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RIVER PROTECTION PROJECT – WASTE TREATMENT PLANT

ENGINEERING SPECIFICATION

FOR

Sealless Centrifugal Pumps to Meet Requirements of API Standard 685, First Edition, for Quality Level Q

Content applicable to ALARA? Yes No

ADR No.
24590-WTP-ADR-M-05-0002

Rev
0

Quality Level

Q

DOE Contract No.
DE-AC27-01RV14136

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SPECIFICATION No. 24590-WTP-3PS-MPC0-T0003							Rev 2

24590-WTP-3PS-MPC0-T0003, Rev 2
Sealless Centrifugal Pumps to Meet Requirements of API
Standard 685, First Edition, for Quality Level Q

Revision History

Revision	Reason for Revision
0	Issue for Use
1	Issue to incorporate requirements of DVR # 24590-WTP-DVR-M-04-0004 (report #DVIR-PMP-025), SCNs 24590-WTP-3PN-MPC0-00001, 24590-WTP-3PN-MPC0-00003, 24590-WTP-3PN-MPC0-00011, & 24590-WTP-3PN-MPC0-00018
2	Issued to incorporate SCNs 24590-WTP-3PN-MPC0-00027, 24590-WTP-3PN-MPC0-00029, and SDDRs 24590-WTP-SDDR-M-05-00719, 24590-WTP-SDDR-M-06-00369 ; Added dBA and SRD acronyms in section 1.4.3; Deleted section 2.3.6; Deleted "or other low melting point metals" in section 4.2.1; Deleted 'QL-1' or 'QL-2' in and replaced with 'Q' on cover sheet and in sections 3.11,3.6.3 and 8.2; Deleted section 3.7.3; Appendix A second paragraph, second line, added 'SRD'.

Handwritten:
 4/21/08
 JF
 4/21/08

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	Safety/Quality Classifications	3
2	Applicable Documents	3
2.1	Codes.....	3
2.2	Industry Standards	3
2.3	Engineering Standards	5
3	Design Requirements	5
3.1	Basic Function	5
3.2	Performance	6
3.3	Design Conditions	6
3.4	Environmental Conditions	8
3.5	Mechanical Requirements	8
3.6	Loadings.....	8
3.7	Electrical Requirements	9
3.8	Instrumentation and Control Requirements	9
3.9	Accessibility and Maintenance.....	9
4	Materials	9
4.1	Construction	9
4.2	Prohibited Materials.....	9
4.3	Special Requirements.....	10
4.4	Storage of Special Materials (e.g., stainless steel) prior to work.....	10
5	Fabrication	10
5.1	Welding.....	10
5.2	Assembly	10
5.3	Heat Treatment	10
5.4	Other Processes (as required)	10
6	Tests and Inspections.....	10
6.1	Personnel Qualifications.....	10

6.2	Non-Destructive Examinations	11
6.3	Shop Tests	11
6.4	Site Tests	11
7	Preparation for Shipment	11
7.1	Cleanliness	11
7.2	Painting	11
7.3	Tagging	11
7.4	Packaging.....	11
8	Quality Assurance.....	12
8.1	QA requirements specific to item(s) or service	12
8.2	Program QA elements.....	12
9	Configuration Management.....	12
10	Documentation and Submittals	12
10.1	General.....	12
10.2	Drawings and Parts Lists	13
10.3	Procedures	13
10.4	Inspection and Test Reports.....	13
10.5	Calculations	13
10.6	Manuals	14
10.7	Schedules.....	14

Appendices

Appendix A	A-i
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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 (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 and deliver sealless centrifugal pumps and accessories in accordance with this specification, including:

- 1.2.1 Sealless Centrifugal pumps, each complete with electric motor and accessories specified on the individual Pump Data Sheets per API Standard 685, 1st Edition and individual Motor Data Sheets, if provided.
- 1.2.2 Stainless steel shim packs shall be furnished for each foot mounting position for each pump and driver. The shims shall be cut and slotted to match each support baseplate. Each shim pack shall contain:
 - 1 each SS shim 0.250" in thickness
 - 2 each SS shim 0.125" in thickness
 - 2 each SS shim 0.0625" in thickness
 - 2 each SS shim 0.040" in thickness
 - 2 each SS shim 0.010" in thickness
 - 2 each SS shim 0.005" in thickness
- 1.2.3 Services of an installation supervisor when required.
- 1.2.4 Sets of all special tools required for installation and maintenance. The order will specify the quantity of tool sets to be furnished.
- 1.2.5 One lot of consumable spare parts per item for start up and one year operation.

