R10630952

ISSUED BY
RPP-WTP PDC

# RIVER PROTECTION PROJECT – WASTE TREATMENT PLANT

## ENGINEERING SPECIFICATION

FOR

## PTF Hot Cell Slurry Pumps to Meet Requirements of API Standard 610, Eighth Edition

03/28/2008.

**EXPORT CONTROLLED INFORMATION** - "Contains technical information whose export is restricted by statute. Violations may result in administrative, civil, or criminal penalties. Limit dissemination to U.S. Department of Energy employees and contractors and other U.S. Government agencies. The cognizant program manager must approve other dissemination. This notice shall not be separated from the attached document.

03/28/2008

**This Document Contains Export Controlled Information**

**Content applicable to ALARA?** ☒ **Yes** ☐ **No**

**ADR No.**
24590-WTP-ADR-M-03-011

**Rev**
1

| Quality Designator |
|---|
| QL |
| DOE Contract No. DE-AC27-01RV14136 |

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

| REV | DATE | BY | CHECK | REVIEW | E&NS | QA | APEM/DEM |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| 1 | 9/15/05 | T. Henry | U. Sen<br>C. Morley | W. Eaton | for S. Woolfolk | for G. Warner | B. Voke |
| 0 | 6/30/03 | J. Albretsen | G. Goolsby | M. Hoffmann | | G. Warner | G. Duncan |

**SPECIFICATION No.**
24590-PTF-3PS-MPC0-T0001

**Rev**
1

## Revision History

| Revision | Reason for Revision |
|---|---|
| 0 | Issued for Use |
| 1 | Issued to incorporate SCNs 24590-WTP-3PN-MPC0-00013, 00016, 00017, and 00025. Revised to include corrective actions identified in CAR #24590-WTP-CAR-QA-05-124 |
| | |
| | |

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to 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.

# Contents

1 Scope ..... 1
1.1 Project Description and Location ..... 1
1.2 Equipment, Material, and Services Required ..... 1
1.3 Work by Others ..... 2
1.4 Definitions and Acronyms ..... 2
1.5 Quality/Seismic Classifications ..... 3
2 Applicable Documents ..... 3
2.1 General ..... 3
2.2 Codes and Industry Standards ..... 3
2.3 Engineering Specifications ..... 4
2.4 Engineering Drawings ..... 5
3 Design Requirements ..... 5
3.1 Basic Function ..... 5
3.2 Performance ..... 6
3.3 Design Conditions ..... 6
3.4 Environmental Conditions ..... 11
3.5 Mechanical Requirements ..... 11
3.6 Loadings ..... 13
3.7 Electrical Requirements ..... 13
3.8 Instrumentation and Control Requirements ..... 14
3.9 Remote Handling Requirements ..... 14
4 Materials ..... 16
4.1 Construction ..... 16
4.2 Prohibited Materials ..... 16
4.3 Special Requirements ..... 17
5 Fabrication ..... 17
5.1 Welding ..... 17
5.2 Assembly ..... 17
5.3 Heat Treatment ..... 17
5.4 Other Processes (as required) ..... 17
6 Tests and Inspections ..... 17
6.1 Personnel Qualifications ..... 17
6.2 Non-Destructive Examinations ..... 18

6.3 Shop Tests ..... 18
6.4 Site Tests ..... 18
6.5 Plumb Lift Test ..... 19
7 Preparation for Shipment ..... 19
7.1 Cleanliness ..... 19
7.2 Painting ..... 19
7.3 Tagging ..... 19
7.4 Packaging and Shipping Instructions ..... 19
8 Quality Assurance ..... 19
8.1 QA requirements specific to item(s) or service ..... 19
8.2 Program QA elements ..... 20
9 Configuration Management ..... 20
10 Documentation and Submittals ..... 20
10.1 Submittals ..... 20

## Appendices

Appendix A Items Supplied by Buyer ..... A-i
Appendix B Pump Bounding Dimensions ..... B-i
Appendix C Radiation Resistant Materials ..... C-i
Appendix D WTP Specific Tailoring for API 610 ..... D-i
Appendix E PUREX Nozzle Bounding Loads ..... E-i
Appendix F WTP Specific Tailoring for AISC M016 ..... F-i

# 1 Scope

## 1.1 Project Description and Location

The River Protection Project - Waste Treatment and Immobilization Plant (WTP) is a complex of waste treatment facilities where the US Department of Energy (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) currently stored in underground storage tanks at the Hanford Site.

The Hanford Site occupies an area of about 560 square miles and is located 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. The Counties of Benton, Franklin, and Grant surround the Hanford Site.

## 1.2 Equipment, Material, and Services Required

Design, furnish materials, fabricate, assemble, test, package, and deliver complete slurry pump units and accessories in accordance with this specification, including:

1.2.1 Dry pit type, vertical slurry pumps, complete with motor, adjustable speed drive, wiring and conduit to electrical connector, tight tolerance remote lifting assembly, jumper connectors attached, all required piping from pump casing to nozzle connectors, seal water reservoir and piping to nozzle connector, remote handling features including nut cups. Remote jumper nozzle connections and electrical jumper connections will be provided by Buyer and installed on pump by Seller. Refer to Appendix A "Items Supplied by Buyer" for details.

1.2.2 Services of a qualified factory technical representative or supervisor to assist in installation and startup at the job site and/or subvendor's shop, if required by Buyer on separate contract.

1.2.3 Sets of all special tools required for installation and maintenance. The order will specify the quantity of tool sets to be furnished.

1.2.4 List of consumable spare parts per item for start-up and one year operation.

1.2.5 The Seller shall recommend perforation size in start-up strainers for each pump application.

1.2.6 Each pump, motor and base assembly shall include all components needed to set pumps on the Process Equipment Platform (PEP) and connect to Buyer's process, electrical, and seal water jumpers. See paragraph 5.2.

1.2.7 Lifting yoke(s) designed to interface with Buyer's cranes.

1.2.8 Design and provide Purex connector supports on the suction and discharge nozzles to restraint the higher interface loads imposed by the Purex connectors as shown on Appendix E from being transmitted to the pump nozzles.

## 1.3 Work by Others

1.3.1 Material unloading and storage at jobsite

1.3.2 Installation labor

1.3.3 PEP studs, dowels, and nuts

1.3.4 Process, Electrical, and Seal Water Jumpers

1.3.5 Electric power supply and connection

1.3.6 Wiring external to the pump and driver

## 1.4 Definitions and Acronyms

### 1.4.1 Definitions

1.4.1.1 Jumper: A remotely removable and replaceable section of pipework or cable used to connect pieces of process equipment to services, process fluids, or other process equipment. Jumpers may include valves, instrumentation, or other process equipment items. See Engineering Specification 24590-WTP-3PS-PF00-T0001 for additional information.

