October 11, 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. 77 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. This RAI concerns Chapters 3, 5, 14, 15, and 16 ESBWR Design Control Document (DCD) Tier 2, Revision 1, and DCD Tier 1, Revision 1.

Chapter 3: 3.6-22

Chapter 5: 5.4-20 and 5.4-53 through 5.4-58

Chapter 14: 14.2-61 through 14.2-62, and 14.3-92 through 14.3-93;

Chapter 15: 15.0-18 through 15.0-25;

Chapter 16: 16.2-33, 52 and 72, and 16.2-90 through 16.2-109.

To support the review schedule, you are requested to respond to this RAI by November 22, 2006.

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

Sincerely,

/RA/

Amy E. Cubbage, Senior 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 Amy Cubbage at (301) 415-2875 or aec@nrc.gov.

Sincerely,

/RA/

Amy E. Cubbage, Senior 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

ACCESSION NO. ML062830229

OFFICE	NESB/PM	NESB/BC(A)
NAME	ACubbage	JColaccino
DATE	10/10/2006	10/11/2006

OFFICIAL RECORD COPY

Distribution for DCD RAI Letter No. 77 dated October 11, 2006

Hard Copy

PUBLIC
NESB R/F
JColaccino
ACubbage

E-Mail

MGavrilas
ACRS
OGC
SGreen
ACubbage
JGaslevic
LRossbach
LQuinones
MBarillas
TKevern
DAllen
NSaltos
VKlein
GThomas
SJones
JHernandez

Requests for Additional Information (RAIs)
ESBWR Design Control Document (DCD), Tier 2, Chapters 3 and 5

RAI Number	Reviewer	Question Summary	Full Text
3.6-22	Tsao J	Remove LBB discussion from the DCD	We are not aware of any plans to use Leak Before Break (LBB) evaluation techniques for the ESBWR however LBB is described or referred to in several areas of the DCD. This primarily involves ESBWR DCD Tier 2, Revision 1, Section 3.6.3 and Appendix 3E, but it also includes references to LBB in ESBWR DCD Tier 1, Revision 1 and in other areas of the ESBWR DCD Tier 2, Revision 1. Please describe your plans to use LBB or remove discussions related to LBB from the DCD if it is not to be part of the certified design.
5.4-20	Davis R Karwoski K	Provide additional details on IC design	In your response to several RAIs (5.4-29, 5.4-33, 5.4-48) you provided some design information pertaining to the isolation condenser (IC). Please provide additional detail including the following: (A) The method of fastening the tubes to the tubesheet (IC drum) including a discussion of whether the tubes were expanded to facilitate tubing the heat exchanger; (B) Any stress risers that may exist along the length of the tube (e.g., bends, expansion transitions) and a discussion of whether they have been stress relieved (or the basis for not stress relieving); (C) Any crevices that may exist; (D) The design of the support structures for the IC tubes, if any, on the “pool side”and their materials of construction; (E) The heat treatment, if any, of the Alloy 600 tubes (and the technical basis for this heat treatment (or why one is not necessary)); (F) The spacing between the tubes and a discussion on the extent to which foreign object search and retrieval can be performed within the array of tubes; (G) More detail regarding the modules of the IC (refer to your response to RAI 5.4-47 in MFN 06-265).