- 1.2.6 Each pump, motor and baseplate assembly shall include all components and accessories fully assembled, piped and wired, requiring only setting on the foundation and connecting to the Buyer's piping, electrical and control systems.
- 1.2.7 The Seller shall advise recommended openings in start-up strainers for each pump application.

1.3 Work by Others

- 1.3.1 Material unloading and storage at jobsite
- 1.3.2 Installation labor
- 1.3.3 Foundation and anchor bolts
- 1.3.4 Interconnecting pipework external to unit
- 1.3.5 Electric power supply and connection
- 1.3.6 Wiring external to pump and driver
- 1.3.7 Motor starters

1.4 Definitions and Acronyms

- 1.4.1 Definitions - API Standard 685 is the same as API 685 or API Standard 685-2000, referenced in the following sections of this specification:

Deleted

- 1.4.2 Acronyms of Organizations

Deleted

Deleted

- ANSI American National Standards Institute
- API American Petroleum Institute
- ASME American Society of Mechanical Engineers
- ASNT American Society for Nondestructive Testing
- Deleted
- Deleted
- Deleted
- Deleted

Deleted

1.4.3 Other Acronyms

BPVC	Boiler and Pressure Vessel Code (ASME)
CFR	Code of Federal Regulations
LAW	Low-Activity Waste
HLW	High Level Waste
WTP	Waste Treatment Plant
RFQ	Request for Quote
BEP	Best Efficiency Point
GPM	Gallons Per Minute
NPSH	Net Positive Suction Head
NPSHR	Net Positive Suction Head Required
QAP	Quality Assurance Program
NDE	Non-Destructive Examination
SRD	Safety Requirements Document
dBA	Decibels

1.5 Safety/Quality 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 Codes

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

2.2 Industry Standards

Includes but not limited to:

- 2.2.1 Deleted
- 2.2.2 Deleted
- 2.2.3 Deleted
- 2.2.4 Deleted
- 2.2.5 Deleted
- 2.2.6 API Std. 685 -2000, 1st Ed. - Sealless Centrifugal Pumps for Petroleum, Heavy Duty Chemical, and Gas Industry Services, as tailored in Appendix A.
- 2.2.7 Deleted
- 2.2.8 Deleted
- 2.2.9 Deleted
- 2.2.10 Deleted
- 2.2.11 Deleted
- 2.2.12 Deleted
- 2.2.13 Deleted
- 2.2.14 ASNT SNT-TC-1A, June, 1980 Edition through 2001 Edition - Personnel Qualification and Certification in Nondestructive Testing
- 2.2.15 Deleted
- 2.2.16 Deleted
- 2.2.17 Deleted
- 2.2.18 Deleted
- 2.2.19 Deleted
- 2.2.20 Deleted
- 2.2.21 ASME B31.3-1996, Process Piping
- 2.2.22 ASME Section VIII, Div 1, Rules for Construction of Pressure Vessels

- 1.1.1 ASME Section II, Div 1, Materials
- 1.1.1 ASME Section V, Nondestructive Examination
- 1.1.1 ASME Section IX, Welding and Brazing Qualifications

2.3 Engineering Standards

- 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, Engineering Specification for Packaging, Handling and Storage Requirements
- 2.3.4 24590-WTP-3PS-MUMI-T0001, Engineering Specification for Medium Voltage Induction Motors
- 2.3.5 24590-WTP-3PS-MUMI-T0002, Engineering Specification for Low Voltage Induction Motors
- 2.3.6 Deleted
- 2.3.7 24590-WTP-3PS-SS90-T0001, Engineering Specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks
- 2.3.8 24590-WTP-3PS-FB01-T0001, Engineering Specification for Structural Design Loads for Seismic Category III & IV Equipment and Tanks

3 Design Requirements

3.1 Basic Function

- 3.1.1 These centrifugal pumps will move liquids to/from/between locations that require a Q pump.
- 3.1.2 The pumps may be located in “hot cells” which will require remote maintenance and handling design features. (See the individual Pump Data Sheets.)

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 The equipment and appurtenances will be used in a plant that has a nominal design life of 40 years. The design objective for these centrifugal pumps shall be based on a useful life expectancy of 40 years with periodic maintenance as recommended by the Seller.

