



RIVER PROTECTION PROJECT – WASTE TREATMENT PLANT

ENGINEERING SPECIFICATION

FOR

LAW Melter Offgas Caustic Scrubber

Content applicable to ALARA?

Yes No

ADR No.

24590-LAW-ADR-M-03-003

Rev

3

Specification changes retroactive?

Yes No

N/A (alpha revision or revision 0)

Quality Level

Q

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

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SPECIFICATION No. 24590-LAW-3PS-MKAS-T0001						Rev 2

Revision History

Revision	Reason for Revision
0	Issued for Purchase
1	Revised section 1.4.2, revised section 3.8.3, deleted any reference to anchor chair, deleted any reference to skirts, deleted any reference to davits, added tailing lug standard detail, added fatigue analysis standard specifications, revised section 3.7.2 deleted all other sections of 3.7.
2	Incorporated previously-issued change documents including 24590-LAW-3PN-MKAS-00002 and 24590-QL-MRA-00003-T0007 - no rev bars shown. Used latest specification template - no rev bars shown for items arranged into new format. The following changes/additions indicated by rev bar and bold font. Revised section 1.3.4 to refer to MDS for insulation. Section 1.4 definitions - deleted unused acronyms/definitions; added EQD. Deleted redundant information in section 1.4.3, covered by section 1.5. Referred to EQD in sections 1.5, 3.2.11, and 3.5 - EQD was incorporated into PO via previous change documents, but appropriate references were not made throughout spec. Clarified vessel mounting and support terminology in 3.2.6 and 3.2.12. Section 3.2.9 - refer to MDS for corrosion allowance. Section 3.4.12 revised scrubber mounting information. Renamed Attachment "A" (was Attachment 1 in spec Rev 1).

Notice

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

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Attachments

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1 Scope

1.1 Project Description and Location

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

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

1.2 Equipment, Material, and Services Required

This specification establishes the minimum requirements for the performance, design, analysis, materials, fabrication, testing, inspection, quality assurance, qualification, documentation, and preparation for shipment of the LAW Melters Offgas Caustic Scrubber, plant item number 24590-LAW-MK-LVP-SCB-00001, for use in the WTP Low-Activity Waste (LAW) Facility.

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

- 1.2.1 Provide design, materials, fabrication, testing, inspection, preparation for shipment, documentation, and submittals of a LAW Melters Offgas Caustic Scrubber, plant item number 24590-LAW-MK-LVP-SCB-00001 in accordance with this specification, its addenda and attachments, the material requisition (MR) # 24590-QL-MRA-MKAS-00003, referenced codes and standards, and Buyer documents.
- 1.2.2 Provide written (process, control, mechanical, hydraulic, and operation) guarantee that all equipment and components supplied by the Seller shall perform to the requirements of this specification, the MR # 24590-QL-MRA-MKAS-00003, referenced codes and standards, and Buyer documents.
- 1.2.3 **Provide Equipment Seismic Qualification.**

1.3 Work by Others

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

- 1.3.1 Shipping of the LAW Melters Offgas Caustic Scrubber.

- 1.3.2 Unloading, storage, and installation labor of all materials and equipment at the Buyer's jobsite.
- 1.3.3 Supply and installation of instrumentation and controls.
- 1.3.4 **Insulation** will be supplied and installed by the Buyer's Subcontractor, nevertheless, Seller shall include insulation in the seismic calculation. **See Reference 2.3.1, the Mechanical Datasheet (MDS), for insulation information.**
- 1.3.5 Buyer shall provide roof level access maintenance platform for top access manway needed to change out demister pads.
- 1.3.6 **The equipment environmental qualification (EEQ) will be performed by the Buyer per Section 3.5. The Seller is NOT required to perform any of the EEQ.**

1.4 Acronyms, Abbreviations, and Definitions

1.4.1 Acronyms and Abbreviations

ALARA	As Low As Reasonably Achievable
ASME	American Society of Mechanical Engineers
CFR	Code of Federal Regulations
CM	Commercial
DF	Decontamination Factor
DOE	US Department of Energy
EEQ	Equipment Environmental Qualification
EQD	Equipment Qualification Datasheet
ESQ	Equipment Seismic Qualification
FMEA	Failure Mode and Effects Analysis
LAW	Low-Activity Waste
LVP	LAW Secondary Offgas/Vessel Vent Process System
MDS	Mechanical Data Sheet
MIL-STD	Military Standard
MR	Material Requisition
MSDS	Material Safety Data Sheet
ORP	Office of River Protection
Q	Quality
QA	Quality Assurance
QAP	Quality Assurance Program
RLD	Radioactive Liquid Waste Disposal
SO _x	Sulfur Oxides
WG	Water Gauge
WTP	Hanford Tank Waste Treatment and Immobilization Plant

1.4.2 Quality Level

The quality level identifies the quality requirements to be applied to the equipment. The identified quality levels are Q and CM (Commercial). Quality level is specifically defined on the associated mechanical data sheets (MDS).

