

Pretreated Waste Storage Tank (PWST) Specification

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Date Published
See SPF Header



Prepared for the U.S. Department of Energy
Hanford Field Office

Contract No. 89303324DEM000096

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LIST OF TERMS

Abbreviations and Acronyms

ACI	American Concrete Institute
API	American Petroleum Institute
ASCE	American Society of Civil Engineers
ASD	Allowable Stress Design
ASME	American Society of Mechanical Engineers
ASTM	ASTM International
ASNT	American Society for Nondestructive Testing
AWS	American Welding Society
BPVC	Boiler and Pressure Vessel Code
CMTR	Certified Material Test Reports
CFR	Code of Federal Regulations
COR	Code of Record
CTR	Certified test report
DOE	U.S. Department of Energy
DST	Double Shell Tank
FEA	Finite Element Analysis
H2C	Hanford Tank Waste Operations & Closure, LLC
HFO	Hanford Field Office
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
ITDC	Integrated Tank Disposition Contract
LRFD	Load and Resistance Factor Design
LILO	Load In and Load Out
M&TE	Measuring and Test Equipment
MTC	Mill Test Certificate
MSR	Master Submittal Register
NIST	National Institute of Standards and Technology
NDE	Non-Destructive Examination
NPS	Nominal pipe size
PQR	Procedure Qualification Records
PQTR	Performance Qualification Test Records
PT	(Liquid) Penetrant Testing
PWST	Pretreated Waste Storage Tank
QA	Quality Assurance
QAP	Quality Assurance Plan
QIP	Quality Inspection Plan
RAMI	Reliability, Availability, Maintainability, and Inspectability
RFI	Request for Information
RMS	Root mean square
RPP	River Protection Project
RT	Radiographic Testing
S/CI	Suspect/Counterfeit Items

SEI	Structural Engineering Institute
SSC	Structures, Systems, and Components
SST	Single Shell Tank
STD	Standard
TPA	Tri-Party Agreement
UNS	Unified Numbering System
UT	Ultrasonic Examination
VT	Visual Testing
WAC	Washington Administrative Code
WARM	West Area Risk Management
WPS	Welding Procedure Specifications
WRC	Welding Research Council

Units

°F	Degree Fahrenheit
°C	Degree Celsius
in.	Inch
lb/ft ³	Pound per cubic foot
lb/in ²	Pound per square inch
mil	One thousandth of an inch
ppm	Parts per million
psi	Pounds per square inch

1.0 INTRODUCTION

This specification provides the requirements for design and procurement of the Pretreated Waste Storage Tank (PWST). The PWST is a horizontal vessel to be installed inside of an underground concrete vault for the storage and transfer of radioactive pretreated tank wastes at the Hanford site. This specification establishes the functions, interfaces, applicable codes and standards, requirements for the design, fabrication, testing, quality, packaging, transportation, and delivery of the PWST vessel.

1.1 SCOPE

Provide labor, materials, and services required for the design, fabrication, inspection, testing, and delivery of the PWST vessel and riser assemblies. The PWST vessel with stubbed penetrations shall be fabricated, inspected, and tested prior to delivery to the Hanford site. After delivery and installation of the vessel into an underground concrete vault at the site, the riser assemblies shall be field welded to the top of the stubbed vessel penetrations.

The PWST is not an ASME code stamped vessel, but it shall be designed, fabricated, quality assured, and documented to the same rigor as that of a Boiler and Pressure Vessel Code (BPVC) Section VIII Division 1 vessel. The omission of a code stamp is driven by administrative considerations and expected inspection intervals, as personnel access inside the vessel nor concrete vault are not planned.

1.2 BACKGROUND

Hanford Tank Waste Operations & Closure LLC (H2C) is the U.S. Department of Energy (DOE), Hanford Field Office (HFO) Tank Farms contractor. H2C is contracted to provide safe, compliant, cost-effective, and energy-efficient services to further the HFO Project Mission. In order to safely complete the HFO Project Mission, various permanent or temporary systems and associated components are required.

The West Area Risk Management (WARM) system provides pretreatment capabilities for the wastes originating from the Single Shell Tanks (SSTs) and Double Shell Tanks (DSTs) located inside the 200W Area and the capability to transfer the pretreated waste to the Load In and Load Out (LILO) station for off-site shipment.

Pretreatment of the radioactive tank wastes stored inside the SSTs and DSTs is to be accomplished by removing entrained solids, Cesium-137, and Strontium-90 from the waste via process modules that utilize Crystalline Silicotitanate (CST) ion exchange media. The pretreated waste is to be transferred to and stored inside of an interim storage tank called the Pretreated Waste Storage Tank, until it is transferred to the LILO station for off-site shipment. The PWST shall receive, store, and transfer waste in accordance with criticality prevention specification for tank farm operations.

The PWST is a 24 ft diameter horizontal vessel with an overall length of approximately 44 ft that is installed inside of an underground containment vault. The horizontal vessel has torispherical heads on both ends and is supported by vessel saddles. Transfer pumps (vertical turbine pumps) installed onto the main (48 inch) PWST riser are utilized to transfer the pretreated waste to the LILO station. During periods in which transfers out of the tank are not occurring, the transfer

pumps are used to recirculate the tank contents from one end of the tank to the other for mixing and solids suspension.

The underground concrete vault into which the PWST vessel is placed is planned to be constructed to prior to transportation and delivery of the PWST vessel. Due to the size of the vessel, the transportation of the PWST to the Hanford site is expected to require barge shipment and road routes without overhead obstructions. After placement of the vessel onto the concrete vault foundation/floor using a crane, the PWST riser assemblies are to be field welded onto the stubbed penetrations of the vessel. The PWST vessel without risers are shown in Figure 1-1.

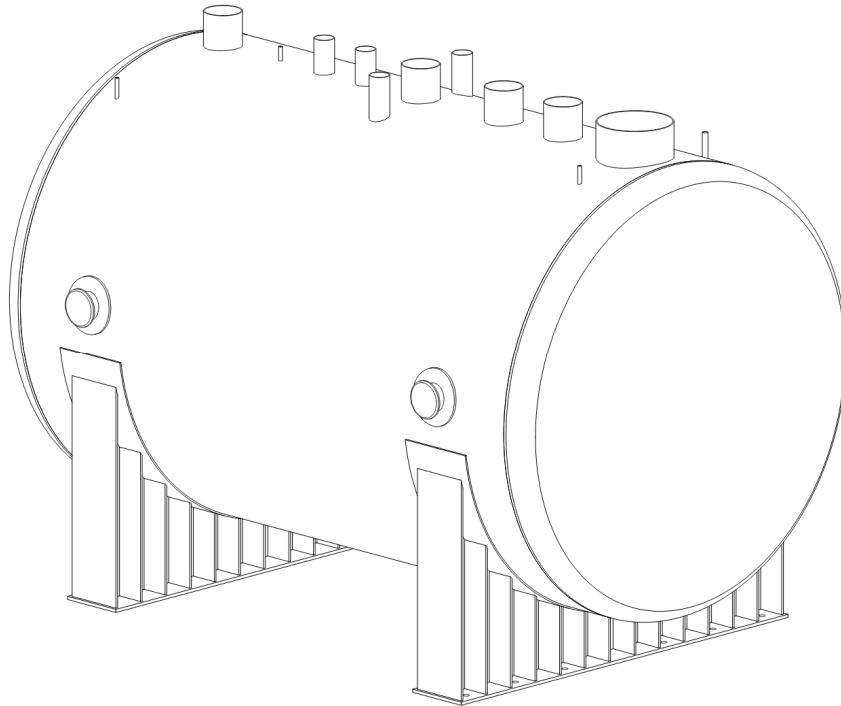


Figure 1-1. PWST Vessel, Without Riser Assemblies

1.3 DEFINITIONS

- BUYER – Integrated Tank Disposition Contract (ITDC) responsible for managing the design, procurement, and construction of the procured item.
- SELLER – Contracted fabricator, vendor, or subcontractor performing work to the contract drawings, procurement data sheets, and technical specifications.
- Subcontractor – Entity that performs work for the SELLER in accordance to this specification.
- Substitution – Any departure from the requirements contained in the purchase order and specification which SELLER proposes to incorporate if approved by BUYER.
- Shall – Denotes project requirements, compliance is required.

- Should – Denotes recommendation or expectation, compliance is expected. If a “should” recommendation cannot be satisfied, justification of an alternative design solution shall be submitted to the BUYER for approval.
- Deviation – Any change or deviation from issued approved drawings, designs, methods, or contract terms and conditions. Changes in products, materials, equipment, methods of construction, and test criteria required by the contract documents proposed by the SELLER after award of the contract are considered to be requests for substitution.
- HOLD POINT – An inspection activity beyond which work shall not proceed until an inspector and/or BUYER is notified and 1) the inspection is performed and released, or 2) the inspection is deferred and can be completed at a later time, or 3) a written waiver is issued by the organization who established the HOLD POINT.

2.0 APPLICABLE DOCUMENTS

The following documents form a part of the basis of design to the extent specified in the applicable sections of this specification. Materials, design, fabrication, examination, and testing shall be per the national codes and standards editions as invoked and supplemented by this specification. Additional national codes and standards not specifically referenced herein but required for the PWST vessel manufacture or testing shall be defined and documented by the SELLER during design development.