RAI Number	Reviewer	Question Summary	Full Text
			The staff notes that more detailed design drawings than that provided in response to RAI 5.4-29 would facilitate the staff's review.
5.4-53	Davis R Karwoski K	Provide additional information regarding IC leak detection.	In DCD Tier 2, Revision 1, Section 5.4.6.2.2, it was indicated that a low-level leak (radiation level above background) results in an alarm to the operator. Please discuss how much above background these alarm setpoints will be (e.g., 2 times background). The staff notes that alarm setpoints slightly above background provide an early indication of a leak. In addition, please discuss operator actions to be taken in response to leakage (given that leakage would be an unanticipated occurrence). Please discuss whether the leak rate from a critical size flaw in an IC tube was determined and used in determining when the IC should be isolated. If not, why not? If so, discuss what you considered to be a critical size flaw.
5.4-54	Davis R Karwoski K	Please discuss the forms of degradation that the IC tubes are considered susceptible to during their design life. Discuss PC/ICC pool water chemistry.	(A) Please discuss the forms of degradation that the IC tubes are considered susceptible to during their design life (given the range of operating and design conditions permitted by the requirements). In your response, include the types of indications that have historically been observed in IC tubes (for those plants that use an IC, refer to RAI 5.4-33, MFN 06-249) and the reason for plugging IC tubes in operating reactors. (B) Discuss water chemistry assumed in PC/ICC pools, and provisions to monitor and maintain chemistry within assumed ranges.
5.4-55	Davis R Karwoski K	Discuss inservice inspection for the IC	In DCD Tier 2, Revision 1, Section 5.4.6.4, you indicated that routine inservice inspection is required for the IC in accordance with ASME Code Section III and Section XI (requirements for design and accessibility of welds). Please confirm that the entire length of all IC welds and the full length of each IC tube will be inspectible after fabrication. Please provide a specific reference to the ASME Code subsection/paragraph that contains the inspection requirements for the IC tubes. If the inspection scope, inspection frequency, inspection method, tube repair criteria, tube repair methods, and acceptance criteria are not included in those requirements, please provide them. In addition, please discuss the technical basis for these requirements. Please discuss the basis for the corrosion allowance used in determining the required wall thickness (please provide a reference to the actual corrosion data). In addition, please discuss whether this corrosion allowance has ever been exceeded in operating BWRs. If it has, please discuss the circumstances (and what requirements are in place to ensure that these

RAI Number	Reviewer	Question Summary	Full Text
			circumstances will not occur in the future). Please discuss the scope of the preservice inspection requirements of the IC tubes. If all tubes are not inspected during the preservice inspection, please discuss the basis.
5.4-56	Davis R Karwoski K	Discussed method/technique for inspecting the IC tubes.	Please confirm that the method/technique for inspecting the IC tubes is capable of detecting general wall thinning, pit-like defects, and stress corrosion cracking along the entire length of the tube (and through the entire tube wall thickness). Please discuss the method/techniques that can be used for inspecting the tubes and the qualification requirements for these methods. Please provide the qualification data supporting the inspection technique (to demonstrate that the tubes are inspectible).
5.4-57	Davis R Karwoski K	Provide additional information for the passive containment cooling system (PCCS) heat exchanger.	Please provide additional information for the passive containment cooling system (PCCS) heat exchanger for the staff to assess its design. (A level of detail similar to that requested for the IC in RAIs 5.4-20, 5.4-53 through 5.4-56 should be provided).
5.4-58	Davis R Karwoski K	Discuss the results of inspections performed on Alloy 600 components in operating BWRs	In your response to RAI 6.1-10 (MFN 06-365, October 4, 2006), you indicated that Alloy 600 has been deployed in several operating BWRs. Please discuss whether any of these plants have isolation condensors. In addition, discuss the inspections performed on these Alloy 600 components and the results. For example, discuss the extent to which the Alloy 600 has been inspected and the results of these inspections. The results should include any changes in the inspection results from the preservice inspection (if no preservice inspection was performed, please indicate so). Please include in your response all indications detected (i.e., not just those that required repair or further evaluation).

RAI Number	Reviewer	Question Summary	Full Text
14.2-61	Jones S	Update Tier 2 Initial Test Program information to incorporate all Tier 1 Test Requirements.	General Review Procedure III.9 of SRP 14.3, Rev. 0, states that the ITAAC should be consistent with the preoperational test program in DCD Tier 2, Section 14.2, since many of the pre-operational tests for structures, systems, and components (SSCs) can be used to satisfy an ITAAC. However, certain ITAAC described in DCD Tier 1, Revision 1, have not been included in DCD Tier 2, Section 14.2, Revision 1, descriptions of preoperational tests. For example: Item 12 of DCD Tier 1, Revision 1, Table 2.4.1-1 states that the accumulator for the pneumatic motor (PM) isolation valves in the isolation condenser (ICS) steam supply and condensate return valves have the capacity to close the valves three times, but DCD Tier 2, Revision 1, Section 14.2 does not describe testing of these accumulators. Similarly, Item 3 of DCD Tier 1, Revision 1, Table 2.6.2-1 states that flow paths for the emergency makeup of the Isolation condenser (IC)/passive containment cooling (PCCS) pools and the spent fuel pool from the offsite water supplies will be confirmed, but DCD Tier 2, Section 14.2 does not describe verification tests. In addition, various staff RAIs have resulted in the addition of ITAAC that involve tests. Update DCD Tier 2 Initial Test Program information to incorporate all DCD Tier 1 Test Requirements.
14.2-62	Jones S	Describe how the flood protection functions of the equipment and floor drain system would be tested.	DCD Tier 2, Revision 1, Sections 3.4 and 9.3 describe that the equipment and floor drain system routes flood water to safe collection areas and prevents backflow of flood water into areas containing important to safety equipment. Describe how these flood protection functions of the system would be tested.

