

GE-Hitachi Nuclear Energy Americas LLC

James C. Kinsey
Project Manager, ESBWR Licensing

PO Box 780 M/C A-55
Wilmington, NC 28402-0780
USA

T 910 675 5057
F 910 362 5057
jim.kinsey@ge.com

MFN 06-146
Supplement 1

Docket No. 52-010

August 7, 2007

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Subject: **Response to Portion of NRC Request for Additional Information -
Letter No. 76 Related to ESBWR Design Certification Application -
DCD Section 7.2 - Instrumentation and Controls - RAI Number 7.2-4
S01**

Enclosure 1 contains GEH's supplemental response to RAI 7.2-4 resulting from an October 11, 2006 letter from the NRC (Reference 1). Enclosure 2 contains the DCD markups. GE's original response to RAI 7.2-4 was transmitted via the Reference 2 letter.

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

Sincerely,



James C. Kinsey
Project Manager, ESBWR Licensing

DO68
NRC

Reference:

1. MFN 06-388 – Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 76 Related to ESBWR Design Certification Application*, dated October 11, 2006
2. MFN 06-146 – Letter from David Hinds to U.S., Nuclear Regulatory Commission, *Partial Response to NRC Request for Additional Information Letter No. 6 Related to ESBWR Design Certification Application – Instrumentation and Control Systems – RAI Numbers 7.0-1, 7.2-1, 7.2-4, 7.9-1, and 9.5-2*, dated May 25, 2006

Enclosure:

1. MFN 06-146, Response to NRC Request for Additional Information Supplement Related to ESBWR Design Certification Application – DCD Section 7.2 – RAI Number 7.2-4 Supplement 1
2. RAI 7.2-4 Supplement 1 DCD Markups

cc: AE Cubbage USNRC (with enclosures)
GB Stramback GE/San Jose (with enclosures)
RE Brown GE/Wilmington (with enclosures)
eDRF 0000-0071-4064

**MFN 06-146
Supplement 1**

Enclosure 1

**Response to NRC Request for Additional Information
Supplements Related to
ESBWR Design Certification Application –
DCD Section 7.2**

RAI Number 7.2-4 Supplement 1

For historical purposes, the original text of RAI 7.2-4 (Reference MFN 06-146) and the GE response is included preceeding the supplemental response.

NRC RAI 7.2-4

With respect to level of detail for design certification application under 10 CFR Part 52, Section B.3.3 of BTP HICB-16 describes material that should be provided in addition to the material identified by Reg. Guide 1.70. Please provide the following: (1) system features provided to meet the requirements of 10 CFR 50.34(f), "TMI related requirements," (2) a description of the overall system architecture and the functional block diagrams for each system, (3) the computer-based I&C system characteristics that the self-diagnostics and on-line testing will detect to indicate computer system failures, (4) the interconnections of test and diagnostics with the system functional hardware and software, and (5) the mechanisms available to modify software in the installed systems. The material identified above should be discussed in sufficient detail to allow staff determination that the design meets requirements related to postulated single failures, common-mode failures, and appropriate signal isolation. Additional detail for the items requested above is provided by BTP HICB16, Section B.3.3.

