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(21)

Comments on Draft Regulatory Guide DG-1157, Damping Values for Seismic Design of Nuclear Power Plants.

The NRC noted that public comments are being solicited on Draft Regulatory Guide DG-1157, *Damping Values for Seismic Design of Nuclear Power Plants*, (including any implementation schedule) and its associated regulatory analysis or value/impact statement. The NRC also noted that comments will be most helpful if received by December 7, 2006.

AREVA NP appreciates the opportunity to provide comments on DG-1157. In general, AREVA NP has significant comments regarding the need for the proposed conservative methods as well as acceptability of some of the technical methods. These comments are outlined below.

Structural Damping

DG-1157 proposes a significant deviation from the historical relationship between stress levels and damping for the selection of damping values for generation of the structural loads and instructure response spectra (IRS) for the safe shutdown earthquake (SSE). The change imposes a much more restrictive limit on the stress levels for which SSE level damping can be used than does Regulatory Guide (RG) 1.61 R0 (1973), American Society of Civil Engineers (ASCE) 4-98 (in Table 3.1-1), or ASCE 43-05 (in Tables 3-3 and 3-4). A common thread in RG 1.61 R0, ASCE 4-98, and ASCE 43-05 is specification that SSE level damping is applicable to development of structural loads and generation of IRS if the stress ratios are at least 50% of code allowable limits. DG-1157 is a significant departure from that guidance by restricting the stress range for applicability of the nominal SSE level damping values in Table 1 to stress ranges at 80% or higher of code allowable limits. For stress levels below 80% of allowable, the use of OBE level damping (for OBE > 1/3 SSE) of Table 2 is specified if justification for alternative values is not provided. The DG is silent regarding applicable damping values for low stress levels for designs with the OBE = 1/3 SSE.

DG-1157 contains the following statement on page 3 regarding the study of structural damping values.

Structural Damping

In 1993, the NRC completed an investigation of the adequacy of original Regulatory Guide 1.61 structure damping values and other recommendations, and reported the results in NUREG/CR-6011 [Ref. 2]. Data were analyzed to identify the parameters that significantly influenced structure damping. **Based on that study, the NRC determined that the original Regulatory Guide 1.61 damping values for structure design were adequate but required one significant revision. Specifically, Regulatory Guide**

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Tempente = ADM-013
AREVA NP INC.
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E-RIDS = ADM-03
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1.61 should distinguish between “friction-bolted” and “bearing-bolted” connections for steel structures. Regulatory Position 1 in Section C of this revised guide provides the updated structural damping values. (emphasis added)

Contrary to this statement, a second change, i.e., the stress level change discussed above, is introduced. The source for the recommendation that the stress range for use of SSE level damping values in IRS generation should be made more restrictive is not provided in the supporting Regulatory Analysis or in NUREG/CR-6919. Further research by AREVA NP indicates that NUREG/CR-6011 appears to be the source for this change. Our concern is that the recommendations in NUREG/CR-6011 appear to be developed without full appreciation for the practical impact on the analysis and design process.

To illustrate the potential impact, consider that the seismic analysis of a reinforced concrete Seismic Category I structure prior to issue of DG-1157 would assume 7% damping in both the generation of structural loads for designing the structure and in the generation of IRS. However, under DG-1157 requirements, both the structural evaluation and generation of IRS would be based on 4% damping (from Table 2) if the stress levels were much less than 80% of allowable limits. This situation creates the potential for an iterative and inefficient design process since it cannot always be demonstrated in advance that appropriate stress levels for Seismic Category I structures exceed 80% of code allowable limits. In fact, the answer will not be known until detailed design using final loads and load combinations.

The potential inefficiency imposed on the design process is magnified for designs utilizing a nuclear island concept with a seismic model comprising multiple sticks on a common foundation. Confirmation of the final damping values for some or all of the sticks will depend on completion of final detailed design results for all structures in the model. Additional seismic analyses may be necessary to develop revised seismic forces for structural evaluation and to generate revised IRS if the stress levels for just some of the structures (sticks) are less than 80% of code allowable limits. Development of those revised loads and IRS would then necessitate reevaluation and possible redesign of the structure(s), systems, and components (SSCs).

In actual practice, applicants may attempt to minimize the uncertainty associated with an iterative design process by making worst-case bounding assumptions about stress levels and damping. Inclusion of the 80% requirement could, therefore, have an unintended and adverse impact on the efficient and economic design of SSCs.

Damping values used for loading or stress analyses should be consistent with the code limits without regard to actual stress. The resulting margin to allowable when using the damping consistent with the allowable will be meaningful using this approach. Using lower damping unduly penalizes structures which might be over designed and causes analytical iterations which are time consuming and unnecessary.

Bolted Damping (in the structural section)

DG-1157 contains the following statement on page 3 regarding the study of structural damping values.

