November 8, 2007

Mr. Robert E. Brown
Senior Vice President, Regulatory Affairs
GE-Hitachi Nuclear Energy Americas, LLC
3901 Castle Hayne Rd MC A-45
Wilmington NC 28401

SUBJECT: ECONOMIC SIMPLIFIED BOILING WATER REACTOR (ESBWR) CHAPTER 16 OPEN ITEMS

Dear Mr. Brown:

As you are aware, the U.S. Nuclear Regulatory Commission staff is preparing the safety evaluation report (SER) for the ESBWR design certification application submitted by GE-Hitachi Nuclear Energy Americas, LLC (GEH) on August 24, 2005. The staff has identified 50 open items for SER Chapter 16, "Technical Specifications," which are enclosed for your information. The staff is prepared to review your responses to the open items and have conference calls and meetings with your staff, as appropriate, to resolve these open items to support issuance of the SER. Please provide a response date for any late or unscheduled open items discussed in the enclosure.

This open item letter is based on the staff's review of the ESBWR Design Control Document (DCD) Revision 3 and Request for Additional Information (RAI) responses received to date. The staff will continue its review as additional RAI responses and other deliverables are submitted. The staff will inform cognizant GEH staff of any resulting changes to the status of Chapter 16.

If you have any questions, please contact Manny Comar at (301) 415-3863, or mmc1@nrc.gov or Eric Oesterle at (301) 415-1365, or ero1@nrc.gov.

Sincerely,

/RA/

Mohammed A. Shuaibi, Chief
ESBWR/ABWR Projects Branch 1
Division of New Reactor Licensing
Office of New Reactors

Docket No. 052-010

Enclosure: As stated

cc: See next page

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ADAMS Accession No. ML072630699

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Letter to Robert E. Brown from Mohammed Shuaibi dated November 8, 2007

SUBJECT: ECONOMIC SIMPLIFIED BOILING WATER REACTOR (ESBWR)
CHAPTER 16 OPEN ITEMS

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ESBWR DESIGN CERTIFICATION REVIEW
CHAPTER 16 TECHNICAL SPECIFICATIONS
OPEN ITEMS

RAI 16.0-1, Supplement No. 1, March 27, 2007, ML070871162

Discuss how the Chapter 16 TS Limiting Condition for Operations (LCOs) were formulated. How has the response to this RAI changed with subsequent Design Control Document (DCD) revisions?

Status: GEH committed to provide a response by August 31, 2007
No response has been submitted as of the date of this letter

RAI 16.0-5, Supplement No. 2, August 31, 2007, ML072420399

The ESBWR control room heating, ventilation, and air conditioning system (CRHAVS) does not rely on air conditioning units for temperature control following isolation of the control room as does the standard technical specification (STS) BWR/6 control room fresh air (CRFA) system. The STS requires an operable control room air conditioning system.

The Bases for Technical Specification (TS) 3.7.2 states that following a design-basis accident (DBA), the CRHAVS air handling units (AHUs) (the air conditioning units) are assumed to initially operate, with power from non-safety related uninterruptible AC sources, for up to 2 hours to remove heat from non-safety loads within the CRHA to maintain temperature ≤ 78° F; at time 2 hours, those non-safety loads are tripped and passive heat loss from the CRHA and the CRHAVS filtered air supply limit temperature increase to 15° F until ac power is restored no later than 72 hours after the event started.

Assuming a CRHA temperature of 93° F is acceptable, the NRC staff requests the applicant to establish an ITAAC to demonstrate the claimed post-accident temperature behavior of the CRHA and passive heat sink.

Alternatively, this issue over CRHA post accident cooling may be resolved by explicitly requiring the AHUs to be operable in LCO 3.7.2, and adding to the design electrical power support sufficient to run the AHUs for 72 hours without offsite or standby ac power.

TS 3.7.2 Action A allows 72 hours to restore temperature in the CRHA to ≤ 78°F. Under normal unit power operating conditions, with CRHA air temperature and passive heat sink at 78° F, and assuming maximum expected ambient air temperature and no AHU cooling available, what temperature could the CRHA air reach in 72 hours? Consider adding a required action to verify CRHA air temperature and passive heat sink temperature at some maximum value, say on an hourly basis, as a condition for operating during the 72-hour window to ensure the capacity of the heat sink remains available in case of a design basis event.

Add a SR to TS 3.7.2 (CRHAVS) for the AHUs, analogous to STS SR 3.7.4.1, or explain in the TS 3.7.2 Bases and reference the DCD discussion of how CRHA temperature remains acceptable during loss of CRHAVS air conditioning for 72 hours after event initiation.

Status: GEH has not committed to a response date.

RAI 16.0-7, Supplement No. 1, August 31, 2007, ML072420399

Identify where modified end states are applied to the ESBWR generic TS actions. For each action where a Mode 3 end state is proposed, provide justification, regardless of whether the modified end state was included in TSTF-423-A. See attached table.

Revise Bases for TS 3.7.3 (Main Condenser Offgas) Action B to explain that entry into Mode 3 is acceptable from a risk perspective as stated in TSTF-423-A.

