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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 121 Related to ESBWR Design Certification Application, RAI Number 19.1-155**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by NRC letter dated December 5, 2007 (Reference 1). The GEH response to RAI Number 19.1-155 is in Enclosure 1.

If you have any questions or require additional information, please contact me.

Sincerely,

Joseph Savage

James C. Kinsey
Vice President, ESBWR Licensing

D068
NRO

Reference:

1. MFN-07-658. Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request For Additional Information Letter No. 121 Related To ESBWR Design Certification Application.* December 5, 2007.

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 121 Related to ESBWR Design Certification Application ESBWR Probabilistic Risk Assessment RAI Number 19.1-155

cc: AE Cubbage USNRC (with enclosure)
GB Stramback GEH/San Jose (with enclosure)
RE Brown GEH/Wilmington (with enclosure)
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Enclosure 1

MFN 08-017

Response to Portion of NRC Request for

Additional Information Letter No. 121

Related to ESBWR Design Certification Application

Probabilistic Risk Assessment

RAI Number 19.1-155

NRC RAI 19.1-155

Section 19.2.1 of the ESBWR Design Control Document (DCD), Revision 4, states: "Where applicable, ASME-RA-Sb-2005 (References 19.2-2 thru 19.2-4) Capability Category 2 attributes are included in the analysis". In order to judge the technical adequacy of the ESBWR PRA documented in NEDO-33201, Revision 2, additional information is needed that describes the extent to which the ESBWR PRA incorporates capability Category 2 attributes of the ASME Standard for PRA (i.e., ASME-RA-Sb-2005, hereafter referred to as "the Standard") as described below:

A. Please identify those high level requirements or Capability Category 2 attributes of the Standard that have not been embodied in the ESBWR PRA. If a requirement or attribute has been omitted because it is considered inapplicable to a PRA developed in support of a Design Certification, please justify the omission.

B. For those high level requirements or capability Category 2 attributes of the Standard that are considered applicable, but have not been incorporated, please address the impact of not including them on the qualitative and quantitative results of the PRA.

C. If a self-assessment or peer review process has been performed for the ESBWR PRA, please describe this process and the facts and observations that came out of it.

GEH Response

A self-assessment was performed to evaluate the technical adequacy of the ESBWR PRA as documented in NEDO-33201, Revision 2. The following responses describe the extent to which the ESBWR PRA incorporates Capability Category II (CC-II) attributes of the ASME Standard for PRA (i.e., ASME-RA-Sb-2005, hereafter referred to as "the Standard"):

- Part A addresses the requirements that are not applicable to a design certification PRA.
- Part B addresses the requirements that are considered to be applicable. However, not all of the CC-II attributes have been incorporated into the PRA model at this time.
- Part C describes the self-assessment review process.

A. GEH Response to Part A – Requirements Not Applicable to a Design Certification PRA

Table 1 lists the Supporting Requirements (SRs) that were identified as not applicable to a design certification PRA. A justification is provided as to why each requirement is not applicable.

B. GEH Response to Part B - Requirements Applicable to a Design Certification PRA But CC-II Attributes Not Incorporated

Table 2 lists the SRs, their corresponding High Level Requirements (HLRs), which were identified as not meeting CC-II attributes of the Standard in the ESBWR PRA.

For the two SRs that are evaluated to not meet the CC-II attributes, the impact of not including them on the qualitative and quantitative results of the PRA is discussed as follows.

Supporting Requirement AS-B3:

AS-B3 was judged to be "NOT MET" because the documentation was identified to be insufficient in either accident sequence or system models for the phenomenological conditions created by the accident progression.

However, there has been extensive discussion on this issue as described in NEDO-33201 Appendix 8D, "Equipment Survivability Analysis", whose purpose is to demonstrate that necessary components and instrumentation will be functional in the severe accident environment so that the plant may be placed in a controlled, stable state. Regular interfaces with design engineers have resulted in multiple design changes to address the phenomenological conditions and their impact. For example, a design of the diesel-driven fire pump is still on-going that would allow the fire pump to inject into a pressurized containment condition. On the other hand, the detail system designs will address those phenomenological conditions and their impact, that are not currently available for PRA to document as bases.

