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ISSUED BY
RPP-WTP PDC

RIVER PROTECTION PROJECT – WASTE TREATMENT PLANT

ENGINEERING SPECIFICATION

FOR

PROCESS BULGE DESIGN AND FABRICATION

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

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Rev
1

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SPECIFICATION No.
24590-WTP-3PS-MX00-T0001

Rev
6

Revision History

Revision	Reason for Revision
A	
0	Issued for Use
1	Document Revision
2	General Revision; Incorporated SDDR 24590-WTP-SDDR-PROC-03-0106 and SCNs 24590-WTP-3PN-MX00-00003 & 24590-WTP-3PN-MX00-00004
3	**Issued for use only for LAW bulges, not PTF bulges.** Incorporated SCN 24590-WTP-3PN-MX00-00006, add 24590-WTP-3PS-JQ06-T0003, 24590-WTP-3PS-JQ06-T0005, 24590-WTP-3PS-JR00-T0010, Implementing Standards for ANSI/AISC N690 in Appendix A, Implementing Standards for AISC M016 in Appendix B, Lifting Equipment Requirements and Nozzle Load Requirements.
4	Issued for Purchase, add column davit requirements
5	Issued for Purchase; incorporated SCNs 24590-WTP-3PN-MX00-00014, -00018, -00020, -00022, and -00023; Clarified Support for Actuator Assemblies; Clarified NDE Personnel Qualification Requirements; Included WTP Specific Tailoring of ASME B31.3-1996.
6	Issued for Purchase; Incorporated by Reference SDDR's 24590-WTP-M-06-00074 and 24590-WTP-M-06-00282, Incorporated changes resulting from CRPT-06-219 (formally CAR-06-250), removed nozzle load tables and place them on the appropriate Process Bulge Data Sheet, included Appendix D for load combinations to be used in analysis.

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1 Scope

1.1 Project Description and Location

1.1.1 The River Protection Project-Waste Treatment and Immobilization Plant (RPP-WTP) is a complex of waste treatment facilities where the U.S. Department of Energy Hanford Site tank waste will be put into stable glass form. The Waste Treatment and Immobilization Plant Contractor will design, build and start-up the RPP-WTP pretreatment and vitrification facilities for the DOE Office of River Protection. The waste treatment facilities will pretreat and immobilize the low-activity waste and high-level waste 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 RPP-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

1.2.1 This specification establishes the requirements for the design, fabrication, project management, quality assurance, inspection, and testing of Process Bulges for use in the RPP-WTP Facilities.

1.2.2 The Seller shall provide fully detailed designs and all labor, materials, equipment, and services necessary to manufacture the Process Bulges in accordance with this specification, Piping and Instrumentation Diagrams (P&IDs), and Process Bulge Data Sheet. Any discrepancies between this specification, referenced specifications, P&IDs, and the Process Bulge Data Sheet shall be brought to the attention of the Buyer for resolution.

1.2.3 The scope of work includes, but is not limited to:

- Detail design of all pipework, confinement, support, maintenance platforms, column davits, and shielding systems as required.
- Fabrication and/or assembly of all items and components.
- Performance testing of equipment to verify and demonstrate functionality and conformance to the design and technical requirements described in this **specification.**
- Leak/pressure testing of all process systems to demonstrate primary and secondary confinement.
- Documentation of testing procedures, testing results, operation and maintenance procedures, and quality assurance procedures.

- Design document review in progressively complete package form. Delivery shall include 30%, 60%, 90%, and final design reviews.

- Preparation for shipping and packaging of all equipment.

- Environmental Qualification of equipment and/or components (as required) and determination of "Qualified Life".

1.2.4 The Seller shall also provide all special tools and/or equipment necessary for operation and maintenance of the Process Bulges and their components. The Seller shall prepare drawings of special tools and/or equipment and submit them to the Buyer for review. Special tools shall not include small hand tools available in the commercial market.

1.2.5 Specific activities excluded from the scope of this specification include:

- On site unloading
- Installation
- Commissioning

1.2.6 The Seller shall not be responsible for the supply of process pumps; the Buyer shall issue this equipment to the Seller as contractor furnished equipment for incorporation into the fabrication. Refer to the MR for the scope of procurement responsibilities for valves, actuators, and instrumentation.

1.3 Work by Others

1.3.1 The Seller may subcontract any portion of the work, provided the quality assurance requirements of this specification are maintained, and provided the Buyer approves the subcontractor and the scope of work.

1.3.2 The Seller will be ultimately responsible for the completeness and quality of all work covered in this specification.

1.4 Acronyms

AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
AP	Air Permit
APC	Additional Protection Class
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
CM	Commercial Material
DBE	Design Basis Earthquake
DOE	U.S. Department of Energy
EQDS	Environmental Qualification Data Sheet
ECDS	**Equipment Cyclic Data Sheets**
ITS	Important to Safety
M&TE	Measurement and Test Equipment
MR	Material Requisition
MDS	**Mechanical Data Sheet**

MSDS	Material Safety Data Sheet
NRTL	Nationally Recognized Testing Laboratory
NQA	National Quality Assurance
OSHA	Occupational Safety & Health Administration
P&ID	Piping and Instrumentation Diagram
PCB	Polychlorinated Biphenyl
PMI	Positive Material identification
PO	Purchase Order
PT	Liquid Penetrant Test
QA	Quality Assurance
QAM	Quality Assurance Manual
QARD	Quality Assurance Requirements and Description
QL	Quality Level
RFQ	Request for Quote
RPP-WTP	River Protection Project-Waste Treatment Plant
RRC	Risk Reduction Class
SC	Safety Class
SC	Seismic Category
SDC	Safety Design Class
SDS	Safety Design Significant
SRD	Safety Requirements Document
SS	Safety Significant
SWL	Safe Working Load
UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
UNC	Unified National Coarse
VT	Visual Test
WAC	Washington Administrative Code

1.5 Definitions

Buyer: Bechtel National Inc. for the RPP-WTP.

Seller: Manufacturer, assembler, fabricator, vendor, supplier, or equal who provides equipment, systems, components, services, or other products for delivery or direct benefit to the Buyer.

Buyer's Representative(s): The Buyer's designee(s), who shall witness onsite operations at the seller and sub-seller sites and perform onsite inspections and surveillance.

HEPA Filter: A high efficiency particulate air filter having a fibrous medium with a particle removal efficiency of 99.97% when tested with essentially mono-dispersed 0.3 μm test aerosol particles.

Important to Safety (ITS): Systems, structures, and components (SSCs) that serve to provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the workers and the public. ITS encompasses the broad class of facility features addressed (not necessarily explicitly) in the top-level radiological, nuclear, and process safety standards and principles that contribute to the safe operation and protection of workers and the public during all phases and aspects of facility operations (**e.g.**, normal operation as well as accident mitigation). ITS includes SSCs designed as Safety Design

Class (SDC)/ *Safety Class (SC)*, Safety Design Significant (SDS)/ *Safety Significant (SS)*, and Risk Reduction Class (RRC)/*Additional Protection Class (APC)*.

Paragraph: When a paragraph of this specification, referenced document, referenced codes, or referenced standards is referenced in this specification, the paragraph referenced and all subparagraphs and sub-subparagraphs of the paragraph shall be considered inclusive.

Quality Level (QL): The quality level identifies the quality requirements to be applied to items and activities. The identified quality levels are Q, and CM.

Quality (Q): Q items and activities shall meet the applicable requirements of NQA-1 (1989).

Commercial Material (CM): Those permanent plant SSCs not identified **as** Q, are CM (which includes both RRC/APC and Non-ITS).

Risk Reduction Class (RRC) - Initial Safety Classification: RRC Systems, Structures, and Components are Important to Safety Systems, Structures, and Components that are neither Safety Design Class nor Safety Design Significant.

Additional Protection Class (APC) - Replacement Safety Classification: Systems, Structures, and Components are Important to Safety Systems, Structures, and Components that are neither Safety Class (SC) nor Safety Significant (SS).

Safety Design Class (SDC) - Initial Safety Classification: an SSC whose safety function is to prevent a worker or maximally exposed member of the public from receiving a radiological or chemical exposure that exceeds the exposure standards defined in the Safety Requirements Document (SRD) , or that is credited for the prevention of a critically event.

Safety Class (SC) - Replacement Safety classification: an SSC, including portions of process systems whose preventive or mitigative function is necessary to limit radioactive material exposure to the public, as determined from safety analyses.

Safety Design Significant (SDS) - Initial Safety Classification: an SSC that is required to ensure that exposure standards for normal operation are not exceeded; whose failure would directly prevent a SDC SSC from performing its safety function; or that implements the defense-in-depth requirements of the SRD Appendix B, section 3.0, Table 1.

Safety Significant (SS) - Replacement Safety Classification: an SSC that is not designated as SC, but whose preventive or mitigate function is a major contributor to defense-in-depth and/or worker safety as determined by safety analyses.

Seismic Category (SC): RPP-WTP seismic classifications for SSCs based on their safety function. Seismic Categories are I (SC-I), II (SC-II), III (SC-III), IV (SC-IV), and V (SC-V).

Seismic Category I (SC-I): ITS equipment/tanks that have a safety function. For the design of SC-I components, no credit for inelastic energy absorption is allowed. SC-I equipment/tanks shall be functional during and after a DBE.

Seismic Category II (SC-II): ITS equipment/tanks whose failure during a seismic event could prevent a SC-I SSC from performing its seismic safety function. For the design of

SC-II equipment/tanks, credit for inelastic energy absorption is allowed. SC-II components shall maintain control and confinement of hazardous materials during and after a DBE, but do not need to be functional.

Seismic Category III (SC-III): (a) ITS SSC, but without SC-I or SC-II safety function, but with a chemical hazard. (b) Non-ITS SSC which has an inventory of radioactive or hazardous material in an amount less than ITS significant quantity.

Seismic Category IV (SC-IV): Non-ITS SSC without an inventory of radioactive or hazardous material, but must meet UBC 1997 loadings.

Seismic Category V (SC-V): Non-ITS SSC not requiring seismic design.

Risk: the product of probability and consequences of any event considered. These factors are, to the extent possible, assigned numeric values so that results of risk evaluations can be ordered using appropriate descriptions.

Safety Classification: categorized as SDC/SC, SDS/SS, or RRC/APC.

1.6 Safety/Quality Classifications

The Quality Level (QL) and Seismic Category (SC) of the Process Bulges are specified on the data sheets in section 2 of the MR.

2 Applicable Documents

2.1 General

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

2.1.2 For the codes and standards listed below, the specific revision or effective date identified, as well as the specific revision or effective date of codes and standards that they incorporate by reference (daughter codes and standards), shall be followed. If a date or revision is not identified, the latest issue, including addenda, at the time of quotation, shall apply. For material standards associated with CM equipment, the Seller shall ensure that the revision associated with currently available material is acceptable for the intended use of the material. The effective dates and revisions listed in section 2 shall apply to subsequent references to the codes and standards within this specification.

2.2 Codes and Standards

2.1.1	WAC 296-24	Washington Administrative Code General Safety and Health Standards
2.1.2	**ANSI**/AISC N690-94	Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities, as tailored in Appendix A **of this specification**

2.1.3	AISC M016-1989	Manual of Steel Construction, Allowable Stress Design, Ninth Edition, as tailored in Appendix B **of this specification**
2.1.4	ASME NQA-1-1989	Quality Assurance Program Requirements for Nuclear Facilities
2.1.5	NFPA 70-1999	National Electrical Code
2.1.6	SNT-TC-1A-**1989**	Society for Non-Destructive Testing
2.1.7	ASME B31.3-1996	Process Piping **as tailored in Appendix C of this specification**
2.1.8	ASME Section VIII **Division 1**	Boiler and Pressure Vessel Code, ***Rules for Construction of Pressure Vessels***
2.1.9	**ASME Section VIII Division 2**	**Boiler and Pressure Vessel Code,** ***Alternate Rules for Construction of Pressure Vessels***
2.1.10	ASME Y14.100	Engineering Drawing Practices
2.1.11	ASME B30.20	Below-the-Hook Lifting Devices

2.3 Engineering Standards

Any additional Engineering Specifications/Standards proposed for use by the Seller shall be reviewed by the Buyer prior to incorporation into the design.

