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.:	**224-8267**
SRP Section:	**03.06.02 – Determination of Rupture Locations and Dynamic Effects Associated with the Postulated Rupture of Piping**
Application Section:	**3.6.2**
Date of RAI Issued:	**09/23/2015**

Question No. 03.06.02-4

In a letter dated July 17, 2015 (ADAMS Accession No. ML15198A561), the applicant provided its responses to the staff's question (MEB 3.6.2 Issue 9) regarding the criteria used for determining the crack locations for non-seismically analyzed ASME B31.1 piping. The staff requests additional information related to two aspects of this response:

a. The applicant stated that through-wall cracks for non-seismically designed ASME B31.1 piping are assumed at the locations that result in severe environmental conditions. The statement of "severe environmental conditions" is not clear and should be clarified.

b. The staff noted that as a part of its response to a staff question (MEB Section 3.6.2 Issue 10) related to postulated leakage cracks configurations, the applicant provided a planned markup of DCD Tier 2, Subsection 3.6.2.1.4.2 which states that for high energy and moderate-energy piping, through-wall cracks are postulated to be in those axial and circumferential locations that result in the most severe environmental consequences. It is not clear whether the criteria as described in the planned DCD Tier 2, Subsection 3.6.2.1.4.2 markup are also applicable to non-seismically designed ASME B31.1 piping. The applicant should clarify whether the criteria described in the planned DCD Tier 2, Subsection 3.6.2.1.4.2 markup are also applicable to non-seismically designed ASME B31.1 piping, with adjustment to the relevant DCD Tier 2 Subsection as appropriate.

Response

a. In the discussion noted, severe environmental conditions pertain to instances when evaluating the environmental conditions in an area where both non-seismic and seismic piping exists. If the estimated mass and energy of the discharged flow from a through-wall crack of non-seismically analyzed ASME B31.1 piping is expected to result

in the most severe environmental conditions (i.e., pressure, temperature, or humidity), then a through-wall crack in that piping, regardless of the stress value of the piping, is assumed in the analysis of environmental conditions.

b. The criteria described in the planned DCD Tier 2, Subsection 3.6.2.1.4.2 markup submitted in response to MEB Section 3.6.2 Issue 10 is also applicable to non-seismically analyzed ASME B31.1 piping. Thus, DCD Tier 2, Subsection 3.6.2.1.4.2 will be revised to incorporate non-seismically analyzed ASME B31.1 piping.

Impact on DCD

DCD Tier 2, Subsection 3.6.2.1.4.2 will be revised as indicated in the attached markup.

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 Reports.

b. Crack configurations

Through-wall cracks are postulated at those axial locations specified in Subsection 3.6.2.1.4.1.2.

high and moderate-energy piping including non-seismically analyzed ASME B31.1 piping

For ~~high-energy piping~~, through-wall cracks are postulated to be in those circumferential locations that result in the most severe environmental consequences. The flow from the crack is assumed to wet all unprotected components within the compartment with consequent flooding in the compartment and communicating compartments.

axial and

Fluid flow from a leakage crack is based on a circular orifice with a cross-sectional area equal to that of a rectangle of one-half the pipe inside diameter in length and one-half the pipe wall thickness in width.

3.6.2.1.5 Details of Containment Penetrations

Details of containment penetrations are described in Subsections 3.8.1 and 3.8.2.

3.6.2.2 Guard Pipe Assembly Design Criteria

Guard pipes are not used in all containment penetrations of high-energy piping.

3.6.2.3 Analytical Methods to Define Forcing Functions and Response Models

3.6.2.3.1 Leak-Before-Break Applied Piping

There are no forcing functions or response models for the piping qualified for LBB.

3.6.2.3.2 Analytical Methods to Define Forcing Functions and Response Models for Piping Not Applied to Leak-Before-Break

This subsection applies to all high-energy piping other than that whose dynamic effects due to pipe breaks are eliminated from the design basis by LBB evaluation.

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Question No. 03.06.02-5

In a letter dated August 4, 2015 (ADAMS Accession No. ML15216A451), the applicant provided its responses to the staff's question (MEB 3.6.2 Issue 5) concerning the APR1400 design criteria for the structure which separates a high-energy line from an essential component. The applicant stated in its response that its design of the separation structure is in accordance with BTP 3-4 and included a planned DCD Tier 2, Subsection 3.6.1.2.1.2 markup. The planned DCD markup states that structures separating a high-energy line from an essential component are designed to withstand the consequences of a pipe break which include effects of pipe whip, jet impingement and sub-compartment pressurization.

The planned DCD markup as described above is not consistent with the staff guideline for as delineated in BTP 3-4, Part B, Item A(iii)(4). It should be noted that the staff guideline for the design of the separating structure is to withstand the consequences of the pipe break in the high-energy line that produces the greatest effect at the structure, rather than withstanding the consequences of "a" pipe break as described in the planned DCD markup. Therefore, the applicant should clarify whether its design criteria for the separation structure are consistent with the staff guideline as delineated in BTP 3-4, Part B, Item A(iii)(4) such that the separating structure is designed to withstand the consequences of the pipe break in the high-energy line that produces the greatest effect at the structure, irrespective of the fact that the criteria identified in DCD Tier 2, Subsection 3.6.2.1.4.1.1 might not need such a break location to be postulated.

Response

The planned DCD Tier 2, Subsection 3.6.1.2.1.2 markup submitted in response to MEB Section 3.6.2 Issue 5 will be replaced to clearly state that the structures separating a high-energy line from an essential component are designed to withstand the consequences of a pipe break in the high-energy line that produces the greatest effect at the structure. DCD Tier 2, Subsection 3.6.1.2.1.2 will be revised to be consistent with the staff guideline as delineated in BTP 3-4,

Part B, Item A(iii)(4).

Impact on DCD

DCD Tier 2, Subsection 3.6.1.2.1.2 will be revised as indicated in the attached markup.

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 Reports.

3.6.1.2.1.2 Barriers and Shields

Protection requirements are met through the protection afforded by the walls, floors, and columns in many cases. Where adequate protection does not exist due to separation, additional barriers, deflectors, or shields are provided as necessary to meet the functional protection requirements. Where compartments, barriers, and structures are required to provide the necessary protection, they are designed to withstand the effects of the postulated failure concurrent with an earthquake event.

Structures separating a high-energy line from an essential component are designed to withstand the consequences of pipe break in high-energy line that produces the greatest effect at the structure.

3.6.1.2.1.3 Piping Restraints

Where adequate protection does not exist due to separation, barriers, or shields, piping restraints are provided as necessary to meet the functional protection requirements. Restraints are not provided when it can be shown that the postulated pipe breaks would not cause unacceptable damage to essential systems or components.

The design criteria for pipe whip restraints are given in Subsection 3.6.2.4.

3.6.1.2.2 Specific Protection Consideration

The design criteria define acceptable types of isolation for safety-related elements and for high-energy lines from similar elements of the redundant train. Separation is accomplished by:

a. Routing the redundant trains through separate compartments

b. Physically separating the redundant trains by a specified minimum distance

c. Separating the redundant trains by structural barriers

The design criteria provide reasonable assurance that a postulated failure of a high-energy line or a safety-related element cannot take more than one safety-related train out of service. The failure of a component or subsystem of one train may cause failure of another portion of the same train; for example, a Division II high-energy pipe may cause failure of a Division II component electrical tray but not failure of any Division I component. The