June 23, 2006

Mr. David H. Hinds, Manager, ESBWR
General Electric Company
P.O. Box 780, M/C L60
Wilmington, NC 28402-0780

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 38 RELATED TO ESBWR DESIGN CERTIFICATION APPLICATION

Dear Mr. Hinds:

By letter dated August 24, 2005, General Electric Company (GE) submitted an application for final design approval and standard design certification of the economic simplified boiling water reactor (ESBWR) standard plant design pursuant to 10 CFR Part 52. The Nuclear Regulatory Commission (NRC) staff is performing a detailed review of this application to enable the staff to reach a conclusion on the safety of the proposed design.

The NRC staff has identified that additional information is needed to continue portions of the review. The staff's request for additional information (RAI) is contained in the enclosure to this letter. These questions concern structural analysis. These questions were sent to you via electronic mail on April 24, 2006, and were discussed with your staff during a telecon on May 19, 2006. You agreed to respond to this RAI on the following schedule:

June 28, 2006: 3.8-3, 6, 13, 14, 18 thru 20, 23, 25 thru 27, 40, 41, 46 thru 49, 51, 56, 63, 64, 82, 83, 87, 90, 91, 100, and 104 thru 106.

August 31, 2006: 3.8-1, 2, 4, 5, 7 thru 12, 15, 16, 21, 22, 29 thru 31, 38, 39, 42 thru 45, 50, 52 thru 55, 57, 58, 60, 61, 66 thru 68, 70 thru 72, 74, 75, 78, and 98.

October 31, 2006: 3.8-17, 24, 28, 32 thru 37, 59, 62, 65, 69, 73, 76, 77, 79 thru 81, 84 thru 86, 88, 89, 92 thru 97, 99, and 101 thru 103.

If you have any questions or comments concerning this matter, you may contact me at (301) 415-2863 or lwr@nrc.gov or you may contact Amy Cubbage at (301) 415-2875 or aec@nrc.gov.

Sincerely,

/RA/

Lawrence Rossbach, Project Manager
ESBWR/ABWR Projects Branch
Division of New Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 52-010

Enclosure: As stated

cc: See next page

If you have any questions or comments concerning this matter, you may contact me at (301) 415-2863 or lwr@nrc.gov or you may contact Amy Cubbage at (301) 415-2875 or aec@nrc.gov.

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ACCESSION NO. ML061740210

OFFICE	NESB/PM	NESB/BC(A)
NAME	LRossbach	ACubbage
DATE	06/ 23 /2006	06/ 23 /2006

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JGaslevic
HAshar
RKaras

cc:

Mr. David H. Hinds, Manager
ESBWR
P.O. Box 780, M/C L60
Wilmington, NC 28402-0780

Mr. George B. Stramback
Manager, Regulatory Services
GE Nuclear Energy
1989 Little Orchard Street, M/C 747
San Jose, CA 95125

Mr. David Lochbaum, Nuclear Safety Engineer
Union of Concerned Scientists
1707 H Street, NW., Suite 600
Washington, DC 20006-3919

Mr. Paul Gunter
Nuclear Information & Resource Service
1424 16th Street, NW, Suite 404
Washington, DC 20036

Mr. James Riccio
Greenpeace
702 H Street, Suite 300
Washington, DC 20001

Mr. Adrian Heymer
Nuclear Energy Institute
Suite 400
1776 I Street, NW
Washington, DC 20006-3708

Mr. Paul Leventhal
Nuclear Control Institute
1000 Connecticut Avenue, NW
Suite 410
Washington, DC 20036

Mr. Ron Simard
6170 Masters Club Drive
Suwanne, GA 30024

Mr. Brendan Hoffman
Research Associate on Nuclear Energy and Environmental Program
215 Pennsylvania Avenue, SE
Washington, DC 20003

Ms. Patricia Campbell
Morgan, Lewis & Bockius, LLP
1111 Pennsylvania Avenue, NW
Washington, DC 20004

Mr. Glenn H. Archinoff
AECL Technologies
481 North Frederick Avenue
Suite 405
Gaithersburg, MD. 20877

Mr. Gary Wright, Director
Division of Nuclear Facility Safety
Illinois Emergency Management Agency
1035 Outer Park Drive
Springfield, IL 62704

Mr. Charles Brinkman
Westinghouse Electric Co.
Washington Operations
12300 Twinbrook Pkwy., Suite 330
Rockville, MD 20852

Mr. Ronald P. Vijuk
Manager of Passive Plant Engineering
AP1000 Project
Westinghouse Electric Company
P. O. Box 355
Pittsburgh, PA 15230-0355

Mr. Ed Wallace, General Manager
Projects
PBMR Pty LTD
PO Box 9396
Centurion 0046
Republic of South Africa

Mr. Russell Bell
Nuclear Energy Institute
Suite 400
1776 I Street, NW
Washington, DC 20006-3708

Mr. Jerald S. Holm
Framatome ANP, Inc.
3315 Old Forest Road
P.O. Box 10935
Lynchburg, VA 24506-0935

Ms. Kathryn Sutton, Esq.
Morgan, Lewis & Bockius, LLP
1111 Pennsylvania Avenue, NW
Washington, DC 20004

Mr. Robert E. Sweeney
IBEX ESI
4641 Montgomery Avenue
Suite 350
Bethesda, MD 20814

Mr. Eugene S. Grecheck
Vice President, Nuclear Support Services
Dominion Energy, Inc.
5000 Dominion Blvd.
Glen Allen, VA 23060

Mr. George A. Zinke
Manager, Project Management
Nuclear Business Development
Entergy Nuclear, M-ECH-683
1340 Echelon Parkway
Jackson, MS 39213

E-Mail:
tom.miller@hq.doe.gov or
tom.miller@ nuclear.energy.gov
mwetterhahn@winston.com
whorin@winston.com
gcesare@enercon.com
jerald.holm@framatome-anp.com
eddie.grant@exeloncorp.com
joseph_hegner@dom.com
steven.hucik@ge.com
david.hinds@ge.com
chris.maslak@ge.com
james1beard@ge.com
louis.quintana@gene.ge.com
wayne.massie@ge.com
kathy.sedney@ge.com
mgiles@entergy.com
george.stramback@gene.ge.com

Requests for Additional Information (RAIs)
ESBWR Design Control Document (DCD) Section 3.8

RAI Number	Reviewer	Question Summary	Full Text
3.8-1	Ashar H.	Preservice and Inservice Requirements	Revision 1 of the Tier 2 DCD, Section 3.8.1.7.3, provides information about inservice inspections of the containment components. It is understandable that the COL applicants will develop plans for preservice and inservice inspections. However, (1) the DCD should provide additional pre-operational inspection requirements (per IWE-2000) specifically pertinent to the ESBWR containment, and (2) the IWE-1220 exclusions cited in Section 3.8.1.7.3.2 of the DCD should be revisited to minimize the inaccessible areas in the containment. Also, because of the high radiation areas in the containment, the remote means of monitoring certain structures and components inside the containments should be part of the DCD.
3.8-2	Ashar H.	Seismic Categorization of Structures and Servicing Systems in Table 3.2-1 of the DCD	Provide a basis for the seismic categorization of the following structures and servicing systems: (1) upper and lower drywell servicing hoists and cranes [Component U31 2. in Table 3.2-1], (2) Reactor Building Heating, Ventilation and Air Conditioning (HVAC) [Component U40], (3) Fuel Building Structure [Component U97] and HVAC [Component U98], and (4) Control Building Structure [Component U73], I/II categorization. Also, discuss the basis for categorizing Intake Structure and Discharge Structures [Component W12] as "Not in Scope."
3.8-3	Ashar H	Provide additional information (description, plans, and sections) for some structural elements. [Section 3.8.1.1]	Provide additional information (description, plans, and sections) for the following structural elements. These include the reinforcement details around major reinforced concrete containment vessel (RCCV) piping penetrations, equipment hatches, and personnel airlocks; structural attachments to the containment internal wall (such as pipe restraints); containment external supports if any, attached to the wall to support external structures/elements; reactor pressure vessel (RPV) stabilizer (referred to in App. 3G.1.3.1.4); reactor building (RB) floor slabs made of composite sections (referred to in App. 3G.1.3.1.1); roof trusses and their supporting columns (referred to in App. 3G.1.3.1.1); and the basaltic concrete at the bottom of the containment. In addition, to facilitate the review, Figure 3.8-1 should be improved to identify a number of elements in the ESBWR containment structure which are not shown. These elements include: the shield wall, RPV stabilizer, RPV skirt, RPV insulation, equipment hatches, wetwell hatch, personnel airlocks, refueling seal, major equipment platforms, quenchers, representative vent pipe and safety relief valve (SRV) downcomer pipe with sleeve (from the drywell into the suppression pool).

RAI Number	Reviewer	Question Summary	Full Text
3.8-4	Ashar H	Explain how the jurisdictional boundaries of the containment meet the ASME BPVC requirements. [Section 3.8.1.1.3]	Describe how the jurisdictional boundaries defined in DCD Section 3.8.1.1.3 and Figure 3.8-1 meet the definition of jurisdictional boundaries as specified in the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME BPVC), Division 2, Subsection CC. Subsection CC of the Code states that "When a structural concrete support is constructed as an integral part of the containment, it shall be included within the jurisdiction of these criteria." There are a number of structural components in the reactor building (RB), such as the RB concrete floor slabs, that are integrally connected to the containment structure that restrain and provide support to the containment under various loads (e.g., internal containment pressure).
3.8-5	Ashar H	a) Provide a description of the differences between the 2004 and 1989 edition of the ASME Code that relate to containment. b) Any change to the use of ASME Code 2004 edition requires NRC review and approval. c) Absence of RG 1.94 as a reference in Section 3.8.1.2.3.	a) DCD Section 3.8.1.2.2 and Table 3.8-9 indicate that ASME BPVC - 2004 is used for the design, fabrication, construction, testing, and in-service inspection of the concrete containment. **The 2004 edition of the Code has not as yet been endorsed by the NRC; however, the 1989 edition was reviewed and accepted during the advanced boiling water reactor (ABWR) review process. Please provide a description of the differences between these two editions of the Code that are applicable to the design of the ESBWR containment (e.g., Subsections CC, NCA, and NE).** **b) Assuming that the staff accepts the implementation of ASME Code 2004 edition for design of the ESBWR containment, the staff considers any deviation from the ASME Code 2004 edition for the design and construction of the containment would require NRC review and approval prior to implementation. This needs to be stated in Sections 3.8.1 and 3.8.2.** c) Since DCD Section 3.8.1.2.3 does not reference Regulatory Guide (RG) 1.94 (Item 29 in Table 3.8-9), provide a discussion of how the provision of ANSI N45.2.5 and RG 1.94 are incorporated in the referenced codes and standards.

