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RIVER PROTECTION PROJECT – WASTE TREATMENT PLANT

ENGINEERING SPECIFICATION

FOR

Vessel-Mounted Vertical Transfer Pumps - LAW Facility

Content applicable to ALARA? ☒ Yes ☐ No

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

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SPECIFICATION No. 24590-WTP-3PS-MPC0-T0008 **Rev** 1

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1 Scope

1.1 Project Description and Location

The River Protection Project - Waste Treatment Plant (WTP) is a complex of waste treatment facilities where the US Department of Energy's (DOE) Hanford Site tank waste will be put into stable glass form. The WTP contractor will design, build, and start up the WTP pretreatment and vitrification facilities for the DOE Office of River Protection (ORP). The waste treatment facilities will pretreat and immobilize the low-activity waste (LAW) and high level waste (HLW) at the Hanford Site. This specification covers only LAW Facility equipment.

The Hanford Site occupies an area of about 560 square miles along the Columbia River, north of the city of Richland, Washington. The WTP facility will be constructed at the east end of the 200 East Area of the Hanford Site. Benton, Franklin, and Grant counties surround the Hanford Site.

1.2 Scope Covered by this Specification

Design, furnish materials, fabricate, package, test and prepare for shipment of complete pump units and appurtenances in accordance with this specification, including the following:

1.2.1 Semi-remote vessel-mounted vertical transfer pumps, complete with motors, wiring and conduit, lifting lugs, eductor primer (if required), nozzle connections, all required piping from pump to nozzle connections, acquisition services documents, and attachments.

1.2.2 Deleted

1.2.3 Deleted

1.2.4 Special tools required for installation and maintenance.

1.2.5 Shop painting of exposed steel surfaces. Stainless steel surfaces shall not be painted.

1.2.6 Operations and maintenance manuals.

1.2.7 Lifting yokes designed to dimensions and configurations supplied by the Buyer.

1.3 Scope Not Covered by this Specification

1.3.1 Pump mounting flange bolt fasteners.

1.3.2 Semi-remote water, slurry, and power jumpers or instrumentation beyond first connection to factory assembled package.

1.3.3 Material unloading, unpacking, inspection, storage and installation labor at the job site.

1.4 Definitions

The equipment covered by this specification will be used in the WTP, where the definitions of terms are:

Cantilevered	Refers to a specific pump configuration where the bearings supporting the rotating pump shaft are positioned at one end of the shaft, leaving the remainder of the shaft unsupported.
Casing	Refers to the volute casing or the bowl assembly, depending on the pump used for these applications.
LAW	Refers to items associated with the Low Activity Waste (LAW) building.
Self-Priming	Refers to the process condition where the impeller will always be in fluid during pumping and the pumps for this application will be of the extended line-shaft bearing type
Semi-Remote	Equipment described as semi-remote in this specification refers to equipment located in the radioactive LAW cell that will normally be accessed from overhead protected levels and minimal human contact.
Vertical Pumps	Refers to equipment that is the subject of this specification, the semi-remote vessel-mounted vertical transfer pumps.

2 Applicable Documents

2.1 General

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

2.1.2 When specific chapters, sections, parts, or paragraphs are listed following a code, industry standard, or reference document, only those chapters, sections, parts, or paragraphs of the document are applicable and shall be applied. If a date or revision is not listed, the latest issue, including addenda, at the time of Request for Proposal (RFP) shall apply. When more than one code, standard, or referenced document covers the same topic, the requirements for all must be met with the most stringent governing.

2.1.3 "Seller Surveillance Inspection" is defined in section 5 of the material requisition. Critical steps in manufacturing and testing, such as witness points and hold points, are also defined in section 5 of the material requisition.

2.2 Industry Standards

Unless otherwise specified herein or on drawings, work under this specification shall be performed in accordance with the codes, standards, and publications to the extent indicated by the references herein. The date of issue (or revision) indicated shall apply.

Sponsor	Number	Subject
ABMA	Std. 7	American Bearing Manufacturers Association - Shaft and Housing Fits for Metric Radial Ball and Roller Bearings
ABMA	Std. 9	American Bearing Manufacturers Association - Load Ratings and Fatigue Life for Ball Bearings
ABMA	Std. 20	American Bearing Manufacturers Association - Radial Bearings of Ball, Cylindrical Roller, and Spherical Roller Types Metric Design
ASME BPVC	Sec. IX	American Society of Mechanical Engineers - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators
ASME/ANSI	Y14.5M	American Society of Mechanical Engineers - Dimensioning and Tolerancing
ASTM	A276	American Society for Testing and Materials - Specification for Stainless Steel Bars and Shapes
ASTM	A802	American Society for Testing and Materials - Standard Practice for Steel Castings, Surface Acceptance Standards, Visual Examination
HI	HI2.6, 2000	Hydraulic Institute Standards-American National Standard for Vertical Pump Tests
NEMA	MG-1	National Electrical Manufacturers Association - Motors and Generators

2.3 Safety/Quality/Seismic Classifications

Safety class, quality level, and seismic category of vertical pumps described in this specification are noted in the individual vertical pump data sheets issued with the material requisition.

2.4 Engineering Specifications

See section 2 of the material requisition for the referencing of engineering specifications.

2.5 Reference Documents and Drawings

See Figure 1 for LAW pump configuration.

3 Design Requirements

3.1 General

The Seller shall control the quality of items and services to ensure that the requirements of this specification, applicable codes and standards, material requisitions, motor and vertical pump data sheets, and other acquisition services documents are met.

3.2 Design Conditions

3.2.1 The equipment and appurtenances will be used in a plant that has a design life of 40 years. Vertical pumps shall be designed for a minimum service life of 20 years when subjected to normal periodic maintenance.

3.2.2 Pumps are generally categorized as semi-remote (as defined in section 1.4), depending on conditions of service as described in this section.

3.2.3 Plant location and environmental conditions are indicated on individual motor and vertical pump data sheets and other attachments to the material requisitions.

3.2.4 To simplify maintenance and spare parts inventory, it is desirable to have two semi-remote pump configurations for the LAW facility (one for cantilever and one for self-priming – described later in this section) for all service conditions shown in the vertical pump data sheets attached to the material requisitions. If one pump configuration for each category is not possible, the Seller shall minimize the number of pump configurations as much as possible. For general configurations see Figure 1 for LAW services.

3.2.5 The semi-remote LAW vertical pumps shall be designed for an exposure life of not less than five years at the specified conditions. Normal maintenance items shall be included, such as bearings, packing, seals, and gaskets, which, due to the semi-remote radioactive environment, shall function with no maintenance required within that period.

3.3 Conditions of Service

3.3.1 Semi-Remote Vertical Pumps

Vertical pumps shall be located in the LAW facility and exposed to a radioactive environment with expected radiation rates as follows.

Operating Dose Rates

Location	
At vessel top mounting flange	0.50 rads/hr
At center of vessel	1.00 rads/hr

Maximum Cumulative Yearly Dose

Location	
At vessel top mounting flange	4.38×10^3 rads
At center of vessel	8.76×10^3 rads

Note: These values are subject to change. Seller shall verify expected radiation levels with Buyer before commencing design.

3.4 Environmental Conditions

3.4.1 The vertical pumps will be located indoors in rooms maintained between 59 °F dry bulb minimum and 113 °F dry bulb maximum temperature during normal operation.

3.4.2 Vertical pumps and components shall not be stored outdoors.

3.5 Pump Construction

3.5.1 General

The vertical pumps are characterized into various groups and classifications for the purposes of design and construction. The following summary outlines the primary classifications, as defined in this specification.

Location	Quality Level	Access	Preferred Design
LAW	CM	Semi-remote	Cantilever
LAW	CM	Semi-remote	Self-priming

Notes:
Quality levels are detailed in section 8.
Semi-remote is defined in section 1.4.
Preferred pump designs are discussed further in the following sections.