2.4 Reference Documents

2.4.1	24590-WTP-3PS-SS90-T0001	Engineering Specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks
2.4.2	24590-WTP-3PS-P000-T0001	Engineering Specification for Piping Material Classes General Description and Summary
2.4.3	24590-WTP-3PS-JQ06-T0003	Engineering Specification for Seismic Qualification of Control and Electrical Systems and Components
2.4.4	24590-WTP-3PS-JQ06-T0005	Engineering Specification for Environmental Qualification of Control and Electrical Systems and Components
2.4.5	24590-WTP-3PS-JQ07-T0001	Engineering Specification for Instrumentation for Package Systems
2.4.6	24590-WTP-3PS-JR00-T0010	Engineering Specification for Liquid Effluent Gamma Monitor - QL
2.4.7	24590-WTP-3PS-JV15-T0001	Engineering Specification for Actuators for On/Off Valves
2.4.8	24590-WTP-3PS-EKP0-T0001	Engineering Specification for Electrical Requirements for Packaged Equipment
2.4.9	24590-WTP-3PS-PS02-T0001	Engineering Specification for Shop Fabrication of Piping
2.4.10	24590-WTP-3PS-G000-T0003	Engineering Specification for Packaging, Handling and Storage Requirements
2.4.11	24590-WTP-3PS-G000-T0001	General Specification for Supplier Quality Assurance Program Requirements
2.4.12	24590-WTP-3PS-G000-T0002	Engineering Specification for Positive Material Identification (PMI)

2.4.13	24590-WTP-3PS-PV00-T0001	Engineering Specification for Technical Supply Conditions for Valves
2.4.14	24590-WTP-3PS-AFPS-T0001	Engineering Specification for Shop Applied Special Protective Coatings for Steel Items and Equipment
2.4.15	24590-WTP-PW-P30T-00001	WTP End Prep Detail for Field Butt Welds
2.4.16	24590-WTP-3PS-SS00-T0002	Engineering Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel
2.4.17	24590-WTP-3PS-FB01-T0001	Engineering Specification for Structural Design Loads for Seismic Category III & IV Equipment and Tanks
2.4.18	RR-C-271D	Federal Specification Chains and Attachments, Welded and Weldless
2.4.19	DOE-RL-92-36	Hanford Site Hoisting and Rigging Manual - Hoists, Jib Cranes, and Monorail Systems
2.4.20	OSHA 29 CFR 1910.179	Occupational Safety and Health Standards Overhead and Gantry Cranes
2.4.21	**24590-WTP-3PS-M000-T0002**	**Engineering Specification for Mechanical Handling Equipment Design & Manufacture**
2.4.22	**24590-WTP-3PS-MV00-T0003**	**Engineering Specification for Pressure Vessel Fatigue Analysis**
2.4.23	**24590-WTP-DC-ST-01-001**	**Structural Design Criteria**

3 Design Requirements

3.1 Basic Function

To support the use of 'hands on' maintainable equipment for process applications in out-cell areas, the Process Bulges are required to provide confinement structures for the safe operation and maintenance of process equipment such as pumps, valves, instruments and associated equipment. The Process Bulges shall have an expected working life of 40 years. Where specific components cannot meet this requirement they shall be identified and a mechanism for their replacement and/or maintenance shall be incorporated into the design.

3.1.1 Process Pumps

3.1.1.1 The Buyer shall supply all process pumps. The process pumps are vertically mounted centrifugal canned motor type and facilitate top-access maintenance techniques.

3.1.1.2 The Seller shall be responsible for the installation of the pumps including all necessary services, supports, electrical and instrumentation requirements.

3.1.1.3 The pump impeller and motor assembly shall be removable vertically.

3.1.1.4 When indicated on the P&ID the Seller shall furnish the pumps with a cooling water flush line to the motor/bearing assembly. The water flush

shall be sacrificial and utilized only where the process fluid is unsuitable for use as the cooling medium.

3.1.1.5 Pump motor housings should be 'potted' to minimize internal fluid hold-up and should be oil free.

3.1.1.6 Power and instrumentation cabling to the pump/motor shall be run in sealed stainless steel conduit through the pump access plate to a terminal box mounted on the pump/motor access plate.

3.1.1.7 Pump supports shall be rigid to minimize pump vibration, deflection, and nozzle loadings.

3.1.1.8 If the pump includes a recirculation cooling water flush line, the line shall be hard piped to the pump, with a removable line from the top of the motor. If a cyclone solids separator is included, it shall be placed to allow an open vertical path for removal of the pump impeller and motor assembly. The cyclone solid separator shall be supported from the side of the Bulge containment.

3.1.2 Process Valve Assemblies

3.1.2.1 **The Seller shall purchase the valves, extended drive spindles and actuators from the Buyer's valve distributor. The Buyer will provide valve distributor upon issuance of the MR for the Bulges. Valves, extended drive spindles and actuators shall be purchased in accordance with specifications 24590-WTP-3PS-PV00-T0001, *Engineering Specification for Technical Supply Conditions for Valves* and 24590-WTP-3PS-JV15-T0001, *Engineering Specification for Actuator On/Off Valves*.**

3.1.2.2 Valves located inside the Process Bulge shall be top accessible valves with extended drive spindles. They shall be operated with either a pneumatic actuator or manually, external to the Bulge confinement. Each drive spindle requires the ability to be locked in place, external to the Bulge.

3.1.2.3 Actuators are pneumatic piston types and supplied complete with solenoid pilot valve, position limit switches, and visual semaphore indication. **Non-ITS** Actuators shall be Fieldbus interface compatible in accordance with specification 24590-WTP-3PS-JV15-T0001, *Engineering Specification for Actuators for On/Off Control Valves*. **ITS Actuators shall be hard wired classic I/O in accordance with specification 24590-WTP-3PS-JQ07-T0001, *Engineering Specification for Instrumentation for Package Systems*.**

3.1.2.4 All actuator/valve assemblies shall be 'fail closed' type unless otherwise stated on the P&ID.

3.1.2.5 All actuators shall be located externally on the top face of the Bulge. A nameplate shall be placed on top of each actuator to allow identification

of the valve from above. Refer to 24590-WTP-3PS-JV15-T0001, *Engineering Specification for Actuator On/Off Valves*, section 7.1, Nameplate, for general mechanical nameplate requirements and attachment details.

3.1.2.6 Manual valves shall have a label attached to the top cap assembly. The label shall identify the valve number and position indication. Nameplate material shall be three-ply laminated plastic with white face, black core. The nameplate size shall be 2 1/2-inch length, 1 inch wide and 1/16-inch thickness. The letter size shall not be smaller than 1/4 inch; font shall be condensed gothic text, and engrave letters through the core with a round or square end cutter; V-shaped are not acceptable and shall be permanently affixed with by means of adhesive and 316 stainless steel screws.

3.1.2.7 Valve tags shall be removed from the valve bodies and attached to the top cap assemblies, external to the Bulge, to prevent them from becoming a sump plugging hazard if they become disconnected from the valve.

3.1.2.8 Extended Drive Shafts connecting the actuators to the valves shall be fitted with rotary seals to maintain confinement, and designed with double universal joints and a telescopic section to allow movement/misalignment of the valves in all three planes. In Bulges with shielding the Extended Drive Shaft shall be designed to prevent a vertical shine path.

3.1.2.9 The Seller shall furnish an air manifold (1" diameter minimum) on the top face of the Process Bulge to supply air to the valve actuators, complete with an air filter and pressure regulator. Each actuator shall be connected to the manifold using 3/8" 316 flexible stainless steel braided tubing and an isolation valve. The manifold and flexible connections shall be sized for the concurrent operation of all actuators. The location of the manifold should be routed so as to minimize the length of connections but must not prevent the removal of any access plate or plug.

3.1.2.10 Each air isolation valve requires a valve nameplate. The nameplate shall have the same number as its corresponding process valve.

3.1.2.11 The Seller shall provide a Valve Inspection Report detailing items inspected, dimensional inspections performed, verification of inspections required by section 5 and 11 of 24590-WTP-3PS-PV00-T0001, *Engineering Specification for Technical Supply Conditions for Valves,* as well as 8.3 of 24590-WTP-3PS-JV15-T0001, *Engineering Specifications for Actuators for On/Off Control Valves* by valve manufacturer (as a minimum). Results shall be documented and submitted in accordance with Section 3 (G-321-V Form) of the MR.

3.1.3 Instrumentation

3.1.3.1 The Seller shall purchase instrumentation in accordance with specification 24590-WTP-3PS-JQ07-T0001, Engineering Specification for Instrumentation for Package Systems.

3.1.3.2 Instrumentation signal transmission shall be per the instrumentation **Data Sheet**.

3.1.3.3 When the instrument **Data Sheet** calls for Foundation Fieldbus, appropriate junction devices and compliant cable products shall be provided. Systems shall consist of:

1) Appropriate four or eight spur blocks with stainless steel receptacles Pepperl + Fuchs F2-JBSC-4.FF.7/8S.LED or F2-JBSC-8.FF.7/8S.LED or Buyer approved equal.

2) Spur cable shall be armored type, Pepperl + Fuchs C-V9-G-OR-XXXM-PVC-V9-FF-S or Buyer approved equal.

3) All unused spur block points shall be capped with a closure cap. Pepperl + Fuchs V9-R-F-COV or Buyer approved equal. The location of the junction should be on the side of the Bulge. Spur cable shall be routed so as to minimize the length, but should not prevent removal of any access plate.

4) The Pepperl + Fuchs V9-R-M2-S, 2-wire connector shall be installed/pre-wired in the head of all Foundation Fieldbus instruments. The Turck RSFV 49-*M/14.5 connector may be used if the ground lug (Terminal 4) is not connected (cut and tap green/yellow (ground)).

3.1.3.4 Each spurblock shall have a nameplate attached to the Bulge near the associated spurblock. These nameplates shall identify the spurblock tag number, spurblock terminals, and associated equipment/instrument by terminal connection.

3.1.3.5 Where Foundation Fieldbus is not used, terminals and junction boxes shall be provided for instrument signals in accordance with specification 24590-WTP-3PS-JQ07-T0001, *Engineering Specification for Instrumentation for Package Systems.*

3.1.3.6 ITS instrumentation systems and components qualification shall be in accordance with specification 24590-WTP-3PS-JQ06-T0005, *Engineering Specification for Environmental Qualification of Control and Electrical Systems and Components*. The Buyer will provide requirements to the Seller in specifications, Technical Notes of the Material Requisition, or **Data Sheets**, as needed.

3.1.3.7 Gamma Monitor design shall be in according with specification 24590-WTP-3PS-JR00-T0010, *Engineering Specification for Liquid Effluents Gamma Monitor - QL.*

3.1.3.8 If the Quality Level and Seismic Category for instruments inside the bulges are not specified on a datasheet they shall be the same as the Quality Level and Seismic Category specified for the Bulge they are contained in. Furthermore, for instruments that have components

internal and external to the bulge, the internal components shall be qualified to the conditions inside the bulge (e.g., radiation and contamination levels), and the external components shall be qualified to the room conditions as specified on the data sheets.

3.1.4 Electrical Equipment

3.1.4.1 All electrical equipment and material, including industrial control panels and cabinets that are assemblies of industrial control devices, shall be suitable for installation and use in conformity with the provisions of NFPA 70-1999. Suitability of equipment shall be evidenced by listing or labeling as a completed assembly by Underwriters Laboratories (UL). Equipment and assemblies not listed or labeled shall be required to bear a UL "Field Evaluated Product" mark. Equipment and materials listed, labeled or field evaluated by other nationally recognized testing laboratories (NRTLs) as recognized by OSHA, may be accepted only after receipt of prior written approval from the Buyer.

3.1.4.2 Refer to specification 24590-WTP-3PS-EKP0-T0001, *Engineering Specification for Electrical Requirements for Packaged Equipment,* for AC voltage requirements.

3.1.4.3 A motor starter and controller shall be integral to the 480V MCC, 13.8/4.16 kV - 480V AC Secondary Unit Substation (Load Center), or the 13.8 kV switchgear. A local controller shall be used if specified. Refer to specification 24590-WTP-3PS-EKP0-T0001, *Engineering Specification for Electrical Requirements for Packaged Equipment,* for general information.

3.1.4.4 Refer to specification 24590-WTP-3PS-EKP0-T0001, *Engineering Specification for Electrical Requirements for Packaged Equipment,* for cable and wiring requirements.

3.1.4.5 Refer to specification 24590-WTP-3PS-EKP0-T0001, *Engineering Specification for Electrical Requirements for Packaged Equipment,* Appendix A, for nameplate requirements for electrical enclosures, equipment, and devices.

3.1.5 Bulge Construction

3.1.5.1 Process Bulges shall generally be comprised of a pipework assembly including pumps, instruments, valves and fittings as required, a confinement assembly, a confinement support structure, and when required, a Maintenance Platform and/or a shielding assembly.

3.1.5.2 Process Bulges shall be furnished with 1" diameter removable inspection plugs to allow access for a 'video-scope'. The plugs shall be located to provide the best access for the viewing of all internal equipment. The number of inspection plugs shall be minimized.

3.2 Performance

3.2.1 Process Bulges shall be designed and fabricated to fulfill the mechanical and process requirements identified on the Data Sheets and drawings identified under section 2 of the MR.

3.2.2 The Seller shall demonstrate that air operated valves complete a full on-off cycle in less than 5 seconds. Refer to 24590-WTP-3PS-JV15-T0001, *Engineering Specification for Actuators for On/Off Valves*, for supplied plant air pressure.

3.2.3 Actuators shall be sized for 80-psig-supply pressure.

3.3 Design Conditions

3.3.1 Process Bulge pipework shall be designed in accordance with the Piping Class Sheets identified in the Process Bulge Data Sheet. Refer to specification 24590-WTP-3PS-P000-T0001, *Engineering Specification for Piping Material Classes General Description and Summary* for general requirements. Specifications for individual pipe classes will be provided, as needed, with the MR.

3.3.2 A recommended spare parts list shall be generated for all components requiring maintenance/replacement over a 40-year life.

3.4 Environmental Conditions

3.4.1 **Equipment Requirements**

The Bulge SSCs shall be evaluated and accepted by the Seller as suitable for continuous operation in service conditions as specified in the Buyer's MDS.

3.4.2 Outdoor Environment Conditions

Site ambient condition is an extreme temperature range of minus 23°F dry-bulb to 113°F dry-bulb, rain, wind, snow, ice, direct sunlight, and a relative humidity of 0% to 100%.