RAI Number	Reviewer	Question Summary	Full Text
3.8-6	Ashar H	Provide a more detailed description of live loads. [3.8.1.3.1]	The description of live load used inside containment given in DCD Section 3.8.1.3.1 needs **to be expanded, similar to the** description presented in Section 3.8.4.3.1.1, if applicable. The description should cover the types of loads included in live loads (e.g., floor area live loads, laydown loads, equipment handling loads), situations where floor area live loads are omitted, and the magnitude of live load that is used for inertia effects caused by seismic and hydrodynamic loadings in the overall building model and in the design of individual local members. If a fraction of the live load is utilized for seismic and hydrodynamic effects, then provide justification for the reduced live load magnitude.
3.8-7	Ashar H	Explain where leak rate test loads are included in the load definitions. [Section 3.8.1.3]	Explain where leak rate test loads are included in the load definitions presented in DCD Section 3.8.1.3. ASME BPVC, Subsection CC-3320, places this load as part of the load P_t and T_t; however, these loads do not appear in the definition of the preoperational loads P_t and T_t described in DCD Section 3.8.1.3.2.
3.8-8	Ashar H	a) Explain how requirements of 10 CFR 50.34(f)(3)(v) are addressed. b) Explain whether internal flooding load on the containment is applicable. [Section 3.1.8.1.3]	a) Explain how the requirements contained in 10 CFR 50.34(f)(3)(v) regarding loads, loading combinations, and design for the ESBWR containment are addressed. b) Explain whether internal flooding of the containment, subsequent to a Loss of Coolant Accident (LOCA), is also applicable to the ESBWR containment design. If so, how is it included in the loading combinations described in DCD Section 3.8.1.3?
3.8-9	Ashar H	Provide a description of the subcategories for SRV and LOCA. Identify information available for audit. [Section 3.8.1.3]	Provide a description of the different subcategories for **SRV discharge (e.g., single** valve, two valve, automatic depressurization system (ADS), and all valves) and for LOCA (large, intermediate, and small) if applicable, and how they are treated in the load combinations described in DCD Section 3.8.1.3. Also, provide a description and the basis for the method used to combine all of the dynamic loads. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.

RAI Number	Reviewer	Question Summary	Full Text
3.8-10	Ashar H	Provide justification for the use of 100/40/40. [Section 3.8.1.3.6]	Please confirm that application of the 100/40/40 method for combining directional responses discussed in DCD Section 3.8.1.3.6 is consistent with the staff-accepted method, as delineated in draft regulatory guide DG-1127 issued for public comment February 2005. If not, provide the technical basis for the differences.
3.8-11	Ashar H	Confirm that all applicable provisions of ASME BPVC, Section III, Div. 2 are satisfied for the containment, unless otherwise noted. [Section 3.8.1.2 and 3.8.2]	Some subsections in DCD Sections 3.8.1 and 3.8.2 state that the containment design meets specific subarticles and paragraphs of the ASME BPVC, Section III, Division 2. Please confirm that all applicable subarticles and paragraphs contained in the ASME Code are also satisfied. This confirmation should indicate that any exceptions to the ASME Code, such as the allowable tangential shear stress carried by orthogonal reinforcement, have been noted in the DCD.
3.8-12	Ashar H	a) Identify which computer programs have already been reviewed in prior plant license applications. b) Confirm that specific information needed for the staff review of computer programs are available for the design audit. [Section 3.8.1.4 & App. 3C]	For the various computer programs described in DCD Appendix 3C, applicable to Seismic Category I structures: (a) Identify which codes have already been reviewed by the NRC on prior plant license applications. Include the name, version, and prior plant license application. This will minimize the review effort needed during the audit. (b) Confirm that the following information is available for each computer program, for staff review during the audit: the author, source, and dated version; a description, and the extent and limitation of the program application; a description of how the computer program has been validated; and the user manuals. For those programs that are not widely recognized and in the public domain, more detailed information (including a summary comparison) is expected, in order to demonstrate that the computer program solutions to a series of applicable test problems are similar to solutions obtained by alternative means such as hand calculations, analytical results published in the literature, other similar computer programs, etc.

RAI Number	Reviewer	Question Summary	Full Text
3.8-13	Ashar H	Provide the basis for calculating soil springs. Identify information available for audit. [Section 3.8.1.4.1.1 and App. 3G]	For the soil springs used in the containment and RB model (DCD Section 3.8.1.4.1.1 and Appendix 3G): a) Explain why the foundation soil springs for rocking and translation are determined based on soil parameters corresponding to the "Soft Site" conditions for seismic and other loads. Include a discussion of the conservatism of this assumption and the basis for the conclusion. b) Explain how the soil springs for the non-seismic loads were determined. If the springs are modeled as having perfectly elastic stiffness, then explain why these stiffness values are so much smaller than the seismic soil springs. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-14	Ashar H	a) Explain how nonlinear temperature gradients through the containment wall are considered. b) Explain whether temperature distributions are considered for the entire year. Identify information available for audit. [App. 3G.1.5.2.1.6 and Table 3G.1-6]	Based on the information presented in Appendix 3G.1.5.2.1.6 - Thermal Loads and Table 3G.1-6, explain the following: a) Even though equivalent linear temperature distributions are tabulated in DCD Table 3G.1-6, explain how nonlinear temperature gradients (e.g. SRV discharge or accident temperatures) through the containment wall are considered. This should include a description of the nonlinear temperature effects on the concrete, liner and liner anchors. b) Temperature values in DCD Table 3G.1-6 are presented for "Winter." Indicate whether temperature distributions are considered for other times of the year as well; if not, then explain. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.

RAI Number	Reviewer	Question Summary	Full Text
3.8-15	Ashar H	Describe how pressure loads acting on the containment and internal structures are calculated and applied. Identify information available for audit. [Section 3.8.1.4.1.1, App 3G.1.5.2.1.7 & App 3B]	Describe how all of the pressure loads acting on the containment and internal structures are calculated and applied to the containment. (DCD Section 3.8.1.4.1.1, Appendix 3G.1.5.2.1.7, and Appendix 3B.) This should include how axisymmetric and nonaxisymmetric loads are applied and how variations in pressure definition parameters (phasing of maximum pressure on different pool boundary locations, dynamic load factor (DLF), variation in loading function frequencies, etc.) are considered. The description should include pressures due to normal operating, accident pressures, and SRV actuations. Explain if negative pressure loads (i.e., net positive external pressure) acting on the containment can occur and will upward pressure loading on the diaphragm floor develop under any conditions. Appendix 3B - Hydrodynamic Load Definitions needs to be expanded to include this information. Some information is presented in App. 3B, however it appears that much of the description is applicable to response spectra generation using a different model than the NASTRAN finite element model. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-16	Ashar H	Provide a description of how dynamic fluid effects are considered for the various loadings. Identify information available for audit. [Section 3.8.1.4.1 & App. 3G]	Provide a description of how the dynamic fluid effects (water mass, fluid-structure interaction, sloshing) associated with the suppression pool, other pools, and water above the drywell head are considered in the model development, analysis, and design of the containment and RB, subjected to the various dynamic loading events. (DCD Section 3.8.1.4.1 and Appendix 3G.) In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.

RAI Number	Reviewer	Question Summary	Full Text
3.8-17	Ashar H	Describe the numerical analytical techniques for containment regions around penetrations. Identify information available for audit. [Section 3.8.1.4.1.1.3, Section 3.8.2.1.3]	DCD Section 3.8.1.4.1.1.3 states that numerical analytical techniques were used to determine the state of stress and behavior of the containment around the openings at major penetrations. DCD Section 3.8.2.1.3 also states this, and adds, "The analysis of the area around the penetrations consists of a three-dimensional finite element analysis with boundaries extending to a region where the discontinuity effects of the opening are negligible." Please provide a description of these analyses, including pictures of the finite element models, identification of the loading conditions, the types of analyses conducted, a summary of the results of the analyses, and comparison to Code acceptance criteria. Include this information in DCD Section 3.8 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-18	Ashar H	Describe how concrete cracking is considered in the overall building analysis. Identify information available for audit. [Section 3.8.1.4.1]	Describe how the reinforced concrete containment shell and basemat material and stiffness properties are represented in the shell finite element NASTRAN model (e.g., monolithic concrete properties with Young's modulus, thickness, Poisson's ratio, and density corresponding to only concrete - neglecting the steel). For pressure, thermal, seismic, and hydrodynamic loads, explain how the effects of concrete cracking are considered in the NASTRAN overall building analysis. If the concrete stresses are very low for some loading combinations, there may still be regions where cracking in the concrete develop due to the containment structural integrity tests (SIT), thermal loads, and pressure loads. (DCD Section 3.8.1.4.1.) In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.

RAI Number	Reviewer	Question Summary	Full Text
3.8-19	Ashar H	Provide a figure showing the 3-D model used to evaluate concrete cracking for thermal loads and explain how redistribution of loads in the overall building model due to concrete cracking is considered. Identify information available for audit. [Section 3.8.1.4.1.3]	Provide a figure showing the 3-D model (including boundary conditions) used to evaluate concrete cracking under thermal loads, which is discussed in DCD Section 3.8.1.4.1.3. Explain how the approach described in this section, which calculates scale factors of the individual member forces at each critical design-basis section, correctly considers the effect of redistributing the loads due to concrete cracking in the overall containment & building model. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-20	Ashar H	Describe how seismic member forces are determined for each section used in design. Identify information available for audit. [Section 3.8.1.4.1 & App. 3G]	Based on the information contained in App. 3G.1.5.2.1.13, it is not clear how seismic member forces for each section are obtained for use in design. If the figures provided in App. 3G are used (i.e., plots of shear, moment, and torsion for the entire “stick model” building versus elevation), rather than individual member forces obtained directly from the NASTRAN model, then explain how the individual member forces (for use in design) are derived. (DCD Section 3.8.1.4.1 and Appendix 3G.) In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-21	Ashar H	Explain why the value of the liner strain presented in DCD Section 3G.1.5.4.1.1 does not match the value in Table 3G.1-35, and explain why the value in the Table exceeds Code allowable limits. [Section 3G.1.5.4.1.1]	Explain why DCD Section 3G.1.5.4.1.1 indicates that the liner maximum strain is 0.0040 while Table 3G.1-35 tabulates a higher value of 0.005, at the cylinder portion of containment under the abnormal loading combination. If the 0.005 strain (in compression) is correct, then it exceeds the ASME Code allowable value of 0.003.