1.4.1.2 Process Equipment Platform (PEP): Platforms located in the PTF Hot Cell for mounting remotely replaceable process equipment, equipment supports, and pipe supports.

1.4.1.3 Remote Handled Equipment: Equipment located in the radioactive Hot Cell (an R5 area) of the Pretreatment Facility (PTF) that will only be accessed by cranes, remote lifting fixtures, power manipulator arm, and a crane mounted impact wrench, and not through direct human contact.

1.4.1.4 See API 610 section 1.4 for additional definitions

### 1.4.2 Acronyms of Organizations

| | |
|---|---|
| API | American Petroleum Institute |
| ASME | American Society of Mechanical Engineers |
| Deleted | |
| Deleted | |

Deleted

### 1.5 Quality/Seismic Classifications

Quality Level and Seismic Category of each pump described in this specification will be on the individual Pump Data Sheets.

# 2 Applicable Documents

### 2.1 General

2.1.1 Work shall be done in accordance with 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 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 in section 2, the latest issue, including addenda, at the time of Request for Quote (RFQ) shall apply. The dates and revisions listed in section 2 shall apply to all subsequent references to codes and standards within this specification. When more than one code, standard, or referenced document covers the same topic, the requirements for all must be met with the most stringent governing.

### 2.2 Codes and Industry Standards

| | | |
|---|---|---|
| 2.2.1 | API 610 - August, 1995 | *Centrifugal Pumps for Petroleum, Heavy Duty Chemical, and Gas Industry Service, Eighth Edition (See its Appendix A for additional Referenced Publications and International Standards)* |
| 2.2.2 | Deleted | |
| 2.2.3 | Deleted | |
| 2.2.4 | Deleted | |
| 2.2.5 | Deleted | |
| 2.2.6 | ASME B31.3-1996 | *Process Piping* |

| | | |
|---|---|---|
| 2.2.7 | ASME Y14.5M-94 | *Dimensioning and Tolerancing* |
| 2.2.8 | AISC M016 - 9th Edition | *Manual of Steel Construction, Allowable Stress Design (ASD)* |

## 2.3 Engineering Specifications

2.3.1 24590-WTP-3PS-G000-T0001, *General Specification for Supplier Quality Assurance Program Requirements*

2.3.2 24590-WTP-3PS-G000-T0002, *Engineering Specification for Positive Material Identification (PMI) for Shop Fabrication*

2.3.3 24590-WTP-3PS-G000-T0003, *General Specification for Packaging, Handling and Storage Requirements*

2.3.4 24590-WTP-3PS-MUMI-T0002, *Engineering Specification for Low Voltage Induction Motors*

2.3.5 24590-WTP-3PS-EVV1-T0001, *Engineering Specification for Low Voltage Adjustable Speed Drives*

2.3.6 24590-WTP-3PS-SS90-T0001, *Engineering Specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks*

2.3.7 24590-WTP-3PS-FB01-T0001, *Engineering Specification for Structural Design Loads for Seismic Category III & IV Equipment and Tanks*

2.3.8 24590-WTP-3PS-PF00-T0001, *Engineering Specification for Jumper Fabrication for PTF and HLW*

2.3.9 24590-WTP-3PS-NWP0-T0001, *Engineering Specification for General Welding and NDE Requirements for Supplier Fabricated Piping*

2.3.10 24590-WTP-3PS-PS02-T0002, *Engineering Specification for Cold Bending of Pipe*

2.3.11 24590-WTP-3PS-SS00-T0002, *Engineering Specification for Welding of Structural Stainless Steel and Welding of Carbon Steel to Structural Stainless Steel*

2.3.12 24590-WTP-3PS-AFPS-T0001, *Engineering Specification for Shop Applied Special Protective Coatings for Steel Items and Equipment*

### 2.4 Engineering Drawings

2.4.1 24590-WTP-M0-M10T-00012001 & 24590-WTP-M0-M10T-00012002, *WTP Vitrification Facility Design Proposal Drawing Remote Impact Wrench Stand & Nut/Bolt Rack*

2.4.2 24590-WTP-M0-50-00016, *WTP Remote Fasteners*

# 3 Design Requirements

### 3.1 Basic Function

3.1.1 These centrifugal pumps will provide motive force to slurries that are radioactive, corrosive, and abrasive. Pumps shall be designed to be interchangeable as much as possible.

3.1.1.1 Data on slurry composition is limited. Slurry composition, generally abrasive and caustic, will vary widely during processing. Pumps will also be flushed with Sodium Hydroxide and/ or Nitric acid. Pumps that are mechanically interchangeable shall be chemically compatible with all fluids' properties on any of the Pump Data Sheets.

3.1.2 The pumps will be located in a "hot cell" and will require remote handling design features. The pumps shall be vertical dry-pit style, consisting of three major assemblies:

- Casing-base assembly
- Back pull-out assembly
- Motor

3.1.2.1 The casing-base assembly shall be designed to mount the pump on PEPs. The casing will have extended suction and discharge lines that attach to jumper connectors.

3.1.2.2 The back pull-out assembly shall be designed so that all the rotating components of the pump (including motor) can be remotely removed using only a crane-mounted impact wrench and crane-mounted lifting yoke while leaving the casing-base assembly in place and process jumper connections undisturbed.

3.1.2.3 The motor removal from the back pull-out assembly shall be coordinated with the Buyer.

3.1.2.4 See Section 3.9 for additional information on remote handling. The Seller shall coordinate with Buyer on remote handling design elements. This includes, but is not limited to, the submission of drawings for Buyer review and comment as specified on the Form G-321-E included in the procurement documents.

## 3.2 Performance

See the individual Pump Data Sheets.

## 3.3 Design Conditions

3.3.1 See the individual Pump Data Sheets.

3.3.2 Pumps shall be designed for an exposure life 5 years at specified conditions. Included are normal maintenance items such as bearings, seals, and gaskets, which, due to remote radioactive environment, shall function with no maintenance required within that period. Casings and motors shall be designed for a minimum continuous-duty service life of 10 years and a nominal intermittent-duty/standby service life of 40 years. Seller shall advise if 5 year no maintenance period is not feasible.

3.3.2.1 The useful life of the back pull-out assembly will be limited by its weakest link (i.e. seal failure, impeller erosion, etc). It is assumed that even after removal of back pull-out assembly and decontamination, that impellers, seals, other components in contact with process fluid will be too radioactive for hands-on repair and replacement. The back pull-out assembly shall be considered a run to failure item and shall be designed to maximize the service life of weak components and minimize decontamination and replacement costs. Although the back pull-out assembly is considered a run to failure item, pumps shall be designed to allow for maintenance during the cold commissioning period.

