KHNPDCDRAIsPEm Resource

From: Ciocco, Jeff
Sent: Monday, December 14, 2015 10:48 AM
To: apr1400rai@khnp.co.kr; KHNPDCDRAIsPEm Resource; Harry (Hyun Seung) Chang; Andy Jiyong Oh; Steven Mannon
Cc: Tsirigotis, Alexander; Clark, Theresa; Ng, Ronnie; Umana, Jessica; Lee, Samuel
Subject: APR1400 Design Certification Application RAI 334-8373 (03.12 - ASME Code Class 1, 2, and 3 Piping Systems and Piping Components and Their Associated Supports)
Attachments: APR1400 DC RAI 334 MEB 8373.pdf

KHNP,

The attachment contains the subject request for additional information (RAI). This RAI was sent to you in draft form. Your licensing review schedule assumes technically correct and complete responses within 30 days of receipt of RAIs. However, KHNP requests, and we grant, 45 days to respond to this RAI. We may adjust the schedule accordingly.

Please submit your RAI response to the NRC Document Control Desk.

Thank you,

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United States Nuclear Regulatory Commission
Protecting People and the Environment

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REQUEST FOR ADDITIONAL INFORMATION 334-8373

Issue Date: 12/14/2015
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 03.12 - ASME Code Class 1, 2, and 3 Piping Systems and Piping Components and TheirAssociated Supports
Application Section:

QUESTIONS

03.12-10

ASME BPV Code Section III, as mandated by 50.55a, requires that piping be evaluated for dynamic loads. DCD Tier 2, Section 3.12.3.4, "Time-History Method," states that for the dynamic response of piping systems, the time-history analysis may be performed using the modal superposition method.

1. The applicant is requested to identify which piping systems are evaluated using time history analysis. In addition, the applicant is requested to indicate whether the analyses are linear or non-linear and specify the time-history analysis technique used (modal superposition method, direct integration method in the time domain, or the complex frequency response method in the frequency domain).
2. DCD Tier 2, Section 3.7.2.1.2, "Time-History Methods," for the modal superposition method refers to ASCE Standard 4-98. ASCE 4-98 discusses an alternate method for considering the number of modes in a modal superposition analysis and states that the number of modes included should be sufficient to ensure that inclusion of all remaining modes does not result in more than a 10 percent increase in the total response of interest. The current NRC technical position, as described in RG 1.92, Revision 2 and Revision 3, is that this approach is "non-conservative and should not be used." The applicant is requested to verify that when modal superposition time history analysis is used, its use conforms to the guidance described in RG 1.92, Revision 2 or 3, or justify an alternative approach.

03.12-11

According to SRP Section 3.9.2.II.2.A(ii), an equivalent static load method is acceptable if certain criteria are met. DCD Tier 2, Section 3.12.3.6, "Small-Bore Piping Method," states that for small-bore piping, either the equivalent static load method or the modal response spectrum method is used.

1. The applicant is requested to justify that, when the equivalent static load method is used, the use of a simplified model is realistic and the results are conservative as described in SRP Section 3.9.2.II.2.A(ii)(1).

2. The applicant is also requested to clarify in the DCD that, when the equivalent static load method is used, the design and simplified analysis accounts for the relative motion between all points of support, as described in SRP Section 3.9.2.II.2.A(ii)(2).

3. The applicant is requested that DCD Tier 2, Section 3.12.3.6, "Small-Bore Piping Method" be revised to describe how the provisions of SRP Section 3.9.2.II.2.A(ii) are addressed or to justify an alternative approach.

03.12-12

According to SRP Section 3.12, Subsection II.B.iii, computer programs used in the piping analysis and pipe support design are to be benchmarked with the appropriate NRC benchmarks. DCD Tier 2, Section 3.12.4.3, "Piping Benchmark Program," states that piping benchmark problems in NUREG/CR-1677, Volume 1 and 2, issued August 1980, are used to validate the PIPESTRESS and ADLPIPE computer programs used in piping system analysis. PIPESTRESS and ADLPIPE, however, are only two of the programs listed in DCD Tier 2, Section 3.12.4.1, for piping analysis and pipe support design. The applicant is requested to discuss benchmark programs for the remainder of computer programs listed in DCD Tier 2, Section 3.12.4.1.

03.12-13

ASME Boiler and Pressure Vessel Code (BPV Code) Section III, as mandated by 10 CFR 50.55a, requires that the effects of seismic and thermal movements of pipe restraints such as equipment nozzles, pipe supports, pipe anchors, and pipe headers (in the case of decoupled pipe branches) are considered in the piping analysis. According to DCD Tier 2, Section 3.12.5.3.3, “Thermal Expansion,” and Section 3.12.5.3.4, “Seismic,” thermal anchor movements (TAMs) and seismic anchor movements (SAMs) less than 1.6 mm (1/16 inch) may be excluded from the piping analysis. The applicant is requested to provide additional information on its approach to demonstrate that when the piping analysis has excluded thermal or seismic pipe restraint movement(s), adequate gap(s) exist in the as-built pipe supports to accommodate the excluded movement(s), including addressing applicable additive loads. It is also suggested that the applicant combine its response with staff RAI xx-8278, Question 28123, which requested similar information specific just to TAMs.

