



**HITACHI**

**GE Hitachi Nuclear Energy**

**James C. Kinsey**  
Vice President, 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 06-189  
Supplement 2

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U.S. Nuclear Regulatory Commission  
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**Subject: Response to Portion of NRC Request for Additional Information,  
RAI Letter No. 109, Related to ESBWR Design Certification  
Application, Seismic Design, RAI Number 3.7-52 S02**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) partial response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) received from the NRC, via Reference 1 (RAI 3.7-52 S02). The previous response was submitted to the NRC via Reference 2 in response to Reference 3 (RAI 3.7-52 S01). The initial request was received from the NRC via Reference 5 (RAI 3.7-52), to which GEH responded, via Reference 4.

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

Sincerely,

James C. Kinsey  
Vice President, ESBWR Licensing

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*NRC*

References:

1. MFN 07-555 from the U.S. Nuclear Regulatory Commission, Chandu Patel, Senior Project Manager, ESBWR/ABWR Projects Branch 1, Division of New Reactor Licensing, Office of New Reactors, to Robert E. Brown, Senior Vice President, Regulatory Affairs, GEH, *Request for Additional Information Letter No. 109 Related to ESBWR Design Certification Application*, dated October 12, 2007.
2. MFN 06-189 Supplement 1 from David H. Hinds to the U.S. Nuclear Regulatory Commission, *Response to Portion of RAI Letter No. 20 Related to ESBWR Design Certification Application – Seismic Design – RAI Numbers 3.7-8 S01, 3.7-11 S01, 3.7-25, S01, 3.7-26 S01, 3.7-52 S01 and 3.7-55 S01 – Supplement 1*, dated December 8, 2007.
3. RAI 3.7-52 S01, resulting from seismic follow-up audit, dated November 2007.
4. MFN 06-189 from David H. Hinds to the U.S. Nuclear Regulatory Commission, *Response to Portion of RAI Letter Number 20 Related to ESBWR Design Certification Application – Seismic Design – RAI numbers 3.7-7, 3.7-8, 3.7-11, 3.7-12, 3.7-25, 3.7-26, 3.7-29, 3.7-34, 3.7-52, and 3.7-55*, dated June 29, 2006.
5. MFN 06-115 from Lawrence Rossbach, Project Manager, ESBWR/ABWR Projects Branch, Division of New Reactor Licensing, Office of Nuclear Reactor Regulation, to David H. Hinds, *Request for Additional Information Letter No.20 Related to ESBWR Design Certification Application*, dated April 24, 2006.

Enclosure:

1. MFN 06-189, Supplement 2, Response to Portion of NRC Request for Additional Information, RAI Letter 109, Related to ESBWR Design Certification Application, Seismic Design, RAI Number 3.7-52 S02.

cc:	AE Cubbage	USNRC (with enclosures)
	RE Brown	GEH/Wilmington (with enclosures)
	GB Stramback	GEH/San Jose (with enclosures)
	DH Hinds	GEH/Wilmington (with enclosures)
	eDRF 0000-0076-4146 Rev. 0	(RAI 3.7-52 S02)

**Enclosure 1**

**MFN 06-189 Supplement 2**

**Response to Portion of NRC Request for Additional**

**Information RAI Letter No. 109**

**Related to ESBWR Design Certification Application<sup>1</sup>**

**Seismic Design**

**RAI Number 3.7-52 S02**

<sup>1</sup> Original Response and Supplement 1 previously submitted under MFNs 06-189 and 06-189S1 without DCD updates are included to provide historical continuity during review.

**NRC RAI 3.7-52**

*DCD Section 3.7.3.13 does not provide any detail about the methods of analysis employed or the acceptance criteria used to determine structural design adequacy of buried conduits, tunnels, and auxiliary systems. In addition, the applicant did not provide the definition for the term "auxiliary systems." The staff requests the following additional information to complete its review:*

- (a) a description of the types of SSCs that are included under the category "auxiliary systems;"*
- (b) a description of the analysis method and acceptance criteria for buried conduits;*
- (c) a description of the analysis method and acceptance criteria for tunnels;*
- (d) a description of the analysis method and acceptance criteria for auxiliary systems.*

**GEH Response**

- (a) See DCD Table 3.2-1 for identification of components in "auxiliary systems". See DCD Chapter 9 for identification and description of "auxiliary systems."
- (b) There are no Seismic Class I buried conduits.
- (c) There are no C-I tunnels in the ESBWR design. Tunnels in the ESBWR are NS but since some tunnels in the ESBWR carry liquid radwaste, the structural acceptance and materials criteria for tunnels are in accordance with RG 1.143 – Safety Class IIa. The method of seismic analysis is the same as building embedded walls, taking into account the requirements described in DCD Section 3.7.3.13.
- (d) Same analysis methods and acceptance criteria is used for Auxiliary systems for underground portions of Category I structures, as shown in DCD Sections 3.8.4 and 3.8.5 for analysis and acceptance criteria details. Refer to DCD Chapter 9 for list of auxiliary systems.