3.5.2 Pump Preferred Design Definitions:

3.5.2.1 Cantilever Pumps

Pumps designated as cantilever pumps are defined for the purposes of this specification as pumps with a shaft and impeller that extends below the radial bearing (located above the mounting flange). Cantilever pumps shall have suction tailpipe and eductor priming assemblies. Cantilever pumps shall not have any bearings located within the interior volume of the vessel. See Appendix B, Pump Design Parameter Summary for individual pump designations.

3.5.2.2 Self-Priming Pumps

Self-priming pumps are defined, for the purposes of this specification, as pumps that have the capability of starting from a low liquid level without the use of a priming eductor or any other external priming

fluid. For all self-priming pumps, no external fluid, other than the main process stream, shall be added to the vessel or discharge piping for any purpose including priming or bearing lubrication (see section 3.5.4.4.3 for an exception for pumps using an extended line-shaft bearing configuration). See Appendix B, Pump Design Parameter Summary, for individual pump designations.

3.5.3 Design parameters are given on the vertical pump data sheets included in the material requisition. Additional parameters for pumps in slurry service are shown in Appendix B.

Important: Seller shall propose designs for all pumps considering vessel nozzle diameters as listed in Appendix B.

3.5.3.1 A pump lifting assembly shall be designed and fabricated by Seller to dimensions and configuration supplied by Buyer, with two lifting lugs located as shown in Figure 1. These lifting lugs shall facilitate a two-point lift by a compatible lift yoke that is in turn lifted by a single main crane hook. Lifting lugs shall be designed to lift 1.5 times the total dry pump weight and shall provide a straight plumb lift of a fully equipped dry pump.

3.5.3.2 A plumb lift test as well as a load test for 1.5 times the normal dry load shall be demonstrated on each unit in the Seller's shop, with Buyer to witness (see section 6.5). The pump shall be lifted off the shop floor and held for 10 minutes. Inspections shall be performed for any deformation or stress cracking at the lifting lugs and at the lifting lugs' attachments or reinforcements to the pump. Buyer will review design calculations related to lifting assembly design.

3.5.4 Semi-Remote Vertical Pumps LAW

3.5.4.1 Semi-remote vertical pumps in the LAW building shall be designed in accordance with CM quality designation requirements as detailed in section 8.1.

3.5.4.2 The LAW pumps are designated as either cantilever or self-priming as defined in section 3.5.2.

3.5.4.3 LAW Pumps - Cantilever

3.5.4.3.1 The preferred design for the LAW pumps designated as cantilever shall be as defined in section 3.5.2. Figure 1, LAW Semi-Remote Vessel-Mounted Vertical Transfer Pumps, illustrates the pump setting and vessel configuration with nominal and critical pump dimensions.

3.5.4.3.2 If the Seller proposes a design other than that described herein, the Seller shall include documentation of two or more successful applications, with contact information, in similar radioactive slurry service for the Buyer to review. Other pump designs may include any design with bearings located below the mounting flange and within the interior volume of the vessel such as vertical line-shaft pumps, submersible canned pumps, or any pump that differs fundamentally from a standard vertical cantilever and tailpipe design.

3.5.4.3.3 The Seller shall design all cantilevered pump components, including casing, impeller, tailpipe, eductor piping, and discharge piping, with the necessary structural supports to withstand all the operating forces, including those from slurry agitation, without incurring

plastic deformation or compromising the structural integrity of the pump. Such forces will be determined and quantified during detailed design.

3.5.4.4 LAW Pumps - Self-Priming

3.5.4.4.1 The preferred design for the LAW pumps designated as self-priming shall be as defined in section 3.5.2, Figure 1. LAW Semi-Remote Vessel-Mounted Vertical Transfer Pumps, illustrates the pump setting and vessel configuration with nominal and critical pump dimensions.

3.5.4.4.2 The Seller shall design all pump components, including casing, impeller, and discharge piping, with the necessary structural supports to withstand all the operating forces, including those from slurry agitation, without incurring plastic deformation or compromising the structural integrity of the pump. Such forces will be determined and quantified during detailed design.

3.5.4.4.3 Self-priming pumps using an extended line-shaft bearing configuration shall be designed with a pressurized support column to protect the shaft assembly from slurry intrusion. The pressurizing media shall be 15 psig of water or inert gas. The Seller shall also provide a method of monitoring the sustained pressure.

3.5.4.5 LAW vertical pumps shall be designed to minimize maintenance personnel radiation exposure time. The number of mounting bolts shall be minimized and designed to allow maintenance personnel to loosen the nuts from above with special wrenches supplied with the equipment. Figure 1 illustrates the desired pump configuration and mounting. Refer to 24590-WTP-3PS-M000-T0002, *General Specification for Mechanical Handling Equipment Design & Manufacture*, for more details on semi-remote handling issues.

3.5.4.6 Deleted (See 3.5.3.1, 3.5.3.2 and 6.5)

3.5.4.7 For LAW application, the main coupling between the drive motor shaft and the vertical pump shaft shall be radiation resistant and shall provide for misalignment (from fabrication and assembly) between the mating shafts at all conditions of service. To simplify pump construction, remote disassembly and re-assembly of coupling is not required for LAW pumps.

3.5.4.8 For LAW application, pumps shall be designed such that the motors can be removed from the pumps and stored in a separate place. Interfacing components on the motor and pump shall have tolerances suitable for motor replacement / interchangeability.

3.5.4.9 For all LAW pumps, the Seller is to provide the process connections (that is, discharge, column fluid pressure, and priming connections) located above the pump mounting flanges.

3.5.5 General Pump Requirements - LAW

3.5.5.1 Pump casings shall be hydrostatically tested in accordance with section 6.2. Castings shall be sound and free from cracks, pits, or nodules in accordance with section 5.1.1. Lined casings are not acceptable.

3.5.5.2 Two or more bearings shall support the vertical rotating pump shaft. In order to improve the stability of the rotating assembly, the bearings shall be preloaded, if necessary, according to bearing size. The load on the thrust bearing shall consist of the sum of the weight of the rotating assembly and the hydraulic thrust and moment from radial thrust and the preload. The load on the radial bearing shall consist of radial components and preload only.

3.5.5.3 All bearings shall be cartridge or standard width, single row radial ball, deep groove (Conrad type) or angular contact type, ABMA (Standard 20) Class 3 Internal Clearance, and selected to give 100,000 hours minimum L_{10} rating life in conformance with ABMA Standard 9.

3.5.5.4 Bearings and bearing seals shall withstand all conditions of service as stated in vertical pump data sheets and in section 3.2.5. Bearing seals shall be designed for the least possible drag on the inner race of the bearing to minimize heat build-up and premature failure. Shaft and housing fits shall be in accordance with ABMA Standard 7.

Note: The Seller shall provide in-place re-greasing for the bearings to allow for re-lubrication of the bearings without removing any components of the motor from their installed positions. An in place grease connector would be located on the LAW vertical pumps for semi-remote access. Semi-remote access for LAW re-greasing applications is defined as an accessible, nonradioactive area for plant personnel to apply grease from a shielded platform, located 4 feet to 5 feet directly above the subject pump. It is imperative that the grease connector be located as close to the bearings as possible (that is, 6 inches or less) in order to minimize opportunities for the grease line to clog due to radiation hardening.

3.5.5.5 Bearings shall be lubricated with Chevron SRI Grease 2 (NLGI Grade 2), as detailed in Specification 24590-WTP-3PS-M000-T0002, *General Specification for Mechanical Handling Equipment Design & Manufacture,* or an approved equivalent radiation-resistant grease in an amount determined by bearing manufacturer. If an alternate grease is recommended, all appropriate technical information shall be submitted for Buyer acceptance.

3.5.5.6 Thrust bearings shall provide full load capabilities if the normal rotation direction of the pump is reversed.

3.5.5.7 Shafts of solid construction are preferred and shall be designed to carry their various loadings without exceeding their normal limits of combined stress, taking into account fatigue stress due to change in load or speed. The first lateral critical speed of shafts and impellers shall be at least 20 % above the maximum operating speed.

