



RIVER PROTECTION PROJECT – WASTE TREATMENT PLANT

**ENGINEERING SPECIFICATION
FOR
DVP Vessel Vent Centrifugal Exhauster**

Content applicable to ALARA?

Yes No

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24590-BOF-ADR-M-16-0004

Rev
0

Specification changes retroactive?

Yes No
 N/A (alpha revision or revision 0)

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

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Revision History

Revision	Reason for Revision	Q Specification Revision Only Margin Reduced?		CM Only
		YES	NO	N/A
0	Initial Issue	N/A	N/A	N/A
1	<p>Issued for Purchase. Conformed to SELLER's offering. Deleted Exhibit 1 Electrical Requirements for Packaged Equipment. Deleted Exhibit 5 Instrumentation for Packaged Systems. Deleted Exhibit 6 Low Voltage Adjustable Speed Drive (Non-Safety). Added notice for AEA 1954 on byproduct materials to Page iii. Section 1.2.3 deleted the discharge silencer. Added Section 2.4 Laws and Regulations. Deleted the Adjustable Speed Drive (ASD) from the Seller's Scope and changed other affected sections accordingly. Adjusted and removed Code years from some Codes and Standards. Deleted Calculations Section and adjusted Sections 3.3 and 10.3.2 to conform Seller's Design Life report and Lifting Lug load analysis. Added new items from specification 24590-WTP-3PS-FB01-T0001 to Exhibit 3. These changes and other minor changes from the Seller's conformance review process for clarification have been identified and are marked in the right-hand margin of the document. There are no applicable EIEs.</p>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
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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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Exhibits

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Exhibit 2 Low Voltage Induction Motors	Exhibit 2, Page 1
Exhibit 3 Structural Design Loads for Seismic III & IV Equipment and Tanks.....	Exhibit 3, Page 1
Exhibit 4 Positive Material Identification (PMI) for Shop Fabrication.....	Exhibit 4, Page 1
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Exhibit 6 Deleted	

1 Scope

1.1 Project Description and Location

The Office of River Protection (ORP) and its contractors manage 177 underground radioactive waste storage tanks at the Hanford Site in Washington. These tanks contain approximately 56 million US gallons of radioactive waste. Bechtel National, Inc. (BNI) has entered into contract with the US Department of Energy to design, construct, and commission the Hanford Tank Waste Treatment and Immobilization Plant (WTP) to process and vitrify this waste into a stable form that is suitable for permanent storage or disposal. The WTP will be constructed in the 200 East Area of the Hanford Site, near Richland, Washington. The main facilities within the WTP complex will be the Pretreatment facility (PTF), Low-Activity Waste facility (LAW), High-Level Waste facility (HLW), Balance of Facilities (BOF), Analytical Laboratory (Lab), and the Effluent Management Facility (EMF).

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 the shipment of the Exhausters downstream of the high efficiency particulate air (HEPA) filters serving the Vessel Vent Off-gas System in the Effluent Management Facility.

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

- 1.2.1 Provide the design, materials, fabrication, testing, qualification, inspection, preparation for shipment, documentation, and submittals of Exhausters, in accordance with this specification and the Mechanical Data Sheets (MDS), purchasing documents, and referenced codes, standards, and documents.
- 1.2.2 Deleted
- 1.2.3 Each Exhauster shall include, but is not limited to, the following:
 - A 460 volt/3-phase/60 Hertz premium efficient motor capable of being controlled by an adjustable speed drive
 - Motor coupling
 - A direct drive fan or blower with a sealed shaft and safety guard
 - Exhauster shaft speed sensor/transmitter
 - 316/316L (with maximum carbon content of 0.030%) Stainless Steel Housing and Mounting Frame
 - Vibration isolators
 - Fused disconnect switch
 - NEMA 4X, Type 304 Stainless Steel Enclosure
 - Flexible metal hose connection
- 1.2.4 Special tools required for installation maintenance, if any.
- 1.2.5 Each exhauster/motor assembly shall come fully assembled, wired and skid mounted requiring only connection to the Buyer's electrical power, control systems and piping.

1.2.6 Provide and submit procedures, reports, manuals, and all documentation per this specification.

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 Handling, storage, and installation of the exhausters at the Buyer's job site.

1.3.2 Installation labor at WTP.

1.3.3 Foundation (concrete floor with embed plates).

1.3.4 Piping external to the inlet and outlet connections.

1.3.5 Electrical power supply to the exhauster motors.

1.3.6 Wiring external to the exhauster motors.

1.3.7 Field testing and inspection.

1.3.8 Transportation Services excluding insurance requirement.

1.3.9 Adjustable Speed Drives (ASD).

1.4 Acronyms, Abbreviations, and Definitions

1.4.1 Acronyms and Abbreviations

AEA	Atomic Energy Act
ABMA	American Bearing Manufacturers Association
AMCA	Air Movement and Control Association
AHJ	Authority Having Jurisdiction
ASD	Adjustable Speed Drive
AWG	American Wire Gauge
ANSI	American National Standards Institute
ASNT	American Society of Nondestructive Testing
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWS	American Welding Society
CFR	Code of Federal Regulations
DOE	US Department of Energy
EMF	Effluent Management Facility
HEPA	High Efficiency Particulate Air
ISO	International Standards Organization
IEEE	Institute of Electrical and Electronics Engineers
MTR	Material Test Report
MDS	Mechanical Data Sheet
MR	Material Requisition
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association

NFPA	National Fire Protection Association
NRTL	Nationally Recognized Testing Laboratory
OEM	Original Equipment Manufacturer
OSHA	Occupational Safety & Health Act
PMI	Positive Material Identification
PQR	Procedure Qualification Records
QA	Quality Assurance
QAP	Quality Assurance Program
SC	Seismic Category
SC	Safety Class
SDDR	Supplier Deviation Disposition Request
SS	Safety Significant
SSC	Structure, System, or Component
UL	Underwriters Laboratories, Inc.
WAC	Washington State Administrative Code
WTP	Hanford Tank Waste Treatment and Immobilization Plant

1.4.2 Definitions

Buyer:	Bechtel National Inc.
Seller:	This term includes manufacturer, assembler, fabricator, supplier, vendor, contractor, sub-contractor, sub-supplier or equal who provides equipment, systems, components, services, or other products for delivery to the Buyer.
Exhausters:	Refers to the Exhausters that move radioactive air through the system.
MR:	Refers to the material requisition for the Exhausters.
MDS:	Refers to the mechanical data sheet for the Exhausters.
C3:	C3 areas are the process areas where the potential for direct contact with radioactive material, contaminated systems and components, or both, exists.
R3:	Radiation classification for areas with a target dose equivalent rate of less than 2.5 mrem/hr. Entry only to carry out prescribed tasks accordance with normal procedures and a Radiation Work Permit. Thermoluminescent Dosimeter and Radiation Worker training required for entry into Radiation Areas.

1.5 Safety/Quality Classifications

1.5.1 The quality level identifies the quality requirements to be applied to the equipment. Quality requirements are specifically defined on the associated mechanical data sheets (MDS) and supplier quality assurance program requirements data sheets. Structures, Systems, and Components identified as SC, SS and/or Air Permit affecting are Quality Level “Q” items. Refer to the MDSs for the quality level designations of the Exhausters.

1.5.2 The Exhausters shall be designed as Seismic Category IV (SC-IV).

2 Applicable Documents

2.1 General

- 2.1.1 Work shall be done in accordance with the referenced codes, standards, and documents listed below, which are an integral part of this specification.
- 2.1.2 When specific chapters, sections, parts or paragraphs are listed following a code, industry standard or referenced document, only those chapters, sections, parts or paragraphs of the document are applicable and shall be applied.
- 2.1.3 For the codes and standards listed in Section 2.2, the specific edition year identified shall be followed. For the codes and standards that are incorporated by reference (daughter codes and standards), the referenced daughter edition or current edition shall be followed. If an edition is not identified, the latest issue, including addenda, at the time of the award shall apply. The edition year listed in Section 2.2 shall apply to subsequent references to the codes and standards within the specification and shall govern in case of conflict with edition years specified in the reference documents listed in Section 2.3. If more than one code, standard or reference document covers the same topic, the requirements for all must be met with the most stringent governing.
- 2.1.4 Deleted

2.2 Codes and Standards

- 2.2.1 Deleted
- 2.2.2 ABMA 1990, *Load Ratings and Fatigue Life for Ball Bearings*.
- 2.2.3 ASME B31.3-1996, *Process Piping*.
- 2.2.4 ASME AG-1-1997 with ASME AG-1a-2000 Addenda, *Code on Nuclear Air and Gas Treatment*.
- 2.2.5 ASME Boiler and Pressure Vessel Code, Section IX, *Qualification Standard for Welding, Brazing and Fusing Procedures, Welders, Brazers; and Welding Brazing and Fusing Operators- Welding, Brazing and Fusing Qualifications*.
- 2.2.6 Deleted
- 2.2.7 ASNT-SNT-TC-1A, *American Society of Non-Destructive Testing Recommended Practice No. SNT-TC-1A Personnel Qualification and Certification in Nondestructive Testing*.
- 2.2.8 AWS D1.1/D1.1M, *Structural Welding Code, Steel*.
- 2.2.9 AWS D1.3, *Structural Welding Code, Sheet Steel*.
- 2.2.10 AWS D1.6, *Structural Welding Code. Stainless Steel*.
- 2.2.11 AWS D9.1, *Sheet Metal Welding Code*.
- 2.2.12 AWS D14.6, *Welding of Rotating Elements of Equipment*.

- 2.2.13 IEEE 1050-1996, *IEEE Guide for Instrumentation and Control Equipment Grounding in Generating Stations.*
- 2.2.14 Deleted
- 2.2.15 ISO 1940-1, *Mechanical Vibration Balance Requirements For Rotors In A Constant (Rigid) State Part 1: Specification and Verification Of Balance Tolerances.*
- 2.2.16 NEMA 250, *Enclosures for Electrical Equipment (1000 Volts Maximum).*
- 2.2.17 NEMA MG1, *Motors and Generators.*
- 2.2.18 NFPA 70-1999, *National Electric Code.*
- 2.2.19 Deleted
- 2.2.20 Deleted
- 2.2.21 AMCA 99, *Standards Handbook.*
- 2.2.22 AMCA 210, *Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.*

2.3 Reference Documents/Drawings

- 2.3.1 24590-WTP-3PS-G000-T0003, *Engineering Specification for Packaging, Handling, and Storage Requirements.*
- 2.3.2 Deleted
- 2.3.3 Deleted
- 2.3.4 24590-WTP-LIST-ESH-16-0001, *Restricted Materials List.*
- 2.3.5 Deleted

2.4 Laws and Regulations

- 2.4.1 10 CFR 835, *Occupational Radiation Protection Program.*
- 2.4.2 10 CFR 851, *Worker Safety and Health Program.*
- 2.4.3 29 CFR 1910, *Occupational Safety and Health Standards.*
- 2.4.4 OSHA 29 CFR 1910, *Subpart O, Machinery and Machine Guarding.*
- 2.4.5 OSHA 29 CFR 1910, *Subpart S, Electrical.*
- 2.4.6 WAC 173-303, *Dangerous Waste Regulations.*

3 Design Requirements

3.1 General

- 3.1.1 Exhausters, electric motors and accessories shall meet requirements specified herein and in the data sheets included in the Material Requisition (MR). Each off-gas skid-mounted exhauster/motor assembly shall include all components and accessories fully assembled and wired requiring only connection to the Buyer's control system, and 480 V power from the remotely located ASDs to the motors.
- 3.1.2 Deleted
- 3.1.3 Deleted

3.2 Basic Function

- 3.2.1 The Exhausters will provide the motive force required to transport air and gaseous effluent to the atmosphere.
- 3.2.2 Exhausters shall remain stable throughout its entire range from free flow to shut off conditions.
- 3.2.3 The Air Permit (Q) function of the exhauster is to provide passive confinement of emissions (motive force is not an Air Permit function).

3.3 Performance

- 3.3.1 Design basis performance and capacity data are listed on the Exhauster Data Sheet.
- 3.3.2 Exhauster performance ratings are to be based on testing in accordance with AMCA 99 and 210. Exhausters shall be capable of performing at conditions shown on the Exhauster Data Sheet.
- 3.3.3 The Exhausters and appurtenances will be used in a plant that has the design life of 40 years. The design objective for these exhausters shall be based on a useful life expectancy of 40 years with periodic maintenance as recommended by the Seller.
- 3.3.4 The Exhausters assembly design life shall consider the effects of radiological and thermal exposure conditions as specified on the mechanical data sheets.

3.4 Design Conditions

- 3.4.1 Exhauster shall be designed to minimize sound pressure level. Seller shall test and provide final sound pressure level if fan exceeds 85 dBA at 3 ft. from the outline of the equipment, when measured 5 ft. above grade/floor or personnel platform level and under free field conditions.
- 3.4.2 Exhauster housing shall be designed to withstand 15 psig water flow through it and 125% of the negative design operating pressure as specified in the Exhauster Data Sheets.

