and height travel limits.

3.6.2 Lifting Bails (Buyer's Use)

3.6.2.1 Lifting Bail requirements have been incorporated into the DEDs.

3.6.3 Canister Interface (Buyer's Use)

3.6.3.1 The canister is made of a 304L series stainless steel. Components (including tools) designed to contact (or with a high likelihood of contacting) the canister and/or canister lid are fabricated of stainless steel and have been designed to limit damage to the canister and canister lid.

3.6.3.2 The HLW Canister Grapples are designed for the following Canister configurations:

Table 3-1 HLW Canister Configurations

Configuration	Details
Empty[i]	1518 lbs,
Partially Filled	1518 lbs < Partially Filled < 9260
Filled[iv]	~9000 lbs, Max Weight 9260 lbs
No Lid	N/A
Primary Lid[i, ii, iii,]	12 lbs 3/16 in thick 0.053 inch above flange (0.178-0.125)
Secondary Lid[i, iii]	12.5 lbs 3/16 in thick 0.440 inch above flange
Rated Capacity	Safe working load conservatively set at 10,000 lbs
Notes: See Appendix G for References (BUYER'S USE) i: BNI Reference[11] ii: BNI Reference[12] iii: BNI Reference[13] iv: BNI Reference[14]	

3.6.4 TLM Interface (Buyer's Use)

3.6.4.1 TLMs are used for manual pin release. This has been incorporated into the design.

3.7 Operational Requirements (Buyer's Use)

3.7.1 Equipment is designed to be remotely operated and controlled by the HLW Grapples control system located out-cave, that is, outside the radiation area.

3.7.2 The layout of the equipment provides easy access for remote operational and maintenance requirements using TLMs and takes into consideration proposed viewing angles.

3.8 Loadings (Buyer's Use only)

3.8.1 There are no seismic requirements or loading analysis required for this specification.[15]

3.9 General Design Requirements

3.9.1 Load cells shall be designed for remote handling including setup, operation, and removal via a TLM (refer to Appendix B).

3.9.2 The load cells will be used in conjunction with the HEH grapple (HEH-TOOL-00001). The load cells shall interface with the HEH-CRN-00003 crane hook. For crane hook details refer to **Table 3-2.**

3.9.3 The canister load cells shall be designed such that they are suitable for the application and environment for which they are used. Refer to section 3.5.2.3 for environmental conditions.

3.9.4 The load cell assemblies shall not drop the grapple.

3.9.5 The maximum below the hook length of the load cell assembly shall be less than 40".

3.9.6 The load cell shall function under the max combined weight of the canister[16] and the Grapple[17] (10,000 lbs).

3.9.7 The load cell readout shall be displayed on a backlit digital display with a 1 inch minimum character height and readable through a shield window or via PTZ (pan, tilt, zoom) camera. The display shall be five digits.

3.9.8 The load cells shall have a "push to test" function in order to verify proper operation of the display.

3.9.9 The load cells shall have a "zero" function and an auto shutoff function that is activated after 15 minutes of “no load” on the grapple.

3.9.10 Minimum required calibration interval shall be 6 months or greater. The SELLER shall supply a calibration certificate and documentation establishing traceability of the load cell calibration to NIST (National Institute of Standards and Technology).

3.9.11 The load cell assembly shall have minimized cracks and crevices. Corrosive-resistant material materials shall be used. Materials and surface finishes shall be conductive to decontamination.

3.9.12 Load cells shall be sufficiently tolerant to decontamination in a 2-5 molar Nitric Acid solution (HN03), or similar.

3.10 Interfacing Equipment

3.10.1 For the Grapples, all interfaces have been addressed by the BUYER. There are not additional requirements for the SELLER. **Table 3-2** lists interfacing equipment and the associated CTN for each.

3.10.2 The SELLER shall incorporate load cell interfacing requirements for the equipment listed in **Table 3-2**, as applicable.

3.10.3 See **Table 2-3** and **Table 2-4** for drawings, datasheets, and other relevant documents for interfacing equipment.

Table 3-2 Interfacing Equipment (Sorted by Canister Sequence)

Description	CTN / Tag	Drawing
HLW Vitrification Canister & Lids	NA	24590-HLW-MX-30-00010001 24590-HLW-MX-30-00010002 24590-HLW-MX-30-00010003 24590-HLW-MX-30-00010004 24590-HLW-MX-30-00010005
Decontamination Cave Crane Maintenance Area Canister Grapple Stand	HDH-MHAN-00004	24590-QL-POA-FH00-00001-03-00001
Decontamination Cave Clean Canister Grapple Stand	HDH-MHAN-00013	
Decontamination Cave Dirty Canister Grapple Stand	HDH-MHAN-00014	
Grapple Stand Maintenance Area Canister Storage Cave	HEH-MHAN-00004	
Three Jaw Grapple Stand	HPH-MHAN-00001	
Canister Grapple Stand	HSH-MHAN-00006[i]	
5 Ton Canister Import Monorail Hoist	HRH-HST-00001	24590-CM-POA-MJKH-00002-01-00015
Lower In-Cave Crane, Canister Handling Cave Hook	HPH-CRN-00001	24590-QL-POA-MJKG-00002-08-00896
Upper In-Cave Crane, Canister Handling Cave Hook	HPH-CRN-00002	24590-QL-POA-MJKG-00002-08-00791
Main Overhead Crane Melter Cave 1 Hook	HSH-CRN-00001[i]	24590-QL-POA-MJKG-00002-08-01834
Decontamination Cave Crane Hook	HDH-CRN-00005	24590-QL-POA-MJKG-00002-08-00583
Canister Rinse Bogie	HDH-TRLY-00003	24590-QL-POA-MQTS-00002-01-148
Rinse Tunnel Canister Rinse Vessel	HDH-VSL-00001	24590-QL-POA-MQTS-00002-01-127
Canister Decontamination Vessel	HDH-VSL-00002 HDH-VSL-00004	24590-CM-POA-MVA0-00008-02-00001 24590-CM-POA-MVA0-00008-02-00010
Decontamination Cave Canister Grapple Load Cell 1, & Cell 2	HEH-MHAN-00013 HEH-MHAN-00014	24590-HLW-M0-HEH-00031001
Canister Storage Cave Crane Hook	HEH-CRN-00003	24590-QL-POA-MJKG-00002-08-01003
HLW Cask	TBD	24590-WTP-ICD-MG-01-014

