U.S. Department of Energy
Office of River Protection
Mr. R. J. Schepens
Manager
P.O. Box 450, MSIN H6-60
Richland, Washington 99352

CCN: 048876

FEB 13 2003

Dear Mr. Schepens:

CONTRACT NO. DE-AC27-01RV14136 – TRANSMITTAL FOR APPROVAL: AUTHORIZATION BASIS AMENDMENT REQUEST 24590-WTP-ABAR-ENS-02-005, REVISION 0, *SEISMIC DESIGN OF PRESSURE VESSELS*

References: 1) CCN 050182, Letter, R. J. Schepens, ORP, to R. F. Naventi, BNI, "Response to Findings of Safety Requirements Document Design Standards Implementation Inspection Report, IR-02-012," 03-OSR-0008, dated January 15, 2003.

2) CCN 038772, Letter, A. R. Veirup, BNI, to M. K. Barrett, ORP, "Closeout Comment/Responses on Balance of Facilities, High Level Waste, Low Activity Waste, and Pretreatment Construction Authorization Requests," dated September 3, 2002.

Bechtel National, Inc. (BNI) is submitting the attached Authorization Basis Amendment Request (ABAR) 24560-WTP-ABAR-ENS-02-005, Revision 0, to the U.S. Department of Energy's, (DOE) Office of River Protection, and the Safety Regulation Division (OSR) for review and approval. The ABAR proposes to (1) revise Safety Requirements Document (SRD) Safety Criteria 4.2-3, (2) add an Ad Hoc Standard to the SRD, and (3) add Section 2.4.11 to the Preliminary Safety Analysis Report to Support Partial Construction Authorization; Volume I (General Information), to clarify how the project vessels are seismically analyzed.

The seismic design of High Level Waste vessels addresses one of the corrective actions for DOE inspection finding IR-02-012-01a-FIN (Reference 1) and is in the response to OSR question HLW-PSAR-163 (Reference 2). This ABAR proposes to use ASME Section III to perform seismic analysis of ASME Section VIII vessels, and use acceptance criteria consistent with ASME Section VIII.

Approval of this ABAR is requested by March 7, 2003.

An electronic copy of ABAR 24590-WTP-ABAR-ESH-02-005, Revision 0, is provided for OSR's information and use.

Please contact Mr. Bill Spezialetti at (509) 371-3074 for any questions or comments.

Very truly yours,

for R. F. Naventi
Project Director

TR/slr

Attachment: Authorization Basis Amendment Request 24590-WTP-ABAR-ENS-02-005, Revision 0, plus attachments

cc:

Allen, B. T. w/o	WTP	MS4-B1
Barr, R. C. w/a (1 hard copy and 1 electronic copy)	OSR	H6-60
Barrett, M. K. w/o	ORP	H6-60
Beranek, F. w/a	WTP	MS4-A1
Betts, J. P. w/o	WTP	MS14-3C
Dickey, R. L. w/a	WTP	MS4-B1
DOE Correspondence Control w/a	ORP	H6-60
Duncan, G. M. w/o	WTP	MS4-D2
Ensign, K. R. w/o	ORP	H6-60
Erickson, L. w/o	ORP	H6-60
Gibson, K. D. w/a	WTP	MS4-B1
Hamel, W. F. w/o	ORP	H6-60
Hanson, A. J. w/o	ORP	H6-60
Klein, D. A. w/o	WTP	MS4-A1
Lorenz, B. D. w/a	WTP	MS4-B1
Naventi, R. F. w/o	WTP	MS14-3C
PDC w/a	WTP	MS11-B
Platt, M. A. w/o	WTP	MS4-B1
QA Project Files w/a	WTP	MS14-4B
Ryan, T. B. w/a	WTP	MS4-B1
Spezialetti, W. R. w/o	WTP	MS4-B1
Taylor, W. J. w/a	ORP	H6-60
Vail, S. W. w/a	WTP	MS4-B2
Veirup, A. R. w/o	WTP	MS14-3B

Authorization Basis Amendment Request

ABAR Number 24590-WTP-ABAR-ENS-02-005 Revision 0

ABAR Title Seismic Design of Pressure Vessels

I. ABAR Review and Approval Signatures

A. ABAR Preparation

	Print/Type Name	Signature	Date
Preparer:	Steve Vail	[signature]	02/04/03
Reviewer:	Cliff Slater	[signature]	2/4/03

B. Required Technical Reviewers

For each person checked, that signature block must be completed.

Review Required?	Organization	Print / Type Name	Signature	Date
☒	E&NS Manager	Fred Beranek	[signature]	2/5/03
☒	QA Manager	George Shell	[signature] Gregg T. Warner for GT Shell	2/5/03
☐	Operations Manager			
☐	Commissioning/Training Manager			
☒	Manager of Engineering	Rich Tosetti	[signature] /RT	2/5/03
☐	Construction Manager			
☐	Area Project Manager			
☒	AB Document Custodian	Ken Gibson/ Lee Dougherty	K.D. Gibson Lee Dougherty	2/4/03 2/4/03
☒	PMT Chair	Dennis Klein	[signature]	2/5/03

Other Affected Organizations	Print / Type Name	Signature	Date
N/A if None	N/A		

C. ABAR Approval

	Print/Type Name	Signature	Date
PSC Chair	Bill Poulson	[signature]	2/5/03
WTP Project Director	Ron Naventi	[signature] for	2/12/03

ABAR Number 24590-WTP-ABAR-ENS-02-005 Revision 0

ABAR Title Seismic Design of Pressure Vessels

II. Description of the Proposed Change to the Authorization Basis

D. Affected Authorization Basis Documents:

Title	Document Number	Revision
Safety Requirements Document – Volume 2	24590-WTP-SRD-ESH-01-001-02	2a
Preliminary Safety Analysis Report to Support Construction Authorization; General Information	24590-WTP-PSAR-ESH-01-002-01	0

Decision to Deviate: ☐ Yes ☒ No

If yes, DTD Number/Revision:

Initiating Document Number/Revision

E. Describe the proposed changes to the Authorization Basis documents:

Provide the details to describe the use of *ASME Boiler and Pressure Vessel Code*, Section III, Division 1, Subsection NC, Subsection NF, Appendix N, and Appendix F as supplemental guidance for seismic design of ASME *Boiler and Pressure Vessel Code*, Section VIII.

Impacts to the schedule and cost are not expected upon DOE acceptance of this ABAR. The seismic analysis of the vessels is currently on hold since the specification describing the seismic analysis is incomplete and reflects the previous ASME Section III evaluation and acceptance criteria. This ABAR affects all SC-I vessels, all SC-II vessels, and SC-III vessels that contain significant chemical inventories.