3.4.3 Materials of construction used shall be in accordance with materials specified on the Exhauster data sheet.

3.5 Mechanical Requirements

3.5.1 General

3.5.1.1 Exhauster inlets and outlets shall be 150 lb. class raised face stainless steel 316/316L (with maximum carbon content 0.030%) flanges conforming to ANSI dimensions.

3.5.1.2 Exhauster housings shall be designed to prevent any internally propelled missiles from penetrating the housing.

3.5.1.3 Unless otherwise specified on Data Sheets, Exhausters shall exhibit “Leak tightness” in accordance with requirements of Section BA 4142 of ASME AG-1-1997.

3.5.1.4 Exhauster drive arrangement shall be shown on Exhauster Data Sheet. Drive arrangement designations shall be per AMCA 99-2404. Designations for rotation and discharge shall be per AMCA 99-2406.

3.5.1.5 When indicated on the Exhauster Data Sheets that Exhausters shall be of Spark Resistant Construction, Exhausters shall be Type A in accordance with AMCA 99-0401-86.

3.5.1.6 The Exhauster’s rotors shall be balanced to Quality Grade 2.5 of ISO 1940-1 with results documented and submitted to the Buyer.

3.5.1.7 The design, manufacture, and testing for exhauster flexible metal hose connection shall be in accordance with ISO 10380 and ASME B31.3, 1996. Non-metallic parts are not permitted. ASTM standard and type/grade for materials of construction shall be included on the fabrication drawings, bill of materials and mechanical data sheets. The connection hoses shall be 36” overall length and 4” diameter.

3.5.2 Bearings

3.5.2.1 Bearings for Exhausters shall have a minimum L-10 service rating life of 100,000 hours unless otherwise noted on the Data Sheet. Bearing rating life shall be established in accordance with ABMA 9 or 11, as applicable.

3.5.2.2 For all Exhausters, it shall be possible to replace the bearings without disconnecting any piping or disassembling of the Exhauster housing.

3.5.2.3 Extended lube lines and fittings shall be provided as required to permit lubrication during operation.

3.6 Loadings

3.6.1 Seller shall design the Exhausters to be self-supporting and be capable of handling the loads and moments imposed on the Exhausters during testing, packaging, shipping, handling, storage, installation, and operation. Seller shall include the evaluation of the forces associated with the equipment lifting lift lugs only in the seismic qualification report. Shipping and handling loads will be enveloped by the seismic qualification.

- 3.6.2 Seller shall complete a seismic analysis of the exhauster equipment. Loadings shall be calculated in accordance with the appropriate requirements Exhibit 3, *Structural Design Loads for Seismic Category III & IV Equipment and Tanks*.

3.7 Electrical Requirements

3.7.1 General

- 3.7.1.1 Deleted
- 3.7.1.2 Motor shall be compliant with Exhibit 2, *Low Voltage Induction Motors*.
- 3.7.1.3 Deleted
- 3.7.1.4 Motor drive combination shall be suitable for operation for the design conditions shown on the Exhauster Data Sheet.
- 3.7.1.5 Non-current carrying metallic parts of electrical equipment shall be bonded together and made electrically continuous. Two grounding pads shall be furnished at diagonally opposite corners at the edge of the skid for connection by the Buyer to the area ground grid, per NFPA 70-1999 Article 250.
- 3.7.1.6 Electrical equipment on the packaged unit shall be bonded to the package unit skid, per NFPA 70-1999 Article 250.
- 3.7.1.7 The enclosure grounding system shall be installed in conformance to IEEE Guide 1050-1996, Section 5.3.1 "Single point grounding system" and shall comply with NFPA 70-1999 Article 250-112(k), Article 250-118, Article 250-119, Article 250-122, Article 250-134, Article 250-138, and Article 250-97 as applicable. Instrumentation enclosures that house digital and analog signaling circuits shall have an equipment safety ground bus and an isolated signal ground bus.
- 3.7.1.8 All interconnecting wiring shall be color-coded in a consistent, uniform, manner. Details of the wire color scheme utilized shall be documented on Seller-provided documentation which is submitted to Buyer for review and acceptance. All interconnecting wiring shall be marked with heat-shrink type markers and all terminal blocks shall be clearly identified. All wiring shall be in accordance with NFPA 70-1999, National Electrical Code.

3.7.2 Raceways

- 3.7.2.1 Deleted

3.7.3 Acceptability of Electrical Equipment

- 3.7.3.1 All electrical equipment for facility and equipment wiring shall be in accordance with NFPA 70-1999.
- 3.7.3.2 All electrical equipment, devices, and materials shall be listed and labeled by an OSHA listed National Recognized Testing Laboratory (NRTL).
- 3.7.3.3 Power supplies shall be NRTL listed or labeled.

3.8 Instrumentation and Control Requirements

- 3.8.1 Exhausters (DVP-EXHR-00001A/B) shall be provided with an exhauster shaft speed sensor (DVP-SE-8110/8116) and transmitter (DVP-ST-8110/8116) to measure and provide the fan speed. Speed transmitters shall have sensors of non-contact type and be loop powered. Any connecting cables or signal conditioners are required to provide an isolated 4-20 mA signal Output.
- 3.8.2 Seller shall provide factory mounted terminal/junction box (NEMA 4X housing) for Buyer interconnection to controls and sensors. Circuits of different voltages (service level) shall be terminated on physically separate terminal strips and clearly labeled to show the circuit voltage. Terminal box location shall prevent signal interference from fan power wires or disconnection switch.
- 3.8.3 Deleted
- 3.8.4 Deleted
- 3.8.5 Deleted

3.9 Accessibility and Maintenance

- 3.9.1 Deleted
- 3.9.2 Seller's recommended accessibility and recommended spares for each piece of equipment shall be included in Seller's submittal.
- 3.9.3 Seller shall provide the inspection and maintenance requirements with the recommended intervals to be performed by the Buyer.
- 3.9.4 Exhausters shall be provided with bolted drive guards that cover the shaft, motor coupling, and bearings. Provisions shall be made for access to the lube fittings without removal of drive guards.
- 3.9.5 Guards shall cover moving parts on all sides where worker access may occur, including rear portions of moving parts.
- 3.9.6 The guards shall comply with Seller's standard requirements.

4 Materials

4.1 Materials and Equipment

- 4.1.1 Seller shall comply with the requirements in Exhibit 4, *Positive Material Identification (PMI) for Shop-Fabrication*; exclude any requirements for black cells and hard-to-reach areas.
- 4.1.2 PMI is required for the materials specified in Exhibit 4, *Positive Material Identification (PMI) for Shop-Fabrication*, Table 1.

- 4.1.3 All materials of construction for the Exhausters shall conform to the requirements of this specification, the MDS, and the purchasing documents.
- 4.1.4 All materials used shall be new and free of defects.
- 4.1.5 All materials used shall be resistant to deterioration when used in a radioactive environment.
- 4.1.6 Material test reports of chemical and physical properties shall be provided for pressure retaining components and non-pressure retaining components, including weld filler material used for the fabrication of the Exhausters. Material test reports of chemical and physical properties for the Exhauster impeller and shaft shall be provided by the Seller. Seller shall submit Quality Verification Documents (material test reports) in accordance with the applicable technical specification and the PO Section 3, Form G-321-E & V.
- 4.1.7 ASME and/or ASTM material designations and grades shall be indicated on the fabrication drawings, bill of materials and mechanical data sheets.
- 4.1.8 Seller shall not substitute materials specified in this specification, the applicable documents, the MDS, and the purchasing documents.
- 4.1.9 All material shall be controlled, issued, handled, and stored with proper identification and traceability. Seller shall prepare and submit material control procedures for Buyer review.
- 4.1.10 Seller shall provide positive material identification (PMI) reports on soft goods utilized in the pressure boundary (i.e., gaskets) at the request of Buyer, unless stated otherwise. PMI method shall be Fourier Transform Infrared Spectroscopy (FTIR).

4.2 Prohibited Materials

- 4.2.1 The materials listed in 24590-WTP-LIST-ESH-16-0001, Restricted Materials List, shall not be used in any supplied equipment and shall not be brought onto the WTP site.
- 4.2.2 Mercury, lead, aluminum, zinc, their alloys, or materials containing such metals as their basic constituents shall not be used in the construction of the Exhausters. Teflon shall not be used in the construction of the Exhausters.
- 4.2.3 All materials in contact with stainless steel shall not cause corrosion or other harmful effects:
- The total fluoride/chloride content shall not exceed 200 ppm.
 - The total sulfur content will not exceed 400 ppm.
 - The total of low melting point metal such as lead, zinc, copper, tin, antimony and mercury shall not exceed 1 percent; mercury shall not exceed 50 ppm.
- 4.2.4 Asbestos shall not be included in any component of the Exhausters.
- 4.2.5 Carbon steel shall not be included in any component of the Exhausters that comes into direct contact with the offgas stream.

5 Fabrication

5.1 General

- 5.1.1 Fabrication of the Exhausters shall conform to the requirements of:
- a) this specification
 - b) the MDS
 - c) the purchasing documents
- 5.1.2 All edges shall be rounded and smooth to the touch. All stainless steel surfaces shall be clean, free of stains, scale, and deposits. All weld spatter, slag, and heat affected zone oxides shall be removed.
- 5.1.3 Seller shall determine and specify tolerances, surface flatness, and finish requirements for assembly and fabrication of the Exhausters at the detailed design stage. At a minimum, all tolerances, surface flatness, and finishes shall be in accordance with the applicable codes, standards, and references documents in Section 2 of this specification.
- 5.1.4 Compliance with this specification and Buyer's authorization of WPS and PQR shall in no way relieve the Seller of the responsibility of providing welds which are sound and suited to the services for which they are intended.
- 5.1.5 Welding symbols shall be in accordance with AWS A2.4.
- 5.1.6 Seller shall ensure that safety measures for the protection of welders and operators involved in welding and cutting shall be in accordance with the practices specified in the ANSI Z49.1, plus all local, state, federal, and other governing regulations.
- 5.1.7 Buyer reserves the right to remove test specimens from any portion of the work to verify the quality of the welding. The Seller, at his expense, shall repair or replace any base metal or filler metal found to be defective.
- 5.1.8 Only Buyer-reviewed procedures and revisions shall be used. When requested, the Seller shall make available to the Buyer the control measures that will be used to ensure that the weld procedures used are current and reviewed for all welding. Welds made to procedures that are not pre-qualified or have not been properly qualified and authorized by Buyer shall be rejected and completely removed.
- 5.1.9 Cleanliness shall be maintained throughout welding. All stubs, rods, flux, slag and other foreign materials shall be removed from the structure.
- 5.1.10 Provide back-up plates and run-out bars as required for full penetration welds. Run-out bars shall be removed upon completion. Back-up plates shall be as shown on the issued design drawings.
- 5.1.11 To avoid iron contamination, austenitic stainless steels shall be protected from the grinding and welding of carbon steels. Only tools (grinders, wire brushes, etc.) designated for use with austenitic stainless steels shall be used in the welding and fabrication of austenitic stainless steel weldments.
- 5.1.12 All surfaces to be welded shall be free of paint, oil, dirt, scale, rust, oxides, and other foreign materials detrimental to weld soundness. All joints shall be free of moisture prior to welding.

The welding of stainless steel components to galvanized or previously galvanized carbon steel is prohibited. The welding of stainless steel components to carbon steel components coated with zinc-bearing paint is also prohibited even if the coating has been removed.

- 5.1.13 All base metals used shall be traceable to a material test report. The material test report shall have actual test report values.
- 5.1.14 Weld bevels may be prepared by machining, grinding, or thermal cutting. The bevel surface shall be smooth and meet the required weld joint design. All weld bevels shall be ground / machined to bright metal prior to welding.
- 5.1.15 The parts to be joined by fillet welds shall be brought together as closely as practicable. The gap between faying surfaces of lap joints should not exceed 1/16 inch. If the separation is greater than 1/16 inch after straightening and assembly, the leg of the fillet weld shall be increased by the amount of separation, but the gap shall not exceed 3/16 inch. The use of filler material as shim stock is prohibited.
- 5.1.16 Flux, weld spatter, and slag shall be removed from each weld bead prior to depositing each succeeding pass.
- 5.1.17 Where full penetration joints are welded from both sides, the first pass shall be back-chipped, ground, or arc-gouged to sound metal before welding the second side. The requirement for back gouging shall be stated on the WPS.
- 5.1.18 Vertical welding shall be vertical-up unless otherwise approved for each specific application.
- 5.1.19 Care should be taken to minimize distortion during welding. Staggering and back-stepping are acceptable methods.
- 5.1.20 Shims and plates may be welded as detailed by the design.
- 5.1.21 The maximum interpass temperature shall not exceed 350 °F for austenitic stainless steels.
- 5.1.22 Equipment manufacturers' requirements and limitations on welding and cutting/gouging in terms of preheat/interpass temperature, heat input, technique and methods shall be followed.
- 5.1.23 Preheat shall be per the applicable Code unless stated otherwise.
- 5.1.24 The Seller shall submit the following for Buyer review and acceptance prior to use in accordance with the G-321-E:
 - Welding Procedure Specifications and Procedure Qualification Records
 - Shop drawings
 - NDE procedures

5.2 Welding and Non-Destructive Examination (NDE) Requirements

- 5.2.1 Welding of the housing joints and housing to mounting platform joints shall conform to the requirements of ASME AG-1 1997 AA-6300. Qualification of welding procedure

specifications and welder or welding operators shall be in accordance with ASME BPVC Code Section IX or AWS D9.1.