3.4.3 Ambient lighting levels for Process Bulge areas will be 30 Lumens/ft^2

3.4.4 Radiation exposure will be as indicated on the Process Bulge Data Sheets and Instrument Data Sheets.

3.4.5 Bulges may be stored outdoors for 12 months prior to installation.

3.4.6 The Environmental Qualification classification will be specified as either "harsh", "mild", or "N/A" **on the Buyer's Process Bulge Data Sheets**. Environmental Qualification is not applicable to CM bulges or components. A mild environment is **an environment expected as a result of normal service conditions and extremes (abnormal) in service conditions where seismic is the only design basis event (DBE) of consequences**. Similarly, a harsh environment is **an environment expected as the result of the postulated service condition appropriate for the design basis event of the RPP-WTP. It is an environment that exceeds the**

conditions of a mild environment. In the event that a component is specified as having to be qualified for a harsh environment, the **Buyer** will indicate **what the** conditions **are that the** equipment shall be qualified **to via the Buyer's MDS.**

3.5 Mechanical Requirements

Process Bulges shall be designed and fabricated in accordance with the technical documents identified under section 2 of the MR. Variations to the design documents are permitted provided that the Seller's proposals meet the criteria stated herein, are communicated through drawings, and a general description of the proposed variation is reviewed and approved by the Buyer prior to fabrication.

3.5.1 Process Bulge Confinement – General Requirements

3.5.1.1 Applicable Bulge Enclosure Design Standards

- **SC-I and SC-II Bulge Enclosure confinement systems shall be designed and fabricated in accordance with ANSI/AISC N690-1994, *Specification for the Design, Fabrication, and Erection of Steel Safety Related Structures for Nuclear Facilities*, as tailored by the Buyer and included as Appendix A of this specification. See Appendix D-1 for the required combined loadings and allowables for ANSI/AISC N690 - 94 designs.**

- **SC-III and SC-IV Bulge Enclosure confinement systems shall be designed and fabricated in accordance with AISC M016-1989, *Manual of Steel Construction, Allowable Stress Design, Ninth Edition*, as tailored by the Buyer and included as Appendix B of this specification. See Appendix D-2 for the required combined loadings and allowables for AISC M016-1989 designs.**

3.5.1.2 The Process Bulge confinement shall be fabricated using fully radiused (1" internal radius) corners along **the** side and bottom edges to assist decontamination. Confinement plate thickness shall be as specified on the Process Bulge Data Sheet.

3.5.1.3 The confinement shall incorporate removable roof plates bolted to a roof support structure using 3/8" UNC stainless steel welded stud bolts and 1/8" thick flat elastomer gaskets. The roof plates shall provide gross access to the Bulge internal systems.

3.5.1.4 The roof plates support structure shall be fabricated from 4"x3" stainless steel angle section as a minimum.

3.5.1.5 The confinement roof structure shall be designed to support the static and dynamic loads including seismic loads from the valve actuator assemblies if there is no shielding.

3.5.1.6 All confinement welds shall be continuous.

3.5.1.7 The base of the confinement shall slope in all directions to a fabricated drain. Minimum design requirements for the drain shall be a single strainer, designed to be manually removable from the exterior of the Bulge. When noted on the Process Bulge **Data Sheet**, the drain shall be fitted with a primary and a secondary strainer and level instrumentation. The primary strainer shall incorporate a weir **(See Figure 3 for a conceptual design of a weir)** in its design to enable leak detection and level instrument testing. The primary strainer assembly shall be operable from the outside of the Bulge via an extended drive spindle.

3.5.1.8 As a minimum, the floor of the Bulge shall have a fall of 1:100 and the drain shall be located at the lowest point.

3.5.1.9 The base shall be adequately supported externally to prevent liquid traps caused by distortion during welding.

3.5.1.10 The confinement's external and internal surface finish shall be equal or better than that specified on the Process Bulge Data Sheet. All proposed surface finishes must be to a standard approved by the Buyer's inspector.

3.5.1.11 The **Bulge** confinement shall be designed for an **abnormal** internal negative pressure **as specified on the Buyer's MDS,** and a positive internal pressure equal to that when completely filled with **process fluid. The specific gravity of the process fluid can be found on the Buyer's MDS**. There shall be no internal stiffeners unless approved by the Buyer.

3.5.1.12 Wash rings/spray nozzles shall be installed within the Bulge confinement at a high level to facilitate decontamination of the Bulge and pipework. The Seller shall determine the number and position of the wash rings. If spray nozzles are used, threaded connections are allowed at the connection of the nozzle and the pipe. Refer to the Process Bulge Data Sheet for pressure and flow limits supplied to the wash ring/spray nozzle.

3.5.1.13 A HEPA filter connection shall be located above the maximum height of the Bulge confinement.

3.5.2 Process Bulge Support Frame

3.5.2.1 The Bulge support frame shall be designed to support the confinement structure completely filled with **process fluid** and, when no shielding is required, a Maintenance Platform and column davits as required. **The specific gravity of the process fluid can be found on the Buyer's MDS.**

3.5.2.2 The confinement structure shall be installed within a Bulge support frame fabricated using a minimum of 4" x 2" heavy gauge stainless steel rectangular hollow section.

3.5.2.3 The confinement shall incorporate stiffening pads at all frame connection points and connection shall be accomplished using continuous fillet welds.

3.5.2.4 The support frame shall incorporate leveling and hold-down features to secure the Bulge to the building structure, and to satisfy the requirements noted in section 3.6.1. The leveling and hold-down features shall conform to the Buyer's embed plate location drawings, provided in section 2 of the MR.

3.5.2.5 The support frame shall be designed such as to eliminate open section ends or any open ends shall be closed with fully welded end plates.

3.5.2.6 The support frame will be welded to carbon steel interface pads by the Buyer as referenced in Section 3.5.2.8 of this specification. Seller shall specify weld details to satisfy the seismic requirements in section 3.6.1 of this specification.

3.5.2.7 Applicable Bulge Support Frame Design Standards

- **SC-I and SC-II Bulge Support Frames shall be designed and fabricated in accordance with ANSI/AISC N690-1994, *Specification for the Design, Fabrication, and Erection of Steel Safety Related Structures for Nuclear Facilities*, as tailored by the Buyer and included as Appendix A of this specification. See Appendix D for exert of the appropriate load combinations and allowables from AISC N690 – 94, *Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities.***

- **SC-III and SC-IV Bulge Support Frames shall be designed and fabricated in accordance with AISC M016-1989, *Manual of Steel Construction, Allowable Stress Design, Ninth Edition*, as tailored by the Buyer and included as Appendix B of this specification. See Appendix D for exert of the appropriate load combinations and allowables from AISC M016-1989, *Manual of Steel Construction, Allowable Stress Design, Ninth Edition.***

3.5.2.8 The Process Bulge Skirt or Support Frame, as appropriate, shall be designed to allow for 1/2" gap between skirt or frame and facility embed plates to allow for carbon steel interface pads and leveling features as indicated in Figure 2. Seller shall specify weld details to satisfy seismic requirements in Section 3.6.1 of this specification.

3.5.3 Process Bulge Shielding

3.5.3.1 Where indicated on the Process Bulge Data Sheets the Bulges shall be fitted with carbon steel shielding plates to the specified thickness.

3.5.3.2 Shielding structures shall be completely self-supporting and shall be constructed using a layered methodology, as required, with each layer of shielding being securely bolted and doweled to its predecessor. The initial layer of shielding plates shall be bolted to the Bulge support frame to ensure positional accuracy of shielding access plugs. 180° and 90° butt joints between adjacent shielding plates shall be alternately overlapped to maintain the required shielding thickness.

3.5.3.3 Shielding structures shall be designed to support the Maintenance Platform, valve actuator assemblies, and column davits, when required.

3.5.3.4 Access plugs shall be provided in the roof shielding plates with suitably engineered lifting points to facilitate pump/motor, valve and instrument access.

3.5.3.5 Access plugs shall be designed to be locked in position.

3.5.3.6 When specified on the Process Bulge Data Sheet internal shielding plates shall be provided between adjacent pumps (when more than one pump is installed) and between pump and valve sections of the Process Bulge.

3.5.3.7 The maximum weight for a single shielding plate or plug required to be removable for maintenance operations shall not exceed 500 pounds. The minimum thickness of the shielding plate shall not be less than 1".

3.5.3.8 The maximum weight for a single shielding plate not routinely removed for maintenance operations shall not exceed 2,500 pounds. The minimum thickness of the shielding plate shall not be less than 1".

3.5.3.9 Each plate shall be uniquely identified using 1/2" high stamped characters to assist assembly and have suitable attachment points for lifting eyes. A sequentially numbered assembly map shall also be provided to assist in installing the shielding plates on site.

3.5.3.10 Where extended drive spindles pass through shielding plates the drive spindles shall be designed such that shielding integrity is not compromised.

3.5.3.11 Shielding will be welded to the facility embeds by Buyer. Seller shall specify weld details to satisfy the seismic requirements in the section 3.6.1 of this specification.

3.5.3.12 Applicable Structural Mounting Component Design Standards

- **SC-I and SC-II Structural Mounting Components shall be designed and fabricated in accordance with ANSI/AISC N690-1994, *Specification for the Design, Fabrication, and Erection of Steel Safety Related Structures for Nuclear Facilities*, as tailored by the Buyer and included as Appendix A of this specification. See Appendix D-1 for the required combined loadings and allowables for ANSI/AISC N690 - 94 designs.**

- **SC-III and SC-IV Bulge Structural Mounting Components shall be designed and fabricated in accordance with AISC M016-1989, *Manual of Steel Construction, Allowable Stress Design, Ninth Edition*, as tailored by the Buyer and included as Appendix B of this specification. See Appendix D-2 for the required combined loadings and allowables for AISC M016-1989 designs.**

3.5.4 Maintenance Platforms

3.5.4.1 The Maintenance Platforms shall be designed to meet **both** the requirements set forth in WAC 296-24, **and the following structural code requirements:**

- **SC-I and SC-II Bulge Maintenance Platforms shall be designed and fabricated in accordance with ANSI/AISC N690-1994, *Specification for the Design, Fabrication, and Erection of Steel Safety Related Structures for Nuclear Facilities*, as tailored by the Buyer and included as Appendix A of this specification. See Appendix D-1 for the required combined loadings and allowables for ANSI/AISC N690 - 94 designs.**

- **SC-III and SC-IV Bulge Maintenance Platforms shall be designed and fabricated in accordance with AISC M016-1989, *Manual of Steel Construction, Allowable Stress Design, Ninth Edition*, as tailored by the Buyer and included as Appendix B of this specification. See Appendix D-2 for the required combined loadings and allowables for AISC M016-1989 designs.**

3.5.4.2 The Maintenance Platform shall have a grid of removable grating sections to allow access to the Bulge below. Each removable section shall be positioned to facilitate maintenance of the Bulge equipment.

3.5.4.3 The Maintenance Platforms shall include guardrails. The guardrails shall be designed per WAC 296-24-750.

3.5.4.4 All openings in the guardrail shall have a safety gate or chain designed per the requirements of WAC 296-24-750.

3.5.4.5 The Maintenance Platform shall be designed in sections and shall be removable. The maximum weight of one section shall not exceed 2,500 pounds. The sections shall be bolted together and bolted to the supporting frame or shielding.

3.5.4.6 The Maintenance Platform shall be bolted to either the external layer of shielding, or the Bulge support frame if no shielding is required.

3.5.4.7 A fixed ladder shall be provided to allow access onto the Maintenance Platform. The ladder shall meet the requirements set forth in WAC 296-24-810. Use a concentrated load of 300 pounds for the ladder design.

3.5.5 Lifting Points

3.5.5.1 Bulges shall not be lifted with the shielding structure attached.

3.5.5.2 External pipework and fittings shall not be used for lifting.

3.5.5.3 Lifting points shall accept standard lifting equipment; chain blocks, wire rope or braiding shall not be permitted. If applicable, the lifting lugs shall be designed to accept Crosby shackles or equivalent meeting Federal

3.5.5.4 All lifting attachments shall have either a safety factor of 3 based on the material yield strength, or 5 based on the material ultimate strength, whichever is most conservative. The lifting points shall have a label clearly identifying its unique number and SWL.

3.5.5.5 All lifting points shall be proof tested in situ and provided with test and examination certificates.

3.5.5.6 Items of equipment having eyebolts fitted, or having lifting points identified, shall be such that the point of lift is over the center of gravity of the equipment. Fitted eyebolts shall be removable for examination.

3.5.5.7 Seller shall provide any special designed lifting equipment not available from a commercial source. Such equipment may include, but is not limited to, rigging devices, such as spreader beams, structural lifting devices, strongbacks, and yokes. Rigging devices shall be designed, tested, and tagged in accordance with the applicable requirements of ASME B30.20.

3.5.6 Fasteners

3.5.6.1 UNC series threads shall be used for all screw fasteners and components with mating threads. This thread form shall be used throughout unless otherwise specified on equipment **Data Sheet**s.

3.5.6.2 Steel bolts, screws, and nuts shall be in accordance with **ASME B31.3-1996 as tailored in Appendix C of this specification** .

3.5.6.3 Stainless steel bolts and cap screws shall be used except where repeated assembly and disassembly are required. In that case bolts and cap screws shall be fabricated from 'Nitronic 60' or equivalent to prevent galling. Stainless steel nuts shall be of type 300 stainless steel in accordance with ASTM F594, unless otherwise stated.

3.5.6.4 Welded Stud Connectors: Capacitor discharge stainless steel weld studs shall be ASTM F593, with the following minimum mechanical properties:

a. Tensile Strength:	95,000 psi
b. Yield Strength:	60,000 psi
c. Elongation:	20% in 4 diameters

3.5.6.5 The use of hexagon headed bolts with sufficient clearance for socket wrenches is preferred. The range of bolt sizes shall be kept to a minimum in order to limit the number of tools required.