RAI Number	Reviewer	Question Summary	Full Text
14.3-92	Jones S	Provide boundary conditions and the basis for the acceptance criterion for peak spent fuel rack temperature.	DCD Tier 1, Revision 1, Table 2.5.6-1, Item Number 2, states that calculations will be performed to determine the maximum temperature of the spent fuel racks. However, neither the boundary conditions for the calculations nor the basis for acceptance are specified in Tier 1 or DCD Tier 2, Section 9.1.2. Provide boundary conditions (e.g., bulk pool temperature and fuel decay heat rate) and the basis for the acceptance criterion for peak spent fuel rack temperature (e.g., no nucleate boiling (voiding) to ensure validity of criticality analysis and/or temperature used to establish rack thermal stress for structural analysis).
14.3-93	Hernandez J	Provide ITAAC for the Circulating Water System	Provide ITAAC in DCD Tier 1 for the Circulating Water System or provide the rational for not including it. The acceptance criteria should include an as-built inspection of the system, testing to demonstrate the system is functioning properly, and testing of the alarms and controls in the main control room.

RAI Number	Reviewer	Question Summary	Full Text
15.0-18	Saltos N	Verification of key assumptions, such as the reliability of I&C systems.	DCD Tier 2 Appendix 15A provides an analysis to determine the frequency of occurrence of events classified as infrequent events. Section 15A.4 lists four "analysis assumptions" that are to be confirmed by the COL applicant: • The feedwater control system (FWCS) is equipped with a triple-redundant, fault-tolerant digital controller (FTDC) including power supplies, and input/output signals. It is required that the Mean Time to Failure (MTTF) of the Feedwater System Controller be higher than 1000 years. Compliance to this requirement should be established through a reliability analysis by the vendor for the controller. • The steam bypass and pressure control (SB&PC) system is equipped with a triple-redundant, fault-tolerant digital controller (FTDC) including power supplies, and input/output signals. It is required that the Mean Time to Failure (MTTF) of the SB&PC Controller be higher than 1000 years. Compliance to this requirement should be established through a reliability analysis by the vendor for the controller. • The reactor water cleanup (RWCU)/shutdown cooling (SDC) system shall be designed with an interlock that prevents accidental engagement of the system in shutdown cooling mode when the reactor is in operation. The interlock feature shall be designed to be single-failure proof. • No single failure in the nitrogen system can lead to an Inadvertent Opening of a Safety/Relief Valve. (A) It is anticipated that the COL applicant would not be able to submit a reliability analysis of this equipment since it would not yet be procured. Explain the rationale for requiring that the COL applicant confirm the reliability of equipment rather than performing bounding assessments of the event frequencies, based on high level design features and principles. (B) Since the event frequencies provided in Appendix 15A form the basis for the categorization of events as "infrequent events" rather than anticipated operational occurrences, these key design features and principles should be

RAI Number	Reviewer	Question Summary	Full Text
15.0-18 (cont.)			included in Tier 1 design descriptions and ITAAC should be provided to verify them. (C) Add a COL information item to include the FWCS and the SB&PC in the design reliability assurance program (D-RAP) to ensure that the COL holder will evaluate the reliability of these components and determine if the equipment is acceptable or if it must be redesigned to achieve a lower failure rate.
15.0-19		Address impact of future design and analyses changes on Chapter 15A analyses results	The staff expects the applicant to revise the analyses presented in DCD Tier 2, Revision 1, Appendix 15A, as necessary, to address design changes as well as changes resulting from the resolution of RAIs related to DCD Tier 2 Chapter 19 and the ESBWR PRA.
15.0-20	Saltos N	Justify assumptions in frequency estimate for “Turbine Trip with Total Bypass Failure” (Section 15A.3.3) and “General load Rejection with Total Turbine Bypass failure” (Section 15A.3.4).	Please provide additional information to justify and/or clarify assumptions and statements made in DCD Tier 2, Revision1, Sections 15A.3.3 and 15A3.4: (A) A simplified process flow diagram of the Turbine Bypass System and associated fault tree that models the failure of seven or more of the 12 available Turbine Bypass Valves (TBVs) on demand. This information should be readily available since it is part of the information needed to respond to RAI 19.1.0-55 of the PRA (basic event N21-SYS-FF-BYPASS). Please include discussion of assumptions made about the failure of TBVs and support systems (e.g., AC power, I&C, compressed air, and individual valve accumulators). (B) It is stated (DCD Tier 2, Revision1, page 15A-4) that *“In the absence of specific data, the failure rates for the TBVs are estimated to be 6.0E-3 per demand, based on the failure for the safety/relief valves...”* The staff believes that the probability that a TBV fails when demanded to open depends on its failure mode and testing frequency. For example, if a TBV is considered to be an air-operated valve (AOV) that can fail to operate to other than the deenergized position, the failure rate of 3E-6/hour should be used in conjunction with anexposure time of 24 months. This would result in a failure probability on demand of 2.63E-2, which is significantly higher than the assumed probability of 6E-3. Please discuss.