3.3.2.2 Motors will be considered reusable. The back pull-out assembly, lifting structure, and electrical wiring to motor shall all be designed to minimize motor removal and replacement time. Seller shall coordinate with Buyer on motor removal tools and procedure.

3.3.2.3 Removal of process jumper connections from the extended casing suction and discharge piping is complicated and replacement of the casing or the entire pump involves significantly more downtime than replacement of just the back pull-out assembly.

3.3.2.3.1 Seller shall design the casing for maximum feasible life under abrasive-corrosive conditions. Seller may offer options such as coatings, liners or other special features to maximize pump casing service life. Elastomers and polymers are not acceptable for coatings or liners. Casing base material shall be selected for maximum abrasion resistance under corrosive conditions whether coatings or liners are offered or not.

Note: If proposed, a replaceable liner must be replaceable by remote handling without disturbing process connections.

3.3.2.3.2 Casings shall be designed with visual provisions to indicate need for casing replacement. The only available method of examining casings in service will be by remotely operated camera during back pull-out assembly replacement. Seller shall specify predicted remaining casing life compared to the back pull-out assembly. The casing shall be designed so that after the wear indicators become visible, the remaining expected life of the casing exceeds the predicted life of a back pull-out assembly to minimize possibility of casing failure.

3.3.2.4 Seller's recommended accessibility and maintenance requirements for each piece of equipment shall be included in the Seller's submittal. Frequency of inspection and maintenance intervals shall be in accordance with equipment Seller's recommendations.

3.3.2.5 Assuming maintenance practices are performed by Buyer as recommended by Seller and based on information provided in individual Pump and Motor Data Sheets, Seller shall provide data similar to the following for the pump and motor:

3.3.2.5.1 Estimated service life and Mean Time Between Failures (MTBF).

3.3.2.5.2 Common modes of failure (i.e. seal failure, bearings seize, motor insulation failure, etc.) and the estimated hours until such an event occurs.

3.3.2.5.3 Steps for replacement of major maintenance items (such as removal of pull out assembly, motor, etc.).

3.3.3 This (Bechtel WTP) specification covers the minimum requirements for centrifugal pumps designed in accordance with API Standard 610, Eighth Edition, "Centrifugal Pumps for Petroleum, Heavy Duty Chemical, and Gas Industry Services" as modified by this section. Bulleted items in API 610 not addressed in this specification shall have the decisions noted on the individual Pump Data Sheets. The intent of using API 610 is to specify a robust and dependable design for aggressive process conditions. It is recognized that certain aspects of API 610 may not be suitable for slurry services. Seller shall list and justify all exceptions to API 610, 8th Edition and submit to Buyer in writing for review and acceptance.

The terms "Supplier" or "Seller" in this specification is equivalent to "Vendor" as defined in API 610.

**<u>API 610 Paragraph Numbers</u>**

**The paragraph numbers in this Section correspond to those in API 610 and each of the paragraphs denotes an "Addition", "Decision", or "Modification" to the API requirements.**

**Section 1 - General**

**Figure 1-2 (Modification) Basic Pump Types: The Wilfley pumps are a modified OH3 design.**

1.2.2 (Decision) Dimensions shall be US Standard. Pumps shall comply with applicable US Standards unless a Code or Standard specified dictates otherwise.

**<u>Section 2 - Basic Design</u>**

2.1.1 (Modification) See paragraph 3.3.2 of this (Bechtel WTP) specification.

2.1.4 (Modification) Pumps shall be furnished with full diameter impellers, 5% head increase will be accomplished by increasing pump speed with adjustable speed drives.

2.1.9 (Decision) Pump Suction Specific Speed (S) shall not exceed 12,000 (calculated using rotative speed in rev/min, BEP flow at the maximum diameter impeller in GPM and NPSH in feet).

Pumps offered with suction specific speeds > 12,000 may be accepted subject to Buyer's written approval.

2.1.12 **(Modification) Ratings shall be within allowable operating range for each pump. The rated capacity may fall outside the region of 80 to 110 percent of best efficiency capacity of the furnished impeller for all pump selections.**

2.1.13 **(Modification) Best efficiency point may fall outside the range of the rated point and the normal point for all pump selections.**

2.1.14 **Maximum allowable sound level shall not exceed 85 dBa at 3 feet.**

2.2.4 (Modification) The maximum allowable working pressure shall apply to all parts referred to in the definition of "pressure casing" (See API paragraph 1.4.40).

2.3.2.1 **(Clarification) Not applicable due to requirement for Purex suction and discharge connectors.**

2.3.3.3 (Decision) Cylindrical threads shall not be used.

2.3.3.10 **(Clarification) Primary seal will be self venting. Secondary seal will be manually vented.**

2.3.3.11 (Decision) Pressure gauge connections shall not be provided.

2.5.1 **(Decision) Semi open impeller is an acceptable design.**

2.5.2 **(Modification) Impellers are threaded and pinned.**

2.6 **(Decision) Renewable wear rings are not required.**

2.6.4.1 (Addition) The wear ring running clearance (adjusted for temperature) and diameter, shall be clearly stated in the **procurement documents** for each service. Pump efficiencies shall be based on the corrected clearances.

2.8.3 **(Modification) Vibration limits shall be in accordance with section ANSI/HI 9.6.4-2000 of the Hydraulic Institute Standards.**

2.8.3.7 **(Modification) Vibration limits shall be in accordance with section ANSI/HI 9.6.4-2000 of the Hydraulic Institute Standards.**

2.9.1.5 **(Modification) Double row bearings are acceptable.**

2.9.2.1 **(Modification) Drivers must be removed to accommodate bearing replacement.**

2.10 **(Modification) Bearings are permanently grease lubricated. This section shall not apply.**

2.11.2.3 (Modification) (Delete "ferrous" from the first sentence.) Pressure boundary and impeller castings shall be repaired as specified in API paragraph 2.11.2.3.1.

## Section 3 - Accessories

3.2.12 (Modification) **Deleted**

3.3 (Modification) Pumps shall have a special base design as specified in this (Bechtel WTP) specification.

3.5.1.4 (Modification) Reservoir mounting will be determined by remote handling requirements. Pumps seal water system shall be fully assembled prior to shipment.

**3.5.1.7 (Clarification) Piping design, materials, joint fabrication, examination, and inspection shall be in accordance with ANSI/ASME B31.3-1996.**

## Section 4 - Inspecition, Testing, and Preparation for Shipment

4.3.3.2 **(Addition)** Bearing temperatures shall be measured at all five points of the performance test. Temperatures for each point shall be taken at steady state conditions or 30 minutes, whichever comes first.

