From: Lawrence Rossbach
To: Kathy K. (GE Energy) Sedney
Date: 3/27/2007 10:58:29 AM
Subject: Comments on various Chapter 16 RAI responses

Attached are comments on the responses to various Chapter 16 (Technical Specification) RAI responses contained in GE letters MFN 06-263, MFN 06-431, MFN 07-022, MFN 07-024, and MFN 07-025. Please contact Chandu Patel (301-415-3025) if you have any questions or would like to arrange a telephone conference to discuss these comments.

Thanks, Larry

CC: Amy Cubbage; C Craig Harbuck; Dan (Personal) Williamson; david.piepmeyer@ge.com; Edwin Forrest; George B. (GE Infra Energy) Stramback; George Thomas; James Pulsipher; jim.kinsey@ge.com; Joel D. (GE Infra Energy) Friday; Jorge Hernandez; Robert Clark; Steve Jones; Terry Beltz; Theodore Tjader

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Comments on ESBWR Chapter 16 Requests for Additional Information (RAI) Responses Contained in GE Letters MFN 06-263 and 431 and MFN 07-022, 024, and 025

1. Comment on response to RAI 16.0-1 from MFN 06-263 (ADAMS accession number ML062360275):

How has the response to this RAI changed with subsequent Design Control Document (DCD) revisions?

2. Comment on response to RAI 16.2-22 from MFN 06-431 (ADAMS accession number ML063240267):

Why is a 0 (zero) psig steam dome pressure scram time unnecessary for the ESBWR?

3. Comment on response to RAI 16.2-30 from MFN 07-022 (ADAMS accession number ML070320106):

The response to RAI 16.2-30 says that GE will submit a supplemental response to this RAI when Revision 3 to the DCD is submitted. We have not received this supplement and it was not listed in GEs letter on supplemental RAI responses schedules (MFN 07-143, ADAMS accession number ML070730652). When will we receive this supplement?

4. Comment on response to RAI 16.2-40 from MFN 06-431:

Summary of Question:
RAI 16.2-40 requested justification for why Technical Specification (TS) 3.5.3 Gravity-Driven Cooling System (GDCS) does not state GDCS pool temperature limits. Accident analysis assumes that GDCS pool temperature is less than or equal to 115°F.

Summary of Response:
GEs response to this RAI stated that the ESBWR accident analysis for peak containment pressure assumes that the initial GDCS water and gas space temperatures are in equilibrium with the drywell air temperature. The analysis assumes an initial temperature of 115°F for both the drywell gases and the GDCS pool water, and that TS 3.6.1.5 ensures that drywell air temperature is maintained less than or equal to this limit. The limit for drywell air temperature limits GDCS pool temperature because there is no mechanism that could cause GDCS pool temperature to rise above drywell air temperature.

Comment on Response:
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 of 171°C (340°F). The GE response also states that "there is no mechanism that could cause GDCS pool temperature to rise above drywell air temperature."

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 into 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. Limiting Condition for Operation (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 a detector(s) loss of function would affect drywell average temperature indication and potential operability of both containment and the GDCS.

5. Comment on response to RAI 16.2-45 from MFN 07-022:

Requiring containment isolation valves (CIVs) and associated instrumentation functions during operations with a potential for draining the reactor vessel (OPDRVs) and irradiated fuel movement should be considered for defense in depth. Also, GEs response to this RAI indicated that a new LCO for Reactor Water Cleanup/Shutdown Cooling (RWCU/SDC) isolation on RWCU system leak detection would be added in TS Section 3.4. When will this TS be added?

6. Comment on response to RAI 16.2-46 from MFN 06-431:

GE revised DCD Subsection 9.1.3.2, 7th paragraph, to state that the flow will be limited to 1000 gpm by a flow restricting orifice. Please revise DCD Figure 9.1-1 to show the functional location of the flow restricting orifice in the drywell spray header and whether it will be inside or outside the reactor building.

7. Comment on response to RAI 16.2-49 from MFN 06-431:

State what the exact DCD changes are related to the resolution to this question. It is not clear that Surveillance Requirement (SR) 3.6.1.1.3 and SRs 3.6.1.6.4 and 5 are sufficient. Why place the instrumentation function for the vacuum breaker isolation in TS 3.6.1.6 instead of TS Section 3.3?

8. Comment on response to RAI 16.2-50 from MFN 07-022:

Although "construction level design details" are not currently available, respond to the original question to the extent permitted by currently available information.

9. Comment on response to RAI 16.2-62 from MFN 06-431:

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

10. Comment on response to RAI 16.2-63 from MFN 06-431:

Include SRs to verify breaker alignment and indicated power availability for each Isolation Power Center bus.