RAI Number	Reviewer	Question Summary	Full Text
3.8-22	Ashar H	a) Explain the basis for using the suppression pool water temperature profile "for a typical plant in southern states." b) Provide the basis for the stainless steel liner corrosion allowance and what is the expected corrosion. [Section 3.8.1.4.1.4]	With regard to DCD Section 3.8.1.4.1.4: a) Explain why the amount of corrosion used for assessing the 60-year life of the suppression pool liner is based on the annual temperature profile of the pool water "for a typical plant in southern states." b) Provide the basis for the 0.12 mm total corrosion allowance used for the Type 304L stainless steel liner/clad material. Identify what is the expected corrosion and how was it determined.
3.8-23	Ashar H	Clarification of related information included in DCD Tier 2, Chapter 1 [Section 1.2.1.2, Table 1.3-3, Table 1.9-20]	The staff reviewed DCD Tier 2, Chapter 1 for information of potential significance to the ESBWR containment design, and identified several areas in need of additional information. The staff requests the applicant to address the following: (1) DCD Tier 2 Section 1.2.1.2, on page 1.2-3, states that the areas above the containment slab and drywell head are flooded in a pool of water during operation, and that this is effective in scrubbing any potential containment leakage through that path. Please describe this hydrostatic loading on the adjacent pool walls, the top slab and the drywell head in greater detail, including the height of the pool, and the pressure gradient. Describe how this loading is included in the load combinations defined in DCD Section 3.8.1 and 3.8.2 and describe the external pressure loading analysis of the drywell head and the results of the analysis; and include the above requested information in DCD Section 3.8.1, Section 3.8.2, and/or Appendix 3G, as applicable. (2) DCD Tier 2 Table 1.3-3 states that the design temperature of the drywell is 171°C (340°F). Please describe how this design temperature was utilized in defining the concrete and steel properties used in the drywell structural analyses; explain how the concrete temperature limits in ASME Section III, Subsection CC (150°F general, 200°F local) are satisfied; and include the requested information in DCD Section 3.8.1, Section 3.8.2, and/or Appendix 3G, as applicable.

RAI Number	Reviewer	Question Summary	Full Text
3.8-24	Ashar H	Provide details for the treatment of fabrication/erection tolerances in the liner plate design/analysis, and for the application of Code strain criteria. Identify information available for audit. [Section 3.8.1.4.1.2]	With regard to DCD Section 3.8.1.4.1.2: (a) DCD Section 3.8.1.4.1.2 states that the liner plate analysis considers deviations in geometry due to fabrication and erection tolerances. Describe the treatment of fabrication/erection tolerances in the evaluation of the liner plate. Was the potential for buckling of the liner plate considered (convex curvature due to fabrication tolerances/concrete shrinkage)? Include this information in DCD Section 3.8.1 and/or Appendix 3G. (b) DCD Section 3.8.1.4.1.2 also states that liner strains are within allowable limits defined by ASME Code Subarticle CC-3720. Describe the analysis that verified this, and discuss how fabrication/erection tolerances are considered in this analysis. Include this information in DCD Section 3.8.1 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-25	Ashar H	Describe how the analysis of a typical liner plate-to-RCCV attachment is performed using the NASTRAN model results. Identify information available for audit. [Section 3.8.1.4.1.2]	Describe how the analysis of a typical liner plate-to-RCCV attachment is performed using the NASTRAN model results. Include this information in DCD Section 3.8.1 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-26	Ashar H	In the NASTRAN model, is the attachment of the liner plate to the RCCV modeled in a manner consistent with the physical attachment scheme? Identify information available for audit. [App. 3G.1.4.1]	In the NASTRAN model, is the attachment of the liner plate to the RCCV modeled in a manner that is consistent with the physical attachment scheme? Please describe the method used to attach the liner plate to concrete in the NASTRAN model, compare it to the physical attachment scheme, and discuss the adequacy of the model to predict realistic strains in the liner plate. Include this information in DCD Section 3.8.1 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.

RAI Number	Reviewer	Question Summary	Full Text
3.8-27	Ashar H	Provide the details of the locally thickened liner plate and additional anchorage at major structural attachments. Identify information available for audit. [Section 3.8.1.1.2]	Provide the details of the locally thickened liner plate and additional anchorage at major structural attachments. Was this modeled in the NASTRAN analyses? If not, discuss the basis for not including it. Include this information in DCD Section 3.8.1 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-28	Ashar H	Provide additional details for the containment mechanical and electrical penetrations. Identify information available for audit. [Section 3.8.2.1.3]	Provide additional details for the containment mechanical and electrical penetrations (other than Main Steam and Feedwater), including the number, types, geometry, analytical models used, loading, summary of results, comparison to Code allowables, and the current status of the design. Is the design final for all penetrations, or is this a COL applicant responsibility? If a COL applicant responsibility, where is this identified in the DCD? Include this information in DCD Section 3.8.2 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-29	Ashar H	Provide more information about the primary + secondary stress condition in drywell head that exceeds the basic code allowable stress by 75%. Identify information available for audit. [Table 3G.1-36, Section 3G.1.5.4.1.4]	DCD Table 3G.1-36 identifies that the Service Level A, B primary + secondary stress condition in the drywell head exceeds the basic code allowable stress by 75% (PL+Pb+Q is 794 MPa calculated vs. 456 MPa allowable). Describe in detail and pictorially the geometry/location of all overstress conditions. Explain why Q is 11 times greater than PL+Pb. Identify the loading condition(s) that created this overstress condition (pressure loads, thermal loads, or a combination). Provide the technical basis for relying on the NE-3228.3 analysis to show acceptability, rather than implementing a design modification to alleviate the high secondary stress. Provide the details of the NE-3228.3 analysis. Include this information in DCD Section 3.8.2 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.

RAI Number	Reviewer	Question Summary	Full Text
3.8-30	Ashar H	Clarify the purpose of the SS cladding on the exterior surface of the drywell head. Describe how the cladding was considered in the drywell head analyses. Identify information available for audit. [Figure 3G.1-51]	DCD Figure 3G.1-51 indicates there is stainless steel (SS) cladding on the exterior surface of the drywell head. Describe the purpose for the SS cladding. If there is water in the space above the drywell head during normal operation, what is the height of water in this space? What is the cladding thickness? How was the SS cladding modeled in the Service Level A and B pressure and thermal analyses of the drywell head? Was the mismatch in thermal expansion coefficients between carbon steel and SS considered in the thermal analyses? Include this information in DCD Section 3.8.2 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-31	Ashar H	Explain the function of the drywell head support brackets, and how they were modeled. Identify information available for audit. [Figure 3G.1-51, Detail C]	Figure 3G.1-51, Detail C, shows six (6) drywell head support brackets. Please explain their function. How were the brackets modeled in the Service Level A and B pressure and thermal analyses of the drywell head? Were local discontinuity stresses and peak stresses calculated and considered in the Code evaluation? If yes, describe the results. If not, explain why not. Include this information in DCD Section 3.8.2 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-32	Ashar H	What is the Service Level A and B cyclic loading design basis for the drywell head? Identify information available for audit. [Section 3.8.2; App. 3G]	The DCD does not address fatigue failure. What is the Service Level A and B cyclic loading design basis for the drywell head? Were any fatigue calculations performed? If not, identify the Code basis for waiving the fatigue evaluation. If so, describe the method used to predict peak stresses and to calculate the cumulative usage factor. Provide the results and the comparison to the Code acceptance criteria. Include this information in DCD Section 3.8.2 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.

RAI Number	Reviewer	Question Summary	Full Text
3.8-33	Ashar H	What is the Service Level A and B cyclic loading design basis for the hot penetrations? Identify information available for audit. [Section 3.8.2; App. 3G]	The DCD does not address fatigue failure. What is the Service Level A and B cyclic loading design basis for the main steam, feedwater, and other hot penetrations? Were any fatigue calculations performed? If not, identify the Code basis for waiving the fatigue evaluation. If so, describe the method used to predict peak stresses and to calculate the cumulative usage factor. Provide the results and the comparison to the Code acceptance criteria. Include this information in DCD Section 3.8.2 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-34	Ashar H	What is the Service Level A and B cyclic loading design basis for the cold penetrations, equipment hatches, and personnel airlocks? Identify information available for audit. [Section 3.8.2; App. 3G]	The DCD does not address fatigue failure. What is the Service Level A and B cyclic loading design basis for the cold penetrations, equipment hatches, and personnel airlocks? Were any fatigue calculations performed? If not, identify the Code basis for waiving the fatigue evaluation. If so, describe the method used to predict peak stresses and to calculate the cumulative usage factor. Provide the results and the comparison to the Code acceptance criteria. Include this information in DCD Section 3.8.2 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-35	Ashar H	Provide details of the main steam and feedwater penetration analyses for both stress and buckling (if applicable). Identify information available for audit. [Section 3.8.2.4.1.3]	Provide details of the main steam and feedwater penetration analyses for both stress and buckling (if applicable). Describe all pressure and thermal conditions applicable to the main steam and feedwater penetrations, and compare the response for each applicable load case to both stress and buckling (if applicable) acceptance criteria. Include this information in DCD Section 3.8.2 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.

