October 10, 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. 68 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 6, 8, 9, and 14 of the ESBWR design control document.

Chapter 6:	6.2-98 through 6.2-101; 6.3-39 and 6.3-42; 6.3-43 through 6.3-61; 6.4-1 through 6.4-4. Please respond to these RAI questions by November 22. 6.3-40 and 6.3-41. Please respond to these RAI questions by October 31.
Chapter 8:	8.5-1 through 8.5-5. Please respond to these RAI questions by October 27.
Chapter 9:	9.4-5 through 9.4-28. Please respond to these RAI questions by November 22.
Chapter 14:	14.3-77. Please respond to this RAI question by November 22.

To support the review schedule, you are requested to respond to these RAIs by the dates indicated above.

If you have questions or comments concerning this matter, please contact me at (301) 415-3207 or saw8@nrc.gov or you may contact Amy Cubbage at (301) 415-2875 or aec@nrc.gov.

Sincerely,

/RA/

Shawn A. Williams, 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

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ACCESSION NO. ML062770002 *See previous concurrence

OFFICE	NESB/PM*	NESB/PM*	NESB/BC(A)
NAME	S.Williams	A.Cubbage	JColaccino
DATE	10/04/2006	10/04/2006	10/10/2006

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Requests for Additional Information (RAIs)
ESBWR Design Control Document (DCD) Tier 2, Revision 1, Chapter 6, 8, 9, and 14

RAI Number	Reviewer	Question Summary	Full Text
6.3-43	Landry R Klein V	GDCS single failure analysis.	Provide additional details on the single failure analysis for the gravity driven cooling system (GDCS). Include details on the selection of the valve that fails and demonstrate that it is the most conservative single failure of the GDCS.
6.3-44	Landry R Klein V	ICS single failure analysis.	The staff was informed during an August 10, 2006, meeting of GE's plans to redesign the isolation condenser system (ICS) to increase the volume of water in the condensate line. State the impact of this planned change on the single failure analyses discussed in Table 6.3-6 of DCD Tier 2, Revision 1, and discuss impact on minimum water levels for the various break scenarios.
6.3-45	Landry R Klein V	Provide comparison of TRACG input decks for containment and reactor vessel water level response.	Provide in tabular format a side by side comparison of the differences between the TRACG input decks used for ESBWR containment and reactor vessel water level response (chimney level) analyses.
6.3-46	Landry R Klein V	Smaller break sizes than complete pipe break.	Provide additional information demonstrating that pipe breaks sizes selected for LOCA analyses are the most limiting sizes. Provide details on how these breaks were selected, include details on different size breaks for the different break locations (break sizes from that greater than the reactor pressure vessel (RPV) make-up rate up to double-ended guillotine breaks should be considered).

RAI Number	Reviewer	Question Summary	Full Text
6.3-47	Landry R Klein V	Provide elevations and pipe sizes.	Provide the elevation (relative to the bottom of the vessel) and diameter for all vessel penetrations including main steam lines, depressurization (DPV)/isolation condenser (IC) lines (DPV stub tube), feedwater lines and branch lines to RPV, reactor water cleanup/shutdown cooling (RWCU/SDC) return lines, isolation condenser return line, passive containment cooling system (PCCS) condensate return lines, GDCS injection lines, GDCS equalizing lines and RWCU/SDC (bottom) drain lines.
6.3-48	Landry R Klein V	Bounding break locations for DPV stub tube and RWCU/SDU breaks.	DCD Tier 2, Revision 1, Section 6.3.3.7.4 states that the maximum inside steam line break and the maximum feedwater line break were analyzed as representative cases for the maximum DPV stub tube break and the maximum RWCU/SDC suction line break. Provide the details from your analysis that demonstrate that the maximum inside steam line break and the maximum feedwater line break bound these cases.
6.3-49	Landry R Klein V	Bounding break locations for ICS condensate and GDCS equalizing line breaks.	Provide details demonstrating that the ICS condensate return line break and the GDCS equalizing line break are bounded by other break locations analyzed.
6.3-50	Landry R Klein V	Axial power shape for LOCA.	Provide the axial power shape used to perform the nominal and bounding LOCA analysis. Provide a discussion on how this shape was selected.
6.3-51	Landry R Klein V	Loss of power assumptions for LOCA analysis.	Provide additional information regarding the loss of power assumptions used during the LOCA analysis. Provide information regarding the timing of loss of off-site power and how it was assumed to occur at the most conservative time.
6.3-52	Landry R Klein V	Scram time delay for LOCA analysis.	GE submittal MFN 05-096 “Summary of September 9, 2005 NRC/GE Conference Call on TRACG LOCA SER Confirmatory Items,” dated September 20, 2005, states for item 7 that the scram time delay was incorporated into the DCD Chapter 6 LOCA cases. What is the scram time delay used? How was it incorporated into the TRACG input decks? Justify the delay time.