11. Comment on response to RAI 16.2-73 from MFN 07-022:

The response to NRC RAI 16.2-73 incorrectly cites the BWR/6 Standard Technical Specifications (STS), NUREG-1434, Revision 3.1, as crediting the volume of water stored above the core as a "safety-related" decay heat removal capability when the reactor cavity is fully flooded. The STS credit this volume as an adequate volume to allow operator action to isolate any potential drain path before forced recirculation cooling would be lost due to loss of inventory. The STS also credit this volume as an adequate temporary heat sink in the event the operating residual heat removal system fails. The volume does not provide a safety-related decay heat removal capability because the pressure boundary for the entire volume is not suitably reliable and safety-related.

As noted in the response to NRC RAI 16.2-73, the RWCU/SDC system performs an important function for coolant inventory loss events by continuing to remove the decay heat so that no safety function is directly challenged. Consistent with Criterion 4 of 10 CFR 50.36 (c)(2)(ii) and the bases for the Residual Heat Removal (RHR) TS of NUREG-1434, provide one of the following for operational Mode 6, "Refueling": (1) a Limiting Condition for Operation for the decay heat removal function performed by the RWCU/SDC system, (2) a Limiting Condition for Operation for a suitable alternative decay heat removal path such as GDCS inventory makeup and an analysis demonstrating adequate heat transfer to an ultimate heat sink assuming boiling in the vessel, or (3) an analysis demonstrating that the remaining coolant inventory above the top of active fuel for all shutdown LOCA events is adequate to provide 72 hours of decay heat removal to an ultimate heat sink without credit for inventory makeup or forced decay heat removal.

12. Comment on response to RAI 16.2-74 from MFN 07-022:

The response to RAI 16.2-74 states that, prior to the removal of the head, GDCS operability requires sufficient Reactor Pressure Vessel (RPV) venting capacity to maintain the RPV depressurized following loss of the normal Decay Heat Removal (DHR) capability. This vent path is part of the primary success path for decay heat removal using the GDCS as a source of inventory makeup, and, therefore, satisfies Criterion 3 of 10 CFR 50.36 (c)(2)(ii). If the Automatic Depressurization System (ADS) is selected as the available vent path, decay heat is released to the containment atmosphere. However, no specific availability controls on the vent path are specified.

Provide supporting analyses and a suitable Limiting Condition for Operation for the Reactor Coolant System (RCS) vent path necessary to allow inventory makeup from GDCS to function as a decay heat removal method in Operational Mode 6 with the reactor vessel head in place.

13. Comment on response to RAI 16.2-76 from MFN 07-022:

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 AP-1000, 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 .

14. Comment on response to RAI 16.2-78 from MFN 06-431:

The response to NRC RAI 16.2-78 stated that GE expects to provide appropriate 'short-term availability controls' in the form of a 'simple Technical Specification.' This TS will include the surveillance testing (including inservice testing) that would apply to the valves in the makeup water transfer line from the fire protection water system and the off-site water supply sources and the Actions that would apply if one or more of the valves in the makeup lines were to fail a surveillance test. However, the response also states no changes will be made to DCD Tier 2, Chapter 16.

It is not clear where these availability controls and simple technical specification would appear if not in

Chapter 16. Provide the availability controls and simple technical specification applicable to the makeup line.

15. Comment on response to RAI 16.2-79 from MFN 06-431:

The response to NRC RAI 16.2-79 stated that GE expects to provide appropriate 'short-term availability controls' in the form of a 'simple Technical Specification.' This TS will address failures affecting the reliability or redundancy of the fire protection water system as a makeup water source with respect to operability of the Isolation Condenser Passive Containment Cooling System (IC/PCCS) pool. However, the response also states no changes will be made to DCD Tier 2, Chapter 16.

It is not clear where these availability controls and simple technical specification would appear if not in Chapter 16. Provide the availability controls and simple technical specification applicable to the fire protection system.

16. Comment on response to RAI 16.2-80 from MFN 06-431:

The response to NRC RAI 16.2-79 stated that GE will revise TS 4.3.2 to use pool level instead of plant elevation so that the requirement is more clearly stated and a plant specific elevation is not required to eliminate the bracketed value. However, the response also states that no changes will be made to DCD Tier 2, Chapter 16.

Response is inconsistent in that it states TS 4.3.2 will be revised but no changes will be made to the DCD. Clarify how DCD Tier 2, Chapter 16 will be revised with respect to TS 4.3.2.

17. Comment on response to RAI 16.2-94 from MFN 07-024 (ADAMS accession number ML070320107):

Summary of Question:
RAI 16.2-94 requested confirmation that the GDCS pool level of 21.65 ft specified for each pool is equivalent to the minimum total drainable inventory of 62,150 ft^3 given in DCD Tier 2, Revision 1, Table 6.3-2.

