# SUPPLEMENTAL 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.:** | **385-8465** |
| **SRP Section:** | **06.02.01.04 - Mass and Energy Release Analysis for Postulated Secondary System Pipe Ruptures** |
| **Application Section:** | **6.2.1.4 - Mass and Energy Release Analysis for Postulated Secondary System Pipe Rupture Inside Containment** |
| **Date of RAI Issue:** | **02/01/2016** |

## Question No. 06.02.01.04-7

The SGN-III computer code is used for the secondary system pipe break analysis. However, the DCD or TeR do not comment on the acceptability of the SGN-III code for this application, which needs to be established. The applicant should document whether the SGN-III computer codes has been validated against pertinent experimental data. The applicant is also suggested to update the title of the KHNP Technical Report APR1400-Z-A-NR-14007-P/NP, i.e., "LOCA Mass and Energy Release Methodology," as it also covers the mass and energy release methodology for both LOCA and secondary pipe ruptures, e.g., MSLBs.

## Response

The KHNP Technical Report APR1400-Z-A-NR-14007-P/NP, "LOCA Mass and Energy Release Methodology," will be updated to cover the mass and energy release methodology for both LOCA and MSLB.

The SGN-III computer codes validated against pertinent experimental data are documented in CESSAR, Appendix 6B.

An important factor in the MSLB analysis is the initial rate of level swell following the break and whether or not the swell is sufficient for the two-phase level to reach the steam generator nozzles. Once the level reaches the nozzles, the two-phase blowdown is so rapid that the increasing specific volume of the steam due to depressurization is sufficient to keep the two-phase level at the nozzle for most of the transient.

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The initial conditions and comparison results for the each experiment are described as follows:

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Table 1 Geometric data from KDL experiments

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Table 2 Comparison of experimental and SGN-III results

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Table 3 Data used in SGN-III for Battelle Test 53B simulation

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Table 4 Data used in SGN-III for General Electric experiments

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Table 5 Data used in SGN-III for Vallecitos experiments

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Figure 1 Two-phase transient level for Battelle Test 53B and SGN-III

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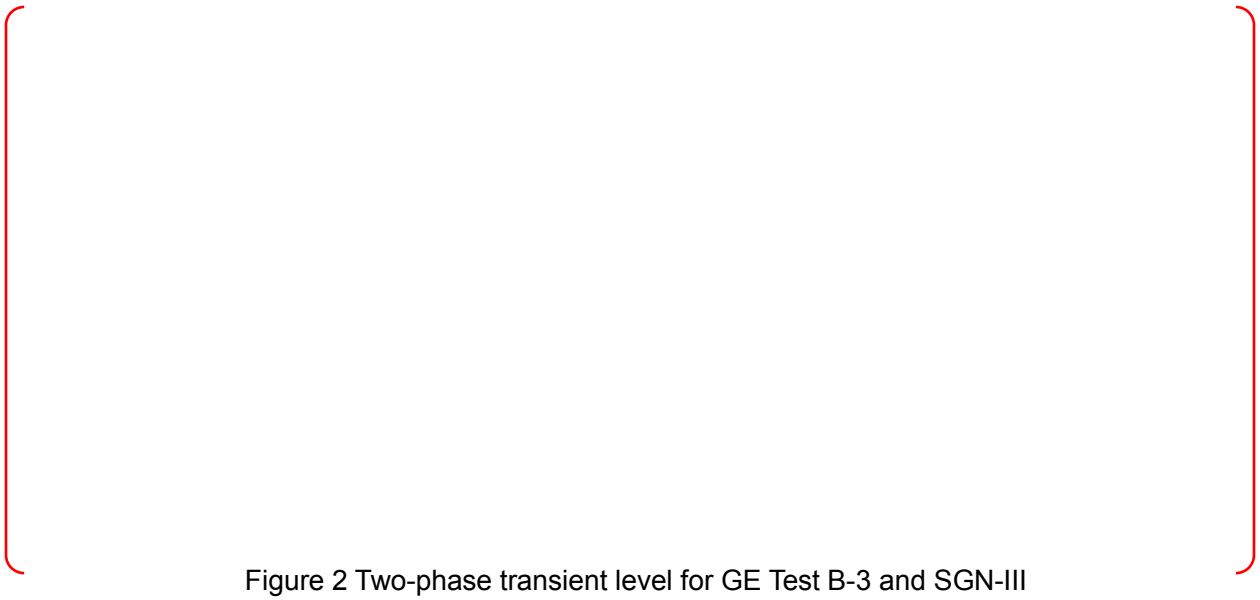

Figure 2 Two-phase transient level for GE Test B-3 and SGN-III

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Figure 3 Two-phase transient level for Vallecitos Test and SGN-III

## Supplemental Question (July 7, 2016 Public Teleconference)

The response states that the KHNP Technical Report APR1400-Z-A-NR-14007-P/NP, "LOCA Mass and Energy Release Methodology", will be updated to cover the mass and energy release methodology for both LOCA and MSLB. However, no mark-ups are submitted for the staff to review and no description is given on what will be updated in the TeR.