RAI Number	Reviewer	Question Summary	Full Text
6.3-53	Landry R Klein V	Constant verses dynamic gap conductance.	NRC staff review of TRACG input decks for LOCA analysis show that you are using a constant gap conductance. Explain the procedures for calculating these gap conductance values. Provide justification that the gap conductance selected is conservative at all times during the LOCA transient.
6.3-54	Landry R Klein V	Use of PRIME03 for fuel thermal conductivity in TRACG.	Section C.1.4.1 of NEDE-32176P, "TRACG Model Description," Revision 3, states that the correlation for thermal conductivity used in TRACG04 for UO2 with and without Gadolinia has been updated to be compatible with the model used in PRIME03. PRIME03 has not been reviewed and approved by the NRC staff. Provide justification for using this model.
6.3-55	Landry R Klein V	Using fuel thermal conductivity and gap conductivity from different sources.	Provide justification for using gas gap conductivity and fuel thermal conductivity from two different analysis codes (GSTRM for gap conductivity and PRIME03 for fuel thermal conductivity).
6.3-56	Landry R Klein V	More details needed on RPS action trip signals and set-points.	Provide more details on the sequence of events than the information that is provided in DCD Tier 2, Revision 1, Tables 6.3-7 through 6.3-10. Include trip signals and set-points for all reactor protection system (RPS) actions. Include actions necessary for long-term core cooling.
6.3-57	Landry R Klein V	Flow rates for passive systems.	Discuss how you plan to verify the assumed flow rates of the passive systems.
6.3-58	Klein V	Provide detailed information on bottom drain line common header configuration	Revision 1 of DCD Tier 2 Figure 5.1-4 shows that two bottom drain lines combine into a common header. What is the diameter of the lines at the vessel penetration? What is the diameter of the common header? Which line is broken for the bottom drain line loss of coolant analysis (LOCA) analysis?
6.3-59	Klein V	Isolation of bottom drain line	In the event of LOCA, are the bottom drain lines isolated? What signal isolates them? Discuss the consequences if these valves were to fail to isolate during any of the LOCA events.
6.3-60	Klein V	Volume of SLCS Tank	DCD Tier 2, Revision 1, Table 9.3-5 gives the minimum volume of the standby liquid control system (SLCS) tanks. Provide the maximum volume of SLC inventory that will be injected, so the staff can evaluate the possibility of boron precipitation,

RAI Number	Reviewer	Question Summary	Full Text
6.3-61	Klein V	Power Coastdown	Provide additional information on power coastdown (i.e., power from delayed neutrons contributing to fission power after the reactor scram) is accounted for with your decay heat curve in your TRACG input deck.
6.2-98	Wagage H Notafrancesco A	RAI 6.2-53 should be revisited using the *bounding* FWLB (one SRV failure)	RAI 6.2-53 should be revisited using the *bounding* feedwater line break (FWLB) (one safety relief valve (SRV) failure), which should include consideration of the following: (A) Explain what conservative assumptions regarding trapping and delayed release of noncondensible gases in drywell/gravity driven cooling system (GDCS) tank dead-ended volumes are made in the TRACG calculations to maximize drywell pressure during the post-GDCS draindown period; (B) In the TRACG calculation (of the bounding FWLB sequence) there are times when liquid water is being injected into the drywell from the FWLB (reactor pressure vessel (RPV) and balance of plant (BOP)). Explain TRACG models for how liquid water sources interact with the drywell atmosphere (i.e., flashing and partitioning of liquid water between atmosphere and pools, and direct contact heat and mass transfer, etc.). What assumptions are made regarding suspension and dropout of liquid water for the drywell atmosphere? (C) Provide transient nitrogen (air) mass profiles in the GDCS tank volumes; (D) Provide the transient RPV downcomer, two-phase water level profile. Indicate periods when liquid water is being injected into the drywell, and provide injected water and drywell atmospheric temperatures for those periods. (E) Provide plots of total PCC inlet vapor, noncondensible gas flows, entrained water droplets/aerosols (kg/s).

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			(F) Discuss any performance implications of wet as opposed to dry steam in the PCCS feed, and whether there has been testing of the PCC heat exchanger operation in a wet-steam environment.
6.2-99	Wagage H Notafrancesco A	Provide VB opening and closing differential pressure settings used in the TRACG calculations for the bounding FWLB (1 SRV failure) scenario	Provide the vacuum breaker (VB) opening and closing differential pressure settings used in the TRACG calculations for the bounding FWLB (1 SRV failure) scenario.
6.2-100	Wagage H Notafrancesco A	Explain pressure spike in short term pressure plot for the FWLB with one SRV failure sequence.	The staff compared Figure 6.2-53_1a in GE's response to RAI 6.2-53, (MFN-06-215 dated July 12, 2006) which is the short-term pressure plot of the FWLB with one SRV failure sequence to DCD Tier 2, Revision 1, Figure 6.3-10, which is the short-term plot of the FWLB with one GDCS valve failure sequence; recognizing that the short-term pressure peak occurs after the depressurization valves (DPVs) actuate (~80 seconds) which provides mass and energy directly to the drywell. It is noted that the automatic depressurization system (ADS) actuates much sooner and flow continues even after the DPVs open, therefore the only difference in the first hundred seconds between the FWLB sequences is that there are nine versus ten SRVs actuated. Please confirm that the one SRV failure case can justify such a sharp drywell peak pressure (i.e., as shown in Figure 6.2-53 1a, where there is a quick rise in pressure of approximately 7 psi), moreover the degree of sharpness to the pressure peak is usually not characteristic of thermal-hydraulic driven conditions. This result could be influenced by the code numerics which should also include the consideration of the applied nodalization scheme.
6.2-101	Wagage H Notafrancesco A	Provide design details for valves connecting the IC/PCCS expansion pools with Dryer/Separator Pool and Reactor Well to provide 72 hours of passive containment cooling capability.	Provide design details for valves connecting the Isolation Condenser (IC)/Passive Containment Cooling (PCC) expansion pools with Dryer/Separator Pool and Reactor Well to provide 72 hours of passive containment cooling capability. (A) Provide the flow areas connecting each of the pool compartments;