RAI Number	Reviewer	Question Summary	Full Text
15.0-20 (cont.)			(C) It is stated (DCD Tier 2, Revision1, page 15A-4) that *"The common cause failure probability of seven valves is estimated by multiplying the individual TBV failure by a beta factor of 0.02. The value of 0.02 is judged to be a conservative value, especially since each valve is equipped with its own accumulator."* However, the data used to estimate common cause failure (CCF) multipliers do not include support system failures, such as compressed air. Therefore, the assumed beta factor may not be conservative. Actually, the value of the CCF multiplier for four or more AOVs reported in the ALWR Utility Requirement Document (Reference 15A-1 of the DCD) is close to 10 percent. Please discuss. (D) It is stated (DCD Tier 2, Revision1, page 15A-4) that *"The only relevant support system is the AC power and loss of AC power results in a different category of initiating event. Therefore, the failure of AC power is not considered...."* The staff believes that all failures that cause turbine bypass failure should be included in the assessed frequency (with the exception of loss of condenser, which is an analyzed event which includes and bounds the event considered in this analysis). Please discuss. (E) Please clarify the statement regarding the existence of groups of 3 or 6 TBVs that are actuated by hydraulic fluid from the main hydraulic lines separated by check valves. How is this design feature modeled for the purpose of assessing the probability of turbine bypass failure? Also, please clarify the statement that *"....the accumulator in each of the TBVs is designed with sufficient capacity to open at least six times."* (F) Please clarify whether the design of the TBVs is finalized and list any requirements for ensuring the availability of individual accumulators for the TBVs with the capabilities assumed in this analysis. (G) The frequency of Loss of Preferred Power (DCD Tier 2, Revision1, Section 15A.3.4) was assumed to be 4.6E-2 per year (PRA value). However, since the frequency of Loss of Preferred Power is site-specific, the assumed value may not be a bounding value which envelopes all potential sites. Please discuss.

RAI Number	Reviewer	Question Summary	Full Text
15.0-21	Saltos N	Justify assumptions in frequency estimate for “Loss of Feedwater Heating with Failure of Selected Control Rod Run-In” (Section 15A.3.6).	The staff notices that only I&C failures are discussed (see RAI 15.0-19) and that the loss of a division of non-Class 1E AC power is not considered in the frequency estimation (see RAI 15.0-21). These issues should be addressed. Also, additional information is needed on the assumed frequency of failure of feedwater heater and the modeling of I&C system in the analysis. (A) The frequency of the failure of feedwater heater is assumed to be 0.02 events per year. This value is taken from an old report of initiating events used in PRAs (NUREG/CR-3862, 1985) and may include significant uncertainty. Such uncertainty may not be as important in the PRA as in the assessment of the frequency of FSAR Chapter 15 events. Please provide additional information to justify the robustness of the assumed frequency value. (B) Additional information is needed for the staff to understand how the I&C systems were modeled in assessing the frequency of the “Loss of Feedwater Heating with Failure of Selected Control Rod Run-In” event. A simplified I&C block diagram, showing the processing of signals, important elements and design features (e.g., redundancy and diversity) and assumptions (e.g., independence and separation) for both automatic and manual actuation of components, would be very helpful. Such a simplified I&C block diagram could help answer staff questions, such as the following: (1) It is stated that the failure probability of the FWCS controller to send the redundant signals to the Rod Control & Information System (RC&IS) equipment, following a loss of feedwater heater event, is judged to be negligible because the FWCS is required for continued plant operation. This assumes that the failure of the FWCS is immediately detected and there are no significant hardware or software common cause failures. Please explain the basis of such assumptions. (2) It appears from the discussion that the RC&IS hardwired signals are back up to the RC&IS dual-redundant signals send to individual control rod logic equipment. However, in calculating the event frequency, the failure probabilities of these two events are added, instead of multiplied. Please clarify. In addition, please confirm that no operator action is required for the hardwired signals.