Notes:
i. HSH Figure(s) do not show HSH-TOOL-00004, The melter cave canister grapple would only be introduced into the melter cave should a canister need to be recovered from a pour tunnel bogie.
ii. See Appendices for compilation of Fig 2-2s from applicable SDD

3.11 Electrical Requirements

3.11.1 There are no electrical requirements for the Grapples.

3.11.2 A connector on the crane load block provides power to the load cell. Alternatively, the load cell may be battery operated.

3.12 Instrumentation and Control Requirements

3.12.1 There are no instrumentation and control requirements for the Grapples.

3.12.2 The load cells shall meet the following requirements.

3.12.2.1 Load cells shall be strain gauge type and be provided with integral amplifiers. Signal output shall be 4 -20mA. The load cells provided shall have a range of 120% of the largest expected weight (see Table 3-1) seen by the load cell and withstand a static overload of 150% of cell capacity.

3.12.2.2 The load cell shall have the following performances:

1) The load cell shall have an accuracy of +/- 1 % of full scale.

2) The load cell shall have a repeatability of +/- 1 % of full scale.

3.12.2.3 Load cells shall be fabricated from 17-7 PH stainless steel, with connecting threads machined as an integral part of the load cells. The entire unit shall be hermetically sealed including connectors.

3.13 Computer Software

3.13.1 There are no software requirements for the Grapples or load cells.

3.14 Equipment Tagging

3.14.1 Each piece of equipment shall be tagged or labeled with its CTN in a visible location after final assembly in accordance with detailed equipment drawing(s) as applicable, and the PO.

3.15 Accessibility and Maintenance

3.15.1 Any Accessibility and/or Maintenance requirements identified during testing shall be submitted to the BUYER.

4 Materials

4.1 Fabrication / Construction

4.1.1 For Grapples, materials are specified in the DEDs.

4.1.2 For Load cells, materials are specified in the design proposal drawing.

4.2 Prohibited Materials

4.2.1 Certain chemicals and materials are restricted from use at WTP. Restricted chemicals and materials are listed in 24590-WTP-LIST-ESH-16-0001, *Restricted Materials List Hanford Tank Waste Treatment and Immobilization Plant (WTP Project).* Inclusion of these chemicals/materials requires specific authorization from the BUYER.

4.3 Stainless Steel Requirements

4.3.1 Materials and chemicals that contact stainless steel shall be in conformance with 24590-WTP-3PS-NW00-T0003, *Engineering Specification for Chemical Requirements for Materials Used in Contact with Austenitic Stainless Steel and Nickel Based Alloys – For HLW and DFHLW*. Austenitic stainless steel and nickel-base alloy materials shall not come in contact with the following:

- Materials with a leachable halogen content exceeding 200 ppm.
- Materials with a leachable sulfur content exceeding 400 ppm.
- Materials with a total of low point metals (such as lead, zinc, copper, tin, antimony, or mercury) exceeding 1 weight percent.

4.3.2 Welded stainless steel fabrications shall use low carbon content grade "L", where appropriate.

4.3.3 Plate and Sheet: Stainless steel sheet shall be type 304, 304L, 316, or 316L conforming to ASTM A240/A240M*, Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications*.

4.3.4 High tensile stainless-steel bars shall be in accordance with ASTM A564/564M, *Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.*

4.4 Fasteners

4.4.1 Fasteners, including torque values are provided in the detailed equipment drawings. If thread sealant is required, it is depicted on the detailed equipment drawings.

4.5 General

4.5.1 All materials shall be in conformance with the BUYER-approved specifications. The SELLER shall obtain written approval for substitution from the BUYER prior to use of material.

4.5.2 Material test reports (MTR) for CM shall be available for review by BUYER upon request. MTRs for Q material or code required material shall be submitted in accordance with the MR. The MTRs shall be legible and be traceable to the material furnished by heat or lot number. All MTRs shall be report forms containing the manufacturer's name.

4.5.3 Q Materials purchased in accordance with this specification shall be accompanied with a certificate of conformance (CoC) supplied by the manufacturer of these items and shall be available to the BUYER for inspection upon request.

5 Fabrication

5.1 General Fabrication Requirements

5.1.1 Controls are to be exercised during all stages of fabrication to minimize exposure of stainless steel to contaminants, and particularly any chloride, which might cause stress corrosion

cracking. Chloride bearing compounds shall be avoided, however, if used, they shall be completely removed by thorough cleaning.

5.1.2 SELLER shall implement controls to ensure that there are no cross-contamination effects from other metals to stainless steel, by ensuring separate storage areas and separating fabrication equipment.

5.1.3 Controls shall be in place to ensure tools that could leave residual carbon steel deposits on the stainless steel are not used. Wire brushes shall be constructed with wire of the same material as the base metal being brushed.

5.1.4 Carbon arc or iron powder cutting shall not be used during fabrication of stainless-steel components.

5.1.5 Workmanship and neat appearance shall be an important aspect of the equipment. Defective or damaged materials shall be replaced or repaired prior to final acceptance. The repair or replacement method shall be approved by the BUYER.

5.2 Radiation Area Fabrication Requirements (Buyer's Use)

5.2.1 Equipment shall be free from pockets or traps where radioactive contamination or water may lodge, or if required, any traps shall have drain holes.

5.2.2 Box sections shall be totally enclosed and leakproof, to prevent the ingress of fluid (such as water) during decontamination. Fabrications shall be designed so that they can be easily cleaned. If water traps are unavoidable, drain holes shall be provided.