Non-Destructive Examination (NDE) and inspection requirements shall be in accordance with AA-6331 and AA-6334.

- a) 100% Visual Testing (VT) shall be performed on all welds. The VT acceptance criteria shall be in accordance with AA-6331.
- b) 100% Liquid Penetrant Testing (PT) shall be performed in accordance with ASTM E165 and the PT acceptance criteria shall be in accordance with AA-6334.
- c) Deleted

5.2.2 Welding procedure specifications to be used in the fabrication of the mounting frame and welders or welding operators performing welding of the mounting frame shall be qualified in accordance with AWS D1.6.

NDE procedures, NDE methods, and NDE acceptance criteria shall be in accordance with AWS D1.6 and the applicable ASTM standards specified in AWS D1.6.

NDE of all fillet and groove welds (complete joint penetration or partial joint penetration) of the mounting frame weldments shall be performed using the VT and PT methods to the extent specified by AWS D1.6 Annex H.

5.2.3 For inlet and outlet connections, welding procedure specifications (WPSs) used to join the raised face flange conforming to ASME B16.5 to the housing assembly (ASME AG-1) shall be qualified in accordance with the requirements of ASME BPVC Section IX. Welders and welding operators shall be qualified in accordance with ASME BPVC Code Section IX.

NDE of the girth and miter weld joining the flange to the housing assembly shall be in accordance with the requirements of ASME B31.3, 1996, Chapter VI for Normal Fluid Service.

Procedures for NDE shall be in accordance with the requirements of B31.3, 1996, Paragraph 343-345.

5.2.4 Welding procedure specifications for welding of rotating parts shall be qualified in accordance with ASE D14.6. Welders or Weld operators shall be qualified in accordance with AWS D14.6.

NDE of all fillet welds and groove welds of rotating parts (complete joint penetration and partial joint penetration) perform 100% PT and VT in accordance with AWS D14.6.

5.2.5 Repairs required as a result of weld rejection by either Buyer or Seller shall be fully documented in accordance with Seller's quality assurance (QA) program. Weld repairs shall be performed in accordance with a buyer approved WPS. Weld repair records shall include NDE reports that provide verification of defect removal and soundness of the completed weld. Weld repair records shall be included with the document page.

5.2.6 Welding procedure specifications (WPSs) and procedure qualification records (PQRs) shall be

submitted to Buyer for review and permission to proceed prior to use. The WPSs and PQRs shall be submitted with a weld map in order to determine the suitability of the WPS for the weld application. Each WPS shall be prepared and qualified in accordance with the requirements of the above listed standards.

- 5.2.7 The Seller shall show the applicable WPS and the nondestructive examination (NDE) method for each weld joint on the weld map. The weld map shall identify each joint with a unique identification number. For each weld joint, the following items shall be specified in the weld map: the joint identification, the joint type, the components to be joined, material specification for each base metal component to be joined, material thickness of the components to be joined, weld filler specification for the filler metal, type of NDE required, the extent of NDE required, the NDE procedure number to be used for examination, the WPS number, and the PMI requirement (yes/no). The weld map may consist of one or more of the following: shop drawings, the applicable weld joint detail, fabrication drawing notes, a table, or a matrix.
- 5.2.8 The Seller's Welder Qualification Records shall be current and made available to the Buyer upon request. All welders and welding operators shall be qualified per the applicable welding code described above. The Buyer reserves the right to require the testing or retesting of welders for qualification in accordance with the applicable code. All costs and material required for the qualification of welders shall be at the Seller's expense.
- 5.2.9 Tack welds shall be made using a Buyer-accepted WPS with weld filler material suitable for the base material.
- 5.2.10 After opening shipping containers of electrodes, fluxes, and other welding materials, their storage and handling shall be as specified in the manufacturer's recommendations and per applicable welding code requirements.
- 5.2.11 Deleted
- 5.2.12 Metal-cored electrodes shall not be used, unless approved by the Buyer.
- 5.2.13 Welding materials shall be selected so that the deposited weld metal is similar in chemical composition and not significantly harder or stronger than the base metal.
- 5.2.14 Acceptable Welding Processes and Limitations:
 - 5.2.14.1 Shielded Metal Arc Welding – SMAW
 - 5.2.14.2 Gas Metal-Arc Welding – GMAW: Spray, including pulse spray transfer – unlimited thickness; Globular metal transfer – 3/8-inch maximum material thickness; Short circuiting transfer mode – Prequalified WPS- 3/16-inch maximum material thickness, Qualified WPS - 1/4-inch maximum material thickness; Surface Tension Transfer® – Prequalified WPS- 3/16-inch maximum material thickness, Qualified WPS - 1/4-inch maximum material thickness
 - 5.2.14.3 Flux Cored Arc Welding – FCAW
 - 5.2.14.4 Gas Tungsten Arc Welding – GTAW
 - 5.2.14.5 Fabrication welding may be achieved by any one or combination of the above welding

processes. The use of other welding processes shall require specific written authorization by Buyer.

6 Tests and Inspections

6.1 General

- 6.1.1 Seller shall conduct and be responsible for all shop tests called for in this specification and applicable Standard and referenced documents. Seller shall furnish all facilities necessary for the performance of such tests.
- 6.1.2 Seller shall submit an inspection and test plan for Buyer review.
- 6.1.3 Seller shall complete and submit reports of all testing and inspections required by this specification and per Form G-321-E & G-321-V of the MR. Each report shall identify the component tested or inspected, date performed, applicable procedures, acceptance criteria, signature of person performing the test or inspection, results, and conclusions.
- 6.1.4 Seller shall submit reports of all control and calibration of measuring and test equipment which shall be in accordance with Article AA-5130 of ASME AG-1.

6.2 Personnel Certifications

- 6.2.1 Personnel performing nondestructive examination (NDE) or reviewing NDE results shall be certified to ASNT-SNT-TC-1 A, Level II or Level III. Personnel who perform NDE (including magnetic particle testing, ultrasonic testing, liquid penetrant testing, electromagnetic testing, leak testing, acoustic emission testing, and visual testing) to specified acceptance criteria shall be qualified to a "Written Practice" (or procedure) meeting the requirement of the American Society for Nondestructive Testing Recommended Practice No. SNT-TC-1A. This "Written Practice" must meet all the requirements from any one given edition of SNT-TC-1A (and its applicable supplements) as follows: 1988, 1992, 1996, 2001, and 2006. Only the SNT-TC-1A edition selected and its applicable supplements shall be used in the "Written Practice" and that edition shall be met in its entirety (except as shown below). Combining SNT-TC-1A contents from one edition year with another edition year is prohibited, except as follows: If the 1988, 1992, or 1996 editions are utilized, the additional requirements for periodic technical performance evaluation and documentation found in paragraphs 10.2 and 12.1 of the 2006 Edition shall also be met.

The re-certification interval for Level III nondestructive examination personnel shall not exceed five years.

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

6.3 Non-Destructive Examinations

- 6.3.1 NDE procedures shall be submitted to Buyer for review and permission to proceed prior to use.

- 6.3.2 Seller shall perform NDE in accordance with Seller's procedures. NDE may include visual and liquid penetrant exam procedures.
- 6.3.3 Exhauster pressure boundary welds shall be 100% visual tested and liquid penetrant tested at a minimum. Exhauster non-pressure boundary welds shall be 100% visual tested.
- 6.3.4 Seller shall submit Quality Verification Documents (NDE reports) in accordance with the applicable technical specification and the PO Section 3, Form G-321-V.

6.4 Shop Tests

- 6.4.1 Seller shall perform standard factory tests, which at a minimum, include the tests listed in Section 6.4.2 through 6.4.9, as well as all tests called out in following Exhibit:
 - a) Deleted
 - b) Exhibit 2: *Low Voltage Induction Motors*, Section 5.1
 - c) Deleted
- 6.4.2 Exhauster performance testing shall be in accordance with AMCA 99 and 210.
- 6.4.3 Functional performance test for electrical equipment.
- 6.4.4 Exhauster casing pressure test.
- 6.4.5 Pressure testing of shaft seal.
- 6.4.6 Vibration performance shall be checked and reported over the entire range of the Exhauster tests.
- 6.4.7 A meg-ohm test of all wires shall be performed prior to termination of all wires pulled into conduit. The meg-ohm test results shall be certified, documented and submitted to Buyer for review.
- 6.4.8 A continuity check of all wiring shall be performed to verify conformance with Seller's wiring schematics. The continuity check test results shall be certified, documented and submitted to Buyer for review.
- 6.4.9 Seller shall provide all equipment to perform a lifting test in the shop, demonstrating that the lifting lugs or attachment points are adequate to support the Exhausters without any distortion.

6.5 Site Tests

- 6.5.1 Buyer startup personnel will perform commission testing after initial installation at the WTP.

7 Preparation for Shipment

7.1 General Requirements

- 7.1.1 Equipment shall be packaged, prepared for shipment, handled, and stored in accordance with 24590-WTP-3PS-G000-T0003, *General Specification for Packaging, Handling, and Storage Requirements*.
- 7.1.2 All results of shop tests and inspections for the Exhausters shall be reviewed by the Buyer prior to preparing and packaging the Exhausters for shipment.
- 7.1.3 Seller shall provide lifting eyes or lugs to facilitate lifting and handling of the exhausters. Lifting eyes or lugs shall be certified suitable for the safe, balanced lifting and the handling of the equipment.

7.2 Cleanliness

- 7.2.1 Seller's cleaning procedures shall be submitted to the Buyer for information
- 7.2.2 Prior to surface preparation, visually examine welds, the exhauster impeller and air stream surfaces of the Exhauster housing. Remove all dirt, oil and grease, loose mill scale, weld spatter and other foreign matter.

7.3 Tagging

- 7.3.1 Nameplates shall be in accordance with Exhibit 2: *Low Voltage Induction Motors*, Section 4.3.
- 7.3.2 The information shall be stamped or etched on the nameplate using characters no less than ¼ inch tall.
- 7.3.3 The attachment and location of nameplates shall be in accordance of Articles AA-9130 and AA-9140 of ASME AG-1.
- 7.3.4 All packages shall be clearly and suitably tagged to at least show the Seller's name, Buyer's name, plant item number, purchase order number, packaged contents, and parts for each packaged.
- 7.3.5 Metal tags that identify the maximum design load (excluding dynamic load factor) shall be provided for all lifting lugs, bails and other lifting points.
- 7.3.6 Deleted
- 7.3.7 Instruments shall have instrument tags showing the instrument tag number, manufacturer's name, model or serial number, Buyer's PO number, body material, pressure, and temperature rating.

7.4 Packaging and Shipping Instructions

- 7.4.1 Exhauster inlet and outlet connections shall be provided with temporary protective covers. These covers will be removed prior to connection to Buyer's piping.

8 Quality Assurance

8.1 General Requirements

Seller's Quality Assurance Program (QAP), as a minimum, shall contain the requirements detailed in the CM Data Sheet Supplier Quality Assurance Program Requirements data sheet listed as Attachment 1 in Part 2 of the MR.

8.2 Quality Related Components

- 8.2.1 The successful bidder must pass a pre-award evaluation by the Buyer. Seller shall demonstrate that its quality program is in compliance with the procurement quality requirements listed in the Supplier Quality Assurance Program Requirements Data Sheet. Seller shall allow the Buyer, its agents, and DOE access to their facility and records pertaining to this purchase order for the purpose of QA audits and surveillance at mutually agreed times.
- 8.2.2 SELLER shall not procure or retrieve material either until BUYER has performed a commercial grade survey of SELLER's quality assurance program or until BUYER has waived this requirement for a commercial grade survey in lieu of other dedication methods.
- 8.2.3 SELLER shall notify BUYER (14) business days in advance of performing an activity requiring Source Verification.
- 8.2.4 The specific Quality Assurance criteria is specified on the CM Datasheet, in the Supplier Category of "*Manufacturing (Design/Build) including Manufacture by Sub-Tier Suppliers*", which is attached to the MR.