2.1 NON-GOVERNMENT CODE OF RECORD DOCUMENTS

The following documents of the exact issue shown in Table 2-1 form a part of this Specification to the extent specified herein and establishes the Code of Record. In the event of conflict between the documents referenced herein and the contents of this Specification, the contents of this Specification shall be considered a superseding requirement.

Table 2-1. Non-Government Code of Record Documents (2 pages).

Document Number	Title
American Petroleum Institute	
API-650, 2020	Welded Tanks for Oil Storage
American Society of Civil Engineers	
ASCE 7-16	Minimum Design Loads and Associated Criteria for Buildings Other Structures
ASCE/SEI 7-22	Minimum Design Loads and Associated Criteria for Buildings and Other Structures
ASCE/SEI 4-16	Seismic Analysis of Safety-Related Nuclear Structures
American Society of Mechanical Engineers	
ASME BPVC, Section II	Materials
ASME BPVC, Section V	Nondestructive Examination
ASME BPVC, Section VIII	Rules for Construction of Pressure Vessels
ASME BPVC, Section IX	Welding, Brazing and Fusing Qualifications
ASME Y14.5	Dimensioning and Tolerancing
ASME B16.25	Buttwelding Ends
ASME B16.5	Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24
ASME B46.1	Surface Texture (Surface Roughness, Waviness, and Lay)
ASME NQA-1	Quality Assurance Requirements for Nuclear Facility Applications
ASME SA-105/SA-105M	Specification for Carbon Steel Forgings for Piping Applications

Table 2-1. Non-Government Code of Record Documents (2 pages).

Document Number	Title
ASME SA-106/SA-106M	Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASME SA-516/SA-516M	Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASME B30.20	Below the Hook Lifting Devices
ASME B30.26	Rigging Hardware
American Society for Nondestructive Testing	
ASNT SNT-TC-1A	Personnel Qualifications and Certification in Nondestructive Testing
ASTM International	
ASTM A36	Standard Specification for Carbon Structural Steel
American Welding Society	
AWS D1.1	Structural Welding Code - Steel
AWS A2.4	Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS QC-1	Specification for AWS Certification of Welding Inspectors
International Organization for Standardization	
ISO/IEC 17025	General Requirements for the Competence of Testing and Calibration Laboratories
Welding Research Council	
Bulletin 107	Local Stresses in Spherical and Cylindrical Shells
Bulletin 297	Local Stresses in Cylindrical Shells due to External Loadings on Nozzles

2.2 NON-GOVERNMENT NON-CODE OF RECORD DOCUMENTS

Documents listed in Table 2-2 constitute a part of this Specification to the extent specified herein. The most current version of the documents shall be used unless otherwise specified. In the event of conflict between the documents referenced herein and the contents of this Specification, the contents of this Specification shall be considered a superseding requirement.

Table 2-2. Non-Government Documents (3 pages).

Document Number	Title
Drawings	
H-14-113515-1	Mechanical, SY PWST System Layout, General Notes
H-14-113515-2	Mechanical, SY PWST System Layout, General Arrangement
H-14-113515-3	Mechanical, SY PWST System Layout, Plan View
H-14-113515-4	Mechanical, SY PWST System Layout, Elevation and Sections

Table 2-2. Non-Government Documents (3 pages).

Document Number	Title
H-14-113515-5	Mechanical, SY PWST System Layout, Elevation and Sections
H-14-113516-1	Mechanical, SY PWST Vessel, General Notes
H-14-113516-2	Mechanical, SY PWST Vessel, General Arrangement
H-14-113516-3	Mechanical, SY PWST Vessel, Sections and Details
H-14-113516-4	Mechanical, SY PWST Vessel, Saddle Details
H-14-113517-1	Mechanical, SY PWST Riser Assemblies, Notes and Parts List
H-14-113517-2	Mechanical, SY PWST Riser Assemblies, 48 In Riser Ass'y
H-14-113517-3	Mechanical, SY PWST Riser Assemblies, 48 In Riser Ass'y
H-14-113517-4	Mechanical, SY PWST Riser Assemblies, 24 In Riser Ass'y
H-14-113517-5	Mechanical, SY PWST Riser Assemblies, 24 In Std Riser Ass'y
H-14-113517-6	Mechanical, SY PWST Riser Assemblies, 12 In Std Riser Ass'y
Hanford Tank Waste Operations & Closure	
OSD-T-151-00007	Operating Specifications for the Double-Shell Storage Tanks
RPP-8360	Lifting Attachment and Lifted Item Evaluation, A Hanford Tank Operating Contractor Process
RPP-CALC-67147	Pretreated Waste Storage Tank (PWST) Vessel and Structural Calculations
RPP-RPT-64319	Preliminary 200 West Area Flowsheet
RPP-RPT-65822	Pretreated Waste Storage Tank (PWST) Design Study
RPP-SPEC-65289	Level 2 Project Specification for West Area Risk Management Project OP192
TFC-BSM-IRM_DC-C-02	Records Management
TFC-BSM-IRM_DC-C-07	Vendor Processes
TFC-ENG-DESIGN-C-10	Engineering Calculations
TFC-ENG-DESIGN-C-25	Technical Document Control
TFC-ENG-DESIGN-C-57	Development and Maintenance of Code of Record
TFC-ENG-STD-02	Environmental and Climatological Design Basis Requirements for ITDC Structures, Systems and Components
TFC-ENG-STD-06	Design Loads for Tank Farm Facilities
TFC-ENG-STD-10	Drawing Standard
TFC-ENG-STD-12	Tank Farm Equipment Identification Numbering and Labeling Standard
TFC-ENG-STD-22	Piping, Jumpers, and Valves
TFC-ENG-STD-45	Design and Installations for Potentially Flammable Atmospheres
TFC-ENG-STD-51	Vendor Calculation Standard
TFC-ENG-STD-52	Subcontractor Welding Standard

Table 2-2. Non-Government Documents (3 pages).

Document Number	Title
TFC-ENG-STD-55	Cleanness Classification and Cleaning Control Standard
TFC-PLN-49	Criticality Safety Program

2.3 GOVERNMENT DOCUMENTS

Documents listed in Table 2-3 constitute a part of this Specification to the extent specified herein. The most current version of the documents shall be used unless otherwise specified. In the event of conflict between the documents referenced herein and the contents of this Specification, the contents of this Specification shall be considered a superseding requirement.

Table 2-3. Government Documents (1 page).

Document Number	Title
Code of Federal Regulations	
10 CFR 830	Nuclear Safety Management
29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926	Safety and Health Regulations for Construction
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 268	Land Disposal Restrictions
49 CFR 173	Shippers - General Requirements for Shipments and Packages
Washington Administrative Code	
WAC 173-303	Dangerous Waste Regulations
WAC 173-360	Underground Storage Tank Regulations
U.S. Department of Energy	
DOE/RL-92-36	Hanford Site Hoisting and Rigging Manual
DOE O 414.1D	Quality Assurance
DOE-STD-1020	Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities
DOE-STD-1027	Hazard Categorization of DOE Nuclear Facilities
DOE-STD-1090	Hoisting and Rigging
DOE-STD-1189	Integration of Safety into the Design Process
DOE G 414.1-3	Suspect/Counterfeit Items Guide for Use with 10 CFR 830 Subpart A, Quality Assurance Requirements, and DOE O 414.1B, Quality Assurance

2.4 HIERARCHY OF CODE

Except in those instances where Washington State has been granted regulatory authority by the Federal Government, the hierarchical relationship among requirements specified in Section 2.0 is as follows:

- Federal requirements (e.g., Code of Federal Regulations).
- Washington State requirements (e.g., Washington Administrative Code).
- Local ordinances.
- U.S. Department of Energy Orders and Standards.
- National consensus codes and standards.
- Hanford Site-specific codes and standards.

This hierarchy establishes the order of precedence of requirements levied in this Specification. In the event of a conflict between two requirements, the SELLER shall submit an RFI per Section 7.8 for clarifications prior to use.

3.0 DESIGN REQUIREMENTS

3.1 GENERAL DESIGN REQUIREMENTS

- 3.1.1 Geometrical configuration, penetration/nozzle size, and material specification shall be as shown by the engineering drawings listed in Table 2-2.
- 3.1.2 The PWST vessel shall be designed in accordance with ASME BPVC Section VIII Division 1. However, the vessel does not require a pressure vessel code stamp. Application of any alternative code case requires BUYER approval.

3.2 SHOP DETAIL DRAWINGS AND ASSEMBLY DRAWINGS

- 3.2.1 Submit shop detail drawings and assembly drawings in PDF and electronic formats. Include the following:
 - A. Details of welding on the drawings. Include weld type, location, extent, finish, Nondestructive Examinations using symbols in accordance with AWS A2.4.
 - B. Shell, head, and penetration/nozzle thicknesses.
 - C. Shell, head, and shell reinforcement details.
 - D. Assembly support details.
 - E. Lifting lugs and lifting lug mounting/reinforcement, including their locations and dimensional tolerances.
 - F. Vessel support saddles and corresponding vessel base plate, attachment and reinforcement to vessel, dimensions, tolerances, and finishes.
 - G. Material descriptions on the drawings of assembly components by their ASME and ASTM designation, alloy designation, and UNS number.
 - H. Dimensions and required tolerances (position, flatness, parallelism, concentricity, perpendicularity, finish) and reference datum planes.
 - I. Show Bill of Materials (BOM) on assembly drawings.