- 1.4.3 Deleted
- 1.4.4 Other definitions
 - 1.4.4.1 Deleted
 - 1.4.4.2 Decontamination Factor (DF): Equals the ratio of the concentration of a component in the inlet gas versus the concentration of the same component in the outlet gas.
 - 1.4.4.3 MDS: Refers to the mechanical data sheet for the LAW Melters Offgas Caustic Scrubber, Buyer document number 24590-LAW-MKD-LVP-00011.
 - 1.4.4.4 MR: Refers to the material requisition for the LAW Melters Offgas Caustic Scrubber, Buyer document number 24590-QL-MRA-MKAS-00003.
 - 1.4.4.5 Deleted
 - 1.4.4.6 Scrubber: Refers to the LAW Melters Offgas Caustic Scrubber, plant item number 24590-LAW-MK-LVP-SCB-00001.
 - 1.4.4.7 **EQD: Refers to the Equipment Qualification Datasheet (EQD) for the LAW Melters Offgas Caustic Scrubber, Reference 2.3.24.**

1.5 Safety/Quality Classifications

Refer to the MDS for the quality level and seismic category designations of the LAW Melters Offgas Caustic Scrubber, **and to the EQD for the safety classification.**

2 Applicable Documents

2.1 General

- 2.1.1 Work shall be done in accordance with the referenced codes, standards, and documents listed below, which are an integral part of this specification. Use of any other edition, revision, or issue requires approval from the Buyer
- 2.1.2 When specific chapters, sections, parts, or paragraphs are listed following a code, industry standard, or reference document, only those chapters, sections, parts, or paragraphs of the document are applicable and shall be applied. If a date or revision is not listed, the latest issue, including addenda, at the time of Request for Quote shall apply. When more than one code, standard, or referenced document covers the same topic, the requirements for all must be met with the most stringent governing.

2.2 Codes

- 2.2.1 ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, *Rules for Construction of Pressure Vessels*.
- 2.2.2 ASME-NQA-1-1989, *Quality Assurance Program Requirements for Nuclear Facilities*.
- 2.2.3 ASME-NQA-2-1989, *Quality Assurance Requirements for Nuclear Facility Applications*, Part 2.2, Section 3.
- 2.2.4 10 CFR 835, *Occupational Radiation Protection*.

2.3 Reference Documents/Drawings

- 2.3.1 24590-LAW-MKD-LVP-00011, Mechanical Data sheet for the LAW Melters Offgas Caustic Scrubber.
- 2.3.2 24590-WTP-3PS-G000-T0001, General Specification for Supplier Quality Assurance Program Requirements.
- 2.3.3 24590-WTP-3PS-G000-T0002, **Engineering** Specification for Positive Material Identification (PMI) for Shop Fabrication.
- 2.3.4 24590-WTP-3PS-G000-T0003, Engineering Specification for Packaging, Handling and Storage Requirements.
- 2.3.5 24590-WTP-3PS-MV00-T0001, Engineering Specification for Pressure Vessel Design and Fabrication.
- 2.3.6 24590-WTP-3PS-MV00-T0002, Engineering Specification for Seismic Qualification Criteria for Pressure Vessels.
- 2.3.7 24590-WTP-3PS-MV00-T0003, Engineering Specification for Pressure Vessel Fatigue Analysis
- 2.3.8 24590-WTP-3PS-FB01-T0001, Engineering Specification for Structural Design Loads for Seismic Category III & IV Equipment and Tanks.
- 2.3.9 24590-WTP-3PS-MVB2-T0001, Engineering Specification for Welding of Pressure Vessels, Heat Exchangers and Boilers.
- 2.3.10 24590-WTP-MV-M59T-00001, Pressure Vessel Tolerances Standard Details.
- 2.3.11 24590-WTP-MV-M59T-00007, Thermowell Connection Standard Details.
- 2.3.12 24590-WTP-MV-M59T-00009, Lifting Lugs Standard Details.
- 2.3.13 24590-WTP-MV-M59T-00010, Tailing Lug Standard Detail
- 2.3.14 24590-WTP-MV-M59T-00012, Grounding Lug Standard Details.

- 2.3.15 24590-WTP-MV-M59T-00016001, Vessel Connections Standard Details Sheet 1 of 3.
- 2.3.16 24590-WTP-MV-M59T-00016002, Vessel Connections Standard Details Sheet 2 of 3.
- 2.3.17 24590-WTP-MV-M59T-00016003, Vessel Connections Standard Details Sheet 3 of 3.
- 2.3.18 24590-WTP-MV-M59T-00017, Vessel Inspection Manway Standard Details.
- 2.3.19 24590-WTP-MV-M59T-00018, Vessel Name Plate Standard Details.
- 2.3.20 24590-WTP-MV-M59T-00026, Anchor Bolt Chair Detail for Vertical Vessels
- 2.3.21 24590-LAW-DB-S13T-00135, LAW Vitrification Building Main Building Partial Concrete Forming Plan Zone 5, ELEV + 48'-0"
- 2.3.22 24590-LAW-DD-S13T-00019, LAW Vitrification Building Main Building Special Embed Plates
- 2.3.23 24590-LAW-DDC-S13T-00047, Anchorage Design for LAW Off Gas Caustic Scrubber
- 2.3.24 **24590-LAW-MKQ-LVP-00001**, Equipment Qualification Datasheet for LAW Melters Offgas Caustic Scrubber
- 2.3.25 24590-WTP-3PS-G000-T0019, Engineering Specification for Acquisition of Commercial Items and Services for use in Safety Applications at WTP
- 2.3.26 **24590-WTP-3PS-G000-T0015, Engineering Specification for Environmental Qualification of Mechanical Equipment**

3 Design Requirements

3.1 Basic Function

The LAW Melters Offgas Caustic Scrubber treats the offgas by removing SO_x gases and provides final offgas cooling. The offgas stream enters the bottom of the Scrubber and flows upward through a quench spray, then through a packed bed. Contaminants in the offgas stream are absorbed into the liquid stream through interaction of the gas, liquid, and packing media. The scrubber liquid flows downward through the packing bed then drains into the Caustic Collection Tank, LVP-TK-00001. The clean offgas is then discharged through a high efficiency mist eliminator internal to the scrubber to prevent carryover. After the Caustic Scrubber, the offgas is released to the facility stack.