3.5.5.8 Special attention shall be given to ensure a smooth, even impeller finish, and care shall be taken to ensure uniformity of shape and finish on the vanes and the space between.

3.5.5.9 The bearing frame shall be constructed and bearing centers spaced so that the shaft and impeller assembly shall have proper support to be free of harmful vibration.

3.5.5.10 Maximum Allowable Vibration Limits

3.5.5.10.1 Motor, shaft, and impeller vibration amplitude shall not be more than 0.002 inches peak-to-peak, measured normal to pump shaft axis and not more than 10 inches above the impeller centerline, in air at motor speed, filtered to shaft speed.

3.5.5.10.2 The pump vibration amplitude shall not be more than 0.001 inches peak-to-peak, measured on the surface of the lower bearing housing normal to shaft axis, in air at motor speed, filtered to shaft speed.

3.5.5.10.3 The pump casing vibration amplitude shall not be more than 0.003 inches peak-to-peak measured outside the surface of the casing normal to shaft axis, pumping water at the design rate, filtered to shaft speed.

3.5.5.11 Shaft seals shall be installed to restrict air in-flow at the point of pump shaft entry to the vessel. A low pressure, non-lubricated stuffing box packed with Grafoil or approved equivalent split-ring, with a minimum compressed axial pitch length of 4 inches shall be furnished and installed by the Seller. Additionally, the Seller shall provide a temporary identification tag to caution against adjusting the Grafoil seal after delivery by Seller.

3.5.5.12 For cantilever pumps, an installed priming system is required to permit pump startup when vessel fluid level is below the pump casing. The priming system shall be a water eductor type of the general configuration shown on Figure 1 and shall be capable of starting the pump over the full range of conditions shown on the vertical pump data sheets and described in this specification. The priming system shall be able to start the pump from a vessel fluid level of 6 inches or more above the specified tailpipe intake height as shown on Figure 1. Available water pressure at the primer nozzle shall be as indicated on vertical pump data sheets. The priming system shall be capable of starting pumps without exceeding the maximum priming liquid volume as stated on the vertical pump data sheets. Priming capabilities will be tested and verified as detailed in section 6.3.5.

3.5.5.13 All pumps shall be provided with keyed impellers with separate threaded lock nuts and double (jam) nuts to positively secure the pump impeller.

3.6 Operational and Design Requirements

3.6.1 The pump head capacity curve (see section 6.3.3) shall be continuously rising from maximum flow to shut-off.

3.6.2 Pump design pressure shall be not less than 25 % above the shut-off head at the specified suction pressure.

3.6.3 The pumps shall operate free of cavitation over the entire range of conditions shown on Appendix B, Pump Design Parameter Summary, and the vertical pump data sheets.

3.6.4 The Seller shall minimize rotational speed of shafts and impellers due to wear considerations and head losses encountered when pumping slurries at high speeds.

3.6.5 Frequency and length of operation for each pump is shown on Appendix A, Pump Operation Summary.

3.6.6 Vertical pumps in slurry service shall be designed to withstand sludge or slurry yield stresses of 300 dynes/cm^2 under normal operation. Startup torque shall be based on two times the normal running torque without priming water.

3.7 Drivers

3.7.1 Motors

3.7.1.1 Drive motors shall conform to the requirements of Specification 24590-WTP-3PS-MUMI-T0002, *Low Voltage Induction Motors*. Adjustable speed drives shall conform to the requirements of Specification 24590-WTP-3PS-EVV1-T0001, *Engineering Specification for Low Voltage Adjustable Speed Drives.*

3.7.1.2 The Seller shall provide each pump with a totally enclosed fan-cooled (TEFC), washdown rated, chemical-type motor in accordance with the motor and vertical pump data sheets included with the material requisition.

3.7.1.3 Motor rated horsepower shall not be exceeded by any operating condition that can develop with the impellers.

3.7.1.4 Motors intended for use with adjustable speed drives shall be rated for inverter duty, with corresponding adjustable speed drives, as detailed on low voltage induction motor data sheets and adjustable speed drive data sheets, included with the material requisition package, in order to allow for varying rheologies and liquid levels of the slurries being pumped. The Seller shall make every effort to minimize the number of sizes and configurations of the motors. A single motor size with variable speed capability for all vertical pumps is preferable. Multiple motor configurations and constant speed motors will be considered if warranted.

3.7.1.5 All motors shall be NEMA design C type (in accordance with NEMA MG-1). The motor shall be the weakest link in a high torque event such that the shaft, impeller blades, and so forth do not fail in any event.

3.7.2 Semi-Remote Service

3.7.2.1 Insulation for semi-remote motors in the LAW radioactive environment shall be radiation resistant to meet conditions of service described in section 3.3.

3.7.2.2 The Seller shall install all required conduit with proper wiring from the motor junction box to the electrical connectors. All electrical components shall be waterproof. Cable shall be radiation resistant for levels shown in section 3.3 (see section 6.3.9).

3.8 Seismic Requirements

3.8.1 The semi-remote vertical pump components, including the mounting plates, shall be designed in accordance with the methods and procedures described in Specification 24590-WTP-3PS-FB01-T0001, *Structural Design Loads for Seismic Category III and IV Equipment and Tanks*, attached to the material requisition.

3.9 Accessibility and Maintenance

3.9.1 The Buyer's layout allows for necessary access and space requirements to facilitate maintenance during normal plant operation or scheduled shutdown.

3.9.2 The Seller's recommended accessibility and maintenance requirements for each piece of equipment shall be included in the Seller's submittal.

3.9.3 For the LAW Facility pumps, frequency of inspection and maintenance intervals shall be in accordance with equipment Seller's recommendations and shall not be less than one year (excluding re-greasing of bearings.)

4 Materials

4.1 General

4.1.1 Pump materials situated above and fastened to the mounting plate (see Figure 1) shall be austenitic stainless steel type 316L. Exceptions will be the pump priming and discharge piping, which shall be constructed of the same material as the respective nozzle, and will extend down to the mounting plate. All piping shall be seamless or welded pipe with 100 % radiographic examination.

Note: The Seller may utilize standard materials of construction for the motor, bearings, and coupling components.

All other components (such as piping, nozzle assemblies, lifting assemblies, main shaft seals, nut retainer, and dutchman) shall be 316L stainless steel unless specified otherwise.

The materials of construction of special components not named herein shall be subject to the Buyer's review.

4.1.2 Pump materials below and including the mounting plate, with the exception of those designated as wet-end components (see section 4.1.4), shall be 316L stainless steel. Stainless steel material shall be in accordance with ASTM A276.

4.1.3 The Seller shall identify, on assembly drawings, all materials (including plate, forging, pipe, bolting) by ASTM material designation, class and UNS number, and shall submit material certificates for the Buyer's review and approval.

4.1.4 Wet-end components, which include the impeller, shaft sleeve, casing, and suction disc, shall be as indicated on vertical pump data sheets.

4.1.5 Gasket selection and configuration shall be based on specific application and performance requirements.

4.1.6 Fasteners shall be as shown on Figure 1.

4.2 Positive Material Identification

4.2.1 All pressure containing parts materials shall be in accordance with 24590-WTP-3PS-G000-T0002, *Specification for Positive Material Identification (PMI).*

4.3 Prohibited Materials

4.3.1 Bronze, copper, lead, zinc, tin, antimony, cadmium, or other low melting point metals, their alloys, or materials containing such metals as their basic constituents or sulfur, and halogens shall not be used in direct contact with stainless steel. This prohibition applies to use of tools, fixtures, paints, coatings and sealing compounds, and any other equipment or materials used by the Seller in handling, assembly, and storage of stainless steel parts or components.

4.3.2 Asbestos, Teflon, and aluminum shall not be used in any component of the vertical pumps.

5 Fabrication

5.1 General

5.1.1 All casting surfaces shall meet severity level-1 visual examination acceptance standards contained in ASTM A-802. Castings shall be free from cracks, tears, voids, or other harmful defects indicative of substandard casting quality.