GE Response

I&C System features that are provided to meet the requirements of 10CFR 50.34(f) "Conformance to TMI Action Plan Requirements TMI Related requirements" are discussed in Subsection 7.1.2.2 of DCD Tier 2, Rev 01. The specific regulatory acceptance criteria and guidelines requirements applicable to each of these systems (safety-related or nonsafety-related but important for plant operation) identified in the Standard Review Plan are identified and tabulated in Table 7.1-1. The regulatory requirements applicability matrix of Table 7.1-1 is followed in Section 7.2 through Section 7.9 for the regulatory conformance discussions of each specific system. The degree of applicability and conformance, along with any clarifications or justification for exceptions, are presented in the evaluation sections for each specific system. The ESBWR instrumentation and control (I&C) systems consist of both safety-related and nonsafety-related control systems. The primary safety-related systems, such as the Reactor Protection System (RPS), Leak Detection and Isolation System (LD&IS), and the ESF initiation logics, are encompassed by the Safety System Logic and Control (SSLC) framework. The safety-related data communication network, the Essential Distributed Control and Information System (E-DCIS), supports the SSLC and safety-related systems. The nonsafety-related (control) systems include all other plant I&C systems, which are supported by the nonsafety-related data communication network, the Non-Essential Distributed Control and Information System (NE-DCIS). A simplified block diagram of the ESBWR I&C architecture is shown in Figure 7.1-1. Specific block diagrams for each system are located in the appropriate system subsections. On-line self-diagnostic tests that check the critical performance of the digital control instrument are performed continuously within SSLC/ESF. An illustration of SSLC and its relationship to the RPS and other interfacing systems is shown in Figure 7.3-5 of DCD Tier 2.

NRC RAI 7.2-4 S01

To followup Staff RAI question 7.2-4, DCD, Tier 2, Revision 1, Section 7.1.2.2 merely provides reference to Appendix 1A, "Response to TMI Related Matters". Section 7.1.2.2 also provides the systems are "generally designed to conform." The degree of conformance for each of the Chapter 7 sections should be updated to define the system features which make that system compliant and to be consistent with Appendix 1A. The applicant is requested to provide functional logic diagrams for all the safety-related systems. The functional logic diagram should include all provisions in the design such as interlocks, bypasses, permissive logic, and manual switches.

GE Response

Table 1A-1 of Appendix 1A, "Response to TMI Related Matters," addresses TMI Action Plan Items as listed in 10 CFR 50.34(f). This has been done to facilitate the review of multidiscipline, multisystem design features that have been designed to address 10 CFR 50.34(f) requirements. Individual system references to specific TMI items are therefore minimized to reduce redundancy and avoid duplication in the text of the referenced systems.

A detailed review of the Table 1A-1 referenced DCD Chapter 7 subsections was completed in response to this supplement. The results indicated that Table 1A-1 and Chapter 7 text, specifically the Regulatory Requirements subsections, required revision. These clarifications are summarized below.

Table 1A-1 will be revised to as follows:

- Add reference to subsections 7.1.3.3, 7.1.5.1.2, 7.1.5.5.1 and 7.1.6.1 to Item I.D.2.
- Added reference to subsection 7.3.4.3.1 (CRHS) and revised reference for SSLC/ESF to 7.3.5.3.1 on Item I.D.3.

Subsections 7.1.3.3, 7.1.5.5.1, 7.1.6.1, 7.3.3.3.6, 7.5.2.3.6, 7.5.3.1.6, and 7.5.4.1.5 will be revised to add a reference to the applicable requirements of 10 CFR 50.34(f)(2) as shown on attachments to this response.

Functional logic diagrams for safety systems were submitted in GE Letter MFN 07-001 dated January 19, 2007. These simplified logic diagrams include provisions such as interlocks, bypasses, permissive logic, and manual switches.

DCD Impact

DCD Tier 2, Subsections 7.1.3.3, 7.1.5.5.1, 7.1.6.1, 7.3.3.3.6, 7.5.2.3.6, 7.5.3.1.6, 7.5.4.1.5, and Table 1A-1 will be revised as noted in the attached markup.

**MFN 06-146
Supplement 1**

Enclosure 2

RAI Number 7.2-4 Supplement 1 DCD Markups

7.1.3.3 Q-DCIS Safety Evaluation

There are at least two safety-related VDUs per division in the MCR and Divisions 1 and 2 each have another VDU located on each remote shutdown panel. The VDUs are used to monitor safety-related information from their connected division and are used to provide manual operator inputs to the safety-related logic. The VDUs provide access to a full range of plant parameters in accordance with the requirements of 10 CFR 50.34(f)(2)(iv), TMI Action Item I.D.2. The VDUs are also used for divisional self-diagnostics and divisional alarms.