Secondly, the SGN-III computer code is used by KHNP for the APR1400 secondary system pipe break analysis. The response of RAI 8465, Question 06.02.01.04-7 does not comment on the acceptability of the SGN-III code for this application, which needs to be established. The staff needs to know the references about the acceptability of the methodology and the SGN-III computer code through prior NRC approval for main steam line break analysis? Is the use of the SGN-III code plant specific?

## Supplemental Response (July 7, 2016 Public Teleconference)

KHNP Technical Report APR1400-Z-A-NR-14007-P/NP, "LOCA and MSLB Mass and Energy Release Methodology," will be updated as indicated in the Attachment, including a title revision, to discuss the mass and energy release methodology for both LOCA and MSLB.

The use of SGN-III code is plant-specific for CE-type nuclear power plants including the APR1400 and OPR1000. The acceptability of the SGN-III code for this application is explained and documented in reference material “SYS80-CESSAR, Appendix 6B.” In this reference, the SGN-III computer code received NRC approval for analyzing the MSLB accident.

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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**

KHNP Technical Report APR1400-Z-A-NR-14007-P/NP, "LOCA Mass and Energy Release Methodology," will be updated to cover the mass and energy release methodology for both LOCA and MSLB as indicated in the Attachment.

This mark-up page will be newly inserted in the full revision of TeR "APR1400-Z-A-NR-14007-NP, Rev.01"

Symbols:

M = feedwater mass, lbm

V = volume of feedwater downstream of MFIV, $ft^3$

$P_{SG}$ = pressure of affected SG, psia

T = feedwater temperature, °F

h = specific enthalpy, Btu/lbm

v = specific volume, $ft^3$/lbm

s = specific entropy, Btu/lbm-$^oF$

$\dot{m}$ = feedwater flow rate from isentropic expansion, lbm/sec

$\dot{m}$ h = feedwater enthalpy rate from isentropic expansion, Btu/sec

t = time, seconds

Δt = time step, seconds

Subscripts:

l = subcooled liquid

f = saturated liquid

g = saturated steam

o = initial

The feedwater flow from isentropic expansion is added to the pumped feedwater flow. The pumped feedwater flow is conservatively assumed to be a constant 330% (220% for 50% power case and 110% for 20% and 0% power cases) of the full power feedwater flow until the MFIVs close.

Also up to 30 minutes before auxiliary feedwater isolation to the affected steam generator following the MSLB, a constant 950 gpm (3596 lpm) auxiliary flow to the affected steam generator is assumed and included in Table 4-7.

### 3.2.10 SGNIII code verification and validation

An important factor in the MSLB analysis is the initial rate of level swell following the break and whether or not the swell is sufficient for the two-phase level to reach the steam generator nozzles. Once the level reaches the nozzles, the two-phase blowdown is so rapid that the increasing specific volume of the steam due to depressurization is sufficient to keep the two-phase level at the nozzle for most of the transient.

This part is the description associated with RAI response 385-8465-Q.6.2.1.4-7.

This mark-up page will be newly inserted in the full revision of TeR "APR1400-Z-A-NR-14007-NP, Rev.01"

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The initial conditions and comparison results for the each experiment are described as follows:

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The use of SGNIII code is plant-specific for CE-type nuclear power plants including the APR1400 and OPR1000. The acceptability of the SGNIII code for this application is explained and documented in Reference 8. In this reference, the SGNIII computer code received NRC approval for analyzing the MSLB accident.

This part is the description associated with RAI response 385-8465-Q.6.2.1.4-7.

This mark-up page will be newly inserted in the full revision of TeR "APR1400-Z-A-NR-14007-NP, Rev.01"

Table 3-5 Geometric data from KDL experiments

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Table 3-6 Comparison of experimental and SGNIII results

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This part is the description associated with RAI response 385-8465-Q.6.2.1.4-7.

This mark-up page will be newly inserted in the full revision of TeR "APR1400-Z-A-NR-14007-NP, Rev.01"

Table 3-7 Data used in SGNIII for Battelle Test 53B simulation

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Table 3-8 Data used in SGNIII for General Electric experiments

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This part is the description associated with RAI response 385-8465-Q.6.2.1.4-7.

This mark-up page will be newly inserted in the full revision of TeR "APR1400-Z-A-NR-14007-NP, Rev.01"

Table 3-9 Data used in SGNIII for Vallecitos experiments

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This part is the description associated with RAI response 385-8465-Q.6.2.1.4-7.