5.1.2 All vertical pumps shall be neatly finished and free of burrs and fins, and other harmful surface conditions.

5.1.3 Semi-remote vertical pumps shall be designed to minimize crevices that can trap contaminants for ease of decontamination. All surfaces are to be polished smooth (RMS 125 finish). Additionally, all non-machined plate, pipe surfaces, and welds shall be glass beaded to a 112 Ra finish (equivalent to 125 RMS machined finish) or better. Actual surface finishes shall be verified with a Profilometer and recorded in Ra format. Material hold-up points internal to the pump shall be minimized.

5.2 Welding Procedures

All welding on pump components shall be in accordance with ASME Section IX, *Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators*. The Seller shall submit all welding procedures for vertical pumps for review.

5.3 Repairs

The repair welding procedure shall include, as a minimum, the following:

a Type and extent of repairable defects

b Defects removal and nondestructive examination used to ensure complete defect removal

c Weld preparation and treatment, including reference to welding procedures qualified in accordance with ASME Section IX

d Nondestructive examination methods

5.4 Painting, Surface Preparation, and Cleaning

All painting, surface preparation, and cleaning for vertical pumps shall be in accordance with the Seller's standard practices unless superceded by additional requirements by the Buyer during design evaluation stage.

6 Inspection and Testing

6.1 General

The Seller shall supply the Buyer with all test data, certified by the Seller, whether witnessed or not. Pumps shall not be shipped until test data and curves have been reviewed by the Buyer.

6.2 Hydrostatic Tests

6.2.1 Each pressure part of the pump shall be hydrostatically tested at 150% of maximum allowable working pressure (MAWP). Hydrostatic tests shall be maintained for at least 30 minutes.

6.2.2 Before a hydrostatic test procedure is implemented, the Seller shall submit it to the Buyer for review.

6.2.3 Water used in hydrostatic testing shall be of potable quality or better. At no time shall it contain over 50 ppm chlorides.

6.2.4 Systems shall be thoroughly drained and dried by wiping or blotting all accessible areas within 24 hours after testing, rinsing, or flushing operations. Water shall not be left in the system before draining for more than 48 hours.

6.3 Performance Tests

6.3.1 A shop performance test shall be conducted with water on all pumps in accordance with Hydraulic Institute (HI2.6) standards at rated speed over the complete range of flow to maximum capacity to demonstrate fulfillment of efficiency and rating guarantees. Performance tests shall be run using the NPSH available to the pump at the site, including adjustments for all expected liquid levels in vessels (described in this specification and in data sheets) and corrected to shop test conditions.

6.3.2 An NPSH at incipient cavitation test shall be performed in accordance with HI standards on one pump of each type specified. At least three flow points shall be tested as a minimum: design point, run out, and minimum flow. At each point, five or more readings shall be taken at increasingly lowered suction pressure until a 3 % drop in head is noted. Acceptance criteria shall be: NPSH Available minus NPSH Required at normal design capacity shall be three (3) feet or greater.

6.3.3 Water test results shall be plotted, showing head, efficiency, and brake horsepower vs. capacity. Water temperatures shall be recorded, and test results corrected to a design average temperature. For pumps in slurry service, in addition to the water head curve above, the Seller

shall provide an estimated slurry head curve for comparison. The thickest slurry shown in Appendix B, Pump Design Parameter Summary, shall be used; specifically, the highest yield stress (if non-Newtonian) and highest viscosity shall be used.

6.3.4 Additional shop test results shall be plotted showing the eductor primer flow rate vs. pressure at the primer nozzle with an indication of minimum pressure, flow, and total quantity of priming water required to prime the pump at the low liquid level shown on Figure 1.

6.3.5 Shop test results must verify that all pumps are capable of starting from the minimum liquid level without exceeding the maximum priming liquid volume as listed in the vertical pump data sheets.

6.3.6 Unusual vibration and noise shall be corrected and documented for each test point. The cause of the noise as well as all corrective action taken shall also be noted. Shop tests must verify all pumps operate within maximum allowable vibration limits specified in section 3.5.5.10.

6.3.7 Witness tests shall be run after final trim has been calculated and applied to pumps. No final witness test shall be run without the Buyer's supplier quality representative (SQR) present. A satisfactory full-speed test shall be run at final impeller diameter before the Buyer's representative is called in to observe the test. A preliminary curve and test data shall be submitted to the Buyer's SQR immediately after each test. The amount of acceptable plus tolerance on head, capacity, and horsepower shall be within the range of tolerances suggested by the HI standards.

6.3.8 Shop tests must verify that the first lateral critical speed of all pump shafts and impellers is at least 20% above the maximum operating speed.

6.3.9 During testing, each pump tested shall be fully supplied with electrical power supplied by means of the electrical connectors per approved design (see section 3.7.2.2).

6.3.10 After tentative acceptance by the Buyer's SQR, the pumps may be readied for shipment but shall not be released until acceptance by the Buyer of formal submission of curves and data, which shall constitute the performance test report.

6.4 Final Dimensional Checks - Semi-Remote Vertical Pumps

6.4.1 After fabrication and testing, the Seller shall verify the dimensional requirements as given in Figure 1 in accordance with the procedures and precision measuring techniques described in Appendix D.

6.4.2 The Seller shall provide proof that the pump and pump appurtenances are dimensionally correct within the specified tolerances. This shall be accomplished by the completion of dimensional record drawings. These drawings, with details of the critical dimensions added by the Seller, shall be submitted to the Buyer for review prior to shipment.

Note: In addition to pump and pump appurtenances above, as-built shim dimensions of each individual shim required for precision placement of the pump shaft thrust and radial bearings shall be recorded on the dimensional record drawings for each pump.

6.4.3 All final dimensional measurements will be witnessed by the Buyer. No witness tests shall be performed without the Buyer's SQR present.

6.5 Plumb Lift Test

One complete pump of each type shall be tested for single point lift with Seller furnished lift yoke, designed to dimensions and configurations supplied by Buyer, connected to lifting lugs. Variation from vertical shall be 1-inch maximum from plumb. All plumb lift tests will be witnessed by Buyer. No witness tests shall be performed without the Buyer's SQR present.

7 Packaging, Handling, and Storage

7.1 General

Packaging, handling, and storage of the vertical pumps shall be in accordance with 24590-WTP-3PS-G000-T0003, *Engineering Specification for Packaging, Handling and Storage Requirements*.

7.2 Tagging

A stainless steel nameplate shall be attached to each vertical pump showing the manufacturer's name, shop location, date of manufacture, serial number, equipment rating, equipment tag numbers, weight of assembly, and material requisition number. Instruments shall be identified with Buyer-provided tag numbers on stainless steel tags using 1/4 inch tall characters.

8 Quality Assurance

8.1 CM Quality Designation - QA Requirements Specific to LAW Items or Service

8.1.1 The Seller's quality assurance program (QAP) requirements are included in 24590-WTP-3PS-G000-T0001.

8.1.2 The Seller's QAP manual shall be submitted to the Buyer for review in accordance with 24590-WTP-3PS-G000-T0001.

8.1.3 Program QA Elements

The Seller's QAP, as a minimum, shall contain the requirements detailed in the supplier quality assurance program requirements data sheets listed in section 2 of the material requisition.

8.2 Seller Deviation

Each Seller shall be required to identify and promptly document all deviations from the requirements of the acquisition documents. Seller-proposed deviations from acquisition services documents shall be initiated by use of a supplier deviation disposition request (SDDR) form, listed in section 2 of the material requisition and attached thereto. In addition, the Seller shall be required to describe the recommended disposition based on appropriate analysis. Submittals of request for deviations from sub-Sellers shall be through the primary Seller to the Buyer.

9 Configuration Management

Equipment or components covered by this specification are identified with plant item numbers as shown in the motor and vertical pump data sheets. Each item shall be identified in accordance with section 7.2, Tagging.

10 Documentation and Submittals

10.1 General

The Seller shall submit to the Buyer engineering and quality verification documents in the forms and quantities shown in Form G-321-E, *Engineering Document Requirements*, and Form G-321-V, *Quality Verification Document Requirements*, attached to section 3 of the material requisition.