RAI Number	Reviewer	Question Summary	Full Text
15.0-22	Saltos N	Justify assumed interlock frequency (1E-3 per year) and operator error probability (1E-3) for "Inadvertent Shutdown Cooling Function Operation" (Section 15A.3.7).	The probability that the operator would inadvertently engage the RWCU/SDC system during power operation, given failure of the interlock feature, is assumed to be 1E-3. This may be a conservative value but no basis is provided in the analysis. It is stated that the RWCU/SDC system will have an interlock feature (no detailed design is available at this time) that will be shown (COL action item) to be single-failure proof. It is argued that the failure rate of a single-failure proof interlock feature is conservatively assessed to be 1E-3 per year. However, there is no basis provided to support the assumed interlock failure frequency. Additional justification is required. Alternatively, the proposed COL action item (to show that the interlock feature is single-failure proof) can be expanded to show, through a reliability analysis, that the mean time to failure (MTTF) is not higher than 1 in 1000 years, and to include the interlock in the D-RAP. Please discuss.
15.0-23	Saltos N	Justify assumptions in frequency estimate for "Inadvertent Opening of a Safety/Relief Valve" frequency estimate (Section 15A.3.8).	Please provide additional information to justify and/or clarify assumptions and statements made in DCD Tier 2, Revision1, Sections 15A.3.8: (A) It is stated (DCD Tier 2, Revision1, page 15A-12) that the probability of low setpoint setting or improperly locked setpoint spring, which goes undetected, is estimated to be negligible. However, no robust basis is provided to support this statement. Please provide historical data, if available, or use bounding arguments in a systematic analysis to estimate the probability of a human error that leads to an inadvertent opening of a relief valve (IORV) event. (B) The probability of excess Nitrogen pressure leading to an IORV was estimated to be 1.5E-6 per year. This value is based on a proposed COL action item to confirm that no single failure in the nitrogen system can lead to IORV and the assumption of independence of failures. Please justify the assumption that no CCFs of the nitrogen supply system can lead to an IORV event. Otherwise assess the CCF contribution and revise the related probability. In addition, the assumed repair time of one week for a nitrogen supply system valve may not be a conservative value and needs to be justified in terms of requirements (e.g., Technical Specifications). (C) It is stated (DCD Tier 2, Revision1, page 15A-12) that *"Per the analysis done for the DPV spurious actuation in Subsection 15A.3.9, the frequency of ......an IORV is 1.91E-04 per year."* The staff could not find this frequency value in DCD Tier 2, Revision 1, Section 15A.3.9. Please explain.

RAI Number	Reviewer	Question Summary	Full Text
15.0-24	Saltos N	Confirm that responses to RAIs 19.1-21 and 22 will address questions related to PRA modeling of the I&C system, including CCFs, which will clarify the analysis in Section 15A.3.9	The analysis performed to estimate the frequency of event “Inadvertent Opening of a Depressurization Valve” relies heavily on PRA modeling of the I&C systems. This includes assumptions about hardware and software CCFs. The staff is waiting for the applicant’s response to Chapter 19.1 (PRA) RAIs (#19.1-21 and #19.1-22) to continue the review of DCD Tier 2, Revision1, Section 15A.3.9. A brief discussion in Subsection DCD Tier 2, Revision1, 15A.3.9.2.2.7, on the frequency contribution of CCFs, does not provide the information the staff needs to understand how I&C hardware and software CCFs were modeled. Please confirm that the responses to RAIs 19.1-21 and 19.1-22 will address questions related to PRA modeling of the I&C system, including CCFs, which also will clarify the analysis in DCD Tier 2, Revision1, Section 15A.3.9. If not, please provide additional information in DCD Tier 2, Appendix 15A to address this concern.
15.0-25	Saltos N	Discuss the contribution of mechanical failures to the frequency of the events.	The contribution of mechanical failures to the frequency of the events is not discussed in many cases. Please discuss the reasons for not considering mechanical failures and clearly state any assumptions made in the analysis regarding mechanical failures. (A) In discussing events “Pressure Regulator Failure - Opening of All Turbine and Control Bypass Valves” and “Pressure Regulator Failure - Closure of All Turbine Control and Bypass Valves” (DCD Tier 2, Sections 15A.3.1 and 15A.3.2, respectively), only the failure of the SB&PC Controller is considered. Please include a simplified flow diagram of the SB&PC system and discuss whether a mechanical failure of the Turbine Control Valves (TCVs) can cause opening or closure of all the Turbine Bypass Valves (TBVs). (B) In discussing events “Loss of Feedwater Heating with Failure of Selected Control Rod Run-In” (DCD Tier 2, Section 15A.3-6) and “Control Rod Withdrawal Error - - during refueling, startup and power operation” (DCD Tier 2, Sections 15A.3.11, 15A.3.12 and 15A.3.13), mechanical failures are nowhere mentioned. In all of these cases a signal is sent to a system (or component) instructing it to perform a certain function but that system or component can be unavailable or fail mechanically. Note: This question is related to RAIs 15.2-6, 15.2-8, and 15.2-10.