Markups of DCD Tier 2 Sections 3.7.3.13, 3.7.3.14 and 3.7.3.15 were provided in MFN 06-189.

**NRC RAI 3.7-52, Supplement 1**

**NRC Assessment Following the November 2, 2006 Audit**

*Provide an explicit description of the design approach and acceptance criteria for buried C-I SSCs since there are electrical cable banks between the CB and RB.*

**GEH Response**

The responses provided to RAI 3.7-52 (b) and (c) under MFN 06-189 are revised as follows:

- (b) There are no Seismic Class I buried conduits. There are Seismic Class I conduits in two electrical duct banks from the CB to the RB.
- (c) There are no C-I tunnels in the ESBWR design. The access tunnels between Seismic Category I or II buildings are C-II. Tunnels carrying liquid radwaste are NS but the structural acceptance and material criteria are in accordance with RG 1.143 – Safety Class IIa.

The electrical duct banks (See (b) above) and yard FPS lines are buried underground utilities with a Seismic Category I classification. The duct banks are located in a closed reinforced concrete trench (or tunnel) covered with backfill and the FPS lines will be located in covered reinforced concrete trenches near the surface with removable covers to facilitate maintenance and inspection access. These items are relatively short since they are routed directly between buildings.

The method of seismic analysis is the same as building embedded walls, taking into account the requirements described in DCD Tier 2 Subsection 3.7.3.13. The effect of wave propagation is accounted for in accordance with Section 3.5.2 and Commentary of ASCE 4-98.

No DCD change was made in response to this RAI Supplement.

**NRC RAI 3.7-52, Supplement 2**

- (1) Confirm that there is no buried Seismic Category I piping, and that no buried Seismic Category I piping will be added at the COL stage. Describe how GEH has communicated the restriction on buried piping in the DCD, and how it will ensure that this restriction will be enforced at the COL stage. Include this information in DCD 3.7.3.13.*
- (2) The staff understands that there are no Seismic Class I [same as Seismic Category I] conduits buried directly in the ground. There are Seismic Class I conduits in two electrical duct banks from the CB to the reactor building (RB). The electrical duct banks are buried underground utilities with a Seismic Category I classification. The duct banks are located in a closed reinforced concrete trench (or tunnel) covered with backfill. These items are relatively short since they are routed directly between buildings.*

*Confirm the above information and include it in DCD 3.7.3.13.*

- (3) The staff understands that yard Fire Protection System (FPS) lines are buried underground utilities with a Seismic Category I classification. The FPS lines will be located in covered reinforced concrete trenches near the surface with removable covers to facilitate maintenance and inspection access. These items are relatively short since they are routed directly between buildings.*

*Confirm the staff's understanding related to FPS lines. Include this information in DCD 3.7.3.13*

- (4) The staff understands that there are no C-I [same as Seismic Category I] tunnels in the ESBWR design. The access tunnels between Seismic Category I or II buildings are C-II. The method of seismic analysis is the same as building embedded walls, taking into account the requirements described in DCD Tier 2 Subsection 3.7.3.13. The effect of wave propagation is accounted for in accordance with Section 3.5.2 and Commentary of ASCE 4-98. The staff's understanding is that GEH's C-II designation denotes an SSC whose failure could negatively impact a safety-related SSC, and is seismically analyzed to the same criteria as a seismic C-I SSC.*

*Confirm the staff's understanding related to buried tunnels. Discuss adherence to the acceptance criteria in the latest revision of SRP 3.7.3 (Rev. 3, March 2007), with respect to acceptable methods for seismic analysis and evaluation of buried SSCs. Provide a technical basis for any deviations from the SRP guidance. Include this information in DCD 3.7.3.13.*

- (5) Specifically identify and describe the buried components of Seismic Category I auxiliary systems. Describe in detail the analysis methodology employed to ensure they can withstand the design-basis seismic ground motion. Include this information in DCD 3.7.3.13.*

**GEH Response**

- (1) GEH confirms that there is no buried Seismic Category I piping in the DCD scope.

DCD Tier 2 Subsection 3.7.3.13 will be clarified to incorporate the above response.

COL applicants referencing a certified design typically incorporate the DCD by reference, with supplements and deviations as appropriate. Deviations and supplements are documented in the COLA FSAR, and therefore are available for review by the NRC.

- (2) The staff's understanding regarding buried conduits is correct except as clarified below. There are four Seismic Category I electrical duct banks from the Control Building (CB) to the Reactor Building (RB). DCD Tier 2 Figure 1.2-2 shows partial routing of the above duct banks.