3.3 ASME PRESSURE VESSEL CALCULATIONS

- 3.3.1 Submit ASME pressure vessel design calculation for BUYER acceptance, incorporating the following design parameters:
 - 3.3.1.1 Design pressure, internal: 12 psig, conservatively high but under 15 psig.
 - 3.3.1.2 Design pressure, external: 3 psig, greater than the maximum negative pressure generated by active ventilation (241-SY tank farm exhaustor).
 - 3.3.1.3 Design temperature: 115°F, per RPP-SPEC-65289.
 - 3.3.1.4 Fluid specific gravity: 1.2, per RPP-RPT-64319.
 - 3.3.1.5 Penetration/nozzle loads and attached equipment removal loads.

- 3.3.1.6 Design loads and design load combinations shall be in accordance with ASCE/SEI 7 and the provisions of ASME BPVC Section VIII Division 1.
- 3.3.1.7 Forces and moments imposed by external loads as shown in Attachment D (TBD). Evaluate per WRC 107/297 and Finite Element Analysis (FEA).
- 3.3.1.8 Seismic spectra as per TFC-ENG-STD-06 is as follows:
 - A. $S_{DS} = 0.402$
 - B. $S_{D1} = 0.3498$
- 3.3.1.9 Corrosion allowance of 1/8 inch for the vessel and 1/16 inch for the penetrations/nozzles, based on historical data with margins, to be verified by detailed corrosion analysis.
- 3.3.1.10 Fluid level (top of shell): 286.5 in., per H-14-113516.
- 3.3.1.11 Nuclear Design Category is NDC-2, per RPP-SPEC-65289.
- 3.3.1.12 Seismic Design Category is SDC-2, per RPP-SPEC-65289.
- 3.3.1.13 Seismic Risk category is IV for NDC-2, per TFC-ENG-STD-06.
- 3.3.1.14 Site Class is D, per TFC-ENG-STD-06.
- 3.3.1.15 Limit State is C, with a response modification factor of 1.2, per TFC-ENG-STD-06.
- 3.3.1.16 Design life: 40 years, per RPP-SPEC-65289.
- 3.3.1.17 The PWST is installed inside of a concrete vault. Therefore, there are no wind or precipitation loads applied.
- 3.3.1.18 All material properties and allowable stresses are obtained from ASME BPVC Section II-D at the design temperature.

3.4 ADDITIONAL DESIGN REQUIREMENTS

- 3.4.1 Qualify the PWST vessel for seismic and concurrent loads, accounting for the following loads:
 - 3.4.1.1 Operating weight.
 - 3.4.1.2 Design pressure and temperature conditions.
 - 3.4.1.3 Penetration/nozzle loads as per Attachment D.
 - 3.4.1.4 Seismic forces in accordance with ASCE/SEI 4.
 - 3.4.1.5 Hydrodynamic loads due to impulsive and convective forces using API or ACI guidelines.
- 3.4.2 Documentation
 - 3.4.2.1 Submit Description of Seismic Qualification Analysis Method.

- 3.4.2.2 Submit Description of Load Combination Method.
- 3.4.2.3 At completion of analysis, submit a stress calculation report. The stress calculation shall include:
 - A. Summary stress report, including input.
 - B. Stress analysis report, include all input-output and sufficient plots to verify model and results.
 - C. Present results in a step-by-step format which is readily auditable by personnel with proper analytical background and include the following:
 - 1. Scope
 - 2. Summary of results and conclusions
 - 3. Load criteria and assumptions
 - 4. Method of analysis
 - 5. Calculation

3.5 LIFTING LUG DESIGN CRITERIA

- 3.5.1 Lifting lugs shall be designed per ASME Section VIII Allowable Stress Design (ASD) or Load and Resistance Factor Design (LRFD) using a weight value of two times the actual lifted weight.
- 3.5.2 Shell stress shall be limited per ASME Section VIII, Division 1.
- 3.5.3 Lifting lugs shall be designed to lift the PWST Vessel without process fluid.
- 3.5.4 Submit lifting lug calculations.

3.6 CALCULATION REQUIREMENTS

- 3.6.1 General
 - 3.6.1.1 Each calculation shall be prepared and signed by an originator competent in the relevant engineering field.
 - 3.6.1.2 Each calculation shall be prepared independent of all assistance by the verifier.
 - 3.6.1.3 Each calculation shall be verified and signed by a verifier.
 - 3.6.1.4 Verifier shall possess qualifications to perform calculation independently.
- 3.6.2 Prepare all calculations in enough detail to ensure that allowable criteria and proper factors of safety have been followed. Provide each calculation with:
 - 3.6.2.1 Enough detail to allow an individual competent in that discipline to understand the methodology, inputs, and results.
 - 3.6.2.2 Objective.

- 3.6.2.3 Statement of problem.
- 3.6.2.4 Assumptions including basis.
- 3.6.2.5 Open items, if any.
- 3.6.2.6 Logical description of calculation methodology.
- 3.6.2.7 Design inputs and assumptions with explanation of assumption bases.
- 3.6.2.8 Codes and standards governing its design, including formulas.
- 3.6.2.9 Calculations and computations, including units.
 - A. For spreadsheet computations, write in the body of the calculation the numerical computations used or attach a formula printout to the spreadsheet calculation.
 - B. The explanation of the calculation method and the computations themselves shall be succinct yet detailed enough to permit a qualified verifier/checker to perform the technical review with minimal interpretation or clarification of the facts presented.
 - C. Present results in a step-by-step format which is readily auditable by personnel skilled in such analysis, include software used and its validation and verification procedure.
 - D. If software is used in preparation of the engineering calculation, all inputs and outputs, shall be identified to allow the analyses to be repeated without recourse to the originator. Submit an electronic copy of all software input and output files. If the software does not provide printing of all input and output, provide screenshots of the input and output information to facilitate the independent checking of the calculation.
 - E. If MathCad or Excel is used, formulas cells shall be explicitly displayed to show exact details for the calculations.
- 3.6.2.10 References.
- 3.6.2.11 Results.
- 3.6.2.12 Conclusions describing how the objective is met.
- 3.6.2.13 Attachments: Attach all inputs relied upon not commonly available in copyrighted print (e.g., component manufactured data, written correspondence, etc.).

3.7 MATERIALS OF CONSTRUCTION

- 3.7.1 Provide materials in accordance with ASME BPVC Section VIII and referenced code sections.
- 3.7.2 Materials designated on reference drawings prefixed with “SA” or “SB” shall be provided in accordance with ASME BPVC Section II.

- 3.7.3 Unless otherwise specified, all materials, components, and parts required by the subcontract, including those permanently installed onto systems, subsystems, and/or assemblies, shall be new and unused.
- 3.7.4 Materials not included by ASME Section II shall adhere to the ASTM designations per the drawings.
- 3.7.5 Identify and maintain material ASTM/ASME designations by lot and heat numbers on the material through fabrication. Identifying marks may be made using low stress metal stamps, where applicable.
- 3.7.6 Plate material used for tank walls shall be supplied as hot-rolled and annealed (or heat-treated) then blast cleaned (or pickled).
- 3.7.7 Use of non-metallic materials which have a total chlorine/chloride content of more than 250 ppm, in contact with vessel components and trunnion, is not acceptable.

3.8 CORROSION EVALUATION

- 3.8.1 All materials in contact with radioactive material shall be corrosion evaluated.
- 3.8.2 Materials of construction in the pressure boundary that is in contact with the tank waste is carbon steel (SA-516 Grade 70). The tank waste composition is provided in RPP-RPT-64319, Preliminary 200 West Area Flowsheet. The suitability of the material of construction shall be evaluated with the assumption that the composition of the tank waste is controlled in accordance to OSD-T-151-00007, Operating Specifications for the Double-Shell Storage Tanks.
- 3.8.3 The SELLER shall submit a corrosion and erosion evaluation report.
 - 3.8.3.1 The corrosion report shall include the evaluation of the following corrosion mechanisms as a minimum:
 - A. General/uniform corrosion
 - B. Pitting corrosion
 - C. Crevice corrosion
 - D. Stress corrosion cracking
 - E. End grain corrosion
 - F. Weld corrosion
 - G. Microbiologically influenced corrosion
 - H. Fatigue corrosion
 - I. Vapor phase corrosion
 - J. Erosion
 - K. Galvanic corrosion
 - L. Cavitation

- 3.8.3.2 Provide a recommendation for the materials of construction to be utilized for the PWST vessel along with their justification.
- 3.8.3.3 Provide a recommendation for the corrosion allowance based on the selected materials of construction.
- 3.8.3.4 Document all references used for the generation of the corrosion evaluation report.
- 3.8.3.5 Attachments: Attach all inputs relied upon not commonly available in copyrighted print (e.g., component manufactured data, written correspondence, etc.).

4.0 FABRICATION REQUIREMENTS

4.1 GENERAL METHODS

- 4.1.1 Fabricate in accordance with manufacturer's standards and other applicable fabrication requirements given by this Specification including the drawings in Section 2.2.
- 4.1.2 Tolerance for dimensions as provided by the drawings in Section 2.2.
- 4.1.3 Verify that the materials of construction used for fabrication are traceable to Certified Material Test Reports.