Comparison of TSTF-423-A Application to NUREG-1434 and ESBWR Generic TS

RAI 16.0-7s1

ESBWR Generic TS (# Mode 3 end state not adopted)			Equivalent STS (*Not revised by TSTF-423)		
Action	Title	End State	Action	Title	End State
NA	NA	NA	3.3.8.2.C.1	Reactor Protection System Electric Power Monitoring	Mode 3
3.3.4.1.E.1	Reactor Coolant System (RCS) Leakage Detection Instrumentation	Mode 3	3.4.7.E.1 3.4.7.E.2 3.4.7.F.1	* RCS Leakage Detection Instrumentation	Mode 4
3.4.1.B.1	Safety Relief Valves (SRVs)	Mode 3	3.4.4.B.1	Safety/Relief Valves (S/RVs)	Mode 3
3.5.1.E.1	# Automatic Depressurization System (ADS) — Operating	Mode 5	3.5.1.G.1	Emergency Core Cooling System — Operating	Mode 3
3.5.2.E.1	# Gravity-Driven Cooling System (GDCS) — Operating	Mode 5	3.5.1.D.1	Emergency Core Cooling System — Operating	Mode 3
3.6.1.1.B.1	Containment	Mode 3	3.6.1.1.B	Primary Containment	Mode 3
3.6.1.2.D.1	Containment Air Lock	Mode 3	3.6.1.2.D.1 3.6.1.2.D.2	* Containment Air Lock	Mode 4
3.6.1.3.E.1	Containment Isolation Valves (CIVs)	Mode 3	3.6.1.3.F.1 3.6.1.3.F.2	* Primary Containment Isolation Valves (PCIVs)	Mode 4
NA	NA	NA	3.6.1.6.B.1	LLS Valves	Mode 3
NA	NA	NA	3.6.1.7.C.1	RHR Containment Spray System	Mode 3
NA	NA	NA	3.6.1.8.C.1	PVLCS	Mode 3
NA	NA	NA	3.6.1.9.C.1	MSIV LCS	Mode 3
NA	NA	NA	3.6.2.3.B.1	RHR Suppression Pool Cooling	Mode 3
3.6.1.4.B.1	Drywell Pressure	Mode 3	3.6.1.4.B.1 3.6.1.4.B.2	* Primary Containment Pressure	Mode 4
3.6.1.5.B.1	Drywell Air Temperature	Mode 3	3.6.1.5.B.1 3.6.1.5.B.2	* Primary Containment Air Temperature	Mode 4

ESBWR Generic TS (# Mode 3 end state not adopted)			Equivalent STS (*Not revised by TSTF-423)		
Action	Title	End State	Action	Title	End State
3.6.1.6.C.1	Wetwell-to-Drywell Vacuum Breakers	Mode 3	3.6.5.6.D.1	Drywell Vacuum Relief System	Mode 3
3.6.3.1.D.1	Reactor Building	Mode 3	3.6.4.1.B.1	Secondary Containment	Mode 3
NA	NA	NA	3.6.4.3.B.1 3.6.4.3.D.1	Standby Gas Treatment System	Mode 3
NA	NA	NA	3.7.1.C.1	Standby Service Water System and Ultimate Heat Sink	Mode 3
3.7.2.D.1	Control Room Habitability Area (CRHA) Heating, Ventilation, and Air Conditioning Subsystem (CRHAVS)	Mode 3	3.7.3.C.1	Control Room Fresh Air System	Mode 3
3.7.2.D.1	CRHAVS	Mode 3	3.7.4.B.1 3.7.4.D.1	Control Room Air Conditioning System	Mode 3
3.7.3.B.1 3.7.3.B.2	Main Condenser Offgas	Mode 3	3.7.5.B.3	Main Condenser Offgas	Mode 3
NA	NA	NA	3.8.1.G.1	AC Sources — Operating	Mode 3
NA	NA	NA	3.8.4.D.1	DC Sources — Operating	Mode 3
NA	NA	NA	3.8.7.B.1	Inverters — Operating	Mode 3
NA	NA	NA	3.8.9.D.1	Distribution Systems — Operating	Mode 3

Status: GEH has not committed to a response date

RAI 16.2-4, Supplement No. 1, October 12, 2007, ML072690003

TS 3.4.2 omits the RCS leakage rate-of-increase limit. The NRC staff reviewed the applicant's response and concluded that the limit for increases in the rate of unidentified leakage could be deleted subject to the condition that the plant would be operated under good operator practices, as described in the response. Every COL applicant should have operating procedures to implement these good operator practices to manage low level RCS leakage.

The staff determined that it needed a COL information item same as the one that was discussed in Open Item 5.2-2. This RAI remains open pending resolution of RAI 5.2-2.

Status: GEH has not committed to a response date

RAI 16.2-14, Supplement No. 1, November 13, 2006, ML063240267

In TS 2.1.1.2, the phrase "Greater than 99.9 percent of the fuel rods in the core would be expected to avoid boiling transition," is a criterion for a safety limit (SL), not a SL. The SL should be a parameter, such as MCPR, or peak C/L temperature, as provided in brackets in NUREG-1434 STS. Justify the omission of a numerical value in the proposed ESBWR TS. Explain the discrepancy between the Bases, which refer to MCPR, and TS SL 2.1.1.2. GEH committed to address this concern in the response to similar questions provided in NRC RAI 15.0-16. This RAI is thus open pending resolution of RAI 15.0-16.

Status: GEH responded to RAI 15.0-16, on September 14, 2007, MFN 07-071, Supplement 1
GEH response is under staff's review

RAI 16.2-32, October 4, 2006, ML062720166

Limiting conditions for operation (LCOs) are the lowest functional capability or performance levels of equipment required for safe operation of the facility. When an LCO of a nuclear reactor is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the technical specifications until the condition can be met (10 CFR 50.36(c)(2)).

The Automatic Depressurization System (ADS) is an integral part of the ECCS because Gravity Driven Control System (GDCS) flow to the reactor pressure vessel (RPV) requires the RPV to be close to containment pressure (B 3.5.1 Automatic Depressurization System (ADS) - Operating). Currently, TS 3.5.1 ACTIONS require a shutdown if three or more ADS SRVs are inoperable OR three or more (depressurization valves) DPVs are inoperable, but would permit continued operation for up to two weeks if two ADS SRVs and two DPV (four valves total) were inoperable.