9 Configuration Management

9.1 General

- 9.1.1 The equipment covered by this specification is identified with the plant item number shown in the MDS in Part 2 of the MR. Each item shall be identified in accordance with Section 7.3 of this specification. Configuration Management is maintained by conformance to approved drawings and procedures. If approved drawings and procedures cannot be followed, Buyer shall be promptly notified.

10 Documentation and Submittals

10.1 General

- 10.1.1 Seller shall submit to Buyer the Engineering and Quality Verification documents in the forms, quantities, and timing shown in Form G-321-E, Engineering Document Requirements, and Form G-321-V, Quality Verification Document Requirements, in Part 2 of the MR.
- 10.1.2 All deviations and/or conflicts considered for incorporation in the work must be submitted to the Buyer on completed Supplier Deviation Disposition Request (SDDR) form, as attached to Part 2 of the MR, for Buyer's approval.

10.2 Schedules

10.2.1 Schedule and Drawing Index

A schedule and drawing index (15EX form) shall be submitted which tracks the scheduled and actual delivery of each submittal.

10.2.2 Engineering and Fabrication Schedule

Seller shall submit an engineering and fabrication schedule with bar charts or critical path method diagrams detailing the chronological sequence of events. Schedule shall include Supplier Quality witness/hold points. Schedule does not suffice for formal notification for witness/hold points for which a separate notification is still required in accordance with the witness/hold point requirements (i.e. 5 days advance notice).

10.3 Submittals

10.3.1 Drawings

10.3.1.1 Outline Drawings

Seller shall provide drawings with equipment layout and outline dimensions. Drawings shall show external envelope, including lugs, centerline(s), location and size for electrical cable, service connections, isometrics, and mounting details. A dimensional layout drawing shall show the location of electrical and control equipment. Outline and dimensional drawings shall be provided for all instruments shipped loose for Buyer's installation. The drawing shall include the instrument tag number. Instrument installation details shall be submitted for the Buyer's review one month prior to proceeding with instrument installations.

In addition, Seller shall provide drawings to meet the requirements of the following:

- a) Deleted
- b) Exhibit 2, *Low Voltage Induction Motors*, Section 9.1.1(b).
- c) Deleted
- d) Deleted
- e) Exhibit 3, *Structural Design Loads for Seismic III & IV Equipment and Tanks*, Section 6.

10.3.1.2 Electrical Drawings, Schematics, and Wiring Drawings

Seller shall provide single line diagrams, schematic diagrams, equipment internal wiring diagrams, instrument loop diagrams, and interconnection wiring diagrams for electrical items. Point to point wiring diagrams shall identify all instruments with the Buyer's tag numbers, grounding methods for incoming cable shields, and instruments with their terminals in relative location. These items shall be in accordance with the following:

- a) Deleted
- b) Exhibit 2, *Low Voltage Induction Motors*, Section 9.1.1(c).
- c) Deleted
- d) Deleted

10.3.1.3 Assembly Drawings

Seller shall provide assembly drawings per Exhibit 2, *Low Voltage Induction Motors*, Section 9.1.1(i).

10.3.2 Data Sheets

10.3.2.1 Mechanical Data Sheet

Seller shall submit Buyer's Exhauster Mechanical data sheet, completely filled out by Seller showing all information required to determine that the units are of the design and materials specified here in. Exhauster performance curves at 60%, 80% and 100% of synchronous speed (3600 RPM) shall be provided.

10.3.2.2 Motor Data Sheets

Seller shall submit completed motor data sheets in accordance with Exhibit 2, *Low Voltage Induction Motors*, Section 9.1.1(a).

10.3.2.3 ASD Data Sheets

Deleted

10.3.2.4 Speed Sensor and Transmitter Data Sheet

Seller shall submit Seller's speed sensor and transmitter data sheets for Buyer's review and acceptance.

10.3.2.5 Design Life Assessment Data

Seller shall provide the confirmation and supporting data to the Buyer that the estimated useful life expectancy of 40 years with periodic maintenance is achievable per this specification section 3.3.3 and 3.3.4. A condition of the assessment is the replacement of bearings based on installed vibration analysis.

10.3.3 Procedures

10.3.3.1 Electrical Test Procedures

Seller shall provide electrical test procedures to demonstrate that design functional and operational parameters (impulse, overload, continuity, voltage, temperature rise) for electrical equipment associated with exhauster are met.

In addition, electrical test procedures shall be in accordance with Exhibit 2, *Low Voltage Induction Motors*, Section 5.1

10.3.3.2 Welding procedures, NDE Procedures, and Personnel Qualifications

Seller shall submit the following procedures for Buyer review:

- a) Welding procedures as noted in section 5.2 of this specification
- b) NDE procedures as noted in section 6.3 of this specification
- c) Personnel qualification as noted in section 6.2.2 of this specification.

10.3.3.3 Material Control Procedures

Seller shall provide material control procedures as described in Section 4.1.9 of this specification.

10.3.3.4 Functional Shop Test Procedure

Seller shall submit functional shop test procedure of instrumentation functional testing to demonstrate to the Buyer the functionality of the system. A simulated input signal shall be injected, varied over the full range for each device, calibrated and checked for correct operation. Instruments shall be calibrated with test and calibration equipment that are traceable to NIST standards. Supplier shall provide certification of calibration for all test equipment used to calibrate instruments.

10.3.3.5 Positive Material Identification (PMI) Procedures

Seller shall submit procedures covering how PMI will be conducted and documented per Exhibit 4, *Positive Material Identification (PMI) for Shop-Fabrication*, Section 3.2.

Additionally, Seller shall submit PMI welds produced by subcontractor as part of Seller quality control verification process.

10.3.3.6 Pressure Test Procedure

Seller shall submit pressure testing procedures that address pressure and shaft leakage tests.

10.3.3.7 Inspection Procedures

Seller shall provide inspection procedures for the purpose of determining that specified requirements (e.g. dimensions, properties, performance results, etc.) are met.

10.3.3.8 Cleaning Procedures

Seller shall provide cleaning procedure as noted in Section 7.2 of this specification.

10.3.3.9 Radiographic Examination Procedures

Deleted

10.3.3.10 Liquid Penetrant Examination Procedures

Seller shall conduct weld inspections for soundness using liquid penetrant examinations on each exhauster in accordance with Section 6.3 of this specification.

10.3.3.11 Weld Consumable Storage and Handling Procedure

Deleted

10.3.4 Lists

10.3.4.1 Recommended Spare Parts List

Seller shall provide a list of recommended spare parts and items subject to wear needing periodic replacement, including the cost of each item. The list shall include manufacturer name, model number, shelf life, storage requirements, and lead time for each item.

In addition, the recommended spare parts list shall comply with the following:

- a) Deleted

- b) Exhibit 2, *Low Voltage Induction Motors*, Section 9.1.1(g).
- c) Deleted

10.3.4.2 Material List

Seller shall provide a material list with specific model, number, manufacturer and catalog cut sheets for all equipment.

10.3.4.3 Electrical Loads

Deleted

10.3.4.4 List of Documents for Buyer during Quality Surveillance Activities

Seller shall make a complete set of Buyer-reviewed drawings and other documents available to the Buyer's representative at the time quality surveillance activities are being conducted.

10.3.4.5 Instruments List

Seller shall populate instrument list in MS Access format provided by Buyer which lists each instrument and is arranged in numerical order. Seller shall populate the required fields as follows:

- a) Instrument tag number
- b) Seller's referenced tag number if applicable
- c) Service description
- d) Instrument type
- e) Signal type
- f) Data sheet number
- g) Location drawing number
- h) Instrument installation details
- i) Manufacturer name
- j) Model number
- k) Calibration range of instrument
- l) Set point
- m) Wiring diagram number
- n) Schematic drawing number
- o) Device address of serial communication link data
- p) I/O address of serial communication link data
- q) Shipped status (installed or loose)

10.3.4.6 Nameplate Engraving Drawings

Seller shall provide nameplate engraving drawings and list for all nameplates furnished. Nameplates shall meet the requirements of Section 7.3 of this specification.

In addition, nameplate engravings list shall be in accordance with:

- a) Deleted
- b) Exhibit 2, *Low Voltage Induction Motors*, Section 4.3

10.3.4.7 Bill of Materials (BOM)

Seller shall provide Bill of Materials (BOM) showing in complete detail split shipment packaging content with associated shipping dates, any sub-tier BOMs, and shipped loose component lists. As a minimum, BOM shall indicate manufacturer's name, part number, Buyer's tag number, Seller's reference drawing number(s), forecast ship date, actual ship date, quantity, weight, length, width, and height for each item.

10.3.5 Reports

10.3.5.1 Mechanical Test Reports

Seller shall provide a test report in accordance with Section 6 of this specification and include the following:

- a) Exhauster housing and shaft seal leakage tests reports
- b) Exhauster performance tests reports, including Exhauster curves
- c) Sound pressure levels
- d) Exhauster wheel/shaft vibration and mechanical test reports

10.3.5.2 Electrical Test Reports

Seller shall provide test reports that address the results of tests performed in accordance with Buyer-approved electrical test procedures.

In addition, electrical test reports shall be in accordance with Exhibit 2, *Low Voltage Induction Motors*, Sections 5.1 and 9.1.1(j)

10.3.5.3 Pressure Test Reports

Seller shall submit pressure test report as noted in Section 6.4.5 of this specification.

10.3.5.4 Inspection and Verification Reports

Seller shall submit quality records and test results for inspection and verification reports, liquid penetrant examination and verification reports, pressure testing and verification reports, visual inspection and verification reports.

Seller shall supply NDE test reports in accordance with Section 6.3 of this specification and welding codes listed in Section 5.2 of this specification.

10.3.5.5 Certificates of Compliance

Seller shall submit a Certificate of Compliance (C of C) document for review and approval by the AHJ that lists the USA Electrical Standard(s) that the equipment is evaluated to for its nationally recognized testing laboratories (NRTL) Listing. The certification shall confirm that the NRTL label will be shown on the OSHA website including the additional markings required to indicate acceptability for use in the USA. Seller shall certify that lifting eyes or lugs are suitable for the safe balanced lifting and handling of the equipment.

10.3.5.6 Motor Test Report

Deleted

10.3.5.7 Positive Material Identification (PMI) Reports

Seller shall submit PMI testing reports, including a PMI map per Exhibit 4, *Positive Material Identification (PMI) for Shop-Fabrication*, Section 6 and Section 4.1.10 of this specification.

10.3.5.8 NRTL Field Evaluation Reports

Deleted

10.3.5.9 ASD Manufacturer Shop Test Reports

Deleted

10.3.5.10 ASD Factory Acceptance Plans and Test Reports

Deleted

10.3.5.11 Exhauster Integral Test Report with Motor

Seller shall submit exhauster integral test report after a complete test with exhauster and motor contained as an assembly with all control devices, and provided instrumentation to demonstrate the parameters required for successful operation of the integrated exhauster system.

10.3.5.12 Exhauster's Rotors Balance Report

Seller shall provide exhauster's rotors balance report as described in Section 3.5.1.6 of this specification.

10.3.5.13 Weld Map

Seller shall submit a weld map which includes all welds in accordance with industry standard and Section 5.2.7 of this specification.

10.3.5.14 NDE Records

Seller shall keep records pertaining to NDE, base materials, filler materials, fabrication, and inspection in accordance with Seller's procedures.

10.3.5.15 Material Test Reports

Seller shall submit material test report (MTR) in accordance with Section 4.1.6 of this specification.

10.3.5.16 Independent Laboratory Qualification

Seller may qualify an independent laboratory for calibration, measurement or testing services if the laboratory meets the criteria listed in [Attachment A, see page 28] of this specification

10.3.5.17 Code Compliance Matrix

Deleted

10.3.5.18 RT Film and Reader Sheets

Deleted

10.3.5.19 Design Analysis Report

Deleted

10.3.5.20 Seismic Analysis

Seller shall provide Seismic Data Report in accordance with Exhibit 3, *Structural Design Loads for Seismic Category III & IV Equipment and Tanks*.

10.3.5.21 Certificates and Inspection Reports

Deleted

10.3.5.22 Code Data Report

Deleted

10.3.6 Calculations

10.3.6.1 Deleted

10.3.7 Product Data

10.3.7.1 Inspection and Test Plans

Seller shall provide their work inspections and tests plans for exhauster and motor.

10.3.7.2 Safety Data Sheets (SDS)

Seller shall submit SDSs for all chemicals and hazardous materials shipped to WTP, including but not limited to lubricants, gears oils, greases, solvent, etc.

10.3.7.3 Shipping Preparation

Seller shall provide shipping information in accordance with 24590-WTP-3PS-G000-T0003, *Engineering Specification for Packaging, Handling, and Storage Requirements*, Section 11.2 (drawings and a proposed tie down plan) and in compliance with the proper nameplate tagging in place per Sections 7.3.1 and 7.3.2 of this specification.