3.5.6.6 High tensile steel fasteners shall not be employed in the construction of lifting equipment.

3.5.6.7 Bolts and set screws in rotating or reciprocating components, or where subject to vibration, shall be locked by a split pin, tab washer or wire, subject to prior approval of the method by the Buyer. Setscrews used for locking purposes do not require locking. Washers, plain or spring, shall not be used unless specifically called for on drawings.

3.5.6.8 Sufficient envelope clearances are required around the bolt head for sockets.

3.5.7 Pipework

3.5.7.1 All piping shall be designed to meet the requirements of ASME B31.3 1996, ***Process Piping,*** **as tailored in Appendix C of this specification.**

3.5.7.2 All pipework systems shall be self-draining with no liquid traps. Direction and magnitude (if specified) of slope shall be as indicated on the P&ID. Unless otherwise specified on the Process Bulge Data Sheet the minimum pipe slope shall be 1:120.

3.5.7.3 All materials for pumps, pipework, valves and fittings shall be in accordance with the P&ID and Process Bulge Data Sheet and fabricated using 100% butt-welded construction unless otherwise stated.

3.5.7.4 Radiographic examination shall be carried out on all primary confinement pipework butt-welds using 100% radiography for Q components or 20% radiography for all other quality levels.

3.5.7.5 Where pipework passes through shielding plates these penetrations shall be positioned such that shielding integrity is not compromised e.g. in areas that have no direct shine-path to the radiological source.

3.5.8 Wall Penetrations

3.5.8.1 All process pipework leaving the Bulge and penetrating a wall shall be contained within a sleeve pipe. This sleeve pipe will provide secondary containment for the primary pipe. Refer to Table 1 for associated sleeve sizes. The Bulge drain and ventilation line (when required) do not require a sleeve pipe.

3.5.8.2 For pipes sloping into the Bulges, the sleeve pipe shall penetrate the Bulge confinement. An anchor washer shall be welded to the high end of the sleeve. The low-end of the sleeve is open to the Bulge confinement, allowing the process pipe to move freely. **When the Bulge P&ID's indicate that the sleeve pipes continue beyond the Seller's scope of supply, then the design shall provide appropriate drainage through the anchor washer by incorporation of a drain hole or open slot on the bottom end of the anchor washer.** See Figure 1 **& 4.**

3.5.8.3 For pipe sloping away from the Bulge confinement, the sleeve pipe shall be welded to the external side of the Bulge confinement. The low-end of

the sleeve is open in the black cell, allowing the process pipe to move freely. See Figure 1.

3.5.8.4 The sleeve pipe and **anchor** washer material shall be **same as** that used for the Bulge confinement.

3.5.9 Floor Penetrations

3.5.9.1 All process pipework leaving the Bulge and penetrating a floor shall be contained within a sleeve pipe. The sleeve pipe will provide secondary confinement for the primary pipe. Refer to Table 1 for associated sleeve sizes. The Bulge drain and ventilation line (when required) do not require a sleeve pipe, See Figure 2.

3.5.9.2 The sleeve pipes shall be welded to the external side of Bulge confinement plate. The sleeve pipe material shall be equal to that used for the Bulge confinement.

3.5.9.3 Deleted

3.5.9.4 Deleted

3.5.10 Column Davits

3.5.10.1 All column davits shall be designed to operate in the space envelope indicated in the Process Bulge Data Sheet. The boom and mast dimensions shall be determined by the Seller.

3.5.10.2 The column davits shall meet the requirements of DOE-RL-92-36, *Hanford Site Hoisting and Rigging Manual Hoists, Jib Cranes, and Monorail Systems*, and OSHA 29 CFR 1910.179 *Occupational Safety and Health Standards Overhead and Gantry Cranes*.

3.5.10.3 The column davits shall meet the performance and material requirements identified in the Process Bulge Data Sheet.

3.5.10.4 The column davits shall be manufacture's standard products, having minimum capacity 500 lbs, unless otherwise specified in the Process Bulge Data Sheet.

3.5.10.5 Seller shall design the column davits to lift valves, actuators, pumps, top cover plates, shielding plugs, gratings, etc. for maintenance operations.

3.5.10.6 The column davits shall be supported by Process Bulge support frame. The thrust and pull forces under load shall be considered.

3.5.10.7 The column davits shall be design to be interchangeable between as many Process Bulges as reasonable. The quantity of the required column davits is specified in section 2 of the MR.

3.5.10.8 The location and the number of column davit supports shall be determined by the Seller, unless otherwise specified in Process Bulge Data Sheet.

3.6 Loadings

3.6.1 Seismic

3.6.1.1 The Seismic Category is identified on the Process Bulge Data Sheet.

3.6.1.2 Seismic Category (SC) I & II Equipment design shall be in accordance with specification 24590-WTP-3PS-SS90-T0001, *Engineering Specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks*.

3.6.1.3 For Seismic Category (SC) III & IV Equipment seismic design shall be in accordance with 24590-WTP-3PS-FB01-T0001, *Engineering Specification for Structural Design Loads for Seismic Category III & IV Equipment and Tanks*.

3.6.1.4 Where required, the Buyer will provide seismic data to enable the Seller to carry out a dynamic seismic analysis for each Process Bulge. Analyses shall be carried out for the pipework (including where applicable pumps with integral motors), confinement, support and shielding systems.

3.6.1.5 Where the ITS instrumentation system and component data sheets indicate SC-I for functional qualification, components shall be designed in according with specification 24590-WTP-3PS-JQ06-T0003, *Engineering Specification for Seismic Qualification of Control and Electrical Systems and Components*.

3.6.1.6 Seismic Detailing requirements for Seismic Category (SC) I & II Equipment shall be in accordance with UBC 1997, Chapter 22, Division V, Section 2213 per Table 1 of the *Structural Design Criteria*, 24590-WTP-DC-ST-01-0001.

3.6.1.7 Seismic Detailing requirements for Seismic Category (SC) III & IV Equipment shall be in accordance with UBC 1997, Chapter 22, Division V, Section 2214 per Table 1 of the *Structural Design Criteria*, 24590-WTP-DC-ST-01-0001.

3.6.1.8 Seller shall provide a Seismic Data Report/Analysis demonstrating the Bulge designs meet the requirements specified in sections 3.6.1.2 or 3.6.1.3 of this specification.

3.6.2 Operation

3.6.2.1 All pumps, pipework, valves and fittings shall be adequately supported so as to minimize vibration, deflection and nozzle loadings.

3.6.2.2 Roof plate structures must be adequately supported to accommodate valve actuator static and dynamic loads.

3.6.3 Maintenance

3.6.3.1 During valve maintenance operations access will be required onto the shielding and roof plate structures. Therefore in addition to the normal operational loads these structures shall be designed to support personnel access loads of 500 lbs.

3.6.4 Nozzle Load

3.6.4.1 The Seller shall design the Bulge to **withstand the nozzle** loading **from the Buyer's facility installed piping**.

- **For LAW &** PTF bulges; the **nozzle** loads listed in **the Process Bulge Data Sheets** are the minimum design loads acting on the Bulges from facility installed piping at the juncture of the nozzle and shell **(unless otherwise noted, see section 3.6.4.2 of this specification). Buyer external pipe nozzle loads for the LAW and PTF Bulges are listed in the Process Bulge Data Sheets in section 2.5 of this specification.**

  Seller shall apply these external loads, in the combined loading sections of Appendix D-1, D-2, and D-3 as applicable.

3.6.4.2 Nozzle load application for wall penetrating pipework shall be applied as follows:

- **At the anchor washer for pipes sloping towards / into the Bulge confinement.**
- **At the Bulge confinement plate for pipes sloping away from the Bulge confinement.**
- **Seller shall calculate the deadweight and seismic loads for open-ended sleeves and apply them as an external load at the Bulge confinement plate.**

Refer to Figure 1.

3.6.4.3 Nozzle loads for floor penetrating pipework shall be applied at the Bulge confinement plate. Refer to Figure 2.

3.6.4.4 When required, the Seller shall either design suitable reinforcement pads in the confinement plates or increase the confinement thickness.

3.6.4.5 **For confinement shell to pipe nozzle connections, ASME Section VIII, Division 2, Appendix 4, Figure 4-130.1, *Stress Categories and Limits of Stress Intensity*, shall be used for establishing combined allowable stress limits, for pipe nozzle to confinement shell design, by analysis only. However, stress values from ASME Section II, Part D, Table 1A for ASME SectionVIII, Division 1 shall be used as the allowable stress S in meeting the stress limits of ASME Section VIII, Division 2,**

Appendix 4, Figure 4-130.1, in lieu of design stress intensity Sm. (See Appendix D-3 for combined loading and allowable requirements)

3.6.5 Fatigue Analysis

3.6.5.1 The Bulge transfer frequency consists of cycle of process fluid through the line followed shortly after by a flush transfer.

3.6.5.2 Seller shall analyze for fatigue per the requirements detailed in 24590-WTP-3PS-MV00-T0003, *Engineering Specification for Pressure Vessel Fatigue Analysis.*

3.6.5.3 The Process Bulge Data Sheets contain the cyclic information on each nozzle in the ECDS section of the Data Sheet.

3.7 Accessibility and Maintenance

3.7.1 Equipment that is expected to require maintenance, calibration or replacement e.g. pumps/motors, valves and instruments shall be located in areas of the Bulge that offer the best access; this will usually be the front and sides of the Bulge.

3.7.2 The location of equipment within the Bulge shall be such that any items requiring lifting during maintenance can be accessed with the column davits supplied by the Seller.

3.7.3 The Bulge roof plates and shielding top plates shall incorporate equipment access ports and shielding plugs respectively for the maintenance of pumps/motors, valves and instruments.

3.7.4 Each access port shall be contained within a bagging ring or tenting flange to facilitate bagging/tenting techniques to maintain confinement during maintenance.

3.7.5 Where indicated on the Process Bulge Data Sheet, pumps shall be fitted with extended casing bolts that shall pass through seals in the pump access plate. The bolts shall enable the pump motor/impeller unit to be unbolted from the pump casing without breaking confinement.

3.7.6 The centerline of the closest piece of internal equipment shall be a minimum of 15" from the cell wall.

4 Materials

4.1 Positive Material Identification

4.1.1 Refer to specification 24590-WTP-3PS-G000-T0002, *Engineering Specification for Positive Material Identification (PMI)* for Positive Material Identification requirements.

4.2 Construction

4.2.1 Seller shall provide Material Safety Data Sheets (MSDS) for all coatings and materials used in the construction of the Process Bulge.

4.2.2 Process fluids may contain caustic solutions (up to pH-14) but nitric acid solutions may also be used for decontamination of the pipework, pump, valves, and instruments/instrument tubing both inside and outside of the pipework assembly. All materials selected by the Seller shall be suitably corrosion and radiation resistant for the specified service.

4.2.3 Materials shall be as specified in the Process Bulge Data Sheet and Instrument Data Sheets. Any proposed substitutes or concessions shall be agreed with the Buyer prior to procurement or incorporation into the work.

4.2.4 All materials shall be new and comply with this specification and relevant standards.

4.2.5 All flanges and pipe fittings shall be welded-neck and long radius types respectively unless otherwise specified and shall conform to ANSI standards.

4.2.6 No threaded flanges or fittings shall be used for process pipework.

4.2.7 Material certificates shall be supplied for all stainless steel pipe, plate, sheet and sections. Materials without specified mill test certificates must be approved by the Buyer prior to ordering; however additional material analysis may be required, either by wet or dry methods, to verify compliance with test certification or to determine material composition. Where such testing is required, any additional costs shall be the responsibility of the Seller.

4.2.8 The Seller shall have and implement provisions to ensure that materials used or supplied are not counterfeit or of suspect origin. Particular attention should be given to high strength bolting material (grade 5 strength equivalent and higher) and pipe fittings.

4.2.9 Appendix C, *Radiation Resistant Materials*, of Engineering Specification 24590-WTP-3PS-M000-T0002, *Engineering Specification for Mechanical Handling Equipment Design & Manufacture*, may be used when selecting non-metallic materials. All Non-metallic components shall be selected to resist the radiation levels specified on the data sheets. In particular this refers to items such as gaskets, seals, o-rings, and other similar items

4.3 Prohibited Materials

4.3.1 No asbestos containing materials, bronze, copper, lead, **Beryllium,** zinc, mercury, tin, antimony, cadmium, or other low melting point metals, PCBs or compounds of lead base paints or lubricants containing lithium or boron shall be used. 'Teflon' or compounds thereof must be qualified for use with the radiation levels specified on the Process Bulge Data Sheet.

4.4 Special Requirements

4.4.1 Where special requirements or restrictions are to be applied to the established items, these will be specified on the Process Bulge Data Sheets or in accompanying contractual documentation. In the absence of such instructions, the manufacturer's standard product shall be supplied as specified or as approved by the Buyer.

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

4.5.1 Stainless steel is susceptible to corrosion caused by the contact and interaction with incompatible materials. All stainless steel material shall be stored in separate areas away from other materials.

4.5.2 The Seller shall submit Material Control Procedures for controlling, handling, storage and trace ability of materials such as weld rods, production items or Government Owned materials.

5 Fabrication

The Seller shall obtain written Final Design approval from the Buyer prior to the start of fabrication activities.

5.1 General Requirements

5.1.1 For all piping, refer to Specification 24590-WTP-3PS-PS02-T0001, *Engineering Specification for Shop Fabrication of Piping*. All welding procedures must be pre-approved by the Buyer prior to the start of fabrication.