Provide the LCO or Action that addresses combinations of degraded ADS SR V, DPV and GDCS, or justify not having combinations. For guidance, note that NUREG-1434 STS address combinations of ADS and low pressure systems being inoperable. For example, STS LCO 3.5.1 says: "One ADS valve inoperable AND One low pressure ECCS injection/spray subsystem inoperable."

Status: GEH committed to provide additional analyses
GEH has not committed to a response date

RAI 16.2-33, Supplement 1, June 6, 2007, ML071580007

With regard to the feedwater control system (FWCS), the applicant's response to RAI 16.2-33 states that "The responses to RAI 15.0-2 and RAI 16.0-1 indicated that this system is not in the primary success path for mitigating transients and accidents because operation of this non-safety-related system provides protection of the turbine and provides only additional margin to the acceptance criteria for applicable events." However, this does not accurately represent the content of the response to RAI 15.0-2 which states that "function of this system is modeled or assumed in several AOO and Infrequent Events to control water level by controlling feedwater flow and therefore mitigates the severity of the events."

Please address this discrepancy.

- If the FWCS is credited in the analysis and needed to mitigate a transient, infrequent

event or accident, it should be included in the TS in accordance with 10 CFR 50.36(c)(2)(ii)(C) Criterion 3.

- If the FWCS is not needed to mitigate any transient, infrequent event or accident, then clearly document this conclusion in the DCD and provide supporting analysis.

Status: GEH committed to provide a response by October 21, 2007
No response has been submitted as of the date of this letter

RAI 16.2-34, Supplement No.1, August 31, 2007, ML072420399

The NRC staff requested the applicant to (1) justify the change from four to two Safety Relief Valves (SRVs) with an operable safety mode required by LCO 3.4.1; (2) explain the methodology for periodic testing of the non-Automatic Depressurization System (ADS) SRVs, including a discussion of why the testing is not included in a TS SR; and, (3) correct an apparent error in DCD Tier 2, Revision 3, Table 5.2-2, in which Note (1) indicates that "The SRVs also perform the automatic depressurization function."

The non-ADS SRVs do not perform an automatic depressurization function. The superscript "(1)" should be deleted from the "Number of Valves" heading. This superscript should be relocated following "ADS SRV" and "Depressurization Valves (DPV)", since only the ADS SRVs and DPVs perform automatic depressurization function. The note should state " (1) The ADS SRVs and DPVs also perform the automatic depressurization function".

Status: GEH has not committed to a response date

RAI 16.2-40, Supplement No. 1, March 27, 2007, ML070871162

DCD Tier 2, Revision 3, Chapter 16B, Bases for TS 3.6.1.5 states that the analysis assumes an initial average drywell air temperature of {46.1°C (115°F)}. This limitation ensures that the safety analysis remains valid by maintaining the expected initial conditions and ensures that the peak Loss-of-Coolant Accident (LOCA) drywell temperature does not exceed the maximum allowable value of 171°C (340°F). The applicant's response also states that "there is no mechanism that could cause GDCS pool temperature to rise above drywell air temperature." However, DCD Tier 2, Revision 3, Table 6.2-2, "Containment Conditions During Normal Operation," indicates that upper and lower drywell average temperatures during normal operation are 57.2°C (135 °F).

DCD Tier 2, Revision 3, Table 9.4-13, "Drywell Cooling System Fan Cooling Units," indicates performance of the upper and lower drywell FCUs with an air inlet temperature of 57.2°C (135°F).
The average drywell temperature is an average of temperature elements located at various elevations and azimuths throughout the drywell.

DCD Tier 2, Revision 3, Chapter 6.2.1.1.2, describes the drywell as consisting of an upper and lower volume, and that the GDCS pools are located in the upper volume of the drywell.

It appears that GDCS bulk water temperature may not be accurately reflected by using drywell average temperature, in that temperatures in the upper levels of the drywell (i.e., in the space surrounding the GDCS pool walls and air space) may be potentially and consistently greater than 115°F – although drywell average temperature is below this value.

It also appears that accident analyses assume an initial drywell temperature of 115°F; however, Tables 6.2-2 and 9.4-13 provide information assuming an upper and lower drywell temperature that could potentially exceed this during normal operation.

Requested Response:

A) Please explain in further detail how GDCS pool temperature is to be adequately determined to be less than or equal to 115°F by referencing an equilibrium with average drywell air temperature. Recommend either directly reading GDCS bulk pool temperature or utilizing drywell air temperature indications adjacent to the GDCS pools (upper drywell volume). Provide this information in the Bases for TS 3.5.3, if required.

B) Please provide an anticipated equilibrium temperature gradient in the drywell - from top to bottom -at full power operation with normal ventilation under design outside air temperature and service water/chill water temperatures. LCO 3.6.1.5 for average drywell temperature states that the limit is to be {less than or equal to 115°F}. Discuss if this temperature limit is consistent with the anticipated equilibrium temperature gradient at full power operation.

C) Please provide a discussion on how drywell average air temperature is to be determined, including the number of detectors per elevation/azimuth. Based on this, discuss how one or more inoperable detectors would affect drywell average temperature indication and potential operability of both containment and the GDCS inoperable.