RAI Number	Reviewer	Question Summary	Full Text
16.1-33	Thomas G	List of non-safety grade equipment	In RAI 15.0-2, the staff requested that General Electric (GE) provide a table in the DCD listing all of the non-safety grade related systems and components used for mitigating transients and accidents analyzed in DCD Tier 2, Chapter 15. GEs response to RAI 15.0-2, MFN 06-331, dated September 25, 2006, was submitted after the response to RAI 16.0-1, MFN 06-263, August 8, 2006, which provided a systematic evaluation of the information in the DCD against the requirements of 10 CFR 50.36(c)(2)(ii). GE is requested to review the response to RAI 16.0-1 in light of the information in the response to RAI 15.0-2 and identify any changes to the response to RAI 16.0-1 or to the Technical Specifications (TS).
16.2-52	Thomas G	SLMCPR Bases	RAI 15.0-16 explained the staff policy for the safety limit for minimum critical power ratio (SLMCPR). Since the staff policy is to include a numerical value for the SLMCPR, the following statement from the BWR/6 Standard Technical Specifications (STS), NUREG-1434, Revision 3, Volume 2, Bases 2.1.1.2a MCPR [GE Fuel], needs to be added if it is correct: "The MCPR SL is determined using a statistical model that combines all the uncertainties in operating parameters and the procedures used to calculate critical power."
16.2-75	Thomas G	Add DCD references to shutdown margin Bases	Add DCD Sections 15.3.8 and 15.3.9 to the references for TS Bases 3.1.1.
16.2-90	Thomas G	Control rod stuck statement deleted from Bases 3.1.3	Why was the following statement from the BWR/6 STS, NUREG-1434, Revision 3, Volume 2, Bases, deleted from DCD Tier 2, Revision 1, Chapter 16, TS Bases 3.1.3, A.1, A.2, A.3 and A.4? "A control rod is considered stuck if it will not insert by either CRD drive water or scram pressure."