Structural Damping

In 1993, the NRC completed an investigation of the adequacy of original Regulatory Guide 1.61 structure damping values and other recommendations, and reported the results in NUREG/CR-6011 [Ref. 2]. Data were analyzed to identify the parameters that significantly influenced structure damping. **Based on that study, the NRC determined that the original Regulatory Guide 1.61 damping values for structure design were adequate but required one significant revision. Specifically, Regulatory Guide 1.61 should distinguish between “friction-bolted” and “bearing-bolted” connections for steel structures.** Regulatory Position 1 in Section C of this revised guide provides the updated structural damping values. (emphasis added)

The term ‘friction bolted’ is not clear. AREVA NP believes it means a slip-critical bolted joint where bolt preload is so high that friction is never overcome and bolt never sees load in shear. This should be clarified.

Piping Damping

The use of 5% damping for envelope uniform support motion is not addressed. Its use has been previously approved in both the AP1000 and System 80+ certified designs. Use of frequency-dependent damping is not an equivalent alternative as that approach results in damping values less than 4% for frequencies greater than 13.3 Hertz (Hz).

Damping values used for loading or stress analyses should be consistent with the code limits without regard to actual stress. The resulting margin to allowable when using the damping consistent with the allowable will be meaningful using this approach. Using lower damping unduly penalizes structures which might be over designed and causes analytical iterations which are time consuming and unnecessary.

AREVA NP recommends that the NRC consider alternate piping damping methods than the approach proposed in DG 1157, as shown in Table 1 of Attachment 1.

AREVA NP prefers option 1 of Table 1; however, the other options are acceptable and listed in order of preference.

Electrical Distribution System Damping

AREVA NP expects that the precedent approach for justifying higher damping values for fully loaded cable tray systems, based on test data, that was used for the AP1000 and ESBWR designs is not precluded by DG-1157.

HVAC Duct Damping

AREVA NP has no comments.

Mechanical and Electrical Component Damping

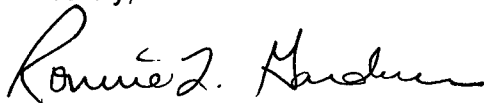
AREVA NP has no comments.

Recommendations for Changes / Requests for Clarification to DG-1157.

1. a. Retain the 50% code allowable limits on the stress levels for which SSE level damping can be used to generate IRS, consistent with RG 1.61, ASCE 43-05, and ASCE 4-98.
b. Damping values used for loading or stress analyses should be consistent with the code limits without regard to actual stress.
2. If the 80% stress level threshold is retained, clarify expectations for damping values to be used in the SSE analysis for plants for which the OBE is defined as 1/3 SSE (and, hence, OBE design cases are not performed) and stress levels for a given structure are much less than 80% of allowable limits. If the damping values in Table 2 are not to be considered the lower bound values for the SSE analysis under these conditions, the appropriate values should be provided.
3. Extend the section on piping to address the use of 5% damping for the envelope uniform support motion response spectra analysis, consistent with prior approvals.
4. AREVA NP recommends that NRC revise piping damping methods as shown in option 1 of Table 1.
5. Clarify definition of a 'friction bolted' connection consistently with AREVA NP understanding (slip-critical bolted joints).

If you have any questions concerning this letter, please contact Mark J. Burzynski. He may be reached by telephone at 434-832-4695 or by e-mail at Mark.Burzynski@areva.com.

Sincerely,



Ronnie L. Gardner, Manager
Site Operations and Regulatory Affairs
AREVA NP Inc.

Enclosure

cc: L. Burkhart
G. Tesfaye
Project 733

Attachment 1

Table 1 – Alternatives for Piping Damping Values in Order of Preference

Option	OBE	SSE	Reference
1 for all seismic analysis	5%	6%	Ware, A. G., The History of Allowable Damping Values for U.S. Nuclear Plant, Piping Transactions of the ASME/Journal of Pressure Vessel Technology, May 1991
2 for all seismic analysis	5%	5%	ASME Appendix N 2001 or later
3 for all seismic analysis	0 to 10 Hz - 5% 10 to 20 Hz - 5% to 3% > 20 Hz – 3%	0 to 10 Hz - 5% 10 to 20 Hz - 5% to 4% > 20 Hz - 4%	Modified N-411 modified to be consistent with the non ASME Code Case N-411 damping for high frequencies
4 for seismic analysis using envelope spectra	0 to 10 Hz - 5% 10 to 20 Hz - 5% to 3% > 20 Hz – 3%	0 to 10 Hz - 5% 10 to 20 Hz - 5% to 4% > 20 Hz - 4%	Modified N-411 modified to be consistent with the non ASME Code Case N-411 damping for high frequencies
for seismic analysis using time history or multi- support spectra	3%	4%	Non-ASME Code Case N-411 damping