DCD Tier 2 Subsection 3.7.3.13 will be clarified to incorporate the above response.

- (3) The staff's understanding regarding Fire Protection System (FPS) lines in the yard is correct except as clarified below. The FPS lines are routed from Fire Water Service Complex (FWSC) to CB, and from FWSC to RB/FB. The routing between FWSC and RB/FB avoids interference with the access tunnel.

DCD Tier 2 Subsection 3.7.3.13 will be clarified to incorporate the above response.

- (4) The staff's understanding regarding tunnels and design approach used is correct.

The Radwaste Tunnel (RT) provides for pipes that transport radioactive waste to the Radwaste Building from RB and TB. The RT is classified Non-Seismic (NS) but the structural acceptance criteria are in accordance with RG 1.143 – Safety Class RW-IIa.

The design of buried structures meet the requirements of SRP 3.7.3 (Rev. 3, March 2007) and no deviations are contemplated. The method of analysis and design is as follows:

- Lateral earth pressures are determined in the same manner as for embedded walls below grade for C-I structures. Effect of wave propagation is accounted in accordance with ASCE 4-98, Section 3.5.2 and Commentary.
- Longitudinal Forces and strains are treated as secondary forces and strains (displacement-controlled).
- Longitudinal compressive strains are limited to 0.3%. The reinforcing steel added to concrete addresses the effect of longitudinal tensile strains.
- Primary loadings are lateral earth pressures, hydrostatic pressures, dead loads, and live loads applied concurrently with seismic excitation.

Resultant stresses due to wave propagation effects and those resulting from the dynamic anchor movement are combined by the SRSS method.

- Differential displacements in soils are included.
- Expansion joints are provided between the tunnel and the connecting building to provide seismic isolation.
- Expansion joints along the tunnel are located no more than 20 m (65.6 ft.) apart.

DCD Tier 2 Subsection 3.7.3.13 will be clarified to state the above.

(5) There are no buried Seismic Category I auxiliary system components.

DCD Tier 2 Subsection 3.7.3.13 will be clarified to incorporate the above response.

**DCD Impact**

DCD Tier 2 Subsection 3.7.3.13 will be revised in the next update as noted in the attached markup.

### 3.7.3.13 Seismic Category I Buried Piping, Conduits and Tunnels

There are no Seismic Category I (C-I) utilities i.e. piping, conduits, or auxiliary system components that are directly buried underground.

Fire Protection System (FPS) yard piping with a C-I classification is installed in covered reinforced concrete trenches near the ground surface with removable covers to facilitate maintenance and inspection access.

There are C-I conduits in four electrical duct banks from the CB to the RB. These electrical duct banks are installed in closed reinforced concrete trenches covered with backfill.

There are no C-I tunnels in the ESBWR design. The access tunnel (AT), which includes walkways between and access to RB, CB, Turbine Building (TB), and Electrical Building (EB) is classified Seismic Category II (C-II). Since C-II structures are designed to the same criteria as C-I structures there is no impact to adjacent C-I structures.

The Radwaste Tunnel (RT) provides for pipes that transport radioactive waste to the Radwaste Building from RB and TB. The RT is classified NS but the structural acceptance criteria are in accordance with RG 1.143 – Safety Class RW-IIa.

For Seismic Category I (C-I) buried conduits, tunnels, and auxiliary systems, the following items are considered in the analysis and design in accordance with SRP 3.7.3 (Rev. 3, March 2007):

- Two types of ground shaking-induced loadings are considered for design:
  - Relative deformations imposed by seismic waves traveling through the surrounding soil or by differential deformations between the soil and anchor points.
  - Lateral earthquake pressures and ground-water effects acting on structures.
- When applicable, the effects caused by local soil settlements, soil arching, etc., are considered in the analysis.
- Lateral earth pressures are determined in the same manner as for embedded walls below grade for C-I structures. Effect of wave propagation is accounted in accordance with ASCE 4-98, Subsection 3.5.2 and Commentary.
- Longitudinal forces and strains are treated as secondary forces and strains (displacement-controlled).
- Longitudinal compressive strains are limited to 0.3%. The reinforcing steel added to the concrete addresses the effect of longitudinal tensile strains.
- Primary loadings are lateral earth pressures, hydrostatic pressures, dead loads, and live loads applied concurrently with seismic excitation. Resultant stresses due to wave propagation effects and those resulting from the dynamic anchor movement are combined by the SRSS method.
- Expansion joints are provided between the tunnel and the connecting building to provide seismic isolation.
- Expansion joints along the tunnel are located no more than 20 m (65.6 ft.) apart. For ESBWR, there is no buried Seismic Category I piping.