5.2.3 All external exposed surfaces including castings, forgings, plate edges, and welds shall be made smooth and free from pockets and porosity, which are likely to hold contamination.

5.3 Finishing Aspects and Coating

5.3.1 All sharp edges of components shall be removed unless they are functionally sharp to serve a specific purpose of equipment.

5.3.2 Equipment shall have a surface finish of 125 microinches (or less), unless otherwise stated in the detailed design documents, in accordance with ASME B46.1, *Surface Texture (Surface Roughness, Waviness & Lay)*, as depicted on detailed equipment drawings.

5.3.3 Coatings depicted in detailed design drawings shall be coated in accordance with 24590-WTP-3PS-AFPS-T0001, *Engineering Specification for Shop Applied Special Protective Coatings for Steel Items and Equipment.*

5.4 Welding

5.4.1 All stainless-steel welding and submittal of associated welding procedure specification (WPS) and procedure qualification record (PQR) shall be in accordance with 24590-WTP-3PS-SS00-T0002, *Engineering Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel.* The WPS/PQR shall be submitted for BUYER review and acceptance as detailed in MR.

5.4.2 Welding shall be in accordance with AWS D14.0/D14.0M, *Machinery and Equipment Welding Specification*, as applicable.

5.4.3 All filler materials and base metals shall be traceable to MTRs. The MTRs shall have actual test report values. All CM MTRs shall be available for inspection and SELLER shall document them via a CoC. All MTRs associated with Q material or code requirements shall be provided as directed on the MR.

5.4.4 SELLER shall inform BUYER of the first operation of each WPS at least 2 weeks prior so that the BUYER may witness. This is a witness point.

5.4.5 SELLER shall provide a weld map drawing that identifies location, weld ID, and nondestructive examination (NDE) requirement as a minimum; and complete relevant information in an Initial Weld Map/Traveler Table or equivalent (see Appendix A). Both documents shall be submitted per the MR. In addition, a Completed Weld Map/Traveler Table shall be submitted per the MR.

6 Tests and Inspections

6.1 Personnel Qualifications

6.1.1 All welders, welding operators, and tackers shall be qualified in accordance with AWS D1.6/D1.6M, *Structural Welding Code – Stainless Steel*, AWS D9.1/D9.1M, *Sheet Metal Welding Code,* or AWS D1.1/D1.1M, *Structural Welding Code – Steel*, as applicable to work being performed. SELLER shall make personnel qualifications available for BUYER review, including in the shop, upon request.

6.1.2 Alternatively, welders, welding operators, and tackers qualified in accordance with ASME BPVC IX are qualified to perform the work as allowed by 24590-WTP-3PS-SS00-T0002*, Engineering Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel.*

6.1.3 SELLER shall submit procedure for qualification of welding personnel for BUYER review and acceptance in accordance with the MR.

6.2 Non-Destructive Examinations

6.2.1 All NDE procedures and NDE of stainless-steel welds and carbon steel to stainless steel welds shall be in accordance with 24590-WTP-3PS-SS00-T0002*, Engineering Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel.*

6.2.2 NDE personnel performing liquid penetrant testing, visual examination operations, and shop tests shall be qualified and certified in accordance with ASNT SNT-TC-1A, *Recommended Practice, Personnel Qualification and Certification in Nondestructive Testing*. All test reports shall be signed by personnel holding either Level II or Level III certifications and who either performed or witnessed the test. A copy of the individual's current certification(s) shall be provided at the SELLER's shop for BUYER review upon request.

6.2.3 NDE reports shall be traceable to the item examined. Include essential examination parameters, signed and dated by the NDE examiner. NDE reports shall be provided in accordance with the MR.

6.2.4 Certified Weld Inspector (CWI) Certificates and Inspector Eye Exams

The following documents shall be made available for review upon request:

- Current AWS CWI certificates
- Current and valid visual acuity examination record.

6.2.5 SELLER shall inform BUYER of the first operation of each NDE procedure at least 2 weeks prior so that the BUYER may witness. This is a witness point.

6.3 Testing

6.3.1 General Testing Requirements

6.3.1.1 SELLER shall submit an inspection and test plan, as per the MR, for BUYER review which summarizes the manufacturing sequences, including SELLER and BUYER hold and witness points for inspection as indicated in the MR and the material acceptance plan, for each test to be performed. Procedure shall include pass/fail criteria for each test.

6.3.1.2 SELLER shall submit testing reports for each test described below. Documentation shall include the results of each trial performed.

6.3.1.3 SELLER shall source all materials and equipment required for performing all testing.

6.3.2 Design Validation Testing Performed on Test Grapple

6.3.2.1 SELLER shall perform testing on one (1) Grapple (item 1 from **Table 1-1**).

6.3.2.2 It is recommended that testing be completed after the first Grapple is fabricated.

6.3.2.3 The SELLER shall submit a design validation test procedure including pass/fail criteria to the BUYER for approval 8 weeks prior to acceptance testing.

6.3.2.4 The SELLER shall notify the BUYER at least three weeks prior to the tests so that the BUYER may witness.

6.3.2.5 The SELLER shall perform code required static load test in accordance with ASME B30.20, Section 1.3.9.2, 125% of 10,000 lbs rated capacity +5% -0% held above floor for 15 minutes.

6.3.2.6 The SELLER shall demonstrate Grapple's ability to withstand one impact of a transported load at a travel speed of 60 ft/min (simulating hitting a wall or an object) without releasing test load. The impact object shall remain stationary and intact throughout the test. The Grapple shall be capable of release with the double set down feature after the impact test is complete.

6.3.2.7 The SELLER shall demonstrate the ability for remote engagement and disengagement with a Canister (Item 11 in **Table 1-1**), within a right circular cylinder cavity of 62.5 cm. This does not apply to the manual release pins.