03.12-14

ASME BPV Code Section III, as mandated by 50.55a, requires that piping be evaluated for seismic loads.

DCD Tier 2, Subsection 3.12.3.2.4, “Modal Combination,” shows that closely spaced modes are combined with the grouping method of Regulatory Guide (RG) 1.92, Revision 1. The grouping method is described in Subsection C.1.2.1 of RG 1.92, Revision 1. The same statement is made in DCD Tier 2, Section 3.9.2.2.6, “Combination of Modal Responses.” In contrast, DCD Tier 2, Section 3.12.5.5, "Combination of Modal Responses," shows that closely spaced modes are combined with the 10-percent method of RG 1.92, Revision 1. The 10-percent method is described in Subsection C.1.2.2 of RG 1.92, Revision 1. The applicant is requested to explain this difference and revise the DCD as appropriate.

03.12-15

NRC Bulletin (BL) 88-08, “Thermal Stresses in Piping Connected to Reactor Cooling Systems,” issued June 22, 1988, requests licensees to identify and evaluate the piping system connected to the RCS susceptible to thermal stratification, cycling, and striping (TASCS) to ensure that the piping will not be subjected to unacceptable thermal stresses. The bulletin recommended nondestructive examinations of potentially affected pipes to assure that no flaws exist, as well as the development and implementation of a program to provide continuing assurance of piping integrity. Ways to provide this assurance include designing the system to withstand the cycles and stresses from valve leakage, instrumenting the piping to detect adverse temperature distributions and establishing appropriate limits, and providing a means to monitor pressure differentials that may lead to valve leakage.

While the applicant was not an addressee of this bulletin, the operating experience described in the bulletin should be incorporated in the design in accordance with 10 CFR 52.47(a)(22). As such, SRP Section 3.12 includes criteria related to this bulletin, to the extent that the issue applies to a given design.

In DCD Tier 2, Section 3.12.5.9, the applicant indicated that APR1400 conforms with the requirements in BL 88-08 for all piping connected to the RCS and that data available from the reference plant have been evaluated and incorporated into the design of the APR1400.

The applicant is requested to provide the following additional information to support the staff's finding related to this provision in SRP Section 3.12 and the requirement in 10 CFR 52.47(a)(22). To the extent that the response addresses programmatic or operational activities that are outside the scope of design certification, the applicant should describe these and include in the DCD a provision for COL applicants to describe these activities.

1. Identify all piping connected to the RCS susceptible to TASCS and discuss the methodology followed for evaluating the effects of TASCS.
2. Discuss features in the design that provide assurance against thermal stratification and thermal oscillation.
3. Discuss whether a program has been established to monitor temperature distributions in affected piping and establish appropriate temperature limits.
4. Discuss means to monitor pressure differentials that may lead to valve leakage.
5. Identify the "reference plant" mentioned in DCD Tier 2, Section 3.12.5.9 and discuss its similarities to the APR1400.
6. Discuss the data collected from the reference plant and the methodology followed in using these data for the evaluation of TASCS in the APR1400 design.

03.12-16

According to SRP Sections 3.12 and 3.9.3, appropriate loads and load combinations should be included in the evaluation of pipe supports. The loading category termed "Dynamic system loadings" included in the loading columns of DCD Tier 2, Tables 3.9-10 and 3.12-1 and 3.12-2 is explained in the notes of these tables as "Dynamic system loadings associated with the emergency condition." Additional information is needed by the staff to understand the definition of this loading category and determine whether the loading conditions for pipe supports is consistent with the relevant SRP guidance. The applicant is requested to:

1. Identify the loads in category termed "Dynamic system loads"
2. Describe how loads caused by design basis pipe breaks and LOCAs are included in the loads presented in DCD Tier 2, Table 3.9-10, Table 3.12-2 and other related tables or DCD descriptions
3. Revise DCD Tier 2, Section 3.12.6.3 to clarify the how the loading combinations for piping supports are addressed. DCD Tier 2, Section 3.12.6.3 states that loading combinations for piping supports are shown in DCD Section 3.12.5.3. The load combinations discussed in DCD Section 3.12.5.3 are discussed in the context of the pipe stress evaluation and not for pipe support design.

The content of this question also relates to RAI 8360, Question 28501 on Section 3.9.3, so the responses to these questions should be coordinated.

03.12-17

According to SRP Section 3.12, Subsection II.D.xi, pipe support gaps should account for the diametrical expansion of the pipe due to pressure and temperature.

DCD Tier 2, Section 3.12.6.11, "Pipe Support Gaps and Clearances," states that the normal design practice for the APR1400 is to use a nominal cold condition gap of 1.6 mm (1/16 inch) on each side of the pipe in the restrained direction and that these small gaps allow radial thermal expansion of the pipe as well as allow rotation of the pipe at the support.

The applicant is requested to discuss how the specified pipe support gap will be checked against the maximum combined radial growth of the pipe due to temperature and pressure to assure that adequate clearance exist to avoid any thermal binding. To the extent that the response addresses programmatic or operational activities that are outside the scope of design certification, the applicant is requested to describe these and include in the DCD a provision for COL applicants to describe these activities.


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