10.3.7.4 Software Configuration Documentation

Deleted

10.3.7.5 Functional Description

Deleted

10.3.7.6 Motor Description

Seller shall provide lubricant and gasket and seal information in accordance with Exhibit 2, *Low Voltage*

Induction Motors, Section 9.1.1(k) and (l).

10.3.7.7 Catalog Data

Deleted

10.3.7.8 Documentation Showing Harmonic Spectrum

Deleted

10.3.7.9 Ferrite Data

Seller shall submit ferrite data on welding materials.

10.3.7.10 Calibration Certificate for Instruments

Seller shall provide certification that all instruments supplied have been calibrated for the ranges appropriate for the selected application using National Institute of Standards and Technology (NIST) traceable calibrators and calibrating equipment. Seller shall provide calibration certificates for each tag number, with model type, model number, and serial number.

10.3.7.11 Motor Data

Seller shall provide the following data (if not already provided on motor data sheets) for use by others to ensure proper ASD interfaces:

- a) Speed-torque Curve
- b) NEMA Design Type
- c) Full Load Current
- d) Rated Horsepower
- e) Voltage
- f) Maximum Safe Operating Speed
- g) Full Load Speed
- h) Enclosure Type
- i) Service Factor
- j) Insulation Class
- k) Temperature Rise Above 40 °C Ambient
- l) Locked Rotor Current at 100 % Rated Voltage
- m) Duty Rating
- n) Resonant speed of motor/driven equipment in lateral, axial and torsional modes
- o) Time to ramp up to full motor speed from start
- p) Time to ramp down from full motor speed to stop

10.3.8 Manuals

10.3.8.1 Operation and Maintenance Manuals

Operation and maintenance manuals shall provide complete, detailed descriptions of components and instrumentation with data sheets showing design, construction, and performance data for equipment. Manual shall include drawings for operation, maintenance and repair, maintenance requirements, instructions and operational trouble-shooting guides. Manual/drawings shall include Original Equipment Manufacturer (OEM) part numbers.

In addition, Seller shall provide motor installation, operation, and maintenance manual and maintenance procedures, in accordance with Exhibit 2, *Low Voltage Induction Motors*, Section 9.1.1(f) and (n).

10.3.8.2 Installation Instruction Manual

Seller shall submit an Installation Instruction Manual in accordance with 24590-WTP-3PS-G000-T0003, *Engineering Specification for Packaging, Handling, and Storage Requirements*, Section 11.1.1.

Erection and installation manual shall provide complete, detailed procedures for installing and placing equipment in initial operation. These manuals shall include all erection and installation drawings.

10.3.8.3 Site Storage, Handling, and Maintenance Requirements Manuals

Seller shall submit a Site Storage, Handling, and Maintenance Requirements Manual with procedures and instructions for site storage, handling, and maintenance that will preserve equipment until it is put into operation in accordance with 24590-WTP-3PS-G000-T0003, *Engineering Specification for Packaging, Handling, and Storage Requirements*, Section 11.1.2.

10.3.8.4 Quality Assurance Manual

Seller shall submit their Quality Assurance Program (QAP) manual for review and acceptance by the Buyer (Section 8).

Attachment A: Qualification of Laboratory Service Providers

Laboratory service providers, such as suppliers of calibration services or material testing/analysis services, may be qualified without audit if they are accredited by the American Association for Laboratory Accreditation (A2LA), National Voluntary Laboratory Accreditation Program (NVLAP); International Accreditation Services, Inc. (IAS); ANSI-ASQ National Accreditation Board (ACLASS); Perry Johnson Laboratory Accreditation, Inc. (PJLA); Laboratory Accreditation Bureau (L-A_B); Korea Laboratory Accreditation Scheme (KOLAS); Sistema Italiano di Accreditamento (ACCREDIA); Comite Francais d' Accreditation (COFRAC); United Kingdom Accreditation Service (UKAS); or certification to ISO 9001 for calibration service providers when the company is in the original equipment manufacturer (OEM) and a justification for using ISO 9001 is documented . Use of these certifications/accreditations requires that:

- a) The supplier's QA Program permits the method of qualification;
- b) The procured service is included in the scope of the certification/accreditation;
- c) The certificate/accreditation must be current at the time the service is provided;
- d) The supplier must have and retain a copy of the certificate/accreditation in effect at the time of the provided service; and
- e) The supplier must evaluate the validity of the certificate/accreditation. This evaluation must be documented and retained for review by the purchaser.

For requisitions issued for quote after December 13, 2010, calibration services obtained using the options above must provide the following information:

- a) Calibration certificate/report shall include identification of the laboratory equipment/standards used.
- b) Calibration certificate/report shall include as-found and as-left data, regardless of the need for adjustment or repair.
- c) Well-defined and documented measurement assurance techniques or uncertainty analyses may be used to verify the adequacy of the measurement process. If such techniques are not used, the collective uncertainty of the measurement standards shall not exceed 25% of the acceptable tolerance for each characteristic being calibrated.
- d) Calibration certificate/repot shall include reference to the calibration procedure number and revision or date, or the report shall reference the Quality Manual and the revision or date.

Exhibit 1

Electrical Requirements for Packaged Equipment

Deleted

Exhibit 2

Low Voltage Induction Motors

Specification 24590-WTP-3PS-MUMI-T0002, Rev. 3 was used to create the following exhibit. Specification change notices (SCNs) have been evaluated and there are no applicable SCNs.

1 Scope	
1.1 General	
1.1.2	If conflicts arise between this exhibit and the primary mechanical packaged specification, the primary specification shall take precedence.
1.2 Equipment, Material, and Services Required	
1.2.2	All motors covered by this exhibit shall conform to the applicable requirements of NEMA MG1, ANSI, and NEC standards, except where a deviation is approved by the Buyer.
1.2.3	Motors manufactured to IEC standards, shall meet the applicable requirements of IEC-60034 and IEC-60072.
1.2.5	All materials and components associated with the fabrication of motors per this exhibit shall be new. Refurbished materials are not acceptable.
1.3 Acceptability Criteria	
1.3.1	All electrical equipment and material shall be suitable for installation and use in conformity with Article 110-3 of the National Electrical Code, NFPA 70-1999.
1.5 Definitions	Buyer: Bechtel National Inc. Supplier: This is a comprehensive term and includes seller, vendor, contractor, subcontractor, sub-supplier, etc. Primary Specification: The mechanical packaged equipment specification in which this "Low Voltage Induction Motors" exhibit is referenced.
2 Applicable Documents	For the purposes of this exhibit, the word "should" shall be replaced with the word "shall" wherever it appears in the referenced Codes and Standards. Any conflicts between the referenced documents shall be identified to the Buyer in writing for resolution. In general, when resolving conflicts, the following order of precedence shall apply: <ul style="list-style-type: none"> • Purchase Order (by the primary specification) • Data Sheets • This Exhibit • Referenced Codes and Standards • Manufacturer Standard
2.1 Codes	NFPA 70-1999 - National Electrical Code
2.2 Industry Standards	IEEE Std. 85 - Test Procedure for Airborne Sound Measurements on Rotating Electric Machinery IEEE Std.112 - Test Procedure for Poly-phase Induction Motors and Generators NEMA MG 1-1998 - Motors and Generators ABMA 9-1990 - Load Ratings and Fatigue life for Ball Bearings ABMA 11-1999 - Load Ratings and Fatigue Life for Roller Bearings IEC-60034 (As applicable) - Rotating Electrical Machines IEC-60072 (As applicable) - Dimensions and Output Series for Rotating Electrical Machines
3 Design Requirements	
3.1 General	
3.1.1	Motors shall be rated for continuous duty for 3-phase, 60 Hz, 460 volts.
3.1.2	All motors shall be NEMA Design B, except in special applications requiring higher starting torques where other NEMA Design is permitted.

3.2 Environmental Conditions	The actual environmental conditions requirement of the motors will be shown in the corresponding primary specification/data sheets.
3.3 Electrical Performance	
3.3.1 Voltage Rating	<ul style="list-style-type: none"> Motors 1/2 Hp to 300 Hp - 460 volts, 3-phase, 60 Hz <u>Note:</u> Deviation from these limits will be permissible if technically justified on a case-by-case basis.
3.3.2 Insulation System	Motors shall be furnished with Class F insulation minimum, and shall be selected for operation within their full load rating without applying the service factor.
3.3.3 Temperature Rise	Ratings shall be based on a maximum ambient temperature of 40 °C, 3,300 feet (1000 m) altitude or less, with a maximum temperature rise of 80 °C by resistance at 1.0 service factor, (90 °C temperature rise at service factor 1.15 up to 150HP). Inverter duty motors shall not exceed Class F rise at any speed under the defined load.
3.3.4 Locked Rotor Current	Unless otherwise approved by the Buyer, the locked rotor current of motors shall not exceed the values as shown in NEMA MG-1-1998, section 12.35.1 "Maximum Locked-Rotor Current for 60-Hz Design B, C, and D Motors at 230 Volts". The locked-rotor current of motors designed for voltage 460 shall be proportional to the ratio, 230/460.
3.3.5 Service Factor	The motor shall be sized so that it will not be loaded beyond its design power rating at service factor of 1.0.
3.3.6 Starting Duty	The motor shall be capable of two successive starts with the motor already at full load temperature, or three successive motor starts at ambient temperature, accelerating the load from zero up to full load speed with the motor terminal voltage between 80% and/or 110% of the rated voltage.
3.5 Mechanical Requirements	
3.5.1 General	
3.5.1.1	All motors heavier than 50 lbs shall be supplied with an eye bolt for lifting.
3.5.1.2	Where practical, the motor base shall be drilled for ground connection. A bolt shall be provided complete with nut and washers.
3.5.1.3	Vertical jacking bolts shall be furnished on all horizontal motors 1000 lbs and heavier.
3.5.1.5	Protection shall be provided against galvanic action between dissimilar metals by the use of gaskets, washers or other appropriate means.
3.5.2 Motor Enclosures	
3.5.2.1	Motor enclosures as required on the data sheets, shall be as follows: <ul style="list-style-type: none"> Motors ½ hp up to 200 hp: TEFC or TENV (IP54 for IEC motors)
3.5.2.2	Motor enclosures, bearing bracket and fan guard shall preferably be of ferrous material unless otherwise specified.
3.5.3 Drains	Where practical, corrosion resistant, replaceable automatic drainage fittings shall be provided at the low point(s) of the motor enclosure for water drainage.
3.5.4 Mounting	The mounting and shaft configuration on all motors shall be defined by the driven equipment manufacturer.
3.5.5 Bearing	
3.5.5.1	Unless otherwise indicated on the motor data sheets, continuous duty motors shall have anti-friction type bearings in accordance with the motor manufacturer's standard design. The bearings shall have basic rating life L-10 of 26,280 h minimum per ABMA 9-1990 or ABMA 11-1999.
3.5.6 Shaft Seals	
3.5.6.1	All motors, except those required to be explosion proof, shall have shaft seals suitable for the environment specified.

3.5.6.2	Shaft seals for continuous duty motors, shall be non-contact-while-rotating type and shall be used on both motor ends.
3.5.7 Rotor	Unless otherwise specified, all motors shall have die cast aluminum rotor cages as standard.
3.5.8 Bearing Lubrication	The lubricant and frequency of lubrication of the motors shall be defined by the manufacturer.
3.6 Conduit Boxes	
3.6.1 Motor Leads Conduit Box	<ul style="list-style-type: none"> a) Conduit boxes shall be rotatable in 90° turns, gasketed, cast iron construction with tapped conduit entrance hole(s). b) Conduit boxes for explosion proof motors shall have a machined metal to metal fit. c) A ground lug shall be provided inside the conduit box on all motors. d) Conduit box size shall be one size larger than NEMA MG-1/NEC standard.
4 Materials	
4.1 Prohibited Materials	The use of asbestos, PCB and mercury in the manufacture, fabrication, assembly and finish of the motors are prohibited.
4.2 Special Requirements	
4.2.1	Design requirements for special motors shall be determined jointly by the Supplier and the Buyer prior to any fabrication of the motor.
4.2.2	Motors for adjustable speed applications shall be rated for inverter duty. They shall be selected by the supplier, and designed and tested in accordance with NEMA MG-1 part 31.
4.3 Nameplates	<p>Each motor shall have a non-corrosive stainless steel nameplate with no less than the minimum information called for in NEMA MG 1. The nameplates shall be attached with pins of the same materials, with the following data as a minimum:</p> <ul style="list-style-type: none"> 1. Manufacturer's Type and Frame designation 2. Horsepower output 3. Time Rating 4. Temperature rise/Insulation Class 5. Speed at rated Load 6. Frequency 7. Number of Phases 8. Rated Voltage 9. Rated Load Current 10. Code Letter for Locked-rotor kVA 11. Service Factor 12. Buyer's Motor Tag No. <p>Additional Nameplate Information:</p> <ul style="list-style-type: none"> 1. Type of Enclosure 2. Manufacturer's name 3. Serial number or date of manufacture 4. Space heater voltage/rating
4.4 Noise Level	
4.4.1	Sound level shall be limited to values per NEMA MG-1, Table 9-1.
5 Tests and Inspections	
5.1 Shop Tests	
5.1.1	Unless with Buyer's prior written approval, all motors, size and type, shall be subjected to a "routine test". A complete or "full test" is required for motors if identified by the primary specification. All tests shall be performed in accordance with applicable National Codes and Industry Standards and/or Manufacturer Standard test procedures and acceptance. As required, all tests shall be performed at the manufacturer's facility. Certified test results shall be

