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MFN 08-086, Supplement 13

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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 126 Related to ESBWR Design Certification Application RAI Numbers 14.3-192, 14.3-244, 14.3-250, 14.3-262 and 14.3-350**

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 20, 2007 (Reference 1).

Enclosure 1 contains the GEH response to RAIs 14.3-192, 14.3-244, 14.3-250, 14.3-262 and 14.3-350. The enclosed changes will be incorporated in the upcoming DCD Revision 5 submittal.

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,

R.E. Brown for/

James C. Kinsey
Vice President, ESBWR Licensing

D068
NRO

Reference:

1. MFN 07-718, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request For Additional Information Letter No. 126 Related To ESBWR Design Certification Application*, December 20, 2007.

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 126 Related to ESBWR Design Certification Application – RAI 14.3-192, 14.3-244, 14.3-250, 14.3-262, and 14.3-350.

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)
	eDRF	0000-0080-2212 – RAIs 14.3-192, 14.3-250, 14.3-350
		0000-0080-7603 – RAI 14.3-262
		0000-0081-7092 – RAI 14.3-244

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Enclosure 1

*Response to Portion of NRC Request for Additional Information Letter No. 126 Related to ESBWR Design Certification Application

RAI Numbers 14.3-192, 14.3-244, 14.3-250, 14.3-262 and 14.3-350.

*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.

NRC RAI 14.3-192

NRC Summary:
CRD Pumps start time

NRC Full Text:
DCD Tier 2, Table 15.2-1, indicates maximum time delays from initiating signal (Pump 1 and 2) as 10 and 25 seconds. If off-site power is not available, the time delay is shown as 145 seconds. These parameters are critical parameters in TRACG analyses for Anticipated Operational Occurrences (AOOs). Add the CRD pump start times to the CRD ITAAC in Tier 1, Section 2.2.2.

GEH RESPONSE

The CRD high pressure makeup flow is no longer in the primary success path for mitigating transients and accidents, for detailed discussion see RAI 15.0-2 S01 (MFN 06-331, Supplement 1, March 12, 2008). The function is credited in the PRA, but does not meet any of the significance criteria for RTNSS. Therefore, the function is simply listed in the design description and the performance values will be removed from Tier 1.

DCD IMPACT

DCD Tier #1, Section 2.2.2 and Table 2.2.2-7 will be revised as shown in the attached markup.

NRC RAI 14.3-244

The I&C ITAAC per NRC guidance NUREG-0800, Section 14.3, it is stated that "Since there is some of this type equipment (i.e. digital) which may be utilized in the electrical distribution systems, the I&C ITAAC should cover this."

GEH Response

The exception that the qualification of digital equipment in "other than harsh" environments be included in Tier 1 is addressed by I&C in Tier 1 Section 3.8, ITAAC #3.

In accordance with the statement from NUREG-0800 Section 14.3 included in this RAI question, Tier 1 Section 3.8, ITAAC #3 will be revised to include digital equipment utilized by the electrical systems.

DCD Tier 1, Revision 5, will revise the DC to read, "Safety-related digital I&C equipment (including digital components in the safety-related electrical distribution system) located in a mild environment is designed to perform its safety-related function under normal and AOO environmental conditions."

DCD Tier 1, Revision 5, will revise the ITA and AC to read, "Safety-related digital I&C equipment (including digital components in the safety-related electrical distribution system) located in a mild environment is identified and:"

DCD Impact

DCD Tier 1, Revision 5, will be revised as noted above and as shown in the attached markup.

NRC RAI 14.3-250

NRC Summary:
Figure to display instrumentation

NRC Full Text:
Display controls in figure 2.2.2-1 listed in the table.

GEH RESPONSE

Tier 1 functional arrangement information can be provided in tabular or graphical form. The form selected is based on the nature of the information. When instruments are shown on the figure, the placement on the figure implies spatial or relational aspects of the configuration (e.g. the instrument is mounted on the accumulator, or the instrument is mounted on the pipe upstream of the check valve) that may not be required. In this case, the tabular form is appropriate because the location of the controls are not critical to the performance of the system during accident and transient conditions.

DCD IMPACT

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

NRC RAI 14.3-262

Clarify the following functional requirements in Section 2.2.14 including the bracketed information at the end.

(6) The containment isolation components that correspond to the isolation functions defined in Table 2.2.14-2 are addressed in Subsection 2.15.1. [TCF510]
(8) Confirmatory analyses to support and validate the DPS design scope. [SMK511]
(9) Failure Modes and Effects Analysis (FMEA) per NUREG/CR-6303 of safety related protection system platforms (RPS and SSLC/ESF) completed to validate the DPS diverse protection function. [SMK512]

GEH RESPONSE

The bracketed information at the end of the ITAAC noted is GEH internal annotation information which was inadvertently retained in the submitted version of the DCD. These annotations will be removed as part of the next DCD Tier 1 revision process.