RAI Number	Reviewer	Question Summary	Full Text
			(B) Explain operator and/or automatic actions that are required to open the valves in pool #17, in order to refill the pools #1 thru #16 shown in Figure 6.2-74 , IC/PCC Pools Configuration, in MFN-06-215 dated July 12, 2006 (response to RAI 6.2-74). (C) Will power be available from the batteries at the time the valves are needed to open. Will the valves open at 72 hours even if the level in the level in the PCC pool has not dropped below the 29.6 meter elevation? (D) Regarding Figure 6.2-74, IC/PCC Pools Configuration, (MFN-06-215); there appears to be one flow path (through a single valve) connecting pool #17 to one half of the upper pools and another flow path through one valve connecting to the other half of the upper pools. It would appear a single valve failure could be postulated in which refill of half the upper pool would not occur and result in continued long-term boil-down of three PCCS heat exchangers. Therefore, the ESBWR DCD Rev1 limiting sequence for determining peak containment pressure, that is a FWLB w/1 SRV failure may not produce the highest peak containment pressure. If Figure 6.2-74 is correct, a revised TRACG FWLB bounding analysis with failure of one of these refill lines should be pursued. If it is not correct, Figure 6.2-47 in MFN-06-215 should be revised and resubmitted, and the IC P&ID submitted in MFN-06-107 dated May 12, 2006, should be revised to show the correct number of valves connecting the pools. (E) Revise DCD Tier 2 to include design details for the IC/PCC pools including the number of valves connecting the IC/PCCS expansion pools with Dryer/Separator Pool and Reactor Well to provide 72 hours of passive containment cooling capability, the automatic and/or operator actions necessary to open the valves, and the instrumentation and setpoints that will signal these actions. Revise DCD Tier 2, Figure 6.2-2, to show the correct number of valves connecting the pools.

RAI Number	Reviewer	Question Summary	Full Text
14.3-77	Wagage H	Provide Tier 1 design description and ITAAC for valves connecting IC/PCCS expansion pools with Dryer/ Separator Pool and Reactor Well to provide 72 hrs of passive cooling capability	DCD Tier 1, Sections 2.4.1 and 2.15.4 should be revised to indicate that valves connecting IC/PCCS expansion pools with Dryer/ Separator Pool and Reactor Well must open to provide 72 hrs of passive cooling capability. Include a figure in Tier 1 showing the configuration of the IC/PCC expansion pools and the connection to the Dryer/Separator Pool and Reactor Well, and provide an ITAAC to verify this configuration.
8.5-1	Raval J	Provide specific detail as to what type of passive cooling features are employed to sustain the CRHA envelope design to a temperature rise of 8.3 ^{0}C in 72-hours.	DCD Tier 2 Section 9.4.1.1 states: "The Control Room Habitability Area (CRHA) is isolated during Station Blackout (SBO) conditions and the safety-related EBAS provides pressurization and breathing quality air." It is further stated in the above section that "The Main Control Room (MCR) temperature rise is limited by the CRHA envelope design to 8.3^0 C for 72-hours in an emergency mode of operation with a SBO event by passive cooling features." However, the specific detail regarding what type of passive cooling features are employed to sustain the CRHA envelope design to a temperature rise of 8.3 ^{0}C in 72-hours was not provided. Please provide specific detail as to what type of passive cooling features are employed to sustain the CRHA envelope design to a temperature rise of 8.3 ^{0}C in 72-hours. Also describe the use of any portable cooling devices such as portable fans, cooling coils, etc., powered from a portable generator needed during this 72-hour period.
8.5-2	Raval J	Provide coping assessment for 8-hour SBO duration concerning the loss of ventilation effects in accordance with Section 7.2.4 of NUMARC-8700.	DCD Tier 2 Section 8.1.5.2.4, Regulatory Requirements, states "The ESBWR does not require AC power to achieve safe shutdown. Thus, ESBWR meets the intent of Regulatory Guide 1.155. The Station Blackout evaluation is provided in Section 15.5." The performance evaluation for SBO based on TRACG to the requirements of 10 CFR 50.63 is presented in DCD Section 15.5.5, Station Blackout. However, it does not address how the ESBWR design conforms with Section 7.2.4, "Effects of Loss of Ventilation," of NUMARC-8700, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors" for 8-hours coping duration. Please provide coping assessment for 8-hour SBO duration concerning the loss of ventilation effects in accordance with Section 7.2.4 of NUMARC-8700.

RAI Number	Reviewer	Question Summary	Full Text
8.5-3	Shum D	Identify/list all the air-operated valves that are required to be cycled to cope with an SBO event of 8-hour duration.	Identify/list all the air-operated valves (necessary for decay heat removal) that are required to be cycled to cope with an SBO event of 8-hour duration.
8.5-4	Shum D	Provide demonstration to ensure that air operated valves required to cope with an SBO event have sufficient compressed air.	Provide additional information to demonstrate that air operated valves required to cope with an SBO event have sufficient compressed air or can be manually operated under SBO conditions for the specified duration of 8 hours.
8.5-5	Shum D	Provide additional information on air-operated valves for SBO event.	For air-operated valves that rely on manual operation as backup to the compressed air to cope with an SBO event, provide the following: * accessibility to the valves in an SBO event; and * identification of the valves to be used in an SBO event.
6.3-39	Lu S	Identify the fiber and particulate contents of the insulation materials described in Chapter 6, the amount of the material, and the location of the insulated cooling water lines.	Please address the following questions related to the debris source term: a) DCD Tier 2, Section 6.1 (Page 6.1-1), states that the thermal insulation materials are primarily metallic and metal-encapsulated. Some antisweat and nonmetallic thermal insulation material will be used on the cooling water lines. Please identify the fiber and particulate contents of these insulation materials, the amount of the material and the location of these cooling water lines. In addition, for the metal-encapsulated insulation, please identify the type of material underneath the metal-encapsulation. If they contain fiber and particulate, please discuss the mass amount. b) If the antisweat insulation, nonmetallic insulation and metal-encapsulated materials contain either fiber or particulate material, please describe the possible destruction mechanisms if they are exposed to a high energy jet from a postulated pipe break. Please discuss the destruction pressures of these materials.

