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MFN 09-319

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Subject: **Response to Portion of NRC RAI Letter No. 328 Related to ESBWR Design Certification Application – Piping Design; RAI Numbers 3.12-3 S04 and 3.12-39**

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) letter number 328 sent by NRC letter dated April 16, 2009 (Reference 1). RAI Numbers 3.12-3 S04 and 3.12-39 are addressed in Enclosure 1.

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

Sincerely,

Richard E. Kingston

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Vice President, ESBWR Licensing

Reference:

1. MFN 09-273 Letter from U.S. Nuclear Regulatory Commission to Jerald G. Brown, GEH, *Request For Additional Information Letter No. 328 Related to ESBWR Design Certification* dated April 16, 2009

Enclosure:

1. Response to Portion of NRC RAI Letter No. 328 Related to ESBWR Design Certification Application – Piping Design; RAI Numbers 3.12-3 S04 and 3.12-39

cc:	AE Cubbage	USNRC (with enclosures)
	JG Head	GEH/Wilmington (with enclosures)
	DH Hinds	GEH/Wilmington (with enclosures)
	eDRF Section	0000-0101-5570 (RAIs 3.12-3 S04 & 3.12-39)

Enclosure 1

MFN 09-319

Response to Portion of NRC Request for

Additional Information Letter No. 328

Related to ESBWR Design Certification Application

Piping Design

RAI Numbers 3.12-3 S04[1], 3.12-39

[1] Original Response to RAI Number 3.12-3 Supplement 3 is included to provide historical continuity during review.

NRC RAI 3.12-3 S03

NRC Summary:

GEH's use of SRSS of group responses in the application of Independent Support Motion (ISM) response spectrum analysis does not meet the current staff position.

NRC Full Text:

GEH uses SRSS of group responses in its application of Independent Support Motion (ISM) response spectrum analysis. The staff position in NUREG-1061, Volume 4 specifies absolute sum. GEH provided the results of a study performed to justify its use of SRSS for group responses in its September 13, 2007, letter. The study compares the results from a sample of two piping runs analyzed using multi-support time history (a method acceptable to the staff) with the proposed GEH

use of ISM with SRSS of group responses. The study indicated that multi-support time history responses exceeded the ISM responses at several locations in the feedwater system, the maximum being 8%. As a consequence, the staff recommends that GEH increase the piping stresses and loads by 10% when using the ISM SRSS method. Alternatively, GEH should follow the staff position in NUREG-1061, Volume 4.

GEH Response

GEH accepted the NRC's recommendation and agreed to increase the piping stresses and loads by 10% when using the ISM SRSS method. The following paragraph was added to the DCD Tier 2, Subsection 3.7.3.9.

'To use the SRSS method for independent support response spectrum (ISM) analysis it is required to include 10 percent margin in the design requirements for piping stress and piping support loads to address the uncertainties that may exist from the use of the SRSS method rather than the absolute sum method (ABS) for the group combination method when performing an ISM analysis'.

Based on this response, DCD Tier 2 Subsections 3.7.3.9 and 3.7.3.12 were revised.

DCD Impact

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

NRC RAI 3.12-3 S04

Provide justification to demonstrate that the selected piping system for ESBWR inside containment could be considered as representative for the ESBWR Class 1, 2, and 3 piping for all building. Clarification on the SRSS method.

Section 3.7.3.9 of ESBWR DCD stated that the independent support motion (ISM) response spectrum method of analysis combines responses of different support groups by the SRSS procedure for component and equipment and additional 10 percent margin for piping stress and piping support loads. Section II.9 of SRP 3.7.3 states that if the ISM method is utilized, all of the criteria presented in NUREG-1061 related to the ISM method must be followed. NUREG-1061 states that group responses for each direction should be combined by the absolute sum method. NUREG-1061 also states that unless the groups are from different structures or if from the same structure, they can be shown to be phase uncorrelated, then SRSS should be used. In RAI 3.12-3 S02, the staff requested the applicant to demonstrate that time histories from different support groups can be shown to be phase uncorrelated, and therefore, SRSS combination can be used. The applicant provided an alternative by performing a dynamic analysis for SSE earthquakes by two different procedures for two typical piping systems for ESBWR inside containment. The staff is requesting the applicant to provide justification to demonstrate that the selected piping system for ESBWR inside containment could be considered as representative for the ESBWR Class 1, 2, ad 3 piping for all building.

