# REVISED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

**APR1400 Design Certification**

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

**Docket No. 52-046**

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| **RAI No.:** | **166-8198** |
| **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:** | **08/20/2015** |

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## Question No. 03.06.02-3

In a public meeting on June 30, 2015, the NRC staff requested (MEB Section 3.6.2 Issue #1) the applicant to clarify the design requirements for the high-energy piping in the break exclusion area defined in DCD Tier 2, Subsection 3.6.2.1.4.3.1. The applicant was also requested to justify the departure, if any, from the staff's guideline as described in Branch Technical Position (BTP) 3-4, Part B, Subsection A(ii). In addition, the NRC staff requested (MEB Section 3.6.2 Issue #2) the applicant to clarify the inconsistencies in the criteria used for determining the break exclusion area (DCD Tier 2, Subsection 3.6.1.4.3.1) and crack exclusion area for high-energy and moderate-energy piping (DCD Tier 2, Subsection 3.6.1.4.3.2) and to justify the departure, if any, from the staff's guideline as described in BTP 3-4, Part B, Item A(ii). In a letter dated August 4, 2015 (ADAMS Accession No. ML15216A451), the applicant provided its responses to these two issues including a markup of DCD Subsection 3.6.2.1.4.1.3.1. The DCD markup includes a list of portions of system piping for which the break exclusion area expands to the auxiliary building anchor wall beyond the isolation valve.

Based on its review of the information provided by the applicant, the staff determined that the DCD Tier 2, Section 3.6.2.1.4.1.3.1, as revised in the markup, primarily addresses the applicant's design requirements for system piping within the break exclusion area. It should be noted that the staff's guideline as delineated in BTP 3-4 is intended to present a means of compliance with the requirements of 10 CFR Part 50, Appendix A, General Design Criteria (GDC) 4 for the design of nuclear power plant structures, systems and components. This approach uses available piping design information to postulate pipe ruptures at locations having relatively higher potential for failure, such that an adequate level of protection may be achieved. Subject to certain design provisions as described in BTP 3-4, Part B, Item A (ii), the staff's guideline allows breaks and cracks associated with high-energy fluid systems piping in containment penetration areas to be excluded from the design basis because of the high consequence that breaks in this area could cause if they occurred. To support the staff's safety determination on the acceptability of expanding the break exclusion area to the auxiliary building anchor wall beyond the isolation valve, the applicant should provide additional information to justify the departure from the staff's guideline as described in BTP 3-4, Part B, Subsection A(ii). Specifically, the applicant should describe how the DCD break exclusion area design requirements are considered and applied to the results of the design of these listed portions of system piping. The information should include the following information related to the additional design provisions for the break exclusion area in BTP 3-4:

a) A summary of pressure and temperature conditions during normal plant conditions (either in operation or maintained pressurized) including their respective operational period, supporting the applicant's categorization of these portions of system piping as high or moderate energy.

b) A figure for the general geometric configuration including the approximate length and any bends in the piping for those portions of system piping in the break exclusion area. The figure should include the inboard isolation valve, outboard isolation valve, and Main Steam Valve House (MSVH) anchor wall and the respective system piping for which breaks are not to be postulated.

c) Based on the figure presented in item (b) above, a discussion of how piping bends, circumferential and longitudinal welds, and overall length were minimized to reduce piping stress and the size of the break exclusion area.

d) A description of access provisions made to permit inservice volumetric examination (as delineated in Item f of DCD Subsection 3.6.2.1.4.1.3.1) of welds described in item (c) above.

e) A discussion on whether the break exclusion only applies to the pertinent main piping (i.e., breaks are postulated for its associated branch piping, if any). If branch piping is included in the break exclusion area, then items (a) through (d) above should be addressed for these piping segments as well.

f) A description of essential systems within the break exclusion area. DCD Subsection 3.6.2.1.4.1.3.1 states that essential equipment is not "concentrated" in the break exclusion zone. This statement is not clear and should be clarified.

## Response – (Rev. 1)

a) Piping conditions of those portions of pipes in the break exclusion area are summarized in the following table, Table 1.

Table 1. Summary of piping conditions in break exclusion area TS

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b) The attachment 1 shows the isometric figures of the portions of piping that are designed using the graded approach in the break exclusion area. This piping for the MS and FW systems are located in the MSVH, rooms 137A31C and 137A31D. The provided figures show the detailed information requested pertaining to the geometric configuration; including, piping lengths, bends, inboard and outboard isolation valves, and MSVH anchors.