3.3.3 This (Bechtel WTP) specification covers the minimum requirements for sealless centrifugal pumps designed in accordance with API Standard 685, First Edition, *Sealless Centrifugal Pumps for Petroleum, Heavy Duty Chemical, and Gas Industry Services* as modified by this section. Bulleted items in API 685 not addressed in this specification shall have the decisions noted on the individual Pump Data Sheets.

The term "Seller" in this specification is equivalent to "Vendor" in API 685. The term "Buyer" in this specification is equivalent to "Purchaser" in API 685.

API 685 Paragraph Numbers

The paragraph numbers in this section correspond to those in API 685 and each of the paragraphs denotes an "Addition", "Decision", or "Modification" to the API requirements.

- 2.2 (Decision) Pumps shall comply with applicable US Standards unless a Code or Standard specified dictates otherwise.
- 5.1 (Decision) Dimensions shall be US Standard.
- 5.4 Delete
- 6.1.1 (Modification) Design service life is 40 years. See Paragraph 3.3.2 of this (Bechtel WTP) specification.
- 6.1.10 (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 the Buyer's written acceptance.
- 6.1.12 (Addition) Pumps for parallel operation shall have equal head rise (within $\pm 1\%$ as measured on the performance test) to shutoff.

- 6.1.15 (Addition) Noise level shall not exceed 85 dBA measured 3 ft from the edge of the baseplate.
- 6.1.29 (Decision) Pumps and auxiliaries shall be suitable for outdoor installation in the climatic zone specified on the data sheets, but will be normally located indoors.
- 6.4.3.6 (Decision) Pressure gauge connections shall not be provided.
- 6.4.3.8.3 (Decision) Cylindrical threads shall not be used.
- 6.4.3.9 Delete
- 6.7.4.1 (Addition) The wear ring running clearance (adjusted for temperature) and diameter, shall be clearly stated in the proposal for each service. Pump efficiencies shall be based on the corrected clearances.
- 8.3.2.1a (Modification) Special-design pumps, as approved by the Buyer, may be segmentally tested at the appropriate section pressure. Hydrostatic testing, whether on a component basis or assembled pump, shall be done after all welding (such as piping connections, drain, vents, seal welding) has been completed.
- 8.3.3.2.1 (Modification) Bearing temperatures shall be measured at all five points of the performance test.
- 8.3.4.1 (Addition) NPSHR test shall be performed if the NPSH required by the pump differs from the specified available NPSH by 3 feet or less. The NPSH test will be a vacuum tank suppression test unless a suction valve throttling test has been approved by the Buyer.
- 9.1.5.2.10 (Addition) If non-sparking coupling guards are required, they shall be specified on the Data Sheets.
- 9.1.5.3.3 (Addition) Centers of mounting pads shall be at the correct relative elevation with 0.002 inch per foot of separation between the pads. Each pad shall be machined flat to within 0.002 inch total variation across the surfaces.
- 9.1.5.3.4 (Addition) Stainless steel shim packs shall be furnished for each foot mounting position for each pump and driver. The shims shall be cut and slotted to match each support baseplate. Each shim pack shall contain shims as specified in Paragraph 1.2.2 of this (Bechtel WTP) specification.
- 9.2.2.4 Plug and socket connection is acceptable for canned motor pumps.

Section 10 Seller's Data: The requirements of Section 3 of the purchasing documents shall be applicable in addition to the API 685 requirements.

End of Comments to API 685

3.3.4 All piping shall be designed to meet the requirements of ASME B31.3 - 1996.

3.4 Environmental Conditions

3.4.1 See individual Pump Data Sheets.

3.4.2 When noted on the Data Sheets, motors shall have radiation shielding or radiation hardened motors, as specified. The shielding shall be furnished by the motor Seller with consideration for motor cooling air flow.

3.4.3 When noted on the Data Sheets, all bearings shall have special radiation resistant lubricants.

3.4.4 When noted on the Data Sheets, the seal elastomer components shall use high radiation-tolerance materials.

3.5 Mechanical Requirements

3.5.1 See API Standard 685 and the individual Pump Data Sheets.

3.5.2 To insure that final alignment can be achieved in the field, the equipment manufacturer shall align the pump and driver to within 0.010 inch parallel offset and 0.002 inch/inch angular in the shop. The bolts shall be centered in their holes after the preliminary alignment. Undercutting of hold-down bolts is not acceptable.

Note: Hold-down bolts shall not be bolt bound after final alignment in the field. The hold-down bolt shall be reasonably centered, based on visual inspection after the final field alignment.