**4.3.3.3.1 (Modification) Vibration limits shall be in accordance with section ANSI/HI 9.6.4-2000 of the Hydraulic Institute Standards.**

**4.3.3.3.2 (Addition) Bearing temperatures may be higher than given in 2.9.2.3 during the shop test.**

Table 4-2 **(Modification) Test results may not be within the rated power (BHP) tolerances due to accumulation of unpredictable internal pump component losses. Total power consumption shall not exceed motor nameplate horsepower throughout the full range, shut off to end of curve, of the furnished impeller.**

4.3.4.1.1 (Addition) NPSHR test shall be performed if the difference between available NPSH and the NPSH required by the pump is less than or equal to 3 feet . The NPSHR test will be a vacuum tank suppression test unless a suction valve throttling test has been approved by the Buyer.

## Section 5 - Specific Pump Types

**5.1.2.2 (Clarification) Not applicable. Pumps shall not be free standing on pads or foundations.**

**5.1.2.3 (Modification) Pumps shall not be designed to float with the suction and discharge pipe.**

**5.1.2.6 (Modification) Continuous venting will not be supplied. Manual venting is acceptable.**

**5.1.2.10 (Modification) Vibration limits shall be in accordance with section ANSI/HI 9.6.4-2000 of the Hydraulic Institute Standards.**

## Section 6 - Vendor's Data

The requirements of Section 3 of the Material Requisition shall be applicable in addition to the API 610 requirements.

Deleted

**END OF COMMENTS TO API 610**

3.3.4 Pump assemblies, with the exception of the process connections where location is specified, shall be designed to fit entirely within dimensions specified in Appendix B "Pump Bounding Dimensions". The elevation of the pump discharge centerline, measured from the bottom of the mounting base, shall not exceed the dimension specified on Appendix B.

3.3.4.1 The pumps shall be designed and fabricated to the dimensions and tolerances specified in drawings provided by Buyer. Dimensions and tolerances shall be in accordance with ASME Y14.5M, Dimensioning and Tolerancing. Dimensions and tolerances are of extreme importance since pumps will be remotely removed and reinstalled to platforms of equal or greater tolerance requirements. Pumps will also interface remotely with high tolerance remote process or electrical jumpers at all pump nozzle connections.

3.3.4.2 The critical tolerances for location, flatness, parallelism of working planes and nozzles will be strictly enforced. This work may require jigs or gauges to be furnished as required by the Seller. If jigs or gauges are used they shall become property of the Buyer.

3.3.4.3 In order to verify all the specified dimensions, the Seller shall:

3.3.4.3.1 Establish x-y coordinates of all guide–pin holes, remote connectors, Acme stud holes, and mounting plate centerlines with reference to the master dowel hole.

3.3.4.3.2 Establish the bottom of the mounting plate as the horizontal datum plane from which pump elevations can be measured.

3.3.4.3.3 Represent all coordinates and targets to be used for precision dimensional verification with easily defined permanent machined features that are not subject to interpretation.

3.3.4.3.4 Submit a written tolerance control procedure to establish and verify horizontal and vertical centerlines, precise horizontal and vertical measurements, flatness and datum planes of all interface points.

3.3.4.4 Seller shall submit as-built drawings that show the remote handled features (setting dimensions, location of guide pins, fasteners, jumper connections, etc.). As-built dimensions shall be established by Seller's methods to decimal inch dimensions (number of places, two, or three, according to respective required dimensions).

## 3.4 Environmental Conditions

3.4.1 All pumps will be located in a highly radioactive area and exposed to operational radiation doses up to approximately 10,000 rad/hr (gamma). See individual Pump Data Sheets for other environmental information.

3.4.1.1 Based upon proposed decontamination methods, the atmosphere may contain vapors from 12% nitric acid. Additionally, items within the hot cell may be exposed to 12% nitric acid spray, mist, splash or collection at low spots. Though a water rinse would normally follow, it is possible for exposure to be protracted.

3.4.2 Motors shall be constructed of radiation resistant materials with total dosage of $10^9$ rads (gamma), rated for inverter-duty, and have a 40 year design life.

3.4.3 All bearings shall use special radiation resistant lubricants. See Appendix C for a list of approved lubricants.

3.4.4 Seal components shall be **constructed from** radiation **and acid** resistant materials **suitable for service life described in section 3.3.2**. See Appendix C for a list of approved **elastomer** materials. **Seal components in high radiation applications shall be constructed from suitable metallic materials. See individual data sheets for specific materials.**

## 3.5 Mechanical Requirements

See API 610 and individual Pump Data Sheets.

3.5.1 Flange fittings are not allowed on process and seal water piping; all connections shall be welded, or use Buyer supplied connectors. Design, fabrication, and/or attachment of piping and connectors shall be per Engineering Specification 24590-WTP-3PS-PF00-T0001.

3.5.2 Mechanical seals shall be a dual seal design suitable for corrosive slurry applications. The Buyer, pump Seller, and mechanical seal supplier shall mutually agree on the best mechanical seal application for each pump's service conditions.

3.5.2.1 Seals will use an API Plan 53 seal fluid system, except as reviewed and agreed by Buyer. Pressure will be provided by the make-up fluid line. Seller's scope includes reservoir, air cooled heat exchanger (as needed), all piping and equipment to and from seal, make-up fluid and drain lines up to and including quick disconnects specified by Buyer, and a block valve on drain line located and designed to be accessible to a remote manipulator arm. No instrumentation for the seal water system shall be included on pump assembly. Buyer will have flow and pressure alarms on the make-up water system.

3.5.2.2 **Dilution of process fluid shall be minimized. Maximum leakage rate into the process shall not exceed 80 cc/hr during normal operation. Leakage rate into process side during normal operation shall be indicated on the mechanical data sheets and submitted for Buyer review.**

3.5.2.3 **Pumps shall be designed for maximum seal life. Pump shaft stiffness and deflection at seal faces, as a minimum, shall be in compliance with API 610. Seller may offer options to further extend seal life.**

3.5.2.4 **Drain valve shall be configured to allow operation of the valve with an impact wrench suspended from an overhead crane. The valve shall be equipped with a position indicator so that the position of the valve can be determined by viewing with the remote camera.**

3.5.2.5 **Seal box and rotating element shall be designed to minimize seal box pressure to ensure the reservoir pressure is greater than the process pressure being sealed. Seller shall provide details of seal box and rotating element design for Buyer's review.**

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

3.5.4 All pump and motor bearings shall be greased for life and be fitted with Inpro/Seal or equivalent labyrinth seal bearing isolators.