The staff also notes that Figure B-3-5 of the GEH study report, MFN 06-119, Supplement 2, (ML072680480) showed phase correlation in the vertical direction. How does this justify the use of the SRSS method?

GEH Response

The selections of piping systems for the response spectrum analysis, the time history analysis and the comparisons have been performed according to the agreement reached between NRC, BNL and GE during the January 2007 audit meeting. The selected piping systems are representative for ESBWR piping inside the containment. This is because most of the piping inside the containment attach to the RPV, are supported by various building structures, and penetrate the containment wall. Therefore, the selected piping cases provide a very good representation of the piping typically seen in containment.

The NRC, in response to RAI 3.12-3 S03, has reviewed the detailed analysis results. The analysis results have demonstrated that SRSS combination yields conservative results for most of the components. The analysis results have also demonstrated that even though the RPV nozzle and vent wall have correlation in the vertical direction, Figure B-3-5 as an example, the effect to the overall results

of the system are small. The resulting changes to the DCD were formulated based from several meeting discussions held between GEH and the NRC.

DCD Impact

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

NRC RAI 3.12-39

Explain how the proposed mass spacing can satisfy the SRP 3.9.2 guidelines.

Section 3.7.3.3.1 of ESBWR DCD stated that mass points are located at spacing no greater than the span that would have a fundamental frequency equal to the cutoff frequency when calculated as a simply supported beam with uniformly distributed mass. Section II.2.A.(i)(2) of SRP 3.9.2 provided the following acceptable guidelines for the number of masses or degrees of freedom in dynamic modeling:

- *Use of an adequate number of masses or degrees of freedom in dynamic modeling to determine the response of all Category I and applicable non-Category I systems and plant equipment. The number is adequate when additional degrees of freedom do not result in more than a 10-percentincrease in responses.*
- *Alternately, the number of degrees of freedom may be taken as equal to twice the number of modes with frequencies less than 33 Hz (cut-off frequency).*

The staff is requesting GEH to explain how the GEH's proposed mass spacing can satisfy the SRP 3.9.2 guidelines.

GEH Response

The mass points spacing guidelines included in the current ESBWR piping analysis are conservative, and exceeds the requirements of SRP 3.9.2 guidelines.

These guidelines were setup before the 1980s. At that time, the computer CPU time was very costly. To reduce the cost of analysis, some engineers tried to minimize the degrees of freedom in the model. Currently the computer CPU time is free and the programs run very fast. Nodes are added to both ends of elbows, both ends of valves, center of gravity of valves and operators, flanges, and supports, etc. The number of degree of freedoms used far exceeded the SRP 3.9.2 requirements.

Take the ESBWR main steam piping analysis as an example. The SRP 3.9.2 requires that the number of degrees of freedom is to be twice the number of modes with frequencies less than 33 Hz (cut-off frequency). Per this dynamic analysis, the number of modes that were less than 33 Hz was 93 modes. Per the SRP 3.9.2 requirement, the number of degree of freedoms is 186 (2 x 93 = 186), and in comparison, the number of degrees of freedom determined by the analysis was 2694, which, far exceeded the requirements of the SRP 3.9.2 guidelines by 14 times (2694/186 =14).

SRP 3.9.2 requires that additional degrees of freedoms do not result in more than a 10-percent increase in responses. During the analysis of main steam piping, it was noticed that when additional nodes were added, no significant differences in results (far less than 1%) were observed; and therefore, the analysis was significantly less than the 10% requirement of SRP 3.9.2.

The PISYS program has a special feature to check the nodal spacing for dynamic analysis. For dynamic analysis the default nodal spacing is three (3) times the outside diameter (3D) of the pipe segment. If the nodal spacing is greater than the 3D limit, extra nodes are added to meet the default value. Therefore, SRP 3.9.2 requirement has been met.

DCD Impact

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