RAI Number	Reviewer	Question Summary	Full Text
16.2-91	Thomas G	Scram times and pressures	DCD Tier 2, Revision 1, Chapter 16, TS Table 3.1.4-1, Control Rod Scram Times: Confirm that the scram times given in DCD Tier 2, Revision 1, Tables 15.2-2 and 15.2-3 are consistent with those given in DCD Tier 2, Revision 1, Chapter 16, TS Table 3.1.4-1. It seems that the scram times are given for different reactor pressures in these Tables, i.e., 950 psig and 1050 psig reactor steam dome pressure in the TS Tables and 1085 psig and between 1085 and 1250 psig bottom vessel pressure in the DCD Section 15.2 Tables. What is the significance of these different pressures?
16.2-92	Thomas G	Trains Vs Sub systems	DCD Tier 2, Revision 1, Chapter 16, TS 3.1.7 uses the term “Trains” for the Standby Liquid Control System (SLCS) whereas the BWR/6 STS, NUREG-1434, Revision 3, uses the term “Subsystems.” Why was the term “Subsystems” changed to “Trains” for ESBWR?
16.2-93	Thomas G	SLCS flow test	(A) Why isn’t the flow test required by the current BWR/6 STS, NUREG-1434, Revision 3, SR 3.1.7.8 to verify flow through one SLCS subsystem included in the proposed TS? (B) The BWR/6 STS, NUREG-1434, Revision 3, bases for SR 3.1.7.8 and 3.1.7.9 includes firing of an explosive SLCS squib valve. DCD Tier 2, Revision 1, Chapter 16, bases for the TS 3.1.7 SR includes verification of the SLCS squib valve actuation by the Inservice Test (IST) Program. Describe how the IST program verifies SLCS squib valve actuation, whether the IST program includes tests similar to this SR from the BWR/6 STS, and if it doesn’t include similar tests, why can’t such tests be performed for the ESBWR?
16.2-94	Thomas G	GDCS pool level	SR 3.5.2.1, Confirm that the Gravity-Driven Cooling System (GDCS) pool level of 21.65 ft specified for each pool is equivalent to the minimum total drainable inventory of 62,150 ft^3 as given in DCD Tier 2, Revision 1, Table 6.3-2.
16.2-95	Thomas G	GDCS flow test	TS 3.5.2, GDCS - Operating, Surveillance Requirements: The GDCS SR do not include a system flow performance surveillance test such as was included in the AP1000 TS for each Core Makeup Tank (SR 3.5.2.7) and In-Containment Refueling Water Storage Tank (SR 3.5.6.9) with a frequency of once in 10 years. Include a similar system level operability test program for ESBWR or explain why such a SR is not proposed.

RAI Number	Reviewer	Question Summary	Full Text
16.2-96	Thomas G	GDCS Component Testing	TS 3.5.2, GDCS - Operating, Surveillance Requirements: DCD Tier 2, Revision 1, Table 6.3-3 lists GDCS components which require surveillance testing. Add the check valves, flushing of injection line, venturi within GDC-RPV injection nozzles and deluge line flushing items from this table to the TS 3.5.2 SR or explain why such a SR is not proposed.
16.2-97	Thomas G	ADS and DPV timers	Confirm that all Automatic Depressurization System (ADS) and Depressurization Valve (DPV) timers are included in the TS.
16.2-98	Thomas G	GDCS LCO Conditions A, B, C, D	TS 3.5.2 Bases: Action A.1 states "If one GDCS injection branch line is inoperable, [at least [4] GDCS injection branch lines will be available to respond..." There are 8 injection branch lines so at least 7 injection branch lines will be available. (A) Clarify why only 4 GDCS injection lines are specified. (B) Clarify Action B.1, since there are 4 equalizing lines and if one equalizing line is inoperable the remaining 3 are operable. (C) Clarify Action C.1 for two GDCS injection branch lines inoperable and Action D.1 for two GDCS equalizing lines inoperable.
16.2-99	Thomas G	Refuel	Bases 3.9.2, Refuel Position One-Rod/Rod Pair-Out Interlock, Background: Why was the following portion of the TS 3.9.2 bases from the BWR/6 STS, NUREG-1434, Revision 3, deleted for the ESBWR? "This specification ensures that the performance of the refuel position one-rod-out interlock in the event of a DBA meets the assumptions used in the safety analysis...".
16.2-100	Thomas G	Mode 6	SR 3.9.2.1 Bases: Change "Mode 5" to " Mode 6" to agree with ESBWR Modes.
16.2-101	Thomas G	RPV Level during refueling	TS 3.9.6, Reactor Pressure Vessel (RPV) Water Level, addresses only movement of the irradiated fuel assemblies. Why was TS 3.9.7, RPV Level for new fuel assemblies and control rods, from BWR/6 STS, NUREG-1434, Revision 3, deleted for the ESBWR? Add new fuel assemblies to the Applicability section.