3.5.5 Remote connectors to facilitate proper mating and remote replacement of jumper assemblies shall be attached and toleranced as shown on the drawings provided by Buyer. Seller shall design and fabricate the support arrangement for the remote connectors shown. Seller shall coordinate with Buyer on support loading requirements. Support design must not encroach on space required for remote impact wrench; see Section 3.9. Remote connector nozzles and components will consist of the types listed below:

a. Remote connector nozzles for process and drain connections

b. Electrical lower connectors

c. Seal water feed line connectors

NOTE: Refer to Appendix A for further details on which nozzles and connectors will be supplied by Buyer.

3.5.6 **Design, materials, joint fabrication, examination and inspection of piping and appurtenances within the boundary of the pump skid shall be in accordance with ASME B31.3-1996.**

3.5.7 **Welding of seal water reservoir shall be performed and inspected by operators and procedures qualified in accordance with ASME Section VIII, Div. 1.**

3.5.7.1 Pumps shall have a drain at the low point in the suction line; the exact location will be specified by Buyer after review of Seller's preliminary design drawings. The suction line drain shall be 2", with the exception of UFP-PMP-00042A/B, which will be specified later. Drains will terminate with a special connector provided by the Buyer. Seller will mount the connector. Drain shall be designed so that all fluid can drain out of pump and the piping to the jumper nozzle connectors.

3.5.8 **Access openings to shaft coupling shall be provided. Openings shall be provided with removable coupling guards to provide protection against rotating elements. Coupling guards shall be solid metal or mesh and shall be hinged and latched for easy access to rotating elements.**

## 3.6 Loadings

3.6.1 Forces and Moments capabilities, as a minimum, shall meet requirements of paragraph 2.4 of API 610. Calculations, if specified, shall be furnished.

3.6.2 **Pumps shall be designed for seismic loads as specified in the individual pump data sheets. Design loads shall be calculated in accordance with 24590-WTP-3PS-SS90-T0001, *Engineering Specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks,* or 24590-WTP-3PS-FB01-T0001, *Engineering Specification for Structural Design Loads for Seismic Category III & IV Equipment and Tanks.***

3.6.3 **The maximum allowable stress values for pumps designated Quality Level QL-1 or QL-2 and Seismic Category SC-I, SC-II or SC-III shall be in accordance with ASME Section VIII, Div 1, Part UG, Section UG-23 (d).**

## 3.7 Electrical Requirements

3.7.1 See the individual Motor Data Sheets, if provided, otherwise the individual Pump Data Sheets.

3.7.1.1 The Seller shall provide each pump with a totally enclosed fan-cooled (TEFC), washdown rated (IP55 protection), severe duty (per **API 610**) motor. Motors shall be designed for vertical operation and bearings shall be selected to give 100,000 hours minimum L10 rating life.

3.7.1.2 The Seller shall install all required conduit with proper wiring from the motor junction box to the electrical jumper connector. All electric components shall be waterproof. Cable shall be **resistant to** radiation **and nitric acid** levels shown in section 3.4.

3.7.1.3 Motor rated horsepower (at 1.0 S.F.) shall not be exceeded at 120% of pump Best Efficiency Point (BEP) **capacity** at rated speed.

3.7.1.4 Motors shall be rated for inverter-duty, with corresponding adjustable speed drives (ASD), as required by individual Pump Data Sheets, in order to allow for varying rheologies and liquid levels of the slurries being pumped.

3.7.1.5 Seller shall consider that cable length between ASD and motor will tentatively be between 350-550 feet in selection of ASDs.

3.7.1.6 The electrical jumper connector will be mounted above the motor. All pumps with 52" base shall have the same mounting location regardless of motor size. Location will be specified by Buyer after review of Seller's preliminary design drawings. The positional tolerance will be 1/16".

3.7.2 Electric motors shall meet the requirements of Engineering Specification 24590-WTP-3PS-MUMI-T0002 for Low Voltage Induction Motors.

3.7.3 Adjustable Speed Drive Motors shall be in accordance with Engineering Specification 24590-WTP-3PS-EVV1-T0001, for Low Voltage Adjustable Speed Drives.

## 3.8 Instrumentation and Control Requirements

3.8.1 See the individual Pump Data Sheets.

## 3.9 Remote Handling Requirements

### 3.9.1 Design Requirements

3.9.1.1 Pumps shall be designed for remote handling. The pump shall be remotely replaceable by means of an overhead crane equipped with an impact wrench, a closed circuit television system for remote viewing, and a power manipulator for smaller, more complex functions. Remote handling and potential radiation exposure require special pump attachments and configuration approaches (see following sections) to be furnished by the Seller.

3.9.1.2 Delicate items, such as seal water system and conduit, shall be shielded by location or guards to protect from damage by crane hook, lifting yoke, and impact wrench during remote handling operations.

3.9.1.3 Pump base shall be 2" thick where studs and dowels from the equipment mounting platform penetrate the pump base. (The entire mounting plate does not need to be 2" thick, only where dowel and studs go through the base.)

3.9.1.4 A pump lifting assembly shall be designed and fabricated by Seller with two lifting lugs that will 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. See paragraph 6.5.1.

> IMPORTANT: The lift yoke shall be counter-weighted, if necessary, to hang plumb by itself, without supporting the pump. Additionally, the <u>pump</u> shall be counter-weighted, if necessary, to provide plumb lift while being hoisted by the test lift yoke.

3.9.1.5 Both the pull-out/motor assembly and the casing-base assembly shall have lifting lugs designed so that the same lifting yoke can be used for either assembly. Lifting lugs on pull-out/motor assembly shall be designed for lifting of the entire pump unit. Seller shall design the pumps to use only one non-adjustable lifting yoke. Seller shall advise Buyer if this is not feasible.

3.9.1.6 Equipment shall be free from pockets or traps where radioactive contamination and/or water may lodge.

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

### 3.9.2 Finish Aspects and Coatings

3.9.2.1 All sharp edges of components shall be removed unless they are functionally sharp. Equipment, that is not painted (or otherwise coated), shall have decontaminable surface finish of 63 microinches (or less) roughness. Hand grinding of surfaces can, in certain circumstances, lead to roughening and should be used with caution.

### 3.9.3 Mounting and Remote Fasteners

3.9.3.1 Equipment mounted in hot cells that require remote installation shall meet the following standards:

- Guide pins or location features shall be installed as means to accurately position equipment.
- Studs, nuts, and guide pins shall be designed in accordance with *WTP Remote Fastener* drawing (24590-WTP-M0-50-00016), items 7, 9, 11, and 14.
- There shall be no loose washers.