4.2 MATERIAL CONTROL

- 4.2.1 Establish a system to control material of fabrication to prevent mix-up with other materials during fabrication.
 - 4.2.1.1 Maintain identification of the materials of fabrication through final assembly.
 - 4.2.1.2 Materials of fabrication shall bear identification marking to ensure that all materials can be identified, including:
 - A. Subcontract numbers
 - B. Heat numbers
 - C. Lot numbers
 - D. Part numbers
 - E. Material type or grade
- 4.2.2 The material control procedures shall address receiving inspection of incoming material, maintenance of material, identification of cut material, issuance of material to the shop for fabrication, and maintenance of documentation of materials.
- 4.2.3 All material shall be identified with the heat and lot numbers prior to and during fabrication. If the piece is too small for marking or tagging, other means shall be used to properly identify the material.
- 4.2.4 SELLER shall develop a system of control that will ensure that only the approved weld filler materials are used. SELLER shall submit Weld Filler Material Control Procedure.
- 4.2.5 Submit Material Control Procedures for all materials.
- 4.2.6 All vessel components are to be processed, handled, packaged, and shipped in a manner to prevent contamination from materials which have a chloride content of more than 250 ppm, including tape, wrapping materials, and marking inks and paint.

4.3 CERTIFIED MATERIAL TEST REPORT

- 4.3.1 Submit Certified Material Test Reports (CMTRs) for all metallic material, including weld filler material delivered. Each CMTR shall be signed or otherwise authenticated by an authorized representative of the manufacturer of the material. Each CMTR shall include a listing of all required physical and chemical property test results, and other content required by the material standards. CMTR documentation shall be legible and reproducible.
- 4.3.2 If the material manufacturer is not accredited to ISO/IEC 17025, then in addition to submitting CMTRs from the manufacturer, the SELLER shall arrange for a qualified laboratory to verify the material chemical and physical properties for each heat/lot used. Submit the additional CMTR documentation. This shall include:
 - 4.3.2.1 Identification of actual chemical and physical tests and results performed on a representative sample of the material Heat/Lot No.
 - 4.3.2.2 Heat/Lot No.
 - 4.3.2.3 Applicable material standard.
 - 4.3.2.4 Statement of test results certification.
 - 4.3.2.5 Identification of testing and certifying organization.
- 4.3.3 If the material manufacturer is accredited to ISO/IEC 17025 for material testing, then the additional testing by a qualified laboratory is not required.
- 4.3.4 Qualified laboratories are those that are accredited to ISO/IEC 17025 for materials testing.
- 4.3.5 Submit current ISO/IEC 17025 Accreditation Certificate(s) for all qualified laboratories, including material manufacturers. The laboratory's Scope of Accreditation shall cover the scope of testing performed by the laboratory (e.g. Mechanical, Chemical).

4.4 WELDING REQUIREMENTS

- 4.4.1 Welding shall be in accordance with the ASME BPVC, Section VIII, Division 1, and Section IX.
- 4.4.2 SELLER shall determine all weld dimensions in accordance with ASME BPVC Section VIII. If the weld dimension in the provided drawings is larger, then the weld size shall follow the drawing requirement.
- 4.4.3 Weld joint and radiography:
 - 4.4.3.1 PWST vessel: Category A, B, and D weld joints shall be full penetration and 100% radiographed per ASME BPVC Section V.
 - 4.4.3.2 Riser assemblies: Field welded to the vessel stub penetrations. Ultrasonic testing is planned in placed of radiographic testing.
- 4.4.4 All internal and external attachment pads shall be welded all around.

- 4.4.5 Thermal cutting process: the cut surface shall be ground or machined to remove all adhering slag, gouges, and discoloration to produce a bright clean surface.
- 4.4.6 All foreign material shall be removed from metal surfaces in the area that is to be welded or that will be heated by welding or other hot-working operations. This includes such materials as dirt, grease, machining or forming lubricants, paint, marking crayons, marking inks, label adhesives, temperature crayons or pellets, and any material containing sulfur, lead, mercury, zinc, antimony, tin, phosphorous, arsenic, selenium, and tellurium.
- 4.4.7 Welding Procedures
 - 4.4.7.1 Submit Welding Procedure Specifications (WPS) and Procedure Qualification Records (PQR) per the requirements of ASME BPVC Section IX.
 - 4.4.7.2 Submit Weld Repair Procedures for acceptance for repair of welds and base materials.
 - 4.4.7.3 Notify BUYER prior to any weld repairs.
 - 4.4.7.4 Submit Repair Reports.
- 4.4.8 Minor repairs shall be in process repairs and shall not exceed 2 inches in length and 1/8 inch in depth. No more than two consecutive minor repairs may be performed in the same region that the weld was made without it becoming a major repair that requires BUYER approval. For PWST vessel pressure boundary welds, regardless of size of defects, if more than two consecutive weld repairs have been performed, it shall be considered a major repair and require BUYER approval.
- 4.4.9 The SELLER shall prepare and submit Major Repair Verification Reports if any major repairs are performed. A Major Repair Verification Report shall include the weld repair locations (maps), material test reports for filler metal, pre- and post- weld heat treatment records, NDE records, and other pertinent information.
- 4.4.10 Weld Maps
 - 4.4.10.1 Prepare weld maps for vessels and structural components. The weld map sketches or charts shall use symbols in accordance with AWS A2.4, identify all welds, and maintain a log identifying type of welds, welders, NDE, and dates of acceptance. These sketches shall be used for controlling weld inspection during fabrication. Each weld shall be individually and uniquely identified.
 - 4.4.10.2 List each weld joint type.
 - 4.4.10.3 WPS used.
 - 4.4.10.4 NDE performed.
 - 4.4.10.5 Welder I.D.
 - 4.4.10.6 Base metal type, grade, and thickness at each joint.
 - 4.4.10.7 Filler metal used.

- 4.4.10.8 Whether back gouge and back welding will be performed.
- 4.4.10.9 Post weld heat treatment, if required.
- 4.4.10.10 Notch toughness testing, if required.
- 4.4.10.11 Submit Preliminary Weld Maps for each system assembly prior to fabrication.
- 4.4.10.12 Submit Weld Map Report after fabrication completion.

4.5 HEAT TREATMENT AND STRESS RELIEVING

- 4.5.1 Machining shall be performed after heat treatment, welding, or any other operation which may change the surface characteristics.
- 4.5.2 If the formed vessel heads are supplied from joined material plates, welds shall be 100% radiographically examined after forming.
 - 4.5.2.1 Minimize the length and amount of welding.
 - 4.5.2.2 Include controlling temperature and time as function of thickness, furnace atmosphere, cooling rate, and method.
 - 4.5.2.3 Procedures shall apply to any stress relieving procedures if such methods are used.
 - 4.5.2.4 Submit heat treatment procedure(s).
 - 4.5.2.5 Submit all heat treatment reports.
 - 4.5.2.6 Perform heat treatment per accepted procedures.

4.6 CONTAMINATION PREVENTION

- 4.6.1 Clean steel surfaces of loose scale, rust, or steel particles that could become embedded in the vessel components and attachments.
- 4.6.2 Weld filler material shall match the base material being joined. Note that the SELLER shall have a procedure to control weld filler materials.
- 4.6.3 All vessel openings and ports shall be capped, plugged or sealed when work is not in progress.

4.7 SURFACE FINISH

- 4.7.1 All surfaces shall be finished smooth, free of pits, gouges, crevices, porosity, inclusions, and indentations to facilitate decontamination and minimize crevice corrosion.
- 4.7.2 Remove weld spatter, sharp edges, corners, projections, pits, scratches, or other sharp depressions, and surface irregularities.
 - 4.7.2.1 All nicks and gouges less than or equal to 0.012 inch deep may be removed by blend grinding.

- 4.7.2.2 All nicks and gouges greater than 0.012 inch deep shall be filled with weld metal and ground smooth.
- 4.7.2.3 Perform liquid penetrant test on welded repair areas.
- 4.7.3 Smooth bumps or depressions on welds and other non-machined surfaces are acceptable.
- 4.7.4 Blend grinding is permitted as long as the metal thickness is not reduced more than 12% of the nominal material thickness.
- 4.7.5 Surface finishes of piping, plate, casting, or bar that are exposed to the process fluid shall be 250 RMS or better. Gasketed surfaces shall have a surface finish of 125 RMS or better.
- 4.7.6 Surface roughness shall be determined in accordance with ASME B46.1.

4.8 CLEANNESS REQUIREMENTS

- 4.8.1 Cleaning of PWST Vessel.
 - 4.8.1.1 Cleaning methods and materials (cleaning solutions) used for cleaning shall be compatible with the materials of construction of the vessel and components being cleaned. Special consideration shall be given to nonmetallic and nonferrous materials.
 - 4.8.1.2 Use of tools (such as those used for grinding, polishing, filing, deburring, and brushing) shall be controlled during fabrication.
- 4.8.2 For final rinsing of the vessel utilize water with less than 50 ppm chlorine.
- 4.8.3 Cleaning procedures shall address as a minimum:
 - 4.8.3.1 Method(s) to be used
 - 4.8.3.2 Equipment type
 - 4.8.3.3 Cleaning media with chloride content documentation
 - 4.8.3.4 Cleaning operation (sequence of operation)
 - 4.8.3.5 Temperature of cleaning media if applicable
 - 4.8.3.6 Cleaning media removal (flushes/rinses)
 - 4.8.3.7 Drying (method and what used)
 - 4.8.3.8 Inspections
 - 4.8.3.9 Acceptance criteria
- 4.8.4 Submit cleaning procedures.
- 4.8.5 Clean all supplied items per accepted procedure.
- 4.8.6 Submit cleaning verification report.

