June 13, 2007

Mr. Ronnie L. Gardner
AREVA NP Inc.
3315 Old Forest Road
P.O. Box 10935
Lynchburg, VA 24506-0935

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION REGARDING ANP-10264NP, "U.S. EPR PIPING ANALYSIS AND PIPE SUPPORT DESIGN TOPICAL REPORT" (TAC NO. MD3128)

Dear Mr. Ronnie L. Gardner:

By letter dated September 29, 2006 (ML062770021), AREVA NP submitted for U.S. Nuclear Regulatory Commission (NRC) staff review Topical Report ANP-10264NP, Revision 0, "U.S. EPR Piping Analysis and Pipe Support Design Topical Report" (ML062770023). The NRC staff has reviewed the application and has determined that additional information is required. Our questions are provided in the Enclosure.

A draft of the additional information requested was provided to you on May 15, 2007 (ML071430124), and discussed with your staff on May 22, 2007. Your staff has agreed that your response would be provided within 30 days of the date of this letter.

If you have any questions regarding this matter, I may be reached at 301-415-3361.

Sincerely,

/RA/

Getachew Tesfaye, Senior Project Manager
EPR Projects Branch 1
Division of New Reactor Licensing
Office of New Reactors

Project 733

Enclosure:
Request for Additional Information

cc Arnold Lee, Jennifer Dixon-Herrity, Larry Burkhart, Joe Colaccino, Tarun Roy

cc w/encl: See next page

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ADAMS ACCESSION NO.: ML071440041

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REQUEST FOR ADDITIONAL INFORMATION (RAI)

ANP-10264NP, "U.S. EPR PIPING ANALYSIS

AND PIPE SUPPORT DESIGN

TOPICAL REPORT" (TAC NO. MD3128)

PROJECT NUMBER 733

RAI EPR-1: Piping and Pipe Support Design - General

Section 1.0 of the Topical Report (TR) states that the reactor coolant loop (RCL) and pressurizer surge line piping requirements, modeling techniques, analysis approaches and acceptance criteria are not specifically addressed in this document and will be included in the design control document (DCD). The TR presents nearly all of the design certification requirements, acceptance criteria, analysis methods and modeling techniques for the American Society for Engineers (ASME) Class 1, 2 and 3 piping and pipe supports, as required in the Standard Review Plan (SRP) Section 3.12 for new reactors. Describe any significant differences between the requirements, techniques, approaches and design criteria for the RCL and pressurizer surge line piping, and those included in the TR.

RAI EPR-2: ASME B31.1 and Section XI Codes

A. In accordance with RG 1.26, Quality Group (QG) D piping that may contain radioactive material is considered to be outside the ASME Code Class 1, 2, and 3 piping systems. The Regulatory Guide (RG) recommends that these piping and pipe supports are to be designed in accordance with the requirements of the ASME B31.1, "Power Piping" Code. Please clarify if the Evolutionary Power Reactor (EPR) piping and pipe supports will have QG D systems; and confirm that whether EPR piping design will use the ASME B31.1 Code for these systems, otherwise provide technical justification for using other than the B31.1 Code requirements for the QG D piping systems.

B. Confirm that ASME Code Section XI requirements will be used in the piping and pipe support design for EPR.

RAI EPR-3: 10CFR50.55a(b) Limitations and Modifications

Section 2.1 of the TR states that for the dynamic loads, including seismic loads, the pipe stress analyses will be performed in accordance with the Sub-articles NB/NC/ND-3650 of the 1993 Addenda of the ASME Code as required by 10CFR50.55a(b)(1)(iii). However, AREVA did not address other limitations and modifications (related to Section III materials, weld leg dimensions, etc.) applicable to piping system design as included in 10CFR50.55a(b)(1). Explain how all limitations and modifications specified in 10CFR50.55a(b) will be satisfied.