3.6 Loadings

3.6.1 Must meet API 685 requirements.

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 III 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 Q and Seismic Category SC-I or 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.
- 3.7.2 Electric motors shall meet the requirements of the applicable sections of API-685, Sealless Centrifugal Pumps for Petroleum, Heavy Duty Chemical, and Gas Industry Services.
- 3.7.3 Deleted.

3.8 Instrumentation and Control Requirements

See the individual Pump Data Sheets.

3.9 Accessibility and Maintenance

- 3.9.1 When Remote Handling capability is required per the individual Pump Data Sheet and/or in Section 2 of the Material Requisition, Technical Notes, detailed specifications and drawings of the Remote Handling requirements will be included. Pumps shall be furnished with Remote Handling provisions in accordance with Project requirements.
- 3.9.2 Detailed drawings of modifications for Remote Handling shall be furnished for Buyer review prior to the start of work.

4 Materials

4.1 Construction

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

4.2 Prohibited Materials

- 4.2.1 Bronze, copper, lead, zinc, tin, antimony, cadmium, their alloys, or molybdenum and halogens, shall not be used in direct contact with stainless steel, with the exception of 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 seals is prohibited.

4.2.3 The use of asbestos is prohibited.

4.3 Special Requirements

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

4.4 Storage of Special Materials (e.g., stainless steel) prior to work

The Seller shall advise any special storage requirements.

5 Fabrication

5.1 Welding

5.1.1 Welding and weld repairs shall follow the requirements of API 685 and other referenced codes and standards as applicable.

5.1.2 Weld repair records shall be included with the document package.

5.2 Assembly

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

5.3 Heat Treatment

Heat treatment shall be conducted as required by Seller, API 685 and other referenced codes and standards.

5.4 Other Processes (as required)

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

6 Tests and Inspections

6.1 Personnel Qualifications

Qualification of Seller's inspection and test personnel will 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 ASNT Standard SNT-TC-1A.

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 Sheet (if provided), API 685 and other applicable standards and reference documents. Tests may be witnessed by the Buyer's Supplier Quality Representative.
- 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. This shall include testing to verify remote handling requirements, if specified.

6.4 Site Tests

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

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 685 and Engineering Specification 24590-WTP-3PS-G000-T0003.

7.2 Painting

After visual examination, all exposed surfaces shall be primed and coated in accordance with Seller's standard procedures and API 685. Seller shall submit their conforming procedures as part of the documentation package. Color, if specified, shall be advised later.

7.3 Tagging

Tagging shall be per Paragraph 6.15 of API 685.

7.4 Packaging

- 7.4.1 All equipment shall be packed, securely anchored and protected for shipment in accordance with Engineering Specification 24590-WTP-3PS-G000-T0003. Pumps, drive motors and all furnished auxiliaries shall be shipped fully assembled on their

specific baseplates. Non-mounted drivers, if approved by Buyer, shall be shipped along with the main assembly.

- 7.4.2 Special applications requiring different shipping instructions shall be mutually agreed by Buyer and Seller.

8 Quality Assurance

8.1 QA requirements specific to item(s) or service

- 8.1.1 The Supplier Quality Assurance Program (QAP) requirements are included in Engineering Specification 24590-WTP-3PS-G000-T0001.
- 8.1.2 Seller's QAP Manual shall be submitted to Buyer for review in accordance with Engineering Specification 24590-WTP-3PS-G000-T0001.

8.2 Program QA elements

Seller's QAP, as a minimum, shall contain the requirements detailed in the Q datasheet of ANSI/ASME NQA-1 (1989) Quality Assurance Program Requirements attached to Section 2 of the purchasing documents.

9 Configuration Management

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

10 Documentation and Submittals

10.1 General

- 10.1.1 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 Section 3 of the purchasing documents, including Forms G-321-E and G-321-V, and Section 10.3 of API 685.
- 10.1.2 The documents and data shall include information listed in the Descriptions in Appendix O of API 685.

10.2 Drawings and Parts Lists

- 10.2.1 Drawings shall satisfy Section 3 of the purchasing documents, and Section 10.3 of API 685.
- 10.2.2 Priced recommended spare parts lists for start-up and one (1) year's operation along with complete lists of equipment parts with drawings showing assembly locations shall be provided, per Paragraph 10.3.5 of API 685. Seller shall identify limits to shelf-life and storage requirements of parts anticipated to have functional life spans shorter than the equipment design life.