Summary of Response:
Response from GE (MFN 07-024 dated January 18, 2007; ML070320107) stated that DCD Tier 2, Revision 1, Table 6.3-2, "GDCS Design Basis Information," was revised to specify that the minimum total drainable inventory (for three GDCS Pools) at the GDCS low level of 6.5 meters is 1746 m^3 (61,659 ft^3). Note: DCD Tier 2, Revision 3, Table 6.3-2, was subsequently revised to reflect a new minimum total drainable volume (for three3 GDCS pools) at GDCS pool low water level of 6.5 meters of 1661 m^3 (58,658 ft^3). There were no specific details provided as to why this volume had been changed.

Comment on Response:
DCD Tier 2, Revision 3, Table 6.2-3 specifies that the total water volume per pool (for pools at 90 and 270 degrees) at normal water level is 560 m^3 (i.e., 1120 m^3 combined) and the total water volume (for pool at 180 degrees) at normal water level is 739 m^3. Table 6.2-3 also provides the non-drainable water volume for each GDCS pool, and those values are 91 m^3 and 78 m^3, respectively. Therefore, at normal water level, the total usable GDCS pool inventory is [(560 - 91) + (560 - 91) + (739 - 78)] m^3 or 1599 m^3.

This usable volume of 1599 m^3 at normal pool water level (from Table 6.2-3) is less than the minimum total drainable inventory of 1661 m^3 at pool low water level (from Table 6.3-2).

Requested Response:
Please explain the apparent discrepancy between the usable volume described in Table 6.2-3 (1599 m^3 at normal pool level) and Table 6.3-2 (1661 m^3 minimum total drainable inventory at pool low water level).

18. Comment on response to RAI 16.2-110 from MFN 07-025 (ADAMS accession number ML070320097):

RAI 16.2-110 requested that GE add a Technical Specification (TS) limiting containment oxygen concentration to less than 4%.

GE has responded that the four criteria of 10 CFR 50.36(c)(2)(ii) do not require it. Criterion 2 covers process variables and operating restrictions, but only those which are related to design basis accidents. They argue that the requirements of 10 CFR 50.44, combustible gas control, are derived from beyond-design-basis or severe accidents, so Criterion 2 does not apply.

They further argue that Criterion 4 does not apply: "A structure, system, or component [SSC] which operating experience or probabilistic risk assessment has shown to be significant to public health and safety." They point out that Criterion 4 does not apply to process variables or initial conditions, but rather is restricted to SSCs.

The staff asserts that the fundamental basis for ESBWR's compliance with 50.44 depends on the containment being inerted. The Federal Register Notice for the final 10 CFR 50.44 rulemaking stated 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. If not inerted, the ESBWR containment will not be protected from combustible gas events and will not be safe enough to allow reactor operation. The public would not have the protection required by the regulation. The staff's position is that there must be a license requirement limiting containment oxygen concentration to less than 4%. If necessary, the TS on containment operability could be enhanced by adding an oxygen concentration limit or surveillance requirement as being necessary for containment operability (a system, per Criterion 4). An explicit TS limit would seem to be prudent for a future licensee; if the TS were silent on oxygen concentration, then an uninerted containment could be declared an inoperable containment, and ESBWR proposed LCO 3.6.1.1 ("Containment shall be OPERABLE.") would allow only one hour before requiring initiation of shutdown. Plant operation with an uninerted containment would result in non-compliance with the requirements of 50.44, which could, at the least, lead to violations, citations, enforcement action, and an over-all less stable regulatory environment, without appropriate surveillance requirements, limiting conditions, and associated actions.

One approach could be to create a TS safety limit for oxygen concentration. 10 CFR 50.36(c)(1) says that "Safety limits for nuclear reactors are limits upon important process variables [e.g., oxygen concentration] that are found to be necessary to reasonably protect the integrity of certain of the physical barriers that guard against the uncontrolled release of radioactivity [e.g., containment]. If any safety limit is exceeded, the reactor must be shut down."

Alternately, a license condition could be imposed to prohibit plant operation if oxygen concentration is greater than or equal to 4%. This would be outside the purview of 50.36.

These approaches to place a regulatory limit on containment oxygen concentration during operation of ESBWR plants would need to be further developed.

The point the staff wishes to make is that it is essential to have a regulatory limit on containment oxygen concentration in ESBWR licenses. Various mechanisms are available, but a separate TS on oxygen concentration, similar to TS 3.6.3.2 in the BWR/4 STS, would allow 24 hours before requiring initiation of shutdown, as well as leeway on inerting and de-inerting during start-up and shut down.

Please propose a regulatory limit requiring containment oxygen concentration to be less than 4%.