5.1.2 Structural welding procedures shall be carried out in accordance with **ANSI**/AISC N690 – 94, *Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities* **as tailored in Appendix A of this specification**, and specification 24590-WTP-3PS-SS00-T0002, *Engineering Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel*. All welding procedures must be pre-approved by the Buyer prior to start of fabrication.

5.2 Assembly

5.2.1 Flatness of the completed Bulge confinements shall be 1/8" per foot, with no greater than 3/16" over the entire length of the Bulge except for areas around cutouts. Areas around cutouts shall be flat within 1/16" per foot.

5.2.2 Cutout locations shall be within +/- 1/8" and cutout size shall be within +/- 1/16" except where noted on the Buyer sketches.

5.2.3 All Bulge confinement corners shall have a 1" +/- 1/16" internal radius.

5.2.4 The minimum material thickness for Bulge confinements shall be in accordance with the Process Bulge Data Sheet.

5.2.5 The Process Bulges shall have edges that are both smooth and not sharp to the touch.

5.2.6 The method of fabrication shall minimize the number and amount of seams, overlaps, or other discontinuities, which could trap radioactive contamination.

5.3 Tolerances

Manufacturing and fabrication tolerances for all equipment, accessories, and components shall conform to the following requirements:

5.3.1 Machined Components:

5.3.1.1 Machined surfaces shall be aligned within +/- 0.5 degrees of design conditions.

5.3.1.2 THICKNESS: Thickness tolerances shall conform to the requirements of the referenced commercial standard. In the absence of such criteria, allowable thickness shall be plus 0.010 inches, minus 0.005 inches.

5.3.1.3 DIMENSIONS: **Buyers preferred dimension scheme,**

a) $0 \le D < 4$ in	+/- 0.010 inch
b) 4 in $\le D <$ 36 in	+/- 0.020 inch
c) 3 ft $\le D <$ 10 ft	+/- 0.030 inch
d) 10 ft $\le D <$ 20 ft	+/- 0.060 inch
e) Over 20 feet	+/- 0.13 inch.

Note: D equals the desired dimension.

5.3.2 Fabricated Components:

5.3.2.1 Nozzle and flange alignment shall be within +/- 0.5 degrees of design conditions.

5.3.2.2 Rotating shaft alignment shall be specified by the Seller to minimize valve-turning torque at the actuator.

5.3.2.3 Thickness tolerances shall conform to the requirements of the referenced commercial standard applicable to the material being fabricated. When plate thicknesses are specified herein or in other supporting documentation they shall be considered to mean minimum thickness.

5.3.2.4 DIMENSIONS: **Buyers preferred dimension scheme,**

a) $0 \le D < 4$ in	+/- 0.020 inch
b) 4 in $\le D <$ 36 in	+/- 0.040 inch
c) 3 ft $\le D <$ 10 ft	+/- 0.060 inch
d) 10 ft $\le D <$ 20 ft	+/- 0.13 inch.
e) Over 20 feet	+/- 0.25 inch.

Note: D equals the desired dimension.

5.3.2.5 Weld joint preparation, for field welds, shall be in accordance with drawing 24590-WTP-PW-P30T-00001, *WTP End Prep Detail for Field Butt Welds*.

6 Tests and Inspections

6.1 Non-Destructive Examinations

6.1.1 Unless otherwise specified all welds shall be inspected in accordance with the requirements outlined in the reference 24590-WTP-3PS-PS02-T0001, *Engineering Specification for Shop Fabrication of Piping*. All primary pipework for **Q** components shall be inspected in accordance with Appendix A of 24590-WTP-3PS-PS02-T0001.

6.1.2 All welds performed on the Process Bulge Confinement, Support Frame, Shielding, or other structural/support components shall be inspected in accordance with the requirements of the appropriate standard as specified in Sections 3.5.1.1, 3.5.2.7, and 3.5.3.12 of this specification.

6.2 Personnel Qualifications

6.2.1 Non-Destructive Examinations of non-structural components shall be performed by an inspector certified to the requirements of SNT-TC-1A-**1989**. The interpretation of the results shall be by either Level II or Level III inspectors certified to SNT-TC-1A-**1989**.

6.2.2 For Personnel Qualification requirements for structural components, refer to **ANSI/**AISC N690-94, *Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities* **as tailored in Appendix A of this specification**, or AISC M016-1989, *Manual of Steel Construction, Allowable Stress Design*, Ninth Edition, as Tailored in Appendix B **of this specification**.

6.2.3 Personnel performing visual inspections of welds shall be either a Certified Weld Inspector (CWI) of the American Welding Society (AWS) or a SNT Level II or Level III inspector.

6.3 Shop Tests

6.3.1 General Requirements

6.3.1.1 The Process Bulge piping shall be hydrostatically tested in accordance with ASME B31.3 1996 **as tailored in Appendix C of this specification**. The Seller shall submit hydrostatic test procedures to Buyer for review and permission to proceed, prior to commencement of testing. The pipework shall be dried after testing.

6.3.1.2 The Process Bulge confinement shall be flooded with test water. After a period of 12 hours there shall be no visible sign of leakage. The confinement shall be dried after testing.

6.3.1.3 Test water used for hydrostatic testing shall be tested for chlorides. The chloride content of the test medium shall not exceed 50 ppm and the water temperature shall not exceed 120°F.

6.3.1.4 Where installed, the Seller shall demonstrate a full removal and replacement operation for pumps, valves, and instruments utilizing the tent or bag-in/bag-out method. The Seller shall provide maintenance manual(s) detailing procedures for removal and replacement of valves, instrumentation, and pumps. Spare o-rings, valve seats, and seals shall be ordered to replace original maintainable parts used in the removal/replacement demonstration. The Seller shall demonstrate the assembly and disassembly of the shielding.

6.3.1.5 The Seller shall demonstrate the correct operation of all valves.

6.3.1.6 Seller shall submit procedures for and perform a wiring insulation test and continuity check. Refer to 24590-WTP-3PS-EKP0-T0001, *Engineering Specification for Electrical Requirements for Packaged Equipment,* section 7.1 for additional testing requirements. Results of the test and check shall be included in the required documentation packages.

6.3.1.7 Seller shall demonstrate all internal equipment and surfaces are thoroughly washed by the spray rings/nozzles.

6.3.1.8 Seller shall demonstrate operation, assembly and disassembly of the column davits.

6.3.2 Surface Finish Inspection

6.3.2.1 The Seller shall develop and implement a procedure for visually inspecting the surface finish of each manufactured item. The inspections shall be performed after completion of all fabrication, cleaning, and testing, and just prior to final packaging.

6.3.2.2 Inspection of weld surface finishes, shall confirm that design requirements listed on the Process Bulge **Data Sheet** have been met.

6.3.2.3 Following inspection, the Seller shall document acceptance of surface finishes.

6.3.3 Visual Weld Inspection

6.3.3.1 The Seller shall develop and implement a procedure to perform visual weld inspections (visual tests, VT) to inspect each weld. The inspection for piping shall be developed in accordance with ASME B31.3 - 1996 **as tailored in Appendix C of this specification**, and shall include inspection materials and acceptance criteria. The remaining VT shall be

developed in accordance with ASME Section VII, **Div 1**. The visual weld inspection procedure shall be submitted to the Buyer for review and approval, prior to the inspection. Surface porosity and undercutting is not allowed.

6.3.3.2 The Seller shall prepare a visual weld inspection report for each fabricated item, which records inspection results, the date and time of inspection, and signatures of certified inspection personnel performing the inspection.

6.3.3.3 The visual weld inspection reports shall be included in the required documentation packages.

6.3.3.4 The Seller shall summarize the VT results in the weld map report for each item.

6.3.3.5 The Seller shall notify the Buyer in advance of inspection. The Buyer may send representatives to witness or perform an independent inspection.

6.3.4 Liquid Penetrant Test

6.3.4.1 The Seller shall develop and implement a procedure to perform a liquid penetrant test (PT) to inspect each weld, excluding handrails. PT testing for piping shall be in accordance with ASME B31.3 – 1996 **as tailored in Appendix C of this specification**. All Remaining PT shall be developed in accordance with ASME Section VII, **Div 1**, and shall include inspection materials, dwell time for dye and developer, and acceptance criteria. The liquid penetrant procedure shall be submitted to the Buyer for review and acceptance, prior to testing.

6.3.4.2 Acceptance criteria for PT inspection shall be in accordance with ASME B31.3 - 1996 **as tailored in Appendix C of this specification**. Surface porosity and undercutting is not allowed.

6.3.4.3 The Seller shall prepare a liquid penetrant test report for each weld connection on each fabricated item, which will record PT inspection results, the weld number, the date and time of inspection, and signatures of the certified inspection personnel performing the test.

6.3.4.4 The Seller shall include the liquid penetrant test reports in the required documentation packages.

6.3.4.5 The Seller shall summarize the PT results in the weld map report for each item.

6.3.4.6 The Seller shall notify the Buyer in advance of the test. The Buyer may send representatives to witness or perform an independent test.

6.3.5 Radiography

6.3.5.1 The Seller shall develop and implement a procedure to perform radiographic weld examinations of piping butt-welds as specified in

3.5.7.4 and of structural welds. The inspection shall be in accordance with **ANSI/**AISC N690-94 **as tailored in Appendix A of this specification**, AISC M016-1989 **as tailored in Appendix B of this specification**, or ASME B31.3-1996 **as tailored in Appendix C of this specification**, as appropriate, and shall include inspection materials and acceptance criteria. The weld radiography procedure shall be submitted to the Buyer for review and approval, prior to performing the radiographic examinations.

6.3.5.2 The Seller shall prepare a weld inspection report for fabricated piping systems, which records inspection results, the date and time of the inspection, and signatures of certified personnel performing the inspection.

6.3.5.3 The weld inspection report shall be included in the required documentation packages along with the exposed film, a copy of the technique and the reader sheets. The film must be suitably packaged to preclude moisture and handling damage.

6.3.5.4 The Seller shall summarize the radiography results in the weld map report for each item.

6.3.5.5 The Seller shall notify the Buyer in advance of inspection. The Buyer may send representatives to witness or perform an independent inspection.

6.3.6 Final Inspection

6.3.6.1 The Seller shall develop and implement a procedure for final inspection of each fabricated item. The inspections shall be performed after completion of all fabrication, cleaning, and testing, and just prior to final packaging.

6.3.6.2 The Seller shall inspect all surfaces for contamination. Visible evidence of contamination is not acceptable.

6.3.6.3 The Seller shall prepare a final inspection report for each item, which documents the results of the final inspection. The Seller shall include the final inspection report in the documentation package for each piece.

6.3.7 Environmental Qualification

6.3.7.1 The Seller shall develop and implement a procedure to perform environmental qualification tests, or similar, when applicable to provide evidence that the equipment supplied is qualified for its environmental design conditions.

6.4 Control of Measurement and Test Equipment

6.4.1 Testing shall be performed using calibrated equipment when required. The equipment shall be calibrated against certified measurement standards, having known valid relationships to national standards, at established intervals to ensure accuracy.

6.4.2 The Seller shall maintain records and mark equipment to show calibration status.

6.4.3 The Seller shall notify the Buyer when M&TE are found to be out of calibration after being used for inspection purposes, in compliance with this specification.

6.5 Inspection and Test Status

The Seller shall maintain a positive system for identifying inspection and testing status of items and systems.

6.6 Control of Nonconforming Items

The Seller shall provide a method of notifying the Buyer of fabrication items and activities, which do not conform to requirements.

7 Preparation for Shipment

7.1 General Requirements

7.1.1 Refer to section 7 of the Material Requisition for general requirements and Specification 24590-WTP-3PS-G000-T0003, *Engineering Specification for Packaging, Handling, and Storage Requirements.*

7.2 Cleanliness

7.2.1 Refer to 24590-WTP-3PS-PS02-T0001, *Engineering Specification for Shop Fabrication of Piping* for general requirements.

7.3 Painting

7.3.1 All ferrous surfaces other than corrosion resistant steel and finished machined mating surfaces shall be prepared and painted by the Seller in accordance with the paint manufacturer's instructions. Refer to specification 24590-WTP-3PS-AFPS-T0001, *Engineering Specification for Shop Applied Special Protective Coatings for Steel Items and Equipment* for painting requirements.

7.4 Tagging

7.4.1 A stainless steel nameplate containing the following information shall be rigidly attached to each Bulge. The nameplate shall be located in a prominent position for ease of visibility. The information shall be stamped or etched using 1/2" high characters. The nameplate shall include the following information, minimum:

Seller's Name/Address/Phone Number
Date of Manufacture
Buyer's Purchase Order Number
Seller's Contract Number
Plant Item Number
Weight of Assembly

7.4.2 When shipping loose bolting material, both **Q** and CM shall be placed in separate containers (box, bag). The container shall be marked with the Buyer Purchase Order Number, Plant Item Number, and Bill of Material item number to facilitate material control and assembly.

7.4.3 Each column davit shall be tagged with a permanent stainless steel tag indicating for which Bulges it was designed.

7.5 Packaging

7.5.1 Refer to 24590-WTP-3PS-G000-T0003, *Engineering Specification for Packaging, Handling and Storage Requirements* for general requirements.

7.6 Documentation

7.6.1 Seller shall ensure that appropriate documentation is prepared and, if required, signed by the appropriate person(s). The shipping documentation shall accurately reflect specific traceability to the items being shipped.