A specialized ISM Team was confirmed by the Process Management Team (PMT) on 11/06/02. Project Procedure, 24590-WTP-GPP-SANA-002, *Hazard Analysis, Development of Hazard Control Strategies, and Identification of Standards,* Section 3.10, "Identification of Standards", states: "Identification of other standards (e.g., standards for quality assurance, conduct of operations, etc.) will be performed by specially constituted teams formed by the PMT in support of the PSAR." The ISM Team for the selection of this standard utilized knowledgeable individuals from Engineering and Commissioning & Training disciplines who were currently on the List of Qualified Individuals (LQI). The ISM Meeting was held on 12/12/02 and the meeting minutes are documented in CCN 049899

F. List associated ABARs and AB documents, if any:

24590-WTP-ABCN-ESH-02-019, Rev. 0, *Deletion of Requirement to Use Target Frequency and Revision to SC 4.1-3 and 4.1-4*

G. Explain why the change is needed:

The SRD specifies *ASME Boiler and Pressure Vessel Code*, Section VIII as an implementing code for design of pressure vessels. ASME Section VIII allows the use of supplemental details which are as safe as those required by the code. ASME Section VIII requires that the loadings to be considered in designing a vessel shall include those from seismic reactions where required. However, no design rules are provided in ASME Section VIII to establish the earthquake loads or to perform the seismic analysis of vessels. Therefore ASME Section III, Appendix N, Section NC, is adopted for SC-I, SC-II, and SC-III

Authorization Basis Amendment Request

ABAR Number 24590-WTP-ABAR-ENS-02-005 Revision 0

ABAR Title Seismic Design of Pressure Vessels

G. Explain why the change is needed:

vessels. ASME Section VIII requires that for the combination of earthquake loading with other loadings, the wall thickness of a vessel shall be determined such that the general membrane stress shall not exceed 1.2 times the maximum allowable stress values used for normal loadings. These allowable stresses will be applied to the vessel, vessel skirts, and vessel supports provided with the vessel. Details regarding the use of ASME Section III are provided in the SRD and PSAR to clarify the use of ASME Section III for seismic analysis of ASME Section VIII vessels.

H. List the implementing activities and the projected completion dates:

Activity	**Date**
Inform DOE that AB has been revised and formally transmit electronic version	30 days or less after DOE approval
Distribute revised controlled copy pages / update WTP Library	30 days after DOE approval

Revise the following implementing documents:

Documents	**Describe extent of revisions**	**Date**
1		
2		

Describe other activities:	**Date**
1	
2	

I. Certification of Continued SRD Adequacy:

If this ABAR involves the deletion or modification of a standard previously identified or established in the SRD, Project Director certification is required. The Project Director's signature certifies that the revised SRD continues to identify a set of standards that provides adequate safety, complies with WTP applicable laws and regulations, and conforms with top-level safety standards and principles. This certification is based on adherence to the DOE/RL-96-0004 standards identification process and successful completion of review and confirmation by the PSC.

WTP Project Director Ron Naventi [signature] for 2/12/03

Print/Type Name *Signature* *Date*

J. Associated Safety Evaluation(s):

Safety Evaluation No.(s): 24590-WTP-SE-ENS-03-020 Rev(s): 0

ABAR Number 24590-WTP-ABAR-ENS-02-005 Revision 0

ABAR Title Seismic Design of Pressure Vessels

K. Attachments:

Attachemnt 1 - Proposed Changes to Safety Requirements Document Volume II
Attachment 2 - Proposed Changes to Preliminary Safety Analysis Report to Support Construction Authorization, General Information
Attahcment 3 - ASME Section III Seismic Design of Vessel Justification
Attachment 4 - Safety Evaluation 24590-WTP-SE-ENS-03-020

4.2 Confinement Design

Safety Criterion: 4.2 - 1

The facility shall be designed to retain the radioactive and hazardous material through a conservatively designed confinement system for normal operations, anticipated operational occurrences, and accident conditions. The confinement system shall protect the worker and public from undue risk of releases such that the radiological and chemical exposure standards of Safety Criteria 2.0-1 and/or 2.0-2 are not exceeded.

Implementing Codes and Standards

24590-WTP-SRD-ESH-01-001-02, *Safety Requirements Document Volume II*
Appendix A, "Implementing Standard for Safety Standards and Requirements Identification"
Appendix B, "Implementing Standard for Defense in Depth"
DOE IG, *Implementation Guide for Nonreactor Nuclear Safety Design Criteria and Explosive Safety Criteria* Section 2.3
DOE Order 420.1, *Facility Safety,* Section 4.1.1.2

Regulatory Basis

DOE/RL-96-0006 *4.1.1.4 Defense in Depth-Mitigation*

Safety Criterion: 4.2 - 2

Important to Safety liquid and gaseous systems and components, including pressure vessels, tanks, heat exchangers, piping, and valves, shall be designed to retain their hazardous inventory such that the radiological and chemical worker or public exposure standards of Safety Criteria 2.0-1 and/or 2.0-2 are not exceeded.

Implementing Codes and Standards

ASME B31.3-96, *Process Piping*
ASME SEC VIII, "Boiler and Pressure Vessel Codes, Rules for Construction of Pressure Vessels"
24590-WTP-SRD-ESH-01-001-02, *Safety Requirements Document Volume II*
Appendix A, "Implementing Standard for Safety Standards and Requirements Identification"

Safety Criterion: 4.2 - 3

Codes and standards for Important to Safety vessels and piping should be supplemented by additional measures (such as erosion/corrosion programs and piping in-service inspections and seismic design and analysis) to mitigate conditions arising that could lead to a release of radiological or chemical material that would exceed the worker or public exposure standards of Safety Criteria 2.0-1 and/or 2.0-2.

Implementing Codes and Standards

ASME SEC III; "Boiler and Pressure Vessel Code, Rules for Construction of Nuclear Facility Components;" NC, NF, APP N, and APP F (for seismic design and analysis only as indicated in Appendix *, "Ad Hoc Implementing Standard for Seismic Design of Pressure Vessels")
24590-WTP-SRD-ESH-01-001-02, *Safety Requirements Document Volume II*
Appendix A, "Implementing Standard for Safety Standards and Requirements Identification"
Appendix E, "Reliability, Availability, Maintainability, and Inspectability (RAMI)"

Appendix H, "Ad Hoc Implementing Standard for Erosion/Corrosion and Assessments"
Appendix *, "Ad Hoc Implementing Standard for Seismic Design of Pressure Vessels"

Regulatory Basis

DOE/RL-96-0006 *4.2.2.4 Proven Engineering Practices/Margins-Codes and Standards*

Safety Criterion: 4.2 - 4

Liquid and gaseous storage systems designated as Important to Safety shall have continuous monitoring to detect the loss or degradation of their safe storage function. As appropriate the following shall be monitored:

1. temperature; pressure; radioactivity in ventilation exhaust and liquid effluent streams
2. liquid levels
3. tank chemistry; condensate and cooling water
4. generation of flammable and explosive mixtures of gases

Implementing Codes and Standards

ANSI N42.18-1980 (Rev 1991), *Specification and Performance of On-Site Instrumentation for Continuously Monitoring Radioactivity in Effluents* [SDC or SDS]
ISA S12.13 PT 1-95, Performance Requirements, Combustible Gas Detectors [SDC or SDS]
ISA S84.01-1996, *Application of Safety Instrumented Systems for the Process Industries* [SDC or SDS]
24590-WTP-SRD-ESH-01-001-02, *Safety Requirements Document Volume II*
Appendix A, "Implementing Standard for Safety Standards and Requirements Identification" [RRC]

Appendix *

Ad Hoc Implementing Standard for Seismic Design of Pressure Vessels

1 Design Codes and Requirements

The pressure vessel design code for WTP is *ASME Boiler and Pressure Vessel Code*, Section VIII, "Rules for Construction of Pressure Vessels". However, the WTP is also required to meet the DOE seismic requirements specified in DOE-STD-1020-94, *Natural Phenomena Hazards and Evaluation for Department of Energy Facilities* as this standard is tailored for the WTP in Appendix C. ASME Section VIII requires that the loadings to be considered in designing a vessel shall include those from seismic reactions where required. However, no design rules are provided in ASME Section VIII to establish the earthquake loads or to perform the seismic analysis of vessels. Therefore *ASME Boiler and Pressure Vessel Code,* Section III, "Rules for Construction of Nuclear Facility Components," Appendix N, Section NC, is adopted for SC-I and SC-II vessels, and SC-III vessels containing a significant chemical inventory. ASME Section VIII requires that for the combination of earthquake loading with other loadings, the wall thickness of a vessel computed by these rules shall be determined such that the general membrane stress shall not exceed 1.2 times the maximum allowable stress values used for normal loadings. These allowable stresses will be applied to the vessel, vessel skirts, and vessel supports provided with the vessel.