6.3.2.8 The SELLER for one HLW grapple shall demonstrate the absolute reliability of the design by performing 500 cycles at rated capacity. One cycle shall consist of:

a) Engaging the HLW Grapple on Test Canister

b) Raising the Test Canister

c) Lowering the Test Canister

d) Raising the Test Canister

e) Lowering the Test Canister

f) Disengaging (Raising) the HLW Grapple from Test Canister

Testing shall be performed using an un-lidded Test Canister, Test Canister with primary lid and Test Canister with secondary lid.

6.3.2.9 After each of the Design Validation Test above:

a) HLW Grapple operability of all motions of mechanisms, including emergency release, shall be verified.

b) Test Canister shall be visually inspected for deformation, cracks and other defects or damage.

c) HLW Grapple shall be visually inspected for deformation, cracks, or other defects.

d) Load bearing welds shall be dye-penetrant inspected.

e) No cracks, deformation, wear or other damage to load bearing or moving parts is allowed, and no stiffness or binding in any mechanism is allowed.

f) Any damage or degradation of function of the Grapple shall be documented and will be reviewed by the BUYER.

6.3.3 Factory Acceptance Testing

6.3.3.1 The SELLER shall submit a factory acceptance test procedure including pass/fail criteria to the BUYER for approval 8 weeks prior to factory acceptance testing. FAT shall include dimensional and surface finish inspection.

6.3.3.2 The SELLER shall notify the BUYER at least three weeks prior to the factory acceptance tests so that the BUYER may witness.

6.3.3.3 Each Grapple shall be tested at the 10,000 lb rated capacity. Test shall include 20 complete cycles simulating actual operating conditions and consisting of:

a) Lowering the Grapple onto the Test Canister.
b) Engaging the Test Canister.
c) Lifting the Test Canister.
d) Moving the Test Canister to new location (total travel distance = 150 feet, achievable by an accrual of smaller consecutive runs)
e) Setting down the Test Canister twice to disengage the Grapple from the Test Canister.
f) Lifting the Grapple and moving it to its starting position

6.3.3.4 Each Grapple shall perform Code Required static load test in accordance with ASME B30.20 Section 1.3.9.2 125% of 10,000 lb rated capacity + 5% -0% held above floor for 15 minutes.

6.3.3.5 After completion of FAT above:

a) HLW Grapple operability of all motions of mechanisms, including emergency release, shall be verified.

b) Test Canister flange shall be visually inspected for deformation, cracks and other defects or damage.

c) HLW Grapple shall be visually inspected for deformation, cracks, or other defects.

d) Load bearing welds shall be dye-penetrant inspected

e) No cracks, deformation, wear or other damage to load bearing or moving parts is allowed, and no stiffness or binding in any mechanism is allowed.

f) Any damage or degradation of function of the Grapple shall be documented and will be reviewed by BUYER.

6.3.3.6 The load cells including hardware attached to load cell shall be load tested.

6.3.3.7 Documentation of all post FAT NDE shall be submitted to the BUYER.

6.3.4 Final Inspection (Prior to Shipping)

6.3.5 The SELLER shall submit the final inspection procedure for BUYER review and permission to proceed. The inspection shall be performed after completion of all fabrication, cleaning and testing, and just prior to final packaging, and include, at a minimum, the following inspections: dimensional, surface, and cleaning.

6.3.6 The SELLER shall inspect all surfaces for contamination. Visible evidence of contamination is not acceptable.

6.3.7 The SELLER shall prepare a final inspection report for each item, which documents the results of the final inspection. The Seller shall include the final inspection report in the documentation package for each piece per the MR.

7 Preparation for Shipment

7.1 Packaging / Shipping & Storage Instructions

7.1.1 Packaging, shipping, handling, and storage of equipment, including shipment tagging, shall be in accordance with the PO and 24590-WTP-3PS-G000-T0056, *Engineering Specification for Packaging, Handling and Storage Requirements for HLW Equipment.*

8 Quality Assurance (Specific QA Strategy identified in MR)

8.1 QA Requirements Specific to Grapples

8.1.1 If SELLER has a BUYER approved QA program to QARD requirements, then QA requirements shall be in accordance with 24590-WTP-3PS-G000-T0053, *Engineering Specification for QARD Supplier Quality Assurance Program Requirements*. The SELLER shall conform to the DOE/RW-0333P QARD (Rev 20) requirements as indicated by a check mark in the Q Data Sheet of DOE/RW-0333P QARD (Rev 20), Quality Assurance Program Requirements. This data sheet is included in the MR.

8.1.2 Alternatively, when the SELLER does not have a BUYER approved QA program to QARD requirements, then the SELLER shall have an approved QA program to ASME NQA-1-2022 requirements and verify WAI performance attributes from Section 3.5 as critical characteristics within the SELLER CGD program in accordance with Engineering Specification for Acquisition of Commercial Items and Services for Use in Safety Applications at WTP 24590-WTP-3PS-G000-T0019. See the Q Datasheet of ANSI/ASME NQA-1 (2022) Quality Assurance Requirements listed in the MR.

8.1.3 Alternatively, QARD requirements will be completed by BUYER at BUYER's facility.

8.1.3.1 SELLER shall have and maintain a BUYER approved Quality Assurance Program meeting the applicable elements of DOE Order 414.1D, as shown in the attachment to the PO titled CM Datasheet of Quality Assurance Program Requirements. SELLER shall submit their Quality Assurance Manual (QAM) for review.

8.2 QA Requirements Specific to Load Cells

8.2.1 SELLER shall have and maintain a BUYER approved Quality Assurance Program meeting the applicable elements of DOE Order 414.1D, as shown in the attachment to the PO titled CM Datasheet of Quality Assurance Program Requirements. SELLER shall submit their Quality Assurance Manual (QAM) for review.

8.3 Program QA Elements

8.3.1 SELLER's Quality Assurance Program (QAP), as a minimum, shall contain the requirements detailed in the Supplier QAP Requirements Data Sheet listed in the MR.

