REVISED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:	**334-8373**
SRP Section:	**03.12 - ASME Code Class 1, 2, and 3 Piping Systems and Piping Components and Their Associated Supports**
Application Section:	**3.12**
Date of RAI Issue:	**12/14/2015**

Question No. 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.

Response – (Rev. 2)

1. SRP 3.9.3 defines the design basis pipe break (DBPB) as those postulated pipe breaks other than a LOCA or MS/FWPB and the DBPB is identified as an emergency condition. This includes postulated pipe breaks in Class 1, 2 and 3 branch lines that

result in the loss of reactor coolant at a rate less than or equal to the capability of the reactor coolant makeup system.

For the APR1400 DC, make-up flow can compensate for the loss of coolant from a break with a 5.56 mm (7/32 in.) internal diameter as described in Subsection 9.3.4. In accordance with the guidance in SRP 3.6.2, postulated breaks in one-inch nominal diameter piping and smaller piping do not require the analysis of the dynamic system loading from a ruptured pipe on components, component supports or core support structures. The DBPB condition also results in RCS temperature and pressure transient conditions and is thus conservatively included as a Level B service condition in the RCS design transients given in Table 3.9-1. Therefore, Level C service loadings including dynamic system loads are not used in any APR1400 analyses.

Postulated breaks in lines larger than 25.4 mm (1 in.) nominal diameter are considered in the pipe break analysis as described in Subsection 3.6.2, and are included in the scope of the branch line pipe break (BLPB), which are treated as a Level D condition. The BLPB scope includes those postulated pipe breaks in lines connected to the RCS that are not eliminated by LBB and that result in the loss of the reactor coolant at a rate in excess of the capability of the reactor coolant makeup system, up to and including a break equivalent in size to the double-ended rupture of the largest pipe of the RCS except those eliminated by LBB. The BLPB scope also includes main steam and main feedwater pipe breaks (MS/FWPB).

Based on the above, the DCD Tier 2 will be revised to delete Service Level C loads including the dynamic system loads.

2. As mentioned above, the loads due to DBPB are not considered in load combinations because the loads are not required in the analysis of dynamic system loads in accordance with SRP 3.6.2. Loads caused by LOCAs except for DBPBs from all potential BLPB conditions are included only in the Service Level D load combination, and are indicated as pipe break loads in Tables 3.9-10, 3.12-2 and other related tables or DCD description. The statement “pipe break loads include loads due to LOCA” will be added as a note in the associated tables.

3. Loading conditions and load combinations for piping supports are defined in Table 3.9-10. Load combinations for piping support design used for Service Levels A, B, C and D always include piping reaction loads calculated for load combinations given in Table 3.12-1 and Table 3.12-2. DCD Tier 2 Subsection 3.12.6.3 will be revised to clarify the loading combinations for piping supports.

   The dead weight of the support itself for Service Levels A, B, C and D, friction loads (Subsection 3.12.6.10) for Service Levels A, B, C and D, Seismic self-weight excitations (Subsection 3.12.6.8) for Service Level D are considered in addition to piping reaction loads.

   Friction forces occurring from the movement of piping due to thermal expansion will be considered with sum of deadweight and applicable signed loads in Service Level A, B, C and D. However, friction force does not need to be considered for cyclic loads, such

as those from an earthquake or other reversing dynamic loads. DCD Tier 2 Subsection 3.12.6.10 and Table 3.9-10 will be revised as indicated in the attachment.

Impact on DCD

DCD Tier 2, Subsections 3.9.3.1, 3.9.4.3, 3.9.5.2, and 3.9.5.2.4, Tables 3.9-2, 3.9-6, 3.9-7, 3.9-10 through 12, 3.12-1, and 3.12-2 will be revised in response to RAI 319-8360 Question 03.09.03-2.

DCD Tier 2, Subsection 3.12.6.3, 3.12.6.10, and Table 3.9-10 will be revised as indicated in the attachment.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.

Standard component supports are designed, manufactured, installed, and tested pursuant to Subsection NF of ASME Section III.

For non-seismic category pipe supports supporting piping analyzed to ASME B31.1, the requirements of ASME B31.1 for supports (Sections 120 and 121) are met, where applicable. In addition, the structural elements are designed using guidance from the AISC 360-05 (Reference 14).