RAI Number	Reviewer	Question Summary	Full Text
3.8-36	Ashar H	Provide details of the two (2) personnel air lock analyses for both stress and buckling (if applicable). Identify information available for audit. [Section 3.8.2.4.1.1]	Provide details of the two (2) personnel air lock analyses for both stress and buckling (if applicable). Describe all pressure and thermal conditions applicable to the personnel air locks, and compare the response for each applicable load case to both stress and buckling (if applicable) acceptance criteria. Include this information in DCD Section 3.8.2 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-37	Ashar H	Provide details of the three (3) containment equipment hatch analyses for both stress and buckling (if applicable). Identify information available for audit. [Section 3.8.2.4.1.2]	Provide details of the three (3) containment equipment hatch analyses for both stress and buckling (if applicable). Describe all pressure and thermal conditions applicable to the equipment hatches, and compare the response for each applicable load case to both stress and buckling (if applicable) acceptance criteria. Include this information in DCD Section 3.8.2 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-38	Ashar H	Provide details of the drywell head analysis for both stress and buckling. Identify information available for audit. [Section 3.8.2.4.1.4]	Provide details of the drywell head analyses for both stress and buckling. Describe all pressure and thermal conditions applicable to the drywell head, and compare the response for each applicable load case to both stress and buckling acceptance criteria. Include this information in DCD Section 3.8.2 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-39	Ashar H	Explain basis for neglecting certain loads in the drywell head analysis. Identify information available for audit. [Section 3G.1.5.2.2.2]	DCD Section 3G.1.5.2.2.2 states that W, W ‘, Ro, Ra, Y, SRV, and LOCA are small and are neglected for the drywell head. Provide a technical basis for this conclusion, for each of these loads. Include this information in DCD Section 3.8.2 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.

RAI Number	Reviewer	Question Summary	Full Text
3.8-40	Ashar H	Provide additional design details for containment internal structures. [Section 3.8.3.1 & App. 3G]	a) Provide information (description, plans, and sections) for several structures inside containment that are not presented in the DCD. These structures include the RPV stabilizer, quenchers, RPV insulation, and the connection of the diaphragm floor to the vent wall. The description should include the analysis and design information comparable to the other containment internal structures, including a description of how the quenchers are anchored to the suppression pool. b) Provide additional design details that are not included in many of the configuration details presented in the figures of Appendix 3G.1. This applies to the RPV support bracket, vent wall, shield wall, gravity-driven cooling system (GDCS) pool, diaphragm floor, and miscellaneous platforms. Taking the RPV Support Bracket as an example, missing design information includes the thickness and dimensions of the plates; weld types, sizes, and lengths; and length of anchor bars embedded in the containment that connect to the RPV support bracket. Include this information in DCD Section 3.8.3 and/or Appendix 3G.
3.8-41	Ashar H	Provide information on how the infill concrete in the diaphragm floor and vent wall was considered in the analysis and design. Identify information available for audit. [Section 3.8.3.1 & App. 3G]	DCD Sections 3.8.3.1.1 and 3.8.3.1.4 indicate that the diaphragm floor (DF) and vent wall (VW) are constructed from steel plates filled with concrete. Section 3G.1.4.1 of Appendix 3G indicates that the infill concrete is conservatively neglected in the analysis model. Neglecting the mass and stiffness of the concrete may not be conservative. Therefore, provide more information which explains how the infill concrete is considered in the analysis and design of these structures. Describe how the mass, stiffness, and strength are considered when analyzing the DF and VW structures for each applicable loading condition. For analysis of thermal transients, how was the infill concrete modeled in heat transfer analyses, and how was the constraint to thermal growth/contraction of the steel plates considered in the thermal stress analyses? Include this information in DCD Section 3.8.3 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.

RAI Number	Reviewer	Question Summary	Full Text
3.8-42	Ashar H	a) Describe how the analysis and design criteria for Seismic Category II satisfies SRP 3.7.2 II,8. b) Describe all Seismic Category II SSCs inside containment. [Section 3.8.3.1.6]	DCD Section 3.8.3.1.6 discusses platforms that are classified as Seismic Category I (C-I) and Seismic Category II (C-II). However, no description is provided regarding how they are analyzed or designed. Some information is presented in DCD Section 3.7, which states that Seismic Category II structures, systems, and components (SSCs) are "designed and/or so physically arranged that the SSE [safe shutdown earthquake] would not cause unacceptable structural interaction or failure." It also states that the methods of seismic analysis and design acceptance criteria for C-II SSCs are the same as C-I; however, the procurement, fabrication, and construction requirements for C-II SSCs are in accordance with industry practices. Based on the above: a) Explain what is meant by the statement "designed and/or so physically arranged that the SSE would not cause unacceptable structural interaction or failure." Provide sufficient information for the staff to confirm that the approach satisfies the three criteria presented in SRP 3.7.2 II,8 for all C-II SSCs. b) Describe any other SSCs that are Seismic Category II inside containment. Include this information in DCD Section 3.8.3.1.6.
3.8-43	Ashar H	Demonstrate the applicability of ANSI/AISC N690-1994s2 (2004). [Section 3.8.3.2]	DCD Section 3.8.3.2 indicates that the design of all containment internal structures conform to ANSI/AISC N690-194s2 (2004). This standard has not been formally reviewed and accepted by the staff. However, the staff has previously accepted ANSI/AISC N690-84 subject to supplemental requirements described in Appendix G of NUREG-1503 (NRC safety evaluation report (SER) on ABWR). Therefore, identify all differences between ANSI/AISCN690-1994s2 (2004) and ANSI/AISC N690-84 (with NRC-accepted supplemental requirements) that affect the ESBWR design. Provide the technical basis which ensures that a comparable level of safety is achieved for each such difference between the two standards.

RAI Number	Reviewer	Question Summary	Full Text
3.8-44	Ashar H	Clarify the commitment to ANSI/ASME NQA-1-1989 through the 1c-1992 Addenda. [Section 3.8.3.2]	DCD Section 3.8.3.2 indicates that the design of all containment internal structures conform to ANSI/ASME NQA-1-1989 and Addenda 1a-1989, 1b-1991, and 1c-1992 as indicated in DCD Table 3.8-6. A note in this table states that more recent revisions exist, however they are not used. DCD Section 17.1 indicates that the quality assurance for the ESBWR design complies with ANSI/ASME NQA-1-1983, and with NQA-1a-1983 for certain aspects of quality assurance (quality assurance program, inspection, and audits). NRC RG 1.28, Rev. 3, August 1985, accepts NQA-1 and NQA-1a-1983 Addenda subject to additions and modifications as identified in the RG. Based on the above, the quality assurance program requirements in DCD Section 3.8.3.2 are not consistent with the commitments presented in DCD Section 17.1. Please clarify which commitments apply and make the necessary revisions in the DCD, or justify the use of different QA requirements for the containment internal structures.
3.8-45	Ashar H	Explain why ASME-2004 is identified as a code applicable to containment internal structures. [Section 3.8.3.2]	DCD Table 3.8-6 lists codes, standards, specifications, and regulations used in the design and construction of Seismic Category I Internal Structures of the containment. Please explain why ASME-2004 is identified within this table.

RAI Number	Reviewer	Question Summary	Full Text
3.8-46	Ashar H	Describe in greater detail the following loads: P_l and P_s, SRV, LOCA, VLC, and AP. Also, provide the sequence for VLC and the method for combining dynamic loads. Identify information available for audit. [Section 3.8.3.3 and Table 3.8-7]	a) DCD Table 3.8-7 presents the load combinations and acceptance criteria for steel structures inside containment. This table identifies loads P_l and P_s, which are not attributed to any load combinations. Explain what these loads represent and what load factors would be applicable. b) Provide a description of the different subcategories for SRV discharge (e.g., single valve, two valve, ADS, and all valves) and for LOCA (large, intermediate, and small) if applicable, and how they are treated in the load combinations. Also, provide a description and the basis for the method used to combine the various dynamic loads that can occur simultaneously. Include in the description the cyclic loading (i.e., number of events and number of cycles per event) for pressure and temperature loads applicable to the various containment internal structures and how the number of cycles were considered in the design. c) For the SRV and LOCA loads, in addition to the direct pressure loads acting on the boundary of the suppression pool walls and floor, provide a description of the other loads associated with these hydrodynamic loads (e.g., jet loads and drag loads on structural members and quenchers), if applicable. Include a discussion of the analysis method and design approach used to evaluate the effects of these loads on the structural members. d) DCD Table 3.8-7 identifies LOCA loads as condensation oscillation (CO), chugging (CHUG), vent line clearing (VLC), and pool swell (PS); and indicates that the sequence of occurrence is given in Appendix 3B. A description of VLC loads is not provided in Appendix 3B and the sequence of VLC with respect to the other loads is omitted in Figure 3B-3 of Appendix 3B. Therefore, provide a description and sequence for the VLC loads. e) Some containment internal structures are subjected to annulus pressurization (AP) loads. However, it is not clear from DCD Table 3.8-7 where AP loads are specified. Therefore, indicate where is the load combination and acceptance criteria for AP loads in DCD Table 3.8-7.

RAI Number	Reviewer	Question Summary	Full Text
			Include this information in DCD Section 3.8.3, Appendix 3B, and/or Appendix 3G, as applicable. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-47	Ashar H	Identify the structures subjected to annulus pressurization (AP) loads and whether AP loads generate building dynamic spectra and displacements. Identify information available for audit. [Section 3.8.3.3.1]	DCD Section 3.8.3.3.1 seems to single out the reactor shield wall for consideration of the Annulus Pressurization (AP) loads, which the DCD states are loads and pressures directly on the reactor shield wall caused by a rupture of a pipe within the reactor vessel shield wall annulus region. Confirm that the loads and effects of the annulus pressurization are considered not only for the reactor vessel shield wall, but for all applicable containment internal structures such as the RPV support bracket, RPV stabilizer, and RPV insulation. Also explain whether the AP loads generate building dynamic spectral loads and displacements (similar to the other hydrodynamic loads) which need to be considered in the analysis and design of other SSCs. Include this information in DCD Section 3.8.3 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.