Status: GEH committed to provide a response by August 31, 2007
No response has been submitted as of the date of this letter

<u>RAI 16.2-45, Supplement No.2, August 31, 2007, ML072420399</u>

Explain how the TS address operability and surveillance requirements for the automatic isolation valves for the RWCU/SDC system, associated with the following proposed isolation instrumentation functions

3.3.6.3.1, “Reactor Vessel Water Level – Low, Level 2,”
3.3.6.3.2, “Reactor Vessel Water Level – Low, Level 1,” and
3.3.6.3.9, “{RWCU/SDC System Differential Flow – High
(Per RWCU/SDC subsystem)},”, and isolation actuation function
3.3.6.4.2, “RWCU/SDC System Lines.”

Status: GEH has not committed to a response date

RAI 16.2-52, Supplement No. 1, October 11, 2006, ML062830229

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.

GEH committed to address this concern in the response to similar questions provided in NRC RAI 15.0-16. This RAI is thus open pending resolution of RAI 15.0-16.

Status: GEH responded to RAI 15.0-16, on September 14, 2007, MFN 07-071, Supplement 1
GEH response is under staff's review

RAI 16.2-55, Supplement no.1, August 31, 2007, ML072420399

The NRC staff will need confirmation from the valve regulated lead acid (VRLA) battery manufacturer that float current monitoring provides an accurate indication of the battery state of charge (SOC) during steady-state and discharge conditions. If float current monitoring does not indicate 100 percent SOC, the COL applicant must commit to additional design margins in the battery sizing calculations to compensate for measurement uncertainty and that these design margins would be stated in the TS Bases.

Status: GEH has not committed to a response date.

RAI 16.2-57, Supplement No.1, August 31, 2007, ML072420399

In RAI 16.2-57 and RAI 16.2-87, the staff requested the applicant to include a value for the minimum acceptable pilot cell temperature. The revised DCD did not justify using battery room temperature and did not state whether continuous monitoring of the battery room temperature with high and low level alarms in the main control room is included in the design. Since battery cell temperature could change for reasons other than ambient conditions (e.g., power flow, resistivity issues or internal shorts, etc.), new SRs should be specified for the battery pilot cells and connected cells. The surveillance Frequency should specify taking temperature measurements at the negative post of battery pilot cells every 31 days and at the negative post of connected cells every 92 days. RAI 16.2-87 is closed because this issue will be tracked under Open Item 16.2-57. (See RAI 16.2-122.)

Status: GEH has not committed to a response date

RAI 16.2-62, Supplement no.1, August 31, 2007, ML072420399

Justify not including TS requirements (LCO, Applicability, Actions, and Surveillance) for these circuits in the Regulatory Treatment of Non-Safety Systems (RTNSS) program.

Status: GEH has not committed to a response date.

RAI 16.2-73, Supplement No.2, November 1, 2007, ML072990309

In a teleconference between the NRC staff and the applicant on September 6, 2007, GEH staff indicated that the information requested by the staff was not clear and the staff agreed to provide a more clarified version of the RAI.

Provide a detailed description of the proposed makeup water transfers and a corresponding markup of the Availability Controls LCO.

Status: GEH has not committed to a response date

RAI 16.2-74, Supplement No.2, November 1, 2007, ML072990309

In a supplement to RAI 16.2-74, the staff recommended providing a specification addressing the need to maintain a vent path for GDCS operability when shutdown. In addition, TS availability controls should be provided for the RWCU/SDC system.

In its response, the applicant proposed a new SR for TS 3.5.3, GDC - Shutdown, to once per 24 hours.

"Verify availability of RPV venting capacity sufficient to allow GDCS injection following loss of decay heat removal capability."

In a teleconference between the NRC staff and the applicant on September 6, 2007, this SR was discussed. The staff suggested that the SR was actually an indirect expansion of the Applicability of the ADS from Modes 1 and 2, to add Mode 5 in order to support GDCS operability in the event of a loss of decay heat removal, because meeting the SR in Mode 5 would require making the ADS operable to provide the necessary vent path. The staff prefers revising the applicability of the ADS specification to the applicant's proposal to add a SR to the shutdown GDCS specification, recognizing that there may be other associated changes, such as to ECCS instrumentation function applicability. Pending revision of the applicability for TS 3.5.1 to include Mode 5, and other appropriate TS changes, this is designated Open Item 16.2-74.

Status: GEH has not committed to a response date

RAI 16.2-75, Supplement No.1, June 6, 2007, ML071580007

The bases discussion regarding the applicable safety analyses for TS 3.1.1, Shutdown Margin, presents the Control Rod Withdrawal Error (RWE) during refueling as the event basis for the shutdown margin (SDM) LCO. Confirm whether RWE during refueling is more limiting than RWE at start up or low power. If RWE at start up or low power is more limiting, then the reference should be changed to RWE during start up; that is, change DCD reference from Section 15.3.7 to 15.3.8. (See staff RAI 15.3-33 regarding analysis of the RWE event during power operation.)

Status: GEH responded on October 15, 2007, MFN 07-024, Supplement 3
GEH response is under staff's review

RAI 16.2-76, Supplement No. 1, March 27, 2007, ML070871162

The response to RAI 16.2-76 states that the complete loss of the Fuel and Auxiliary Pools Cooling System (FAPCS) is not currently analyzed as an Anticipated Operational occurrence (AOO), Infrequent Event, or Design Basis Accident (DBA) in Revision 2 of the DCD Tier 2, Chapter 15. The response also states that, since the complete loss of the FAPCS is not an analyzed AOO or DBA, the initial conditions assumed in the evaluation of that event do not meet Criterion 2 of 10 CFR 50.36(c)(2)(ii).

