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MFN 06-119
Supplement 7

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

Subject: **Response to an NRC Phone Call for Clarification Related to ESBWR Design Certification Application – Piping Design – RAI Number 3.12-27 S01**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to a U.S. Nuclear Regulatory Commission (NRC) phone call (Reference 1) which revises the response to a portion of the NRC Request for Additional Information (RAI) Letter No. 16 dated March 30, 2006 (Reference 2). The revised GEH response to RAI Number 3.12-27 S01 is addressed in Enclosure 1.

The GEH response to RAI 3.12-27 was submitted via Reference 3 in partial response to NRC Letter No. 16 (Reference 2). The GEH response to RAI 3.12-27 S01 was submitted via Reference 5 in partial response to an Email from Amy Cubbage (Reference 4).

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.

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NRO

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

Sincerely,

James C. Kinsey

James C. Kinsey
Vice President, ESBWR Licensing

References:

1. NRC (Chandu Patel) phone call dated March 14, 2008
2. MFN 06-103, Letter from U.S. Nuclear Regulatory Commission to 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
3. MFN 06-119, Response to Portion of NRC Request for Additional Information Letter No. 16 Related to ESBWR Design Certification Application – Piping Design – RAI Numbers 3.12-1 through 3.12-37, dated May 3, 2006
4. Email from NRC (Amy Cubbage) dated May 20, 2007
5. MFN 06-119 Supplement 4, Response to Portion of NRC Request for Additional Information Letter No. 16 Related to ESBWR Design Certification Application – Piping Design – RAI Numbers 3.12-11 S01, 3.12-22 S01 through 3.12-27 S01, dated January 2, 2008

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 1

cc:

AE Cubbage	USNRC (with enclosure)
RE Brown	GEH/Wilmington (with enclosure)
DH Hinds	GEH/Wilmington (with enclosure)
GB Stramback	GEH/San Jose (with enclosure)
eDRF	0000-0075-9909, Revision 2

Enclosure 1

MFN 06-119
Supplement 7

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 1

(Revised as result of phone call with NRC)

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.

Enclosure 1

For historical purposes, the original text of RAI 3.12-27 and the GE response is included. The 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.

Enclosure 1

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.

Enclosure 1

RAI 3.12-27 S01 Revised Response

In a NRC telephone call on March 14, 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.

absolute sum (ABS) method for the group combination method when performing an ISM analysis.

In addition to the inertial response discussed above, the effects of relative support displacements are considered. The maximum relative support displacements are obtained from the dynamic analysis of the building, or as a conservative approximation, by using the floor response spectra. For the latter option, the maximum displacement of each support is predicted by $S_d = S_a g/\omega^2$, where S_a is the spectral acceleration in "g's" at the high-frequency end of the spectrum curve (which, in turn, is equal to the maximum floor acceleration), g is the gravity constant, and ω is the fundamental frequency of the primary support structure in radians per second. The support displacements are imposed on the supported systems in a conservative (i.e., most unfavorable combination) manner and static analysis is performed for each orthogonal direction. The 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 (SAM) 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 Uniform Support Motion (USM) analysis, per SRP Section 3.9.2, absolute sum (ABS) method is used to combine the inertia results and the seismic anchor motion (SAM) results for piping support design. For the piping stress analyses, SRSS combination method is used.

RAI 3.12-27 S01

When the piping analysis is performed by Independent Support Motion (ISM), the piping stresses and support loads are increased by 10% when using the SRSS group combination method. With the additional 10% added to the piping stresses and the support loads, the inertia and the SAM are combined by SRSS for piping stresses and support loads.

RAI 3.12-27 S01

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 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, which includes walkways between and access to RB, CB, TB, and Electrical Building 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~~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.