9 Configuration Management

9.1 Configuration management shall be in accordance with 24590-WTP-3PS-G000-T0050, *Engineering Specification for Supplier Documentation*.

10 Documentation and Submittals

10.1 General

10.1.1 Documentation and submittal requirements shall be in accordance with the requirements of the MR, PO, and 24590-WTP-3PS-G000-T0050, *Engineering Specification for Supplier Documentation*.

10.1.2 The MR, drawings, and data requirements lists all documentation and submittals required by this specification.

10.1.3 Each submittal and document shall be legible and reproducible. Documents with substandard legibility or documents that can no longer be reproduced without substantial degradation to legibility are not acceptable when the legibility issue/concern applies to required technical data or information. All documents shall have a light, clear backgrounds with sharp, opaque object, definition lines, and noncrowded dimensioning and lettering. Reproducible submittals shall be black-on-white. Electronic files may include color.

10.1.4 Any changes or revisions to BUYER prepared documentation shall be submitted as per the original, unless specifically noted otherwise in the PO.

10.2 Submittals

10.2.1 Drawings

10.2.1.1 All drawings shall be in accordance with the MR.

10.2.1.2 SELLER shall prepare weld-map drawings identifying all welds and the type of NDE inspection applied to each.

10.2.1.3 SELLER shall submit a CoC stating all requirements of this specification are met.

10.2.2 Calculations

Not Required for Grapple Build to Print. It is expected that Load Cell will be assembled from commercial off-the-shelf components not requiring analysis.

10.2.3 Manuals and Training Material(s)

10.2.3.1 SELLER shall submit the following manual(s) as per the MR:

- Erection/installation manuals/instructions
- Operating manuals/instructions
- Maintenance manuals/instructions
- Site storage and handling manuals/instructions
- Emergency manuals/instructions

10.2.3.2 SELLER shall submit training material supplementing the operating and maintenance manual(s) discussed above.

10.2.4 Procedures

10.2.4.1 WPSs/PQRs, welding personnel qualification procedure, NDE personnel qualification procedure, NDE (including VT) procedures, coating and cleaning procedures (if applicable), dimensional inspection, test procedures, and final inspection procedures discussed in this specification shall be submitted to BUYER as per the MR. Procedures for the manufacture of commercial off-the-shelf items (unmodified catalog items) do not need to be submitted.

10.2.5 Inspection and Test Reports

10.2.5.1 Dimensional, cleaning and coating (if applicable), surface finish, final inspection, MTRs and all NDE inspection and test reports shall be submitted to BUYER per this specification and if included in the MR.

10.2.6 Schedules

10.2.6.1 The SELLER shall submit for review, a schedule identifying all milestones necessary to demonstrate that the equipment will be delivered in accordance with the designation project schedule.

10.2.7 Spare Parts List

10.2.7.1 If identified during Design Validation Testing, a spare parts list shall be compiled. The spare parts list shall include names of manufacturers with appropriate model numbers and special ordering instructions for replaceable parts, if required.

10.3 Design Review Meetings

10.3.1 Engineering Design Kick-off Meeting

10.3.1.1 The contract award kick-off meeting will be conducted at the BUYER's facility or virtually as determined by the BUYER to ensure the newly awarded contract is clear and that the SELLER has a clear understanding of the scope of the contract.

10.3.1.2 Interim Design Review (IDR) is not required for Grapples as the design is complete.

10.3.1.3 IDR is not required for load cells due to the simplicity of the anticipated design.

Appendix A (For Seller Use) Weld Map/Traveler

Page: _____of _____

WELD MAP (WM) / TRAVELER (T)

This document or a similar document is for use by the vendor in fulfillment of MR submittal requirements.
This document or a similar document is to be submitted as a Weld Map after the WPSs/PQRs as part of the MR submittal requirement. This document or a similar document is to be submitted as a Traveler (completed weld map) as part of the MR submittal requirement.

Job Number: _____ Vessel Number: _____ PO Number: _____

Bechtel Drawing Number (1)	Joint #	Joint Type and Extent (2)	Joint ID (3)	Nozzle # (if applicable)	Base Metal		Weld Filler		Material Thickness	Postweld Heat Treatment (5)	Welder ID	NDE		PMI Report #	Weld Repairs (6)	Other Activities (7)	WPS & Rev No.	Welding Inspector
					Spec/Type/ P-No. (4)	Heat/Lot #	Spec/Type (4)	Heat/Lot #				Method / Extent	Report #					Date/Initials
WM	WM	WM	WM	WM	WM		WM		WM	WM		WM					WM	
T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T

WM - This information is required to be provided on this Weld Map document (or a similar document) and submitted after the WPSs/PQRs in fulfilment of the MR requirement before fabrication commences.
T - This information is required to be provided on the Traveler Document as material receiving, fabrication, inspection, testing, and NDE records are completed. This document (or a similar document) is to be submitted in fulfillment of the MR requirement.

(1) List only the digits of the Bechtel drawing number following the PO number (e.g. The x's in 24590-QL-POA-MKAS-00001-xx-xxxxx)
(2) e.g. Butt, T-Joint, Corner, Lap all around, intermittent weld length and pitch
(3) e.g. Head to Shell
(4) e.g. SA240-304 (base metal); SFA-5.22 E309LTX-X (Weld Filler)
(5) For (WM): List PWHT procedure #. For (T) List PWHT report #.
(6) e.g. R1 for the first repair, R2 for the second repair
(7) Other Activities: any base metal repairs exceeding 3/8" or 10% of the section thickness (whichever is smaller).