In compliance with seismic requirements as specified in DOE-STD-1020-94, the response spectrum or UBC static loads are applied and the ASME Section III methodology is used for the seismic analysis of the pressure vessels.

ASME Section VIII, Division 1, provides the basic design principles and formulas for the design of pressure vessels. ASME Section VIII contains mandatory guidance for pressure vessel materials, design, fabrication, examination, inspection, testing, certification, and pressure relief. ASME Section VIII requires that seismic reactions be considered in designing a vessel. However, it does not specify how seismic loads are to be considered. It does not contain rules to cover all details of design and construction. Where complete details are not given, it is intended that the designer shall provide details of design and construction that will be as safe as those provided by the rules of the ASME Section VIII. Therefore, the following codes are adopted to supplement the design rules of ASME Section VIII in the area of seismic design, subject to the restrictions imposed by this code:

- ASME Section III, "Rules for Construction of Nuclear Components"
- Uniform Building Code

The embedded supports for the vessels and the studs and nuts securing the vessels to the embeds are designed in accordance with ANSI/AISC N690-94, *Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities.*

2 Load Combinations and Acceptance Criteria for Pressure Vessels and Integral Supports

According to ASME Section VIII, in addition to loadings caused by internal or external design pressure, weight of the vessel and normal contents under operating or test conditions, superimposed static reactions, attachments, cyclic and dynamic reactions, impact reactions, temperature gradients and thermal expansions, and abnormal pressures, the pressure vessel must be design for loads caused by wind, snow, and seismic reactions. Earthquake loading and wind loading need not be considered to act simultaneously.

For SC- I and SC-II pressure vessels, the response spectra method of seismic loading shall be used. For SC-III pressure vessels, the UBC static method of seismic loading shall be used.

4.2 Maximum Allowable Tensile Stress

The maximum allowable tensile stress values for different materials of construction of ASME Section VIII, Division 1 vessels shall be those specified in ASME Section II, Part D, and Subpart 1.

4.2 Maximum Allowable Longitudinal Compressive Stress

The maximum allowable longitudinal compressive stress used in the vessel design shall meet the requirements of paragraph UG-23 (b) of the ASME Section VIII, Division 1.

4.2 Maximum General Primary Membrane Stress

The wall thickness of a vessel shall be determined such that for any combination of loadings listed in paragraph UG-22 of ASME Section VIII, Division 1 that induce primary stresses and are expected to occur simultaneously during normal operation of the vessel, the induced maximum general primary membrane stress does not exceed the maximum allowable stress in tension.

4.2 Combined Primary Membrane Plus Primary Bending Stress

The combination of loads shall not induce a combined maximum primary membrane stress plus primary bending stress across the vessel wall thickness, which exceeds 1.5 times the maximum allowable stress value in tension.

4.2 Combination of Seismic Loadings with Other Loadings

For the combination of seismic loading with other loadings per UG-22, the wall thickness of a vessel shall be determined such that the general primary membrane stress shall not exceed 1.2 times the permitted maximum allowable stress specified in Sections 2.1, 2.2, 2.3, or 2.4 above. Seismic loading and wind loading need not be considered to act simultaneously.

4.2 Seismic Analysis for Design of Pressure Vessels and Integral Supports

ASME Section VIII requires the pressure vessel to be designed for earthquake loads and to meet the design criteria specified in the code. However, no design rules are provided in ASME Section VIII to establish earthquake loads and to perform the seismic analysis of pressure vessels. Therefore, ASME Section III, Subsection NC, Subsection NF, and Appendix F, Appendix N, and the UBC are adopted for the seismic analysis of WTP pressure vessels.

ASME Section III, Appendix N, provides Dynamic Analysis Methods, and details of seismic analysis. ASME Section III does not require dynamic analysis. However, the design of nuclear components requires consideration of the seismic and other dynamic inputs, which are defined in the Design Specifications for the component. Component design may be based on the use of static forces resulting from equivalent earthquake acceleration acting at the centers of gravity of the extended masses, or a dynamic system analysis may be used to show how seismic loading is transmitted from the defined ground motions to all parts of the buildings, structures, equipment, and components. N-1100 through N-1200 of Appendix N are presented to illustrate one or more acceptable steps for seismic dynamic analysis. It is not intended that these steps are the only acceptable ones, since the seismic dynamic analysis involves a series of steps, and some of these steps have acceptable alternative methods. Dynamic analysis in general uses techniques, which are illustrated in seismic analysis.

4.2 Acceptance Criteria for Structural Ring Supports and Securing Studs and Nuts

The structural ring supports and studs and nuts securing the vessels to the structural ring supports shall be designed in accordance with ANSI/AISC N690-94, *Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities.* ANSI/AISC N690-94 states that for the extreme load condition due to the design basis earthquake, the normal stresses allowables may be increased by a factor of 1.6.

3 Seismic Technique for Pressure Vessels

The method of analysis used by the pressure vessel vendor to evaluate the seismic loads in the pressure vessel shall be as follows:

- SC-I ASME Section III, Division 1, Subsections NC-3200 and NC-3300
- SC-II ASME Section III, Division 1, Appendix F
- SC-III ASME Section III, Division 1, Appendix F

The method of analysis used by the pressure vessel vendor to evaluate the seismic loads in the pressure vessel supports supplied as part of the vessel shall be as follows:

- SC-I ASME Section III, Division 1, Subsections NF,

- SC-II ASME Section III, Division 1, Subsections NF
- SC-III ASME Section III, Division 1, Appendix F

The stresses in the vessels and supports shall not exceed those specified in paragraph 2 above.

2 Facility Description

Contents

2.4.10.3 Computer Software

The Bechtel Pipe Support Family of Programs (PCFAPPS), also known as ME150 Family of Pipe Support Programs, consists of the following programs along with their functions:

- FAPPS (ME150) - Frame Analysis Program for Pipe Supports is an interactive frame analysis program specifically developed for the analysis and design of pipe support frames, associated welds, base plates, embedments, and local effects such as punching shear, web crippling and local flange bending. The program performs code check for AISC, ASME2001, Section III, Subsection NF and AIJ codes for normal, upset, emergency and faulted load conditions.
- BASE PLATE (ME035) - Nonlinear Base Plate Analysis Program is intended for analyzing/designing base plate of pipe supports. ME035 is a combination of pre-processor, SAP, and post-processor. It has the capacity of analyzing flexible base plates on a geometrically nonlinear foundation.
- MAPPS (ME153) - Miscellaneous Application Program for Pipe Supports performs various pipe support related analyses using project unique criteria files. The analytical modules are Non-Uniform Weld Analysis, Non-Standard Clamp Analysis, Plate Anchor Analysis, Clip Angle Analysis, Bolt Spacing Analysis, Local Effect Evaluation, Beta Angle Check, Uniform Weld Analysis, 4Bolt Program, ME035 Pre-processor, and Loading Transformation.
- SMAPPS (ME152) - Standard Frame Analysis Program for Pipe Supports analyzes and designs commonly used standard frames for pipe supports, including associated welds and base plates with anchors for AISC, ASME Section III, Subsection NF requirements and project deflection/stiffness requirements.
- SIGNIT (ME149) - Signature Ready Engineered Calculation System for Pipe Support generates "signature-ready" calculations for pipe supports. It integrates necessary program outputs; develops the necessary portions of the calculations such as objective, methodology, conclusions, summary of results (margin factors), check list, assumptions, and sources of data and references; and organizes the calculation package.