	provided as identified in the primary specification.
5.1.2	The primary equipment Supplier shall maintain all test schedules and upon notification, the Buyer has the option to witness all the tests to be performed on the motor(s). The primary equipment Supplier has the ultimate responsibility of all submittals.
5.1.3	As a minimum, the following are considered "Routine Test" and "Full Test".
5.1.3.1	Routine Test: <ul style="list-style-type: none"> a) Measurement of winding resistance (cold). b) No-load readings of current, power, and nominal speed at rated voltage and frequency. c) Mechanical vibration check in accordance with NEMA MG-1, Part 7, using either elastic or rigid mount. d) High potential test in accordance with Paragraph 12.3 of NEMA MG-1 Part 12.
5.1.3.2	Full test (Performance Test): <ul style="list-style-type: none"> a) Not used. b) Not used. c) Not used. d) High potential test in accordance with Paragraph 12.3 of NEMA MG-1 Part 12. e) Inspection (at full load) of bearings and mechanical operation of motor. f) Not used. g) Not used. h) Not used. i) Not used. j) Measurement to allow calculation of efficiency at full, three quarter and half load. k) Measurement to allow calculation of power factor at full, three quarter and half load. l) Mechanical vibration check in accordance with NEMA MG-1, Part 7, using either elastic or rigid mount. <p>In cases where one or more of the "full" tests are specified and there are duplicate motors, only one motor will be subjected for the specified "full" tests.</p>
6 Preparation for Shipment	Packaging, shipping, handling and storage requirements for motors, associated with this exhibit shall be in accordance with applicable sections of the Material Requisition/Purchase Order of the primary specification.
9 Documentation and Submittals	
9.1 General	
9.1.1	For each motor supplied by the driven-equipment manufacturer, the Supplier shall furnish the following documents as per form G-321E in the primary material requisition: <ul style="list-style-type: none"> a) Completed motor data sheets attached to the primary material requisition. b) Dimensional Outline Drawings for motor including terminal box dimensional details and arrangement. c) Wiring diagram d) Not used e) Not used f) Installation, operation and maintenance manual g) Recommended spare parts list for one year of operation h) Not used i) Assembly drawing, if required j) Test reports as specified in the primary specification

	<ul style="list-style-type: none">k) Lubricant Data - Supplier shall identify the manufacturer, grade, viscosity, applicable API standard or recommended substitutions. SDS shall be provided for the lubricant.l) Data for the gaskets or seals - Supplier to provide the shelf life and cure dates of gaskets or sealsm) Not usedn) Maintenance procedures
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Exhibit 3

Structural Design Loads for Seismic III & IV Equipment and Tanks

Specification 24590-WTP-3PS-FB01-T0001, Rev. 6 was used to create the following exhibit. Specification change notices (SCNs) have been evaluated and there are no applicable SCNs.

1 Scope	
1.1 General	<p>This exhibit provides structural design loads for Seismic Category III (SC-III) and Seismic Category IV (SC-IV) equipment and tanks on the River Protection Project – Waste Treatment Plant (RPP-WTP) located at the Department of Energy (DOE) Hanford Site in Richland, Washington. The seismic categories are derived from the performance categories defined in DOE-STD-1020-94 (Ref. 2.7). This specification also defines the seismic design load for SC-III qualification testing. The loads include dead, live, wind, fluid, earthquake, snow, ashfall, lateral earth pressure, operating pipe reaction, and thermal loads.</p> <p>This exhibit is to be used in combination with the Equipment/Tank Technical Specifications, which may include supplemental codes applicable to the specific Structure, System, or Component (SSC). In case of conflicts between this exhibit and other technical requirements in the Equipment/Tank Technical Specifications, the Seller shall identify such conflicts to the Buyer in writing and obtain resolutions documented in writing. These conflicts may also include inconsistency of load definitions, conditions and combinations as specified by the referenced codes and standards.</p>
1.2 Definitions	<p>EQUIPMENT: Mechanical, electrical, or control system component or element that is part of a mechanical and/or electrical system.</p> <p>SC-IV EQUIPMENT/TANK: Equipment/Tank required to be designed for the SC-IV loads and load combinations provided in this exhibit. This includes equipment/tank assigned SC-IV for seismic design per the facility-specific Preliminary Documented Safety Analysis (PDSA) document or Documented Safety Analysis document.</p>
2 Applicable Documents	For the codes and standards listed below, the specific revision or effective date identified, as well as the specific revision or effective date of codes and standards that they incorporate by reference (daughter codes and standards), shall be followed. The effective dates and revisions listed in Section 2 shall apply to subsequent references to the codes and standards within this exhibit.
2.1 American Concrete Institute (ACI)	ACI 318-99 Building Code Requirements for Structural Concrete and Commentary.
2.2 American Concrete Institute (ACI)	ACI 349-01 Code Requirements for Nuclear Safety related Concrete Structures and Commentary.
2.3 American Institute of Steel Construction (AISC)	AISC M016-89 Manual of Steel Construction — Allowable Stress Design, Ninth Edition.
2.4 American Society of Civil Engineers (ASCE)	Manuals and reports on Engineering Practice; No. 78, Structural Fire Protection, ASCE 1992.
2.5 American Society of Civil Engineers (ASCE)	Minimum Design Loads for Buildings and Other Structures, ASCE 7-98.
2.6 American Society for Testing and Materials (ASTM) International	Material for steel anchor bolts, ASTM F1554 grade 36, unless specified otherwise on the design drawings.
2.7 Department of Energy (DOE)	DOE-STD-1020-94 (Including Change Notice #1 dated Jan 1996) Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities.
2.9 International Conference of Building Officials	Uniform Building code, UBC-97

(ICBO)	
2.11 ANSI American National Standards Institute (ANSI)	ANSI/AISCC N690-1994, Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities
2.15 American Society of Mechanical Engineers (ASME)	ASME Boiler and Pressure Vessel Code, Section II, Part D, Subpart 1 (Any edition of the code between 1995 and current edition)
3 Methodology	<p>Methodology used in the seismic design of Seismic Category III & IV equipment and tanks shall be as defined in the Equipment/Tank Technical Specifications and the supplemental codes applicable to the SSC.</p> <p>For SC-IV equipment designed to UBC-97 (Ref. 2.9) Section 1632, attachments for floor or roof mounted equipment weighing less than 400 pounds need not be designed.</p> <p>Stainless Steel supports for Quality Level Q equipment shall be qualified using the allowable stresses from ANSI/AISC N690-1994 (Ref 2.11) and the load combinations from section 5.1 of this specification.</p> <p>Stainless Steel Supports for Commercial Grade (CM) equipment shall be qualified using the allowable stresses from either ANSI/AISC N690-1994 (Ref 2.11) or AISC M016-89 (Ref 2.3) and the load combinations from section 5.1 of this exhibit.</p>
4 Design Loads	
4.3 Earthquake Loads	
4.3.1	<p>Earthquake loads on equipment and tanks supported by structures shall be calculated per the provisions of UBC-97 (Ref 2.9), Section 1632, using the following parameters:</p> <p>$I_p = 1.0$ For SC-IV equipment tanks $C_a = 0.24$</p> <p>$a_p = 1.0$ for rigidly mounted rigid* equipment $= 2.5$ for flexible equipment** and flexibly mounted rigid equipment $= 1.0$ for tanks</p> <p>* Rigid equipment are defined as those with a fundamental period of less than or equal to 0.06 seconds ($\geq 17\text{Hz}$).</p> <p>** Flexible equipment are defined as those with a fundamental period of greater than 0.06 seconds ($< 17\text{Hz}$).</p> <p>$R_p = 3.0$ To be used when equipment is attached directly to structural steel $= 1.5^{***}$ To be used by suppliers unless otherwise specified on the Equipment/Tank Specification</p> <p>*** Based on actual conditions and location, Buyer's Civil, Structural, Architectural (CSA) personnel may approve an R_p of 3.0 in calculations.</p>
4.3.2	<p>Earthquake loads for self-supporting tanks (i.e. supported on their own foundation) shall be calculated per the provisions of UBC-97 (Ref. 2.9), Section 1634, using the following parameters:</p> <p>$I = 1.0$ for SC-IV tanks $C_a = 0.24$ $C_v = 0.32$</p>

4.3.3	<p>For qualification by analysis, the loads and load combinations per Section 5 of this specification shall be combined with the appropriate loads and load combinations from Equipment/Tank Specifications. Anchorage analysis of equipment must also meet the loading requirements of this specification.</p> <p>UBC-97 (Ref. 2.9) requires that structures, systems, and components be designed for seismic loads. Building structures and non-building structures shall be designed for the seismic forces described in UBC-97 Sections 1630 and 1634, respectively. The vertical component of earthquake ground motion may be taken as zero for Allowable Stress Design. Systems and components (equipment) shall be designed for lateral seismic forces only, as described in Section 1632. Self-supporting tanks shall be designed for lateral seismic forces as described in Section 1634. Alternatively, systems and components (equipment) may be qualified by testing, as described in Section 4.3.4</p>
4.4 Dead Loads	Dead loads include the weight of permanent equipment/tanks as well as their Attachments.
4.6 Thermal Loads	
4.6.1 Base Temperature	The base temperature for thermal analyses shall be 70 °F. This temperature is based on recommendations from ACI 349 (Ref. 2.2).
4.6.2 Outdoor Ambient Temperatures	<p>Unless specified otherwise in the Equipment/Tank Technical Specifications or datasheets, ambient air temperatures shall be as follows:</p> <p>For SC-IV equipment: 115 °F maximum, -25 °F minimum</p>
4.6.3 Operating Temperatures (Normal and Abnormal), T _o	Operating (normal and abnormal) temperatures are provided in WTP Equipment/Tank Technical Specification. Abnormal Temperatures are due to an anticipated eight-hour loss of cooling event, which is postulated to occur once per year, and is not the result of an accident or natural phenomena hazards (NPH). Abnormal temperature thermal loads shall not be considered concurrent with earthquake (E) loads. For load combinations which include earthquake (E), T _o shall be normal operating temperature thermal loads only. For load combinations without seismic (E), T _o shall be greater of normal or abnormal operating temperature thermal loads.
4.6.5 Temperature Limitations on Structural Elements	SC-IV designed steel and stainless steel structures shall use reduced yield stress (F _y) and elastic modulus (E) in accordance with the ASCE Engineering Practice 78 (Ref. 2.4), see example provided in Appendix A.
5 Loads and Load Combinations	The following loads and load combinations are applicable to both SC-III and SC-IV equipment and tanks.
5.1 Structural Steel Design Load Combinations	<p>For the design of equipment and tanks, the following loads shall be combined with other applicable loads, per the provisions of the Equipment/Tank Technical documents included with the Purchase Order (P.O.).</p> <ul style="list-style-type: none"> A Ashfall Loads D Dead Loads E Earthquake (Seismic) Loads (Due to DBE) L Live Loads S_N Snow Loads W Wind Loads T_o Thermal Loads during Normal & Abnormal Operating Conditions T_a Thermal Loads due to Accident (DBE) Temperature P_o Maximum or minimum differential pressure load generated by Normal or Abnormal HVAC operations P_a Maximum or minimum differential pressure load generated by DBE S Allowable Stress per Allowable Stress Design Method <p>For the design of equipment/tank supports, the following service-level load combinations shall apply. Note: the 1/3 allowable stress increase discussed in UBC-97 (Ref. 2.9), Section</p>