ENCLOSURE

RAI EPR-4: Mathematical Modeling

TR Section 4.2 states that the seismic analysis methods for seismic Category I systems to withstand the effects of a safe shutdown earthquate (SSE) and to maintain the capability of performing their safety function will use the methods in accordance with SRP 3.7.3.

A. Describe the mathematical representation of a piping system, including the development of the mass, stiffness, and damping matrices in the analytical model, that will be used in the three methods of analysis (i.e., response spectrum, time history, and equivalent static load methods). Also, discuss the types of loading functions that will be used in each of these methods of analysis.

B. Confirm if these methods of analysis will be limited to an elastic basis. If not, discuss the application limits for these three methods.

C. Identify conditions or limits when each of these three methods of analysis will be used in obtaining the piping system responses.

D. Discuss the analysis methods that will be used in the design of non-seismic Category I (or seismic Category II) piping systems.

RAI EPR-5: Piping Analysis Methods

After constructing a mathematical model to reflect the static or dynamic characteristics of the piping system, describe the step by step computations (e.g., static analysis, modal analysis, modal participation factors) that may be performed to obtain the piping system response for each of the three methods of analysis (i.e., response spectrum, time history, and equivalent static load methods).

RAI EPR-6: Piping Analysis Criteria

A. SRP Section 3.9.2, Item II.2.A(i)(3) requires an investigation for a sufficient number of modes to be included in the piping modeling to ensure that all significant modes have participated in the analysis. Provide the criterion that would ensure this requirement.

B. The cutoff frequency for modal responses is defined as the frequency at which the spectral acceleration approximately returns to the zero period acceleration (ZPA) of the input response spectrum. Define this cutoff frequency qualitatively or quantitatively for seismic and other building dynamic loads (if any) applicable to the piping analysis for the EPR.

RAI EPR-7: Branch Pipe Inputs

When a small seismic Category I or non-seismic Category I piping is directly attached to seismic Category I piping, it can be decoupled from seismic Category I piping if it satisfies the decoupling criteria. However, the TR did not describe how the inputs for the small branch piping will be determined for both inertial and seismic anchor motion (SAM) response analyses when the piping system is decoupled from a large pipe run or connected to flexible equipment connections. The staff notes that computer code RESPECT (TR Section 5.1.8) generates seismic amplified response spectra at the branch nozzle locations in a model of a piping system. Describe the seismic analysis methods and procedures, including the input response spectra and input SAM displacements, that apply to the small branch piping design when decoupled from a large run pipe or connected to flexible equipment. The description should also discuss how any amplification effects and SAM effects, from the main run pipe at the attachment to the small branch pipe, are considered.

RAI EPR-8: Independent Support Motion Method

The current staff position for the Independent Support Motion (ISM) method of analysis is presented in Volume 4, Section 2 of NUREG-1061, "Report of the US NRC Piping Review Committee. "Some differences (e.g., modal combinations per RG 1.92 for uniform support motion (USM) only) were noted between the ISM method of response combinations (both methods and their sequence) presented in the TR Section 4.2.2.2.2, and the method given in NUREG-1061. Indicate whether all of the provisions (for groups, modes, spatial and inertial and SAM combination methods) contained in NUREG-1061 for the ISM method of analysis will be followed or provide the technical justification for any alternatives or methods described in the TR.

RAI EPR-9: Time History Analysis Using Modal Superposition Method

Since many of the dynamic loads specified in the TR, using the time history method of analysis, may have a short duration and contain very high frequency content, the use of the modal superposition method must consider all modes up to the appropriate cutoff frequency as well as the missing mass contribution. Discuss how the proposed modal superposition method will address these considerations in accordance with RG 1.92, Rev.2.

RAI EPR-10: Time Step for Time History Analysis

In a time history analysis, the numerical integration time step, Δt, must be sufficiently small to accurately define the dynamic excitation and to ensure stability and convergence of the solution up to the highest frequency of significance. In TR Section 4.2.3, AREVA indicates that for the most commonly used numerical integration methods, the maximum time step is limited to one-tenth of the shortest period of significance. However, this is typically selected for choosing an initial time step which is later checked against analysis results and their stability and convergence. An acceptable approach for selecting the time step, Δt, is that the Δt used shall be small enough such that the use of ½ of Δt does not change the response by more than 10%. Indicate whether this is part of the analysis requirements for time history method of analysis or provide a technical justification for not considering this criterion along with the criterion for initially choosing the time step described for seismic and other dynamic loading analyses.