PCFAPPS for the WTP was verified or installation tested by running test cases supplied on each computer and comparing the results to the real values. PCFAPPS for the WTP was validated through test problem comparison of the PCFAPPS. PCFAPPS for pipe support design has been validated previously by Bechtel Corporation; this validation is referenced in the WTP validation and verification report for PCFAPPS.

SIGNIT was not verified or validated, because it is a report writer code.

2.4.11 Vessel Seismic Design

2.4.11.1 Design Codes and Requirements

The pressure vessel design code for WTP is *ASME Boiler and Pressure Vessel Code*, Section VIII, "Rules for Construction of Pressure Vessels". However, the WTP is also required to meet the DOE seismic requirements specified in DOE-STD-1020-94, *Natural Phenomena Hazards and Evaluation for Department of Energy Facilities* as this standard is tailored for the WTP in Appendix C. ASME Section VIII requires that the loadings to be considered in designing a vessel shall include those from seismic reactions where required. However, no design rules are provided in ASME Section VIII to establish the earthquake loads or to perform the seismic analysis of vessels. Therefore *ASME Boiler and Pressure Vessel Code,* Section III, "Rules for Construction of Nuclear Facility Components," Appendix N, Section NC, is adopted for SC-I and SC-II vessels, and SC-III vessels containing a significant chemical inventory. ASME Section VIII requires that for the combination of earthquake loading with other loadings, the wall thickness of a vessel computed by these rules shall be determined such that the general membrane stress shall not exceed 1.2 times the maximum allowable stress values used for normal loadings. These allowable stresses will be applied to the vessel, vessel skirts, and vessel supports provided with the vessel.

In compliance with seismic requirements as specified in DOE-STD-1020-94, the response spectrum or UBC static loads are applied and the ASME Section III methodology is used for the seismic analysis of the pressure vessels.

ASME Section VIII, Division 1, provides the basic design principles and formulas for the design of pressure vessels. ASME Section VIII contains mandatory guidance for pressure vessel materials, design, fabrication, examination, inspection, testing, certification, and pressure relief. ASME Section VIII requires that seismic reactions be considered in designing a vessel. However, it does not specify how seismic loads are to be considered. It does not contain rules to cover all details of design and construction. Where complete details are not given, it is intended that the designer shall provide details of design and construction which will be as safe as those provided by the rules of the ASME Section VIII. Therefore, the following codes are adopted to supplement the design rules of ASME Section VIII in the area of seismic design, subject to the restrictions imposed by this code:

- ASME Section III, "Rules for Construction of Nuclear Components"
- Uniform Building Code

The embedded supports for the vessels and the studs and nuts securing the vessels to the embeds are designed in accordance with ANSI/AISC N690-94, *Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities.*

2.4.11.2 Load Combinations and Acceptance Criteria for Pressure Vessels and Integral Supports

According to ASME Section VIII, in addition to loadings caused by internal or external design pressure, weight of the vessel and normal contents under operating or test conditions, superimposed static reactions, attachments, cyclic and dynamic reactions, impact reactions, temperature gradients and thermal expansions, and abnormal pressures, the pressure vessel must be design for loads caused by wind, snow, and seismic reactions. Earthquake loading and wind loading need not be considered to act simultaneously.

For SC- I and SC-II pressure vessels, the response spectra method of seismic loading shall be used. For SC-III pressure vessels, the UBC static method of seismic loading shall be used.

2.4.11.2.1 Maximum Allowable Tensile Stress

The maximum allowable tensile stress values for different materials of construction of ASME Section VIII, Division 1 vessels shall be those specified in ASME Section II, Part D, and Subpart 1.

2.4.11.2.2 Maximum Allowable Longitudinal Compressive Stress

The maximum allowable longitudinal compressive stress used in the vessel design shall meet the requirements of paragraph UG-23 (b) of the ASME Section VIII, Division 1.

2.4.11.2.3 Maximum General Primary Membrane Stress

The wall thickness of a vessel shall be determined such that for any combination of loadings listed in paragraph UG-22 of ASME Section VIII, Division 1 that induce primary stresses and are expected to occur simultaneously during normal operation of the vessel, the induced maximum general primary membrane stress does not exceed the maximum allowable stress in tension.

2.4.11.2.4 Combined Primary Membrane Plus Primary Bending Stress

The combination of loads shall not induce a combined maximum primary membrane stress plus primary bending stress across the vessel wall thickness, which exceeds 1.5 times the maximum allowable stress value in tension.

2.4.11.2.5 Combination of Seismic Loadings with Other Loadings

For the combination of seismic loading with other loadings per UG-22, the wall thickness of a vessel shall be determined such that the general primary membrane stress shall not exceed 1.2 times the permitted maximum allowable stress specified in Sections 2.4.11.2.1, 2.4.11.2.2, 2.4.11.2.3, or 2.4.11.2.4 above. Seismic loading and wind loading need not be considered to act simultaneously.

2.4.11.2.6 Seismic Analysis for Design of Pressure Vessels and Integral Supports

ASME Section VIII requires the pressure vessel to be designed for earthquake loads and to meet the design criteria specified in the code. However, no design rules are provided in ASME Section VIII to establish earthquake loads and to perform the seismic analysis of pressure vessels. Therefore, ASME Section III, Subsection NC, Subsection NF, and Appendix F, Appendix N, and the UCB are adopted for the seismic analysis of WTP pressure vessels.

ASME Section III, Appendix N, provides Dynamic Analysis Methods, and details of seismic analysis. ASME Section III does not require dynamic analysis. However, the design of nuclear components requires consideration of the seismic and other dynamic inputs which are defined in the Design Specifications for the component. Component design may be based on the use of static forces resulting from equivalent earthquake acceleration acting at the centers of gravity of the extended masses, or a dynamic system analysis may be used to show how seismic loading is transmitted from the defined ground motions to all parts of the buildings, structures, equipment, and components. N-1100 through N-1200 of this Appendix are presented to illustrate one or more acceptable steps for seismic dynamic analysis. It is not intended that these steps are the only acceptable ones, since the seismic dynamic analysis involves a series of steps, and some of these steps have acceptable alternative methods. Dynamic analysis in general uses techniques which are illustrated in seismic analysis.

2.4.11.2.7 Acceptance Criteria for Structural Ring Supports and Securing Studs and Nuts

The structural ring supports and studs and nuts securing the vessels to the structural ring supports shall be designed in accordance with ANSI/AISC N690-94, *Specification for the Design, Fabrication, and*

Erection of Steel Safety-Related Structures for Nuclear Facilities. ANSI/AISC N690-94 states that for the extreme load condition due to the design basis earthquake, the normal stresses allowables may be increased by a factor of 1.6.