The spent fuel pool coolant inventory performs a passive safety function analogous to that of the Isolation Condenser (IC) pool, but with a more direct path for decay heat removal from the fuel. The loss of the FAPCS is an AOO in that the condition may result from a loss of offsite power and/or failure of non-safety related equipment. The location of the description of the occurrence in Chapter 9 as opposed to Chapter 15 is not a valid basis for determining the applicability of 10 CFR 50.36 (c)(2)(ii). The ESBWR is unlike the BWR-6 design considered for NUREG-1434 in that no redundant, safety related makeup water supply is provided. Instead, the pool inventory itself is credited in maintaining adequate cooling, like the AP1000, which has TS LCOs 3.7.5 and 3.7.9 that together ensure an adequate coolant inventory for 72 hours without forced cooling. Therefore, provide an analysis evaluating the anticipated occurrence of a loss of the FAPCS and a technical specification LCO for the initial condition required for spent fuel pool inventory to satisfy the analysis.

Provide an analysis of the anticipated occurrence of a loss of the FAPCS and an associated technical specification for spent fuel pool inventory.

Provide a detailed analysis (initial conditions, assumptions, and methods were not described), and the available information in the DCD is insufficient to perform a good quality independent analysis. Second, the basis for the water level specification does not address the safety-related function of the inventory (i.e., to cover the first 72 hours). The initial inventory, as a surrogate for makeup, should be safety-related per 10 CFR 50.2 and SRP 9.1.3. Finally, the action statement for pool inventory should include a provision to preclude adding irradiated fuel to the pool if the minimum level is not satisfied.

Status: GEH committed to provide additional analyses in a topical report.
GEH has not committed to a response date

RAI 16.2-89, Supplement 1, August 31, 2007, ML072420399

Provide justification for referencing IEEE 450-1995, and ensure that the battery maintenance program in proposed TS 5.5.10 is comprehensive. In a follow-up question, the staff stated that it had not yet endorsed IEEE Standard 1188-2005, and requested the applicant to revise the program to state the following:

This program provides for battery restoration and maintenance which includes the following:

a. Actions to restore battery cells with float voltage < 2.18 VDC,

b. Actions to determine the cause and correct when cell temperatures deviate more than 3°C (5°F) from each other.

c. Actions to verify that remaining cells are ≥ 2.14 VDC when a cell or cells have been found to be < 2.18 VDC.

The content of TS 5.5.10 is designated Open Item 16.2-89, Supplement No. 1.

Status: GEH has not committed to a response date

RAI 16.2-97, Supplement No. 1, June 6, 2007, ML071580006

In its letter response to RAI 16.2-97, MFN 07-024, the applicant stated it had added response time testing of the ECCS actuation logic with SR 3.3.5.2.2, "Verify the ECCS Response Time of each required division is within limits." The associated TS bases for this SR does not explicitly describe the ADV and DPV "timers" as being included in the surveillance. The bases for TS 3.3.5.2, "ECCS Actuation," mention "timers" once in the third paragraph of the background discussion and once in the third paragraph of the LCO discussion. The staff does not concur with the applicant's contention that ADS and DPV timers are implicitly included in the TS because it does not find that testing the timers is clearly included in SR 3.3.5.2.2. Since the timers are very critical for the function of ECCS, timers should be included in the TS explicitly.

Status: GEH responded on October 15, 2007, MFN 07-024, Supplement 3
GEH response is under staff's review

RAI 16.2-98 Supplement No.1, August 24, 2007, ML072420077

Technical Specification Limiting Condition for Operation (LCO) 3.5.2, Conditions A and B in Revision 3 of Tier 2 of the DCD allow plant operation with only 3 gravity driven cooling system injection and one equalizing line out of the 8 available injection and 4 equalizing lines. In Bases it is stated that "This completion time is acceptable because the analysis described in Reference 4 determined that 3 injection branch lines [and 1 equalizing line] is sufficient to respond to the design basis LOCA." In a teleconference on March 26, 2007, GEH stated that the analysis to support this LCO was not performed and that the LCO actions should be placed in "brackets" indicating that the information is either plant specific or not yet complete. GEH stated that the brackets were left off in error. The staff requests that GEH put the LCO 3.5.2, Conditions A and B, actions and associated Bases in brackets in the next revision of the DCD. If GEH completes the supporting analysis by this time, the staff instead requests that GE submit the analysis.

Status: GEH committed to provide detail analyses
GEH has not committed to a response date

RAI 16.2-99, Supplement No. 1, January 18, 2007, ML070320107

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..."

GEH committed to address this concern in the response to similar questions provided in NRC RAI 4.6-23. (Control Rod Drop Accident (CRDA)). This RAI is thus open pending resolution of RAI 4.6-23.

Status: GEH responded to RAI 4.6-23 on June 19, 2007, MFN 07-253
GEH response is under staff's review

RAI 16.2-101, January 18, 2007, ML070320107

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.

GEH committed to address this concern in the response to similar questions provided in NRC RAI 4.6-23. (Control Rod Drop Accident (CRDA)). This RAI is thus open pending resolution of RAI 4.6-23.

Status: GEH responded to RAI 4.6-23 on June 19, 2007, MFN 07-253
GEH response is under staff's review

RAI 16.2-109, January 18, 2007, ML070320107

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.

Status: GEH responded to RAI 4.6-23 on June 19, 2007, MFN 07-253
GEH response is under staff's review

RAI 16.2-110, Supplement no.1, August 31, 2007, ML072420399

The regulatory limit proposed by the applicant, based on the future design certification rulemaking for ESBWR, will be too far removed from the day-to-day operation of a plant to provide sufficient control of and attention to the containment oxygen concentration limit. It adds little to the requirements already present in 10 CFR 50.44. Further, using the applicant's suggested Availability Control also lacks sufficient regulatory force. The staff's position is that a TS LCO must be established for an inerted containment to meet 10 CFR 50.36(c)(2)(ii)(D). The structure is the inerted containment. The NRC has determined that combustible gases produced by beyond design-basis accidents involving both fuel-cladding oxidation and core-concrete interaction would be risk-significant for plants with inerted containments, if not for the inerted containment atmosphere. It is essential to have a regulatory limit on containment oxygen concentration in each ESBWR plant license, meaning a TS LCO. Provide a TS of this type in DCD Tier 2, Chapter 16.