RAI EPR-11: Time History Analysis Uncertainties

TR Section 4.2.3 states that to account for uncertainties in the structural analysis using the time history method, similar to peak shifting in the response spectrum method of analysis, three separate input time histories with modified time steps will be analyzed. Alternatively, the time histories at the attachment points may be derived considering variations in the concrete stiffness.

A. Describe the detailed procedure for using the peak shifting method that will be used in the time history method of analysis with modified time steps for seismic and other dynamic loadings.

B. Describe all of the dynamic loads for which the time history will be adjusted to account for material and/or modeling uncertainties and provide the basis for the amount of the adjustment.

C. Explain how the time histories at the attachment point derived considering variations in the concrete stiffness are alternate to the peak shifting method to be used in the time history method of analysis. Also, provide the percentage variations in the concrete stiffness to be used in the EPR piping design.

RAI EPR-12: Equivalent Static Load Analysis

Confirm that the equivalent static load is always determined by multiplying 1.5 to the peak acceleration for all cases including a single degree of freedom system with known fundamental frequency or a rigid system with the fundamental frequency beyond the cutoff frequency. If not, then provide the criterion that will be used for these special cases.

RAI EPR-13: Small Bore Piping

The TR did neither define nor address the design of small bore piping to be used in the EPR piping design. Define the small bore piping to be used in the EPR piping design and discuss, with technical bases, the methods of analysis (handbook or a system flexibility analysis) that will be used in the small bore piping design for ASME Class 1, 2, 3 and QG D piping.

RAI EPR-14: Non-Seismic/Seismic Interaction

A. TR Section 4.4.1 states that non-seismic piping which cannot be completely separated from seismic systems is routed as far away as possible. With examples, please discuss under what conditions this type of isolation is used in the EPR piping design and also, quantify the meaning of “as far away as possible.”

B. TR Section 4.4.2 states that following the failure of the non-seismic pipe, (i) if the non-seismic piping is supported by seismic restraints within the ASME B31.1 Code-suggested pipe support spacing shown in TR Table 4-1, it is considered to lose its pressure boundary integrity, but not fall onto a safety-related piping or equipment. Provide the technical basis for this assumption. (ii) the side motion of a failed moderate energy piping is assumed to be ±6 inches (centerline to centerline) from the original position. Provide the technical basis for this assumption of ±6 inches side motion for all pipe sizes. (iii) safety-related piping with NPS and thickness equal to or greater than that of the non-seismic piping may be assumed to stop the downward motion of the non-seismic piping without failure of the safety-related piping. Provide the technical basis for this assumption.

RAI EPR-15: Buried Piping

TR Section 3.10 did not give details on the analysis method and how the criteria are to be applied in the design of buried piping.

A. Based on the criteria presented in the TR, describe the analysis method and design requirements that will be used for buried piping design (including buried pipe tunnel if used in the design). Explain how these methods compare to the analytical methods referenced in the recently published NRC Standard Review Plan 3.7.3, Rev. 3, (i.e., ASCE Standard 4-98, ASCE Report - Seismic Response of Buried Pipes and Structural Components, and NUREG/CR-1161).

B. Why doesn't TR Section 3.10 include consideration of ground-water effects and soil arching effects which could increase or decrease the stresses in the pipe due to the overlying soil plus the ground surface loads?

C. How is the assumption related to soil liquefaction and fault displacement, which is noted in TR Section 3.10, assured?