3.9.3.2 For individual equipment pieces that require periodic replacement where the impact wrench use is impractical and the manipulator is required, socket head cap screws shall be used. Size of these screws shall no be less than 3/8", have a 30° tapered lead on the thread and be coarse threads in accordance with fastener standards of ASME B31.3. Fastener materials shall be selected to minimize galling. When using stainless steel as the bolt, nut, or base material, then Nitronic 60 shall be specified as the alternative mating material.

3.9.3.3 Seller shall design equipment to accommodate access for impact wrench and / or its extensions for installation and removal of fasteners. See drawings 24590-WTP-M0-M10T-00012001 and 24590-WTP-M0-M10T-00012002 for WTP impact wrench envelopes.

3.9.3.4 Setting dimensions and guide pin locations shall be recorded in the as-built drawings, including installation drawings and maintenance manuals. See paragraph 3.3.4.4.

3.9.3.5 All fasteners threads shall have nickel "Never-Seeze"® anti-seize lubricant applied to them or an equivalent approved by Buyer.

3.9.3.6 Snap rings, roll pins, cotter pins, and spring clips shall not be used to secure remotely replaceable items.

3.9.3.7 Fasteners shall be loaded in tension, and not in shear. Dowel pins or shoulders shall ensure proper alignment and be designed to carry the shear loads.

3.9.3.8 Seller shall design equipment such that screw fasteners are not used to "pull" the equipment into alignment.

### 3.9.4 Remote Guides

3.9.4.1 "Blind" guide features, whose alignment with the mating parts cannot be verified visually, shall be avoided, unless auxiliary visual guide features are used.

3.9.4.2 Precision guides shall be designed such that mating parts do not seize during assembly.

3.9.5 **Impact Wrench Interface**

3.9.5.1 Seller shall not exceed the torque ability of the impact wrench (750 ft-lbs removal, 450 ft-lbs tightening) used for remote fasteners on equipment in a cell.

3.9.5.2 Seller shall submit to Buyer torque requirements for all fasteners used in installation and fasteners that need to be removed for doing maintenance.

3.9.5.3 Seller shall not exceed envelope dimensions for impact wrench including anti-rotation bar and direction of approach when installing fasteners. The minimum clearance from the centerline of the fastener to the nearest obstruction is 3". See drawings 24590-WTP-M0-M10T-00012001 and 24590-WTP-M0-M10T-00012002 for details on the wrench.

3.9.5.4 Seller shall verify with Buyer that location of fasteners will meet impact wrench accessibility.

3.9.5.5 All nuts that are to be removed remotely by impact wrench shall have a vertical path with 3" clearance between the impact wrench housing and any obstruction. Seller shall use dowels, studs, nuts, and nutcups specified by Buyer. See drawing 24590-WTP-M0-50-00016, items 7, 9, 11, and 14.

# 4 Materials

## 4.1 Construction

See the individual Pump Data Sheets and, if provided, the individual Motor Data Sheets. Seller may offer options for materials that provide superior service life with corrosive, abrasive slurries than those specified on the individual pump data sheets. Due to proposed decontamination methods (see 3.4.1.1), all exposed equipment on the pump shall be made of stainless steel or better materials. This includes the seal water system, couplings, bearing frames, motor stands, conduit, etc. An exception shall be allowed for the motor, which shall have an epoxy coating suitable for hot cell conditions and decontamination processes. Motors shall use Coating Schedule No. 5.10, System Code T (see Engineering Specification 24590-WTP-3PS-AFPS-T0001, Appendix D) or Buyer approved alternate per paragraph 7.2.

## 4.2 Prohibited Materials

4.2.1 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 molybdenum based lubricants and halogens, shall not be used in direct contact with stainless steel, with the exception of oil impregnated bronze bearings. This prohibition applies to the 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.

4.2.2 The use of Teflon is prohibited.

4.2.3 The use of asbestos is prohibited.

### 4.3 Special Requirements

4.3.1 See the individual Pump Data Sheets and, if provided, the individual Motor Data Sheets.

# 5 Fabrication

### 5.1 Welding

5.1.1 Welding and weld repairs shall follow the requirements of API 610, Engineering Specifications 24590-WTP-3PS-SS00-T0002 and 24590-WTP-3PS-NWP0-T0001, and other referenced codes and standards as applicable.

5.1.1.1 Casing repairs shall be in accordance with API 610 paragraph 2.11.2.3.1. Other casing repair methods, such as impregnation, are not allowed.

### 5.2 Assembly

Where possible, the pump, motor, base assemblies shall be shipped as a complete package. When this is not feasible, Seller shall advise Buyer in advance.

### 5.3 Heat Treatment

Heat treatment shall be conducted as required by Seller, API 610 and other referenced codes and standards.

### 5.4 Other Processes

Positive Material Identification is required for all pressure retaining components per Engineering Specification 24590-WTP-3PS-G000-T0002.

# 6 Tests and Inspections

### 6.1 Personnel Qualifications

Qualification of Seller's inspection and test personnel shall be verified by the Buyer's Supplier Quality Representative.

## 6.2 Non-Destructive Examinations

Personnel performing non-destructive examinations or reviewing such test results shall be certified to ASME B31.3-1996.

## 6.3 Shop Tests

6.3.1 Seller shall conduct and be responsible for all shop tests listed in the individual Pump Data Sheets, the individual Motor Data Sheets (if provided), this specification, Engineering Specification 24590-WTP-3PS-PF00-T0001, API 610 and other applicable standards and reference documents. Tests may be witnessed by the Buyer's Supplier Quality Representative. Seller shall **submit** all **certified** test data **for Buyer's review. Although water may be used for hydraulic performance characteristic test, data shall be corrected to illustrate performance characteristics based on process properties described on the mechanical data sheets.**

6.3.1.1 Water used in testing shall not contain more than 50 parts per million chlorides as specified in API 610 paragraph 4.3.2.3.

6.3.1.2 The complete pump casing, jumper nozzle piping assembly, **and fully assembled seal water piping assembly including all components** shall be hydrotested. Seller shall submit hydrotest procedure for Buyer review and permission to proceed prior to any hydrotests with jumper nozzle connectors.

6.3.2 Seller shall furnish all facilities necessary for the performance of such tests. In the event Seller's own facilities are not suitable for such tests, Seller shall advise Buyer and obtain advanced written permission for using alternative facilities.

6.3.2.1 During assembly at the factory, each motor shall be checked to verify that the electrical circuits are good through the electrical connectors supplied by Buyer.