Status: GEH has not committed to a response date.

RAI 16.2-112, April 12, 2007, ML070920099

DCD Tier 2, Revision 3, Section 16, SR 3.6.1.1.3 requests to "verify the combined leakage rate through all vacuum breaker lines is ≤ {0.1 cm^2 (1.0 x 10^{-4} ft^2) (A/√K)} when tested at ≥ { kPaD (psid)}." This is inconsistent with corresponding STS SR 3.6.5.1.1, and inconsistent in itself:

The DCD SR applies only to the leakage through the vacuum breaker lines, while the STS SR applies to 10 percent of the total bypass leakage between drywell and wetwell, which was used in calculating peak containment pressure in DCD Tier 2, Revision 3, Section 6.2. Please explain how you ensure that the assumed total

bypass leakage between the drywell and wetwell will not be exceeded during operation of the reactor.

The left side of the first inequality sign (≤) refers to a "leakage rate" but the expression on the right side of the sign has numbers with dimensions of area, which is inconsistent with the former. Please fix the inconsistency.

Status: GEH committed to provide a response by November 9, 2007

RAI 16.2-118, April 12, 2007, ML070920099

Please address the following topics in regard to TS 3.7.2, "Control Room Habitability Area (CRHA) Heating, and Air Conditioning (HVAC) Subsystem (CRHAVS)" in DCD Rev 3:

A. Revise the 4th sentence in Applicable Safety Analyses discussion in Bases to state: No single active or passive failure will cause the loss of outside air to the CRHA.

B. Required Action A.1 specifies 72 hours to recover from inadequate cooling in the CRHA as evidenced by temperature above limit of 78°F. Under worst case conditions assumed in the design, what temperature would be reached in the CRHA in 72 hours and afterwards during plant shutdown; could those temperatures interfere with capability to safely shutdown the plant during both normal and DBA operating conditions? That is, provide additional technical justification for the 72 hour completion time beyond that given in the Bases background discussion and the Bases for Required Action A.1.

C. Use "System" instead of "Subsystem" in the name of the CRHAVS TS. Also, do not use both "Subsystem" and "train" - use one or the other throughout the TS.

D. Recommend requiring an operable AHU for each CRHAVS subsystem to be operable, and revise Action A to address an inoperable subsystem due to an inoperable AHU, then allow appropriate restoration time for the CRHA cooling contingent upon maintaining temperature within limits. Specify an action requirement to periodically check temperature. Also add a surveillance to verify the heat removal capability of the AHUs similar to STS SR 3.7.4.1.

Status: GEH committed to provide a response by August 31, 2007
No response has been submitted as of the date of this letter

RAI 16.2-119, Supplement 1, July 3, 2007, ML071840208

The staff asked the applicant to provide an analysis that explicitly assumes just one SRV functions in order for TS LCO 3.4.1 to require just two SRVs to be operable. In its response to RAI 21.6-91 (MFN 07-256), the applicant stated, "Changes to DCD Tier 2, Figure 5.2-4 will be made in response to this RAI. Figure 5.2-4 will be updated based on the result of a TRACG analysis that uses the following input files: MSIVF_EOC_NOFW.INP and SCRAM_PRESS_8GROUPS.TDT." Since the applicant proposes, in TS LCO 3.4.1, to rely on only one SRV for overpressure protection, it should verify that these input files, which are used to generate Figure 5.2-4, credit only one SRV.

In addition, the applicant is requested to correct the apparent discrepancy between the last sentence of the first paragraph of DCD Tier 2 Section 5.2.2.3.3 where it states the [full open] flow through three SRVs (not one) are needed to mitigate the MSIV closure with high neutron flux scram event.

Status: GEH committed to provide a response by December 6, 2007

RAI 16.2-122, May 10, 2007, ML071230389

Limiting condition for operation (LCO) 3.8.3.D and SR 3.8.3.4 include Required Actions and Surveillance Requirements for battery room temperature. Explain basis for battery room temperature and why the DCD or TS Bases does not require continuous monitoring of the battery room temperature with alarms in the main control room when room temperature is below or above established design limits.

Since battery cell temperature could change for reasons other than ambient conditions (e.g., power flow, resistivity issues/internal shorts, etc.), a new LCO should be specified for the battery pilot cells and connected cells. The surveillance frequency associated with these LCO's should specify that the battery pilot cell temperature measurements at the negative post be performed every 31 days and every 92 days for connected cells.

Status: GEH committed to provide a response by September 28, 2007
No response has been submitted as of the date of this letter

RAI 16.2-123, May 10, 2007, ML071230389

Explain how battery room temperature will be maintained during loss of ac power. Battery performance is dependent on battery temperature. Provide assurance that the battery will perform its intended function without ac power to the battery room ventilation and AC systems. Discuss battery margins (i.e., aging margin, design margin, temperature correction factor, float current monitoring uncertainty for 100 percent state of charge) and potential for thermal runaway.