2.4.11.3 Seismic Technique for Pressure Vessels

The method of analysis used by the pressure vessel vendor to evaluate the seismic loads in the pressure vessel shall be as follows:

- SC-I ASME Section III, Division 1, Subsections NC-3200 and NC-3300
- SC-II ASME Section III, Division 1, Appendix F
- SC-III ASME Section III, Division 1, Appendix F

The method of analysis used by the pressure vessel vendor to evaluate the seismic loads in the pressure vessel supports shall be as follows:

- SC-I ASME Section III, Division 1, Subsections NF
- SC-II ASME Section III, Division 1, Subsections NF
- SC-III ASME Section III, Division 1, Appendix F

The stresses in the vessels and supports shall not exceed the those specified in paragraph 2 above.

2.5 Process Description

The WTP will pretreat mixed radioactive waste and immobilize the waste in a glass matrix using a vitrification process, as shown in Figure 2-2.

The PT Facility will receive combined HLW and LAW waste feeds dewatered in evaporators and the Sr/TRU solids precipitated before being routed to the ultrafiltration complex. During ultrafiltration the solids will be separated with the liquid. Cs and Tc will then be removed from the liquor. The waste will be concentrated before transfer to the LAW vitrification facility. The waste feed will be blended with glass-forming materials at the LAW facility, and vitrified in the melter. System design to accommodate storage of 1.5 million US gallons of LAW feed, ability to receive low-activity waste and high-level waste transfers separately from tank farms and ability to provide 60 days HLW feed capability are under consideration.

The radioactive solids from ultrafiltration will be blended with Cs, Tc, and possibly other concentrated radioactive streams before transfer to the HLW vitrification facility. The waste feed will be blended with glass forming materials at the HLW facility and the resultant mixture will then be fed to the melters.

Two vitrification processes will be used: the LAW vitrification facility produces immobilized low-activity waste (ILAW) and the HLW vitrification facility produces immobilized high-level waste (IHLW). Both types of immobilized waste will take the form of glass encased in stainless steel containers (ILAW) and canisters (HLAW). The containers/canisters will be temporarily stored at the WTP, then transferred to another permitted facility following DOE acceptance of the ILAW container or IHLW canister.

1 Purpose

The *Safety Requirements Document* (SRD) identifies *ASME Boiler and Pressure Vessel Code*, Section VIII, as the code used to design important to safety (ITS) vessels. ASME Section VIII does not provide explicit rules for seismic design but allows the engineer to make a selection of an appropriate set of rules from another code if design for seismic loads is necessary. Consistent with this, pertinent sections of the *ASME Boiler and Pressure Vessel Code*, Section III, "Rules for Construction of Nuclear Facility Components," were chosen for this part of the design. The purpose of this document is to justify the use of ASME Section III methodology for determining the seismic loads on River Protection Project-Waste Treatment and Immobilization Plant (WTP) facility vessels, the failure of which could cause the radiological and chemical worker or public exposure standards of Safety Requirements Document (SRD) Safety Criteria 2.0-1 and/or 2.0-2 to be exceeded. The seismic design of SC-IV, and SC-V vessels are not included since failure of these systems will not cause the exposure standards to be exceeded.

2 Background

The WTP facility processes and stores radioactive and hazardous materials. Consequently it is necessary to ensure that the facility can provide adequate level of safety to facility and co-located workers and the public. To achieve this objective, the facility is required to be designed to withstand the effects of natural phenomena hazards, such as earthquakes, without significant damage or loss of safety function.

The seismic design includes dynamic as well as static analyses. The dynamic analysis covers development of design response spectra for the Design Basis Earthquake (DBE) and associated input time histories, soil-structure interaction modeling and analysis, and generation of seismic loads and in-structure response spectra. The static analysis criteria cover computation of seismic loads using static force procedures. The design criteria meet the seismic design requirements of DOE-STD-1020-94, *Natural Phenomena Hazards - Design and Evaluation Criteria for Department of Energy Facilities*, as modified by RPT-W375-RU-00003, *Applicability of DOE Documents to the Design of TWRS-P Facility for Natural Phenomena Hazards.*

3 Seismic Categorization of Structures, Systems and Components

The WTP structures, systems, and components (SSCs) are categorized as Seismic Category I, II, III, IV, and V, in accordance with their safety function. These safety functions are determined by the hazard evaluation process described in SRD, Appendix A, "Implementing Standards for Safety Standards and Requirements Identification" through the ISM process and by engineering analyses. Definition of the seismic categories are as follows:

<u>Seismic Category I (SC-II)</u>

SSCs that are designated Safety Design Class (SDC) (excepting those so designated based solely on chemical hazards) and that are required to perform a safety function as a result of a given NPH shall be designed to withstand the NPH loadings of that NPH as provided in SRD Table 4-1. These SSCs are designated Seismic Category I (SC-I) for earthquakes and Performance Category 3 (PC-3) for other NPH.

Seismic Category II (SC-II)

SSCs that are designated Safety Design Significant (SDS) (excepting those so designated based solely on chemical hazards) whose continued function is not required for an NPH event, but whose failure as a result of an NPH event could reduce the functioning of a Safety Design Class SSC such that exposure standards might be exceeded, shall be designed to withstand the NPH loadings of that NPH as provided in SRD Table 4-1. For these SSCs, however, for seismic response only, **credit may be taken for inelastic energy absorption** per Table 2-4 of DOE-STD-1020-94. These SSCs are designated SC-II for earthquakes and PC-3 for other NPH.

Seismic Category III (SC-III)

SSCs included under items 1, 2, or 3 below are designated Seismic Category III (SC-III) for earthquakes and Performance Category 2 (PC-2) for other NPH, and shall be designed to withstand the NPH loadings as provided in SRD Table 4-2.

1 Safety Design Class (SDC) and Safety Design Significant (SDS) SSCs that do not have an NPH safety function,
2 SSCs that have a seismic safety function solely because they protect workers and members of the public from exposure to chemical hazards, and
3 Risk Reduction Class (RRC) SSCs that provide primary confinement of significant inventories of radioactive materials but in amounts less than quantities that require an SDC or SDS designation.

Seismic Category IV (SC-IV)

RRC SSCs that have been designated as RRC do not provide primary confinement of significant inventories of radioactive materials. SSCs designated as RRC that do not provide primary confinement of significant inventories of radioactive materials shall be designated Seismic Category IV (SC-IV) for earthquakes and Performance Category 1 (PC-1) for other NPH, in accordance with the PC-1 requirements of DOE-STD-1020-94.

Seismic Category V (SC-V)

SSC not important to safety and without any seismic design requirements. These components are designated Seismic Category V (SC-V) for earthquake and Performance Category 0 (PC-0) for other NPH.

4 Design Basis Earthquake

4.1 Definition of the Design Basis Earthquake

Project document RPT-W375-RU00002, Rev. 2, *TWRS-P Facility Design Basis Earthquake-Peak Acceleration, Seismic Response Spectra, and Seismic Design Approach,* establishes the DBE peak ground acceleration (PGA) for the WTP site based on PC-3 categorization of the Facility and consequent return period of 2000 years per Table 2-1 of DOE-STD-1020-94. The PGA is based on the mean seismic hazard curve for the 200-East Area of the Hanford Site corresponding to the 2000-year return period with a horizontal PGA of 0.24 g for SC-I and SC-II facilities. Although this value is appropriate for the design of WTP, the project has conservatively chosen to use a value of 0.26 g for the horizontal PGA for SC-I and SC-II structures based on the mean seismic hazard curve for the 200-West Area corresponding to the 2000-year return period. Since the acceleration response spectra for the 200-West Area envelop the spectra corresponding to the 200-East area at all frequencies, the response spectra for the 200-West Area are conservatively adopted to develop the WTP facility DBE response spectra consistent with the adoption of the 0.26 g horizontal PGA. The vertical response spectra was conservatively modified by increasing the spectra acceleration between 1 Hz and 3 Hz. For structures with horizontal frequencies above 33 Hz, the PGA of 0.26 g shall be used. For structures with vertical frequencies above 50 Hz, the vertical PGA of 0.18 g shall be used.

