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MFN 06-119
Supplement 9

Docket No. 52-010

November 13, 2008

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

Subject: **Revision 3 Response to Portion of NRC Request for Additional Information Letter No. 16 Related to ESBWR Design Certification Application – Radiation Protection – RAI Number 3.12-27 S01**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) supplemental response to a portion of the U.S. Nuclear Regulatory Commission Request for Additional Information (RAI) sent by NRC Letter 16 (Reference 1). The initial RAI 3.12-27 S01 was received via Reference 2. Additional GEH responses were requested via NRC phone calls (References 3, 4, and 5. RAI Number 3.12-27 S01 Revision 3 response is addressed in Enclosure 1, based on Reference 5.

If you have any questions about the information provided here, please contact me.

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

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NRO

References:

1. MFN 06-103, *Letter from U.S. Nuclear Regulatory Commission to Mr. David H. Hinds, Manager, ESBWR, General Electric Company, Request For Additional Information Letter No. 16 Related To ESBWR Design Certification Application*, dated March 30, 2006 (RAI 3.12-27)
2. E-Mail from Amy Cubbage, U.S. Nuclear Regulatory Commission, to GE, dated May 20, 2007 (RAI 3.12-27 S01)
3. NRC Phone call on March 05, 2008, (Chandu Patel) (RAI 3.12-27 S01 Revision 1)
4. NRC Phone call on April 16, 2008, (Chandu Patel) (RAI 3.12-27 Revision 2)
5. NRC Phone call on April 16, 2008, (Chandu Patel) (RAI 3.12-27 Revision 3)

Enclosure:

1. Revised Response to Portion of NRC Request for Additional Information Letter No. 16 Related to ESBWR Design Certification Application - Piping Design - RAI Number 3.12-27 S01, Revision 3

cc:

AE Cubbage	USNRC (with enclosure)
RE Brown	GEH/Wilmington (with enclosure)
DH Hinds	GEH/Wilmington (with enclosure)
eDRF	0000-0075-9909 Rev. 6

Enclosure 1

MFN 06-119
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Revised Response to Portion of NRC Request

for Additional Information Letter No. 16

Related to ESBWR Design Certification Application

Piping Design

RAI Number 3.12-27 S01

Revision 3

For historical purposes, the original text of RAI 3.12-27, 3.12-27 S01, 3.12-27 S01 Rev. 1 and the GE responses are included. These historical responses do not include any attachments or DCD mark-ups.

NRC RAI 3.12-27

DCD Tier 2, Section 3.7.3.12, discusses the effect of differential building movement on piping systems that are anchored and restrained to floors and walls of buildings that may have differential movements during a dynamic event. SRP 3.9.2 Section II.2.g states that the responses due to the inertial effect and relative displacement for multiply-supported equipment and components with distinct inputs should be combined by the absolute sum method. Provide the combination methods that are to be used in the design of ESBWR piping systems for the inertial responses and SAM responses caused by relative displacements for all analysis methods (including ISM).

GE Response

DCD Tier 2, Section 3.7.3.12, discusses the effect of differential building movement on piping systems that are anchored and restrained to floors and walls of buildings that may have differential movements during a dynamic event. In general, the piping systems are anchored and restrained to floors and walls of buildings that may have differential movements during a seismic event. The movements may range from insignificant differential displacements between rigid walls of a common building at low elevations to relatively large displacements between separate buildings at a high seismic activity site.

Piping system is different from multiply-supported equipment. For piping system, the induced displacements in compliance with NB 3653 are treated differently than the inertia displacements. The SRSS method is a standard industrial practice to combine the inertial responses and SAM responses caused by relative displacements.

NRC RAI 3.12-27 S01

SRSS combination of the inertial and SAM responses for USM method of analysis is not consistent with the staff position in the Standard Review Plan (SRP). GE should provide additional technical justification for this position.

GEH Original Response (ref. MFN 06-119, Supplement 4)

During the NRC audit meeting held between Jan.9, 2007 and Jan.13, 2007 at San Jose, CA (reference NRC "Audit Trip Report," ML070930012), the NRC staff found that the SRSS combination for the inertial and the SAM responses is acceptable for the piping stress analysis, except for piping support designs. For piping support design, the absolute sum method (ABS) is used.

DCD Original Impact (ref. MFN 06-119, Supplement 4)

DCD Tier 2, Section 3.7.3.12 has been revised as shown in the attached markup 3.

RAI 3.12-27 S01 Revision 1 Response

In a NRC telephone call on March 05, 2008, GE agreed to the following responses and changes to the DCD that replaces the prior GEH response to RAI 3.12-27 S01 in its entirety:

(1) GEH agreed if the piping analysis is performed using uniform support motion analysis (USM), then per SRP Section 3.9.2, the absolute sum (ABS) method will be used to combine the inertia and seismic anchor motion (SAM) analysis results for piping support design. For the piping stress analysis, SRSS combination is acceptable.

(2) For ISM analysis, the NRC Staff provided guidelines in RAI 3.12-3 S03 and GEH agrees to increase the piping stresses and support loads by 10% when using the ISM SRSS method.