A sodium hydroxide solution is added periodically to the Caustic Collection Tank to improve removal of acid gases. Process Service Water is added to the Caustic Collection Tank to maintain a specific gravity in the scrubbing solution consistent with a maximum of 10% dissolved solids. Dissolved solids content in the Caustic Collection Tank shall not exceed 10%

by weight. Out of specification liquid discharges to RLD system. Recirculation pump transfers solution from Caustic Collection Tank to the scrubber.

The Caustic Scrubber will have alarms and interlocks for high differential pressure and accumulation of liquid in the **lower head**.

3.2 General

3.2.1 As Low As Reasonably Achievable (ALARA) principles shall be applied to the design of the LAW Melters Offgas Caustic Scrubber per 10 CFR 835, Occupational Radiation Protection.

3.2.2 Seller shall design the LAW Melters Offgas Caustic Scrubber to the requirements of the following:

- This specification
- Applicable codes, standards, and documents in chapter 2 of this specification
- Reference 2.3.5 (Section 1.4 is not applicable.)
- The MDS (**Reference 2.3.1**)
- The MR.

3.2.3 The LAW Melters Offgas Caustic Scrubber, including the Packed Column and Dry Packing Mist Eliminator Section, shall be designed to operate continuously for a minimum service life of 40 years. Seller shall provide documentation, including but not limited to calculations and analyses, to support their design and performance of the equipment.

3.2.4 Seller shall refer to section 3.3 for design performance of the Scrubber. If specific components cannot meet the required service life of 40 years, they shall be identified, and a mechanism for their replacement and / or maintenance shall be incorporated into the design.

3.2.5 Seller shall provide a written performance guarantee for the LAW Melters Offgas Caustic Scrubber. This guarantee shall include, but not be limited to, process and design calculations that substantiate the performance of the equipment for a period of 40 years, (excluding consumables).

3.2.6 The main components of the LAW Melters Offgas Caustic Scrubber shall include, but shall not be limited to, the following:

- **Vessel mounting and support system**
- A vertical column consisting of the following:
 - An offgas inlet cooling and quenching system
 - A packed section (which may have one or more packed beds), random or structured, for offgas scrubbing
 - A liquid distribution system for the scrubbing solution above the packed section
 - A mist eliminator in the exit
 - Wash system for the mist eliminator and/or the packed section
 - Associated nozzles
 - Manway
 - Insulation Support Ring
 - Lifting Lugs.

- Tailing lug(s)
- Grounding Lugs.

Seller shall design, furnish and install all internals and their associated supports unless noted otherwise.

- 3.2.7 Seller shall identify all interfaces and requirements for external connections supplied by the Buyer. The type and location of interfaces shall be reviewed and approved by the Buyer prior to fabrication.
- 3.2.8 Seller shall design the LAW Melters Offgas Caustic Scrubber and its internals, particularly the packed sections, to meet the requirements of testing, packaging, shipping (in the vertical and horizontal positions), handling, storage, installation, and operation of the Scrubber.
- 3.2.9 **Refer to the MDS for corrosion allowance.**
- 3.2.10 Seller shall provide the Optimum Recirculation Flow Rate and Delivery Pressure at the Scrubber equipment nozzle needed by the Buyer to design and purchase the Offgas Caustic Scrubber Recirculation Pumps and Motors, LVP-PMP-00003A/B.
- 3.2.11 The Seller shall provide equipment reliability figures for all major components and sub-components of the Scrubber. The definition of components and sub-components is at the Seller's discretion. The reliability figures shall include, as a minimum, the following:
- Failure rate or mean time between failure (whichever is available)
 - Estimated modes of failure (example, vessel failure, valve leakage, gasket failure, etc.). This may be delineated in a **Failure Modes and Effects Analysis (FMEA)**. The method used to perform the FMEA (example, MIL-STD-1629) and the year shall be specified. Also, all assumptions used to perform the FMEA shall be stated.
 - Recommended maintenance and frequency.
 - Estimated time to perform the recommended maintenance.

The data above shall be based on the physical and environmental conditions delineated in this specification and associated MDS **and EQD**. Where possible, the Seller shall compare the figures for the equipment in this specification to similar equipment sold and serviced by the Seller.

- 3.2.12 Seller shall provide the vessel **mounting and support system** as shown on the MDS.
- 3.2.13 **Equipment Seismic Qualification shall be in accordance with the parameters of References 2.3.8 and 2.3.24.**

3.3 Performance

- 3.3.1 Seller shall refer to the MDS for performance requirements and inlet offgas composition. Seller shall submit an updated MDS with the required Seller input for review by the Buyer per Form G-321-E of the MR.