Status: GEH committed to provide a response by September 28, 2007
No response has been submitted as of the date of this letter

RAI 16.2-126, May 10, 2007, ML071230389

LCO 3.8.1, Required Action A2, states that if one or both required battery chargers are inoperable on one required division, the associated battery must be returned to the fully charged condition. Fully charged condition is specified in the Bases as either three consecutive hourly current readings change less than {0.5} amps or the float current is <{2} amps. LCO 3.8.1 must define fully charged condition, not the bases. In addition, no technical justification was given for three consecutive hourly readings change of less than {0.5} amps in lieu of float current < than {2} amps.

Status: GEH committed to provide a response by September 28, 2007
No response has been submitted as of the date of this letter

RAI 16.2-129, May 10, 2007, ML071230389

The Bases for LCO 3.8.1, DC Sources, state that all safety-related Class 1E loads are isolated from the IPC buses by diodes on the output of both the nonsafety-related rectifiers and the 250 VDC bus associated with the DC sources. Explain why there are no surveillance requirements to periodically verify that the blocking diodes are operable.

Status: GEH committed to provide a response by September 28, 2007
No response has been submitted as of the date of this letter

RAI 16.2-134, Supplement No. 1, June 26, 2007, ML071780203

The reduced safety system capability described by the condition "Capability Not Maintained" describes multiple SSC failures, representing a loss of two or three required channels or divisions of instrumentation out of four installed channels or divisions. This Condition would permit the plant to operate for up to one hour with one or more accident prevention or mitigation functions of safety-related SSCs not operable. This is not an acceptable remedial action allowance. For this specified plant condition, the staff will only accept a required action to immediately exit the TS Applicability or immediately enter LCO 3.0.3. Revise the required action and completion time accordingly.

Status: GEH responded on October 15, MFN 07-533
GEH response is under staff's review

RAI 16.2-135, May 10, 2007, ML071230389

Equipment within an RPS division of trip actuators includes load drivers and controllers for automatic scram and air header dump initiation. Load drivers are addressed in LCO 3.3.1.2. Operability requirements for the controllers are not addressed within the ESBWR DCD TS. Justify excluding controllers for automatic scram and air header dump initiation from TS.

Status: GEH committed to provide a response by August 31, 2007
No response has been submitted as of the date of this letter

RAI 16.2-136, May 10, 2007, ML071230389

The LCO for RPS Manual Actuation states that the Division 1 and 2 manual actuation channels and Mode Switch Actuation channels must be operable. Revise the ESBWR TS Section 3.3.1.3, "Reactor Protection System Manual Actuation," LCO to add the number of channels required to be operable for each manual actuation feature.

Status: GEH responded on October 15, MFN 07-533
GEH response is under staff's review

RAI 16.2-137, May 10, 2007, ML071230389

In ESBWR TS Section 3.3.1.3, "Reactor Protection System Manual Actuation," the Actions Note permitting separate condition entry for each function does not match the per channel requirements in the LCO. Revise the specification to make the Note and LCO refer to the same basis for usage.

Status: GEH responded on October 15, MFN 07-533
GEH response is under staff's review

RAI 16.2-138, May 10, 2007, ML071230389

In ESBWR TS Section 3.3.1.3, “Reactor Protection System Manual Actuation,” for the Actions Condition of “One or more channels inoperable,” the reduced functional capability of the degraded condition described represents a loss one or both required channels of instrumentation for one or both manual actuation items. This condition would permit the plant to operate for up to 12 hours with a loss of all required safety system RPS manual actuation instrumentation. Additional information is needed to justify that the loss of function condition is a credible condition for which a temporary relaxation of the required design basis should be approved. Justify why operation should be permitted with more than one channel of each type of ESBWR manual actuation channels inoperable. Note that NUREG-1434 permits only one RPS manual actuation functions channel to be inoperable.

Status: GEH responded on October 15, MFN 07-533
GEH response is under staff's review

RAI 16.2-139, May 10, 2007, ML071230389

Instrumentation LCOs state the number of divisions required to be operable, whereas, associated Actions Conditions refer to required channels inoperable. Revise LCOs to state the number of channels required to be operable for each division.

Status: GEH responded on October 15, MFN 07-533
GEH response is under staff's review

RAI 16.2-141, May 10, 2007, ML071230389

SRNM instrumentation is required to be operable by LCO 3.3.1.6, "Startup Range Neutron Monitor Instrumentation," and LCO 3.3.1.4, NMS Instrumentation. The applicability requirements for both LCOs include Mode 6; however, surveillance requirements for these LCOs are not comparable. Explain the reasons for duplicating instrumentation requirements. Revise the TS to eliminate duplicate applicabilities. In terms of compliance with 10 CFR 50.36 and the instrumentation design basis, explain why LCO 3.3.1.4 Channel Calibrations require testing in accordance with the Setpoint Control Program whereas, LCO 3.3.1.6 does not.

Status: GEH responded on August 30, 2007, MFN 07-476
GEH response is under staff's review

RAI 16.2-142, May 10, 2007, ML071230389

The proposed end state for RCS Leakage Detection Instrumentation LCO 3.3.4.1, LCO 3.3.6.3, Table 3.3.6.3-1, Function 13 (feedwater isolation instrumentation), and LCO 3.3.6.4, Table 3.3.6.4-1 Function 14 (Feedwater Isolation Valves) and Function 15 (Feedwater Pump Breakers) is Mode 3; whereas these Functions have Modes 1, 2, 3 and 4 applicabilities. Add Required Actions to place the plant in Mode 5 as the TS required end state. See RAI 16.0-7.

Status: GEH responded on October 15, MFN 07-533
GEH response is under staff's review

RAI 16.2-145, May 10, 2007, ML071230389

Channel operability based on allowable values (AVs), pre-defined as-found tolerance bands, and as-left tolerance bands as specified in the TS for the ESBWR are applicable only to analog protection systems using bistables. For the ESBWR digital protection systems, setpoints are controlled in the TS. The ESBWR TS require that the Nominal trip setpoint, embedded in the digital protection system, be equal to or conservative with respect to the LSSS.