5.0 QUALITY ASSURANCE REQUIREMENTS

5.1 GENERAL QUALITY REQUIREMENTS

- 5.1.1 The BUYER reserves the right to review aspects of the design, fabrication, inspection, examination, and testing of the equipment to the extent necessary to ensure compliance to this specification and code requirements.
- 5.1.2 Review includes the right to access the SELLER's facilities, including sub-tier subcontractors, for review, audit, surveillance, and witnessing of fabrication, inspection, examination, and testing activities.
- 5.1.3 Technical and quality changes to the subcontract are only valid and executable in written form as defined in the subcontract documents, including this specification.
- 5.1.4 The SELLER's work processes shall provide for the identification, control, and reporting of suspect/counterfeit parts (S/CI) to ensure that items supplied to BUYER are free of S/CIs.
- 5.1.5 The SELLER shall have a Quality Assurance Program (QAP) that meets the requirements in ASME NQA-1, Quality Assurance Requirements for Nuclear Facility Applications, and DOE O 414.1D, Quality Assurance that are passed down via Statements of Work. The quality assurance program used by the SELLER shall be approved by the BUYER.

5.2 SELLER QUALITY ASSURANCE PROGRAM REQUIREMENTS

- 5.2.1 QA Program
 - 5.2.1.1 A documented quality assurance program shall be planned, implemented, and maintained. The program shall identify the activities and items to which it applies. The program shall provide control over activities affecting quality to an extent consistent with their importance. The program shall include monitoring activities against acceptance criteria in a manner sufficient to provide assurance that the activities affecting quality are performed satisfactorily. The program shall be established at the earliest time consistent with the schedule for accomplishing the activities.
 - 5.2.1.2 The program shall provide for the planning and accomplishment of activities affecting quality under suitably controlled conditions. Controlled conditions include the use of appropriate equipment, suitable environmental conditions for completing the activity, and assurance that prerequisites for the given activity have been satisfied. The program shall provide for any special controls, processes, test equipment, tools, and skills to attain the required quality of activities and items and for verification of that quality. The organization shall establish and implement processes to detect and correct quality problems.

- 5.2.1.3 The program shall provide for indoctrination, training, and qualification as necessary of personnel performing or managing activities affecting quality to ensure that suitable proficiency is achieved and maintained.
- 5.2.1.4 Management shall regularly assess the adequacy and effective implementation of the quality assurance program.
- 5.2.2 Design control
 - 5.2.2.1 The design shall be defined, controlled, and verified. Design inputs shall be specified on a timely basis and translated into design documents. Design interfaces shall be identified and controlled. Design adequacy shall be verified by individuals other than those who designed the item or computer program. Design changes shall be governed by control measures commensurate with those applied to the original design.
- 5.2.3 Document control
 - 5.2.3.1 The preparation, issue and change of documents that specify quality requirements or prescribe activities affecting quality shall be controlled to ensure that correct documents are being employed. Such documents, including changes thereto, shall be reviewed for adequacy and approved for release by authorized personnel.
- 5.2.4 Control of Purchased Items and Services
 - 5.2.4.1 The procurement of items and services shall be controlled to assure conformance with specified requirements. Such control shall provide for the following as appropriate: source evaluation and selection, evaluation of objective evidence of quality furnished by the SELLER, source inspection, audit and examination of the items or services upon delivery or completion.
- 5.2.5 Identification and Control of Items
 - 5.2.5.1 Controls shall be established to assure that only correct and acceptable items are used or installed. Identification shall be maintained on the items or in documents traceable to the items, or in a manner which assures that identification is established and maintained.
- 5.2.6 Control of Special Processes
 - 5.2.6.1 Processes affecting quality of items or services shall be controlled. Special process that control or verify quality, such as those used in welding, heat treating, and nondestructive examination, shall be performed by qualified personnel using qualified procedures in accordance with specified requirements
- 5.2.7 Inspection
 - 5.2.7.1 Inspections required verifying conformance of an item or activity to specified requirements shall be planned and executed. Characteristics

to be inspected and inspection methods to be employed shall be specified. Inspection results shall be documented. Inspection for acceptance shall be performed by persons other than those who performed or directly supervised the work being inspected.

5.2.8 Test control

5.2.8.1 Tests required to verify conformance of an item to specified requirements and to demonstrate that items will perform satisfactorily in service shall be planned and executed. Characteristics to be tested and test methods to be employed shall be specified. Test results shall be documented and their conformance with acceptance criteria shall be evaluated. Tests required to collect data, such as for siting or design input, shall be planned, executed, documented, and evaluated. Computer program test procedures shall provide for demonstrating the adherence of the computer program to documented requirements. The procedures shall also provide for evaluating technical adequacy through comparison of test results from alternative methods such as hand calculations, calculations using comparable proven programs, or empirical data and information from technical literature.

5.2.9 Control of Measuring & Testing Equipment

5.2.9.1 Tools, gauges, instruments and other measuring and test equipment used for activities affecting quality shall be controlled and at specified periods calibrated and adjusted to maintain accuracy within necessary limits.

5.2.10 Control of Nonconforming Items

5.2.10.1 Items that do not conform to specified requirements shall be controlled to prevent inadvertent installation or use. Controls shall provide for identification, documentation, evaluation, segregation when practical, and disposition of nonconforming items, and for notification to affected organizations.

5.2.11 Quality Assurance Records

5.2.11.1 The control of quality assurance records shall be established consistently with the schedule for accomplishing work activities. Quality assurance records shall furnish documentary evidence that items or activities meet specified quality requirements. Quality assurance records shall be identified, generated, authenticated, and maintained, and their final disposition specified. Record control requirements and responsibilities for these activities shall be documented.

5.2.12 Handling, Storage, and Shipping

5.2.12.1 Handling, storage, cleaning, packaging, shipping, and preservation of items shall be controlled to prevent damage or loss and to minimize deterioration. These activities shall be conducted in accordance with

established work and inspection instructions, drawings, specifications, shipment instructions, or other pertinent documents or procedures specified for use in conducting the activity.

5.3 ASME BPVC SECTION VIII

- 5.3.1 The SELLER shall be audited, approved, and certified by ASME BPVC certification board including mandatory Appendix 10, i.e., possess a quality system certificate (Material, Manufacturer, Material, relief device calibration, etc.). The sub-tier subcontractors (if not the SELLER) shall as a minimum, document and maintain a quality system including an identification and verification program per applicable ASME BPVC Section VIII requirements, including mandatory Appendix 10.
- 5.3.2 These systems shall be used during the performance of the subcontract and shall be subject to audit and approval by BUYER or its representatives as warranted.

5.4 SUBCONTRACTORS

- 5.4.1 When subcontracting any portion of this subcontract or when procuring structures, systems, components, items and materials, the SELLER is required to flow down the applicable technical and QA program requirements to sub-tier Subcontractors. The BUYER reserves the right, at any time, to verify that the applicable technical and QA requirements have been correctly selected and imposed on SELLER's sub- tier SELLERs. Access to lower tier sub-SELLER facilities will be requested through the SELLER prior to access and may be performed jointly.
- 5.4.2 The flow down of requirements encompasses verification that the sub-tier SELLER has been appropriately qualified for performance of activities complying with this procurement.
- 5.4.3 The SELLER shall maintain objective evidence of the flow down of requirements to sub-tier SELLERs, subsequent successful implementation of requirements, and provide such evidence to BUYER upon request.
- 5.4.4 The SELLER is furthermore responsible to flow down all commercial Terms and Conditions, including articles incorporated by reference, to all sub-tier SELLERs.

5.5 QUALITY INSPECTION PLAN

- 5.5.1 Develop a Quality Inspection Plan (QIP) document that details the scheduled fabrication, assembly, installation, inspections examinations, and tests required by the Purchase Order, Codes and Standards, and the requirements of this Specification.
- 5.5.2 Include any inspections/examinations/tests not specifically defined by Purchase Order, Codes and Standards or this Specification to demonstrate conformance to the requirements for the activity.

- 5.5.3 State specific acceptance criteria and limits for each inspection/examination/test.
- 5.5.4 The QIP attributes shall be established sequentially to follow the fabrication process.
- 5.5.5 Include all HOLD POINTs established in the SELLER Surveillance Plan provided by the purchaser.
- 5.5.6 Reference SELLER implementing procedures and forms to be utilized in association with each inspection/examination/test.
- 5.5.7 Submit the Quality Inspection Plan to BUYER for acceptance 4 weeks prior to the start of fabrication.

5.6 QUALITY CONTROL INSPECTION REPORT

- 5.6.1 Submit a final Quality Control Inspection Report after completion of all inspection activities including:
 - 5.6.1.1 Confirmation that all inspection and related activities identified in the plan have been completed.
 - 5.6.1.2 Cross reference the activities in the plan to the individual inspection, examination, and testing records.

5.7 INSPECTION AND TEST PLAN

- 5.7.1 The SELLER shall:
 - 5.7.1.1 Submit an inspection and test plan as required by this subcontract for BUYER acceptance. The plan shall detail the scheduled fabrication, assembly, installation, inspection, examination, and test processes as applicable to be performed and schedule for completion and delivery of items. The plan shall be submitted prior to initiation of any manufacturing, inspection, or test activity, for incorporation of BUYER reviews and approvals, source inspection, witness and HOLD POINTs as applicable.
 - 5.7.1.2 Submit a Final Quality Control Inspection Report after completion of all inspection activities including:
 - 5.7.1.3 Confirmation that all inspections and related activities identified in the plan have been completed.
 - 5.7.1.4 Cross reference the activities in the plan to the individual inspection, examination, and testing records.
- 5.7.2 SELLER Records
 - 5.7.2.1 Retain documents and other records generated in association with this specification during the specification, to include but not limited to:
 - A. SELLER documents, including this specification.
 - B. Engineering and Quality documentation submittals.