	<p>1612.3.2, has been incorporated into the following combinations through the use of the 0.75 factor. No further stress increase is allowed.</p> <p>The following load combinations are based on Section 1612.3.2 of UBC-97 and using the Allowable Stress Design Values of AISC M016, ASD Ninth Edition (Ref. 2.3).</p> $S = D+L+A+P_o+T_o$ $S = D+L+S_N+P_o+T_o$ $S = 0.75(D+L+W+P_o+T_o)$ $S = 0.75(D+L+S_N/2+W+P_o+T_o)$ $S = 0.75(D+L+S_N+W/2+P_o+T_o)$ $S = 0.75(D+L+P_o+T_o+E/1.4)$ $S = 0.75(0.9D+P_o+T_o\pm E/1.4)$ $S = 0.75(D+L+P_a+T_a)$ $S = 0.75(D+L+T_a+E/1.4)$ <p align="right">Where T_a is Due to HELB</p>
5.1.2 Other Loads	<p>Where other loads are to be considered in design, each applicable load shall be added to the combinations specified above per requirements of Section 1612.3.3 of UBC-97 (ref. 2.9).</p>
5.2 Reinforced Concrete Design Load Combinations (Anchorage design)	<p>For equipment and tanks anchorage design, the following loads shall be combined with other applicable loads, per the provisions of the Equipment/Tank Technical Specifications.</p> <ul style="list-style-type: none"> A Ashfall Loads D Dead Loads E Earthquake Loads F Fluid Loads H Lateral Earth Pressure Load L Live Loads R_o Operating Pipe Reaction Load S_N Snow Loads T_o Thermal Loads during Normal & Abnormal Operating Conditions W Wind Loads T_a Thermal Loads due to Accident (DBE) Temperature P_o Maximum or minimum differential pressure load generated by Normal or Abnormal HVAC operations P_a Maximum or minimum differential pressure load generated by DBE U Required Strength per Strength Design Method <p>The following load combinations are based on section 9.2 of ACI 318 (Ref. 2. 1).</p> $U = 1.4D+1.7L+1.7A$ $U = 1.4D+1.7L+1.7S_N$ $U = 0.75(1.4D+1.7L+1.7W)$ $U = 0.75(1.4D+1.7L+1.7S_N+1.7W)$ $U = 0.9D\pm 1.3W$ $U = 1.4D+1.7L+1.7A+1.7H$ $U = 1.4D+1.7L+1.7S_N+1.7H$ $U = 0.9D+1.7H$ $U = 1.4D+1.7L+1.7A+1.4F$ $U = 1.4D+1.7L+1.7S_N+1.4F$ $U = 0.9D+1.4F$ $U = 1.4(D+T_o)$ <p>In addition, the following load combinations based on UBC Section 1612.2.2 shall apply.</p>

	$U = 1.1(0.9D \pm E)$ $U = 0.75(1.4D + 1.7L + 1.7S_N + 1.4T_a + 1.4R_o)$ <p>Where T_a is Accident (DBE) Temperature [see 4.6.4(b)]</p> $U = D + L + S_N + F + H + T_a + R_o + E$ <p>Where T_a is due to (HELB) [see 4.6.4(a)]</p> $U = 0.75(1.4D + 1.7L + 1.4T_o + 1.4P_o + 1.4R_o)$ $U = 0.75(1.4D + 1.7L + 1.7S_N + 1.4T_o + 1.4P_o + 1.4R_o)$ $U = 1.4(D + T_o + P_o)$ $U = 1.1(1.2D + L + 0.2S_N + 1.3F + 1.6H + 1.2T_o + 1.2P_o + 1.2R_o + E)$ <p>Where T_o and P_o are the normal operating values only</p> $U = 0.75(1.4D + 1.7L + 1.7S_N + 1.4T_a + 1.4P_a + 1.4R_o)$ $U = D + L + S_N + F + H + T_a + P_a + R_o$
6 Equipment and Tank Anchorage	<p>The Supplier shall furnish the Buyer with the following information:</p> <ul style="list-style-type: none"> • Location of anchorage in relation to equipment. • Design loads on the anchorage shall be reported by individual load and load combination. • Coordinate system and sign conventions. <p>The selected anchor bolt material for the WTP project is ASTM F1554 (Ref. 2.6). Use of other anchor bolt materials, require the approval of the Buyer.</p>

Appendix A

Strength and Modulus Reduction for Structural Steel & Stainless Steel

The equation below is from ASCE Manuals and Reports on Engineering Practice No. 78, Structural Fire Protection, Appendix A.1.2.2 for $0^{\circ}\text{C} < \text{Temperature} < 600^{\circ}\text{C}$ ($32^{\circ}\text{F} < \text{Temperature} < 1112^{\circ}\text{F}$)

For A36 Steel: Tensile yield strength, $F_y := 36 \cdot \text{ksi}$ Modulus of Elasticity, $E := 29 \cdot 10^3 \cdot \text{ksi}$

$$F_{y\text{Reduction}_1} := \left[1 + \frac{\frac{5}{9} \cdot (\text{Temp}_1 - 32)}{900 \cdot \ln \left[\frac{\frac{5}{9} \cdot (\text{Temp}_1 - 32)}{1750} \right]} \right] \cdot F_y$$

$$E_{\text{Reduction}_1} := \left[1 + \frac{\frac{5}{9} \cdot (\text{Temp}_1 - 32)}{2000 \cdot \ln \left[\frac{\frac{5}{9} \cdot (\text{Temp}_1 - 32)}{1100} \right]} \right] \cdot E$$

The tensile strength and modulus of elasticity of steel decrease with increasing temperature as shown below for A36 steel:

<u>Yield Strength</u>	<u>Temperature °F</u>	<u>Modulus of Elasticity</u>
35.2	> 150	28.7·10 ³
34.7	200	28.5·10 ³
34.2	250	28.2·10 ³
33.6	300	27.9·10 ³
32.2	400	27.2·10 ³
30.5	500	26.4·10 ³
28.6	600	25.3·10 ³
27.6	650	24.7·10 ³
26.4	700	24·10 ³
25.2	750	23.3·10 ³
23.9	800	22.5·10 ³
22.5	850	21.5·10 ³
21	900	20.5·10 ³
19.5	950	19.4·10 ³
17.8	1000	18.1·10 ³

$F_{y\text{Reduction}} =$ ksi Temp = $E_{\text{Reduction}} =$ ksi

Exhibit 4

Positive Material Identification (PMI) for Shop Fabrication

Specification 24590-WTP-3PS-G000-T0002, Rev. 9 was used to create the following exhibit. Specification change notices (SCNs) have been evaluated and there are no applicable SCNs.

1 Scope	This exhibit covers the minimum requirements for and the extent of application of Positive Material Identification (PMI) testing of shop fabricated pressure retaining equipment and piping. This exhibit applies to shop fabrication only.
3 Technical Requirements	
3.1 General	<p>The purpose of PMI is to provide evidence that the materials are correctly supplied as specified by project documents. PMI is required for shop-fabricated items fabricated from the alloys identified in Table 1.</p> <p>When required by this exhibit, PMI testing will be done on each component of a pressure retaining assembly. This shall include each individual segment of pipe, each plate, and all other pieces of base materials (e.g., forgings, fittings, and tubing) and all required pressure retaining welds.</p> <p>For purposes of this exhibit, the following definitions are used:</p> <p><u>Alloy</u>: Metallic materials (including welding filler materials) which contain alloying elements including but not limited to: Chromium (Cr), Nickel (Ni), Molybdenum (Mo), Copper (Cu) or Tungsten (W).</p> <p><u>300 Series Stainless</u>: Austenitic Stainless Steels (304L, 316L, etc.)</p> <p><u>6 % Mo</u>: AL6XN, 254 SMO, etc.</p> <p><u>Duplex Stainless Steel</u>: CD4MCu, etc.</p> <p><u>Nickel Base</u>: Alloy C-22, 625, 690, etc.</p>
3.2 Responsibility	The Seller shall submit to the Buyer, for review and comment prior to fabrication, procedures covering how PMI will be conducted and documented. The Seller's procedures shall include the instrument manufacturer's procedures and requirements, operator qualification/re-qualification requirements, instrument calibration method(s), calibration frequency during testing, criteria for acceptance or rejection, material identification method, and record keeping.
3.3 Verification Method	
3.3.1	<p>Instruments used for PMI shall be of the type that will provide quantitative, recordable, elemental composition results for positive identification of the alloy elements present.</p> <ol style="list-style-type: none"> a) PMI shall be done per the procedures outlined by the manufacturer of the PMI instrument being used. Modification of these procedures must be approved by the Buyer. b) Each PMI instrument shall be calibrated according to the manufacturer's requirements.

3.3.2	<p>The methods/instruments listed below are acceptable. In application, they must not be used in a "go-no-go" mode. The only acceptable objective is the positive identification, listing, and quantification of the relevant elements listed in Section 7.</p> <p>a) Portable X-ray fluorescence analyzers. Use is limited to the following instruments or their equivalent unless prior approval is given by the Buyer:</p> <ul style="list-style-type: none"> • TN Technologies Alloy Analyzer 9266, 9277 (The Metallurgist XR) or 9288 • Outokumpu X-Met 840, or X-Met 880 • Niton Alloy Analyzer (800 Series) • Thermo Scientific Niton XL3t Analyzer • Metorex X-Met 920, X-Met 3000TA or X-Met 3000TX Metal Analyzer • Innov-X Systems XT Series Analyzer • Innov-X Systems Alpha 6500 Series Analyzer • Innov-X Systems Delta Model DP-2000, DS-2000, or DC-200 Analyzer <p>b) Portable optical emission analyzers. Use is limited to the following instruments or their equivalent unless prior approval is given by the Buyer:</p> <ul style="list-style-type: none"> • SpectroPort Model TP-07 or TFO-02 • Outokumpu ARC-MET 900 or the New Spectrotest • SpectroLab, Spectrotest and Spectrotest Jr. <p>Any other instrument will require Buyer's approval via the submittal process.</p> <p>Note: Arc strikes, if any, need not be removed.</p>
3.3.3	<p>In lieu of using portable instruments, chemical analysis can be performed on actual material samples. Care must be exercised while collecting samples, as contamination can be contributed by the removal tools. Sample extraction shall not weaken or reduce the functionality of the component. Laboratory analysis reports shall be traceable to the individual component from which the sample was taken (See Section 6, below).</p>
3.3.4	<p>Parts that are too small to be tested using an alloy analyzer are exempt from PMI testing. If such exemption is claimed, the PMI procedure shall specify the minimum part size capable of being tested.</p>
3.4 Welding Consumable Control	<p>In addition to PMI testing required by this exhibit, the Seller shall have in place, and implement, welding consumable material control systems that can be verified by auditing. PMI of completed pressure retaining welds is required as indicated in Table 1. Production "Run Off" weld test coupons may be used for chemical analysis checks.</p>
4 Extent of PMI	<p>PMI shall be performed on completed equipment, or assembled parts of equipment, at such time as to ensure that only verified materials have been used in the fabrication and final assembly of components. If the assembled equipment configuration prevents PMI of any individual part, then that part shall be tested prior to assembly and be noted as such on the PMI documentation.</p>
4.1 Vessels, Exchangers, Tanks, Filters and other Manufactured Equipment	<p>Vessels, exchangers, and other manufactured equipment shall have PMI testing performed at the Seller's facilities. This shall include piping and components supplied as part of an equipment "package" or skid.</p>

4.2 Shop Fabricated Piping	
4.2.1	PMI is required for all piping and piping components, circumferential pressure retaining welds, and non-autogenous longitudinal welds as indicated in Tables 1 and 2. Note that to the greatest extent possible (considering minimum size restraints of the PMI analyzer), the requirements for examining tubing are equivalent to that of piping.
4.2.2	PMI is not required on autogenous welds, fillet welds, or socket welds.
4.4 Valves and Pumps	PMI of valves and pumps is required for materials as indicated in Table 1 and piping fluid codes as indicated in Table 2.
4.5 Bulk Materials (Straight Run Piping, Fittings, Stock Valves, Etc.)	PMI is required as indicated in Table 1. Table 2 does not apply.
5 Identification	
5.1 General	All shop-fabricated items/pieces that have been successfully subjected to the required PMI shall be marked. The mark shall be durable and last through transportation and receiving inspection at the Buyer's facility. See Section 7 for items that do not pass PMI.
5.2 Marking Materials	Marking materials and adhesive tape selected shall not cause corrosion or other harmful effects. Requirements for marking materials: <ul style="list-style-type: none"> • The total chloride/flouride content shall not exceed 200 ppm. • The total sulfur content shall not exceed 400 ppm. • The total of low melting point metals such as lead, zinc, copper, tin, antimony, and mercury shall not exceed 1 percent; of this, mercury shall not exceed 50 ppm.
5.3 Equipment and Equipment Components	When it has been verified that the material has a composition consistent with the material specified, then it must be stamped with letters "PMIV". Use low stress stamps for identification. Items that cannot be stamped shall have an alternate system of marking. Heat exchanger tubing shall not be stamped. Any alternate system, and the items for which it will be used, must have Buyer approval. To the maximum extent possible, the stamping/markings shall be located for ease of future reference/verification.
5.4 Piping Materials	When it has been verified that the material has a composition consistent with the material specified, then a colored adhesive tape, or other approved marking method, shall be applied at one end to facilitate proper identification.
5.5 Fasteners and Small Parts	Fasteners and small parts shall be marked in accordance with the Seller's procedure using a hard marking method, an indelible ink, or paint.
6 Records of PMI	Results shall be recorded on PMI report forms, which shall indicate, as a minimum, the following for each examination: <ol style="list-style-type: none"> a) Name of inspector b) Date of testing c) Test method, including PMI instrument name and serial number d) Equipment tag number or pipe spool number (PO number for bulk items) for the specific piece tested e) Quantitative analysis results for relevant elements (see Section 7) <p>A PMI map consisting of assembly and sub-assembly drawings shall be prepared for each piece of fabricated equipment or pipe spool. The map shall include components and welds and show the locations of PMI testing.</p> <p>An extended Shop Spool Sheet shall be provided for each individual spool number where PMI was done.</p> <p>In the case of bulk items, PMI results may be submitted in the form of a certificate verifying that</p>