RAI Number	Reviewer	Question Summary	Full Text
6.3-40	Lu S	Provide TRACG results to demonstrate that the equalization line check valves do not open during any design basis LOCA cases within 72 hours of a LOCA and beyond.	In DCD Tier 2, Section 6.3, it was indicated that the suppression pool equalization lines are considered part of emergency core cooling system (ECCS) and that they are credited for the bottom drain line loss of coolant accident (LOCA) case. However, GE representatives have stated in meetings that for all design basis LOCA scenarios, the equalization line check valves are not opened due to high vessel downcomer water level. Please provide TRACG analysis results (differential pressure (DP) across equalization line check valves) for all design basis LOCA cases to demonstrate that the valves would not be opened during design basis LOCA cases within 72 hours of a LOCA and beyond. In addition, please provide the calculation uncertainties of the calculated DP across the check valves.
6.3-41	Lu S	Provide additional justification that the design of the GDCS is adequate to prevent debris from blocking the GDCS injection line and/or fuel bundles.	There is a narrow opening between the gravity driven cooling system (GCDS) pool airspace and the drywell (DW). DCD Tier 2, Section 6.3.2.7.2, states that the GCDS pool airspace opening to the DW will be covered by mesh screens or equivalent to prevent debris from entering the GDCS pool and potentially blocking the coolant flow through the fuel. Please specify wither a mesh screen or an alternate feature will be used to prevent debris from entering the GDCS pool. The size of the opening between the GDCS pool airspace and the DW and the proposed mesh screen may significantly reduce the amount of the debris getting into the pool, however, it does not eliminate the possibility that a nearby two-phase jet may push a certain amount of debris into the pool and cause injection line or fuel bundle inlet blockage. Without strainers at the inlet of the GDCS injection lines, any debris brought into the GDCS pool by two-phase jets could possibly get into the injection lines and potentially block valves in the system. Please evaluate the current GDCS design and justify why strainers are not necessary at the inlet of the GDCS injection lines to prevent debris from causing injection line and/or fuel bundle blockages.

RAI Number	Reviewer	Question Summary	Full Text
6.3-42	Lu S	Provide the maximum steam velocity at the inlet of the PCCS suction line calculated by the TRACG code for all design basis LOCA cases.	During a LOCA, if the passive containment cooling system (PCCS) heat exchanger inlets are within the zone of influence (ZOI), debris ingress is expected. Please provide the maximum steam velocity at the inlet of the PCCS suction line calculated by the TRACG code for all design basis LOCA cases. Discuss the impact of the debris on the heat transfer performance of the heat exchanger.
6.4-1	Raval J Walker H	Provide a list of Codes and Standards used in the design of the ESBWR Control Room Habitability Systems.	In DCD Tier 2, Rev. 1, Section 6.4, "Control Room Habitability Systems," the applicant did not provide a list of Codes and Standards used in the design of the ESBWR Control Room Habitability Systems. The design of these systems will typically reference ASTM Standards, ASHRAE Standards, Regulatory Guides, the *Code of Federal Regulations*, and others. Provide (as references) a list of Codes and Standards used in the design of the ESBWR Control Room Habitability Systems. The NRC staff expects the ESBWR design to commit to the latest revisions of the applicable Codes and Standards and include this commitment in the DCD.
6.4-2	Raval J Walker H	Relocate the system description of EBAS from DCD Tier 2 Section 9.4.1 to DCD Tier 2 Section 6.4 and provide additional systems details.	Relocate the system description of emergency breathing air system (EBAS) from DCD Tier 2, Rev. 1, Section 9.4.1 to DCD Tier 2 Section 6.4. Also, the systems described in DCD Tier 2, Sections 6.4 and 9.4.1 should include additional details as follows: a. Provide component descriptions of major components (compressed breathing air tanks, isolation and relief valves, piping, instrumentation including flow orifices and flow and pressure indicators, self contained portable breathing apparatus, etc.) with their applicable Codes and Standards and their design features (e.g., capacity, material, differential pressures, leak tightness, etc.) b. Provide details of the design features of the concrete walls, slabs, system components, control room habitability area (CRHA) envelope doors, sealing materials (for construction joints and penetrations) piping, conduits, electrical cable trays penetrations, etc., and unfiltered inleakages inside CRHA envelope.

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			c. Provide a detailed description of how the inservice inspection and testing will be conducted in accordance with applicable Technical Specifications. d. Confirm that: 1) EBAS air flow rate is sufficient to maintain pressurization of the CRHA envelope of at least 1/8-inches of W.G. with respect to adjacent areas 2) Air quality including carbon dioxide concentration below one-half percent by volume for 5 persons (evaluate for maximum numbers of occupants during accident conditions) within the CRHA envelope is within the guidelines of Table 1, and Appendix C, Table C-1, of the ASHRAE Standard 62-[Latest-Edition]. 3) State that the storage capacity of the compressed breathing air tanks is verified to assure 72-hours of air supply, i.e., 72-hours for the required number of CRHA envelope occupants (provide data indicating the amount of air stored in cfm and the corresponding pressure). In addition, provide a discussion explaining how the breathing air quality meets the U.S. Occupational Safety and Health Administration (OSHA) and ASHRAE Standards. e. Provide a description of how air sampling is performed and at what frequency to conform with the guidelines of Table 1, and Appendix C, Table C-1 of the ASHRAE Standard 62-[Latest-Edition]. f. GDC 19, “Control Room,” requires applicants to provide adequate protection to permit access and occupancy of the control room under accident conditions including loss of coolant accidents. In order to meet GDC 19 requirements, the control room shall be maintained by providing safety-related radiation protection, toxic protection and safety-related cooling function.