Overall, this issue is a documentation issue that can be resolved by including discussion on phenomenological conditions in either accident sequence or system models.

Supporting Requirement SY-B11:

SY-B11 was judged to be "CC-I" for some system models. While each modeled ESBWR system has been evaluated in the self-assessment process, not all the systems were assigned a CC-I grading for SY-B11.

The system models have already captured the dominant failure modes for those systems that are required for initiation and actuation. Simplified models of initiation and actuation failures have been developed and significant risk contributors have been evaluated with sensitivity studies. With a passive design and redundancies that are built in the ESBWR system designs, the uncertainties associated with the detail modeling of initiation and actuation failures are not risk significant.

Revision 2 of NEDO-33201 section 4.5.11, PRA Insights, states that "The I&C system is comprised of redundant, robust hardware. From a design perspective, it is very reliable. Q-DCIS and N-DCIS are, at their heart, computer based systems, running high quality software. As such, the only weakness of the system is failure of the software." More detailed modeling of hardware will not change this risk insight.

C. GEH Response to Part C – Self-Assessment Review Process

The ESBWR PRA technical capability was assessed by PRA staff members against the entire set of technical requirements in the ASME Probabilistic Risk Assessment (PRA) Standard as amended by Regulatory Guide 1.200 Revision 1. Additional guidance was provided by NEI 00-02 "Industry Peer Review Process Guidelines". It is important to note that the ASME PRA Standard is written for an operating plant and has some limitations for assessment of a design certification PRA. In contrast, the ESBWR design certification PRA includes areas not currently covered in the ASME Standard.

The applicability of the ASME elements to various sections of NEDO-33201, Revision 2 is outlined below. Sections marked N/A were not within the scope of the self-assessment.

NEDO-33201 Rev 2 Sections	Topic	ASME Element
1	INTRODUCTION	N/A
2	INITIATING EVENTS	IE
3	ACCIDENT SEQUENCE ANALYSIS	AS, SC
4	SYSTEM ANALYSIS	SY
5	DATA ANALYSIS	DA
6	HUMAN RELIABILITY ANALYSIS	HR
7	CORE DAMAGE FREQUENCY QUANTIFICATION	QU
8	CONTAINMENT PERFORMANCE	LE
9	SOURCE TERMS	LE
10	CONSEQUENCE ANALYSIS	N/A
11	UNCERTAINTY AND SENSITIVITY ANALYSIS	QU
12	PROBABILISTIC FIRE ANALYSIS	RG1.200 Section 1.2 & 1.3
13	PROBABILISTIC FLOOD ANALYSIS	IF
14	HIGH WIND RISK	RG1.200 Section 1.2 & 1.3

NEDO-33201 Rev 2 Sections	Topic	ASME Element
15	SEISMIC MARGINS ANALYSIS	RG1.200 Section 1.2 & 1.3
16	SHUTDOWN RISK	N/A
17	RESULTS SUMMARY	QU
18	PRA INSIGHTS AFFECTING ESBWR DESIGN	N/A
19	RELIABILITY AND MAINTAINABILITY	N/A
20	REGULATORY TREATMENT OF NON-SAFETY SYSTEMS (RTNSS)	N/A
21	SEVERE ACCIDENT MANAGEMENT	N/A

The ESBWR PRA self-assessment team consists of 5 team members with a total of 49 years in PRA, who are also experienced in self-assessment. The team members' expertise covers all ASME technical elements. The team members remained independent with respect to the reviewed technical elements to achieve the objective of being self-critical.

The results of the assessment have been documented in a set of ACCESS databases, one database for tables and the other for applications.

The team graded capability category for each ASME technical element supporting requirements (SRs). Facts and Observations (F&Os) were prepared to document any issues that were identified during the review of the ESBWR PRA against the amended ASME Standard.