- 3.3.2 Total SOx removal efficiency of 97% is required with the scrubber reagent between pH9 and pH14.
- 3.3.3 Seller shall recommend the optimum rate of recirculation for the scrubbing solution.
- 3.3.4 Seller shall determine the optimum operating pH range for the scrubbing solution to achieve the required performance while minimizing generation of dissolved solids.
- 3.3.5 The overall offgas pressure drop across the scrubber shall not exceed the maximum allowable pressure drop specified in the MDS.
- 3.3.6 The flooding percentage of the packed bed shall not exceed 60% at the recirculation rate in section 3.3.3.
- 3.3.7 Seller shall recommend any additional operating parameters that must be monitored for the Scrubber to achieve the required performance.
- 3.3.8 Seller shall provide detailed operating instructions, in the form of a manual or similar document, describing how to operate the Scrubber for all conditions (startup, normal, abnormal, shutdown) to achieve the required performance.

3.4 Design Conditions

- 3.4.1 Seller shall refer to the MDS for the allowable space envelope and design conditions of the LAW Melters Offgas Caustic Scrubber. Seller shall provide LAW Melters Offgas Caustic Scrubber dimensions as well as the dry, testing, and operating weights for the scrubber, and submit an updated MDS per Form G-321-E of the MR.
- 3.4.2 Deleted
- 3.4.3 Nozzle and manway design shall be in accordance with Reference 2.3.5. (Section 1.4 is not applicable.)
- 3.4.4 Nozzle loading and reinforcement requirements shall be in accordance with Reference 2.3.5 (Section 1.4 is not applicable.), and/or as specified on the MDS.
- 3.4.5 Lifting lug design shall be in accordance with Reference 2.3.12.
- 3.4.6 Tailing Lug design shall be in accordance with Reference 2.3.13.
- 3.4.7 Grounding lug design shall be in accordance with Reference 2.3.14.
- 3.4.8 Inspection manway design shall be in accordance with Detail 2 of Reference 2.3.18, Lifting eye shall be included for removal of the flange.
- 3.4.9 Deleted
- 3.4.10 Seller shall provide a nameplate for the Scrubber in accordance with Reference 2.3.19.

- 3.4.11 Seller shall furnish and install the insulation legs and Support Ring(s) as specified in Attachment A.
- 3.4.12 **Seller shall design, fabricate, and install scrubber anchor bolt chairs to secure the scrubber at 8 equally spaced locations starting at 22.5 degrees off Building North.** Anchor Bolt Chair design and fabrication shall comply with Reference 2.3.20, Detail 2E. Buyer will provide 1.5" diameter A193 threaded rod anchors (per Reference 2.3.23) at the above specified locations. Seller shall provide detailed fabrication drawings showing **anchor bolt chair design details. The anchor bolt chairs shall be modeled/analyzed to resist tensile loads only. Seller shall analyze/design the scrubber to resist lateral shear at 8 intermediate points between the anchor chairs. The lateral shear shall be resisted by bearing between the vessel base ring and shear bars. The shear bars will be welded on embeds which will be located at intermediate points between anchor chairs. A minimum bearing width of 6" between the shear bar and base ring is required.**

3.5 Equipment Environmental Qualification (EEQ)

- 3.5.1 See EQD (Ref 2.3.24) for environmental conditions.
- 3.5.2 **Environmental qualification of the equipment will be performed by Buyer in accordance with requirements identified in this section. Seller is not required to perform any of the environmental qualification. Requirements in this section are not applicable to Seller.**
- 3.5.2.1 **Equipment covered under this specification shall be environmentally qualified in accordance with the Buyer's specification, 24590-WTP-3PS-G000-T0015.**
- 3.5.2.2 **The equipment shall be evaluated and accepted as suitable to operate in the environment specified on the EQD.**
- 3.5.2.3 **Equipment is considered to be qualified when it meets the performance parameters used to demonstrate that the equipment can perform its safety function for the bounding service conditions defined in the MDS and EQD.**
- 3.5.2.4 **Qualification documentation shall be compiled by the Buyer to provide evidence that the equipment is qualified for its application per 24590-WTP-DC-ENG-06-001. The documentation shall be organized in an understandable and traceable manner that is conducive to independent audits.**

3.6 Loadings

- 3.6.1 Seller shall perform seismic analysis to meet with the requirements of Reference 2.3.6 and Reference 2.3.8.
- 3.6.2 Seller shall perform fatigue assessment / analysis in accordance with the requirements of Reference 2.3.7
- 3.6.3 **For SC-III/IV equipment support, code evaluation of load bearing stainless steel components (Safety SC-III) shall be in accordance with ANSI/AISC N690-94. Code**

evaluation of other load bearing steel components shall be in accordance with AISC M016-89.