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			In DCD Tier 2, Rev. 1, Table 6.4-1, the applicant provided temperature profiles for the CRHA envelope during normal operation and station Blackout (SBO) conditions. However, DCD Tier 2, Rev. 1, Section 6.4 does not address CRHA envelope environment and equipment operability under accident conditions. Address the safety-related cooling function by providing a habitable environment below the human threshold and maintaining appropriate equipment operability inside CRHA envelope such that the control room operators can carry out needed actions to maintain the nuclear power plant in a safe condition under accident conditions, including loss-of-coolant accidents. g. The applicant did not address the "Failure Mode and Effect Analysis" (FMEA) in DCD Tier 2, Rev. 1, Sections 6.4 and 9.4.1 when concluding that EBAS is capable of functioning in spite of the loss of active components and detecting and controlling leakage of airborne contamination (radiation, smoke, and toxic chemicals) to meet the requirements of GDC 19 and conform with the guidance of NUREG-0800, Standard Review Plan (SRP) Section 6.4, "Control Room Habitability System" and SRP Section 9.4.1, "Control Room Area Ventilation System." Provide a FMEA (table format preferred) and provide EBAS and CRHA heating, ventilation, and air conditioning sub-system (CRHAHVS) assessments in DCD Tier 2 Sections 6.4 and 9.4.1 to conclude that EBAS and CRHAHVS are capable of functioning despite the loss of active components, detecting and controlling leakage of airborne contamination (radiation, smoke, and toxic chemicals), and functioning during a loss-of-power events.
6.4-3	Raval J Walker H	Provide information regarding onsite chemicals and a list of main control room habitability indications and alarms.	Provide information regarding onsite chemicals (table format preferred) with chemical names such as hydrogen, nitrogen, CO2, oxygen scavenger, pH addition, sulfuric acid, sodium hydroxide, dispersant, fuel oil, corrosion and scale inhibitors, biocide/disinfectant, algicide, etc., with their associated states (i.e., gas or liquid), and their specific building locations for the staff's review. Also provide a list of main control room habitability indications and alarms, and information regarding loss of ac power heat load limits including type of rooms, room numbers, heat load for 0-24 hours in "btu/sec," and heat load for 24-72 hours in "btu/sec."

RAI Number	Reviewer	Question Summary	Full Text
6.4-4	Raval J Walker H	Revise DCD Tier 2 Figure 6.4-1 to show details such as major components and piping.	Revise DCD Tier 2, Rev. 1, Figure 6.4-1, “Emergency Breathing Air System Schematic Diagram,” to show details such as major components (e.g., compressed breathing air tanks, pressure control and relief valves, orifices, pressure relief dampers, etc.) and piping (located inside and outside the CRHA envelope) with their Tag numbers and associated instrumentation including sizing and capacity data.
9.4-5	Raval J Walker H	Provide a list of Codes and Standards used in the design of the ESBWR air conditioning, heating, cooling, and ventilation systems.	In DCD Tier 2, Rev. 1, Section 9.4, “Air Conditioning, Heating, Cooling, and Ventilation,” the applicant did not provide a list of Codes and Standards used in the design of the ESBWR air conditioning, heating, cooling, and ventilation systems. The design of these systems will typically reference ASTM Standards, ASHRAE Standards, Regulatory Guides, the Code of Federal Regulations, and others. Provide (as references) a list of Codes and Standards used in the design of the ESBWR air conditioning, heating, cooling, and ventilation systems. The NRC staff expects the ESBWR design to commit to the latest revisions of the applicable Codes and Standards and include this commitment in the DCD.
9.4-6	Raval J Walker H	In DCD Tier 2 Section 9.4 provide a summary with the plant areas served by the nuclear filtration systems.	In DCD Tier 2 Section 9.4 provide a summary (table format preferred) with the plant areas served by the nuclear filtration systems including CRHAHVS, radwaste building HVAC (RWBHVAC), turbine building HVAC (TBHVS), controlled area ventilation subsystem of reactor building HVAC (CONAVS), refueling and pool area ventilation subsystem of fuel building HVAC(REPAVS), and technical support center(TSC) HVAC subsystems with their associated design/testing standards, filtration efficiency, design air flow rates and ambient pressure data, humidity control, charcoal adsorber thickness and maximum in-leakage flow. In addition, identify the minimum instrumentation and controls for the nuclear filtration systems (in accordance with regulatory guide (RG) 1.140 and ASME N509, Table 4-2).
9.4-7	Raval J Walker H	The applicant should relocate the content of DCD Tier 2, Section 9.4.9 to DCD Tier 2 Section 6.2.5.2.	“Containment Inerting System” is described in two different places, i.e., DCD Tier 2, Rev. 1, Sections 6.2.5.2 and 9.4.9. However, the “Containment Inerting System” should be in DCD Tier 2, Section 6.2.5, “Combustible Gas Control in Containment,” and not as part of “DCD Tier 2 Section 9.4. Therefore, the applicant should relocate the content of DCD Tier 2, Section 9.4.9 to DCD Tier 2, Section 6.2.5.2.

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9.4-8	Raval J Walker H	Provide component descriptions for each of the HVAC systems described in DCD Tier 2, Section 9.4 and updated system figures.	In general, the Codes and standards are identified in DCD Tier 2, Rev. 1, Table 1.9-22 that are applicable to ESBWR design. However, DCD Tier 2, Rev. 1, Sections 6.4 and 9.4, do not have component descriptions indicating the type of components and their capacities, and specific Codes and standards used for design, fabrication and testing of the system components for EBAS and various HVAC systems. In addition, the supplied engineering drawings do not contain sufficient details as would be included on piping and instrument diagrams (P&ID) that would include equipment Tag Numbers, flow and sizing data, notes, etc., that assist in determining how this system operates. Therefore, provide: a. Component descriptions for each of the HVAC systems described in DCD Tier 2 Sections 9.4.1, 9.4.2, 9.4.3, 9.4.4, 9.4.6, 9.4.7, and 9.4.8 and control room habitability systems described in DCD Tier 2, Section 6.4, including Code and Standards information for the system equipment (e.g., fans, cooling and heating coils, filters, compressed breathing air tanks, two stage pressure regulators, isolation valves, sample ports, flow indicators, flow orifices, CRHA distribution piping, including flow orifices and flow and pressure indicators, relief valves and dampers, ductwork, and unique capacity/sizing information). b. Updated system figures including sufficient details such as simplified instrumentation and control logics, piping criteria designation, equipment Tag Numbers, flow and sizing data, applicable P&ID notes, etc.
9.4-9	J. Raval & H. Walker	Explain how ESBWR complies with each position listed in the RGs 1.29, 1.78, 1.140, 1.155, 1.194, 1.196, and 1.197, and Bulletin 80-03.	The applicant referenced the applicability of various Regulatory Guides (RGs) for the ESBWR design in DCD Tier 2, Rev. 1, Table 1.9-21; provide details in DCD Tier 2 explaining how ESBWR complies with each position listed in the RGs 1.29, 1.78, 1.140, 1.155, 1.194, 1.196, and 1.197, and Inspection and Enforcement Bulletin 80-03. Also, provide details in DCD Tier 2 discussing the applicability of Generic letters (GLs) 99-02 and 2003-01.