UBC specifies the use of an earthquake with a 500 yr return period. DOE-STD-1020-94, section 2.2, specifies a 1,000 yr return period for PC-2 SSCs. The facility model response spectrum analysis uses the UBC spectra in Figure 16-3 of the code for Zone 2B with a soil profile type S_c. These spectra bound the site-specific spectra pertaining to a 1,000 yr return period.

The only seismic design requirements for SC-I, SC-II, and SC-III SSCs are determined from the 2000-year return period earthquake. There is no design requirement that the SSCs be designed to withstand earthquakes with a more frequent return period. The seismic design of the WTP facility involves ensuring that adequate protection is provided to the worker, co-located worker, and the public following a DBE. It does not involve returning the facility to operation following a DBE. However, a seismic probability risk analysis (PRA) is being conducted to assess the robustness of the seismic design. This is consistent with the DOE letter 01-OSR-0322 of August 16, 2001 (CCN: 022406) which states that:

> The Guideline for unlikely events (those occurring once per 100 years to once per 10,000 years) is, "the facility should be capable of returning to operation following potentially extensive corrective action or repair." The facility seismic criteria currently require that all ITS SSCs that contain significant quantities of radioactive or hazardous materials, be able to withstand at least a 1000 year design basis earthquake. In addition, in a more severe, credible earthquake, the facility risk goals should be met. If there are instances where the satisfaction of these seismic criteria is not sufficient to also meet the Table 1 General Guidelines, additional design robustness should be incorporated to meet the Guidelines, or an alternative proposed, with justification, to OSR.
>
> Also, the Guidelines are not intended to impose criteria for the return to service of the facility on SSCs that are not important-to-safety. If DOE considers it appropriate to impose additional criteria for the protection of the Waste Treatment Plant investment in the event of an accident, these will be the subject of separate correspondence.

Therefore, following a DBE it may be uneconomical to repair the WTP-RPP facility, and the DOE is willing to accept this investment protection risk. There is no effort to identify a "safe shutdown earthquake" for which continued operation without repair would be ensured. For vessels, the project has chosen to ensure that all vessels shall be designed to accommodate design basis earthquake loads without exceeding the stress limitations allowed by ASME Section VIII. Note that many of the SC-II, and SC-III, SSCs should remain functional following earthquakes of lesser magnitude and more frequent return periods.

5 Seismic Analysis of SC-I and SC-II Systems and Components

A dynamic analysis or an equivalent static analysis shall be used based on the characteristics and complexities of the SC-I or SC-II system or component. In lieu of an analysis, equipment can be seismically qualified by test.

5.1 Dynamic Analysis

5.1.1 Methods

The dynamic analysis shall be accomplished using the response spectrum, frequency domain, or time history approach. Time-history analysis shall be performed using either the direct integration method or the modal superposition method.

5.1.2 Equipment Modeling

Unless a more complex model, e.g., a finite element model, is required, the equipment shall be represented by a lumped-mass system consisting of discrete masses connected by weightless springs. The criteria used to lump masses shall be as follows:

a The number of masses is chosen so that all significant modes are included. The modes are considered as significant if the corresponding natural frequencies are less than 33 Hz and the stresses calculated from these modes are greater than 10 % of the total stresses obtained from lower modes. This approach is acceptable provided at least 90 % of the loading/inertia is contained in the modes used. Alternatively, the number of degrees or freedom are taken more than twice the number of modes with frequencies less than 33 Hz.

b The mass is lumped where a significant concentrated weight is located or where there is a significant change in either the geometry or stiffness.

5.1.3 Damping

The damping values shall be the Response Level 1 values of Table 2-3 of DOE-STD-1020-94 (except where noted) and are reproduced below:

System/Component	Damping (% of critical)
Welded and friction bolted metal structures	2
Bearing-bolted steel structures	4
Reinforced concrete structures	4
Massive, low stressed components	2
Light-welded instrument racks	2
Electrical cabinets and other equipment	3
Liquid containing metal tanks (impulsive)	2
Liquid containing metal tanks (sloshing)	0.5
Friction-bolted steel structures	2

System/Component	Damping (% of critical)
Piping systems	ASME Code Case N-411
HVAC Ductwork	3
Cable trays up to half-full	3
Cable trays more than half-full	10

Note that the damping values for Response Level 1 are lower and more conservative than those for Response Level 2 or 3.

5.2 Equivalent Static Analysis

Equivalent static analysis method may be used in lieu of a dynamic analysis if the system or component can be realistically represented by a simple model. A static analysis shall be performed by applying equivalent static forces at the mass locations in two principal horizontal directions and the vertical direction. The equivalent static force at a mass location shall be computed as the product of the mass and the seismic acceleration value applicable to that mass location. The seismic acceleration values shall be as follows:

a Single Mode Dominant Response - The acceleration value from the applicable in-structure response spectrum shall be used. In lieu of calculating the natural frequency, the peak value of the in-structure response spectrum shall be used.

b Multiple Mode Dominant Response - 1.5 times the peak acceleration value of the applicable in-structure response spectrum shall be used.

5.3 Total Seismic Response

The total seismic response shall be computed by combining the co-directional responses from the two horizontal and the vertical analysis by either the SRSS method or the Component Factor method (1/0.4/0.4).

5.4 Code Requirements for SC-I and SC-II Vessels

ASME Section VIII requires that the loadings to be considered in designing a vessel shall include those from seismic reactions where required. However, no design rules are provided in ASME Section VIII to establish the earthquake loads or to perform the seismic analysis of vessels. Therefore ASME Section III, Appendix N, Section NC, is adopted for SC-I and SC-II vessels. ASME Section VIII requires that for the combination of earthquake loading with other loadings, the wall thickness of a vessel computed by these rules shall be determined such that the general membrane stress shall not exceed 1.2 times the maximum allowable stress values used for normal loadings. These allowable stresses will be applied to the vessel, vessel skirts, and vessel supports provided with the vessel.

5.5 Code Requirements for Vessel Supports

The ASME Section VIII vessels are normally supported and secured to steel embeds designed in accordance with AISC N690, *American National Standard Nuclear Facilities - Steel Safety-Related Structures for Design*.

6 Seismic Analysis of SC-III Systems and Components

Each Seismic Analysis of SC-III Systems and Components Seismic analysis will be performed using static and dynamic methods. For WTP, the most commonly used static method based on the UBC is used for SC-III vessels. Earthquake loads on SC-III SSCs shall be calculated per UBC using the static force procedures.

6.1 Static Force Procedure

The lateral seismic force on systems and components, F_p, shall be calculated per UBC Formula 32-1:

$F_p = 4.0\ C_a\ I_p\ W_p$ where

W_p is the weight of the system or component

C_a, the seismic coefficient, shall be equal to 0.24

I_p, the Importance Factor, shall be taken as 1.50 for SC-III systems and components

Alternatively, F_p may be calculated using UBC Formula (32-2), with the provision that it shall not be less than $0.7\ C_a\ I_p\ W_p$ and need not be more than $4\ C_a\ I_p\ W_p$. F_p shall be distributed in proportion to the mass distribution of the system and components.