7.1.5.5.1 Safety Parameter Displays (SPDS) System

The SPDS displays provide critical plant operating parameters such as power, water level, temperatures, pressure, flows, and status of pumps, valves, etc., allowing MCR operators to follow the plant EOPs to shut down the reactor, maintain adequate core cooling, cool down the reactor to cold shutdown conditions and maintain primary containment integrity as required by ~~NUREG-0737, Supplement 1~~ 10 CFR 50.34(f)(2)(iv) TMI Action Item I.D.2. -Specific SPDS are available in the MCR and parameters are available on the main plant mimic on the MCR Wide Display Panel (WDP).

7.1.6.1 Conformance with the Code of Federal Regulations

10 CFR 50.55a(a)(1) "Quality Standards for Systems Important to Safety"

10 CFR 50.55a(h) "Protection and Safety Systems," compliance with IEEE Std. 603

10 CFR 50.34(f) "Conformance with to Three Mile Island (TMI) Action Plan Requirements":

- Response to TMI related matters is generically ~~generally~~ addressed in Chapter 1, Appendix 1A. TMI action plan requirements are identified relative to the systems in Table 7.1-1. The applicable systems are generally designed to conform. However, because of the design features of the ESBWR, several of these requirements are not applicable. These are identified as follows:
 - II.K.3.13 – HPCI and RCIC Initiation Levels
 - II.K.3.15 - Isolation of HPCI and RCIC (Turbine Driven)
 - II.K.3.21 - Automatic Restart of LPCS and LPCI
 - II.K.3.22 - RCIC Automatic Switchover of Suction Supply

For the others, the degree of conformance, along with any clarifications or exceptions, is discussed in the safety evaluation subsections of Sections 7.2 through 7.8. The TMI action items applicable to the I&C systems are:

- 50.34(f)(2)(iv) [I.D.2] Safety parameter display system
- 50.34(f)(2)(v) [I.D.3] Bypass and Inoperable Status Indication
- 50.34(f)(2)(xii) [II.E.1.2] Auxiliary Feedwater System Automatic Initiation and Flow Indication
- 50.34(f)(2)(xvii) [II.F.1] Accident Monitoring Instrumentation
- 50.34(f)(2)(xviii) [II.F.2] Inadequate Core Cooling Instrumentation

7.3.3.3.6 TMI Action Plan Requirements:

In accordance with the SRP for 7.3 and with Table 7.1-1, 10 CFR 50.34(f)(2)(v) (I.D.3), ~~and 10 CFR 50.34(f)(2)(xiv) (II.E.4.2) and 10 CFR 50.34(f)(2)(xxvi)(III.D.1.1)~~ apply to the LD&IS_Leak Detection and Isolation System. The LD&IS complies with the requirements as indicated above. However, TMI action plan requirements are generically addressed in Appendix 1A.

7.5.2.3.6 TMI Action Plan Requirements:

In accordance with SRP 7.5, and with Table 7.1-1, 10 CFR 50.34(f)(2)(v) [I.D.3], 10 CFR 50.34(f)(2)(xvii) [II.F.1] 10 CFR 50.34(f)(2)(xxvii)[III.D.3.3], and 10 CFR 50.34 (f)(2)(xix)[II.F.3] apply to the Containment Monitoring System. The CMS complies with these requirements, as indicated above. However, TMI action plan requirements are generically addressed in Appendix 1A.

7.5.3.1.6 TMI Action Plan Requirements:

In accordance with SRP 7.5 and with Table 7.1-1, 10 CFR 50.34(f)(2)(v) [I.D.3], 10 CFR 50.34(f)(2)(xvii)—[II.F.1], 10 CFR 50.34(f)(2)(xxvii)[III.D.3.3], and 10 CFR 50.34 (f)(2)(xix)[II.F.3] apply to the Process Radiation Monitoring System. The PRMS complies with these requirements, as indicated above. However, TMI action plan requirements are generically addressed in Appendix 1A.