10.2 Submittals

The Seller shall submit the following:

10.2.1 Drawings

Drawings shall show the following information:

10.2.1.1 The outline dimensions of the vertical pumps, including outline and detail drawings for each major component. These drawings shall reflect the "as-shipped" configuration of the equipment and instrumentation.

10.2.1.2 Details of construction

10.2.1.3 Mounting dimensions and information required for the design of supports and foundations

10.2.1.4 Operating weight of each vertical pump

10.2.1.5 Dynamic loading on mounting flange

10.2.1.6 The space required for the removal of components

10.2.1.7 The weight of individual components

10.2.1.8 The locations and identification of parts that are included in the parts list

10.2.1.9 Wiring, schematic diagrams, and connection. Diagrams shall include wire gauges and fuse sizes applicable to the supplied units only.

10.2.1.10 The ASTM or equivalent designation for materials

10.2.1.11 Nameplate lists

10.2.2 Procedures

Procedures shall include the following:

10.2.2.1 Welding procedures

10.2.2.2 Procedures for repairs of rejected items or parts

10.2.2.3 Electrical component performance test procedures

10.2.2.4 Seller's shipping preparation procedures, including initial startup and checkout procedures, instructions for final alignment checks and any other special instructions prior to initial start-up in facility.

10.2.2.5 Startup, shutdown, and idle procedures

10.2.2.6 Special instruction for installing and maintaining any packing and seals for shafts, bearings, or similar items. Include special instructions for extended (up to 3-years) storage or idle conditions prior to initial start-up in facility.

10.2.2.7 Procedure for all priming operations using an eductor or similar item, including special instructions and sequence for pump startup for all liquid level scenarios

10.2.2.8 For in-place re-greasing (see section 3.5.5.4), the Seller shall submit a full procedure for this re-lubrication process, including all materials needed, proper sequence, special remote crane operator instructions, and instructions for semi-remote access.

10.2.2.9 Seller shall submit a written tolerance control procedure to establish and verify horizontal and vertical centerlines, precise horizontal and vertical measurements, flatness, and datum planes for dimensional measurement of vertical pumps.

10.2.3 Inspection and Test Reports

10.2.3.1 Records of repairs and rejected items or parts

10.2.3.2 Electrical component performance test reports

10.2.3.3 Bench test mechanical performance reports

10.2.4 Calculations

Calculations shall be submitted for the Buyer's review and permission to proceed.

10.2.4.1 Seismic analysis

10.2.4.2 Lifting lug stress analysis

10.2.5 Manuals

Manuals and instructions shall be supplied per the G-321-E form and shall include the following:

10.2.5.1 Erection and installation manuals that provide complete, detailed procedures for installing and placing equipment in initial operation. The manuals shall include all erection and installation drawings. A minimum of five (5) sets of each manual type shall be provided.

10.2.5.2 Operation and maintenance manuals that provide complete, detailed descriptions of components and accessories, including data sheets showing design, construction and performance data for equipment. Manuals shall include drawings required for operation, maintenance and repair, maintenance requirements, instructions, and operational troubleshooting guides. Motor to pump alignment criteria shall be provided by the Seller, including any special alignment criteria.

10.2.5.3 Instruction manuals shall cover every item purchased, including materials that the Seller has obtained from a subcontractor. The Seller shall obtain such manuals and lists, and submit them to the Buyer.

10.2.5.4 The Seller shall provide instructions regarding site storage and preparation and protection of equipment after installation and prior to operation.

10.2.6 Certificates of Conformance

10.2.6.1 The Seller shall provide certificates of conformance demonstrating compliance with all applicable standards, specifications, and drawings.

10.2.6.2 The Seller shall certify that lifting eyes or lugs and/or spreader bars are suitable for the safe, balanced lifting and handling of the equipment.

10.2.7 Lists and Schedules

Lists and schedules shall include the following:

10.2.7.1 Schedule of engineering and fabrication

10.2.7.2 Parts list, and cost for parts and items subject to deterioration and replacement

10.2.7.3 List of recommended spare parts

10.2.8 Materials Certificates/Statistics

Material certificates of compliance shall be submitted for components of the vertical pumps. The certificates shall include certified material test reports of chemical and physical properties for all stress components.

10.2.9 Data

Data shall include the following:

10.2.9.1 Buyer's Motor and Vertical Pump Data Sheets, completely filled out by the Seller, showing all information required to determine that the units are of the design and materials specified herein.

10.2.10 Design and Technology Selection Criteria

10.2.10.1 Bearing Grease Selection

If an alternative grease for bearings is recommended other than that specified herein (section 3.5.5.5), all appropriate technical information shall be submitted for Buyer acceptance.

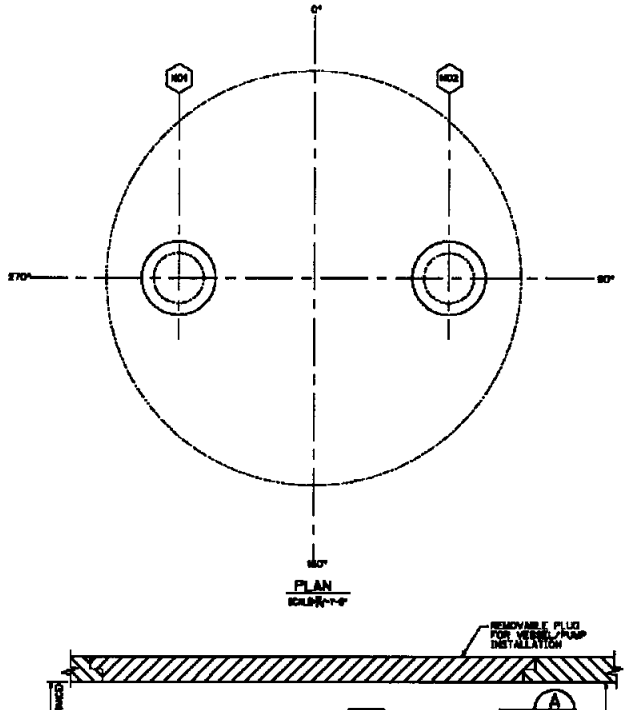
10.2.10.2 Deleted

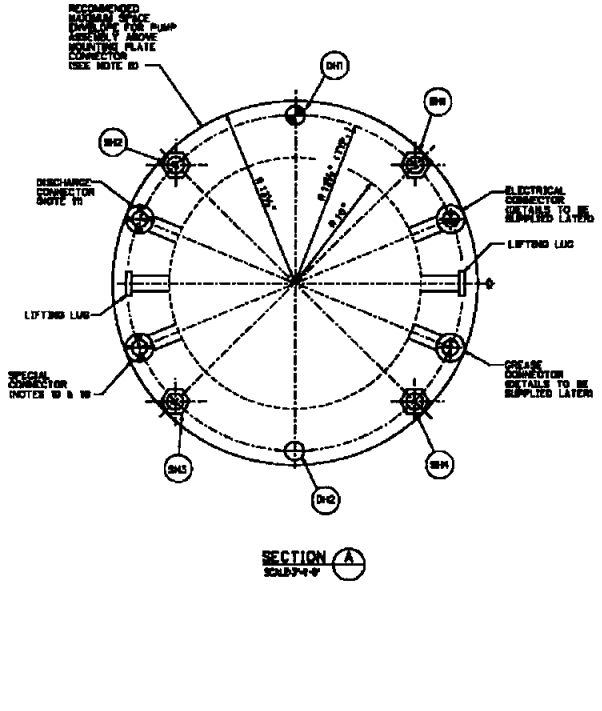
10.2.11 Material Safety Data Sheets

Material Safety Data Sheets shall be provided for all oils, greases, paints, preservatives, and all other chemicals and chemical products that are shipped with the vertical pumps.