- C. Any document generated for this subcontract (e.g., procedures, reports, certifications, qualifications, letters, etc.) not required as a submittal (e.g., “in-process” quality assurance records).
- 5.7.2.2 The records shall be accessible to BUYER, upon request, during the subcontract and the retention period.
- 5.7.2.3 Records pertaining to this specification shall be retained by the SELLER for not less than ten years after completion.
 - A. Make retained records available to BUYER upon request within 45 days during the retention period.
 - B. Dispose of retained records after the retention period in accordance with SELLER’s records management program.
 - C. BUYER shall be notified no less than 90 days prior to the end of the retention period.

5.8 PERSONNEL QUALIFICATIONS/CERTIFICATION

- 5.8.1 Personnel performing activities affecting quality shall be qualified or certified in accordance with the BUYER accepted SELLER's Quality Assurance Program.
- 5.8.2 NDE personnel involved in visual, radiographic, and dye penetrant examination shall be qualified and certified in accordance with ASNT, SNT-TC-1A, Level II minimum. The SELLER shall submit NDE personnel certification for all applicable NDE methods for BUYER review and approval prior to implementation. Certification records shall include, as applicable:
 - 5.8.2.1 SELLER NDE qualification and certification
 - 5.8.2.2 Qualifications of certifying authority
 - 5.8.2.3 Identification of certified personnel
 - 5.8.2.4 Basis of certified personnel qualification
 - 5.8.2.5 NDE method and certification Level
 - 5.8.2.6 Initial certification and certification expiration dates
 - 5.8.2.7 Current and valid annual visual acuity examination, to include color perception.
- 5.8.3 All visual welding inspectors shall be certified in accordance with the applicable ASME Code and to their company’s visual welding inspection procedure and shall maintain a current and valid visual acuity examination.
- 5.8.4 Welders shall be qualified in accordance with the applicable requirements of ASME specifications as required by the subcontract. The SELLER shall submit to BUYER for acceptance copies of Welder Performance Qualification Test Records (PQTR) that will be employed in the performance of welding.
- 5.8.5 Changes and revisions to welding documentation must be resubmitted to BUYER for acceptance prior to use.

- 5.8.6 Hydrostatic test, Inspection, and Performance and Functional test personnel shall be qualified in accordance with the applicable code and with SELLER's Quality Assurance Program.
- 5.8.7 Submit the following personnel qualification or certification records prior to the start of fabrication and re-submit as necessary (e.g., eye certs for inspectors, certs with expiration dates, etc.):
 - 5.8.7.1 Hydrostatic Test Personnel Qualifications
 - 5.8.7.2 Performance and Functional Test Personnel Qualifications/Certifications
 - 5.8.7.3 Inspection and Examination Personnel Qualifications

6.0 INSPECTIONS AND HOLD POINTS

6.1 HOLD POINTS

- 6.1.1 HOLD POINT indicates inspection activity beyond which work shall not proceed until an inspector and/or BUYER is notified and 1) the inspection is performed and released, or 2) the inspection is deferred and can be completed at a later time, or 3) a written waiver is issued by the organization who established the HOLD POINT.
- 6.1.2 BUYER and designated representatives reserve the right to access the SELLER's facility, including any lower tier Subcontractor facility, to verify the quality and progress of work, and to perform source inspections, surveillances, and audits at any stage of the work.
- 6.1.3 All items are subject to source inspection at the SELLER's or sub-tier SELLER's facility. The SELLER maintains responsibility for source inspection of Subcontractors. The SELLER shall notify BUYER at least 15 working days in advance of the time items will reach any HOLD POINTS.
- 6.1.4 Examinations and inspections shall be performed and documented in accordance with accepted procedures.
- 6.1.5 Examinations refer to the quality control verification activities described as examinations in applicable codes. All documentation shall be reviewed by the BUYER and/or designated representatives.

6.2 INSPECTIONS AND EXAMINATIONS

- 6.2.1 Interim dimensional verification during fabrication [HOLD POINT]:
 - 6.2.1.1 During fabrication, the BUYER shall verify the dimensional record data.
 - 6.2.1.2 Submit an interim dimensional record report during fabrication.
- 6.2.2 Assembly dimensional inspection [HOLD POINT]:
 - 6.2.2.1 Submit dimensional inspection procedure that ensures that accessible dimensions are in accordance with the approved fabrication and assembly drawings and dimensional record drawing.
 - 6.2.2.2 BUYER provides secondary verification of the dimensional record drawing.
 - 6.2.2.3 SELLER shop completes inspection of the dimensional record drawing.
 - 6.2.2.4 Independent shop completes inspection of the dimensional record drawing.
 - 6.2.2.5 Submit the updated dimensional record drawing.
- 6.2.3 ASME visual examination:

- 6.2.3.1 Submit Visual Testing (VT) examination procedure that is in accordance with ASME BPVC, Section V.
- 6.2.3.2 Submit Visual Examination Reports.
- 6.2.4 Radiographic Examinations:
 - 6.2.4.1 Submit Radiographic Testing (RT) examination procedure that is in accordance with ASME BPVC Section V.
 - 6.2.4.2 Perform RT examination of welded joints required by BPVC Section VIII, Division 1, UW-3 designation.
 - 6.2.4.3 Acceptance criteria in accordance with the ASME BPVC, Section VIII, Division 1, UW-51.
 - 6.2.4.4 Submit RT Examination Report.
- 6.2.5 Liquid Penetrant Examinations:
 - 6.2.5.1 Submit Liquid Penetrant Testing (PT) examination procedure in accordance with ASME BPVC, Section V.
 - 6.2.5.2 Examine welds that are not included in Radiographic Examination section by PT method.
 - 6.2.5.3 Acceptance criteria in accordance with ASME BPVC, Section VIII, Division 1, Appendix 8.
 - 6.2.5.4 Submit PT Examination Report.
- 6.2.6 Ultrasonic Examinations:
 - 6.2.6.1 Ultrasonic Testing (UT) examination shall be used when RT is not feasible.
 - 6.2.6.2 Ultrasonic examination and evaluation shall be in accordance with ASME Section VIII.
 - 6.2.6.3 Prior to use, submit the Ultrasonic Examination Procedures.
 - 6.2.6.4 Submit Ultrasonic Examination (UT) and Verification Reports.

6.3 SELLER TESTING REQUIREMENTS

- 6.3.1 Balance, Load, and Fit-Up [HOLD POINT]:
 - 6.3.1.1 Perform Balance, Load, and Fit-up Test of the PWST vessel.
 - 6.3.1.2 After the Balance, Load, and Fit-up Test, perform NDE inspections to determine if any deformation or stress cracking has occurred at the lifting lugs and at the lifting lugs attachments or reinforcements to the vessel.
 - A. Visually examine 100% of the lifting lug welded attachments/reinforcements to the vessel.
 - B. Perform 100% PT examination of the lifting lug welds.

- 6.3.1.3 Submit Balance, Load, and Fit-up Test Report.
- 6.3.2 Lifting Lug Proof Testing [HOLD POINT]:
 - 6.3.2.1 Submit Lifting Lug Proof Test Procedure, including the following as a minimum:
 - A. Compliance with ASME B30.26, ASME B30.20 and DOE-STD-1090, Hoisting and Rigging.
 - B. Lifting lug proof test shall be performed at 200 tons (approximately 2x the dead weight, TBV).
 - C. After each lifting lug proof test, perform NDE inspections to determine if any deformation or stress cracking has occurred at the lifting lugs and at the lifting lugs attachments or reinforcements to the vessel.
 - D. Perform 100% PT examination of the lifting lug welds.
 - E. Visually examine 100% of the lifting lug welded attachments/reinforcements to the vessel.
 - 6.3.2.2 Submit Lifting Lug Proof Test Report.
- 6.3.3 Hydrostatic Testing [HOLD POINT]:
 - 6.3.3.1 Perform hydrostatic testing in accordance with applicable ASME BPVC requirements.
 - 6.3.3.2 Test water shall have less than 250 ppm chlorides and final rinse shall have less than 50 ppm chloride.
 - 6.3.3.3 Submit Hydrostatic Test Procedures.
 - 6.3.3.4 Submit Hydrostatic Test Reports.

7.0 SUBMITTALS

7.1 DOCUMENT SUBMITTALS

Unless otherwise specified, SELLER's submittals shall be per the following subsections. All electronic submittals shall be in a suitable format per TFC-BSM-IRM-DC-C-02 and in compliance with TFC-BSM-IRMDC-C-07.

Required document submittals are identified and listed on the procurement Master Submittal Register (MSR). The MSR identifies the minimum submittals required by this Specification and identifies when the submittals are required to be submitted in the procurement process. The MSR included with the purchase order will constitute the governing MSR.

All deliverable documentation shall be complete, accurate, legible, and reproducible. Before delivery, design media and documents shall be reviewed by personnel for technical adequacy and appropriate content in accordance with the SELLER's Quality Assurance Program/Procedures of the SELLER. The SELLER shall attest, in writing, to the accuracy and completeness of the information contained in the final deliverables.

Deliverables shall be subject to approval by the BUYER's Technical Representative or the BUYER. Deliverables shall comply with this Specification and technical basis documents and other requirements identified herein.