3.7 Instrumentation and Control Requirements

- 3.7.1 Deleted
- 3.7.2 Seller shall provide a recommended set point for the maximum liquid level in the Scrubber that will not result in a restriction of the melter offgas release stream. Furthermore, the Seller shall provide recommended set points for any additional operating parameters identified per the requirements of Section 3.3.7.
- 3.7.3 Deleted
- 3.7.4 Deleted
- 3.7.5 Deleted
- 3.7.6 Deleted

3.8 Accessibility and Maintenance

- 3.8.1 Accessibility and maintenance requirements shall be per this specification and MDS.
- 3.8.2 The LAW Melter Offgas Caustic Scrubber will be located in an area that requires hands-on maintenance **by workers** in protective clothing (i.e., gloves, **face shields**, respirators, etc.). The design shall accommodate such restrictions / limitations.
- 3.8.3 Seller shall design and install a wash system to clean the dry-packing and mist eliminator and packed sections, as and when required. Seller shall recommend the frequency and period of cleaning as preventive maintenance for the given duty conditions. The wash system will be supplied with Process Water. Process Water quality is specified on MDS.
- 3.8.4 Operations and Maintenance (O&M)-specific Seller data is required to support operations, maintenance, and training programs. Operations and Maintenance (O&M)- specific Seller data shall contain the following as a minimum:
 - 3.8.4.1 *Operations and maintenance documentation* directory that includes a list of documents, components, subcomponents, etc. and a table of contents.
 - 3.8.4.2 *General manual layout* that includes title page, table of contents, manual contents and Seller contact information (such as telephone, fax, email numbers).
 - 3.8.4.3 *Deleted*
 - 3.8.4.4 *Operations manual* for equipment that includes descriptive and control information, operating standards and codes, recommended personal protective equipment, operating

procedures, detailed assembly/disassembly drawings and assembly / disassembly instructions.

- 3.8.4.5 *Maintenance manuals* for the care and maintenance of products, materials, systems and equipment that include content divided into sections for each component / subcomponent, source information, product information, maintenance procedures, repair materials, and source including Seller service representative contact information, maintenance and service schedule, spare part list, and source information for special tools.
- 3.8.4.6 *Training material or media* that include information or instruction (course) from the manufacturers to use in training personnel to properly operate and maintain the equipment.

4 Materials

4.1 Construction

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

- ASME Section VIII, Div 1
- This specification
- Reference 2.3.5 (Section 1.4 is not applicable.)
- Reference 2.3.3
- The MDS (Reference 2.3.1)
- The MR.

4.1.2 Seller shall provide Material Safety Data Sheets (MSDSs) or **certificate of compliance** for all materials **that come into contact with** the Scrubber.

4.1.3 **Seller shall submit a table/spreadsheet of all components/parts that perform or support a safety function. Include both metallic and non-metallic components/parts. The list shall contain, at a minimum, the following information for each component/part:**

- **Name / description**
- **Drawing number and item number on that drawing**
- **Material**
- **Safety function supported**
- **Role that component/part plays in support of the safety function**
- **Recommended maintenance/replacement frequency, if applicable, to maintain 40-yr life**

4.1.4 **For components/parts identified in 4.1.3, Seller shall submit either PMI documentation in accordance with Reference 2.3.3, or vendor cut-sheet/datasheet information for items not subject to PMI.**

4.1.5 **Seller shall submit performance-based test results that validate the pressure boundary (confinement) safety function at operating conditions for components that are part of the pressure boundary but are not analyzed by the structural/seismic analysis, for example, gaskets.**

4.2 Prohibited/Restricted Materials

- 4.2.1 See Reference 2.3.5 Section 4 regarding mercury and other low melting point metals.
- 4.2.2 See Reference 2.3.5 Section 4 regarding the use of sulfides and halides.
- 4.2.3 Asbestos shall not be included in any component of the Scrubber.
- 4.2.4 Carbon steel shall not be included in any component in contact with fluid and the vessel.
- 4.2.5 Deleted.

5 Fabrication

5.1 General

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

- This specification
- Reference 2.3.5 (Section 1.4 is not applicable.)
- The MR.

5.1.2 Fabrication tolerances shall conform to the requirements of ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, *Rules for Construction of Pressure Vessels*, and Reference 2.3.10.

5.2 Welding

Welding of the Scrubber shall conform to the requirements of the documents listed in paragraph 5.1.1 of this specification and Reference 2.3.9.

6 Tests and Inspections

6.1 General

6.1.1 Seller shall conduct and be responsible for all testing and inspections of the Scrubber per the requirements of:

- This specification
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, Rules for Construction of Pressure Vessels
- Reference 2.3.5 (Section 1.4 is not applicable.)
- The MR.

6.1.2 Seller shall submit a detailed inspection and testing plan. The plan shall identify all inspection and testing hold/witness points including the Buyer's hold/witness points. When the operation

requires a procedure, the procedure number shall be designated on the plan. In addition, Seller shall develop and submit detailed test and inspection procedures for conducting all testing and inspections required per this specification, applicable codes, standards, reference documents, and the test plan.

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

6.2 Non-Destructive Examinations

Nondestructive Examination requirements shall be in accordance with Reference 2.3.5. (Section 1.4 is not applicable.)

7 Preparation for Shipment

7.1 General

- 7.1.1 The Scrubber shall be prepared for shipment in accordance with:

- Reference 2.3.5 (Section 1.4 is not applicable.)
- Reference 2.3.4
- ASME-NQA-2-1989, Quality Assurance Requirements for Nuclear Facility Applications, Part 2.2, Section 3, Level D items.

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

7.2 Cleanliness

All equipment shall be thoroughly cleaned of all debris, trash, loose mill scale, tools, and foreign matter, and dried in preparation for shipment.

7.3 Tagging

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

7.4 Documentation

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

7.5 Shipping, Handling, and Storage Instructions

Seller shall submit shipping weights as well as detailed shipping, handling, and storage instructions for the Scrubber prior to its shipment per **Reference 2.3.4** and Form G-321-E of the MR.