7.5.4.1.5 TMI Action Plan Requirements

In accordance with SRP 7.5 and with Table 7.1-1, 10 CFR 50.34(f)(2)(xvii) [II.F.1] and 10 CFR 50.34(f)(2)(xix) [II.F.3], and 10 CFR 50.34(f)(2)(xxvii)[III.D.3.3], apply to the Area Radiation Monitoring System. The ARMS complies with these requirements, as indicated above. However, TMI action plan requirements are generically addressed in Appendix 1A.

Table 1A-1
TMI Action Plan Items

Regulation	TMI Item	Description	ESBWR Resolution	Associated Tier 2 Location(s)
			<p>design features of the control room MMIS described in Subsection 18.4.2.</p> <p>Chapter 18 describes the ESBWR MMIS design goals and bases, the standard MMIS design features and the detailed MMIS design and implementation process, with embedded design acceptance criteria, for the ESBWR standard plant operator interface.</p> <p>A <u>detailed control-room design review</u> DCRDR-specified in NUREG-0737 is not required by SRP Section 18.1.</p>	
10 CFR 50.34(f)(2)(iv)	I.D.2	Provide a plant safety parameter display console that will display to operators a minimum set of parameters defining the safety status of the plant, capable of displaying a full range of important plant parameters and data trends on demand, and capable of indicating when process limits are being approached or exceeded.	<p>The ESBWR Control Room Design incorporates the features that display to operators a set of parameters responding to the symptom driven EPGs defining the safety status of the plant, capable of displaying a full range of important plant parameters and data trends on demand, and capable of indicating when process limits are being approached or exceeded.</p> <p>The principal functions of the SPDS as required by Supplement 1 to NUREG-0737 are integrated into the control room operator interface design, as permitted by SRP Section 18.</p> <p>The ESBWR control room operator interface</p>	<p>18.1.2, <u>7.1.3.3,</u> <u>7.1.5.1.2,</u> <u>7.1.5.5.1 and</u> <u>7.1.6.1</u></p>

Table 1A-1
TMI Action Plan Items

Regulation	TMI Item	Description	ESBWR Resolution	Associated Tier 2 Location(s)
			design incorporates the SPDS function as part of the plant status summary information which is continuously displayed on the fixed-position displays on a large display panel, and also incorporates the use of on-screen control video display units (VDUs), independent of the plant computer, for control and monitoring of both safety-related and nonsafety-related systems. Other VDUs, driven by the plant computer, are available for monitoring of safety-related systems and monitoring and control of nonsafety-related systems.	
10 CFR 50.34(f)(2)(v)	I.D.3	Provide for automatic indication of the bypassed and [in]operable status of safety systems.	ESBWR design of I&C provides automatic indication of the bypasses and inoperable status of safety systems.	7.1.2.2, 7.1.2.2.1, 7.1.2.2.3 (General); 7.2.1.8.1 (RPS); 7.2.2.3.2 (NMS); 7.2.3.3.2.1 (SPTM); 7.3.1.1.3.1 (ADS);

Table 1A-1
TMI Action Plan Items

Regulation	TMI Item	Description	ESBWR Resolution	Associated Tier 2 Location(s)
				7.3.1.2.3.1 (GDCS); 7.3.3.3.1, 7.3.3.3.6 (LD&IS); <u>7.3.4.3.1</u> (CRHS); 7.3.5.4.3.1 (SSLIC/ESF); 7.5.1.3.1.1 (PAMS); 7.5.2.3.1, 7.5.2.3.6 (CMS); 7.5.3.1.1, 7.5.3.1.6 (PRMS); 7.6.1.3.3, 7.6.1.3.7 (HP/LP Interlocks); 7.1.2.4.1.3.1 (Q-DCIS); Table 7.1-1