The capability category grades are described as follows:

CC Grade	Interpretation
Deleted	Deleted SR
I	Capable of supporting applications requiring that Capability Category or lower
II	Capable of supporting applications requiring that Capability Category or lower
III	Capable of supporting applications requiring that Capability Category or lower
Met	Capable of supporting applications in all Capability Categories

CC Grade	Interpretation
N/A	Not applicable to the evaluated PRA models
Not Met	Does not meet minimum standard

The "Significance Level" of the F&Os is described as follows:

- "A" F&Os represent issues that are extremely important and should be addressed as soon as possible, but are not considered applicable to the ESBWR PRA because the ESBWR is not an operating unit.
- "B" F&Os represent issues that should be addressed in the next ESBWR PRA update.
- "C" F&Os are desirable for flexibility and consistency with the industry.
- "D" F&Os are editorial or minor technical issues.
- "S" F&Os show superior treatment that exceeds what would be found in most PRAs.

The self-assessment generated no "A" level F&O, 3 "B" level F&Os, 126 "C" level F&Os, 75 "D" level F&Os. Thirteen observations have been identified on superior treatment ("S" level F&Os) that exceeds what would be found in most PRAs. Among these F&Os, one "B" level F&O was generated for fire analysis, which is outside the Standard but described in RG 1.200. One "C" level and one "D" level F&Os were generated for high wind and seismic analyses, respectively.

The majority of the F&Os were generated for system analysis (SY) since every system was assessed separately. A large number of "C" level F&Os were generated as reminders for the responsible engineers to incorporate certain attributes in the Standard when the ESBWR PRA model is updated for the next phases (prior to fuel load and operational).

The following are the three "B" level F&Os that will be addressed in next revision of ESBWR PRA:

AS-B3-001:

Description:

Discussion in the documentation was identified to be insufficient in either accident sequence or system models for the phenomenological conditions created by the accident progression. Phenomenological impacts include generation of harsh environments affecting temperature, pressure, debris, water levels, humidity, etc. that could impact the success of the system or function under consideration [e.g., loss of pump net positive suction head (NPSH), clogging of flow paths].

Impact:

This issue is a documentation issue. The accident sequence or system model sections should be enhanced to address the identified issue. Refer to GEH Part B response for impact of not including CC-II attributes of SR AR-B3 on the qualitative and quantitative results of the PRA.

SY-A1-061:

Description:

Inadequate treatment of seismically induced fires as it pertains to the fire initiation analysis.

Impact:

Currently there is not enough seismic design information available for evaluation. However, design requirements will be implemented to prevent any significant risk contribution from seismically induced fire.

SY-A4-002

Description:

Due to the nature of the design process, the PRA engineers are not aware of all changes to the ESBWR design that could affect the PRA.

Impact:

This finding is to ensure ESBWR PRA reflects the as-designed plant in the detailed design phase. This finding does not have significant impact on the design certification PRA since it is periodically updated to reflect the design information documented in the current revision of DCD.

PRA group members are involved in design activities and evaluate risk changes associated with proposed design changes. New program has been implemented to enhance the communication between design/system engineers and the PRA engineers that will ensure the ESBWR PRA reflects the as-designed plant.

DCD Impact

No DCD changes will be made in response to this RAI.

No changes to NEDO-33201 will be made in response to this RAI.