Submittals shall be provided in electronic format unless available only as a hard copy. Electronic submittals may be sent to LAWPSVENDOR@rl.gov or delivered via a H2C designated File Transfer Protocol site. Electronic formats must be non-password protected in one of the following formats:

- Microsoft® Office Compatible
- Portable Document Format (PDF)
- Tagged Image File Format (TIFF)
- Graphics Interchange Format (GIF)
- Joint Photographic Experts Group (JPEG)
- Windows Media Video (WMV)
- Standard for the Exchange of Product Model Data (STEP)
- Moving Picture Expert Group (MPEG)
- Extensible Markup Language (XML)
- HyperText Markup Language (HTML)
- Comma Separated Values (CSV)
- Text (TXT)
- Initial Graphics Exchange Specification (IGES)
- AutoCAD Drawing (DWG)

7.2 LIST OF SUBMITTALS

- 7.2.1 Engineering documents
 - 7.2.1.1 ASME pressure vessel design calculation
 - 7.2.1.2 Shop detail drawings and assembly drawings
 - 7.2.1.3 Seismic qualification analysis method
 - 7.2.1.4 Load combination method
 - 7.2.1.5 Stress report

- 7.2.1.6 Lifting lug calculation
- 7.2.1.7 Corrosion evaluation report
- 7.2.1.8 Weld filler material control procedure
- 7.2.1.9 Material control procedure
- 7.2.1.10 CMTRs and required verification reports
- 7.2.1.11 Current ISO/IEC 17025 accreditation certificate(s) for all qualified laboratories, including material manufacturers
- 7.2.1.12 Welding procedures specifications
- 7.2.1.13 Procedure qualification records
- 7.2.1.14 Weld repair procedure
- 7.2.1.15 Repair reports
- 7.2.1.16 Preliminary weld maps
- 7.2.1.17 Heat treatment procedures
- 7.2.1.18 Heat treatment reports
- 7.2.1.19 As-built drawings
- 7.2.1.20 Quality assurance program manual
- 7.2.1.21 Quality inspection plan
- 7.2.1.22 Inspection and test plan
- 7.2.1.23 Detailed activity schedule
- 7.2.1.24 Packaging, handling, shipping, and storage procedure
- 7.2.1.25 Lifting and installation procedure
- 7.2.1.26 Dimensional inspection procedure
- 7.2.1.27 Dimensional record drawing
- 7.2.1.28 Visual testing examination procedure
- 7.2.1.29 Radiographic testing examination procedure
- 7.2.1.30 Ultrasonic examination procedure
- 7.2.1.31 Balance, load, and fit-up procedure
- 7.2.1.32 Lifting lug proof test procedure
- 7.2.1.33 Hydrostatic test procedure
- 7.2.2 Quality verification documents:
 - 7.2.2.1 Method of qualification
 - 7.2.2.2 Repair verification report
 - 7.2.2.3 Weld map report

- 7.2.2.4 Final quality control inspection report
- 7.2.2.5 Visual examination report
- 7.2.2.6 Radiographic examination (RT) report
- 7.2.2.7 Liquid penetrant examination (PT) report
- 7.2.2.8 Balance, load, and fit-up test report
- 7.2.2.9 Lifting lug proof test report
- 7.2.2.10 Hydrostatic test report
- 7.2.3 All documents shall be revised to incorporate BUYER comments and resubmitted to BUYER for review and acceptance.
- 7.2.4 BUYER acceptance of engineering documents and quality verification documents does not relieve the SELLER of any part of their obligation to:
 - 7.2.4.1 Satisfy the requirements defined in this specification
 - 7.2.4.2 Ensure correctness of engineering documents
 - 7.2.4.3 Ensure adequacy and suitability of material and equipment represented

7.3 DETAILED ACTIVITY SCHEDULE

- 7.3.1 The schedule start date shall be based on the subcontract award date. The schedule shall include summary level activities and detailed activities. The summary level activities shall vertically integrate with the detailed activities. The detailed activities shall have enough detail to status and communicate weekly activities and progress. Develop a schedule to address as a minimum:
 - 7.3.1.1 Milestones identified in the subcontract
 - 7.3.1.2 Material procurement
 - 7.3.1.3 Design (including submittals)
 - 7.3.1.4 Fabrication (including submittals)
 - 7.3.1.5 Shop testing/inspection (including submittals)
 - 7.3.1.6 Preparation for shipment (including submittals)
 - 7.3.1.7 Delivery

7.4 PROCEDURES

- 7.4.1 Prepare in accordance with referenced National Codes and Standards and specification requirements defined for each type of examination. Develop procedures not covered by National Codes and Standards to demonstrate the requirements of this specification.
- 7.4.2 State specific acceptance criteria and limits for each criterion confirmed.
- 7.4.3 Provide an example of report and the content generated from each procedure.

7.5 REPORTS

- 7.5.1 Develop reports in accordance with accepted procedure and include the following, at a minimum:
 - 7.5.1.1 Sample report with explanation of report entries included in procedure
 - 7.5.1.2 Type of activity performed.
 - 7.5.1.3 Subcontract number.
 - 7.5.1.4 Specification number and applicable section.
 - 7.5.1.5 Component number.
 - 7.5.1.6 Record identification number and calibration expiration dates of M&TE used.
 - 7.5.1.7 Initials and date of personnel performing the activity.
 - 7.5.1.8 Signature and date of inspector determining the validity and acceptability of the reported data.

7.6 PACKAGING, HANDLING, SHIPPING, AND STORAGE REQUIREMENTS

Due to its size, transportation of the PWST vessel to the Hanford site is expected to require barge shipment and road routes without overhead obstructions. The underground concrete vault into which the PWST vessel is placed is planned to be constructed to prior to transportation and delivery of the PWST vessel.

- 7.6.1 Submit a Packaging, Handling, Shipping, and Storage Procedure
 - 7.6.1.1 The PWST vessel shall be shipped assembled as shown in H-14-113516 (Table 2.2). Include shipping procedure and details of support drawings.
 - 7.6.1.2 Any loose components shall be packaged to prevent damage during shipment.
- 7.6.2 Handling
 - 7.6.2.1 Detailed handling instructions, including lifting instructions, shall be included in the Packaging, Handling, Shipping, and Storage Procedure.
 - 7.6.2.2 Procedure shall include handling instructions for the PWST vessel without process fluid filled.
- 7.6.3 Shipping
 - 7.6.3.1 A detailed packing list for each shipment shall be provided.
 - A. The packing list shall identify every item in the shipment.
 - B. The list shall contain the following:
 - 1. SELLER and model/tag number, as applicable
 - 2. Material type, as applicable

3. Drawing reference
 4. Weight
 5. Quantity
- 7.6.3.2 Submit a lift and tie-down procedure for fasten all items to the carrier vehicle for transport to BUYER. The procedure is to be accepted by BUYER.
- 7.6.3.3 Boxed or crated components shall be blocked and securely fastened on the carrier vehicle to prevent shifting, crushing, or bumping during transport.
- 7.6.3.4 Quality verification documents shall be packaged and included with the final shipment.
- 7.6.3.5 Do not ship equipment without release for shipment signed by BUYER and signed by SELLER.
- 7.6.4 Storage
- 7.6.4.1 Protect from airborne contamination (e.g., rain, snow, dust, dirt, salt spray, and fumes detrimental to the item).
- 7.6.4.2 Include penetration covers suitable for 5 years storage.
- 7.6.4.3 Include protective covers for studs and dowels.

7.7 MARKING AND IDENTIFICATION

- 7.7.1 Provide a name plate for the PWST vessel in accordance with TFC-PLN-05, Conduct of Operations Implementation Plan; TFC-ENG-STD-12, Tank Farm Equipment Identification Numbering and Labeling Standard; and applicable drawings. The nameplate shall be 11 GA. carbon-steel using minimum 1” high lettering and attached by tack welding. Perform dye penetrant test of the tack weld.
- 7.7.2 Integrity assessment of the PWST vessel inside the concrete vault are planned to be performed using remote tank crawlers. The inspection path of the tank crawlers shall be painted with high visibility color as shown in H-14-113516 (Table 2.2).
- 7.7.3 Before pressure testing, seal weld data plate to the equipment in a location visible by a camera mounted above the vessel taking into account further assembly and installation.
- 7.7.4 Data plates to be attached in a manner that do not:
- 7.7.4.1 Prevent nor inhibit required tests and inspections,
 - 7.7.4.2 Impair the integrity of the equipment.

7.8 REQUEST FOR INFORMATION

Any changes shall be submitted per the RFI process requirements detailed in TFC-BSM-IRM-DC-C-07.