Table 2.2.14-2 defines the containment isolation functions, including MSIV Closure (DPS), ICS isolation valve closure (DPS), RWCU/SDC isolation valve closure (DPS), and FW isolation (DPS). The containment isolation components that correspond to these isolation functions are addressed in Subsection 2.15.1.

Confirmatory analyses are required to support and validate the DPS design scope. The acceptance criterion is that DPS design ensures releases during a common mode protection system failure coincident with the design basis events discussed in the Safety Analyses are within 10 CFR 100 limits (or percentage thereof) as specified in BTP HICB-19. An ITAAC was requested by the NRC through RAI 7.8-5 and agreed to by GEH, Letter MFN 06-472, December 20, 2006.

NUREG/CR-6303 requires an FMEA of safety-related protection system platforms (RPS and SSLC/ESF in order to identify CMF vulnerabilities. An ITAAC was requested by the NRC through RAI 14.3-94 and agreed to by GEH, Letter MFN 06-482, December 31, 2006. To match the level of detail contained in other ITAACs, references to types of failure modes will be removed.

DCD IMPACT

DCD Tier 1, Rev. 4 Table 2.2.14-4 will be revised as shown in the attached markup.

NRC RAI 14.3-350

NRC Summary:
CRDS interfacing systems

NRC Full Text:
For ITAAC Table 2.2.2-7 Item 9, the ITA & AC are not consistent with the DC regarding associated interfacing systems. The staff requests that the applicant modify the ITA and AC to include a verification of the associated interfacing systems specified in Table 2.2.2-3. In addition, the AC should include verification of that the list of systems identified as interfaces in Table 2.2.2-3 is a complete list. The applicant should confirm that there are other ITAAC to verify the functional performance of the associated interfacing systems.

In addition, the applicant should consider clarifying the DC such that it commits to the CRD system functioning as defined in Table 2.2.2-3 to be consistent with the ITA and AC. As written, it sounds more like verification of the functional arrangement of the system.

GEH RESPONSE

Tier # 1, Section 2.2.2, Table 2.2.2-7, Item # 9 ITA and AC will be revised to include verification of the associated interfacing systems specified in Table 2.2.2-3. The AC will also be revised to include a verification of all of the interfacing systems. The ITAAC to verify the functional performance of the associated interfacing systems as listed in Table 2.2.2-3 is as follows: RPS and ITAAC Table 2.2.7-4; DPS and ITAAC Table 2.2.14-4; and RC&IS and ITAAC Table 2.2.1-6. The Design Commitment to the CRD system functioning as defined in Table 2.2.2-3 is adequate considering the revision to the ITA and AC.

DCD IMPACT

DCD Tier # 1, Section 2.2.2, Table 2.2.2-7 Item # 9 ITA and AC will be revised as noted in the attached markup.

(8) ~~For the high-pressure makeup mode of operation, the minimum flow supplied to the reactor is 3920 l/min (1036 gpm) with both CRD pumps operating and 1960 l/min (518 gpm) with one pump operating with reactor pressure less than or equal to 8.62 MpaG (1250 psig).~~The HPCRD has a high-pressure makeup mode of operation that injects water to the RPV via the RWCU/SDC return path.

(9) CRD system automatic functions, initiators, and associated interfacing systems are defined in Table 2.2.2-3.

(10) CRD system controls and interlocks are defined in Table 2.2.2-4.

(11) CRD system minimum inventory of alarms, displays, controls, and status indications in the main control room are addressed in Section 3.3.

(12) CRD maximum allowable scram times for vessel bottom pressures below 7.481 MPa gauge (1085 psig) are defined in Table 2.2.2-2.

(13) Conformance with IEEE Std. 603 requirements by the safety-related control system structures, systems, and components defined in Tier 1 Tables 2.2.2-1~~,~~ and 2.2.2-6~~, and 2.2.2-7,~~ is addressed in Subsection 2.2.15.

(14) The equipment qualification of CRDS components defined in Tables 2.2.2-1, 2.2.2-6, and 2.2.2-6, is addressed in Section 3.8.

(15) CRDS software is developed in accordance with the software development program described in Section 3.2.

(16) The FMCRD has an electro-mechanical brake with a minimum required holding torque on the motor drive shaft.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.2.2-7 defines the inspections, tests, and/or analyses, together with associated acceptance criteria for the CRD system.

Table 2.2.2-7

ITAAC For Control Rod Drive System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7. Valves defined in Table 2.2.2-5 and 2.2.2-6 as having an active safety-related function open, close, or both open and close under differential pressure, fluid flow, and temperature conditions.	Tests of installed valves will be performed for opening, closing, or both opening and closing under system preoperational differential pressure, fluid flow, and temperature conditions.	Test report(s) document that, upon receipt of the actuating signal, each valve opens, closes, or both opens and closes, depending upon the valve's safety function.
8. The HPCRD has a high-pressure makeup mode of operation that injects water to the RPV via the RWCU/SDC return path. ~~For the high pressure makeup mode of operation, the minimum flow supplied to the reactor is [3920] l/min ([1036] gpm) with both CRD pumps operating and [1960] l/min ([518] gpm) with one pump operating with reactor pressure less than or equal to [8.62] MpaG ([1250] psig).~~	Test(s) of the HPCRD high-pressure makeup ~~flow capacity of the CRD pumps~~mode of operation will be conducted ~~in a test facility~~on the as-built system verifying that water is injected to the RPV via the RWCU/SDC return path.	Test report(s) document that the ~~CRDHS~~ HPCRD high-pressure makeup mode of operation injects water to the RPV via the RWCU/SDC return path. ~~delivers a minimum flow of [3920] l/min ([1036] gpm) with both CRD pumps operating and [1960] l/min ([518] gpm) with one CRD pump operating against a pressure less than or equal to [8.62] MPaG ([1250] psig).~~