8 Quality Assurance

8.1 QA requirements specific to item(s) or service

All items shall be manufactured in accordance with Seller's **Quality Assurance Program** that meets the requirements of ASME NQA-1-1989, and has been previously evaluated and accepted by the WTP Quality Assurance Organization.

8.2 Program QA elements

8.2.1 Seller's QAP requirements are specified in Reference 2.3.2.

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

8.2.3 Seller shall demonstrate that its quality program is in compliance with the procurement quality requirements listed in the Supplier Quality Assurance Program Requirements Data Sheet. Seller shall allow the Buyer, its agents, and DOE access to their facility and records pertaining to this purchase order for the purpose of QA audits and surveillance at mutually agreed times.

9 Configuration Management

9.1 The equipment covered by this specification is identified with the plant item number shown in the MDS. The equipment shall be identified in accordance with paragraph 7.3, Tagging, of this specification and Reference 2.3.19

9.2 Substitutions and deviations shall be in accordance with MR section 2.6.

10 Documentation and Submittals

10.1 General

10.1.1 Seller shall submit to Buyer all detailed designs, documentation, procedures, instructions, calculations, analyses, simulations, manufacturer data, inspection reports, test reports, certifications, operation and maintenance manuals (such as procedure, staffing, and training), spare part lists, MSDSs, and drawings; including as-built drawings required per this specification, its addenda, and attachments, the MR, and referenced codes, standards, and Buyer documents.

- 10.1.2 Seller shall submit to Buyer the Engineering and Quality Verification documents in the forms, quantities, and timeframes shown in Form G-321-E, *Engineering Document Requirements*, and Form G-321-V, *Quality Verification Document Requirements*, in Section 3 of the MR.
- 10.1.3 Each documentation transmittal package shall have a documentation inventory sheet attached listing all documents and the number of pages in each document.

10.2 Submittals

10.2.1 Drawings

Seller shall submit assembly/shop detail drawings for Buyer's review. In addition to the drawing requirements outlined in the G-321-E descriptions, assembly/shop detail drawings shall include the following as minimum information for each item, but not limited to the following list:

- Shell and head thickness
- Head type
- Shipping weight and test weight
- Center of gravity
- Lifting lugs
- Diameter and tangent-to-tangent dimensions, and appropriate anchorage or support details
- Nozzle schedule with nozzle marks and service conditions the same as the Bechtel data sheet
- Governing moment and shear for earthquake, as applicable
- Foundation and mounting details
- Materials and parts list with locations.

10.2.2 Manuals/Instructions

Seller shall submit to Buyer Erection/Installation Manuals/Instructions, Maintenance Manual/Instructions for review and comment. Refer to Form G-321-E for submittal schedule requirements.

10.2.3 Inspection and Test Reports

Seller shall submit completed reports per Section 6.1.4 of this specification and the G-321-V Form.

10.2.4 Calculations

- 10.2.4.1 Refer to this specification and Form G-321-E for required calculations. All calculations to be provided to the Buyer shall be orderly, complete, and sufficiently clear to permit verification. The body of the calculations shall include:

- Objective
- Inputs

- Background
- Applicable Code and Standards
- Methodology
- Assumptions, if required. The calculation shall not contain any assumptions that require verification; Seller shall close all assumptions.
- Calculation.
- Results and Conclusion
- References
- Attachments
- The computer programs, if required, shall including the following information:
 - Input and Output
 - Detail description of the program (by inclusion or by reference)
 - Program name
 - Program version/release used

10.2.4.2 The units of measure to be used for this project are US customary units, not imperial or metric units. Calculations customarily performed using other units and/or software applications that use these units as their normal practice are acceptable for project use. The result of those analyses must be converted to US customary units.