7.6.2 Seller shall ensure that appropriate documentation is prepared for the Process Bulges. At a minimum, documentation shall include the following information, as applicable:

- Manufacturer name, model number, and serial number
- Plant Item Number

7.7 Shipping Instructions

Shipping shall be conducted in accordance with Buyer specification 24590-WTP-3PS-G000-T0003, *Engineering Specification for Packaging, Handling and Storage Requirements.*

7.7.1 Process Bulges shall be shipped completely assembled. When required, shielding, Maintenance Platforms, and ladders shall be shipped separately.

7.7.2 Weatherproof shipping lists (two per packaged item) shall be prepared and submitted, and shall clearly identify the contents of each package sent to the Buyer. All submittals and shipping boxes shall be identified with the Buyer's PO number.

7.7.3 Seller shall provide a complete identification and location of temporary material contained within the equipment for shipment, handling, or storage that must be removed prior to commissioning (e.g., shipping blocks, glove bags, components shipped inside larger sections, etc.). In addition, the Seller shall provide instructions for the removal of temporary materials, as required.

7.7.4 The Process Bulges shall be mounted on skids, in crates, or in boxes, as suited for the intended method of transport. Lifting weight shall be clearly marked on both the equipment and its shipping documents.

8 Quality Assurance

8.1 General Requirements

The Quality Level will be identified on the Process Bulge Data Sheet and on the QA Data Sheet issued with the MR. Refer to section 9 of the Material Requisition for general requirements, and Specification 24590-WTP-3PS-G000-T0001, *General Specification for Supplier Quality Assurance Program Requirements*.

8.2 Quality (Q) Related Components

8.2.1 Seller shall have in place a QA program meeting the requirements of NQA-1 (1989), marked as applicable in the Supplier Quality Assurance Program Requirements Data Sheet attached to the MR, and Specification 24590-WTP-3PS-G000-T0001, *General Specification for Supplier Quality Assurance Program Requirements*.

8.2.2 The successful bidder must pass a pre-award survey by the Buyer. Seller shall demonstrate that its quality program is in compliance with the procurement quality requirements listed in the Supplier Quality Assurance Program Requirements Data Sheet. The Seller shall allow the Buyer, Buyer's Representative, and DOE access to their facility and records pertaining to this PO for the purpose of QA audits and surveillance at mutually agreed times.

8.2.3 All items shall be manufactured in accordance with the Seller's Quality Assurance Program that meets the requirements of NQA-1 (1989), and has been previously evaluated and accepted by the RPP-WTP QA organization.

8.2.4 Seller shall submit their QA program and work plan to the Buyer for review prior to commencement of work. The plan shall include documents and procedures to implement work and include a matrix of essential QA elements cross-referenced with documents/procedures.

9 Configuration Management

Equipment and/or components covered by this specification are identified with Plant Item Numbers, shown on the data sheets included in section 2 of the MR. Bulges shall be identified in accordance with Tagging in section 7.4 of this specification.

10 Documentation and Submittals

10.1 General Requirements

10.1.1 Seller shall submit to the Buyer all detailed designs, documentation, procedures, instructions, calculations, analyses, manufacturer's data, inspection reports, test reports, certifications, certificates, manuals, MSDS, and drawings required per this specification, the applicable codes, standards, and reference documents in Section 2 of this specification, and the MR.

10.1.2 Seller shall submit to 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 the MR.

10.1.3 Seller shall submit a report identifying any deviations and/or conflicts per Section 2 of the MR to the Buyer for review.

10.1.4 All documentation submittal packages shall have a documentation inventory sheet attached, listing all documents and the number of pages.

10.1.5 All detailed designs, drawings, supporting calculations, supporting analysis, supporting models, procedures, instructions, manufacturer data, operations manuals, and maintenance manuals shall be issued to the Buyer for review prior to the manufacture of the Process Bulges, special tools, and/or purchase of special tools and gaskets.

10.1.6 Seller shall submit storage requirements and instructions for Buyer's review. Documentation shall include maintenance requirements for the equipment and its components while in storage.

10.1.7 Data sheets in section 2 of the MR shall be marked-up by the Seller and submitted to the Buyer for the review with the detailed design. Seller shall fill in all of the information that is marked as "To be determined by the vendor" and mark-up actual overall Process Bulge dimensions based on the detailed design.

10.1.8 Seller shall provide all operations manuals, maintenance manuals, and spare parts lists for Process Bulges and components, as applicable.

10.1.9 Seller shall provide a Certificate of Compliance to the Buyer, which certifies that any equipment or components requiring Environmental Qualification (as specified in Section 2 of the Material Requisition) are qualified for their specified environment. As a minimum, Environmental Qualification Documentation shall contain:

- Identification of each type of equipment, component, or sub-component subject to Environmental Qualification (e.g. solenoids, wire, pressure transmitters, etc.)
- Equipment tag numbers, as applicable
- Environmental Qualification Conditions in accordance with requirements as specified in the Technical Notes of the MR
- Qualification method
- Qualified Life under specified conditions

10.2 30% Design Review

10.2.1 Seller shall conduct a 30% design review with the Buyer. Seller shall submit all drawings, procedures, calculations, analysis, and supplementary information necessary to conduct the 30% design review to the Buyer for review.

10.2.2 Finalized outline dimensions for the Process Bulges shall be included in the 30% design review. Finalized dimensions shall, at a minimum, include the following:

- dimensioned layout drawings of the Process Bulge, shielding and Maintenance Platform
- pipe slopes and nozzle locations
- platform configuration and attachments, ladder location, and openings in the platform guardrails
- penetration in walls/floor details
- volume of the internal pipework
- weight of the Process Bulge including shielding and Maintenance Platform, where required
- anchor requirements (anchor size, location, layout, etc.)
- completed Buyer supplied Mechanical Data Sheets, Electrical Data Sheets, and Instrument Data Sheets, as applicable
- preliminary maintenance procedure, including bag-in/bag-out procedure.

10.3 60% Design Review

10.3.1 Seller shall conduct a 60% design review with the Buyer. Seller shall submit all drawings, procedures, calculations, analyses, and supplementary information necessary to conduct the 60% design review to the Buyer for review including as a minimum:

- equipment assembly/arrangement drawings
- shop detail drawings with sufficient detail to facilitate fabrication, manufacture, or installation. This includes a complete Bill of Material (BOM), internal piping details, cross-sectional details, structural details, and anchor details
- wiring diagrams including schematic diagrams and interconnecting wiring diagrams for electrical/instrumentation requirements
- instrument air schematic diagrams
- engineering calculations and analyses (seismic and nozzle loads)

10.4 90% Design Review

10.4.1 Seller shall conduct a 90% design review with the Buyer. Seller shall submit all drawings, procedures, calculations, analyses, and information necessary to conduct a 90% design review to the Buyer for review.

10.5 Final Design Review

10.5.1 The Seller shall provide a final design report including all design documents, manuals, and drawings that are required by this specification.

10.6 Drawings

10.6.1 All drawings shall be produced per the drawing practices set forth in ASME Y14.100, *Engineering Drawing Practices.*

10.6.2 As-built drawings, with final dimensions, shall be developed and submitted after completion of the Bulge fabrication.

10.7 Calculations

All calculations to be provided shall be orderly, complete, and sufficiently clear to permit verification. The body of the calculations shall include:

- **The calculation shall be identifiable by: Subject (including component identifier), Originator, Reviewer, Approver, Revision and Date.**
- **Definition of the objective of the analysis (e.g; Purpose, Objective or Scope)**
- **Methodology**
- **Definition of design inputs and their sources**
- **References with identification of specific editions, revisions, dates**
- **Identification of assumptions and indication of those that require verification. If none of the assumptions require verification, the calculation shall state such.**
- **Identification of computer calculations including:**
  - **Computer Type**
  - **Identification of the program and revision/version**
  - **Evidence of or reference to the computer program verification**
  - **Bases or reference to the bases supporting application of the computer program to the specific physical problem being solved. (See sections 10.7.1.1, 10.7.1.2 and 10.7.1.3 for design code requirements)**
- **Equations used for all computations**
- **Numerical calculations including identification of units used**
- **A concise statement addressing the calculation results and/or recommendations**

- A table of contents for complex calculations

10.7.1 Design Stress Reports

Design Stress Reports shall include, as a minimum, the following information

10.7.1.1 ANSI/AISC N690 and AISC M016 for Bulge Enclosure Confinement Design

- All modeling inputs, applied loads, constraints, assumptions, etc., shall be provided for configuration compliance reviews.
- Compliance to the buckling requirements of ANSI/AISC N690 or AISC M016, as applicable, shall be provided. Note that the buckling formula in section Q1.5.9.1 of the ANSI/AISC N690-1994 code shall apply to AISC M016 for austenitic stainless steel buckling qualification.
- For each load case supply the resulting reaction loads at each of the embed interfaces.
- Weld sizing calculations, for all welds, shall be provided. Fillet welds are to be evaluated for shear stress on the basis of resultant loads on the throat along with considerations for the base metal.
- Bolt evaluation shall be performed in accordance with ANSI/AISC N690, section Q1.6.3 or AISC M016 requirements.
- For Finite Element Analysis (FEA) by Computer Program, submit the bases or reference to the bases that supports applicability of the computer program to the specific physical problem being solved. (e.g.; application /validation to steel code formulas and allowable stresses).
- For FEA, resultants must be cast in forms appropriate to code criteria being considered, e.g., column buckling with shell element models could be evaluated with axial stresses averaged over the member section to represent the appropriate axial compressive stress. The analysis must clearly identify the loads and criteria being addressed

10.7.1.2 ASME VIII, Div 2, Appendix 4, Nozzle to Shell Design Only

- All modeling inputs, applied loads, constraints, assumptions, etc., shall be provided for configuration compliance reviews.
- Compliance to ASME VIII, Div 2, Appendix 4, sections 4-131, 4-132, 4-133 and 4-134 shall be provided for the nozzle to shell connections.
- Weld sizing calculations, for all welds, shall be provided.
- For FEA Computer Program analysis, submittal for the bases or reference to the bases supporting application of the

computer program to the specific physical problem being solved. (e.g.; application/validation to the ASME VIII, Div 2, Appendix 4, Maximum Shear Stress Theory.)

- **Tresca (max shear) stress intensity outputs for each combined loading condition shall be compared with the allowable stress limit. Von Mises values are not acceptable.**

10.7.1.3 ASME B31.3 Piping Design

- **All modeling inputs, applied loads, constraints, assumptions, etc., shall be provided for configuration compliance reviews.**
- **ASME B31.3 piping stress analysis shall show all pipe supports, guides and anchor points. Pipe support details shall be provided. All nozzle displacements, seismic anchor moments, component deadweights and nozzle flexibilities shall be applied in the analysis.**
- **For Bulges that are SC-I and SC-II, supply the resulting nozzle displacements (in the X, Y, Z directions) at the location where the Buyers nozzle loads are applied.**
- **All other structural qualifications, such as: pipe supports, lifting lugs/devices, platforms/ladders, etc.**
- **For FEA Computer Program analysis, submittal for the bases or reference to the bases supporting application of the computer program to the specific physical problem being solved. [e.g.; application/validity to the ASME B31.3 design requirements in accordance with B31.3-96, section 300(c)(3)].**

10.8 Schedules

10.8.1 A detailed schedule of engineering, document submittal, material purchase, fabrication, shop tests, and shipment shall be submitted.

10.8.2 All procedures and instructions shall be completed and submitted to the Buyer a minimum of eight (8) weeks prior to Process Bulge shipment.

11 References

11.1 Incorporated Design Changes

- 24590-WTP-3PN-MX00-00003
- 24590-WTP-SDDR-PROC-03-0106
- 24590-WTP-3PN-MX00-00004
- 24590-WTP-3PN-MX00-00006
- 24590-WTP-3PN-MX00-00014
- 24590-WTP-3PN-MX00-00018
- 24590-WTP-3PN-MX00-00020

- 24590-WTP-3PN-MX00-00022
- 24590-WTP-3PN-MX00-00023

11.2 Design Changes Incorporated by Reference

- 24590-WTP-SDDR-PROC-03-0102
- 24590-WTP-SDDR-PROC-02-0063
- 24590-WTP-SDDR-PROC-05-00601
- 24590-WTP-SDDR-M-05-00332
- 24590-WTP-SDDR-M-05-00474
- 24590-WTP-SDDR-M-05-00685
- **24590-WTP-SDDR-M-06-00074**
- **24590-WTP-SDDR-M-06-00282**

Figure 1 Typical Representation of Process Pipework and Sleeve Pipes Penetrating the Cell Wall