6.3.3 **Sound level testing shall be conducted during pump performance testing to demonstrate compliance with sound level of 85 dBa at 3 feet.**

6.3.4 **Each ASD supplied shall be functionally tested with each respective motor to ensure proper operation of the motor and drive.**

## 6.4 Site Tests

6.4.1 Buyer's startup personnel will run field performance tests after installation. Buyer may request Seller's assistance during startup.

### 6.5 Plumb Lift Test

6.5.1 The complete pump of each type/size shall be tested for single point lift with Seller furnished lift yoke, designed to interface with Buyer's cranes, connected to lifting lugs. A plumb lift test as well as a load test for 1.5 times the normal dry load shall be demonstrated on each type/size of pump in the Seller's shop, with Buyer to witness. The pump shall be lifted off the shop floor and held for 10 minutes. Variation from vertical shall be 1" maximum from plumb. Liquid penetrant inspections shall be performed, to verify there is no deformation or stress cracking at the lifting lugs and at the lifting lugs' attachments or reinforcements to the pump. No witness tests shall be performed without Buyer's Supplier Quality Representative (SQR) being present. Buyer will review design calculations related to lifting assembly design.

# 7 Preparation for Shipment

### 7.1 Cleanliness

All dirt, oil, grease, loose mill scale, weld spatter and other foreign matter shall be removed from all surfaces per API 610 and General Specification 24590-WTP-3PS-G000-T0003.

### 7.2 Painting

All exposed carbon steel and iron surfaces (e.g. motor) shall be primed and coated in accordance with Engineering Specification 24590-WTP-3PS-AFPS-T0001, Coating Schedule 5.10 (Appendix D), System Code T (Appendix C). Seller may propose an alternative epoxy coating, if it is suitable for nitric acid decontamination and high radiation environments. Seller shall submit their proposed coating specification and conforming procedures for Buyer review and acceptance prior to fabrication or procurement.

### 7.3 Tagging

Tagging shall be per paragraph 2.12 of API 610.

### 7.4 Packaging and Shipping Instructions

7.4.1 All equipment shall be packed, securely anchored and protected for shipment in accordance with General Specification 24590-WTP-3PS-G000-T0003. Pumps, drive motors and all furnished auxiliaries shall be shipped fully assembled on their specific bases. Non-mounted motors, if approved by Buyer, shall be shipped along with the main assembly. See paragraph 5.2.

# 8 Quality Assurance

### 8.1 QA requirements specific to item(s) or service

8.1.1 The Seller Quality Assurance Program (QAP) requirements are specified in General Specification 24590-WTP-3PS-G000-T0001 and the procurement documents.

8.1.2 Seller's QAP Manual shall be submitted to Buyer for review in accordance with General Specification 24590-WTP-3PS-G000-T0001 and the procurement documents.

### 8.2 Program QA elements

Seller's Quality Assurance Program, as a minimum, shall contain the requirements detailed in the Supplier Quality Assurance Program Requirements Data Sheet(s) included in Section 2 of the Material Requisition.

# 9 Configuration Management

Equipment and/or components covered by this specification are identified with Plant Item (equipment tag) numbers as given on the individual Data Sheets. Each item shall be tagged per Section 7.3.

# 10 Documentation and Submittals

### 10.1 Submittals

Submittals and document quantities, including Drawings, Installation Procedures, Inspection and Test Reports, Calculations, Manuals, Certificates of Conformance, Schedules, Material Certificates, and others appropriate to the purchased equipment, are detailed in the Material Requisition, including Forms G-321-E and G-321-V.

**10.2 The Seller shall submit analysis results or test results from section 3.6.3 of this specification for review and approval by Buyer. Submittal shall include the lowest bounding natural frequencies of the pump systems obtained with the lump-mass-system model.**

# Appendix A

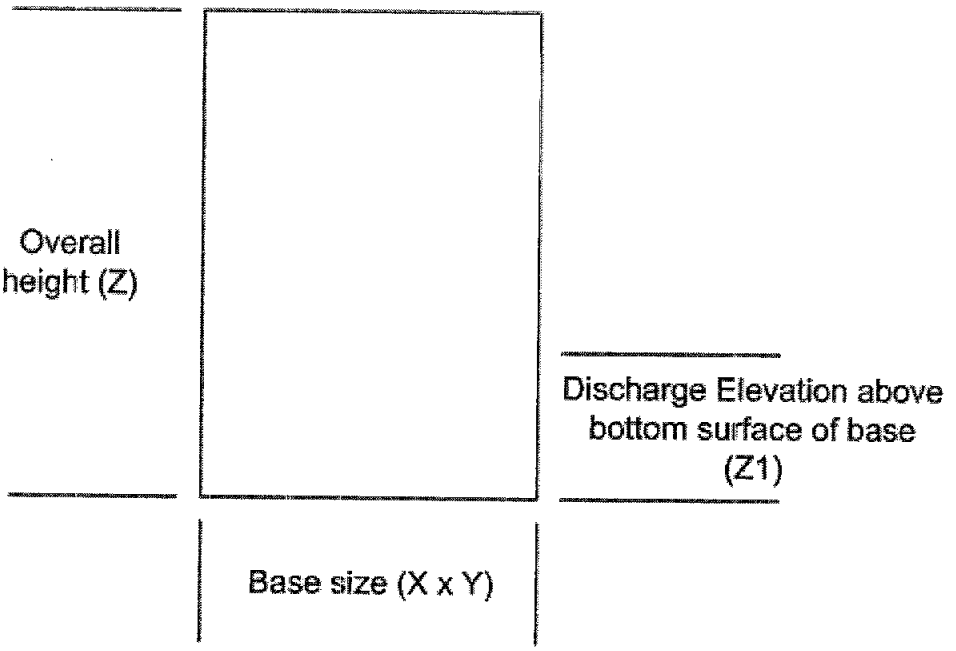
# Items Supplied by Buyer

| Item No. | Description | Quantity |
|---|---|---|
| 1 | Remote Electrical Lower Connector with all required internal components | 1 set per pump |
| 2 | Mating to remote Electrical Lower Holder Assembly, with all required internal components to be installed by Seller, with 30' of shielded wire (Required for testing, to be assembled by Seller) | 1 set for each type of remote Electrical Lower Connector |
| 3 | Remote Process Connector Nozzles | 3 per pump |
| 4 | Upper Process Connector Assemblies (required for hydraulic testing) | 1or 2 for every connector type and size as needed |
| 5 | Seal Water Connectors | 1 per pump |
| 6 | Blind Connectors for Drain | 1 per pump |