c) When routing the piping, piping bends, circumferential welds, and overall length are minimized to reduce piping stress and the size of the break exclusion area to the extent possible. Longitudinal welds are not used for any piping in the break exclusion area. As a result of the piping stress analyses that are performed, opportunities to reduce piping stresses were reviewed. Such was the case for the MS piping line no., 9-521-MS121-AA, which was designed with a loop configuration to lower the stress impact due to thermal expansion. The attachment 2 shows the stresses calculated by the sum of Eq. (9) and (10) in paragraph NC-3653 with comparison to 0.8(1.8Sh+Sa) for piping systems (MS271, MS272, FW209 and FW219) analyzed in the graded approach. The attachment 3 shows the piping system figures which node and segment information could be obtained.

d) As part of the generic design effort, KHNP ensures that there is sufficient accessibility to the pipe welds and for the installation of access provisions based on the APR1400 reference plant. The COL applicant is to design the access platform to perform inservice volumetric examination of the welds described in item (c) above.

e) Branch piping is included in the break exclusion area. MS and FW piping includes branch lines in the MSVH which are designed and analyzed in the graded approach to meet the break exclusion requirements. These piping segments are identified in the attached piping isometrics. SD system piping in Table 1 is designed with same approach used for MS and FW piping by COL applicant. And other high-energy piping in Table 1 is designed by COL applicant in accordance with ASME code piping design criteria.

f) Essential systems important to safety in the break exclusion area are MS, FW and SD. A limited number of essential components are in the MSVH or break exclusion zone and include the isolation valves in the piping systems, the main steam atmospheric dump valves, and the MSSVs. Other safety related equipment is installed outside the MSVH to avoid the concentration of components important to safety within the break exclusion zone.

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**Impact on DCD**

There is no impact on the DCD.

**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.

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Figure 1 High-Energy Line for Feedwater System in MSVH (209-01)

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Figure 2 High-Energy Line for Feedwater System in MSVH (219-01)

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Figure 3 High-Energy Line for Feedwater System in MSVH (219-02)

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Figure 4 High-Energy Line for Main Steam System in MSVH (271-01)

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Figure 5 High-Energy Line for Main Steam System in MSVH (271-02)

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Figure 6 High-Energy Line for Main Steam System in MSVH (271-03)

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Figure 7 High-Energy Line for Main Steam System in MSVH (271-04)

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Figure 8 High-Energy Line for Main Steam System in MSVH (271-05)

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Figure 9 High-Energy Line for Main Steam System in MSVH (271-06)

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Figure 10 High-Energy Line for Main Steam System in MSVH (271-07)

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Figure 11 High-Energy Line for Main Steam System in MSVH (271-08)

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Figure 12 High-Energy Line for Main Steam System in MSVH (271-09)

Non-Proprietary



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Figure 13 High-Energy Line for Main Steam System in MSVH (271-10)

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Figure 14 High-Energy Line for Main Steam System in MSVH (271-11)

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Figure 15 High-Energy Line for Main Steam System in MSVH (272-01)

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Figure 16 High-Energy Line for Main Steam System in MSVH (272-02)

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Figure 17 High-Energy Line for Main Steam System in MSVH (272-03)

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Figure 18 High-Energy Line for Main Steam System in MSVH (272-04)

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Figure 19 High-Energy Line for Main Steam System in MSVH (272-05)

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Figure 20 High-Energy Line for Main Steam System in MSVH (272-06)

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Figure 21 High-Energy Line for Main Steam System in MSVH (272-07)

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Figure 22 High-Energy Line for Main Steam System in MSVH (272-08)

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Figure 23 High-Energy Line for Main Steam System in MSVH (272-09)

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Figure 24 High-Energy Line for Main Steam System in MSVH (272-10)

Non-Proprietary



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Figure 25 High-Energy Line for Main Steam System in MSVH (272-11)

Table 1. High Energy Line Stress Check for FW209(1/2)

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Table 1. High Energy Line Stress Check for FW209(2/2)

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Table 1. High Energy Line Stress Check for FW219(1/4)

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Table 1. High Energy Line Stress Check for FW219(2/4)

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Table 1. High Energy Line Stress Check for FW219(3/4)

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Table 1. High Energy Line Stress Check for FW219(4/4)

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Table 1. High Energy Line Stress Check for MS271(1/5)

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Table 1. High Energy Line Stress Check for MS271(2/5)

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Table 1. High Energy Line Stress Check for MS271(3/5)

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Table 1. High Energy Line Stress Check for MS271(4/5)

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Table 1. High Energy Line Stress Check for MS271(5/5)

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Table 1. High Energy Line Stress Check for MS272(1/4)

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Table 1. High Energy Line Stress Check for MS272(2/4)

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Table 1. High Energy Line Stress Check for MS272(3/4)

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Table 1. High Energy Line Stress Check for MS272(4/4)

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Figure 1 Piping Subsystem Drawing for FW209

**Non-Proprietary**



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Figure 2 Piping Subsystem Drawing for FW219

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Figure 3 Piping Subsystem Drawing for MS271

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Figure 4 Piping Subsystem Drawing for MS272