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9.4-10	Raval J Walker H	Revise DCD Tier 2, Sections 6.4 and 9.4 in detail to conform with the guidance of B-36, B-66, Issue 83, and TMI TAP Item III.D.3.4.	The applicant referenced the conformance of the Task Action Plan Items B-36 and B-66, Generic Issue 83, and TMI Task Action Plan (TAP) Item III.D.3.4, "Control Room Habitability,"in DCD Tier 2, Rev. 1, Table 1.11-1. However, you have not addressed the detailed conformance in DCD Tier 2, Rev. 1, Sections 6.4 and 9.4. Therefore, revise DCD Tier 2, Sections 6.4 and 9.4 in detail to conform with the guidance and requirements of B-36, B-66, Issue 83, and TMI TAP Item III.D.3.4.
9.4-11	J. Raval & H. Walker	Quantify the expression of slightly negative and slightly positive differential pressure.	In DCD Tier 2, Rev. 1, Sections 9.4.3, 9.4.4.2, 9.4.6.5 and 9.4.7.1, the expression of both slightly negative and slightly positive is used when referring to differential pressure. Quantify these expressions by providing values for slightly positive and slightly negative for these sections, and if these expressions are used other places in the DCD, provide values there also. In addition, provide intake and exhaust flows for all systems that are required to support differential pressure (table format preferred).
9.4-12	J. Raval & H. Walker	Relocate the entire contents of the text concerning the safety-related EBAS in DCD Tier 2, Section 9.4.1 to DCD Tier 2, Section 6.4.	EBAS is a stand-alone system and is one of the safety-related control room habitability systems as described in DCD Tier 2, Rev. 1, Section 6.4 and is not a conventional HVAC and filtration system relied on during accident conditions for current operating reactors. Therefore, the applicant should relocate the entire contents of the text concerning the safety-related EBAS in DCD Tier 2, Rev. 1, Section 9.4.1 to DCD Tier 2, Section 6.4. Verify that DCD Tier 2, Section 6.4 contains EBAS information including its safety design basis and power generation design basis, safety-related areas being served with their temperature profile, post 72-hour design basis, Codes and Standards of the equipment involved (compressed breathing air tanks, isolation and relief valves, piping, instrumentation including flow orifices and flow and pressure indicators, etc.), system description, safety operation, safety evaluation, testing and inspection requirements, and instrumentation requirements. Also, revise the text of DCD Tier 2, Section 9.4.1, as needed to reflect these changes.
9.4-13	Raval J Walker H	Clarify inconsistency in DCD Section 9.4.1.	DCD Tier 2, Rev. 1, Section 9.4.1 is titled "Control Room Area Ventilation System (CRAVS)," but the text of DCD Tier 2, Rev. 1, Section 9.4.1, Paragraph 1, refers to the system as "Control Building Heating, Ventilation and Air Conditioning System (CBHVS)," Please clarify inconsistency.

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9.4-14	Raval J Walker H	Explain how the CRHAHVS periodic tests meet RGs 1.52 and 1.140 respectively or provide an acceptable alternative approach.	The applicant stated in DCD Tier 2, Rev. 1, Section 9.4.1.4 that, "the CRHAHVS filtration components are periodically tested in accordance with ANSI/ASME N509, Nuclear Power Plant Air Cleaning Units and Components, and ANSI/ASME N510, Testing of Nuclear Power Plant Air Cleaning Systems. HEPA filters are tested periodically with dioctyl phthalate (DOP), and the charcoal filters are periodically tested for bypass." Please explain how these periodic tests meet the NRC staff's acceptance criteria for engineered safety feature (ESF) and normal atmospheric cleanup systems air filtration and adsorption units contained in RGs 1.52 and 1.140 respectively or provide an acceptable alternative approach. Include information in DCD Tier 2, Section 9.4.1.4.
9.4-15	Raval J Walker H	Update section 9.4.1 to provide details demonstrating how the ESBWR design for the control room ventilation system meets the acceptance criteria	The applicant stated in DCD Tier 2, Rev. 1, Tables 1.9-9 and 1.9-20 that ESBWR conforms with the guidance of SRP Section 9.4.1, Revision 2, for control room area ventilation system. SRP Section 9.4.1 lists the acceptance criteria as GDC 2, 4, 5, 19, and 60 and provides guidance on how to meet these criteria, in a way that is acceptable to the NRC staff, for the control room area ventilation system. However, DCD Tier 2, Rev. 1, Section 9.4.1 does not contain details on how these criteria will be met. For example, RG 1.29 provides an acceptable way to comply with GDC 2, RG 1.78 provides some information (but not all) regarding compliance with GDC 19. Update section 9.4.1 to provide details demonstrating how the ESBWR design for the control room ventilation system meets the acceptance criteria of GDC 2, GDC 4, GDC 5, GDC 19, and GDC 60.
9.4-16	Raval J Walker H	Explain phrase "[raw807]" on Section 9.4.1.1, Page 9.4-2, Line Number 7.	Explain what the phrase "[raw807]" means on Page 9.4-2, Line Number 7 of DCD Tier 2, Rev. 1, Section 9.4.1.1. Also define similar references to other phrases elsewhere in DCD Tier 1 and Tier 2 and revise these documents as needed.