RAI Number	Reviewer	Question Summary	Full Text
3.8-48	Ashar H	Describe the model(s) and analysis method(s) used to develop the building inertia loads and building displacements due to both hydrodynamic loading and seismic loading. Identify information available for audit. [Section 3.8.3.4]	DCD Section 3.8.3.4 indicates that the containment internal structures are included in the NASTRAN finite element model described in DCD Subsection 3.8.1.4.1.1. The finite element model described in DCD Subsection 3.8.1.4.1.1 includes the containment, containment internal structures (CIS), reactor building (RB), and fuel building (FB). This subsection also indicates that for LOCA and SRV loadings, the hydrodynamic pressures, as described in Appendix 3B, are applied as equivalent static pressures equal to the dynamic peak value times a dynamic load factor. Appendix 3F “RESPONSE OF STRUCTURES TO CONTAINMENT LOADS” states that this appendix specifies the design for safety-related structures, systems, and components as applicable due to dynamic excitations originating in the primary containment in the event of operational transients and LOCA. The input containment loads are described in Appendix 3B. The containment loads considered for structural dynamic response analysis are (1) Hydrodynamic Loads which are Condensation Oscillation (CO), Pool Chugging (CH), Horizontal Vent Chugging (HVL), Local Condensation Oscillation (LCO) and Safety Relief Valve discharge (SRV) in the Suppression Pool (SP), and (2) Pipe Break Loads which consist of Annulus Pressurization (AP) in the annulus between the Reactor Shield Wall (RSW) and Reactor Pressure Vessel (RPV), nozzle jet, jet impingement and pipe whip restraint loads. The staff notes that Appendix 3F is not referenced anywhere in DCD Section 3.8 or Appendix 3G. Therefore, the staff requires additional information to clarify how the dynamic effects of the hydrodynamic loadings were analyzed and how the results were included in the design calculations for the affected structures.

RAI Number	Reviewer	Question Summary	Full Text
			(a) What computer code was used for the hydrodynamic analyses described in Appendix 3F? **(b) Provide detailed information on how the symmetric and asymmetric hydrodynamic loads are applied in the time history analysis.** (c) In Appendix 3F, horizontal and vertical floor response spectra are presented for 4 locations. What is the significance of these 4 locations, compared to any other location? Were response spectra generated at additional locations for future use in subsystem analyses? (d) From the response spectral plots, it appears that the zero period acceleration (ZPA) frequency is above 100 Hz for several of the loadings; however, the plot is truncated at 100 Hz. Please explain this. (e) Describe how the hydrodynamic response spectra were/will be utilized in the ESBWR detailed design. (f) Describe how the structure responses to the hydrodynamic loadings were incorporated into the design evaluation of the affected structures, for load combinations that include hydrodynamic loads. Include this information in DCD Section 3.8 and/or Appendix 3G, as applicable. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-49	Ashar H	Provide a description how the RPV is represented in the NASTRAN model. Identify information available for audit. [Section 3.8.3.4 and App. 3G]	From the finite element NASTRAN model shown in various figures in Appendix 3G, it is not clear how the RPV has been represented in the model. Therefore, provide a description how the RPV is included in the model. If it is not modeled discretely as a separate structure/component, then discuss how its mass and stiffness have been represented in the overall NASTRAN model. Include this information in DCD Section 3.8.3 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.

RAI Number	Reviewer	Question Summary	Full Text
3.8-50	Ashar H	a) Explain why the thermal load induced by friction during radial thermal growth of the RPV is not considered. b) Provide a description of how the RPV support bracket resists horizontal loads. Identify information available for audit. [Section 3.8.3.4.2]	a) DCD Section 3.8.3.4.2 states that the RPV feet can slide radially, and therefore there are no thermal expansion loads from the RPV support acting on the RPV support bracket. **Since frictional resistance could potentially induce thermal expansion loads during radial thermal growth of the RPV, describe the RPV feet/RPV support bracket design features that minimize frictional resistance to sliding, including the coefficient of friction between the surfaces in contact.** b) Although a description is provided about the design of the RPV support bracket allowing unrestrained radial growth, it does not discuss how the design resists horizontal loads. Provide a description of how the RPV support bracket resists horizontal forces for all applicable loads. Include this information in DCD Section 3.8.3 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-51	Ashar H	Describe the analysis approach used with the finite element model for each of the applicable loads. Identify information available for audit. [Section 3.8.3.4 and App. 3G]	From the information presented in DCD 3.8.3.4 and Appendix 3G, it is not clear how the individual member forces from thermal, seismic, hydrodynamic, and other loads are obtained from the finite element model. a) Provide a description of what type of analyses (static, response spectra, time history, etc.) are used with the finite element model for each of the applicable loads in order to obtain individual member forces for design. b) For thermal loading consideration, define the transient and steady state thermal loads, nonlinear temperature distributions, analysis approach, model, and design approach utilized for the major containment internal structures. Include this information in DCD Section 3.8.3 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.

RAI Number	Reviewer	Question Summary	Full Text
3.8-52	Ashar H	Describe the criteria used for the design of cable trays, conduits, and ventilation ducts inside containment. Identify information available for audit. [Section 3.8.3]	DCD Section 3.9.2 presents the criteria, testing procedures, and dynamic analyses used to ensure the structural and functional integrity of piping systems, mechanical equipment, reactor internals, and their supports (including supports for conduits, cable trays, and ventilation ducts) under vibratory loadings. DCD Section 3.10.3.2 describes the design approach for cable tray and conduit supports. Although some limited information is provided in DCD Sections 3.9.2 and 3.10.3 about the design of supports for conduits, cable trays, and ventilation ducts, no information could be located that covers design criteria for conduits, cable trays, and ventilation ducts. Containment internal structures have attached conduits, cable trays, and ventilation ducts. However, DCD Section 3.8.3 does not describe the design criteria used for cable trays, conduits, and ventilation ducts. Therefore, please provide a description of the analysis and design criteria (i.e., description; applicable codes, standards, and specifications; loads and load combinations; acceptance criteria; and analysis and design procedures) used for cable trays, conduits, and ventilation ducts inside containment. Include this information in the DCD. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-53	Ashar H	Explain whether there are any other pipe break loads acting on containment internal structures and describe the loads, models, analysis, and design approach. Identify information available for audit. [Section 3.8.3.4 and App. 3G]	From the information provided in Section 3.8.3 and Appendix 3G, it is not clear whether there are any other pipe rupture loads acting on containment internal structures other than the FW and RWCU breaks which induce annulus pressurization loads on the reactor shield wall. Explain whether there are any other pipe break loads acting on containment internal structures and describe the loads, models, analysis, and design approach for these loads. Include this information in DCD Section 3.8.3 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.

RAI Number	Reviewer	Question Summary	Full Text
3.8-54	Ashar H	Explain why the acceptance criteria is identified as ANIS/AISC –690 rather than Table 3.8-7. [Section 3.8.3.5]	DCD Sections 3.8.3.5.1 through 3.8.3.5.6 state that the structural acceptance criteria for each of the containment internal structures are in accordance with ANSI/AISC –690. Explain why these statements do not specify that the structural acceptance criteria for each of the containment internal structures are in accordance with Table 3.8-7, where (as noted in footnote 5 of DCD Table 3.8-7) the allowable elastic working stress (S) is the allowable stress limit specified in Part 1 of ANSI/AISC –690.
3.8-55	Ashar H	Provide a description of the in-service inspection of the diaphragm floor and vent wall. [Section 3.8.3.7]	DCD Section 3.8.3.7 states that testing and in-service inspection of the diaphragm floor and vent wall are discussed in Subsection 3.8.1.7. Since DCD Section 3.8.1.7 does not discuss the in-service inspection of these two structures, provide a description of the in-service inspection of the diaphragm floor and vent wall. Include this information in DCD Section 3.8.3.7.
3.8-56	Ashar H	Provide a description and show on Figure 3G.1-55 how the diaphragm floor and radial support beams are connected. [Section 3.8.3.4.1]	DCD Section 3.8.3.4.1 describes the analysis and design of the diaphragm floor and DCD Figure 3G.1-55 provides a drawing of the diaphragm floor. From this information it is not clear whether the diaphragm floor is attached to the radial support beams in a manner that makes them respond as an integral member. Provide a description in DCD Section 3.8.3.4.1 and show in DCD Figure 3G.1-55 how the diaphragm floor and radial support beams are connected.
3.8-57	Ashar H	**Describe the criteria used for the design of cable trays, conduits, and ventilation ducts in Other Seismic Category I Structures.** [Section 3.8.4]	DCD Section 3.8.3.6 describes the materials used for the containment internal structures. For many of these structures, several material types are listed (e.g., ASTM A572 or A709 HPS 70W). Explain whether (1) both are listed because each type is used in a different location; or (2) different material choices are available to the COL applicant. Identify and compare the key material properties of the different materials listed. Include this information in DCD Section 3.8.3.6.

RAI Number	Reviewer	Question Summary	Full Text
3.8-58	Ashar H	Explain whether Regulatory Guide 1.160 and 10 CFR 50.65 requirements, related to structures monitoring and maintenance, are applicable to the ESBWR design, or why not. [Section 3.8.3.7]	DCD Section 3.8.3.7 states that a formal program of testing and in-service inspection is not planned for the internal structures except for the diaphragm floor and vent wall. DCD Section 3.8.3.7 also states that the other internal structures are not directly related to the functioning of the containment system; therefore, no testing or inspection is performed. For the other structures, confirm that Regulatory Guide 1.160 and 10 CFR 50.65 "Maintenance Rule" requirements for structures monitoring and maintenance are applicable to the ESBWR design. If this is not the case, provide the technical basis. Include this information in DCD Section 3.8.3.7.
3.8-59	Ashar H	Describe any special provisions to facilitate ISI of containment internal structures. [Section 3.8.3.7]	General Design Criterion 53, in part, requires that the reactor containment be designed to permit appropriate periodic inspection of all important areas. RAI 3.8-1 requests that the applicant address this for the concrete and steel elements of the ESBWR containment structure. A stated industry design criterion for advanced reactors is to accommodate inservice inspection (ISI) of critical areas. The staff considers that monitoring and maintaining the condition of containment internal structures is essential for plant safety. DCD Section 3.8.3 does not address any special design provisions (e.g., providing sufficient physical access, providing alternative means for identification of conditions in inaccessible areas that can lead to degradation, remote visual monitoring of high radiation areas) to accommodate inservice inspection of containment internal structures. Please include a description of any special design provisions for containment internal structures in DCD Section 3.8.3.7. If none have been incorporated in the ESBWR design, please provide the technical basis for concluding that they are not necessary.
3.8-60	Ashar H	Clarify design of Main Steam Tunnel for Guard Pipe support forces. Identify information available for audit. [Section 3.8.4]	DCD Section 3.8.4 (pg 3.8-28) states that: "The main steam tunnel walls protect the RB from potential impact by rupture of the high-energy main steam pipes that extend to the Turbine Building. Thus the RB walls of the main steam tunnel are designed to accommodate the guard pipe support forces." Clarify that all high energy lines in the main steam tunnel are protected by guard pipes. If not, explain why the tunnels are only designed for "guard pipe support forces." Also, the staff notes that Section 3.6.2.4 states that the ESBWR does not require guard pipes. Clarify this discrepancy and explain where the criteria for the design of any guard pipes used in the ESBWR design is discussed in the DCD. Include this information in DCD Section 3.8.4. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.