In addition to the pipe support design codes mentioned above, expansion anchors and other steel embedments in concrete are designed in accordance with Subsection 3.12.6.4.

3.12.6.2 Jurisdictional Boundaries

The jurisdictional boundary between the pipe and its support structure follows the guidance of NB-1132, NC-1132, or ND-1132, as appropriate for the ASME Section III Class of piping involved.

The jurisdictional boundary between the pipe support and the building structure follows the guidance of ASME Section III, NF-1130. In general, for attachments to building steel, the boundary is taken at the interface with the building steel, with the weld being designed to the rules of NF. For attachments to concrete building structures, the boundary is generally at the weld of the support member to a baseplate or embedded plate, with the weld again being designed to the rules of NF.

3.12.6.3 Loads and Load Combinations

Loading conditions and load combinations for piping supports are defined in Table 3.9-10. Load combinations for piping support design used for Service Levels A, B, C, and D include piping reaction loads calculated for load combinations given in Table 3.12-1 and Table 3.12-2.The ~~dead weight~~ of the support itself for Service Levels A, B, C, and D, friction loads (Subsection 3.12.6.10) for Service ~~Level A~~, seismic self-weight excitations (Subsection 3.12.6.8) for Service Level D are considered in addition to piping reaction loads.

deadweight

Levels A, B, C, and D

The stress limits for pipe support designs meet the criteria of ASME Section III, Subsection NF.

Each support modeled as rigid is checked with the deflection in the restrained directions to a maximum of 1.6 mm (1/16 in.) for SSE loadings, and a maximum of 3.2 mm (1/8 in.) for other loadings.

3.12.6.8 Seismic Self-Weight Excitation

The excitation of the support structure to SSE loadings is to be included in the pipe support analysis. Damping values for welded and bolted structures are given in Revision 1 to NRC RG 1.61 (Reference 7). This support self-weight SSE response and the piping inertial load SSE response are to be combined by absolute summation.

3.12.6.9 Design of Supplementary Steel

This subsection provides design information on any supplementary steel required to connect the main support structure to the building structure.

As addressed in Subsection 3.12.6.1, all seismic Category I pipe supports for the APR1400 are designed to ASME Section III, NF. For non-seismic pipe supports, AISC 360-05 (Reference 14) is used for the supplementary steel, as it is for the main support structure.

3.12.6.10 Consideration of Friction Forces

Deleted

Friction forces are developed in the pipe support when a pipe slides across the surface of a support member in the unrestrained directions under thermal expansion conditions. Because friction is due to the ~~gradual~~ movement of the pipe, loads from friction are ~~only~~ calculated using the deadweight and ~~thermal~~ loads normal to the applicable support member.

applicable signed

Specifically, the friction forces need to be calculated only if the thermal movement in the applicable unrestrained directions is greater than 1.6 mm (1/16 in.). The coefficient of friction is taken as 0.3 for steel-to-steel conditions and 0.1 for low-friction slide/bearing plates.

3.12.6.11 Pipe Support Gaps and Clearances

For guide type pipe supports modeled as rigid restraints in the piping analysis, the typical industry design practice is to provide small gaps between the pipe and its surrounding structural members. These small gaps allow radial thermal expansion of the pipe as well as allow rotation of the pipe at the support. The normal design practice for the APR1400 is to use a nominal cold condition gap of 1.6 mm (1/16 in.) on each side of the pipe in the

Table 3.9-10

Loading Conditions and Load Combinations Requirements for ASME Section III Class 1, 2, and 3 Piping Supports

Service Level	Loading Combination
Level A	Weight Thermal(1) ~~Friction~~
Level B	Weight Thermal(1) IRWST discharge loads (3) Dynamic fluid loads(2)
Level C	No loads (Refer to Subsection 3.9.3.1)
Level D	Weight Thermal(1) IRWST discharge loads (3) Dynamic fluid loads(2) SSE inertia SSE seismic movements Pipe break loads(4)

Friction(5)

(1) Thermal conditions (including ambient temperature) to be combined to provide maximum load combinations.

(2) Dynamic fluid loads due to safety/relief valve thrust, steam hammer, and water hammer.

(3) In-containment refueling water storage tank discharge loads.

(4) Pipe break loads include loads due to LOCA.

Add (5) Friction forces included are from the movement of piping due to thermal expansion with sum of deadweight and applicable signed loads.