Where an improved national standard or approved physical test data provide a basis for the earthquake-resistant design or a system or component, such a standard or data shall be acceptable with the limitations specified in the UBC code.

For multiply-supported SC-III systems and components, relative seismic support displacement shall be considered using the value of story drift. The response from the relative seismic support displacement analysis shall be combined with the response from the inertial loads by the SRSS method.

6.2 UBC Values of Importance Factor

Section 2.4.1 of DOE-STD-1020-94 specifies requirements for the design of PC-2 (SC-III) systems and components. These requirements are based on 1994 UBC. Since 1997 UBC is current, its requirements are followed in the design of WTP. The DOE Standard does not indicate the value of the importance factor, I_p, to be used. The I_p values are used from UBC Table 16-K corresponding to the I values.

6.3 Code Requirements for SC-III Vessels

ASME Section VIII requires that the loadings to be considered in designing a vessel shall include those from seismic reactions where required. However, no design rules are provided in ASME Section VIII to establish the earthquake loads or to perform the seismic analysis of vessels. Therefore ASME Section III, Appendix N, Section NC, is adopted for SC-III vessels. ASME Section VIII requires that for the combination of earthquake loading with other loadings, the wall thickness of a vessel computed by these rules shall be determined such that the general membrane stress shall not exceed 1.2 times the maximum allowable stress values used for normal loadings. WTP has chosen to adopt this rule for the vessel, vessel skirts, and vessel supports provided with the vessel.

7 Use of Other Codes for Seismic Analysis

ASME Section VIII, Division 1, Paragraph U-2(g) states that this Division of Section VIII does not contain rules to cover all details and construction. Where complete details are not given, it is intended that the Manufacturer, subject to the acceptance of the Inspector, shall provide details of design and construction which will be as safe as those provided by the rules of this Division.

Therefore ASME Section VIII allows the use of additional rules to cover seismic design and analysis. The use of ASME Section III provides a detailed method of analyzing for seismic loads in vessels. Since the allowable stresses in vessels are also limited to those allowed by ASME Section VIII, the design using ASME Section III methods will be as safe as that required by ASME Section VIII.

8 Comparison of Allowable Stresses

8.1 Vessels Stresses

ASME Section VIII, Paragraph UG-23 (a), (b), and (c) provide the general primary stress levels for tension, compression, and general primary membrane stress. The general primary membrane stress is the combination of maximum primary membrane stress plus primary bending stress and is limited to 1.5 times the maximum allowable stress in tension. Paragraph UG-23 (d) states that for the combination of earthquake loading with other loadings, the wall thickness of a vessel computed by these rules shall be determined such that the general primary membrane stress shall not exceed 1.2 times the maximum allowable stress permitted in UG-23 (a), (b), and (c).

ASME Section III, Paragraph NC-3321, limits the general membrane stress to less that the allowable stress value and limits the general membrane stress plus the bending stress to 1.5 times the allowable stress, for Service Level A loadings. For Service Level B loadings, Paragraph NC-3321 limits the general membrane stress to less than 1.1 times the allowable stress value and the general membrane stress plus bending stress to less than 1.65 times the allowable stress value. For Service Level D loadings, Paragraph NC-3321 limits the general membrane stress to less than 2.0 times the allowable stress value and the general membrane stress plus bending stress to less than 2.4 times the allowable stress value.

In both ASME Section VIII, Paragraph UG-23, and ASME Section III, Paragraph NC-3321, the allowable stress values (S) are given in Subpart 1 of Section II, Part D.

Code	Loading	Primary Membrane Stress	Primary Membrane Stress Plus Primary Bending Stress
ASME VIII, Paragraph UG-23	Normal	S	1.5 S
ASME VIII, Paragraph UG-23	Occasional	1.2 S	1.8 S
ASME III, Paragraph NC-3321	Level A	S	1.5 S
ASME III, Paragraph NC-3321	Level B	1.1 S	1.65 S
ASME III, Paragraph NC-3321	Level D	2.0 S	2.4 S

The WTP project has chosen to limit the stress values to those allowed by ASME Section VIII, Paragraph UG-23 for earthquake loadings. These stress limitation are greater than those allowed by ASME Section III, Paragraph NC-3321 for Service Level B loads but less than those allowed by ASME Section III, Paragraph NC-3321 for Service Level D loads.

8.2 Vessel Support Stresses

The ASME Section III vessel are supported by structural steel embeds which are designed in accordance with ANSI/AISC N690-1994, *Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities*. The vessels are also secured by studs and nuts designed in accordance with ANSI/AISC N690-1994. This is the same codes used in the design of the associated building structural steel. For extreme environmental conditions, ANSI/AISC N690-1994 allows the stresses to be increased by a factor of 1.6.

Safety Checklist for Design

This checklist shall be used for a safety screening of primary design drawings and specifications. The checklist shall be used for safety evaluations associated with actual authorization basis changes (ABCN or ABAR).

Design Document No: N/A **Rev:** N/A

ABCN/ABAR No: (if used as safety evaluation) 24590-WTP-ABAR-ENS-02-005, Rev. 0

Safety Evaluation No: (if used as SE) 24590-WTP-SE-ENS-03-020

Brief description of Design Change:

Provide the details to describe the use of *ASME Boiler and Pressure Vessel Code*, Section III, Division 1, Subsection NC, Subsection NF, Appendix N, and Appendix F as supplemental guidance for seismic design of ASME *Boiler and Pressure Vessel Code*, Section VIII

AB Documents Impacted:

Document Number	Rev	Section
24590-WTP-SRD-ESH-01-001-02, Safety Requirements Document – Volume 2	2a	4.2-3, Add new Ad Hoc Implementing Standard
24590-WTP-PSAR-ESH-01-002-01, Preliminary Safety Analysis Report to Support Construction Authorization; General Information	0	Add new Section 2.4.11

This safety checklist aids in determining if this design change falls within the threshold of changes that may be made without prior DOE approval. It also serves to document the engineering safety evaluation of this design change.

GENERAL REVIEW		YES	NO
1.	Does the change modify or delete a standard prescribed in the Safety Requirements Document Volume II (SRD)?	☒	☐
2.	Does the change alter the location, function, or reliability of an SSC described in the AB[1]?	☐	☒
3.	Is there a change in classification, new items being classified, or existing items deleted? (SDC, SDS, RRC, SC-I, SC-II, SC-III, PC-3, PC-2)	☐	☒
4.	Does the change affect the safety function descriptions in Chapter 4 of the PSAR?	☐	☒
5.	For any of the SSCs, does this change affect any of the associated control strategy development (CSD) records?	☐	☒
6.	Are any other Authorization Basis documents affected by this change? (ISMP, QAM, or RPP) (Also ISAR & HAR)[2]	☐	☒

[1] This question refers to SSC's described in the LCAR, PCAR, and PSAR, including text descriptions and figures in Chapter 2 of the PSAR.

[2] Assumes ISAR and HAR have not yet been superseded by PSAR.

Safety Checklist for Design

This checklist shall be used for a safety screening of primary design drawings and specifications. The checklist shall be used for safety evaluations associated with actual authorization basis changes (ABCN or ABAR).

Design Document No: N/A **Rev:** N/A

ABCN/ABAR No: (if used as safety evaluation) 24590-WTP-ABAR-ENS-02-005, Rev. 0

Safety Evaluation No: (if used as SE) 24590-WTP-SE-ENS-03-020

If any question above is checked "YES", an ABCN or ABAR is probably required. Contact E&NS for assistance. Continue with answering all the Technical Review questions.