D. TR Table 3-4 provides the design conditions, load combinations and acceptance criteria for Class 2/3 buried piping. Explain clearly the term non-repeated anchor movement, Equation 9U (vs 9), and Equation 9E (vs 9). While the intent may be interpreted, it is important that these terms be clearly defined in the TR. For Equations 10M and 11M, which are identified as "modified to include axial friction forces," provide the equations to show how they are modified.

E. For the Faulted loading condition in TR Table 3-4, why isn't the load thermal anchor movement (TAM) included in the load combination, as it is in Table 3-2 for Class 2 & 3 Piping? Also, why is the stress criteria of $3S_h$ used rather than the minimum of 3.0 S_h and 2.0 S_y, as presented in Table 3-2?

F. Confirm that Note 5 in the TR Table is applicable to all cases cited in TR Table 3-4 since it is not referenced in the Table like the other notes are. Also, explain how the criteria of NC/ND-3133 of the ASME Code (Note 5 in the Table) will be implemented in conjunction with meeting the loads and loading conditions specified in Table 3-4.

RAI EPR-16: Computer Codes

TR Section 5.1 provides short descriptions of the major computer programs to be used in the analysis and design of safety-related piping systems. Piping related computer programs include SUPERPIPE, BWSPAN, BWHIST, BWSPEC, COMPAR2, CRAFT2, P91232, and RESPECT. AREVA states that SUPERPIPE has been thoroughly verified and validated to U.S. NRC standards. For all other computer codes, AREVA did not indicate if these programs are verified for their application by appropriate methods, such as hand calculations, or comparison with results from similar programs, experimental tests, or published literature, including analytical results or numerical results to the benchmark problems and validated as the piping program. Moreover, AREVA did not mention how the quality of these programs and computer results is controlled. To facilitate the staff review of the computer programs used in the EPR design, provide the following additional information:

A. Identify which computer programs will be used during the design certification phase.

B. Identify which programs have previously been reviewed by the NRC on prior plant license applications. Include the program name, version, and prior plant license application. As stated in SRP 3.9.1, this will eliminate the need for the licensee to resubmit, in a subsequent license application, the computer solutions to the test problems used for verification.

C. Confirm that the following information is available for staff review for each program: the author, source, dated version, and facility; a description, and the extent and limitation of the program application; and the computer solutions to the test problems described above.

RAI EPR-17: Inclusion of Support Mass

TR Section 5.2 describes a criterion for inclusion of support masses to the piping model mass at the support attachment location and states that a portion of the weight of the support is considered in the piping analysis and also, because the mass of a given support will not contribute to the piping response in the direction of the support, only the unsupported directions need to be considered.

A. Clarify under what conditions only a portion of the support weight would be considered.

B. Provide justification as to why the support mass would not contribute to the piping response in the direction of the support if the support is flexible (e.g., spring hangers).

RAI EPR-18: Piping Model Structural Boundaries

TR Sections 5.4.1.2 and 5.4.1.3 describe two alternate approaches of separating a piping analysis model using an elbow or a tee within the piping model. While these approaches may be technically sound, no references or technical justifications are provided for each of these methods. Provide technical justifications and limitations (if any) for these two methods of establishing piping model terminations. Also, discuss the basis for selecting the dimensions of L_1 and L_2 in TR Figure 5-1 for a restrained elbow and Figure 5-2 for a restrained tee.

RAI EPR-19: Piping Model Boundaries Using Model Isolations

TR Sections 5.4.3.1 and 5.4.3.2 describe two approaches of dividing a large piping analysis model using the overlap region or the influence zone method. While these approaches may be technically sound, no references or technical justifications are provided for each of these methods. Provide technical justifications and limitations (if any) for these two methods of isolating piping models. Also, discuss the basis for selecting the overlap region and the influence zone in TR Figure 5-3.

RAI EPR-20: Piping Benchmark Program

Final piping and pipe support stress analyses cannot be completed before design certification because their completion is dependent on as-built or as-procured information. Under a piping benchmark program, the combined operating license (COL) applicant applies his computer program to construct a series of selected piping system mathematical models that are representative of the standard plant piping designs. Please confirm if AREVA has established such a piping benchmark program to be used by the COL applicants and whether its own piping analysis computer code described in Section 5.1 was verified using models representative of the U.S. EPR.