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9.4-17	Raval J Walker H	Discuss compliance with GDC 19 requirements	DCD Tier 2, Rev. 1, Sections 6.4 and 9.4.1 is silent with respect to temperature profiles for the human threshold. In order for the staff to understand how operators will be able to take appropriate actions, and to maintain appropriate equipment operability inside the CRHA during first 72-hours, and for the period of 72-hours to 30 days following the onset of an accident, provide a discussion demonstrating how the ESBWR design meets the requirement of GDC 19 to provide a control room from which actions can be taken to operate the nuclear power unit safely under normal conditions and to maintain it in a safe condition under accident conditions. Also, provide data (table format preferred)on temperature and humidity profiles during the above periods in DCD Tier 2 Sections 9.4.1 and 6.4.
9.4-18	Raval J Walker H	Discuss compliance of spent fuel pool area ventilation system design with GDC 2, GDC 5, GDC 60, and GDC 61.	The applicant stated in DCD Tier 2, Rev. 1, Tables 1.9-9 and 1.9-20 that ESBWR conforms with the guidance of SRP, Section 9.4.2, Revision 2, for spent fuel pool area ventilation system. SRP Section 9.4.2 lists the acceptance criteria as GDC 2, 5, 60, and 61 and provides guidance on how to meet these criteria, in a way that is acceptable to the NRC staff, for the spent fuel pool area ventilation system. However, DCD Tier 2, Rev. 1, Section 9.4.2 does not contain details on how these criteria will be met. For example, RG 1.29 provides an acceptable way to comply with GDC 2. Provide details demonstrating how the ESBWR design for the spent fuel pool area ventilation system meets the acceptance criteria of GDC 2, GDC 5, GDC 60, and GDC 6. Update DCD Tier 2 Section 9.4.2 to include these details.

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9.4-19	Raval J Walker H	Discuss compliance of radwaste building heating, ventilation and air conditioning system design with GDC 2, GDC 5, and GDC 60.	The applicant stated in DCD Tier 2, Rev. 1, Tables 1.9-9 and 1.9-20 that ESBWR conforms with the guidance of SRP, Section 9.4.3, Revision 2, for auxiliary and radwaste area ventilation system. SRP Section 9.4.3 lists the acceptance criteria as GDC 2, 5, and 60 and provides guidance on how to meet these criteria, in a way that is acceptable to the NRC staff, for the radwaste building heating, ventilation and air conditioning system. However, DCD Tier 2, Rev. 1, Section 9.4.3 does not contain details on how these criteria will be met. For example, RG 1.29 provides an acceptable way to comply with GDC 2. Provide details demonstrating how the ESBWR design for the radwaste building heating, ventilation and air conditioning system meets the acceptance criteria of GDC 2, GDC 5, and GDC 60. Update DCD Tier 2, Section 9.4.3 to include these details.
9.4-20	Raval J Walker H	Correct RG 1.140 title and confirm commitment to RG 1.140, Revision 2.	The applicant stated in DCD Tier 2, Rev. 1, Section 9.4.3.4 that "Filtration units, including HEPA filters, are periodically tested in accordance with RG 1.140, Nuclear Air and Gas Treatment." However, the correct title of RG 1.140 is "Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Normal Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants." Correct RG 1.140 title and confirm commitment to RG 1.140, Revision 2.
9.4-21	Raval J Walker H	Discuss compliance of turbine building HVAC system design with GDC 2, GDC 5, and GDC 60.	The applicant stated in DCD Tier 2, Rev. 1, Tables 1.9-9 and 1.9-20 that ESBWR conforms with the guidance of SRP Section 9.4.4, Revision 2, for turbine area ventilation system. SRP Section 9.4.4 lists the acceptance criteria as GDC 2, 5, and 60 and provides guidance on how to meet these criteria, in a way that is acceptable to the NRC staff, for the turbine building ventilation system. However, DCD Tier 2, Rev. 1, Section 9.4.4 does not contain details on how these criteria will be met. For example, RG 1.29 provides an acceptable way to comply with GDC 2. Provide details demonstrating how the ESBWR design for the turbine building HVAC system meets the acceptance criteria of GDC 2, GDC 5, and GDC 60. Update DCD Tier 2, Section 9.4.4 to include these details.
9.4-22	Raval J Walker H	Explain how the TBHV periodic tests meet RGs 1.52 and 1.140 or provide an acceptable alternative approach.	The applicant stated in DCD Tier 2, Rev. 1, Section 9.4.4.4 that, "The TBHV system filtration components are periodically tested in accordance with ANSI/ASME N509, Nuclear Power Plant Air Cleaning Units and Components, and ANSI/ASME N510, Testing of Nuclear Power Plant Air

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			Cleaning Systems. HEPA filters are tested periodically with a challenge aerosol, and the charcoal filters are periodically tested for bypass." a. Please explain how these periodic tests meet the NRC staff's acceptance criteria for ESF and normal atmospheric cleanup systems air filtration and adsorption units contained in RGs 1.52 and 1.140 respectively or provide an acceptable alternative approach. Include information in DCD. b. In addition, DCD Tier 2, Rev. 1, does not include tables for "Major Equipment" and "Design Parameters" for the Turbine Building HVAC System as it does for other systems such as CBHVS, FBHVS, RWBHVACS etc. Tables for this system should also be included in the DCD. c. Figure 9.4-8, "TBHV Simplified System Diagram," does not include charcoal filters as it should. Please correct this figure as necessary to include all applicable parts of the TBHV System.
9.4-23	Raval J Walker H	Discuss compliance of reactor building HVAC system design with GDC 2, GDC 5, GDC 60.	The applicant stated in DCD Tier 2, Rev. 1, Tables 1.9-9 and 1.9-20 that ESBWR conforms with the guidance of SRP, Section 9.4.3, Revision 2, for auxiliary and radwaste area ventilation system. The NRC staff considers the criteria contained in SRP Section 9.4.3 applies to reactor building HVAC system. SRP Section 9.4.3 lists the acceptance criteria as GDC 2, 5, and 60 and provides guidance on how to meet these criteria, in a way that is acceptable to the NRC staff, for the reactor building HVAC system. However, DCD Tier2 Section 9.4.6 does not contain details on how these criteria will be met. For example, RG 1.29 provides an acceptable way to comply with GDC 2. Provide details demonstrating how the ESBWR design for the reactor building HVAC system meets the acceptance criteria of GDC 2, GDC 5, GDC 60. Update DCD Tier 2 Section 9.4.6 to include these details.

