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U.S. Nuclear Regulatory Commission
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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 160 Related to ESBWR Design Certification Application, RAI Number 14.3-176**

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 March 6, 2008 (Reference 1). The GEH response to RAI Number 14.3-176 is in Enclosure 1.

Verified DCD changes associated with this RAI response are identified in the enclosed DCD markups by enclosing the text within a black box. The marked-up pages may contain unverified changes in addition to the verified changes resulting from this RAI response. Other changes shown in the markup(s) may not be fully developed and approved for inclusion in DCD Revision 5.

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

Sincerely,

James C. Kinsey

James C. Kinsey
Vice President, ESBWR Licensing

D068
NRO

Reference:

1. MFN-08-221. Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request For Additional Information Letter No. 160 Related To ESBWR Design Certification Application.* March 6, 2008.

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 160 Related to ESBWR Design Certification Application, ESBWR Probabilistic Risk Assessment, RAI Number 14.3-176

2. Attachment 1 DCD Tier 1 Section 2.11.4 and Table 2.11.4-1

cc:	AE Cubbage	USNRC (with enclosure)
	GB Stramback	GEH/San Jose (with enclosure)
	RE Brown	GEH/Wilmington (with enclosure)
	DH Hinds	GEH/Wilmington (with enclosure)
	eDRFSection	0000-0082-9572

Enclosure 1

MFN 08-334

*Response to Portion of NRC Request for

Additional Information Letter No. 160

Related to ESBWR Design Certification Application

ESBWR Probabilistic Risk Assessment

RAI Number 14.3-176

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NRC RAI 14.3-176

Turbine Missile Probability and Turbine material, design, inspection and test verification Turbine material, design, inspection and test verification.

a. *In Revision 3 of the DCD Tier 1, Section 2.11.4 discussed external turbine missile probability and required it to be less than 1x10-4 per turbine year. Revision 3 also included an ITAAC #5 in Table 2.11.4-1 that confirmed the probability was less than 1x10-4 per turbine year and verified the calculation existed. Revision 4 deleted the Tier 1 missile probability discussion and the ITAAC.*

   In order for the staff to conclude that GDC 4 is satisfied, the staff requests that the applicant revise Revision 4 of DCD Tier 1 to add a description of the "P1 probability", i.e. P1 < 10-4 for turbine failure resulting in the ejection of turbine rotor fragments in terms of the criteria shown in Table 3.5.1.3-1 of SRP Section 3.5.1.3.

b. *In Revision 3 of the DCD Tier 1, Section 2.11.4 discussed Turbine Disk Integrity being provided through the combined use of selected materials with suitable toughness, analyses, testing, inspections, and operating procedures. Tier 1 of the DCD also discussed how turbine components and valves would be in-service tested and inspected in accordance with industry practice or as required to meet the Original Equipment Manufacturer's (OEM) turbine missile generation probability requirements. Revision 3 also included an ITAAC #4 in Table 2.11.4-1 which provided a means to verify the materials, analyses, testing, inspections, and operating procedures to ensure turbine disk integrity. Revision 4 deleted these turbine disk integrity related discussions and the ITAAC.*

   In order for the staff to conclude that GDC 4 is satisfied, the staff requests that the applicant revise Revision 4 of DCD Tier 1 to add an ITAAC to verify that the as-built turbine material properties, the turbine rotor and blade designs and pre-service and inservice inspection and testing requirements meet the requirements of the turbine missile generation probability calculation.

This RAI supercedes the previously issued RAI 14.3-176 (RAI Letter No. 126, Adams Accession No. ML073532238)

GEH Response

The requested ITAAC in DCD Tier 1 will be provided in Revision 5 in accordance with the attached proposed markup.

DCD Impact

DCD Tier 1, Section 2.11.4 and Table 2.11.4-1, will be revised per the attached markup.

Attachment 1

MFN 08-334

DCD Tier 1 Revision 5 Markup
Section 2.11.4 and Table 2.11.4-1

2.11.4 Main Turbine System

Design Description

The Main Turbine System (MT) is nonsafety-related. The ESBWR standard plant design has a favorably oriented turbine to minimize any potential impact on safety-related structures and equipment.