Provide documentation to show that TS will require surveillances to verify operability of the critical functions (1) internal diagnostic methods that can monitor the "health" of different processors/memory boards and perform software checks to ensure that the proper software is executing, and (2) power-up tests (RAM, EPROM, etc.) and error checking on the data links as well as tests by a transmitting channel to ascertain that the transmitted signal has been properly received by the receiving channels during the channel functional test. This information is needed to understand how the proposed Setpoint Control Program will ensure that the requirements of 10 CFR 50.36(c)(2)(ii)(A) are met.

Status: GEH committed to provide a response by September 28, 2007
No response has been submitted as of the date of this letter

RAI 16.2-146, May 10, 2007, ML071230389

Specification 5.5.11, "Setpoint Control Program (SCP)," requires establishing and documenting Nominal Trip Setpoints (NTSPs), Allowable Values (AVs), and As-Found and Leave Alone Tolerance Bands, and the methodologies used to determine these values for TS instrumentation functions in the following TS Sections: 3.3.1.1, RPS; 3.3.1.4, NMS; 3.3.5.1, ECCS; 3.3.5.3, ICS; 3.3.6.1, MSIV; 3.3.6.3, Isolation; and 3.3.7.1, CRHAVS.

For these instrumentation functions, Channel Calibration tests must evaluate a channel to verify it is functioning as required, before returning it to service, when the as-found channel setpoint is found conservative with respect to the Allowable Value but outside its predefined As-Found Tolerance Band.

Define the terms NTSP, AV, and As-Found and Leave Alone Tolerance Bands for the instrument functions in the above list of Specifications, and justify why these methodology terms were chosen for establishing digital protection channel operability during a Channel Calibration. Explain qualitatively, what is meant by a Leave Alone Tolerance Band (TS 5.5.11.b) for a digital protection channel. This information is needed to understand how the proposed SCP will ensure that the requirements of 10 CFR 50.36(c)(2)(ii)(A) are met.

Status: GEH committed to provide a response by October 21, 2007
No response has been submitted as of the date of this letter

RAI 16.2-147, May 10, 2007, ML071230389

Provide data to show that the self test report meets the requirements of a Channel Check without performing the required comparison of the parameter.

Status: GEH responded on August 30, 2007, MFN 07-476
GEH response is under staff's review

RAI 16.2-148, May 10, 2007, ML071230389

Provide data to show that the self test report meets the requirements of a Channel Functional Test without performing a test to inject a simulated or actual signal into the channel as close to the sensor as practicable to verify operability of all devices in the channel required for channel operability.

Status: GEH responded on August 30, 2007, MFN 07-476
GEH response is under staff's review

RAI 16.2-149, May 10, 2007, ML071230389

Provide analysis to show that elements of the Setpoint Control Program are sufficient to ensure that the requirements of 10 CFR 50.36(c)(3) will be met including an appropriate basis for Setpoint Design Basis for each instrumentation function with a specified instrument calibration performed in accordance with the Setpoint Control Program.

Status: GEH committed to provide a response by October 21, 2007
No response has been submitted as of the date of this letter

RAI 16.2-150, Supplement 1, November 1, 2007, ML072990309

The responses to RAIs 16.2-150 and 16.2-151 are unacceptable. The LCO and LCO surveillance requirements need to be consistent. Currently for RPS, NMS, ECCS, ICS, MSIV Isolation, and CRVHAS actuation, the LCO includes three channels, but the SR (i.e., STAGERED TEST BASIS) frequency is based on four channels. If, the fourth channel is included in the surveillance requirements, then the LCO need to be rewritten to include the fourth channel. If, the LCO is limited to three channels, then the surveillance requirements need to be limited to three channels. As stated in the RAIs that this RAI supplements, this change is needed to comply with 10 CFR 50.36(c)(3). 10 CFR 50.36(c)(3), in part, states that SRs "are requirements relating to test, calibration, or inspection …… and that the limiting conditions for operations will be met." Since the fourth channel is not included in the LCO, it should not be included in the surveillance requirements.

Revise the proposed generic Technical Specifications and associated discussion(s) in the proposed generic Technical Specifications Bases to make the number of channels in the LCO and LCO surveillance requirements consistent

Status: GEH has not committed to a response date.

RAI 16.2-152, May 10, 2007, ML071230389

A Channel Functional Test (CFT) shall be the injection of a simulated or actual signal into the channel as close to the sensor as practicable to verify operability of all devices in the channel required for channel operability. Add Bases to ESBWR DCD Instrumentation TS to identify all devices in the channel required to be tested by a CFT for each instrument function.

Status: GEH committed to provide a response by September 28, 2007
No response has been submitted as of the date of this letter

RAI 16.2-153, May 10, 2007, ML071230389

ESBWR instrumentation TS require a Logic System Functional Test (LSFT) to be a test of all components required for operability of a logic circuit. Add Bases to ESBWR DCD Instrumentation TS to define logic circuit and identify the logic circuit devices tested by LSFT.

Status: GEH committed to provide a response by September 28, 2007
No response has been submitted as of the date of this letter

RAI 16.2-154, May 10, 2007, ML071230389

Identify all ESBWR DCD TS LCO instrumentation devices required to be operable to ensure the LCO specified safety function can be met. Show that ESBWR DCD TS required testing and calibration will ensure the necessary quality of instrumentation devices is maintained.

Status: GEH committed to provide a response by September 28, 2007
No response has been submitted as of the date of this letter

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