10.3 Procedures

- 10.3.1 All exposed surfaces shall be cleaned and painted in accordance with Seller's standard procedures and API 685. Seller shall submit their cleaning and painting procedures.
- 10.3.2 Seller shall submit all mechanical, electrical, and NDE test procedures for Buyer review.
- 10.3.3 Seller shall submit weld repair procedures for Buyer review if applicable.

10.4 Inspection and Test Reports

- 10.4.1 Inspection and Test Reports shall be provided in accordance with Sections 3 and 5 of the purchasing documents, and Appendix O of API 685. Reports shall include NDE, hydro static, mechanical, electrical, and hydraulic test reports.

10.5 Calculations

- 10.5.1 The Seller shall submit the analysis results or test results from section 3.6 of this specification for review by Buyer.
- 10.5.2 Forces and Moments capabilities, as a minimum, shall meet requirements of Paragraph 6.5 of API 685. Calculations, if specified, shall be furnished.

10.6 Manuals

- 10.6.1 Manuals shall be furnished to provide information on the correct installation, operation and maintenance of the equipment assembly. The manuals shall be as described in Appendix O of API 685.

10.7 Schedules

- 10.7.1 Manufacturing schedules and progress reports shall be furnished and sent directly to the Project Expeditor as shown in Section 3 of the purchasing documents.

11 Design Changes Incorporated by reference

*24590-WTP-SDDR-M-05-00719

*24590-WTP-SDDR-M-06-00369

Appendix A

API Standard 685, Sealless Centrifugal Pumps for Petroleum, Heavy Duty Chemical, and Gas Industry Services, First Edition, October 2000.

WTP Specific Tailoring

The following tailoring of API 685 is required for use as an implementing standard for centrifugal pumps handling waste streams required by SRD Safety Criterion 4.2-2 confinement requirements.

Sections 6.3 Pressure Casings, 6.5 External Nozzles Forces and Moments, 6.11 Materials, 6.12 Castings, 6.13 Welding, 6.14 Low Temperature, 7.3 Piping and Appurtenances, 8.2.2 Material Inspection, and 8.3.2 Hydrostatic Test

Sealless centrifugal pumps which provide a confinement function in accordance with Safety Criterion 4.2-2 shall meet the requirements of sections 6.3, 6.5, 6.11, 6.12, 6.13, 6.14, 7.3, 8.2.2, and 8.3.2 of API Standard 685-2000.

Justification: The API sections listed above are required to meet the SRD 4.2-2 requirements for confinement design for Important to Safety sealless 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 685, section 6.5, provides the allowable nozzle loadings.

API Standard 685, section 6.3 pressure casings, referencing ASME Section VIII, Div. I, requires that stress used in the design for any given material shall not exceed ASME Section II values for the same material.

API Standard 685, section 6.11 specifies ASME Section VIII, Div. 1 and ASME Section IX, for the materials, casting factors, welding, and weld quality to be used as the acceptance standards for maintaining pressure integrity of WTP pumps.

API Standard 685, section 6.12 allows the repair of weldable steel used in castings provided it is done in accordance with ASME Section IX.

API Standard 685, section 6.13 requires that welding of piping, pressure-containing parts, and wetted parts and heat treatment of welds shall be performed in accordance with ASME Section VIII and ASME Section IX.

API Standard 685, section 6.14 requires that pumps operated at a low temperature comply with the material requirement in ASME Section VIII.

API Standard 685, section 7.3 specifies that the piping design, materials, joint fabrication, examination, and inspection be done in accordance with ASME B31.3.

API Standard 685, section 8.2.2 states that for material inspection including radiography, ultrasonic, magnetic particle, and liquid penetration inspection shall meet the acceptance standard used for casting per ASME Section V or ASME Section VIII, Div.1.

API Standard 685, section 8.3.2 requires the hydrostatic test to be maintained for a minimum of 30 minutes at 1.5 times maximum allowable working pressure for leaks or seepage through the casing or casing joint, and it is more stringent than ASME Section VIII or ASME B31.3-1996 for pressure boundary testing. Section 8.3.2 references ANSI/ASME B31.3 or Section II, Division 1 of the ASME Code for arriving at test pressures.

API Standard 685 sections 6.3, 6.5, 6.11, 6.12, 6.13, 6.14, 7.3, 8.2.2, and 8.3.2 include the applicable ASME Section VIII, Div.1, and ASME B31.3, requirements, and provide adequate requirements to ensure the confinement design for Important to Safety sealless pumps.