Figure 1 **LAW Semi-Remote Vessel-Mounted Vertical Transfer Pumps**

NOZZLE	SIZE	SCHEDULE/WALL	SERVICE/REMARKS	FLANGE	MAT'L SPEC GRADE	CLASS RATING (PSIG/°F)
ALL	20"	.406"	LAW PUMP FLANGE			

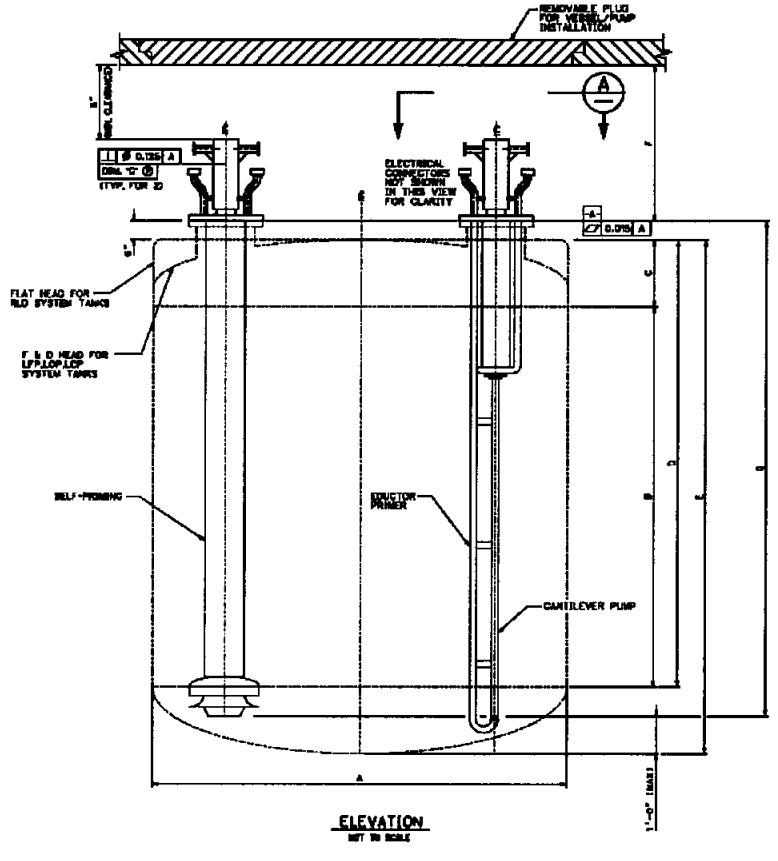




NOTES

1. THE PUMP COMPONENTS IN SLURRY SERVICE SHALL WITHSTAND EMERGENCY STARTUP TORQUES AS PER 24590-WTP-3PS-MPC0-T0008 "ENGINEERING SPECIFICATION FOR VESSEL-MOUNTED VERTICAL TRANSFER PUMPS - LAW FACILITY".
2. FOR VERTICAL CANTILEVER CONFIGURATION, RETAINER SHAFT DESIGN SHOULD TAKE INTO ACCOUNT HYDRAULIC FORCES, CRITICAL SPEED, AND MEMBERING SHAFT WEIGHT AND SHALL BE BY SELLER.
3. LIFTING LUG LOCATIONS SHOWN MAY BE ALTERED WITH PRIOR APPROVAL IF REQUIRED TO ACCOMMODATE PUMP DRIVE CONFIGURATION.
4. ALL DIM. IN INCHES PER ANSI Y14.5M-1994 UNLESS OTHERWISE INDICATED.
5. ALL BOLTED CONNECTIONS SHALL BE POSITIVELY SECURED.
6. ALL DIMENSIONS APPROXIMATE. BUYER TO APPROVE PRIOR TO FABRICATION.
7. DELETED.
8. MOUNTING PLATE OUTER DIAMETER SHALL MATCH ANSI B16.5M 150 LB FLANGE DIMENSIONS. RECOMMENDED MINIMUM SPACE ENVELOPE FOR PUMP ASSEMBLY SHALL BE FLANGE OUTER DIAMETER.
9. DELETED.
10. FOR THE LFP, LOP & RLD CONFIGURATIONS THIS CONNECTOR WILL BE A PRIMING CONNECTION. FOR THE LCP SELF-PRIMING CONFIGURATION THIS CONNECTOR WILL BE A SUPPORT COLUMN FLUID PRESSURE CONNECTION.
11. SELLER TO PROVIDE PIPE ENDS PREPARED FOR INSTALLATION OF IMPACT UNION FITTINGS WITH BUTT WELD CONFIGURATION. INSTALLATION AND FITTINGS ARE BY BUYER.
12. DIMENSIONING AND TOLERANCING ARE PER ANSI Y14.5M (STANDARD FOR DIMENSIONING AND TOLERANCING).

STUB/DOWEL PIN HOLE LOCATIONS AND DIAMETERS					
NOZZ.	X-AXIS	Y-AXIS	⌖ TOLERANCE	HOLE SIZE	⌀ TOLERANCE
SH1	0	0	⌖ .000	1.500	±.005
SH2	0	+20.00	⌖ .030	1.500	±.005
SH1	5.639	-3.661	⌖ .125	1.312	±0.030
SH2	-5.639	-3.661	⌖ .125	1.312	±0.030
SH3	-5.639	-21.339	⌖ .125	1.312	±0.030
SH4	5.639	-21.339	⌖ .125	1.312	±0.030



PUMP AND VESSEL DIMENSIONS BY SYSTEM				
	LFP	LOP	LCP	RLD
A	19'-0"	12'-0"	44'-0"	18'-0"
B	89'-6 ½"	6'-1½"	13'-9"	N/A
C	1'-6⅝"	1'-8 ½"	2'-3 ½"	N/A
D	13'-2⅜"	10'-1"	39'-0 ½"	89'-2"
E	14'-05⅝"	12'-0"	17'-3½"	18'-10⅝"
F	9'-6 "	19-3"	6'-3"	4'-3"
TANK HEAD TYPE	F & D	F & D	F & D	FLAT

TOLERANCES ON ALL DIMENSIONS, UNLESS OTHERWISE NOTED, TO BE	
	DECIMALS:
ANGLES ±0° 30'	.X ± .1
FRACTIONS ± 1/8"	.XX ± .05
SURFACE FINISH 125	.XXX ± .010

FIGURE 1
LAW SEMI-REMOTE VESSEL MOUNTED VERTICAL TRANSFER PUMPS
ATTACHMENT TO SPECIFICATION 24590-WTP-3PS-MPC0-T0008
LAW VESSEL MOUNTED VERTICAL TRANSFER PUMPS FOR LFP, LOP, LCP, & RLD SYSTEM

Appendix A

Pump Operation Summary

#	Pump ID#	Vessel Description	Pump Frequency	Pump Duration (SEE NOTE 1)
			[hours between batches]	[minutes]
1	LCP-PMP-00001A	LAW Concentrate Receipt Pump	16	25
2	LCP-PMP-00001B	LAW Concentrate Receipt Pump	16	25
3	LCP-PMP-00002A	LAW Concentrate Receipt Pump	16	25
4	LCP-PMP-00002B	LAW Concentrate Receipt Pump	16	25
5	LFP-PMP-00001A	Melter 1 Feed Preparation Vessel Pump	16	60
6	LFP-PMP-00001B	Melter 1 Feed Preparation Vessel Pump	16	60
7	LFP-PMP-00002	Melter 1 Feed Vessel Pump	As Needed	60
8	LFP-PMP-00003A	Melter 2 Feed Preparation Vessel Pump	16	60
9	LFP-PMP-00003B	Melter 2 Feed Preparation Vessel Pump	16	60
10	LFP-PMP-00004	Melter 2 Feed Vessel Pump	As Needed	60
11	LOP-PMP-00001	SBS Condensate Vessel Pump	24 / Continuous	107 (transfer) / recirc.
12	LOP-PMP-00002	SBS Condensate Vessel Pump	24 / Continuous	107 (transfer) / recirc.
13	LOP-PMP-00004	SBS Condensate Vessel Pump	24 / Continuous	107 (transfer) / recirc.
14	LOP-PMP-00005	SBS Condensate Vessel Pump	24 / Continuous	107 (transfer) / recirc.
15	RLD-PMP-00001A	Plant Wash Vessel Pump	63	91
16	RLD-PMP-00001B	Plant Wash Vessel Pump	63	91
17	RLD-PMP-00003A	SBS Condensate Collection Vessel Pump	43	91
18	RLD-PMP-00003B	SBS Condensate Collection Vessel Pump	43	91

