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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 107 Related to ESBWR Design Certification Application - Technical Specifications - RAI Number 16.2-110 S02**

Enclosures 1 and 2 contain the subject supplemental RAI response resulting from NRC RAI Letter No. 107. The GE Hitachi Nuclear Energy (GEH) responses to the original and S01 RAIs were provided in the Reference 1 letter.

If you have any questions or require additional information regarding the information provided here, please contact me.

Sincerely,

Joseph Savage
James C. Kinsey
Vice President, ESBWR Licensing

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NRO

Reference:

1. MFN 07-025 Supplement 1, Letter from James C. Kinsey to U.S. Nuclear Regulatory Commission, *Response to Portion of NRC Request for Additional Information Letter No. 79 Related to ESBWR Design Certification Application - Technical Specifications - RAI Number 16.2-110 S01*, June 29, 2007

Enclosure:

1. MFN 07-025, Supplement 2 - Response to Portion of NRC Request for Additional Information Letter No. 107 Related to ESBWR Design Certification Application - Technical Specifications - RAI Number 16.2-110 S02
2. MFN 07-025, Supplement 2 - DCD Tier 2, Chapter 16, Draft Revisions for RAI 16.2-110 S02

cc:	AE Cubbage	USNRC (with enclosure)
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Enclosure 1

MFN 07-025, Supplement 2

Response to Portion of NRC Request for

Additional Information Letter No. 107

Related to ESBWR Design Certification Application

- Technical Specifications -

RAI Number 16.2-110 S02

NRC RAI 16.2-110

Proposed Technical Specification (TS) Section 3.6, Containment Systems, apparently does not have a TS for containment oxygen concentration. GE's response to RAI 16.0-1, dated August 8, 2006, in Enclosure 1, Attachment 2, item 27, asserts that an operating restriction on oxygen concentration (to less than 4% by volume) is not required as an initial condition in the analysis of any design-basis event, so it does not meet Criterion 2 of 10 CFR 50.36 and is not included in the proposed Technical Specifications.

However, both the NRC staff and the nuclear industry's Technical Specification Task Force have stated that such a TS is required.

(A) When 10 CFR 50.44, "Combustible Gas Control in Containment," was revised in 2003, the staff issued a model safety evaluation (SE) for implementation of the revised rule through the Consolidated Line Item Improvement Process (ADAMS Accession No. ML032600597, September 12, 2003). The model SE states, on page 13, that "...requirements for primary containment oxygen concentration will be retained in TS for plant designs with an inerted containment." Furthermore, the current standard TS for BWR/4 plants (NUREG-1433, Rev. 3.1) includes TS 3.6.3.2, Primary Containment Oxygen Concentration, which states that "The primary containment oxygen concentration shall be < 4.0 volume percent."

(B) Technical Specification Task Force Traveler TSTF-447, Rev. 1, dated July 18, 2003, "Elimination of Hydrogen Recombiners and Change to Hydrogen and Oxygen Monitors," which has been accepted by the staff, states: "For plant designs with an inerted containment, the requirement for primary containment oxygen concentration will be retained in Technical Specifications."

In light of these positions, add a TS limiting containment oxygen concentration to less than 4% by volume.

GE Response

As stated in the model safety evaluation for implementation of the revised 10 CFR 50.44, "Combustible Gas Control In Containment," dated September 12, 2003, the basis for retention of this requirement in Technical Specifications (TS) is that it meets Criterion 2 of 10 CFR 50.36(c)(2)(ii) in that it is a process variable, design feature, or operating restriction that is an initial condition of a design basis accident or transient analysis that either assumes the failure of or presents a challenge to the integrity of a fission product barrier. This is based on the fact that calculations typically included in Chapter 6 of Updated Final Safety Analysis Reports assume that the primary containment is inerted, that is, oxygen concentration < 4.0 volume percent, when a design basis LOCA occurs.

Design Control Document (DCD), Tier 2, Subsection 6.2.5.5, "Post Accident Radiolytic Oxygen Generation," states that for a design basis loss of coolant accident (LOCA) in the ESBWR, the Automatic Depressurization System (ADS) would depressurize the reactor vessel and the Gravity Driven Cooling System (GDCS) would provide gravity driven flow into the vessel for emergency core cooling. The safety analyses show that the core does not uncover during this event and as a result, there is no fuel damage or fuel clad-coolant interaction that would result in the release of fission products or hydrogen. Thus, for the ESBWR Design Basis Accident (DBA), the generation of post accident oxygen would not result in a combustible gas condition and a design basis LOCA does not have to be considered in this regard. Therefore, GE's response to RAI 16.0-1, dated August 8, 2006, in Enclosure 1, Attachment 2, item 27, concluded that containment oxygen assumptions do not meet Criterion 2 of 10 CFR 50.36 and are not included in the proposed Technical Specifications.