Appendix B (For Seller Use) Telemanipulator Information

When designing equipment that will interface with a telemanipulator (TLM) designs shall be made to account for the following attributes:

A TLM is a device which, through electronic, hydraulic, or mechanical linkages, allows a hand-like mechanism to be controlled by a human operator and is used for remote-handling of equipment in radiation areas too hot for human entry. Operation of an arm is manipulated by an individual standing in a low or non-radiation environment and viewing operations through a lead glass window. Operations are typically done with pairs of TLMs. The TLMs have a 50 lb. load rating and are equipped with two fingers that have a gripping area of 0.5 inches wide by 1.75 inches long with the exception of system HSH that has a finger area of 0.5 inches wide by 2.50 inches long. To assist in TLM longevity, the weight of interfacing Equipment/hardware, and push/pull forces interfacing with the TLM should be rated at or less than 40 lbs. so there is a safety factor integrated for the TLM.

TLM operability and feasibility is inversely proportional to the reach, i.e. the farther the reach, the harder the operation for the TLM and the simpler the movement should be considered. Typically, TLMs are close range remote handling equipment. TLMs are operationally limited at extended reaches and have limited basic motions, e.g. push/pull (side to side, and forward and back), and lifting and transporting items. It is not advisable to design equipment/hardware that will require complex movements at these extended reaches. In addition, consideration should be given to what is expected at the finger interface; gripping and non-gripping tasks, e.g. actually gripping an item or using closed fingers to slide an item from a position. If gripping, a milled slot or equivalent feature should be incorporated for the finger to fit into, thereby, preventing the equipment/hardware from being twisted within the grip of the TLM fingers and preventing accidental drops.

Due to the pivot design of the arm, height and location of remote equipment and operations should be considered. The operating envelope of the TLM resembles a cone shape. For instance, when the arm is positioned concentric with the encast liner in the wall, the arm does not have any side to side movements but is purely rotational. As the arm is lowered, side to side movement increases until the full operating envelope of the TLM is recognized when it is positioned vertically. See 24590-WTP-M0-10-00014, *WTP Vitrification System Design Proposal Drawing MSM Manipulator Dimensions*, for TLM envelope and dimensions.

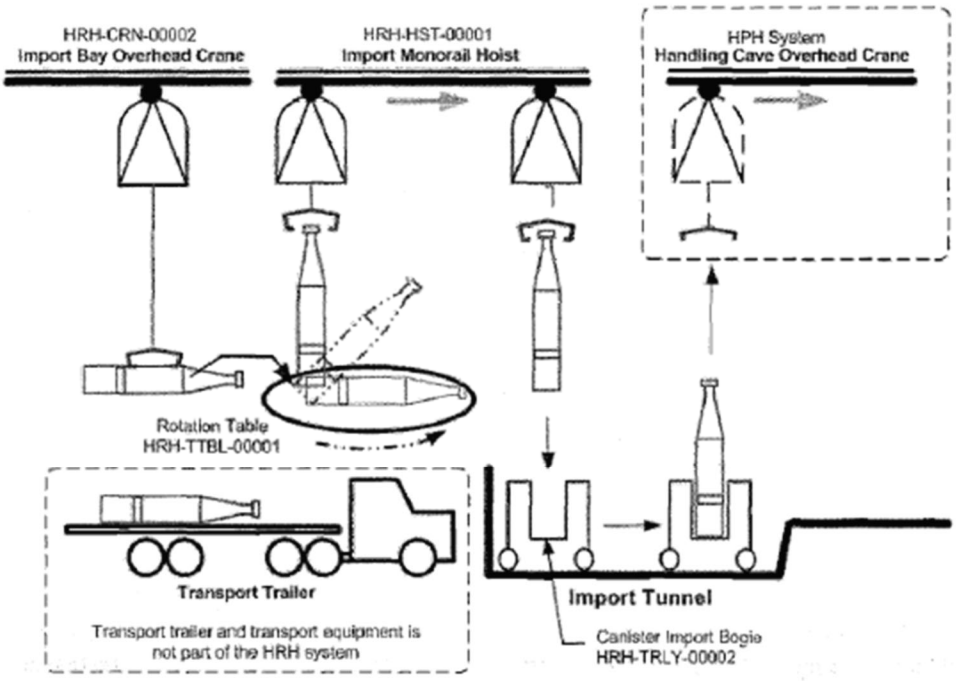
HLW has renamed master-slave manipulator (MSM) to telemanipulator (TLM). Reference documents may not reflect this update. MSM(s) shall be referred to as TLM(s).

System	Model CRL*	Power Manipulator Model PAR**	TLM Adapter Drawing	Power Manipulator Adapter Drawing ***	TLM Lifting/Power Manipulator Lifting Capacity
HEH	RE-T	N/A	24590-HLW-M0-HSH-00083	N/A	50 lbs./NA

* Seller Central Research Laboratories (CRL) with 360° wrist rotation
** Seller PAR Systems with 360° wrist rotation
*** MSM Adapter Drawing and Power Manipulator Adapter Drawing

Appendix C (Buyer's Use) HRH System Design Description

Figure 2-2 HRH System Boundary Simplified Diagram



Note: Control of crane and hoist are locally controlled by digital radio or a pendant backup. Control of inspection/rotation table is locally controlled from a panel. Control of bogie is performed through the MHJ.