NOTE 1: Finite times shown in this column are for batch transfers only.
All pumps shown as recirc. should be designed for continuous service.
All other pumps should be designed for intermittent service in addition
to transfer durations shown (nom. 30 min. per day)

Appendix B

Pump Design Parameter Summary

#	Bldg	Sys	Pump ID#	Quality Level	Access	Preferred Design	Nozzle Size [in]	Vessel ID#	Vessel Description	Mix Descrip	Mix Nature	If Non-Newt	Yield Stress [dynes/cm^2]		Consistency [cP]			Density [g/cm^3]		Solids Content			Part. Size Dist. [microns]		Chem. Comp
													Max	Min	Max	Design	Min	Max	Min	Total	Dissolved	Undissolved	Max	Average	
1	LAW	LCP	LCP-PMP-00001A	CM	Semi- Remote	Self-priming	20	LCP-VSL-00001	LAW Concentrate Receipt [1]	Homogeneous	Newtonian	N/A	None	None	15	-	0.4	1.47	1	45	45	0	-	15	see sheet 2
2	LAW	LCP	LCP-PMP-00001B	CM	Semi- Remote	Self-priming	20	LCP-VSL-00001	LAW Concentrate Receipt [1]	Homogeneous	Newtonian	N/A	None	None	15	-	1	1.47	1	45	45	0	-	15	see sheet 2
3	LAW	LCP	LCP-PMP-00002A	CM	Semi- Remote	Self-priming	20	LCP-VSL-00002	LAW Concentrate Receipt [2]	Homogeneous	Newtonian	N/A	None	None	15	-	1	1.47	1	45	45	0	-	15	see sheet 2
4	LAW	LCP	LCP-PMP-00002B	CM	Semi- Remote	Self-priming	20	LCP-VSL-00002	LAW Concentrate Receipt [2]	Homogeneous	Newtonian	N/A	None	None	15	-	1	1.47	1	45	45	0	-	15	see sheet 2
5	LAW	LFP	LFP-PMP-00001A	CM	Semi- Remote	Cantilever	20	LFP-VSL-00001	Melter 1 Feed Preparation Vessel	Solid Suspension	Non-Newtonian	Thixotropic	150	0	90	-	0.4	1.83	1.67	63.4	33.4	30	243	48.7	see sheet 2
6	LAW	LFP	LFP-PMP-00001B	CM	Semi- Remote	Cantilever	20	LFP-VSL-00001	Melter 1 Feed Preparation Vessel	Solid Suspension	Non-Newtonian	Thixotropic	150	0	90	-	0.4	1.83	1.67	63.4	33.4	30	243	48.7	see sheet 2
7	LAW	LFP	LFP-PMP-00002	CM	Semi- Remote	Cantilever	20	LFP-VSL-00002	Melter 1 Feed Vessel	Solid Suspension	Non-Newtonian	Thixotropic	150	0	90	-	0.4	1.83	1.67	63.4	33.4	30	243	48.7	see sheet 2
8	LAW	LFP	LFP-PMP-00003A	CM	Semi- Remote	Cantilever	20	LFP-VSL-00003	Melter 2 Feed Preparation Vessel	Solid Suspension	Non-Newtonian	Thixotropic	150	0	90	-	0.4	1.83	1.67	63.4	33.4	30	243	48.7	see sheet 2
9	LAW	LFP	LFP-PMP-00003B	CM	Semi- Remote	Cantilever	20	LFP-VSL-00003	Melter 2 Feed Preparation Vessel	Solid Suspension	Non-Newtonian	Thixotropic	150	0	90	-	0.4	1.83	1.67	63.4	33.4	30	243	48.7	see sheet 2
10	LAW	LFP	LFP-PMP-00004	CM	Semi- Remote	Cantilever	20	LFP-VSL-00004	Melter 2 Feed Vessel	Solid Suspension	Non-Newtonian	Thixotropic	150	0	90	-	0.4	1.83	1.67	63.4	33.4	30	243	48.7	see sheet 2
11	LAW	LOP	LOP-PMP-00001	CM	Semi- Remote	Cantilever	20	LOP-VSL-00001	SBS Condensate Vessel	Homogeneous	Newtonian	N/A	N/A	N/A	-	0.66	-	1.025	-	5	2	3	25	5	<5% solids, N/A
12	LAW	LOP	LOP-PMP-00002	CM	Semi- Remote	Cantilever	20	LOP-VSL-00001	SBS Condensate Vessel	Homogeneous	Newtonian	N/A	N/A	N/A	-	0.66	-	1.025	-	5	2	3	25	5	<5% solids, N/A
13	LAW	LOP	LOP-PMP-00004	CM	Semi- Remote	Cantilever	20	LOP-VSL-00002	SBS Condensate Vessel	Homogeneous	Newtonian	N/A	N/A	N/A	-	0.66	-	1.025	-	5	2	3	25	5	<5% solids, N/A
14	LAW	LOP	LOP-PMP-00005	CM	Semi- Remote	Cantilever	20	LOP-VSL-00002	SBS Condensate Vessel	Homogeneous	Newtonian	N/A	N/A	N/A	-	0.66	-	1.025	-	5	2	3	25	5	<5% solids, N/A
15	LAW	RLD	RLD-PMP-00001A	CM	Semi- Remote	Cantilever	20	RLD-VSL-00003	Plant Wash Vessel	Homogeneous	Newtonian	N/A	N/A	N/A	-	1	-	1.02	1	1	2	-	-	-	<1% solids, N/A
16	LAW	RLD	RLD-PMP-00001B	CM	Semi- Remote	Cantilever	20	RLD-VSL-00003	Plant Wash Vessel	Homogeneous	Newtonian	N/A	N/A	N/A	-	1	-	1.02	1	1	2	-	-	-	<1% solids, N/A
17	LAW	RLD	RLD-PMP-00003A	CM	Semi- Remote	Cantilever	20	RLD-VSL-00005	SBS Condensate Collection Vessel	Homogeneous	Newtonian	N/A	N/A	N/A	-	1	-	1.02	1	5	2	-	-	-	<1% solids, N/A
18	LAW	RLD	RLD-PMP-00003B	CM	Semi- Remote	Cantilever	20	RLD-VSL-00005	SBS Condensate Collection Vessel	Homogeneous	Newtonian	N/A	N/A	N/A	-	1	-	1.02	1	5	2	-	-	-	<1% solids, N/A

Abbreviations for Systems

- **LCP** LAW Concentrate Receipt Process System
- **LFP** LAW Melter Feed Process System
- **LOP** LAW Primary Offgas Process System
- **RLD** LAW Radioactive Liquid Waste Disposal System

IMPORTANT: These values are subject to change.
Information listed here will be updated as design progresses if required.
Seller shall verify values with Buyer before initiating detailed design.
In the event of a discrepancy between values shown here and the data sheets or elsewhere in this Bid package, Seller shall use the most conservative values.