RAI EPR-21: Model Decoupling Criteria

TR Section 5.4.2 states that adequate flexibility in the branch line is provided by maintaining a minimum length from the run pipe to the first restraint of ½ of the pipe span in TR Table 4-1 for the branch line. The mass to be considered at the branch connection of the run pipe is the mass of ½ of the first span of the branch pipe, including concentrated weights, in each direction. However, AREVA did not discuss other effects (e.g., moment or torsional load at the branch connection) of the eccentric concentrated masses, such as valves, in the first one-half span length from the main run pipe. Provide technical justification on how to account for the effect of a large concentrated mass near the branch connection in the decoupling criteria discussed in the TR.

RAI EPR-22: Dynamic Analysis of Branch Lines

TR Section 5.4.2 states that for the SSE inertia load case, each individual run pipe movement shall be analyzed as a separate anchor movement load case on the branch line and combined with its respective load case by absolute summation. Provide additional clarification to explain this procedure.

RAI EPR-23: Model Isolation and Analysis

A. TR Section 5.5 states that when the isolation methods discussed in TR Section 5.4.3 are used, isolation of dynamic effects is provided by three (3) seismic restraints in each of the three orthogonal directions beyond the seismic Category I design boundary. However, TR Section 5.4.3.1 states that as a minimum, four (4) such restraints in each orthogonal direction in the overlap region are required for the same isolation method. Explain this discrepancy.

B. TR Section 5.5 states that for loads resulting from the potential failure of the non-seismic piping and pipe supports, three separate analyses are performed by applying a plastic moment in each of three orthogonal directions at the termination of the model and then the results of these three analyses are enveloped. Please clarify how these loads are calculated and how the results from the three analyses are combined with the results of the dynamic analysis of the seismic Category I piping.

RAI EPR-24: Transient Loads

Provide the list of transients and the number of events associated with each of these transients during a life span of 60 years that will be part of the design requirements of ASME Code Class piping and pipe supports. If such a list is not developed at this stage of the design certification, then include this in the DCD or include as one of the COL-Action Items listed in TR Table 1-1.

RAI EPR-25: Piping Load Combinations

The staff needs clarification of several items associated with TR Section 3.3 and Tables 3-1 and 3-2.

A. In TR Section 3.3.1.7, it is stated that pipe breaks in the RCL, main steam and pressurizer surge lines which meet the leak-before-break (LBB) size criteria are eliminated from the consideration based on LBB analysis. However, the impact of smaller attached lines and other lines outside the LBB analyzed zone will be considered. Per SECY 93-087, the staff has approved the LBB approach on a case-by-case basis for austenitic stainless steel and carbon steel with stainless steel clad piping inside the primary containment and pipe size of at least 6-inch NPS. Based on this document, appropriate bounding limits are to be established using preliminary analysis results during the design certification phase and verified during the COL phase by performing the appropriate ITAAC discussed in it. Discuss the technical basis for exclusion of pipe break analysis for the above three lines, with the LBB criteria to be used for the EPR piping design.

B. Note 3 to TR Table 3-1 states that dynamic loads are to be combined considering timing and causal relationships. SSE and Design Basis Pipe Break (including loss-of-coolant accident (LOCA)) shall be combined using the square root of the sum of the squares (SRSS) method. This is acceptable in accordance to NUREG-0484, Rev. 1. However, for dynamic responses resulting from the same initiating events (other than SSE), when time-phase relationship between the responses cannot be established, the absolute summation of these dynamic responses should be used. Confirm if this is true for the EPR piping design. If not, discuss with technical justification the combination method to be used when multiple LOCA or other dynamic load events are required to be combined. This combination criterion is also applicable to note 5 of the TR Table 3-2, which states that dynamic loads are combined by the SRSS.