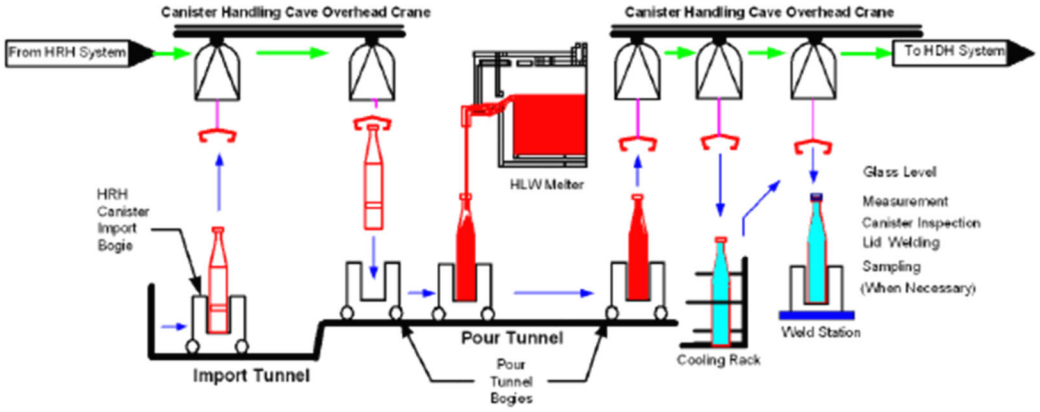
2.1 System Functions/Safety Functions

This section defines the HRH functions that need to be addressed by the system design. Figure 2-3 provides the functional block diagram for the HRH system, indicating the internal and external systems and utilities that provide the primary support or interface for that function. Section 3 provides the design requirements to meet both functional and performance expectations and demands of the HRH operations.

System interfaces are provided for reference only. See Section 1.5 for the list of relevant system designators. Except where a level of interface needs to be defined, no attempt is made in this document to define functions, performance, or design requirements for interfacing systems.

Appendix D (Buyer's Use) HPH System Design Documents

Figure 2-2 HPH Simplified System Diagram



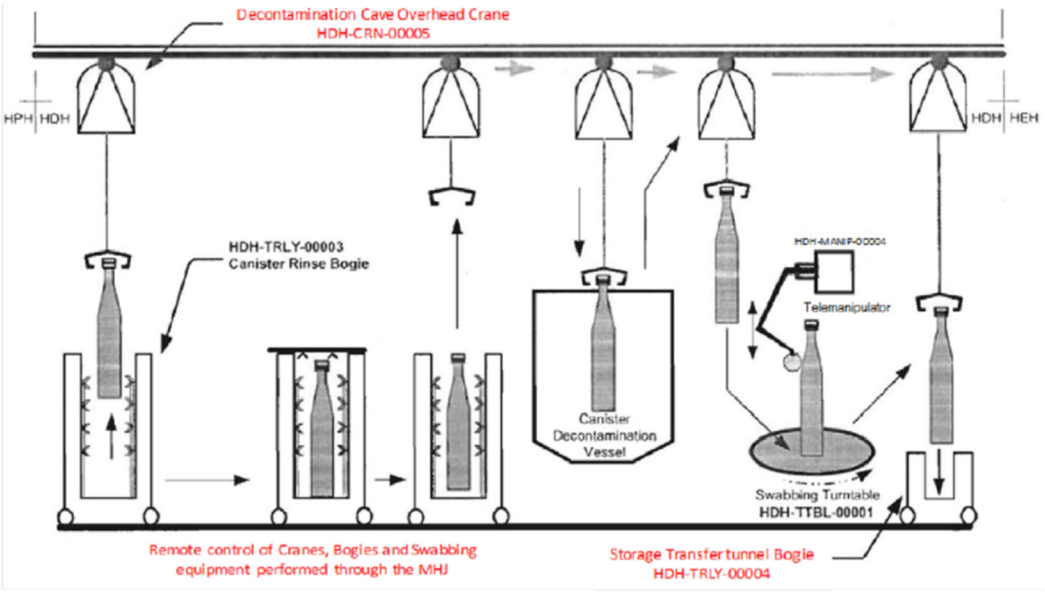
2.1 System Functions/Safety Functions

This section defines the HPH system functions and attributes that need to be addressed by the system design. Figure 2-3 provides the functional block diagrams for the HPH system, indicating the internal and external systems and utilities that provide the primary support or interface for that function. Section 3 provides the design requirements to meet both functional and other requirements. System interfaces are provided for reference only. Except where a level of interface needs to be defined, no attempt is made in this document to define functions, performance, or design requirements for interfacing systems.

Note:
HSH Figure(s) do not show HSH-TOOL-00004,
The melter cave canister grapple would only be introduced into the melter cave should a canister need to be recovered from a pour tunnel bogie.

Appendix E (Buyer's Use) HDH System Design Documents.

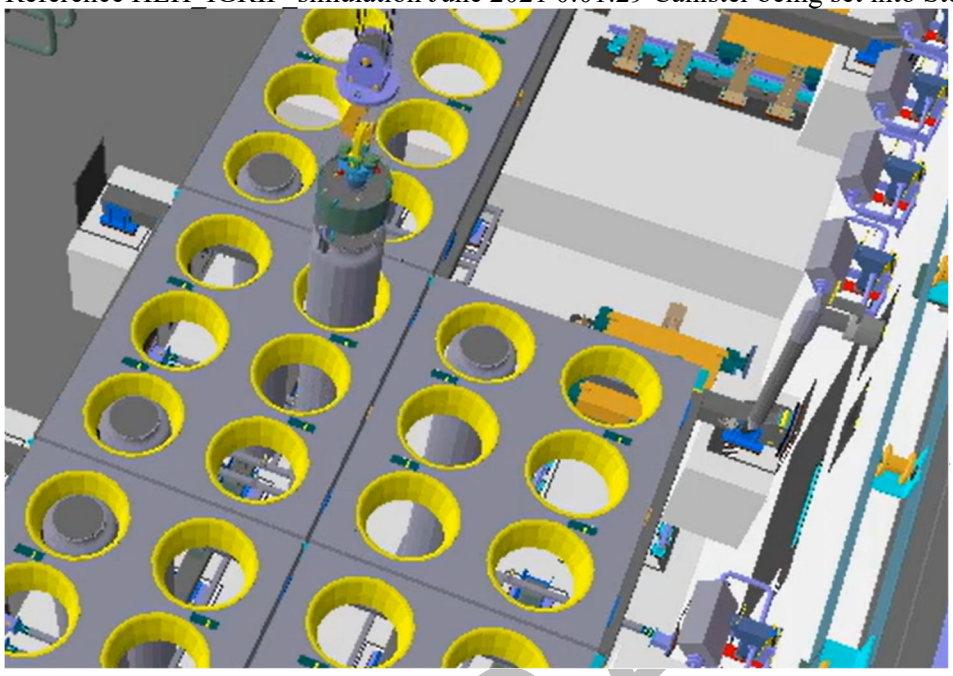
Figure 2-3 HLW HDH Systems Mechanical Flow Diagram