TECHNICAL REVIEW These questions evaluate design change affects on DBE hazards analysis.				
SYSTEMS (general)		**YES**	**NO**	**N/A**
7.	Are any new components being added containing radioactive or hazardous materials?	☐	☒	☐
8.	Is a different type of component used to perform the safety function?	☐	☒	☐
9.	Does the change modify SDC/SDS component's function (e.g. auto to manual), failure mode or reliability?	☐	☒	☐
10.	Is there a change in the volume or critical dimension of any tank containing radioactive or hazardous materials?	☐	☒	☐
11.	Does the change increase the concentration or amount of radioactive or hazardous materials being handled?	☐	☒	☐
12.	Is there an increase in system design or operating pressure or temperature?	☐	☒	☐
13.	Are design imposed position control requirements for valves changed?	☐	☒	☐
14.	Does the change route high or moderate energy lines near SDC/SDS SSCs?	☐	☒	☐
15.	For non-ITS modifications, does the design resulting from the modifications affect any SSCs which is SDC (e.g. non-seismic/seismic)?	☐	☐	☒
16.	Are there changes to material selection affecting corrosion/ erosion resistant materials?	☐	☒	☐
17.	Are there changes to position related interlocks?	☐	☒	☐
18.	Does the change reduce the tank purge air flow that may affect hydrogen accumulation?	☐	☒	☐
19.	Is there a change in the chemical composition of the process material that affect chemical reactions or increase hydrogen generation?	☐	☒	☐
CONTROLS & INSTRUMENTATION AND ELECTRICAL		**YES**	**NO**	**N/A**
20.	Are any process level or chemical control points, trips or alarms changed?	☐	☒	☐
21.	Are requirements for redundancy/separation/isolation of SDC/SDS SSCs changed?	☐	☒	☐
22.	Are single failure requirements for ITS SSCs changed?	☐	☒	☐
23.	Does the change add or remove any Vital Bus Loads (Emergency Diesel Generator)?	☐	☒	☐
24.	Are any loads added or removed from SDC uninterruptible power supplies (UPS)?	☐	☒	☐
25.	Are any time delays or actuation times changed?	☐	☒	☐

Safety Checklist for Design

This checklist shall be used for a safety screening of primary design drawings and specifications. The checklist shall be used for safety evaluations associated with actual authorization basis changes (ABCN or ABAR).

Design Document No: N/A **Rev:** N/A

ABCN/ABAR No: (if used as safety evaluation) 24590-WTP-ABAR-ENS-02-005, Rev. 0

Safety Evaluation No: (if used as SE) 24590-WTP-SE-ENS-03-020

CONTROLS & INSTRUMENTATION AND ELECTRICAL		YES	NO	N/A
26.	Does the change reduce the Emergency Diesel Generator operating capabilities (e.g. fuel oil inventory)?	☐	☒	☐
RADIOLOGICAL AND HVAC		**YES**	**NO**	**N/A**
27.	Does the change modify the Radiation Monitoring System location or response?	☐	☒	☐
28.	Does the change modify any portion of HVAC system, including doors and/or walls which may change air flow patterns, that is within the RCA?	☐	☒	☐
29.	Are any door interlocks or alarms changed?	☐	☒	☐
30.	Are there any changes to the C5/R5 zone boundaries?	☐	☒	☐
31.	Is any radiation shielding changed including shield wall openings?	☐	☒	☐
CIVIL/STRUCTURAL		**YES**	**NO**	**N/A**
32.	Are there any increases in loads or changes in load paths?	☐	☒	☐
33.	Are there any increases in floor or wall loads or significant relocation of loads?	☐	☒	☐
34.	Does the change affect the melter glass spill event?	☐	☒	☐
FIRE PROTECTION		**YES**	**NO**	**N/A**
35.	Is there an increase in combustible loading or ignition sources in any fire area including electrical cables?	☐	☒	☐
36.	Does the change affect fire barriers separating fire areas or redundant SDC SSCs?	☐	☒	☐
REGULATORY (These questions to be answered for SE only)		**YES**	**NO**	**N/A**
37.	Based on the answers to the above technical questions and any other analysis, does the change create a new DBE?	☐	☒	☐
38.	Based on the answers to the above technical questions and any other analysis, does the change result in more than a minimal ($\geq$ 10 %) increase in the frequency or consequence of an analyzed DBE as described in the Safety Analysis Report?	☐	☒	☐
39.	Based on the answers to the above technical questions and any other analysis, does the change result in more than a minimal decrease in the Safety Functions of important-to-safety SSCs or change how a Safety Design Class SSC meets its respective safety function?	☐	☒	☐
40.	Does the change result in a noncompliance with applicable laws and regulations (i.e., 10CFR820, 830, and 835), nonconformance to top-level safety standards (i.e., DOE/RL-96-0006), or fail to provide adequate safety?	☐	☒	☐

Safety Checklist for Design

This checklist shall be used for a safety screening of primary design drawings and specifications. The checklist shall be used for safety evaluations associated with actual authorization basis changes (ABCN or ABAR).

Design Document No: N/A **Rev:** N/A

ABCN/ABAR No: (if used as safety evaluation) 24590-WTP-ABAR-ENS-02-005, Rev. 0

Safety Evaluation No: (if used as SE) 24590-WTP-SE-ENS-03-020

REGULATORY		YES	NO	N/A
41.	Does the change result in nonconformance to the contract requirements associated with the authorization basis document(s) affected by the change?	☐	☒	☐
42.	Does the change result in an inconsistency with other commitments and descriptions contained in portions of the authorization basis or an authorization agreement not being revised?	☒	☐	☐

If any of the Technical Review questions is answered "YES", a DBE hazards analysis may be affected that may require ISM process review prior to proceeding with the change. Contact E&NS for assistance in determining if an ISM review is required or if there are questions on DOE approval of the change.

All "YES" answers for questions 1 through 36 must be explained in greater detail. "Yes" or "No" answers to questions 37-42 must be explained in greater detail. Provide a description and/or explanation below and on the ABCN or ABAR, as appropriate.

Describe or explain answers, as appropriate

1. The revision to Safety Criterion 4.2-3 of the SRD and the addition of the Ad Hoc Implementing Standard for Seismic Design of Vessels to the SRD changes and modifies the requirements in SRD Volume II.

37. The details of the seismic design and analysis of vessels does not create or change a design basis event, but it does determine how stresses will be evaluated during and following a design basis earthquake.

38. The details of the seismic design and analysis of vessels does not increase the quantities, change the location, or affect the release rates of radioactive or dangerous materials. It does determine how stresses will be evaluated during and following a design basis earthquake.

39. The details of the seismic design and analysis of vessels does allow stress levels are in accordance with ASME Section VIII for vessels and integral supports and in accordance with ANSI/AISC N960 for structural supports, such as embedded ring supports.

40.The seismic design and analysis of vessels in accordance with the provided details does not result in a noncompliance with applicable laws or top-level documents and does not fail to provided adequate safety.

41. The details of the seismic design and analysis of vessels does not result in nonconformace with contactual requirements associated with the authorization basis.

42. the details of the seismic design and analysis of vessels does result in inconsistencies in the SRD or PSAR. Providing the details in the SRD and PSAR does ensure consistency between the SRD requirements and the PSAR requirements..

	Print/Type Name	Signature	Date
Prepared By:	Steve Vail	[signature]	2/5/03
Reviewed By: (Discipline AB Reviewer)	Sharok Khabir	[signature]	2/5/03