C. Note 8 to TR Table 3-1 states that the earthquake inertial load used in the Level D Primary Stress (Equation 9F) calculations shall be taken as the peak SSE inertial load. The earthquake anchor motion load used in the Level D Primary Stress (Equation 9F) calculations shall be taken as the peak SSE anchor motion load. The staff position on the use of a single-earthquake design in SECY-93-087 states that the effects of anchor displacements in the piping caused by an SSE be considered with the Service Level D limits. For simplified elastic-plastic discontinuity analysis, if Eq. 10 cannot be satisfied for all pairs of load sets, then the alternative analysis per NB-3653.6 for Service Level D should be followed. In addition, the combined moment range for either the resultant thermal expansion and thermal anchor movements plus ½ the SSE seismic anchor motion or the resultant moment due to the full SSE anchor motion alone, whichever is greater must satisfy the equation (known as Eq. 12a) given in NB-3656(b)(4). Clarify if this is applicable to EPR piping design. Also, justify why this anchor motion stress is categorized as a primary stress in the TR Table 3-1 for the faulted condition.

D. Identify the applicability of notes 3 and 5 in the TR Table 3-2.

E. Explain why equation 11a under NC/ND-3653.2 is not included in the TR Table. Are there any dynamic loads other than the SSE (e.g., building response due to hydrodynamic loads such as SRV actuation) that can occur?

RAI EPR-26: Piping Damping Values

In TR Section 4.2.5, it is identified that Rev. 0 of the RG 1.61 values of damping will be used in the seismic analysis of structures, systems, and components (SSCs) using ISM response spectrum analysis or time history analysis. However, for piping systems analyzed using USM response spectrum analysis, 5% damping will be used provided that the system is not susceptible to stress corrosion cracking. Five percent damping will not be used for analyzing the dynamic response of piping systems using supports designed to dissipate energy by yielding.

A. Since staff has issued the Rev.1 of RG 1.61 in March 2007, indicate if the design of EPR piping systems will use Rev. 1 of the RG-recommended damping values.

B. For piping systems analyzed using uniform support motion response spectrum analysis and 5% damping, verify that all of the limitations specified in RG 1.84 for ASME Code Case N-411 (or RG 1.61, Rev.1) will be met.

C. Also, discuss what damping values will be used for cases when the system is susceptible to SCC and when using supports designed to dissipate energy by yielding.

RAI EPR-27: Modal Combinations

In TR Section 4.2.2.3.1, it is stated that for the response spectrum method of analysis, the modal contributions to the inertial responses are normally combined by the SRSS method. If some or all of the modes are closely spaced, any one of the methods (Grouping method, 10% method, and Double Sum method, as well as the less conservative methods in revision 2 of the RG 1.92) is applicable for the combination of modal responses. This combination method is applicable to both USM and ISM methods of analysis.

A. If guidance given in Revision 2 of the RG 1.92 is used for the EPR piping design, then Revision 2 of the RG no longer recognizes the Grouping method, 10% method and Double Sum method for closely spaced modes. These methods are renamed and AREVA should identify them as noted in the RG.

B. TR states that for closely spaced modes AREVA may use less conservative methods discussed in the RG. Please identify which methods are less conservative methods and explain why they are less conservative with respect to the other method(s).

RAI EPR-28: Missing Mass

TR Section 4.2.2.3.2 presents a procedure to account for high-frequency modes in the response spectrum methods for calculating seismic and other dynamic load responses.

A. Discuss the differences in the mathematical derivations of the high frequency modes presented in the TR versus the methods acceptable to the staff as given in RG 1.92, Rev. 2.

B. The TR states that the response from high frequency modes will be included in the response of the piping system if it results in an increase in the dynamic results of more than 10%. However, in accordance with RG 1.92, Rev.2, C.1.4.1, this criterion may yield non-conservative results and should not be used. Since this guideline does not consider the total mass that is missing, which, in the limit, could be 10%, provide technical justification for using this criteria as a screening requirement for including the effects of any missing mass.