RAI Number	Reviewer	Question Summary	Full Text
3.8-61	Ashar H	Clarify design of masonry walls. [Section 3.8.4]	DCD Section 3.8.4 (pg 3.8-28) states that Seismic Category I masonry walls are not used in the design. Explain if there are any non-safety related masonry walls used in the ESBWR design. If so, provide the criteria used to design such walls to assure that their failure does not affect any safety related structures, systems or components.
3.8-62	Ashar H	Provide structural design criteria for Seismic Category II structures. [Section 3.8.4]	DCD Section 3.8.4 mentions several Seismic Category II structures (e.g., control building (CB) above grade and FB penthouse). Describe all Seismic Category II structures and explain each structure's physical relationship to Seismic Category I structures. Provide the structural design criteria used for all Seismic Category II structures to assure that they do not effect the performance of Seismic Category I structures, systems and components under all loading conditions. Provide sufficient information for the staff to confirm that the approach satisfies the three criteria presented in SRP 3.7.2 II,8 for all C-II SSC. **Include this information in DCD Section 3.8.4.**
3.8-63	Ashar H	Provide information on relationship of CB and RB/FB foundation mats. [Section 3.8.4.1.2]	It is the staff's understanding that the CB is supported on a foundation mat that is independent of the RB and FB. Provide plan and section views showing the relationship of the CB and RB/FB foundation mats and superstructures and confirm that these structures are independent of each other. **Include this information in DCD Section 3.8.4 and/or Appendix 3G.**
3.8-64	Ashar H	Provide criteria to design frame members. Identify information available for audit. [Section 3.8.4.1.2]	DCD Section 3.8.4.1.2 states that the CB frame members such as beams or columns are designed to resist vertical loads and to accommodate deformations of the walls in case of earthquake conditions. A similar statement appears in Section 3.8.4.1.3 for the Fuel Building and Section 3.8.4.1.4 for the Emergency Breathing Air System (EBAS) Building. Provide the structural design criteria, including the deformation limits, used to design these frame members. **Include this information in DCD Section 3.8.4 and/or Appendix 3G. In addition**, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.

RAI Number	Reviewer	Question Summary	Full Text
3.8-65	Ashar H	Provide summary report for EBAS Building. Identify information available for audit. [Section 3.8.4.1.4]	DCD Section 3.8.4.1.4, which discusses the EBAS Building, does not reference a summary report in Appendix 3G that contains a description of the EBAS Building, the loads and load combinations, reinforcement stresses, and concrete reinforcement details for the basemat, seismic walls and floors. Provide this information similar to that provided for the other Seismic Category I structures. Also provide plan and section views showing the relationship of the EBAS, CB and RB/FB foundation mats and superstructures and confirm that these structures are independent of each other. Include this information in DCD Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-66	Ashar H	Identify and explain any exceptions to codes, standards, specifications, and regulatory guides. [Section 3.8.4.2 and Table 3.8-9]	DCD Section 3.8.4.2 refers to Table 3.8-9 for the “applicable” documents for the design of the Reactor Building, Control Building, Fuel Building and Radwaste Building. Table 3.8-9 lists the Codes, Standards, Specifications, and Regulations Used in the Design and Construction of Seismic Category I Structures. It is noted that the title of this table includes “regulations,” however, the reference list actually includes a list of regulatory guides. For each item in Table 3.8-9, identify and explain any exceptions to codes and standards for the ESBWR design.
3.8-67	Ashar H	Explain exceptions to items in Table 3.8-9 for RB design. [Section 3.8.4.2.1]	DCD Section 3.8.4.2.1 states that the applicable documents for the RB design are shown in Table 3.8-9, except items 4, 11, 30 and 32. With regard to the exceptions listed: (1) Explain why there is no exception to item 3 (ASME Subsection CC) while there is an exception to item 4 (ASME Subsection NE) and item 30 (RG 1.136 for Concrete Containments), (2) Explain the exception to item 11 (2005 AISC Specification for Structural Steel Building).
3.8-68	Ashar H	Explain reference to 10CFR73.2 and 73.55 for CB. [Section 3.8.4.2.2]	DCD Section 3.8.4.2.2 states that the NRC Rules and Regulations Title 10, Chapter 1, Code of Federal Regulations, Part 73.2 and 73.55 shall be met for the Control Building. These rules pertain to the physical protection of plants and materials. Explain why these rules are specifically referenced for the Control Building and are not referenced for other Category I structures. Also explain how these rules will be implemented for each category I structure.

RAI Number	Reviewer	Question Summary	Full Text
3.8-69	Ashar H	Provide design criteria for spent fuel pool racks and associated structures. Identify information available for audit. [Section 3.8.4.2.3]	DCD Section 3.8.4.2.3 discusses the applicable documents for the Fuel Building design, but does not specifically discuss the criteria for design of the spent fuel pool racks and associated structures. Provide a description of the criteria and the design of the spent fuel pool and racks. This description should include sufficient information so that the staff can determine if the criteria and design of the spent fuel pool racks and associated structures meets the staff technical position described in Appendix D to SRP Section 3.8.4. Include this information in DCD Section 3.8.4 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-70	Ashar H	Describe provisions for spent fuel pool leakage monitoring. [Section 3.8.4.2.5]	DCD Section 3.8.4.2.5 discusses the welding and subsequent inspections of pool liners during construction. Clarify that these procedures apply to all pool liners, including the spent fuel pool liner. For the spent fuel pool liner, explain whether the liner welds will include leak chase channels to monitor any spent fuel pool leakage during operation. If so, describe the design of the system and what is expected of the COL applicant. If not, describe how the potential for spent fuel pool leakage will be monitored during operation. Include this information in DCD Section 3.8.4.2.5.
3.8-71	Ashar H	Explain why LOCA and other loads are not considered in the design of the Reactor Building. Identify information available for audit. [Section 3.8.4.3.1.1]	DCD Section 3.8.4.3.1.1 identifies the loads for the Reactor Building. Pa is defined as the accident pressure at the main steam tunnel due to a high energy line break. Ta is defined as the thermal effects (including To which may occur during a design accident). It is noted that the Reactor Building is structurally connected to the Containment walls at all floor elevations. The Containment structure is also supported on the same foundation as the Reactor Building. Therefore, explain why the Reactor Building is not designed for the effects of Ra, Ta, Pa, CO, CHUG, VLC and PS as defined in Section 3.8.1.3.5 for the Containment, as well as SRV loads, as defined in Section 3.8.1.3.1. Some of these loads may not have a direct effect on the Reactor Building, but since the Reactor Building supports the Containment, the loads are transmitted to the Reactor Building floors and walls. Also explain why the dynamic effects of the above loads are not considered in the design of the entire Reactor Building. Include this information in DCD Section 3.8.4 and/or Appendix 3G. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.

RAI Number	Reviewer	Question Summary	Full Text
3.8-72	Ashar H	Provide justification for the use of 100/40/40. [Sections 3.8.4.3.1.2 and 3.8.4.3.1.3]	**Please confirm that application of the 100/40/40 method for combining directional responses is consistent with the staff-accepted method, as delineated in DG-1127. If not, provide the technical basis for the differences.**
3.8-73	Ashar H	Explain Ta and why LOCA and other loads are not considered in the design of the Control Building. [Section 3.8.4.3.2]	DCD Section 3.8.4.3.2 states that accident pressure loads (Pa) do not exist for the Control Building. Section 3G.2.5.2.1.6 states that thermal loads (Ta) for the Control Building are evaluated for abnormal (LOCA) conditions. Explain how the Control Building is affected by LOCA thermal loads. Also provide the technical basis why the dynamic effects of LOCA, SRV discharge, condensation oscillation, and chugging are not applicable to the design of the Control Building. **Include this information in DCD Section 3.8.4.3.2 and/or Appendix 3G.**
3.8-74	Ashar H	Explain why LOCA and other loads are not considered in the design of the Fuel Building. Identify information available for audit. [Section 3.8.4.3.3]	DCD Section 3.8.4.3.3 states that accident pressure loads (Pa) do not exist for the Fuel Building. In Section 3.8.4, the DCD states that the Reactor Building and Fuel Building are built on a common foundation mat and are structurally integrated into one building. The Reactor Building is also structurally connected to the Containment walls at all floor elevations and the Containment structure is also supported on the same foundation as the Reactor Building. Therefore, explain why the Fuel Building is not designed for the effects of Ra, Ta, Pa, CO, CHUG, VLC and PS, as defined in Section 3.8.1.3.5 for the Containment, as well as SRV loads, as defined in Section 3.8.1.3.1. Some of these loads may not have a direct effect on the Fuel Building, but the loads may be transmitted to the Fuel Building floors and walls. Also explain why the dynamic effects of the above loads are not considered in the design of the entire Fuel Building. It is also noted that DCD Section 3G.3.5.2.1.1 does not define either Pa or Ta for the Fuel Building; however, Table 3G.3-4 includes Pa and Ta in two of the three selected load combinations [LOCA (1.5Pa) 72 hours and LOCA + SSE 72 hours]. Explain the LOCA loads considered in these two load combinations and correct the loads defined in Section 3G.3.5.2.1.1 and Section 3.8.4.3.3. **Include this information in DCD Section 3.8.4 and/or Appendix 3G. In addition**, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-75	Ashar H	Check incorrect reference to SRP 3.8.1. [Section 3.8.4.5.1]	Section 3.8.4.5.1 references SRP 3.8.1 Section II.3. This appears to be an incorrect reference. Please check this section and correct as needed. If this is not an error, please explain the reference to SRP 3.8.1.