RAI Number	Reviewer	Question Summary	Full Text
16.2-102	Thomas G	Indicate when bracketed information in the TS will be resolved	Create a footnote for each bracketed item currently in the ESBWR TS to indicate whether the bracketed item will be filled in with standard value during the design certification (DC) review, or the value will remain bracketed to be filled in later by the COL applicant or holder. Please provide a table listing all of the bracketed items indicating DC, COL applicant, or COL holder responsibility.
16.2-103	Thomas G	Two STS Required Actions were removed from TS 3.1.1	BWR/6 STS, NUREG-1434, Revision 3, includes for TS 3.1.1 Shutdown Margin, LCO 3.1.1 Required Action D.4 “Initiate action to restore isolation capability in each required [secondary containment] penetration flow path not isolated” and Required Action E.5 “Initiate action to restore isolation capability in each required [secondary containment] penetration flow path not isolated.” These Required Actions are not in the proposed ESBWR TS. Provide the basis for exclusion of these Required Actions.
16.2-104	Thomas G	Deviation from STS SR 3.1.3.5 frequency	The BWR/6 STS, NUREG-1434, Revision 3, SR 3.1.3.5 Frequency includes “Each time the control rod is withdrawn to ‘full out’ position.” This portion of the SR Frequency was excluded from ESBWR STS. The overtravel position feature in the BWR/6 provides a positive check on the coupling integrity, since only an uncoupled CRD can reach the overtravel position. Provide basis for the exclusion of this SR Frequency from the ESBWR STS.
16.2-105	Thomas G	Deviation from STS “Notch Position” in TS Table 3.1.4-1	In ESBWR TS Table 3.1.4-1, Control Rod Scram Times, the column listing “Control Rod Percent Insertion” should list notch positions as is done in the BWR/6 STS, NUREG-1434, Revision 3. It is noted that in certain locations of 3.1.1 and 3.1.4 percent rod position is listed in brackets, with the assumption that these would be converted to notch position in later revisions of the TS. However, the column in Table 3.1.4-1 indicates that Control Rod Percent Insertion may be the means by which notch position is described in ESBWR STS. Provide a discussion of how control rod percent insertion versus notch position will provide benefit to licensed operators.
16.2-106	Thomas G	Deviation from STS SR 3.1.7.6 frequency	ESBWR TS SR 3.1.7.6 Frequency requires verification of boron solution concentration every 92 days, increased from the 31 days in BWR/6 STS, NUREG-1434, Revision 3, SR 3.1.7.5. Provide justification for the frequency change.
16.2-107	Thomas G	Deviation from STS TS 3.5.1 Required Actions	BWR/6 STS, NUREG-1434, Revision 3, SR LCO 3.5.1, Required Action G.2 “Reduce reactor steam dome pressure...” is omitted from ESBWR TS 3.5.1 Condition C, two ADS safety-relief valves (SRVs) inoperable, Condition D, two DPVs inoperable, and Condition E, three or more ADS SRVs or DPVs inoperable. Explain in detail why depressurization is not required for conditions C, D and E.

RAI Number	Reviewer	Question Summary	Full Text
16.2-108	Klein V Thomas G	TS 3.5.2 Action D unanalyzed condition	The Bases for TS 3.5.2, GDCS - Operating, Action D, Two equalizing lines inoperable, on page B 3.5.2-5 of DCD Tier 2, Revision 1, states that "This completion time is acceptable because the analysis described in Reference 5 (ECCS Topical Report-TBD) determined that [1] equalizing line is sufficient to respond to the design basis LOCA". Please submit the reference to justify this conclusion.
16.2-109	Thomas G	Bases for TS 3.11 and 3.1.1	In TS Bases 3.1.1, and 3.1.3, the control rod drop accident (CRDA) discussion was deleted from the bases. In TS Bases 3.1.3, A.1,A.2,A.3 and A.4, 3.1.6, 3.10.7, and 3.10.8, the CRDA is replaced by Rod Withdrawal Error (RWE) analyses. The treatment on the CRDA in the DCD is currently an open question (see NRC RAI 4.6-23). The treatment of CRDA in the TS Bases may need to be revised depending on the resolution of this issue.

ESBWR Mailing List

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

Mr, Jay M. Gutierrez
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

Ms. Sandra Sloan
Areva NP, Inc.
3315 Old Forest Road
P.O. Box 10935
Lynchburg, VA 24506-0935

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
sfrantz@morganlewis.com
ksutton@morganlewis.com
jgutierrez@morganlewis.com
mwetterhahn@winston.com
whorin@winston.com
gcesare@enercon.com
jerald.holm@framatome-anp.com
erg-xl@cox.net
joseph_hegner@dom.com
mark.beaumont@wsms.com
steven.hucik@ge.com
patriciaL.campbell@ge.com
bob.brown@ge.com
david.hinds@ge.com
chris.maslak@ge.com
James1.Beard@ge.com
kathy.sedney@ge.com
mgiles@entergy.com
tansel.selekler@nuclear.energy.gov or
tansel.selekler@hq.doe.gov
Frostie.white@ge.com
David.piepmeyer@ge.com
george.stramback@gene.ge.com