This conclusion, that Criterion 2 is not applicable, is also consistent with the existing Industry proposal to revise the Bases for those plants committed to retaining a Specification on oxygen concentration to reflect retention based on Criterion 4 of 10 CFR 50.36 (i.e., TSTF-478, "BWR Technical Specification Changes that Implement the Revised Rule for Combustible Gas Control").

Furthermore, from the Statements of Considerations (SOCs) for the Final Rule adopting the revisions to 10 CFR 50.44 (68FR54123, September 16, 2003) combustible gas control is clearly a beyond design basis accident (i.e., severe accident) issue. Limitations for these beyond design basis accidents have not been applied to evaluations against the criteria of 10 CFR 50.36(c)(2)(ii). Regarding the Technical Specification requirement for inerting, these SOCs acknowledge that for the existing BWR plants: "Retaining the requirement maintains the current level of public protection." This, in effect, mandates applicability of 10 CFR 50.36(c)(2)(ii), Criterion 4, on existing plants.

The ESBWR design certification does not fall under this discussion and reasoning for existing plants (i.e., there is no "current level of public protection" standard to evaluate). Furthermore, 50.36(c)(2)(ii)(D), Criterion 4, does not apply to a process variable or initial condition (e.g., as Criterion 2 does). Criterion 4 is restricted to SSCs. However, because the basis of the ESBWR severe accident analysis assumes containment inerting, GE commits to include an Availability Control, similar to other Regulatory Treatment of Non-Safety Systems (RTNSS) Availability Controls, in an Appendix to DCD Chapter 19. The Availability Control will be modeled after the BWR4 NUREG-1433, LCO 3.6.3.2, "Primary Containment Oxygen Concentration," and will be incorporated in DCD Chapter 19, Revision 3.

DCD Impact

An Availability Control for containment oxygen concentration will be included in an Appendix to DCD, Tier 2, Chapter 19 Revision 3.

NRC RAI 16.2-110, Supplement 1

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 noncompliance 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%.

GE Response

As stated in the Staff's comment, ESBWR compliance with 10CFR 50.44 requires the containment be inerted. Supporting that regulatory requirement, DCD Tier 2, Revision 3, subsections 6.2.5.1 and 9.4.9.1 state the design basis for the ESBWR is for an inerted containment. Since Tier 2 is incorporated by reference in the Regulations upon design certification, there are ESBWR-specific regulatory limitations imposed to assure the containment is inerted.

GE recognizes the benefit of proposing a regulatory allowance for a limited time to operate with the containment oxygen concentration below the limit. Such a control was proposed in the previous response by way of the inclusion of an Availability Control within the Regulatory Treatment of Non-Safety Systems (RTNSS) Controls to be included in DCD, Tier 2, Chapter 19.

This Availability Control, imposing a limiting condition for containment oxygen concentration, will also provide for the appropriate compensatory actions and restoration timeframes for operation with the containment atmosphere not inerted to within limits. Appropriate surveillance requirements to monitor this condition will also be provided.

The original GE action to include an Availability Control, similar to other RTNSS Availability Controls, modeled after the BWR4 NUREG-1433, LCO 3.6.3.2, "Primary Containment Oxygen Concentration," will provide the limit on containment oxygen concentration as well as the leeway on inerting and de-inerting during start-up and shut down that the Staff discusses above.

DCD Impact

An Availability Control for containment oxygen concentration will be included in an Appendix to DCD, Tier 2, Chapter 19 Revision 4.

NRC RAI 16.2-110 S02

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 limiting condition for operation 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.

GEH Response

GEH will provide a new Technical Specification (TS) 3.6.1.8, "Containment Oxygen Concentration," and associated Bases in DCD Chapters 16 and 16B, respectively. In addition, GEH will delete Availability Control (AC) 3.6.1, "Containment Oxygen," from Chapter 19.