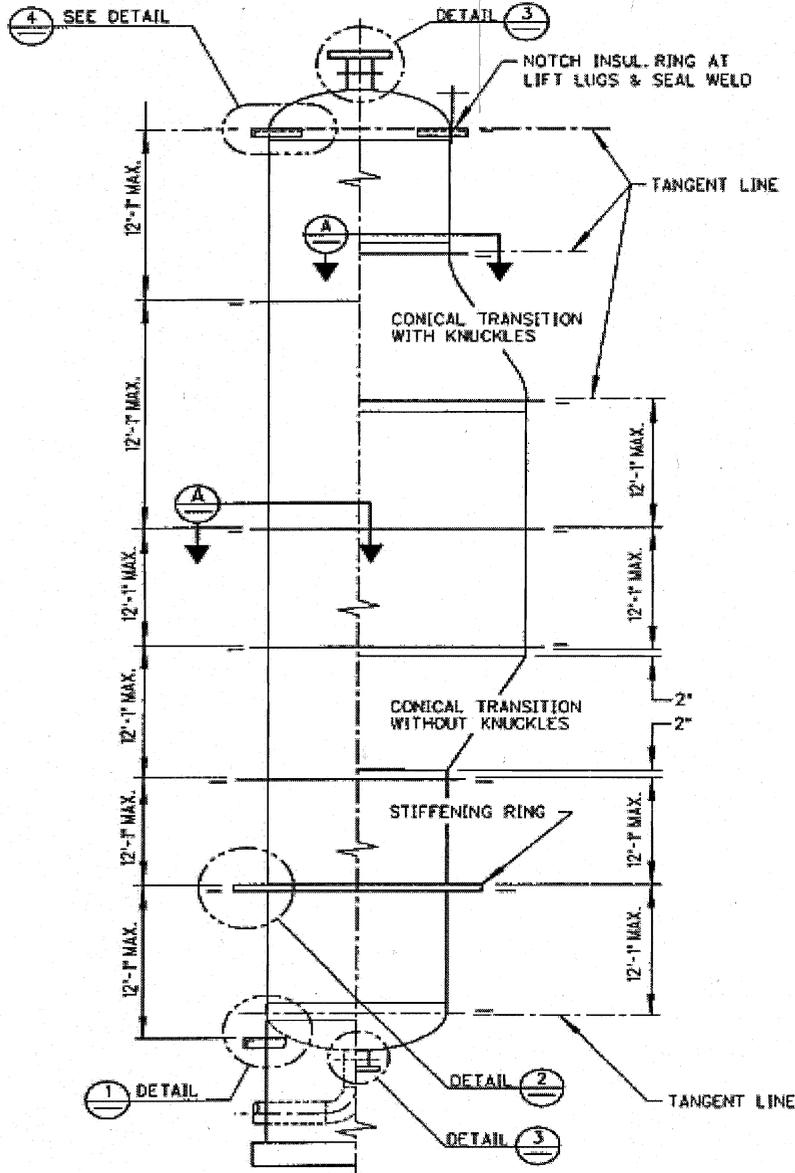
10.2.5 Certificates of Conformance

Seller shall submit per Section 1.2.2 of this specification.

10.2.6 Schedules

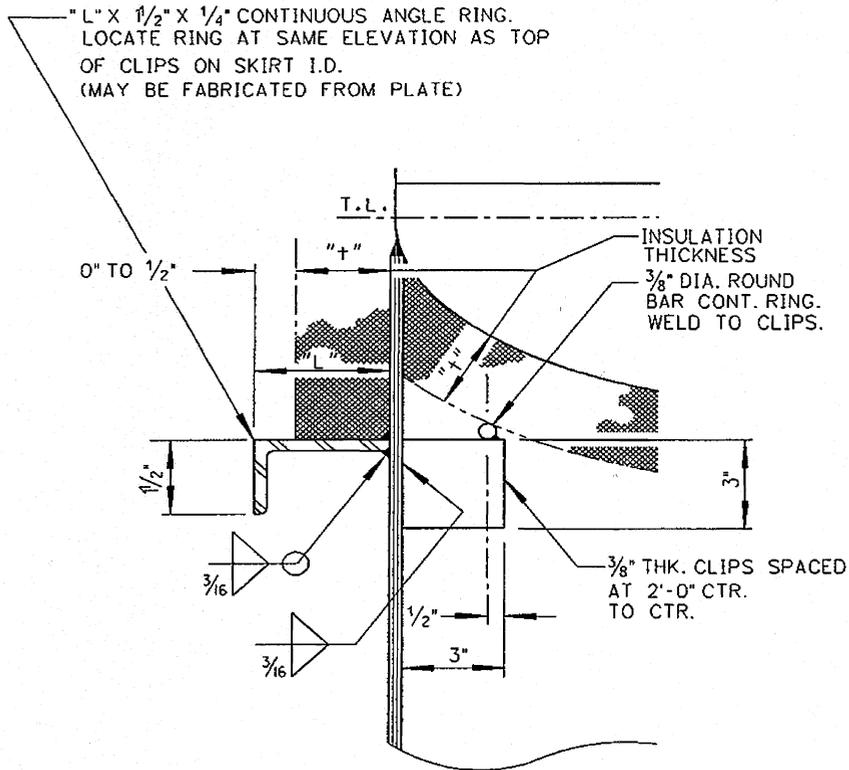
A detailed schedule of engineering, document submittals, material purchases, fabrication, shop tests, and shipment shall be submitted using Form 15EX per Section 3 of the MR.