# Appendix B

## Pump Bounding Dimensions

| Vertical Slurry Pumps | | | | |
|---|---|---|---|---|
| | Dimensions Limits (inches) | | | |
| Pump | Base size (X x Y) | Overall height (Z) | Discharge centerline elevation (Z1) | Assembly Weight Limit (lbs) |
| FRP-PMP-00001 | 66 x 66" | 168" | 27" | 17,000 |
| FRP-PMP-00002A | 52 x 52" | 132" | 24" | 10,000 |
| FEP-PMP-00007A/B | 52 x 52" | 132" | 24" | 10,000 |
| FEP-PMP-00008A/B | 52 x 52" | 132" | 24" | 10,000 |
| HLP-PMP-00017A | 52 x 52" | 132" | 24" | 10,000 |
| HLP-PMP-00017B | 52 x 52" | 132" | 24" | 10,000 |
| HLP-PMP-00019A/B | 52 x 52" | 132" | 24" | 10,000 |
| HLP-PMP-00021 | 52 x 52" | 132" | 24" | 10,000 |
| RDP-PMP-00008 A/B | 52 x 52" | 132" | 24" | 10,000 |
| UFP-PMP-00041A/B | 52 x 52" | 132" | 24" | 10,000 |
| UFP-PMP-00042A/B | 66 x 66" | 168" | 42" | 19,000 |



# Appendix C

## Radiation Resistant Materials

| Material | Gamma Radiation Damage Threshold (Rads) |
|---|---|
| ORGANICS-ELASTOMERS | |
| Polytetrafluoroethylene ("TEFLON" TFE, PTFE) | 1.5E+04 |
| Acrylic Rubber | 5.0E+06 |
| Butyl Rubber | 1.0E+06 |
| Fluoro Rubber | 5.0E+06 |
| Hypalon | 1.0E+07 |
| Natural Rubber | 3.0E+07 |
| Neoprene | 1.0E+07 |
| Acrylonitride Rubber | 1.0E+07 |
| Polysulfide Rubber (Thiokol) | 3.0E+07 |
| Silicone Rubber | 8.0E+06 |
| Styrene Butadiene Rubber | 2.0E+07 |
| Polyurethane Rubber | 4.0E+07 |
| Ethylene Propylene Rubber (e.g. EPDM) | 8.0E+07 |
| Hexafluoropropylene-vinylidene | 8.0E+05 |

| Material | Gamma Radiation Damage Threshold (Rads) |
|---|---|
| copolymer<br><br>(e.g. VITON) | |
| **SYNTHETIC FIBERS** | |
| Polymide (nylon) | 3.0E+5 |
| Aromatic Polymide (Nomex) | 7.0E+07 |
| Polyacrylic (Orlon,Acrylon) | 2.0E+07 |
| Vinyl (Saran, dynel) | 3.0E+06 |
| Polyester (dacron) | 2.0E+07 |
| **LUBRICANTS** | |
| Synthetic aromatic oil NRRG-159 (NLGI Grade 2 ½)<br><br>Used for antifriction bearings, motors and pumps. | 3.0E+09 |
| Synthetic aromatic oil NRRG-235 (NLGI Grade 2)<br><br>Used for low-speed, high-load sliding surfaces, screw mechanisms. | 5.0E+09 |
| Synthetic aromatic oil with molybdenum sulphide NRRG-509 (NLGI Grade 0)<br><br>Used for enclosed gear trains or any services including a semi-fluid lubricant | 5.0E+09 |
| Chevron SRI Grease 2 (NLGI Grade 2) – Use on antifriction bearings, motors, pumps, accessories. | 5.0E+08 |
| Chevron OC Turbine Oil – general | 0.5E+08 |

| Material | Gamma Radiation Damage Threshold (Rads) |
|---|---|
| purpose oil lubrication | |
| Chlorofluorocarbons & Fluorinated Compounds | <1.0E+05 |
| **INSULATORS** | |
| Teflon | As above |
| Polyethylene | 4.0E+09 |
| Mylar (magnetic tape) | 4.0E+09 |
| Polypropylene | 8.7E+08 |
| Glass (paper & cloth) | 1.3E+09 |
| Phenol formaldehyde (Bakelite) | 2.6E+07 |
| Polyvinyl Chloride | 2.2E+08 |
| Anodized aluminum | 1.3E+09 |
| **ADHESIVES** | |
| Epoxy-phenolic adhesives | 1.0E+09 |
| Epoxy Adhesives | 5.0E+08 |
| Nitrile rubber phenolic adhesives | 5.0E+08 |
| **INORGANICS** | |
| Polystyrene | 1.0E+10 |
| Ceramics | 1.0E+10 |
| Stainless Steels, carbon steels | 1.0E+11 |
| Aluminum alloys | 1.0E+12 |

# Appendix D

# WTP Specific Tailoring for API 610

API Standard 610, Centrifugal Pumps for Petroleum, Heavy Duty Chemical, and Gas Industry Services, Eighth Edition, August 1995.

WTP Specific Tailoring

The following tailoring of API 610 is required for use as an implementing standard for centrifugal pumps handling radioactive waste streams required to Safety Criterion 4.2-2 confinement requirements.

API 610 Sections 2.2 Pressure Casings, 2.4 External Nozzle Forces and Moments, 2.7 Mechanical Seals, 2.1.1 Materials, 3.5 Piping and Appurtenances, 4.2.2 Material Inspection, and 4.3.2 Hydrostatic Test

> Centrifugal pumps which provide a confinement function in accordance with Safety Criterion 4.2-2 shall meet the requirements of sections 2.2, 2.4, 2.7, 2.11, 3.5, 4.2.2, and 4.3.2 of API Standard 610-1995, Eighth Edition.

Justification: The API sections listed above are required to meet the SRD 4.2-2 requirements for confinement design for Important to Safety centrifugal pumps. This approach ensures that pumping equipment supplied and installed in the WTP can be relied upon to maintain confinement of radioactive process streams during operating conditions including shutdown. ASME Sections II, V, VIII, and IX are referenced in these standards as the acceptance standards for the materials, design, welding, heat treating, and inspection.

API Standard 610, section 2.2 pressure casings, referencing ASME Section VIII, Div. 1, requires that stress used in the design for any given material shall not exceed ASME Section II values for the same material.

API Standard 610, section 2.4, provides the allowable nozzle loadings.

API Standard 610, section 2.7 requires that mechanical seals shall be furnished unless otherwise specified; and unless otherwise specified, seals and sealing systems to be furnished in accordance with API standard 682; and when they do not comply with API Standard 682, seals shall meet the requirements of API Standard 610 sections 2.7.3.1 through 2.7.3.23.

API Standard 610, section 2.11, specifies ASME Section VIII, Div. I, and ASME Section IX, for the materials, casting factors, welding and weld quality, and low temperature requirements and provides the acceptance standards for inspecting the pressure boundary of the WTP pumps.