In order to allow containment entries for required Startup Tests without having increased personnel risks due to an oxygen deficient atmosphere, GEH proposes to incorporate a new Special Operations TS. TS 3.10.9, "Oxygen Concentration - Startup Test Program," will allow suspension of the requirements of LCO 3.6.1.8 for the first 120 Effective Full Power Days, during performance of Startup Tests. The proposed TS 3.10.9 is generally consistent with NUREG-0123, BWR/4 STS, TS 3.10.5, "Oxygen Concentration," as modified and presented in NEDC-31681, "BWR Owner's Group Improved Technical Specifications," for BWR/4 improved TS 3.10.12, "Oxygen Concentration - Startup Test Program."

DCD Impact

DCD Chapters 16 and 16B will be revised by the addition of TS 3.6.1.8, "Containment Oxygen Concentration," and TS 3.10.9, "Oxygen Concentration - Startup Test Program," as shown in Enclosure 2. DCD Chapter 19 will be revised by the deletion of AC 3.6.1, "Containment Oxygen," (to be included in Revision 5 of Chapter 19).

Enclosure 2

MFN 07-025, Supplement 2

DCD Tier 2, Chapter 16, Draft Revisions for RAI 16.2-110 S02

3.6 CONTAINMENT SYSTEMS

3.6.1.8 Containment Oxygen Concentration

LCO 3.6.1.8 Containment oxygen concentration shall be < 4.0 volume percent.

APPLICABILITY: During the time period:

a. From 24 hours after THERMAL POWER > 15% RTP following startup,

b. Until 24 hours prior to THERMAL POWER ≤ 15% RTP.

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. Containment oxygen concentration not within limit.	A.1	Restore oxygen concentration to within limit.	24 hours
B. Required Action and associated Completion Time not met.	B.1	Reduce THERMAL POWER to ≤ 15% RTP.	8 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.6.1.8.1	Verify containment oxygen concentration is within limit.	7 days

B 3.6 CONTAINMENT SYSTEMS

B 3.6.1.8 Containment Oxygen Concentration

BASES

BACKGROUND	All nuclear reactors must be designed to withstand events that generate hydrogen either due to the zirconium metal water reaction in the core or due to radiolysis. The primary method to control hydrogen is to inert the containment to meet 10 CFR 50.44(c)(2). With the containment inert, that is, oxygen concentration < 4.0 volume percent (v/o), a combustible mixture cannot be present in the containment for any hydrogen concentration. An event that rapidly generates hydrogen from zirconium metal water reaction could result in excessive hydrogen in containment, but oxygen concentration will remain < 4.0 v/o and no combustion can occur. This LCO ensures that oxygen concentration does not exceed 4.0 v/o during operation in the applicable conditions.
APPLICABLE SAFETY ANALYSES	The Reference 1 calculations assume that the containment is inerted when a Design Basis Accident (DBA) loss of coolant accident (LOCA) occurs. Thus, the hydrogen assumed to be released to the primary containment as a result of metal water reaction in the reactor core will not produce combustible gas mixtures in the primary containment. The safety analyses show that the core does not uncover during the DBA LOCA and as a result, there is no fuel damage or fuel clad-coolant interaction leading to significant hydrogen generation that would result in a combustible gas condition (Ref. 1). Therefore, containment oxygen concentration does not satisfy any of the 10 CFR 50.36(d)(2)(ii) criteria. This LCO is included in accordance with NRC guidance provided in Reference 2.
LCO	The containment oxygen concentration is maintained < 4.0 v/o to maintain acceptable risk mitigation of combustible gases produced by beyond design-basis accidents involving both fuel-cladding oxidation and core-concrete interaction.
APPLICABILITY	The containment oxygen concentration must be within the specified limit, except as allowed by the relaxations during startup and shutdown addressed below. The containment must be inert with THERMAL POWER > 15% RTP, since this is the condition with the highest probability of an event that could lead to significant hydrogen generation.

BASES

Inerting the containment is an operational problem because it prevents containment access without an appropriate breathing apparatus. Therefore, the containment is inerted as late as possible in the plant startup and de-inerted as soon as possible in the plant shutdown. When operating with THERMAL POWER ≤ 15% RTP, the potential for an event that generates significant hydrogen is low and the primary containment need not be inert. Furthermore, the probability of an event that generates hydrogen occurring within the first 24 hours of a startup, or within the last 24 hours before a shutdown, is low enough that these "windows," when the primary containment is not inerted, are also justified. The 24-hour time period is a reasonable amount of time to allow plant personnel to perform post-startup inspections, as well as inerting or de-inerting.