Table 1 Requirements Not Applicable to a Design Certification PRA and Justification	
SR Index	**Justification**
AS-A5	Requirement is met except the portion not applicable to a design certification PRA since the plant-specific information is not available, especially the procedures.
AS-A9	Requirement is met except the portion not applicable to a design certification PRA since bounding analyses are more appropriate to a design PRA.
DA-A3	Requirement is met except the portion not applicable to a design certification PRA since generic data are more appropriate.
DA-C1	Requirement is met except the portion not applicable to a design certification PRA since generic data are more appropriate.
DA-C10	Requirement is deleted for a design certification PRA since neither surveillance test procedures nor test data are available.
DA-C11	Requirement is deleted for a design certification PRA since maintenance and testing data are not available.
DA-C11a	Requirement is met except the portion not applicable to a design certification PRA since the unavailability cannot be "counted" in a design certification PRA.
DA-C12	Requirement is met except the portion not applicable to a design certification PRA since the "actual" time cannot be evaluated and best source for information for a design certification PRA is the design engineer. Generic values for unavailability are more appropriate.
DA-C13	Requirement is met except the portion not applicable to a design certification PRA since the actual plant experience is not available.
DA-C14	Requirement is met except the portion not applicable to a design certification PRA since the actual plant experience is not available.
DA-C15	Requirement is deleted for a design certification PRA since the plant-specific data for recovery are not available.
DA-C2	Requirement is deleted for a design certification PRA since the plant-specific data for recovery are not available.
DA-C3	Requirement is deleted for a design certification PRA since the plant-specific data for recovery are not available.
DA-C4	Requirement is deleted for a design certification PRA since the plant-specific data for recovery are not available.
DA-C5	Requirement is deleted for a design certification PRA since the plant-specific data for recovery are not available.
DA-C6	Requirement is deleted for a design certification PRA since the plant-specific data for recovery are not available.
DA-C7	Requirement is met except the portion not applicable to a design certification PRA since the actual plant experience is not available. Technical Specifications can be used for estimation for a design certification PRA.
DA-C8	Requirement is met except the portion not applicable to a design certification PRA since the actual plant experience is not available. Technical Specifications can be used for estimation for a design certification PRA.

Table 1 Requirements Not Applicable to a Design Certification PRA and Justification	
SR Index	**Justification**
DA-C9	Requirement is met except the portion not applicable to a design certification PRA since the actual plant experience is not available. Technical Specifications can be used for estimation for a design certification PRA.
DA-D4	Requirement is met except the portion not applicable to a design certification PRA since there should be no requirement for use of a Bayesian approach.
DA-D6	Requirement is met except the portion not applicable to a design certification PRA since the use of generic values for common cause failure factors should be more appropriate.
DA-D6a	Requirement is deleted for a design certification PRA since generic data are used and no screening should be performed.
DA-D7	Requirement is deleted for a design certification PRA since no past data are available.
DA-E2	Requirement is met except the portion not applicable to a design certification PRA since the actual plant experience is not available.
HR-A1	Requirement is met except the portion not applicable to a design certification PRA. Design specifications and the test requirements should be used instead of procedures and practices, which are not available for a design certification PRA.
HR-A2	Requirement is met except the portion not applicable to a design certification PRA. Design specifications and the test requirements should be used instead of procedures and practices, which are not available for a design certification PRA.
HR-A3	Requirement is deleted for a design certification PRA since no work practices can be identified.
HR-D2	Requirement is met except the portion not applicable to a design certification PRA since it is more appropriate to use screen estimates for pre-initiator HEPs.
HR-D4	Requirement is deleted for a design certification PRA since the recovery of pre-initiator errors cannot be modeled in the required details.
HR-E1	Requirement is met except the portion not applicable to a design certification PRA since the plant-specific procedures are not available.
HR-E2	Requirement is met except the portion not applicable to a design certification PRA since the term "either in response to procedural direction or as skill-of-the-craft," is not applicable.
HR-E3	Requirement is deleted for a design certification PRA since no procedures can be identified and no plant operators or training personnel are available for interviews.
HR-G3	Requirement is met except the portion not applicable to a design certification PRA since a bounding approach is more appropriate for a design certification PRA.
HR-G6	Requirement is met except the portion not applicable to a design certification PRA. The term "plant history, procedures, operational practices, and experience" is not applicable to a design certification PRA.