Typical Chemical Composition of Slurries

LAW SLURRY LEGEND:

LCP Refers to pretreated waste for LCP pumps.
LFP-MFPV Refers to Melter Feed for LFP-PMP-00001A/B, and 00003A/B
LFP-GFC Refers to Glass Forming Chemicals for LFP-PMP-00001A/B, and 00003A/B
LFP-MFV Refers to Melter Feed for LFP-PMP-00002, and 00004

Compound	LCP [wt%]	LFP-MFPV [wt%]	LFP-GFC [wt%]	LFP-MFV [wt%]
Al_2O_3	5.6%	5.3%	5.1%	5.3%
B_2O_3	0.6%	5.4%	8.3%	5.4%
Na_2O	41.0%	17.0%	3.8%	17.0%
Fe_2O_3	0.1%	3.7%	5.7%	3.7%
SiO_2	0.4%	33.1%	51.2%	33.1%
SO_3	0.9%	0.3%	0.005%	0.3%
ZrO_2	0.1%	1.5%	2.3%	1.5%
ZnO	0.1%	1.4%	2.1%	1.4%
Other	51.2%	32.3%	21.5%	32.3%

Appendix C

Connectors

Appendix C

Connectors

1.0 General

Drawings and brief descriptions of the types of connectors proposed for the vertical pumps are detailed in section 3. Certain connectors shown here will be supplied by the Buyer, as described in this specification and in Appendix D, and the Seller shall be responsible for incorporating the proper interfaces and locations into their final designs. The final selection of connector size and type is subject to change and shall be approved by the Buyer prior to fabrication of the pumps.

2.0 Connector Selection

2.1 Semi-Remote Process Connectors - LAW

The semi-remote process connectors will be 150# Raised Face flanges.

Semi-Remote Electrical Connectors - LAW

The semi-remote electrical connectors shall be standard electrical connections sized appropriately for the specific power applications. Semi-remote electrical connectors shall be supplied by the Seller.

3.0 Connector Technology

General

Figure C3.1 DELETED

Appendix D
Final Dimensional Measurements of Pumps by Seller

Appendix D

Final Dimensional Measurements of Pumps by Seller

1.0 Purpose

The Seller shall perform dimensional measurements for all vertical pumps, all nozzles, and all appurtenances at the Seller's shop. All as-built dimensions obtained thereby shall be recorded as required in Paragraph 6.4.1 of Specification 24590-WTP-3PS-MPC0-T00008. The Seller shall give the Buyer opportunity to witness all final dimensional measurements and review all dimensional records prior to shipment.

2.0 Scope

2.1 Items Included

The Seller shall furnish the following:

- Enclosed and/or partitioned separate temperature controlled area
- Level precision floor surface or surfaces
- Instrument supports, platforms, ladders, stairs, and guardrails
- Overhead crane access
- Lighting
- Facility and support drawings
- Vertical pump support stand
- Lifting yokes, fabricated to dimensions and configurations supplied by Buyer
- Optical instruments and scales

3.0 Requirements - Shop Facilities

3.1 The Seller shall provide a measurement area for final dimensional verification. This will require approximately 30 feet of headroom to the bottom of the crane hook. A vertical pump stand with a level, flat surface matching the tolerances of the pump support plates is required for mounting pumps during dimensional check. The measurement area shall be temperature controlled to 70 °F ± 5 °F. The Seller shall supply calibrated thermometers with traceable calibration sheets. This temperature shall be maintained during the dimensional measurement by the Seller.

3.2 The Seller shall make final dimensional measurements using their own equipment, such as calibrated jig transits, tilting levels, and calibrated and certified scales. Scales shall be graduated to 0.01 inch. The optical instruments shall be equipped with micrometers graduated to 0.001 inch.

3.3 The vertical pump support plate face shall be profiled at 15 degree intervals and plotted for record.

3.4 The Seller shall allow adequate time to perform final dimensional measurement of each pump in the presence of the Buyer's representative to witness/observe the Seller's inspection activity. The Seller shall also provide appropriate notification to the Buyer for each witnessed inspection activity. Note that the Seller has sole responsibility for quality control inspections of their products.

3.5 There shall be no visual interference with the optical measurements performed by the Seller. Examples of visual interference are arc welding and equipment movement.

3.6 The Seller shall provide rigid supports for optical transits and levels. These supports shall be freestanding and not touching the remote vertical pumps. Substantial platforms, ladders, stairs, and handrails shall be provided, all meeting OSHA requirements. The instrument supports shall be set up a minimum of 7 feet away from the vertical pump stand and at least 3 feet higher.

3.7 The Seller shall submit the following drawings for the Buyer's review:

a The measurement enclosure area

b The vertical pump stand

c The optical instrument supports

d Substantial platforms, ladders, and handrails

e The crane interface

3.8 The Seller shall furnish one balanced lifting yoke, or one for each lifting lug configuration as necessary, to the dimensions and configurations supplied by the Buyer, for the plumb lift testing of the vertical pumps.

3.9 The Seller shall provide adequate lighting to facilitate the optical dimensional measurements. Lighting should generally be 100-foot candle average where measurements will be made.

Engineering Document Review

EDR No.* 24590- Rev.*

Return to Preparer:	Marshall Nielsen c/o Bill Honsaker	MS6-P2	371-4542
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	Mechanical Systems, Central Eng.	5/19/04	5/26/04
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Reviewer / Recipient	Discipline	Mail Stop	Info Only Recipient	Reviewer / Recipient	Discipline	Mail Stop	Info Only Recipient
[redacted]	Mech. Sys. Central	MS6-P2					
Mac Sanvictores	LAW Systems Eng.	MS12-2B					

EXTERNAL REVIEWING ORGANIZATIONS

Point of Contact	Organization	Mail Stop	Point of Contact	Organization	Mail Stop
☐ Betty Tornow	Project Director	MS14-3C	☐ Karen Vacca	Operations	MS12-B
☐ Betty Tornow	Project Manager	MS14-3C	☐ Amorette Pryor	Project Administrative Services	MS11-B
☐ Earl Duda	Acquisition Services	MS6-P1	☐ Buck Payne	Project Controls	MS4-A2
☐ Liz Hagie	Business Services	MS14-3C	☒ Michelle Mitchell	Quality Assurance	MS14-4B
☐ Paul Petrusha	Construction	MS4-A1	☐ Tamela Michaud	Safety Assurance	MS14-4A
☒ Emmy Sauceda	Environmental & Nuclear Safety	MS4-C1			

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

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

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

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

DOCUMENTS REVIEWED

Document Number	Next Rev	Document Number	Next Rev
24590-WTP-3PS-MPC0-T0008	1		

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	Name (Print)	*Location*	*Telephone*
	Mechanical Systems, Central Eng.	5/19/04	5/26/04
	Discipline	*Date*	*Comments Due Date*

REVIEW RESULTS

Reviewer: C Morley *Name (Print)* Organization: MS Return Date: 6/1/04

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

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

Notes/Comments:

Comments Resolved: Chris Morley *Print/Type Name* *Signature* 6/2/04. *Date*

Engineering Document Review

EDR No.* 24590- Rev.*

Return to Preparer:	Marshall Nielsen c/o Bill Honsaker	MS6-P2	371-4542
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Chris Morley	Mech. Sys. Central	MS6-P2					
[redacted]	**LAW Systems Eng.**	**MS12-2B**					

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	Discipline	*Date*	*Comments Due Date*

REVIEW RESULTS

Reviewer: M. SANVICTORES (*Name (Print)*) Organization: Mech Sys Return Date: 5/20/04

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

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

Notes/Comments:

Comments Resolved: M. SANVICTORES (*Print/Type Name*) (*Signature*) 6/8/04 (*Date*)

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Chris Morley	Mech. Sys. Central	MS6-P2					
Mac Sanvictores	LAW Systems Eng.	MS12-2B					

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	Discipline	*Date*	*Comments Due Date*

REVIEW RESULTS

Reviewer: E Saucedo/PDC Organization: E&NS Return Date: 5/25/04

Name (Print)

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

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

Notes/Comments:

Comments Resolved:

Print/Type Name	*Signature*	*Date*

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DOCUMENTS REVIEWED

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	Name (Print)	*Location*	*Telephone*
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	Discipline	*Date*	*Comments Due Date*

REVIEW RESULTS

Reviewer: BILL DEY *Name (Print)* Organization: QA Return Date: 25 May 2004

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

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

Notes/Comments:

Comments Resolved: BILL DEY *Print/Type Name* [signature] *Signature* 28 May 2004 *Date*

Document reviewed: 24590-WTP-3PS-MPC0-T0008, Rev. 1