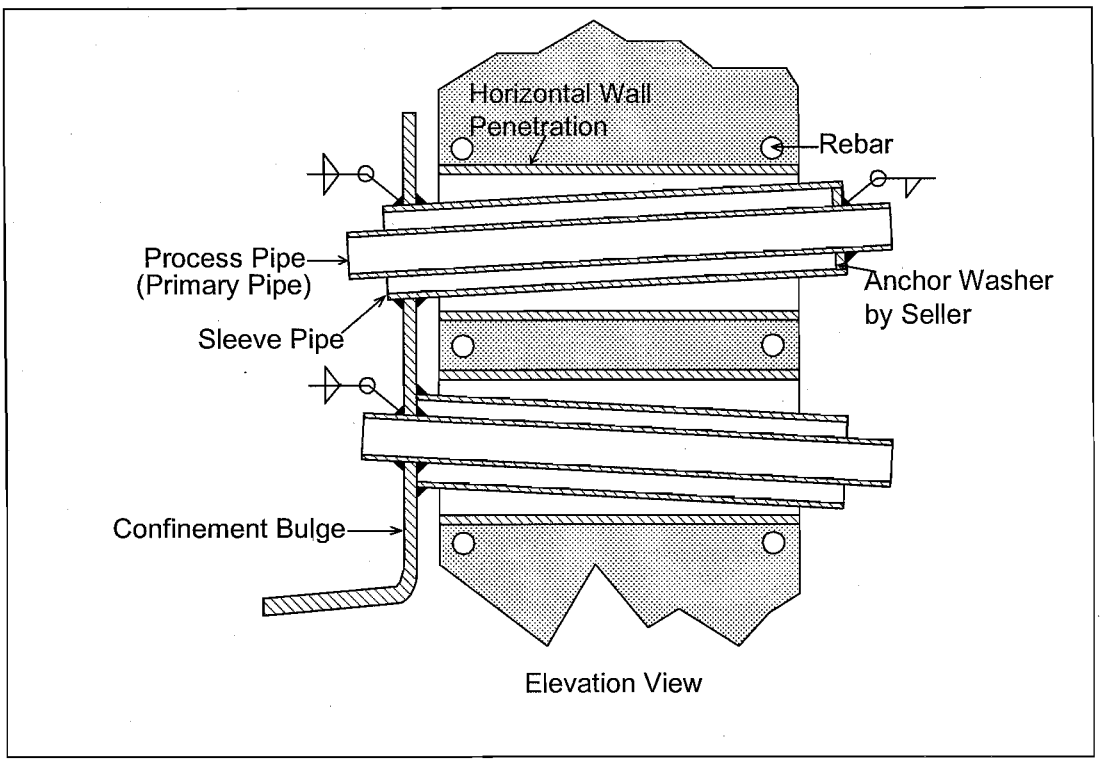

Figure 2 Typical Representations of Process Pipework and Floor Penetrations

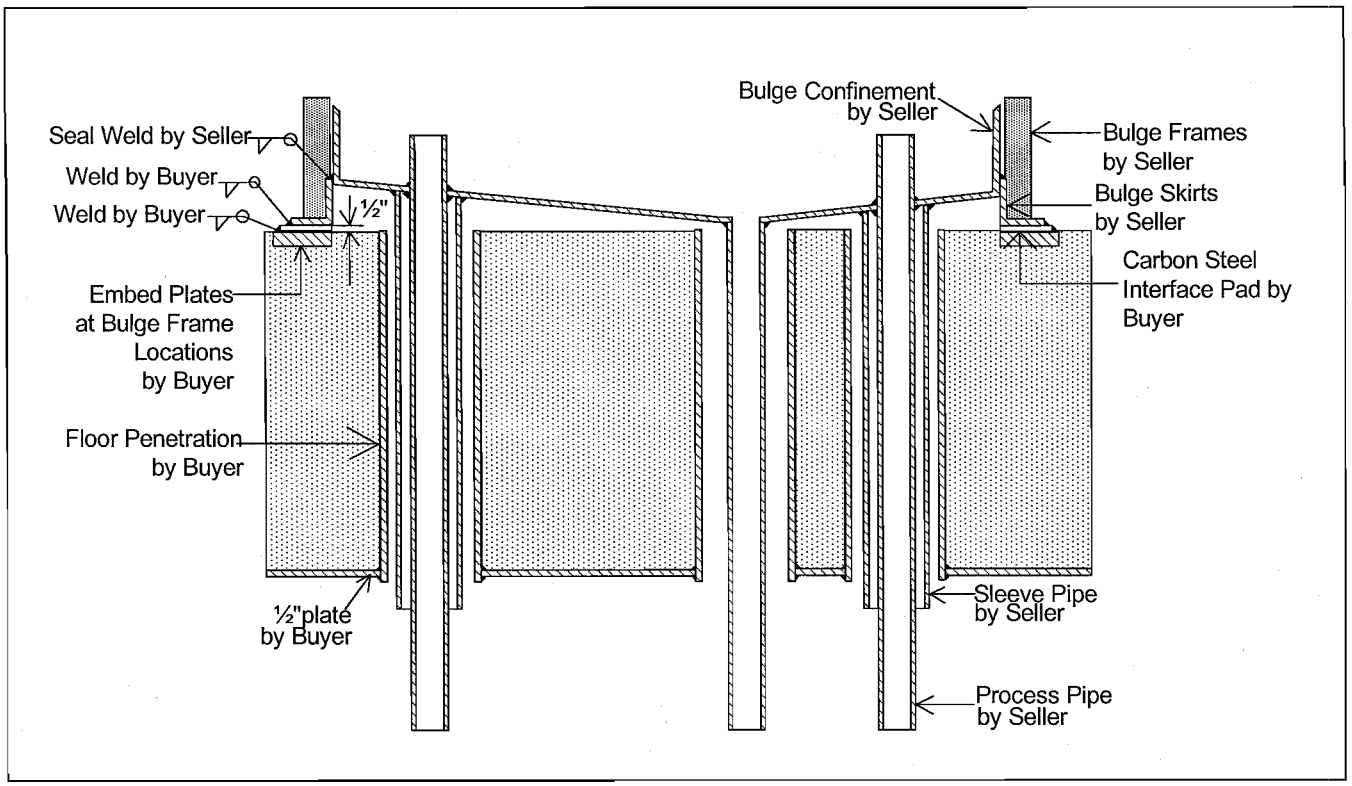

Figure 3 Conceptual Weir Design as a Primary and Secondary Strainer

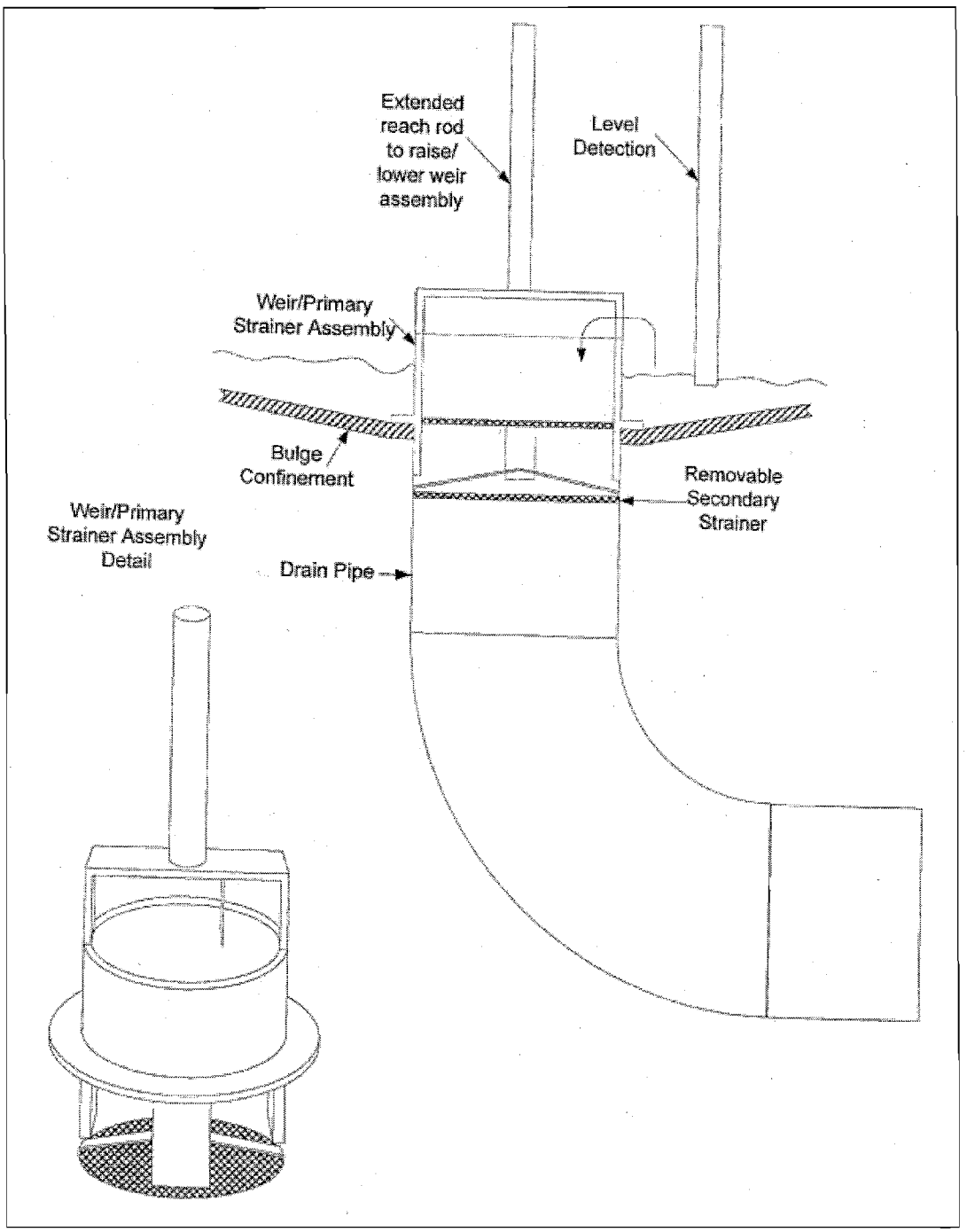

Figure 4 Conceptual Anchor Washers that Allow Drainage to Pass Through

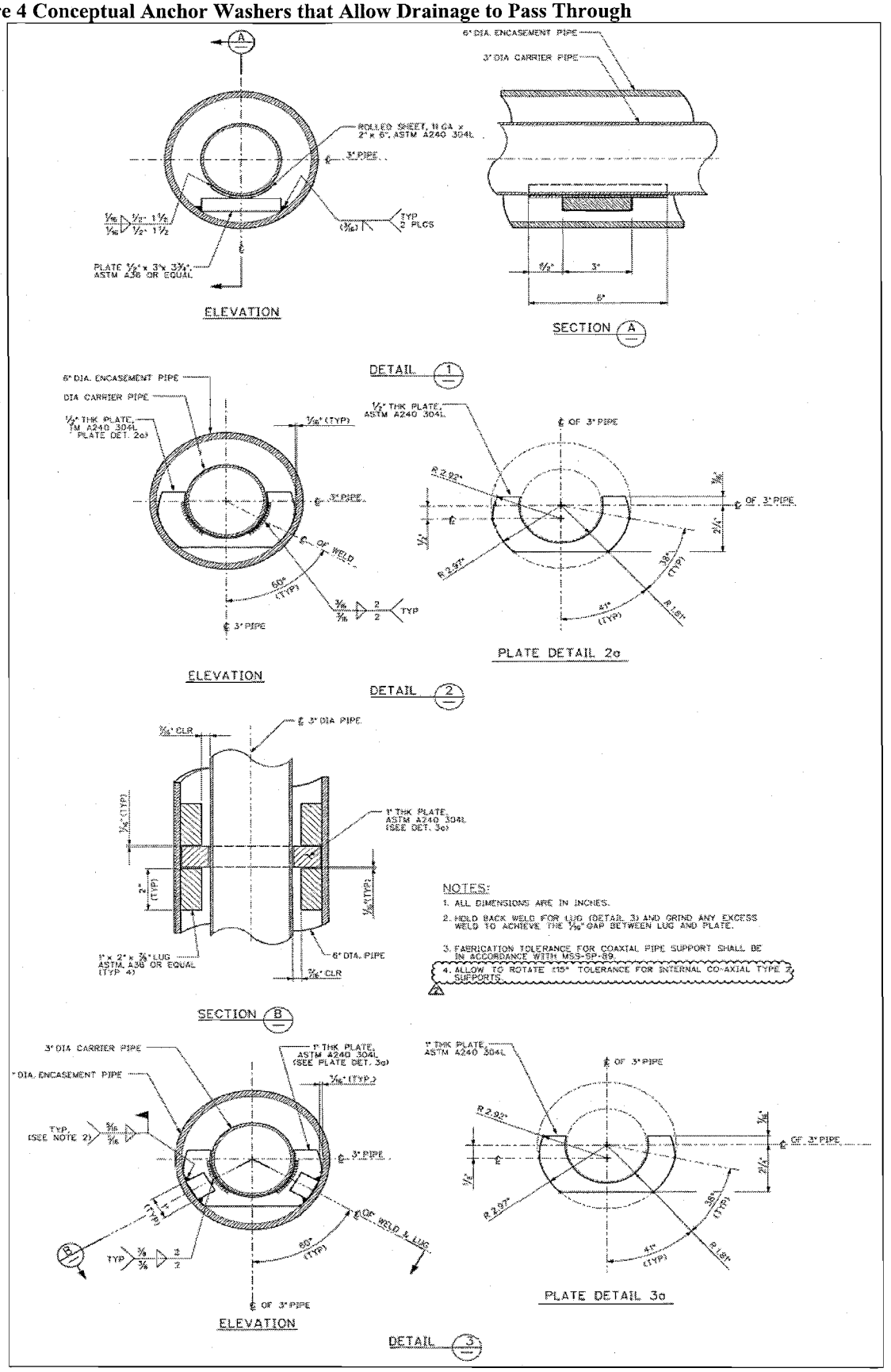

Table 1 **Process Pipe and Sleeve Pipe Sizes**

Process Pipe Size	Sleeve Pipe Size	Sleeve Pipe Schedule
1.0"	2.0"	40S
1.5"	3.0"	40S
2.0"	3.0"	40S
3.0"	4.0"	10S
4.0"	6.0"	10S
6.0"	8.0"	10S

Table 2 Minimum Design Loads for PTF Bulges

Deleted, PTF Bulge nozzle loads are located on appropriate PTF Bulge Data Sheet.