C. The TR also states that peak modal responses of the system at frequencies above the ZPA are considered to be in phase. Thus, the responses of all high frequency modes are combined by absolute summation. Explain if the peak modal responses are in phase, then why the absolute sum method is recommended for the EPR piping design.

D. Finally, the TR states that this missing mass mode is considered to have a modal frequency and acceleration equal to the cut-off frequency used in the modal analysis. These modal results are combined with the low frequency modal results using the methods described in TR Section 4.2.2.3.1 for the low frequency modes (per RG 1.92). Please explain the combination method for the results to be used from both low and high frequency modes.

RAI EPR-29: Nonlinear Vibrations Due to Support Gaps

The TR does not provide an analytical method to account for nonlinear effects of excessively large gaps (for frame type supports) between the pipe and supports subject to high frequency vibration loads. Should such large gaps exist, provide the piping analysis method to be used to address the nonlinearity when subjected to vibratory loads with significant high-frequency caused by the gaps between the pipe and its supports.

RAI EPR-30: Thermal Stratification

A. TR Section 3.7.1 states that the main feedwater nozzle is located in the conical section of the steam generator which aids in reducing thermal stratification. Please explain how this reduces thermal stratification.

B. TR Section 3.7.2 states that the surge line may not be subjected to significant stratification/striping effects due to design features that mitigate these effects. Describe these design features and explain how they mitigate the effects of thermal stratification in the surge line.

RAI EPR-31: Safety Relief Valve

Describe the SRV design parameters and criteria that will need to be specified to the COL applicant to ensure that the specific piping configuration and safety relief valves (SRVs) purchased and installed at the COL applicant stage will match the test and design parameters used at the design certification stage. An example is the minimum rise time for the SRV valve operation; this can greatly affect the transient loads imposed on the piping system analysis. Also, any change in the discharge piping system configuration may affect the SRV loadings.

RAI EPR-32: Composite Damping

The composite modal damping ratio can be used when the modal superposition method of analysis (either time history or response spectrum) is used, as described in SRP Section 3.7.2, II.13. If AREVA plans to use composite modal damping for U.S. EPR piping design, provide a description of the methods for determining the composite modal damping value.

RAI EPR-33: Codes for Support Design

A. TR Section 6.1 states that for Service Levels A, B and C, the seismic Category I pipe supports will be designed in accordance with Subsection NF of the ASME Code and for Service Level D, Appendix F of Section III of the ASME Code will be utilized. However, TR Section 6.2 states that all piping supports designed in accordance with the rules of Subsection NF of the Code up to the building structure interface are defined by the jurisdictional boundaries in Subsection NF-1130 of the ASME Codes. (i) Since Appendix F of the Section III provides only the Service Level D limits for evaluation of loading [per Code Table NF-3523(b)-1 for stress limit factors] for Class 1, 2, 3 and MC type supports, clarify if the seismic Category I pipe supports will be designed to ASME Subsection NF for all four Service Level A, B, C and D loads, while using the acceptance stress limits by the Appendix F for Service Level D supports. (ii) Also, clarify if the Subsection NF will be used to manufacture, install and test all seismic Category I pipe supports. If not, which other standard will be used.

B. AREVA also states that seismic Category II pipe supports are designed to ANSI/AISC N690, "Specification for the Design, Fabrication and Erection of Steel Safety-Related Structures for Nuclear Facilities." These standards are used to design the structures or structural elements of a support for nuclear facilities, not the standard component supports (e.g., clamps, snubbers). ASME Code Subsection NF is typically used for seismic Category II pipe supports. Identify the standard that will be used to design, manufacture, install and test seismic Category II pipe supports.