Table 1 Requirements Not Applicable to a Design Certification PRA and Justification	
SR Index	**Justification**
HR-H2	Requirement is met except the portion not applicable to a design certification PRA since the operator recovery actions should be minimized for a design certification PRA.
IE-A3a	Requirement is met except the portion not applicable to a design certification PRA. It is more appropriate to review the design specifications to identify any new challenges.
IE-A5	Requirement is met except the portion not applicable to a design certification PRA since no plant-specific operation experience is available.
IE-C2	Requirement is deleted for a design certification PRA since no plant-specific data are available.
IE-C9	Requirement is met except the portion not applicable to a design certification PRA. It is more appropriate to consider new designs.
IF-A1a	Requirement is met except the portion not applicable to a design certification PRA. It is more appropriate to define flood areas with a bounding approach.
IF-A3	Requirement is met except the portion not applicable to a design certification PRA. It is more appropriate to reflect the as-designed unit for a design certification PRA.
IF-A4	Requirement is met except the portion not applicable to a design certification PRA since a walkdown cannot be performed.
IF-B1a	Requirement is deleted for a design certification PRA since there are no multi-unit site considerations.
IF-C4a	Requirement is deleted for a design certification PRA since there are no multi-unit site considerations.
IF-C9	Requirement is met except the portion not applicable to a design certification PRA since a walkdown cannot be performed.
IF-D5a	Requirement is met except the portion not applicable to a design certification PRA since no operating experience is available.
IF-E8	Requirement is met except the portion not applicable to a design certification PRA since a walkdown cannot be performed.
LE-B1	Requirement is met except the portion not applicable to a design certification PRA since LERF is no longer applicable and the LERF/LRF contributors need to be re-evaluated for a design certification PRA.
QU-D1b	Requirement is met except the portion not applicable to a design certification PRA since no plant operation experience is available.
QU-D3	Requirement is met except the portion not applicable to a design certification PRA since there may be no similar design for a design certification PRA.
QU-D5a	Requirement is met except the portion not applicable to a design certification PRA since SSCs and operator actions that contribute to initiating event frequencies and event mitigation are not required in a design certification PRA.
SC-A4a	Requirement is deleted for a design certification PRA since there are no multi-unit site considerations.
SC-A6	Requirement is met except the portion not applicable to a design certification PRA since no plant procedures are available.
SY-A18	Requirement is met except the portion not applicable to a design certification PRA since no actual practices and history of the plant are available.

Table 1 Requirements Not Applicable to a Design Certification PRA and Justification	
SR Index	**Justification**
SY-A18a	Requirement is met except the portion not applicable to a design certification PRA since no planned activity is available.
SY-A2	Requirement is met except the portion not applicable to a design certification PRA. The term "as-built and as-operated" should be changed to "as-designed" for a design certification PRA.
SY-A3	Requirement is met except the portion not applicable to a design certification PRA. The term "as-built and as-operated" should be changed to "as-designed" for a design certification PRA.
SY-A4	Requirement is met except the portion not applicable to a design certification PRA. The term "as-built and as-operated" should be changed to "as-designed" for a design certification PRA.
SY-B6	Requirement is met except the portion not applicable to a design certification PRA. The term "as-built and as-operated" should be changed to "as-designed" for a design certification PRA.
SY-B8	Requirement is met except the portion not applicable to a design certification PRA since a walkdown cannot be performed for a design certification PRA.

Table 2 Requirements Applicable to a Design Certification PRA But CC-II Attributes Not Incorporated

Technical Element	HLR	SR	CC-II Attributes (Including Across the Board Attributes for all Capability Categories)
AS	HLR-AS-B	AS-B3	For each accident sequence, IDENTIFY the phenomenological conditions created by the accident progression. Phenomenological impacts include generation of harsh environments affecting temperature, pressure, debris, water levels, humidity, etc. that could impact the success of the system or function under consideration [e.g., loss of pump net positive suction head (NPSH), clogging of flow paths]. INCLUDE the impact of the accident progression phenomena, either in the accident sequence models or in the system models.
SY	HLR-SY-B	SY-B11	MODEL those systems that are required for initiation and actuation of a system. In the model quantification, INCLUDE the presence of the conditions needed for automatic actuation (e.g., low vessel water level). INCLUDE permissive and lockout signals that are required to complete actuation logic.