(3) NRC Staff agreed that for ISM analysis with 10% being added for piping stresses and support loads, the inertia and the SAM can be combined by SRSS for piping stress and support loads. GEH clarifies that for piping stress analysis, the inertia and SAM (seismic anchor motion) are not treated separately to meet the NB-3653 Equations. The inertia and SAM are combined to meet the requirements for all NB-3653 Equations.

DCD Revised Impact

DCD Tier 2, Subsection 3.7.3.12 will be revised to add the ABS combination requirement, as shown in the attached markup for Revision 5 of the DCD.

RAI 3.12-27 S01 Revision 2 Response

In a NRC telephone call on April 16, 2008, GE agreed to the following responses and changes to the DCD that replaces the prior GEH response to RAI 3.12-27 S01 in its entirety:

(1) GEH agreed if the piping analysis is performed using USM (uniform support motion analysis), then, per SRP Section 3.9.2, the absolute sum (ABS) method will be used to combine the inertia and SAM (seismic anchor motion) analysis results for piping support design.

DCD Tier 2, Section 3.7.3.12 will be revised to add the ABS combination requirement.

(2) For ISM analysis, the NRC Staff provided guidelines in RAI 3.12-3 S03 and GEH agrees to increase the piping stresses and support loads by 10% when using the ISM SRSS method.

(3) NRC staff agreed that for ISM analysis with 10% being added for piping stresses and support loads, the inertia and the SAM can be combined by SRSS for piping stresses and support loads. GEH clarifies that for piping stress analysis, the inertia and SAM (seismic anchor motion) are not treated separately to meet the NB-3653 Equations. The inertia and SAM are combined to meet the requirements for all NB-3653 Equations.

DCD Revised Impact

DCD Tier 2, Subsection 3.7.3.12 will be revised to add the ABS combination requirement, as shown in the attached markup for Revision 5 of the DCD.

RAI 3.12-27 S01 Revision 3 Response

In a NRC telephone call on April 16, 2008, GE agreed to the following responses and changes to the DCD that replaces the prior GEH response to RAI 3.12-27 S01 in its entirety:

(1) GEH agreed if the piping analysis is performed using USM (uniform support motion analysis), then, per SRP Section 3.9.2, the absolute sum (ABS) method will be used to combine the inertia and SAM (seismic anchor motion) analysis results for both piping and piping support design.

DCD Tier 2, Section 3.7.3.12 will be revised to add the ABS combination requirement.

(2) For ISM analysis, the NRC Staff provided guidelines in RAI 3.12-3 S03 and GEH agrees to increase the piping stresses and support loads by 10% when using the ISM SRSS method.

(3) NRC staff agreed that for ISM analysis with 10% being added for piping stresses and support loads, the inertia and the SAM can be combined by SRSS for piping stresses and support loads. GEH clarifies that for piping stress analysis, the inertia and SAM (seismic anchor motion) are not treated separately to meet the NB-3653 Equations. The inertia and SAM are combined to meet the requirements for all NB-3653 Equations.

DCD Revised Impact

DCD Tier 2, Subsection 3.7.3.12 will be revised to add the ABS combination requirement, as shown in the attached markup, for Revision 6 of the DCD.

resulting responses are combined with the inertia effects by the SRSS method. Because the OBE design is not required, the displacement-induced SSE stresses due to seismic anchor motion are included in Service Level D load combinations.

In place of the response spectrum analysis, the ISM time history method of analysis is used for multi-supported systems subjected to distinct support motions, in which case both inertial and relative displacement effects are already included.

3.7.3.10 Use of Equivalent Vertical Static Factors

Equivalent vertical static factors are used when the requirements for the static coefficient method in Subsection 3.7.2.1.3 are satisfied.

3.7.3.11 Torsional Effects of Eccentric Masses

Torsional effects of eccentric masses are included for subsystems similar to that for the piping systems discussed in Subsection 3.7.3.3.1.

3.7.3.12 Effect of Differential Building Movements

In most cases, subsystems are anchored and restrained to floors and walls of buildings that may have differential movements during a seismic event. The movements may range from insignificant differential displacements between rigid walls of a common building at low elevations to relatively large displacements between separate buildings at a high seismic activity site.

Differential endpoint or restraint deflections cause forces and moments to be induced into the system. The stress thus produced is a secondary stress. It is justifiable to place this stress, which results from restraint of free-end displacement of the system, in the secondary stress category because the stresses are self-limiting and, when the stresses exceed yield strength, minor distortions or deformations within the system satisfy the condition which caused the stress to occur.

When the piping analysis is performed using USM analysis, per SRP Section 3.9.2, absolute sum method is used to combine the inertia results and the seismic anchor motion results for both piping and piping support design.

When the piping analysis is performed by ISM, the piping stresses and pipe support loads are increased by 10% when using the SRSS group combination method. With the additional 10% added to the piping stresses and the pipe support loads, the inertia and the seismic anchor motion are combined by SRSS for piping stresses and pipe support loads.

3.7.3.13 Seismic Category I Buried Piping, Conduits and Tunnels

~~There are no~~ All Seismic Category I utilities (i.e. piping, conduits, or auxiliary system components), that are ~~directly buried~~routed underground are installed in concrete trenches or in concrete duct banks in direct contact with soil.

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