C. AREVA states that non-seismic category pipe supports are designed using guidance from the AISC Manual of Steel Construction. This manual is used to design steel constructions in frame type or other structural element of component supports. Based on TR Section 6.2, ASME Code B31.1 is being used for a certain class of piping (also see request for additional information (RAI) EPR-2). The design of all supports for the non-nuclear piping (that typically uses B31.1 for piping analysis) should satisfy the requirements of ASME/ANSI B31.1 Power Piping Code, Paragraph 120 for loads on pipe supporting elements and Paragraph 121 for design of pipe supporting elements. Clarify if this is applicable to U.S. EPR pipe support design, otherwise explain how the AISC manual will be used to design component supports (e.g., clamps, springs).

RAI EPR-34: Load Combination for Supports

While reviewing TR Section 6.3, the staff needs clarification of the following items.

A. TR Section 6.3.11 provided a minimum design load criteria that will be used for all supports so that uniformity is obtained in the load carrying capability of the supports. All supports will be designed for the largest of the following three loads: 100% of the Level A condition load, the weight of a standard ASME B31.1 span of water filled, schedule 80 pipe, and minimum value of 150 pounds. Provide the technical basis for this criteria.

B. TR Table 6-1 provides the specific load combinations that will be used in the design of pipe supports. The acceptance criteria associated with the Service Levels will be per ASME Code, Subsection NF, ANSI/AISC N690 or the AISC Manual of Steel Construction, as appropriate. Note 1 to the Table states that operating basis earthquake (OBE) inertia and SAM loads are not included in the design of Class 2/3 piping. Explain how the seismic inertia and SAM loads are accounted for in the design of Class 2/3 pipe supports. Also, clarify how the same table is applicable to snubbers, struts, and anchors/guides.

C. AREVA discusses wind/tornado loads in TR Sections 6.3.5 and 6.3.6 for pipe supports. However, for the piping in TR Section 3.3.1.6, AREVA identified these loads to be COL-Action Item 3. Clarify AREVA's position on this.

RAI EPR-35: Snubber Design

AREVA, in TR Section 6.6, states that design specifications are to be provided to the snubber suppliers and the installation and operation of snubbers will be verified by the COL applicant. For design certification, SRP Section 3.9.3 requires that design, installation, operation and testing of the snubbers should be included in the design document. Clarify, whether AREVA intends to include all design-related specifications associated with snubbers in the TR or in the DCD.

RAI EPR-36: Support Stiffness

AREVA does not adequately describe in TR Section 6.7 how the representative stiffness values are developed for all supports other than snubbers. Describe:

1. the approach used to develop the representative stiffness values,

2. the procedure that will be imposed to ensure that the final designed supports match the stiffness values assumed in the piping analysis,

3. the procedure used to consider the mass (along with the support stiffness) if the pipe support is not dynamically rigid, and

4. the same information [(1), (2), and (3) above] for the building steel/structure (i.e., beyond the NF jurisdictional boundary) and for equipment to which the piping may be connected to.

RAI EPR-37: Inclusion of Support Self-Weight Excitation

In TR Section 6.8, AREVA did not indicate if the criteria presented is also applicable to other dynamic loads and did not discuss how the damping value will be used in the response spectrum analysis.

A. Clarify whether the criterion presented in the TR is also applicable to other dynamic loads. If not, provide technical justification.

B. Since the piping and support structure damping value may be different per RG 1.61, discuss what damping value will be used in the response spectrum analysis when the support structure is also modeled as part of the piping analysis. See also RAI EPR-32.

RAI EPR-38: Instrument Line Support Design

TR Section 6.12 states that the applicable loading combinations for instrumentation lines will follow those used for normal and faulted levels in TR Table 6-1. Please explain why the load combinations for upset and emergency levels in TR Table 6-1 are not applicable to instrumentation line supports.

RAI EPR-39: Pipe Deflection Limits

In TR Section 6.13, AREVA provided examples of the limitations which include travel limits for spring hangers, stroke limits for snubbers, swing angles for rods, struts and snubbers, alignment angles between clamps or end brackets with their associated struts and snubbers, and the variability check for variable spring supports. In addition to the manufacturer's recommended limits, allowances will be made in the initial designs for tolerances on such limits. Please specify the actual allowable limits that are applicable to EPR support design for pipe deflection limits.

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