8.0 REFERENCES

- 10 CFR 830, Nuclear Safety Management, Code of Federal Regulations, as amended, Washington, D.C.
- 29 CFR 1910, Occupational Safety and Health Standards, Code of Federal Regulations, as amended.
- 29 CFR 1926, Safety and Health Regulations for Construction, Code of Federal Regulations, as amended, Washington, D.C.
- 40 CFR 264, Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, Code of Federal Regulations, as amended, Washington, D.C.
- 40 CFR 265, Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, Code of Federal Regulations, as amended, Washington, D.C.
- 40 CFR 268, Land Disposal Restrictions, Code of Federal Regulations, as amended, Washington, D.C.
- 49 CFR 173, Shippers - General Requirements for Shipments and Packagings, Code of Federal Regulations, as amended, Washington, D.C.
- API-650, 2020, Welded Tanks for Oil Storage, American Petroleum Institute, Washington, D.C.
- ASCE 4-16, 2016, Seismic Analysis of Safety-Related Nuclear Structures, American Society of Civil Engineers, Reston, Virginia.
- ASCE 7-16, 2017, Minimum Design Loads and Associated Criteria for Buildings and Other Structures, American Society of Civil Engineers, Reston, Virginia.
- ASCE 7-22, 2022, Minimum Design Loads and Associated Criteria for Buildings and Other Structures, American Society of Civil Engineers, Reston, Virginia.
- ASME B&PVC, Section II, 2025, Boiler and Pressure Vessel Code (B&PVC) – Materials, American Society of Mechanical Engineers, New York, New York.
- ASME B&PVC, Section IX, 2025, Boiler and Pressure Vessel Code (B&PVC) – Welding Brazing, and Fusing Qualifications, American Society of Mechanical Engineers, New York, New York.
- ASME B&PVC, Section V, 2025, Boiler and Pressure Vessel Code (B&PVC) – Nondestructive Examination, American Society of Mechanical Engineers, New York, New York.

ASME B&PVC Section VIII, Division 1, 2025, Boiler and Pressure Vessel Code (B&PVC) – Rules for Construction of Pressure Vessels Division 1, American Society of Mechanical Engineers, New York, New York.

ASME B16.25, 2022, Buttwelding Ends, American Society of Mechanical Engineers, New York, New York.

ASME B16.5, 2025, Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24, American Society of Mechanical Engineers, New York, New York.

ASME B30.20, 2025, Below-the-Hook Lifting Devices, American Society of Mechanical Engineers, New York, New York.

ASME B30.26, 2021, Rigging Hardware, American Society of Mechanical Engineers, New York, New York.

ASME B46.1, 2019, Surface Texture (Surface Roughness, Waviness, and Lay), American Society of Mechanical Engineers, New York, New York.

ASME NQA-1, 2024, Quality Assurance Requirements for Nuclear Facility Applications, American Society of Mechanical Engineers, New York, New York.

ASME SA-105/105M, 2024, Specification for Carbon Steel Forgings for Piping Applications, American Society of Mechanical Engineers, New York, New York.

ASME SA-106/106M, 2019, Specification for Seamless Carbon Steel Pipe for High-Temperature Service, American Society of Mechanical Engineers, New York, New York.

ASME SA-516/516M, 2025, Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service, American Society of Mechanical Engineers, New York, New York.

ASME Y14.5, 2018, Dimensioning and Tolerancing, American Society of Mechanical Engineers, New York, New York.

ASNT SNT-TC-1A, 2024, Personnel Qualifications and Certification in Nondestructive Testing, American Society for Nondestructive Testing, Columbus, Ohio.

ASTM A36, 2019, Standard Specification for Carbon Structural Steel, West Conshohocken, Pennsylvania.

AWS A2.4, 2020, Standard Symbols for Welding, Brazing and Nondestructive Examination, American Welding Society, Doral, Florida.

AWS D1.1, 2025, Structural Welding Code – Steel, American Welding Society, Doral, Florida.

AWS QC-1, 2016, Standard for AWS Certification of Welding Inspectors, American Welding Society, Doral, Florida.

DOE G 414.1-3, 2004, Suspect/Counterfeit Items Guide, U.S. Department of Energy, Washington, D.C.

DOE O 414.1D Chg 1, 2020, Quality Assurance Order, U.S. Department of Energy, Washington, D.C.

DOE/RL-92-36, 2024, Hanford Site Hoisting and Rigging Manual, Rev 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-STD-1020, 2016, Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities, Washington, D.C.

DOE-STD-1027 Chg 1, 2018, Hazard Categorization of DOE Facilities, Washington, D.C.

DOE-STD-1090, 2020, Hoisting and Rigging, U.S. Department of Energy, Washington, D.C.

DOE-STD-1189, 2016, Integration of Safety into the Design Process, U.S. Department of Energy, Washington, D.C.

H-14-113515-1, SY PWST System Layout, General Notes, Rev C, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

H-14-113515-2, SY PWST System Layout, General Arrangement, Rev C, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

H-14-113515-3, SY PWST System Layout, Plan View, Rev C, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

H-14-113515-4, SY PWST System Layout, Elevation and Sections, Rev C, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

H-14-113515-5, SY PWST System Layout, Elevation and Sections, Rev C, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

H-14-113516-1, SY PWST Vessel, General Notes, Rev C, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

H-14-113516-2, SY PWST Vessel, General Arrangement, Rev B, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

H-14-113516-3, SY PWST Vessel, Sections and Details, Rev B, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

- H-14-113516-4, SY PWST Vessel, Saddle Details, Rev B, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.
- H-14-113517-1, SY PWST Riser Assemblies, Notes and Parts List, Rev B, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.
- H-14-113517-2, SY PWST Riser Assemblies, 48 In Riser Ass'y, Rev B, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.
- H-14-113517-3, SY PWST Riser Assemblies, 48 In Riser Ass'y, Rev B, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.
- H-14-113517-4, SY PWST Riser Assemblies, 24 In Riser Ass'y, Rev B, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.
- H-14-113517-5, SY PWST Riser Assemblies, 24 In Std Riser Ass'y, Rev B, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.
- H-14-113517-6, SY PWST Riser Assemblies, 12 In Riser Ass'y, Rev B, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.
- ISO/IEC 17025, 2017, General Requirements for the Competence of Testing and Calibration Laboratories, International Organization for Standardization, Geneva, Switzerland.
- OSD-T-151-00007, Operating Specifications for the Double-Shell Storage Tanks, Rev 33, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.
- RPP-8360, Lifting Attachment and Lifted Item Evaluation, Rev 7, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.
- RPP-CALC-67147, PWST Vessel and Structural Calculation, Rev B, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.
- RPP-RPT-64319, Preliminary 200 West Area Flowsheet, Rev 2A, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.
- RPP-RPT-65822, Pretreated Waste Storage Tank (PWST) Design Study, Rev B, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.
- RPP-SPEC-65289, Level 2 Project Specification for West Area Risk Management Project OP192, Rev 4, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.
- TFC-BSM-IRM-DC-C-02, Records Management, Rev F-36, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

TFC-BSM-IRM-DC-C-07, Vendor Processes, Rev A-21, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

TFC-ENG-DESIGN-C-10, Engineering Calculations, Rev B-20, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

TFC-ENG-DESIGN-C-25, Technical Document Control Standard, Rev G-13, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

TFC-ENG-DESIGN-C-57, Development and Maintenance of Code of Record Standard, Rev C-3, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

TFC-ENG-FAC SUP-C-25, Hoisting, Rigging, and Load Handling, and Transport, Rev E-10, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

TFC-ENG-STD-02, Environmental and Climatological Design Basis Requirements for Systems, Structures, and Components, Rev B-3, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

TFC-ENG-STD-06, Design Loads for Tank Farm Facilities, Rev F-2, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

TFC-ENG-STD-10, Drawing Standard, Rev A-22, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

TFC-ENG-STD-12, Tank Farm Equipment Identification Numbering and Labeling Standard, Rev E-7, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

TFC-ENG-STD-22, Piping, Jumpers, and Valves Standard, Rev G-8, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

TFC-ENG-STD-25, Transfer Pumps Standard, Rev D-9, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

TFC-ENG-STD-45, Design and Installations for Potentially Flammable Atmospheres Standard, Rev B-10, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

TFC-ENG-STD-51, Vendor Calculation Standard, Rev B-0, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

TFC-ENG-STD-52, Subcontractor Welding Standard, Rev B-2, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

TFC-ENG-STD-55, Cleanness Classification and Cleaning Control Standard, Rev A-1, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

TFC-PLN-05, Conduct of Operations Implementation Plan, Rev G-4, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

TFC-PLN-49, Criticality Safety Program Management Plan, Rev H-3, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

WAC 173-303, 2023, Dangerous Waste Regulations, Washington State Department of Ecology, Lacey, Washington.

WAC 173-360A, 2023, Underground Tank Storage Regulations, Washington State Department of Ecology, Lacey, Washington.

WRC Bulletin 107, 2024, Local Stresses in Spherical and Cylindrical Shells, Welding Research Council, New York, New York.

WRC Bulletin 297, 2024, Local Stresses in Cylindrical Shells due to External Loadings on Nozzles, Welding Research Council, New York, New York.

9.0 ATTACHMENTS

The following attachments are included in this specification:

- A. Engineering Document Requirements
- B. Quality Verification Document Requirements
- C. Supplier Quality Assurance Program Requirements
- D. Forces and Moments on the Penetrations/Nozzles

Requirements that are specified in Sections 3, 4, 5, 6, and 7 are summarized and listed in Attachments A, B, and C. Attachment D provides minimum penetration/nozzle loading to be utilized in the PWST vessel design. The details of these attachments will be populated during final design stage.

ATTACHMENT A

ENGINEERING DOCUMENT REQUIREMENTS

TBD

To be provided during final design stage

ATTACHMENT B

QUALITY VERIFICATION DOCUMENT REQUIREMENTS

TBD

To be provided during final design stage

ATTACHMENT C

SUPPLIER QUALITY ASSURANCE PROGRAM REQUIREMENTS

TBD

To be provided during final design stage

ATTACHMENT D

FORCES AND MOMENTS ON THE PENETRATION/NOZZLES

TBD

To be provided during final design stage