	<p>parts were tested according to the requirements of this exhibit. Results shall be reported by heat/lot and shall include the following:</p> <ul style="list-style-type: none"> a) Name of inspector b) Date of testing c) Test method, including PMI instrument name and serial number d) Type and number of pieces tested e) Acceptable composition ranges for the relevant elements (see Section 7) f) Material identified <p>PMI forms shall become a part of the permanent inspection records. Seller shall submit the completed forms as part of the Final Document Package when required by the Form G-321-V in the Purchase Order.</p>												
<p>7 Acceptance, Rejection and Retesting Requirements</p>	<p>All materials tested shall be identified by the PMI instrument as being consistent with the composition of the specified material. The results shall fall within the chemical composition requirements of the ASTM, AWS or other applicable material specification allowing for the accuracy of the instrument. Any questionable PMI result shall be re-analyzed by the same or another instrument, after verification of proper surface preparation. See Section 7.1, below, for materials and welds that fail to meet requirements on the second analysis.</p> <p>The following elements shall be identified and recorded, even if the instrument does provide immediate identification (e.g. display of "316", "6 Mo", etc.):</p> <table border="1" data-bbox="537 877 1365 1066"> <thead> <tr> <th>Alloy</th> <th>Elements</th> </tr> </thead> <tbody> <tr> <td>304, 304L</td> <td>Ni, Cr</td> </tr> <tr> <td>316, 316L</td> <td>Ni, Cr, Mo</td> </tr> <tr> <td>347</td> <td>Ni, Cr, Nb</td> </tr> <tr> <td>Duplex, 6% Mo, 254 SMO, AL6XN, etc.</td> <td>Ni, Cr, No, Cu</td> </tr> <tr> <td>Nickel base alloys, C-22, 625, 690, etc.</td> <td>Ni, Cr, Mo, W</td> </tr> </tbody> </table> <p>Welds joining dissimilar base materials or having filler materials that do not match the base material composition may include an allowance for dilution. Acceptable composition ranges for commonly used combinations of base material and weld filler metals are included in Table 3. Other combinations, when required, shall be identified to the Buyer for approval. Please note that the only proper use of Table 3 is for assessing dissimilar welds.</p>	Alloy	Elements	304, 304L	Ni, Cr	316, 316L	Ni, Cr, Mo	347	Ni, Cr, Nb	Duplex, 6% Mo, 254 SMO, AL6XN, etc.	Ni, Cr, No, Cu	Nickel base alloys, C-22, 625, 690, etc.	Ni, Cr, Mo, W
Alloy	Elements												
304, 304L	Ni, Cr												
316, 316L	Ni, Cr, Mo												
347	Ni, Cr, Nb												
Duplex, 6% Mo, 254 SMO, AL6XN, etc.	Ni, Cr, No, Cu												
Nickel base alloys, C-22, 625, 690, etc.	Ni, Cr, Mo, W												
<p>7.1</p>	<p>If any material, component, or weld of a type not requiring 100% testing is found to be unacceptable, all other materials, components, or welds (same heat, lot, etc.) represented by that failed item shall be considered suspect. The Buyer shall be notified immediately if a component is confirmed to have failed the PMI. The Seller will then have the following options, with Buyer concurrence:</p> <ul style="list-style-type: none"> a) Scrapping/removing all materials, components, or welds represented by the test piece (all of that heat, lot, etc.) and replacing with new components or filler metals, or b) Performing 100 percent examination of the remainder of the represented materials, components, or welds, and replacing each item that fails the PMI check, or c) Verifying correct chemistry by laboratory chemical analysis. 												
<p>7.2</p>	<p>If questionable values obtained with portable analyzers are verified by laboratory analysis, the laboratory analysis data shall be used and recorded.</p>												
<p>7.3</p>	<p>Any item or component containing materials that have not passed the PMI shall be clearly marked as "DO NOT USE — PMI FAILED" and segregated from the remainder of the stock.</p>												

Table 1 PMI Requirements for Shop Fabricated Items/Pieces

ITEM - (NOTE 1)	VERIFICATION REQUIRED
Type 304 & 304L Stainless Steel Components	No
Type 316, 316L, & 347 Stainless Steel Components	Yes – 100%
6% Mo Components	Yes – 100%
Duplex Stainless Steel Components	Yes – 100%
Nickel Base Alloy Components	Yes – 100%
Alloy Valves	Yes – 100% Body and Bonnet Only
Alloy Pumps	Yes – 100% Casing Only
Alloy Piping – including non-autogenous longitudinal welds (Spools, Fittings, Straight-Run Pipe, and Tubing)	Yes – 100% for 6 % Mo alloys and Nickel base alloys Yes – 100% for 316L, used in the fluid codes listed in Table 2
Alloy Pressure Retaining Welds	Yes – 100% of completed welds that join material required to have PMI testing
Bolting — B8M used for Pressure Retaining Connections	Yes – 5 % of total bolts, minimum one check per heat
Alloy Heat Exchanger Tubing	Yes – 5 % of total tubes, minimum one check per heat
Venturis	Yes – 100% pipes and welds

Note:

1. The following items are exempted unless specifically designated for PMI by the Purchase Order:

- a) All type 304L stainless steel components, piping, and welds
- b) Deleted
- c) Non pressure-retaining parts, such as baffles, trays, tray clips, supports, pall-rings, support rings, etc.
- d) Non pressure-retaining welds and sections of piping, such as drains, vents, overflows, etc.
- e) Gaskets
- f) Instrumentation (except when the instrument is a shop fabricated piping component placed in-line of a piping system requiring PMI)
- g) Internal instruments parts (including pressure retaining parts)
- h) Instrument tubing less than 1/2 inch in diameter
- i) HVAC ducting
- j) Piping components located within piping systems for which PMI is NOT required.

Table 2 Fluid Codes Requiring PMI Testing (Shop Fabricated Piping and Piping System Components)

Fluid Code		Fluid Code		Fluid Code	
DR	Suspect Radioactive Steam	GU	Nitric Acid Fume	GV	Vessel Vent Radioactive
HN	Nitric Acid	HR	Recovered Nitric Acid	PA	Radioactive Aqueous
PB	LAW Feed	PC	HLW Feed Slurry	PE	Entrained Solids Concentrate
PF	Cs/Tc Concentrate	PH	LAW Melter Feed	PJ	HLW Melter Feed
PP	Ultrafilter Permeate	PR	Suspect Radioactive Liquid	PS	Suspect Radioactive Slurry
PU	Suspect Radioactive Gas/Vapor	PV	Strontium Carbonate	PW	Radioactive Gas/Vapor
PX	Radioactive Slurry	PZ	Waste Feed	RK	Sodium Permanganate
ZE	Plant Wash Fluid	ZF	Plant Washings	ZH	Acidic Effluent
ZJ	Alkaline Effluent	ZL	Spent IX Resin	ZN	Neutralized Effluent
ZR	Suspect Radioactive Condensate	ZS	Process Radioactive Condensate	ZX	Special Decontaminant
ZY	Scrubber Effluent				

Table 3 Base Material and Weld Filler Metal Composition Requirements (Wt %)

MATERIAL	Cr	Ni	Mo	Cu	W	Notes
304L BM	18.0 - 20.0	8.0 - 12.0	---	---	---	
308L WFM	19.5 - 22.0	9.0 - 11.0	0.75 max	---	---	E/ER308L & LT
304L Welds	18.0 - 22.0	8.0 - 12.0	0.75 max	---	---	Note 1
304L BM	18.0 - 20.0	8.0 - 12.0	---	---	---	
316L BM	16.0 - 18.0	10.0 - 14.0	2.0 - 3.0	---	---	
316L WFM	17.0 - 20.0	11.0 - 14.0	2.0 - 3.0	---	---	E/ER316L & LT
304L/316L Welds	16.0 - 20.0	8.0 - 14.0	3.0 max	---	---	Note 1
304L BM	18.0 - 20.0	8.0 - 12.0	---	---	---	
316L BM	16.0 - 18.0	10.0 - 14.0	2.0 - 3.0	---	---	
308L WFM	19.5 - 22.0	9.0 - 11.0	0.75 max	---	---	E/ER308L & LT
304L/316L Welds	16.0 - 22.0	8.0 - 14.0	3.0 max	---	---	Note 1
304L BM	18.0 - 20.0	8.0 - 12.0	---	---	---	
308L WFM	19.5 - 22.0	9.0 - 11.0	0.75 max	---	---	E/ER308L & LT
CD4MCu BM	24.5 - 26.5	4.75 - 6.0	1.75 - 2.25	2.75 - 3.25	---	
304L/CD4MCu Welds	18.0 - 26.5	4.75 - 12.0	2.0 max	---	---	Note 1

Table 3 Base Material and Weld Filler Metal Composition Requirements (Wt %) (cont.)

MATERIAL	Cr	Ni	Mo	Cu	W	Notes
316L BM	16.0 - 18.0	10.0 - 14.0	2.0 - 3.0	---	---	
316L WFM	17.0 - 20.0	11.0 - 14.0	2.0 - 3.0	---	---	E/ER316L & LT
316L Welds	16.0 - 20.0	10.0 - 14.0	2.0 - 3.0	---	---	Note 1
316L BM	16.0 - 18.0	10.0 - 14.0	2.0 - 3.0	---	---	
316L WFM	17.0 - 20.0	11.0 - 14.0	2.0 - 3.0	---	---	E/ER316L & LT
CD4MCu BM	24.5 - 26.5	4.75 - 6.0	1.75 - 2.25	2.75 - 3.25	---	
316L/CD4MCu Welds	16.0 - 26.5	4.75 - 16.0	1.75 - 3.0	---	---	Note 1
AL6XN BM	20.0 - 22.0	23.5 - 25.5	6.0 - 7.0	0.75 max	---	
625 WFM	20.0 - 23.0	58.0 min	8.0 - 10.0	0.50 max	---	E/ERNiCrMo-3
AL6XN Welds	20.0 - 23.0	25.5 min	7.0 - 10.0	0.75 max	---	Note 2
C-22 BM	20.0 - 22.5	Remainder	12.5 - 14.5	---	2.5 - 3.5	
CD4MCu BM	24.5 - 26.5	4.75 - 6.0	1.75 - 2.25	2.75 - 3.25	---	
C-22 WFM	20.0 - 22.5	Remainder	12.5 - 14.5	0.5 max	2.5 - 3.5	E/ERNiCrMo-10
C-22/CD4MCu Welds	16.0 - 22.5	25.0 min	10.5 - 14.5	---	2.5 - 4.5	
C-22 BM	20.0 - 22.5	Remainder	12.5 - 14.5	---	2.5 - 3.5	
C-22 WFM	20.0 - 22.5	Remainder	12.5 - 14.5	0.5 max	2.5 - 3.5	E/ERNiCrMo-10
C-22 Welds	20.0 - 22.5	52.0 min	12.5 - 14.5	---	2.5 - 3.5	Note 1
Alloy 625 BM	20.0 - 23.0	58.0 min	8.0 - 10.0	---	---	
to 304L	18.0 - 20.0	8.0 - 12.0	---	---	---	
to 316L	16.0 - 18.0	10.0 - 14.0	2.0 - 3.0	---	---	
625 WFM	20.0 - 23.0	55.0 min	8.0 - 10.0	0.50 max	---	E/ERNiCrMo-3
Alloy 625 to 304L/316L Welds	19.0 - 23.0	50.0 min	8.0 min	0.50 max	---	
AL6XN (N08367) BM	20.0 - 22.0	23.5 - 25.5	6.0 - 7.0	0.75 max	---	
to 304L	18.0 - 20.0	8.0 - 12.0	---	---	---	
to 316L	16.0 - 18.0	10.0 - 14.0	2.0 - 3.0	---	---	
625 WFM	20.0 - 23.0	55.0 min	8.0 - 10.0	0.50 max	---	E/ERNiCrMo-3
N08367 to 304L/316L Welds	19.0 - 23.0	25.0 min	4.0 - 10.0	---	---	

BM = Base metal; WFM = Weld filler metal

Notes:

1. Acceptance is based on the combined base metal and WFM spec requirements.
2. Acceptance is based on WFM spec and the expected amount of dilution for molybdenum.

Exhibit 5

Instrumentation for Packaged Systems

Deleted

Exhibit 6

Low Voltage Adjustable Speed Drives (Non-Safety)

Deleted