3.8 ENVIRONMENTAL QUALIFICATION OF MECHANICAL AND ELECTRICAL EQUIPMENT

Design Description

(1) Safety-related electrical equipment located in a harsh environment can perform its safety-related function under normal, abnormal and design bases accident environmental conditions.

(2) Safety-related mechanical equipment located in a harsh environment can perform its safety-related function under normal, abnormal and design bases accident environmental conditions.

(3) Safety-related digital I&C equipment (including digital components in the safety-related electrical distribution system) located in a mild environment is designed to perform its safety-related function under normal and AOO environmental conditions.

Inspections, Tests, Analyses, and Acceptance Criteria

Table 3.8-1 specifies the environmental qualification inspections, test, analyses, and associated acceptance criteria for safety-related mechanical and electrical equipment.

Table 3.8-1

ITAAC for Environmental Qualification of Mechanical and Electrical Equipment

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
3. Safety-related digital I&C equipment (including digital components in the safety-related electrical distribution system) located in a mild environment is designed to perform its safety-related function under normal and AOO environmental conditions.	Safety-related digital I&C equipment (including digital components in the safety-related electrical distribution system) located in a mild environment is identified and:	
	i. Analysis will be performed to identify the environmental design bases including the definition of anticipated operational occurrences and normal environments.	i. Report(s) document the analyses results identifying the environmental design bases including the definition of anticipated operational occurrences and normal environments for safety-related digital I&C equipment (including digital components in the safety-related electrical distribution system) located in a mild environment:
	ii. Type tests, analyses, or a combination of type tests and analyses will be performed on safety-related digital I&C equipment located in a mild environment.	ii. Report(s) exist and conclude that all safety-related digital I&C equipment (including digital components in the safety-related electrical distribution system) located in a mild environment is qualified to perform its safety function during the applicable normal and abnormal environmental conditions by type tests, analyses, or a combination of type tests and analyses for the time required to perform the safety function.

Table 2.2.14-4

ITAAC For Diverse Instrumentation and Controls

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9. Failure Modes and Effects Analysis (FMEA) per NUREG/CR-6303 of safety-related protection system platforms (RPS and SSLC/ESF) completed to validate the DPS diverse protection function.	Complete FMEA per NUREG/CR-6303 to validate the DPS protection functions described in LTR NEDO-33251.	Report(s) exist(s) and conclude(s) that the completed FMEA ~~(which address NUREG/CR-6303 Type 1-3 failures)~~ for the RPS and SSLC/ESF safety-related platforms have been addressed in the DPS design scope. {{DAC}}
10. DICS software is developed in accordance with the software development program described in Section 3.2.	See Section 3.2.	See Section 3.2.

Table 2.2.2-7

ITAAC For Control Rod Drive System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9. CRD system automatic functions, initiators, and associated interfacing systems are defined in Table 2.2.2-3.	Inspections will be performed to verify that the as-built CRD system conforms with the automatic functions, initiators, and associated interfacing systems defined in Table 2.2.2-3. Test(s) and type test(s) will be performed on the as-built system using simulated signals initiated from all of the associated interfacing as-built systems specified in Table 2.2.2-3..	Inspection report(s) document that the as-built CRD system conforms with the automatic functions, initiators, and associated interfacing systems defined in Table 2.2.2-3. Test and type test report(s) document the system is capable of performing the functions defined in Table 2.2.2-3 using simulated signals initiated from all of the associated interfacing as-built systems specified in Table 2.2.2-3.
10. CRD system controls and interlocks are defined in Table 2.2.2-4.	Test(s) and type test(s) will be performed on the as-built system using simulated signals.	Test and type test report(s) document that the system controls and interlocks exist, can be retrieved in the main control room, or are performed in response to simulated signals and manual actions as defined in Table 2.2.2-4.
11. CRD system minimum inventory of alarms, displays, controls, and status indications in the main control room are addressed in Section 3.3.	See Section 3.3.	See Section 3.3.
12. CRD maximum allowable scram times for vessel bottom pressures below 7.481 MPa gauge (1085 psig) are defined in Table 2.2.2-2.	Test(s) will be performed of each CRD control rod pair scram function using simulated signals.	Test report(s) document that scram times for each control rod pair are less than or equal to the maximum allowable scram times defined in Table 2.2.2-2.