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9.4-24	Raval J Walker H	Explain how the Reactor Building HVAC purge exhaust filter periodic tests meet RGs 1.52 and 1.140 or provide an acceptable alternative approach.	The applicant stated in DCD Tier 2, Rev. 1, Section 9.4.6.4 that, "The Reactor Building HVAC purge exhaust filter components are periodically tested in accordance with ANSI/ASME N509, Nuclear Power Plant Air Cleaning Units and Components, and ANSI/ASME N510, Testing of Nuclear Air treatment Systems. HEPA filters are tested for penetration of a challenge aerosol periodically." Please explain how these periodic tests meet the NRC staff's acceptance criteria for ESF and normal atmospheric cleanup systems air filtration and adsorption units contained in RGs 1.52 and 1.140 respectively or provide an acceptable alternative approach. Include information in DCD Tier 2, Sections 9.4 and 6.4.
9.4-25	Raval J Walker H	Discuss compliance of the TSC HVAC subsystem design with GDC 2, GDC 4, GDC 5, GDC 19, and GDC 60.	The applicant stated in DCD Tier 2, Rev. 1, Tables 1.9-9 and 1.9-20 that ESBWR conforms with the guidance of SRP, Section 9.4.1, Revision 2 for control room area ventilation system. The NRC staff considers the criteria contained in SRP Section 9.4.1 to also apply to TSC HVAC subsystem. SRP Section 9.4.1 lists the acceptance criteria as GDC 2, 4, 5, 19, and 60 and provides guidance on how to meet these criteria, in a way that is acceptable to the NRC staff, for the TSC HVAC subsystem. However, DCD Tier 2, Rev. 1, Section 9.4.7 does not contain details on how this criteria will be met. For example, RG 1.29 provides an acceptable way to comply with GDC 2, RG 1.78 provides some information (but not all) regarding compliance with GDC 19. Provide details demonstrating how the ESBWR design for the TSC HVAC subsystem meets the acceptance criteria of GDC 2, GDC 4, GDC 5, GDC 19, and GDC 60. Update DCD Tier 2, Section 9.4.7 to include these details.
9.4-26	Raval J Walker H	Discuss compliance of DG HVAC subsystem design with GDC 2, GDC 5, and GDC 60.	The applicant stated in DCD Tier 2, Rev. 1, Tables 1.9-9 and 1.9-20 that ESBWR conforms with the guidance of SRP, Section 9.4.3, Revision 2, for auxiliary and radwaste area ventilation system. The NRC staff considers the criteria contained in SRP Section 9.4.3 to also apply to diesel generator (DG) HVAC subsystem. SRP Section 9.4.3 lists the acceptance criteria as GDC 2, 5, and 60 and provides guidance on how to meet these criteria, in a way that is acceptable to the NRC staff, for the DG HVAC subsystem. However, DCD Tier 2, Rev. 1, Section 9.4.3 does not contain details on how these criteria will be met. For example, RG 1.29 provides an acceptable way to comply with GDC 2. Provide details demonstrating how the ESBWR

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			design for the DG HVAC subsystem meets the acceptance criteria of GDC 2, GDC 5, and GDC 60. Update DCD Tier 2 Section 9.4.7 to include these details.
9.4-27	Raval J Walker H	Explain how the EBHV filtration periodic tests meet RGs 1.52 and 1.140 respectively or provide an acceptable alternative approach.	The applicant stated in DCD Tier 2, Rev. 1, Section 9.4.7.4 that, "the EBHV filtration components are periodically tested in accordance with ANSI/ASME N509, Nuclear Power Plant Air Cleaning Units and Components, and ANSI/ASME N510, Testing of Nuclear Air Cleaning Systems. HEPA filters are tested periodically, and the charcoal filters are periodically tested for bypass." a. Please explain how these periodic tests meet the NRC staff's acceptance criteria for ESF and normal atmospheric cleanup systems air filtration and adsorption units contained in RGs 1.52 and 1.140, respectively, or provide an acceptable alternative approach. Include this information in the DCD. b. In addition, DCD Tier 2, Rev. 1, does not include tables for "Major Equipment" and "Design Parameters" for the TSC HVAC subsystem as it does for other systems such as CBHVS, FBHVS, RWBHVACS, etc. Tables for this system should also be included in the DCD.
9.4-28	Raval J Walker H	Discuss compliance of the drywell cooling system design with GDC 2, GDC 5, and GDC 60.	The applicant stated in DCD Tier 2, Rev. 1, Tables 1.9-9 and 1.9-20 that the ESBWR conforms with the guidance of SRP, Section 9.4.3, Revision 2, for auxiliary and radwaste area ventilation system. The NRC staff considers the criteria contained in SRP Section 9.4.3 to also apply to drywell cooling system. SRP Section 9.4.3 lists the acceptance criteria as GDC 2, 5, and 60, and provides guidance on how to meet these criteria, in a way that is acceptable to the NRC staff, for the drywell cooling system. However, DCD Tier 2, Rev. 1, Section 9.4.8 does not contain details on how these criteria will be met. For example, RG 1.29 provides an acceptable way to comply with GDC 2. Provide details demonstrating how the ESBWR design for the drywell cooling system meets the acceptance criteria of GDC 2, GDC 5, and GDC 60. Update DCD Tier 2, Section 9.4.7 to include these details.

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