ACTIONS

A.1

If oxygen concentration is ≥ 4.0 v/o at any time while operating with THERMAL POWER > 15% RTP, with the exception of the relaxations allowed during startup and shutdown, oxygen concentration must be restored to < 4.0 v/o within 24 hours. The 24-hour Completion Time is allowed when oxygen concentration is ≥ 4.0 v/o based on engineering judgment considering the low probability and long duration of an event that would generate significant amounts of hydrogen occurring during this period.

B.1

If oxygen concentration cannot be restored to within limits within the required Completion Time, the plant must be brought to a MODE or other specified condition in which the LCO does not apply. To achieve this status, THERMAL POWER must be reduced to ≤ 15% RTP within 8 hours. The 8-hour Completion Time is reasonable, based on operating experience, to reduce reactor power from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.6.1.8.1

The containment must be determined to be inert by verifying that oxygen concentration is < 4.0 v/o. The 7-day Frequency is based on the slow rate at which oxygen concentration can change and on other indications of abnormal conditions (which would lead to more frequent checking by

BASES

operators in accordance with plant procedures). Also, this Frequency has been shown to be acceptable through operating experience.

REFERENCES

1. Section 6.2.5.
2. NRC letter, Manny Comar to General Electric Company, "Request for Additional Information Letter No. 107 Related to ESBWR Design Certification Application," dated August 31, 2007.

3.10 SPECIAL OPERATIONS

3.10.9 Oxygen Concentration - Startup Test Program

LCO 3.10.9 The requirements of LCO 3.6.1.8, Containment Oxygen Concentration, may be suspended during performance of the Startup Test Program provided ≤ 120 Effective Full Power Days (EFPD) of operation from initial startup of the unit.

APPLICABILITY: THERMAL POWER > 15% RTP with LCO 3.6.1.8 not met.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. The above requirement not met.	A.1 Enter the applicable Condition of the affected LCO.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.10.9.1 Verify operation ≤ 120 EFPD.	7 days

B 3.6 SPECIAL OPERATIONS

B 3.10.9 Oxygen Concentration - Startup Test Program

BASES

BACKGROUND	Testing performed as part of the Startup Test Program (Ref. 1) requires containment entries to inspect components following the performance of some tests. LCO 3.6.1.8, Containment Oxygen Concentration, requires the Containment to be inerted with the oxygen concentration maintained below 4.0 volume percent (v/o). This Special Operations LCO provides appropriate restriction to allow containment entries for the required Startup Test Program without having increased personnel risks due to an oxygen deficient atmosphere.
APPLICABLE SAFETY ANALYSES	The Containment oxygen concentration is maintained below 4.0 v/o to ensure that an event which produces any amount of hydrogen does not result in a combustible mixture inside containment. The time allowed with the requirements for containment inerting suspended is sufficiently short such that the probability of an event requiring an inerted atmosphere is very low. Additionally, due to the minimal exposure of the fuel, the decay heat and fission product levels are not significant. As described in LCO 3.0.7, compliance with Special Operations LCOs is optional and therefore no specific criteria of 10 CFR 50.36(d)(2)(ii) applies. Special Operations LCOs provide flexibility to perform certain operations by appropriately modifying requirements of other LCOs.
LCO	As described in LCO 3.0.7, compliance with this Special Operations LCO is optional. However, to perform portions of the Startup Test Program it is impractical to have the containment inerted. To minimize the probability of an accident that assumes an inerted containment, the requirements of LCO 3.6.1.8 are only allowed to be suspended during the initial 120 effective full power days of operation.
APPLICABILITY	Suspension of the requirements for containment inerting with THERMAL POWER > 15% RTP are applied during the Startup Test Program up to 120 effective full power days of operation. This minimizes the probability of an event requiring an inerted containment and also minimizes the decay heat and fission product levels in the fuel.

BASES

ACTIONS	A.1 With the requirements of the LCO not met, the provisions of LCO 3.6.1.8 are no longer exempted and the appropriate ACTIONS of the affected LCO (LCO 3.6.1.8) are required to be taken. The Required Action is provided to restore compliance with the Technical Specification overridden by this Special Operations LCO. Compliance will also result in exiting the Applicability of this Special Operations LCO.	
SURVEILLANCE REQUIREMENTS	SR 3.10.9.1 Periodic verification of the allowed 120 effective full power days of operation established by the LCO provides adequate assurance the reactor is operated within the bounds of the LCO. The 7-day Frequency is acceptable given the slow and predictable change in time of core operation.	
REFERENCES	1. Chapter 14.	