(1) The physical layout of the system assures that protection is provided to essential systems and components, as required, from the effects of high and moderate energy MT system piping failures or failure of the connection(s) from the low pressure turbine exhaust hood(s) to the condenser. Essential systems and components are defined in BTP SPLB 3-1 as systems and components required to shut down the reactor and mitigate the consequences of a postulated piping failure, without offsite power.

(2) The MT has a favorable orientation to minimize the potential effects of turbine missiles. ~~Favorably oriented turbine generators are located such that the containment and most safety-related Systems, Structures and Components outside containment are excluded from the low-trajectory hazard zone described in RG 1.115.~~ The safety-related SSCs that are located within the low-trajectory turbine missile strike zone are either safeguarded from direct turbine missile strike or are failsafe in design.

(3) The MT control valve closing times are limited to mitigate Abnormal Events.

(4) The MT stop valve ~~nominal~~ closing times are limited to mitigate Abnormal Events.

(5) The MT can accommodate sufficient steam flow through three control valves to mitigate Abnormal Events.

(6) The Turbine Missile Probability Analysis concludes the probability of turbine failure resulting in the ejection of turbine rotor (or internal structure) fragments through the turbine casing is less than the regulatory limiting value.

(7) The as-built turbine material properties, turbine rotor and blade designs, pre-service inspection and testing results and in-service testing and inspection requirements meet the requirements defined in the Turbine Missile Probability Analysis. RAI 14.3-176

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.11.4-1 provides a definition of the inspections, tests, and/or analyses, together with associated acceptance criteria for the Main Turbine.

Table 2.11.4-1

ITAAC For The Main Turbine System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
3. The MT control valve closing times are limited to mitigate Abnormal Events.	Testing and/or analysis of the as-built MT and/or type testing of a single turbine control valve will be performed to confirm control valve closing times.	A report exists and documents that the MT control valve fast closing time characteristic is limited to a minimum greater than or equal to ~~[~~0.08 seconds~~]~~ and that the servo closing time is limited to a minimum greater~~a maximum less~~ than or equal to ~~[~~2.5 seconds~~]~~.
4. The MT stop valve ~~nominal~~ closing times ~~is~~ are limited to mitigate Abnormal Events.	Testing and/or analysis of the as-built MT and/or type testing of a single turbine stop valve will be performed to confirm stop valve ~~nominal~~ closing time.	A report exists and documents that the MT stop valve ~~nominal~~ closing time is limited to a minimum greater than ~~[~~0.100 seconds~~]~~.
5. The MT can accommodate sufficient steam flow through three control valves to mitigate Abnormal Events.	An inspection of the analysis of the as-built MT will be performed to confirm that the MT can accommodate sufficient steam flow through three control valves.	A report exists and concludes that the MT can accommodate a flow greater than or equal to [85%] of rated steam flow through three control valves.
6. The Turbine Missile Probability Analysis concludes the probability of turbine failure resulting in the ejection of turbine rotor (or internal structure) fragments through the turbine casing is less than the regulatory limiting value.	A turbine missile probability analysis will be performed to demonstrate the probability of turbine failure resulting in the ejection of turbine rotor (or internal structure) fragments through the turbine casing is less than the regulatory limiting value.	A Turbine Missile Probability Analysis Report exists and documents that the probability of turbine failure resulting in the ejection of turbine rotor (or internal structure) fragments through the turbine casing is less than $1x10^{-4}$ per year. RAI 14.3-176

Table 2.11.4-1

ITAAC For The Main Turbine System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7. The as-built turbine material properties, turbine rotor and blade designs, pre-service inspection and testing results, and in-service testing and inspection requirements meet the requirements defined in the Turbine Missile Probability Analysis.	An inspection of the as-built turbine material properties, turbine rotor and blade designs, pre-service inspection and testing results, and in-service testing and inspection requirements will be conducted.	Report(s) document that as-built turbine material properties, turbine rotor and blade designs, pre-service inspection and testing results, and in-service inspection and testing requirements meet the requirements of the turbine missile probability analysis. RAI 14.3-176