RAI Number	Reviewer	Question Summary	Full Text
3.8-76	Ashar H	Provide information on Materials, QC and Special Construction Techniques for Other Cat I Structures. [Section 3.8.4]	Provide information on Materials, Quality Control, and Special Construction Techniques for Other Seismic Category I Structures. This information is normally included in Section 3.8.4.6, but has not been provided in the ESBWR DCD. SRP 3.8.4 provides guidance as to the type of information that the staff expects to review. Include this information in a new DCD Section 3.8.4.6.
3.8-77	Ashar H	Describe the criteria used for the design of cable trays, conduits, and ventilation ducts in Other Seismic Category I Structures. Identify information available for audit. [Section 3.8.4]	DCD Section 3.9.2 presents the criteria, testing procedures, and dynamic analyses used to ensure the structural and functional integrity of piping systems, mechanical equipment, reactor internals, and their supports (including supports for conduits, cable trays, and ventilation ducts) under vibratory loadings. DCD Section 3.10.3.2 describes the design approach for cable tray and conduit supports. Although some limited information is provided in DCD Sections 3.9.2 and 3.10.3 about the design of supports for conduits, cable trays, and ventilation ducts, no information could be located that covers design criteria for conduits, cable trays, and ventilation ducts. Other Seismic Category I Structures have attached conduits, cable trays, and ventilation ducts. However, DCD Section 3.8.4 does not describe the design criteria used for cable trays, conduits, ventilation ducts. Therefore, please provide a description of the analysis and design criteria (i.e., description; applicable codes, standards, and specifications; loads and load combinations; acceptance criteria; and analysis and design procedures) used for cable trays, conduits, and ventilation ducts in Other Category I Structures. Include this information in the DCD. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-78	Ashar H	Demonstrate the applicability of ANSI/AISC N690-1994s2 (2004). [Section 3.8.4.2]	DCD Section 3.8.4.2 indicates that the design of the Seismic Category I Structures conform to ANSI/AISC N690-1994s2 (2004). This standard has not been formally reviewed and accepted by the staff. However, the staff has previously accepted ANIS/AISC N690-84 subject to supplemental requirements described in Appendix G of NUREG-1503 (NRC SER on ABWR). Therefore, identify all differences between ANSI/AISCN690-1994s2 (2004) and ANIS/AISC N690-84 (with NRC-accepted supplemental requirements) that affect the ESBWR design. Provide the technical basis which ensures that a comparable level of safety is achieved for each such difference between the two standards.

RAI Number	Reviewer	Question Summary	Full Text
3.8-79	Ashar H	Confirm if TB, SB and RW Buildings are designed to Seismic Category II requirements. [Section 3.8.4]	Confirm that the Turbine Building (TB), Service Building (SB), and Radwaste (RW) Building, which are in close proximity to Category I structures, are designed to Seismic Category II requirements. If not, explain why not. **Include this information in DCD Section 3.8.4**
3.8-80	Ashar H	Explain status of ESBWR building designs and COL applicant responsibilities. [Section 3.8.4]	What buildings other than the RB, FB and CB have been designed and evaluated to applicable acceptance criteria? What is the status of the EBAS and RW Building designs? What are the COL applicant responsibilities and what are the standard plant design restrictions/limitations/requirements for the design of buildings not covered in the DCD? **Include this information in the DCD.**
3.8-81	Ashar H	Provide information on testing and inservice surveillance requirements. Explain whether RG 1.160 and 10 CFR 50.65 requirements are applicable. [Section 3.8.4]	The DCD does not discuss testing and inservice inspection requirements for Other Seismic Category I Structures. This information is normally included in Section 3.8.4.7, but has not been provided in the ESBWR DCD. Describe any requirements for testing and inservice inspection of Other Seismic Category I Structures. Explain whether Regulatory Guide 1.160 and 10 CFR 50.65 requirements, related to structures monitoring and maintenance, are applicable to the ESBWR Other Seismic Category I Structures. If not, explain why not. **Include this information in new DCD Section 3.8.4.7.**
3.8-82	Ashar H	Explain why certain load combinations were not selected for the Section 3G summary report. Also clarify that all load combinations were checked in the final design. Identify information available for audit. [Section 3G.1.5.2.2.4]	DCD Section 3G.1.5.2.2.4 states that based on previous experience, critical load combinations are selected for the Reactor Building design. The selected load combinations are shown in Table 3G.1-11. Explain why Load Combination 7 from Table 3.8-15, which includes the effects of tornado loads, is not included as a critical load combination in Table 3G.1-11. It would appear that tornado loads would have a significant effect on the design of the exterior walls of the Reactor Building. Also explain why load Combination 4 in Table 3G.1-11 is considered to be a more critical load combination than Load Combination 3 in Table 3.8-15. Also clarify whether in the final design of all Seismic Category I Structures, all required load combinations were checked by the design engineer. **Include this information in DCD Appendix 3G. In addition**, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.

RAI Number	Reviewer	Question Summary	Full Text
3.8-83	Ashar H	Explain why load combinations for W and Wt are not included. [Section 3G.1.5.3]	Explain why DCD Section 3G.1.5.3 does not include the load combinations for wind (W) and tornado loads (Wt), as defined in Table 3.8-14. Include this information in DCD Appendix 3G.
3.8-84	Ashar H	Clarify the commitment to ANSI/ASME NQA-1-1989 through the 1c-1992 Addenda. [Section 3.8.4.2]	DCD Section 3.8.4.2 indicates that the design of Other Category I Structures conform to ANSI/ASME NQA-1-1989 and Addenda 1a-1989, 1b-1991, and 1c-1992, as indicated in DCD Table 3.8-9. A note in this table states that more recent revisions exist, however they are not used. DCD Section 17.1 indicates that the quality assurance for the ESBWR design complies with ANSI/ASME NQA-1-1983, and with NQA-1a-1983 for certain aspects of quality assurance (quality assurance program, inspection, and audits). NRC RG 1.28, Rev. 3, August 1985, accepts NQA-1 and NQA-1a-1983 Addenda subject to additions and modifications as identified in the RG. Based on the above, the quality assurance program requirements in DCD Section 3.8.4.2 are not consistent with the commitments presented in DCD Section 17.1. Please clarify which commitments apply and make the necessary revisions in the DCD, or justify the use of different QA requirements for the Other Seismic Category I Structures.
3.8-85	Ashar H	Identify deviations between ACI 349-97/RG 1.142 and ACI 349-01. [Section 3.8.4.2]	DCD Section 3.8.4.2 indicates that the design and construction of Other Seismic Category I Structures conform to ACI 349-01 and Regulatory Guide 1.142, November 2001, as indicated in Table 3.8-9. RG1.142, states the staff's position on the use of ACI 349-97. Since the staff has not formally reviewed and endorsed ACI 349-01 at this time, identify all deviations between ACI 349-97/RG 1.142 and ACI 349-01 that affect the ESBWR design. Also provide the technical basis for ensuring that a comparable level of safety is achieved for each such deviation.
3.8-86	Ashar H	Describe any special provisions to facilitate ISI of Other Category I Structures. [Section 3.8.4]	General Design Criterion 53, in part, requires that the reactor containment be designed to permit appropriate periodic inspection of all important areas. RAI 3.8-1 requests that the applicant address this for the concrete and steel elements of the ESBWR containment structure. A stated industry design criterion for advanced reactors is to accommodate inservice inspection of critical areas. The staff considers that monitoring and maintaining the condition of Other Category I Structures is essential for plant safety. DCD Section 3.8.4 does not address any special design provisions (e.g., providing sufficient physical access, providing alternative means for identification of conditions in inaccessible areas that can lead to degradation, remote visual monitoring of high radiation areas) to accommodate inservice inspection of Other Category I Structures. Please include a description of any special design provisions for Other Category I Sructures in new DCD Section 3.8.4.7. If none have been incorporated in the ESBWR design, please provide the technical basis for concluding that they are not necessary.

RAI Number	Reviewer	Question Summary	Full Text
3.8-87	Ashar H	Clarify how bending moments in the foundation are determined for seismic loads. Identify information available for audit. [Section 3.8.5.4]	Section 3.8.5.4 indicates that the design of the RB/FB foundation mat involves determining shear and bending moments of the substructure, including interaction of the basemat with the underlying foundation materials. However, **DCD Section 3.7 indicates that dynamic analyses are performed using simplified frequency-independent impedance functions, which implies that the dynamic analyses are performed using rigid base assumptions. DCD Section 3.8.5 or Appendix 3G needs to describe the procedures that are employed to determine the bending moments induced in the basemat under applied seismic loads**. **Include this information in DCD Section 3.8.3 and/or Appendix 3G. In addition**, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-88	Ashar H	Clarify how potential lift-off effects and the range of site conditions were considered in the sliding analysis. [Section 3.8.5.4]	DCD Section 3.8.5.4 indicates that a main objective of the design of the foundation is to ensure that there is adequate frictional and passive resistance to prevent sliding of the structure when subjected to lateral loads. However, the DCD does not indicate how the analysis is to be performed and how lift-off effects, if appropriate, are to be captured in this analysis. The DCD also indicates that the capability of the foundation to transfer shear is evaluated when waterproofing is used beneath the basemat. The DCD needs to indicate the procedures employed to assess such effects for a potential range of site conditions varying from soil sites with shear wave velocities of the order of 1,000 fps to hard rock sites.
3.8-89	Ashar H	Clarify COL applicant requirements related to use of foundation waterproofing. Identify information available for audit. [Section 3.8.5.4]	DCD Section 3.8.5.4 states that the capability of the foundation to transfer shear with waterproofing is a COL item, and refers to Section 3.8.6.1. DCD Section 3.8.6.1 states that the COL applicant shall demonstrate the capability of foundations to transfer shear loads where foundation waterproofing is used. The staff needs additional information. Explain the technical issue in detail. With respect to waterproofing, what is the ESBWR standard plant assumption used in conducting the foundation sliding analyses? Why is the capability to transfer shear with waterproofing a COL item? How does a COL applicant confirm that it is in compliance with the standard plant foundation design assumptions for a selected, site-specific waterproofing material? Include the information requested above in DCD Section 3.8.5.4. **In addition**, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.