Attachment A

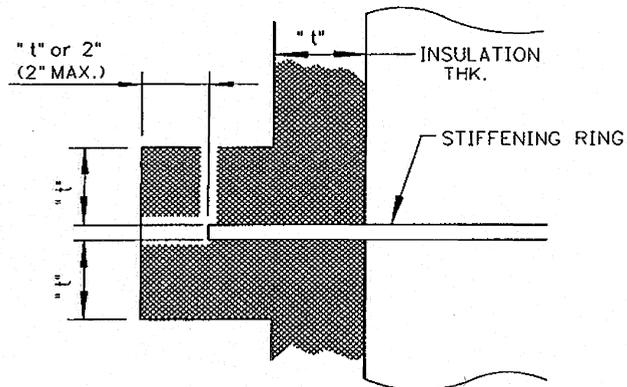


INSULATION SUPPORT DETAIL

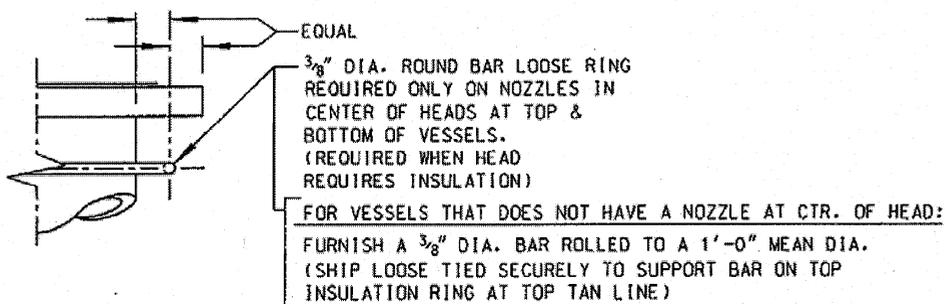
- NOTES:**
- 1) Insulation thickness ("t") will be specified on the Mechanical Data Sheet.
 - 2) Insulation thickness does not include the weather protection jacket.
 - 3) Material: as noted on the Mechanical Data Sheet.
 - 4) The term "skirt" is **interchangeable with** "leg supports".
 - 5) This typical detail may not depict the exact configuration – shown to account for all **potential configurations for any vessel that requires insulation.**



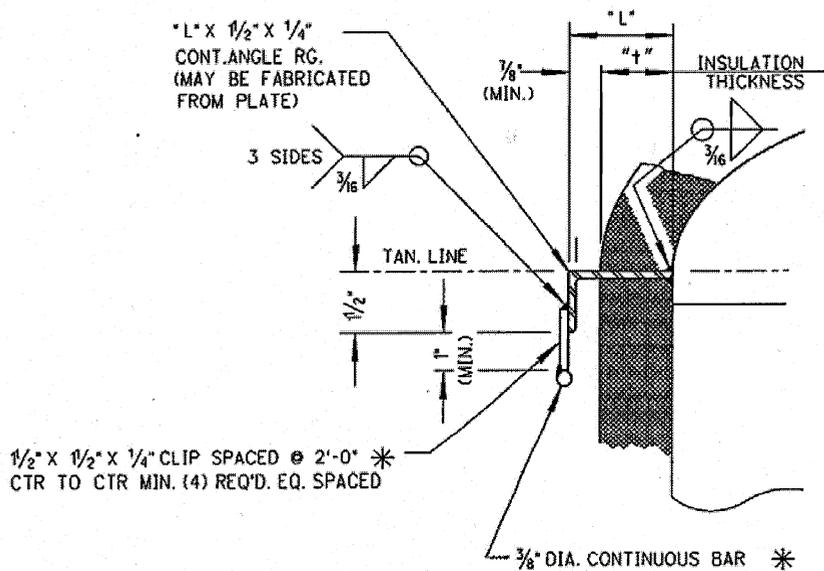
DETAIL 1
 TYPICAL VESSEL SKIRT INSULATION



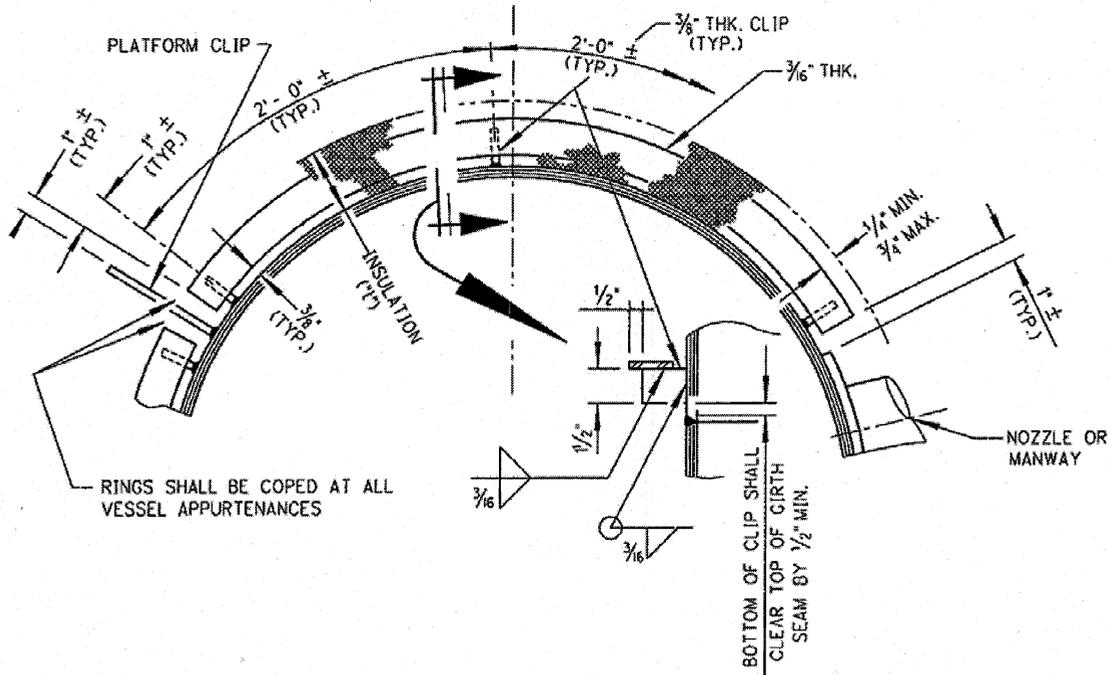
DETAIL 2
 INSULATION AROUND STIFFENING RING



DETAIL 3



DETAIL 4
 TOP RING FOR



SECTION A
TYPICAL VERTICAL VESSEL INSULATION SUPPORT RING