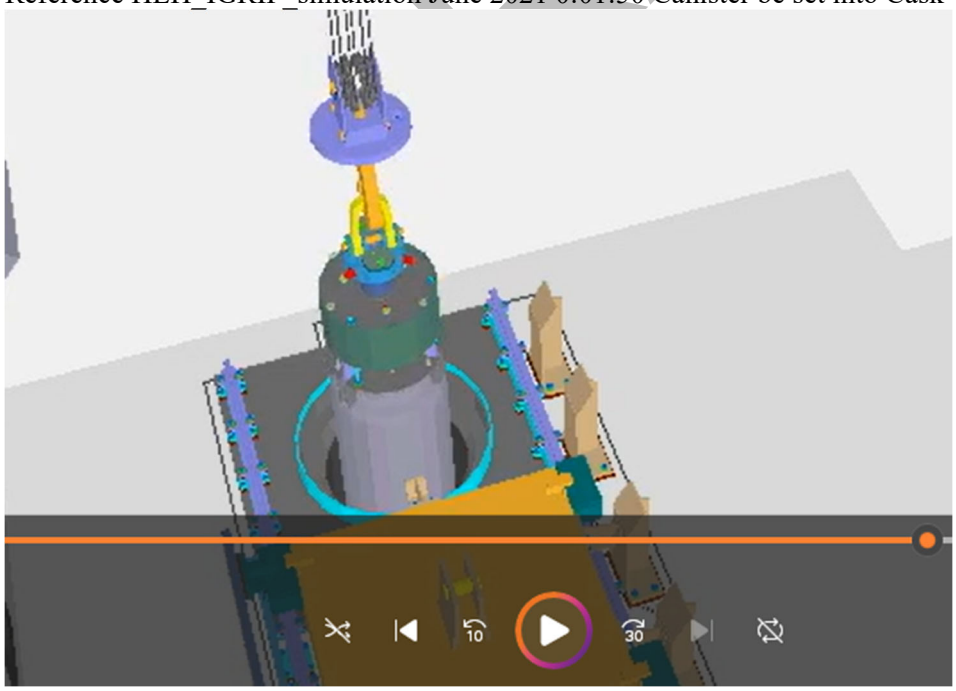
Note:
Operation of manual release pins is not necessary when canister is inside any vessel or cask

Appendix F (Buyer's Use) HEH IGRIP

Reference HEH_IGRIP_simulation June 2021 0:01:29 Canister being set into Storage Rack



Reference HEH_IGRIP_simulation June 2021 0:01:50 Canister be set into Cask



Appendix G (Buyer's Use) Requirement Source References

[1]24590-WTP-DB-ENG-18-001, Rev 4, *Basis of Design for the High-Level Waste (HLW) Facility and DFHLW Supporting Facilities*, Section 11.7.2.1
[2] 24590-HLW-3PS-MT00-T0003, Rev 0, *Engineering Specification for HLW*, section 5.2.7.2
[3] 24590-HLW-U0D-W16T-00001, Rev. 5, *HLW Room Environment Data Sheet*, PDF Page 23 of 31
[4] 24590-HLW-U0D-W16T-00001, Rev. 5, *HLW Room Environment Data Sheet*, PDF Page 23 of 31
[5] 24590-HLW-M6C-30-00033, Rev 0, *Room Ambient Dose Rates for The HLW Facility*, Section 2.6 Unshielded Dose Rates, High values for rooms H-0132 & H-0136
[6] 24590-HLW-PL-RT-07-0001 Rev 3, 0, *IHLW WASTE FORM COMPLIANCE PLAN FOR THE HANFORD TANK WASTE TREATMENT AND IMMOBILIZATION PLANT*, Section 4.1, WAPS 1.4.2 Lifting flange temperature drops below 375 °C. Calculation 24590-HLW-M0C-M37T-00010 Rev 0 section 2.8 uses 600 °F.
[7] 24590-HLW-RPT-PR-01-001, Rev 16, *Waste Acceptance Impacting Items and Activities*, Pg 55 of 65
[8] 24590-HLW-RPT-PR-01-001, Rev 16, *Waste Acceptance Impacting Items and Activities*, Pg 48 of 65
[9] 24590-HLW-U0D-W16T-00001, Rev. 5, *HLW Room Environment Data Sheet*, PDF Page 23 of 31,
[10] 24590-HLW-M6C-30-00033, Rev 0, *Room Ambient Dose Rates for The HLW Facility*, Section 2.6 Unshielded Dose Rates, High values for rooms H-0132 & H-0136
[11] 24590-HLW-MX-30-00010001, Rev 0, *HLW Vitrification Canister Assembly Drawing (3/8 In Wall)* Note 5
[12] 24590-HLW-MX-30-00010002, Rev 0, *HLW Vitrification Canister Assembly Drawing (3/8 In Wall)* Detail E
[13] 24590-HLW-MX-30-00010004, Rev 0, *HLW Vitrification Canister Assembly Drawing (3/8 In Wall)* Detail F, H
[14] 24590-HLW-3ZD-HPH-00001, Rev 3*, HLW Canister Pour Handling (HPH) System Design Description* Section 4.1.3.2
[15] CCN 343268
[16] 24590-HLW-M0C-30-00003, Rev 0, *HLW Canister Weight and Volume Calculations*, Attachment C- Weight, Volume, and Glass Fill Height Calculations Based on Nominal Dimensions
[17] 24590-HLW-MX-30-00011001, Rev 0, *HLW Vitrification System Fabrication Drawing Grapple Assembly*