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3.8-90	Ashar H	Describe how the worst-case resulting forces are determined for foundations. Identify information available for audit. [Section 3.8.5.4]	DCD Section 3.8.5.4 indicates that the foundations are evaluated for the worst resulting forces from the superstructure, but does not indicate how the worst-case scenario is to be determined. DCD Section 3.8.5.4 needs to indicate the procedures being used to evaluate the worst conditions. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-91	Ashar H	Clarify the design/analysis methods for foundations. Identify information available for audit. [Section 3.8.5.4]	DCD Section 3.8.5.4 states that the foundations are analyzed using "well-established methods". Identify the references for and describe the "well-established methods" used to analyze the foundations. Demonstrate conformance of these methods with the requirements of SRP 3.8.5. Include this information in DCD Section 3.8.5.4. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-92	Ashar H	Clarify how settlement was considered in the design/evaluation of ESBWR foundations/structures. Identify information available for audit. [Section 3.8.5.4]	DCD Section 3.8.5.4 indicates that the standard design is developed using a range of soil conditions as detailed in Appendix 3A. Appendix 3A describes the range in shear wave velocities considered in SSI analyses, and only focuses on assumed uniform site conditions. Section 3.8.5.4 also states that total and differential settlements of the foundations must be considered, but refers to Section 3.8.6.2 for COL information. Section 3.8.5.4 does not indicate if any potential effects of static or dynamic differential settlement effects have been incorporated into the design of the standard plant nor the magnitude of settlement that was considered. Also, the effect of settlement on construction procedures is not addressed. DCD Section 3.8.5.4 needs to clarify how settlement issues are incorporated into the generic design of the standard plant, and identify limitations on the magnitude of settlements. (a) Explain how the potential for settlement was considered in the ESBWR standard plant design. (b) What is the allowable settlement that can be accommodated by the ESBWR foundations/structures? Include this information in DCD Section 3.8.5.4. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.

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3.8-93	Ashar H	Define the COL applicant actions required to confirm that the predicted site-specific settlement meets the standard plant design assumptions. Identify information available for audit. [Sections 3.8.5.4 and 3.8.6.2]	Section 3.8.5.4 states that total and differential settlements of the foundations must be considered, but refers to Section 3.8.6.2 for COL information. The DCD needs to clarify how settlement issues are incorporated into the generic design of the standard plant, and identify limitations on the magnitude of settlements, so that the COL applicant can ensure compliance with the standard design. Define the COL applicant actions required to confirm that the predicted site-specific settlement meets the standard plant design assumptions. Include this information in the DCD. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-94	Ashar H	Define the maximum toe pressure used in the basemat design. [Section 3.8.5.4]	DCD Section 3.8.5.4 indicates that the design incorporates an evaluation of the worst loads resulting from the superstructures and loads directly applied to the foundation mat, due to static and dynamic load combinations. However, the DCD does not identify the maximum allowable toe pressure that is acceptable for the basemat design, under the worst-case static and dynamic loads. This information is needed so that evaluations can be made at the COL stage for site-specific conditions. Include the maximum toe pressure used in the basemat design in DCD Table 3.8-13.
3.8-95	Ashar H	Clarify site-specific soil bearing capacity requirements. [Section 3.8.5.4]	DCD Section 3.8.5.4 indicates that site-specific allowable bearing capacities are no less than the calculated static and dynamic bearing pressures, and refers to Section 3.7.5.1 for COL information. Section 3.7.5.1 states that the site allowable foundation bearing capacities are no less than the values in Section 3G.1.5.5 for RB, Section 3G.2.5.5 for CB and Section 3G.3.5.5 for FB. Section 3G.1.5.5 refers to Table 3G.1-58; Section 3G.2.5.5 refers to Table 3G.2-24; and Section 3G.3.5.5 refers back to Section 3G.1.5.5. The circuitous referencing employed is confusing and unnecessary. Expand the discussion of bearing capacities as a function of site conditions (soft, medium, hard) in DCD Section 3.8.5.4, and directly reference the Appendix 3G tables that contain the pertinent information.

RAI Number	Reviewer	Question Summary	Full Text
3.8-96	Ashar H	Clarify sliding analysis methodology. Identify information available for audit. [Section 3.8.5.5]	DCD Section 3.8.5.5 presents two specifications of appropriate safety factors (SF) for foundation design. The SF against sliding indicates that sliding resistance is judged as the sum of both shear friction along the basemat and passive pressures induced due to embedment effects. However, the DCD does not indicate (1) how these effects are to consider consistent lateral displacement criteria (that is, the displacement effect on passive pressure is not the same as on friction development) and (2) how the effect of waterproofing is to impact the development of basemat friction capacity. DCD Section 3.8.5.5 needs to clearly indicate how these effects are incorporated into the standard plant design for the considered range of acceptable site conditions considered. Include this information in DCD Section 3.8.5.5. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-97	Ashar H	Clarify uplift (floatation) analysis methodology. Identify information available for audit. [Section 3.8.5.5]	DCD Section 3.8.5.5 presents two specifications of appropriate safety factors (SF) for foundation design. The SF against uplift indicates that the full calculated dead load will be used to counteract the potential effects of buoyancy. However, due to the uncertainty in calculation of plant dead loads, it is typical to limit the effective dead load to a fraction of the best estimate dead load, being typically limited to 0.90 of the full dead load. DCD Section 3.8.5.5 needs to clarify how the dead load will be defined for this uplift evaluation, including the treatment of the stored volume of water in the pools. Include this information in DCD Section 3.8.5.5. In addition, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-98	Ashar H	Note on overturning analysis methodology. [Section 3.8.5.5]	DCD Section 3.8.5.5 refers to DCD Section 3.7.2.14 for a description of the overturning analysis methodology. The staff has previously requested additional information on this subject in RAI 3.7-48. Revise DCD Section 3.8.5.5 if needed as a result of any changes made to Section 3.7.2.14 in response to RAI 3.7-48.
3.8-99	Ashar H	Clarify ISI commitments. [Section 3.8.5.7]	DCD Section 3.8.5.7 indicates that there are no testing or ISI requirements for the foundations. Has the applicant committed to RG 1.160 for monitoring of structures to meet the requirements of 10 CFR 50.65? If so, then modify DCD Section 3.8.5.7 to indicate this. If not, provide the technical basis in DCD Section 3.8.5.7.

RAI Number	Reviewer	Question Summary	Full Text
3.8-100	Ashar H	Clarify finite element modeling of the RB/FB foundation mat, Identify information available for audit. [Figure 3G.1-9]	DCD Figure 3G.1-9 shows the finite element (FE) Model of RB/FB Foundation Mat. Describe the type of finite elements used to model the foundation mat. Are they classical thin plate/shell type elements that have only membrane and bending behavior, or are they ""thick shell"" elements that also account for shear deformation also? How is the transition between the 5.1 meters and the 4 meters portions of the mat modeled? Given the thickness of the foundation mat identified in Table 3.8-13 (5.1 and 4 meters), provide the technical basis for using plate/shell type elements. **Include this information in DCD Appendix 3G. In addition**, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-101	Ashar H	Justify 2 sets of codes, standards, and specifications. Identify information available for audit. [Section 3.8.5.2]	DCD Section 3.8.5.2 implies that two separate sets of codes, standards, and specifications were used for the common RCCV/RB/FB foundation. Was the common foundation supporting the RCCV, RB, and FB actually designed to two different sets of codes, standards and specifications, as indicated, or was a uniform design basis employed? If two different design bases were employed, explain how this was implemented and justify the jurisdictional boundary. **Include this information in DCD Section 3.8.5.2. In addition**, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-102	Ashar H	Justify 2 sets of loads and load combinations. Identify information available for audit. [Section 3.8.5.3]	DCD Section 3.8.5.3 implies that two different sets of loads and load combinations were used for design of the common RCCV/RB/FB foundation. For the common foundation supporting the RCCV, RB, and FB, explain how two different sets of loads and load combinations were implemented, and justify the jurisdictional boundary. **Include this information in DCD Section 3.8.5.3. In addition**, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.

RAI Number	Reviewer	Question Summary	Full Text
3.8-103	Ashar H	Justify 2 sets of structural acceptance criteria. Identify information available for audit. [Section 3.8.5.5]	DCD Section 3.8.5.5 describes the structural acceptance criteria for foundations, and states that the containment portion follows DCD Section 3.8.1.5, and the rest of the foundations follow DCD Section 3.8.4.5. Was the common foundation supporting the RCCV, RB, and FB actually designed to two different sets of structural acceptance criteria, as indicated, or was uniform structural acceptance criteria employed? If two different structural acceptance criteria were employed, explain how this was implemented and justify the jurisdictional boundary. **Include this information in DCD Section 3.8.5.5. In addition**, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-104	Ashar H	Discuss numerical stability of NASTRAN solution. Identify information available for audit. [App. 3G figures of NASTRAN FE model]	Given the large disparity of element sizes in the NASTRAN model, how was the numerical stability of the solution checked and verified? In addition, a number of triangular elements around penetrations have large height-to-base aspect ratios, and likely produce less accurate results. Discuss any limitations on the use of the numerical results for these elements. **Include this information in DCD Appendix 3G. In addition**, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-105	Ashar H	Explain NASTRAN mesh. Identify information available for audit. [App. 3G Figures 3G.1-12, 3G.1-13]	Why is the desirable mesh shown in Figure 3G.1-13 for the suppression pool slab not duplicated for the top slab shown in Figure 3G.1-12? Why is the mesh un-symmetrical with respect to the 90-270 plane? **Include this information in DCD Appendix 3G. In addition**, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.
3.8-106	Ashar H	Explain NASTRAN results. Identify information available for audit. [App. 3G Figures 3G.1-30, 3G.1-31, 3G.1-38]	Explain why there is movement in the -x direction under dead load in Figure 3G.1-30, movement in the +x direction under drywell unit pressure in Figure 3G.1-31, and a slight rotation about y under vertical seismic load in Figure 3G.1-38. **Include this information in DCD Appendix 3G. In addition**, (1) identify the applicable detailed report/calculation (number, title, revision and date, and brief description of content) that will be available for audit by the staff, and (2) reference this report/calculation in the DCD.