Table 3 Minimum Design Loads for LAW Bulges

Deleted, LAW & UFP Bulge nozzle loads are located on appropriate LAW & UFP Bulge Data Sheet

Appendix A - ANSI /AISC N690 Tailoring

Implementing Standards for ANSI/AISC N690, "Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities"

Revision: 1994
Sponsoring Organization: American National Standards Institute/American Institute of Steel Construction
WTP Specific Tailoring

The following tailoring of ANSI/AISC N690 is required for use by the WTP contractor as an Implementing Standard for structural design.

Page 22, Section Q1.5.7.1 Primary Stresses

Revise the stress limit coefficients for compression in Table Q1.5.7.1 as follows:

- 1.3 instead of 1.5 [stated in footnote (c)] in load combinations 2,5, and 6
- 1.4 instead of 1.6 in load combinations 7, 8, and 9
- 1.6 instead of 1.7 in load combination 11

Justification: These changes are made for consistency with the NRC requirements of Appendix F of section 3.8.4 of NUREG-0800 (Draft Rev. 2).

Page 22, Section Q1.5.7.1 Primary Stresses

Delete the following load combinations:

4. D + L + Eo
6. D + L + Ro + To + Eo

Justification: These load combinations are required for evaluation of an Operation Basis Earthquake (OBE). The WTP project has not identified an OBE event.

Appendix B - AISC M016 Tailoring

Implementing Standards for AISC M016, Manual of Steel Construction, Allowable Stress Design (ASD)

Revision: 9th Edition
Sponsoring Organization: American Institute of Steel Construction

WTP Specific Tailoring

The following tailoring of M016 is required for use by the WTP contractor as an implementing standard for design of structural steel for Seismic Category III SSCs.

No specific section

Load combinations for design of structural steel members utilize those identified in UBC 97, section 1612.3.

Justification: These load combinations represent the commercial requirements for allowable stress design of structural steel. Use of these load combinations will ensure compliance with the commercial design in accordance with the UBC.

No specific section

Seismic detailing requirements shall be in accordance with UBC 97, Chapter 22, Division V, section 2214, for moderate seismic risk structures.

Justification: The requirements contained in this section contain accepted industry practice for design of important commercial steel structures. Use of this section will ensure compliance with the commercial design in accordance with the UBC.

Appendix C - ASME B31.3 Tailoring

Implementing Standards for ASME B31.3, "Process Piping"

Revision: 1996
Sponsoring Organization: ASME

WTP Specific Tailoring

The following tailoring of ASME B31.3, *Process Piping*, is required for use by the WTP as an Implementing Standard for: (1) the fabrication and installation of those portions of the C5V ductwork that are being embedded in concrete, (2) the use of ASME B16.9 welding tees in accordance with ASME B31.3-2002, (3) use of vacuum box leak testing, and (4) the ASME B31.3-1998, paragraph 345.2.3(c), allowance for not leak testing closure welds outside of inaccessible areas.

- The tailored sections of ASME B31.3 applicable to welding tees will only be used for ASME B16.9 welding tees. As long as the stress intensification factors from ASME B31.3-2002 are used in the stress analysis for the welding tees, welding tees fabricated to either the 1996 or the 2002 edition of ASME B31.3 can be used. Below is a description of those portions of ASME B31.3, Appendix D, Table D300, that apply to welding tees and the section of the SRD to which they will apply.

Piping providing a confinement function in accordance with SRD 4.2-2 will comply with ASME B31.3-1996, *Process Piping*, with the following modifications:

In Table D300, the description of welding tee per ASME B16.9 Shall be revised so it is consistent with that shown in Table D300 of ASME B31.3-2002

		Stress Intensification Factor [Notes (2), (3)]			
Description	**Flexibility Factor k**	**Out-of-Plane, i_o**	**In-Plane i_I**	**Flexibility Characteristic, h**	**Sketch**
Welded tee per ASME B16.9 [Notes (2), (4), (6), (11), (13)]	1	$\frac{0.9}{h^{2/3}}$	$3/4\ i_o + 1/4$	$3.1\frac{\overline{T}}{r_2}$	Same as ASME B31.3-1996

This means that for welding tees per ASME B16.9, note 11 in Table D300 is also changed to:

(11) If $r_x \geq 1/8 D_b$ and $T_c \geq 1.5\overline{T}$, a flexibility characteristic of $4.4\overline{T}/r_2$ may be used.

Justification: The use of a lower flexibility characteristic for welding tees per ASME B16.9 in accordance with ASME B31.3-2002 will increase both the out-of-plane and in-plane stress intensification factors. The increased stress intensification factors will reduce the allowable out-of-plane and in-plane moments that can be applied to the welding tee and keep the calculated stress below the stress allowable by ASME B31.3-1996

Appendix D - Combined Loadings

D-1 Combined Loadings for ANSI/AISC N690 - Bulge Confinement, Frame Designs, Structural Mounting Components, & Maintenance Platform

Combined Loading (See notes 2, 3, 4 and 8)	Load Application	ANSI/AISC N690 Allowable Stress S_{N690} = *S (See Note 1)
$P_{Normal} + D + L + Noz_{(D)}$	All	S
$P_{Normal} + D + L + R_0 + T_0$	All	S (See note 5)
$P_{Normal} + D + L + R_0 + S_{Bulge} + T_0$ $P_{Abnormal} + D + L + T_a + R_0 + S_{Bulge}$	Load combination also applies except for the design of members in compression and shear, or for bolted connections	1.6S
$P_{Normal} + D + L + R_0 + T_0 + S_{Bulge}$ $P_{Abnormal} + D + L + T_a + R_0$	Load combination also applies for the design of members in compression and shear and for bolted connections.	1.4S
$P_{Abnormal} + D + L + T_a + R_0 + S_{Bulge}$	Load combination applies for the design of members in compression.	1.6S
$P_{Abnormal} + D + L + T_a + R_0 + S_{Bulge}$	Load combination applies for design of members in shear and for design of bolted connections	1.4S

* S is the allowable stress per Allowable Stress Design Method

NOTES:

1) For temperatures above 150 ^{0}F the minimum yield stress, F_y, and F_u shall be reduced by 5% for every 100 ^{0}F increase in temperature above 100 ^{0}F as required by AISC N690, section CQ1.5. Ref: ANSI/AISC N690-1994, section CQ1.5.

   The modulus of elasticity, E, shall be reduced per Equation D-1. Ref: ASCE Manuals and Reports on Engineering Practice No. 78, Structural Fire Protection, Appendix A.1.2.2

2) Where any load reduces the effect of other loads, the corresponding coefficient for that load shall be taken as 0.9 if it can be demonstrated that the load is always present or occurs simultaneously with other loads. Otherwise, the coefficient for that load shall be taken as zero.
3) All load combinations shall be checked for zero live load condition.
4) Pressure load P_{Normal} or $P_{Anormal}$ shall be based on worse case minimum or maximum values.
5) For primary plus secondary stress, the allowable limits are increased by a factor of 1.3 per Appendix A above.
6) In no instance shall the allowable stress exceed $0.7F_u$ in axial tension nor $0.7F_u$ times the ratio Z/S for tension plus bending.
7) Secondary stresses which are used to limit primary stresses shall be treated as primary stresses. Excluded are the nozzle to shell connections.
8) The Combined Loading equations are directly referenced from the *Structural Design Criteria*, 24590-WTP-DC-ST-01-0001.

Equation D-1

$$E_{\text{Re duction}} = \left[1 + \left(\frac{(5/9)x(Temp - 32)}{2000\ L_N\left[\frac{(5/9)x(Temp - 32)}{1100}\right]}\right)\right] x(E)$$

Nomenclature:

L_N = natural logarithm

P_{Normal} = Maximum or Minimum Confinement Pressure for Normal Conditions

$P_{Abnormal}$ = Maximum or Minimum Confinement Pressure for Abnormal Conditions

D = Deadweight
Noz (D) = Piping Nozzle Loads: Deadweight (D) from Vendor and Buyer Piping
L = Live Loads
$\mathbf{R_0}$ = Piping Nozzle Reaction Loads: [Deadweight (D) + Thermal (T) + Seismic (S)] from Vendor and Buyer Piping
$\mathbf{T_0}$ = Thermal Loads during Normal Operating Conditions
$\mathbf{T_a}$ = Thermal Loads during Accident Conditions
$\mathbf{S_{Bulge}}$ = Seismic Bulge Load (24590-WTP-3PS-SS90-T0001 for SC-I/II)

D-2 Combined Loadings for AISC M016 - Bulge Confinement, Frame Designs, Structural Mounting Components, & Maintenance Platform

Combined Loading (see Note 2)	AISC M016 Allowable Stress S_{N690} = *S (see Note 3)
$D + L + Noz_{(D)}$	S
$\pm P_{Normal} + D + L + Noz_{(D)}$	S
$\pm P_{Abnormal} + D + L + Noz_{(D+T)} + (0.714 \times S_{Bulge})$	1.33S

* S is the allowable stress per Allowable Stress Design Method.

NOTES:

1) The buckling formula in section Q1.5.9.1 of the ANSI/AISC N690-1994 code shall apply to AISC M016 for austenitic stainless steel material buckling qualification (e.g.., compression, compression and bending).
2) Pressure load P_{normal} or $P_{abnormal}$ shall be based on worse case minimum or maximum values.
3) For temperatures above 150 ^{0}F the modulus of elasticity, E, and the minimum yield stress, F_y, shall be reduced to the values of Equation 3-1 and Equation 3-2 respectfully. Ref: ASCE Manuals and Reports on Engineering Practice No. 78, Structural Fire Protection, Appendix A.1.2.2.
4) Where any load reduces the effect of other loads, the corresponding coefficient for that load shall be taken as 0.9 if it can be demonstrated that the load is always present or occurs simultaneously with other loads. Otherwise, the coefficient for that load shall be taken as zero

Equation D-1

$$E_{\text{Re duction}} = \left[1 + \left(\frac{(5/9)x(Temp - 32)}{2000\ L_N\left[\frac{(5/9)x(Temp - 32)}{1100}\right]}\right)\right] x(E)$$

Equation D-2

$$F_{y\ \text{Re duction}} = \left[1 + \left(\frac{(5/9)x(Temp - 32)}{900\ L_N\left[\frac{(5/9)x(Temp - 32)}{1750}\right]}\right)\right] x(F_y)$$

Nomenclature:

$\mathbf{L_N}$ = natural logarithm
$\mathbf{P_{Normal}}$ = Maximum or Minimum Confinement Pressure for Normal Conditions
$\mathbf{P_{Abnormal}}$ = Maximum or Minimum Confinement Pressure for Abnormal Conditions
D = Deadweight
L = Live Loads
$\mathbf{Noz_{(D+T)}}$ = Piping Nozzle Loads: [Deadweight (D) + Thermal (T)] from Vendor and Buyer Piping
$\mathbf{S_{Bulge}}$ = Seismic Bulge Load (24590-WTP-3PS-FB01-T0001 for SC-III/IV)

D-3 Combined Loadings for ASME VIII, Div 2, Appendix 4, Nozzle to Confinement Shell Design

Normal Loading	1) Stress Limits Per ASME VIII, Div 2, Appendix 4, Fig. 4-130.1 2) Allowable Stress per ASME VIII, Div 1. (see Note 1) $S_{ASME\ VIII,\ Div\ 1\ @\ Max\ Op\ Temp\ F} = **S$
$P_{Normal} + D + L + Noz_{(D+T)}$	1.5S
$P_{Normal} + D + L + Noz_{(D+T)} + \Delta T$	$*S_{PS} > 3S$ or $2S_y$
Abnormal Loading	1) Stress Limits Per ASME VIII, Div 2, Appendix 4, Fig. 4-130.1 2) Allowable Stress per ASME VIII, Div 1. (see Note 2) $S_{ASME\ VIII,\ Div1\ @\ Max\ Abnormal\ Temp\ F} = **S$
$P_{Abnormal} + D + L + Noz_{(D+T)} + S_{Nozzle} + S_{Bulge}$	$1.5 \times 1.2S = 1.8S$
$P_{Abnormal} + D + L + Noz_{(D+T)} + S_{Nozzle} + S_{Bulge} + \Delta T$	$*S_{PS} > 3S$ or $2S_y$

* Allowable yield stress S_y shall be per ASME II, Part D, Table Y-1.

** Allowable stress S shall be per ASME VIII, Div 1 as specified in ASME II, Part D, Table 1A as follows:
Where two stress values are specified for the same material and related to deformation governed by a footnote:

- Use the higher stress value for abnormal conditions
- Use the lower stress value for normal conditions

NOTES:

1) Primary membrane stress shall be 1S for normal conditions and 1.2S for abnormal conditions.
2) If applicable, peak stresses shall be evaluated per the stress limits and allowables of ASME VIII, Div 2, Appendix 4, Figure 4-130.1.

Nomenclature:

P_{Normal} = Maximum or Minimum Confinement Pressure for Normal Conditions

$P_{Abnormal}$ = Maximum or Minimum Confinement Pressure for Abnormal Conditions

D = Deadweight

L = Live Loads

$Noz_{(D+T)}$ = Piping Nozzle Loads: [Deadweight (D) + Thermal (T)] from Vendor and Buyer Piping

S_{Nozzle} = Piping Nozzle Loads: Seismic (S) from Vendor and Buyer Piping

S_{Bulge} = Seismic Bulge Load (24590-WTP-3PS-SS90-T0001 for SC-I/II or 24590-WTP-3PS-FB01-T0001 for SC-III/IV)

ΔT = Minimum Shell to Maximum Pipe Differential Temperature: [(Pipe Nozzle Operating Temp) − (59^0F)]