# RESPONSE TO AUDIT ISSUES

**APR1400 Topical Reports**

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

**Docket No. PROJ0782**

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|---|---|
| **Review Section** | **TR Realistic Evaluation Methodology for LBLOCA of the APR1400** |
| **Application Section** | **Topical Report: APR1400-F-A-TR-12004 Realistic Evaluation Methodology for Large-Break LOCA of the APR1400** |
| **Issue Date** | **08/13/2015** |

## Audit Issues No. 27-k

NUREG/CR-5429, Section 2.2.2 discusses issues related to model nodalization. Address the following issues regarding nodalization of the APR1400:

k. In order to adequately simulate the depletion time of the pressurizer and liquid drainage during the blowdown period, the nodalization of the pressurizer surge line should be consistent with the actual plant geometry. However, the description for the pressurizer surge line nodalization is not provided in Section 4.2.1 of the topical report. According to the RELAP5 base model input deck, the surge line is modeled using a single inclined hydraulic component. Additionally, the loss coefficient through surge line pipe is set to be computed by the code which neglects the turns and orientation changes in the line. Justify the selected nodalization and loss coefficients including any references to nodalization sensitivity studies comparing the pressurizer flow into upper plenum against the available special effects tests and/or integral effects tests data.

## Response

1) Nodalization of surge line

The surge line of pressurizer is modeled as a SNGLVOL component as show in Figure 1 and the detailed information of surge line are as follows.

[

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In order to predict the depletion of pressurizer, the pressurizer and surge line are modeled as PIPE component with [ ]TS and SNGLVOL component respectively to reflect the assessment result against LOFT test. Figure 2 shows the pressurizer level. It is confirmed that the calculation result using this nodalization is adequately predicted comparing to the result of LOFT test. Based on the result, the nodalization of pressurizer and surge line mentioned above is used in the plant calculation.

2) Loss coefficient of surge line

The pressurizer surge line is modeled by SNGLVOL component and the geometric loss coefficient including the effect of elbows, entrance/exit nozzles and others (flow screen, thermal sleeve, etc) for the insurge/outsurge flow is used at the branch region (310 component) which connecting hot leg and surge line pipes. The loss coefficient of surge line is as follows:

nominal max min

[

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The nominal values are applied for surge line K-factor above. It may need to confirm the sensitivity study for conservativeness. The sensitivity study results of loss coefficient are shown in Table 1. The depletion time of the pressurizer is almost same in accordance with change of loss coefficient. Based on this result, the effect of loss coefficient of surge line is not significant.

3) Nodalization sensitivity

The drawings of pressurizer surge line for APR1400 are illustrated in Figure 3. The surge line

piping is composed of [
]TS Figure 4 shows the nodalization of surge line used in CAREM and the new nodalization consistent with actual plant geometry. In case of the new pressurizer surge line modeling reflecting the actual plant geometry, the surge line is modeled by PIPE component with [
]TS The results of nodalization sensitivity show no significant difference in the hydrodynamic behavior as shown in Figure 5 to Figure 8.

Table 1. Depletion Time of the Pressurizer

| | Nominal | Max | Min |
|---|---|---|---|
| Empty Time (sec) | 25.0 | 25.6 | 24.8 |


Figure 1. Nodalization of Pressurizer Surge Line

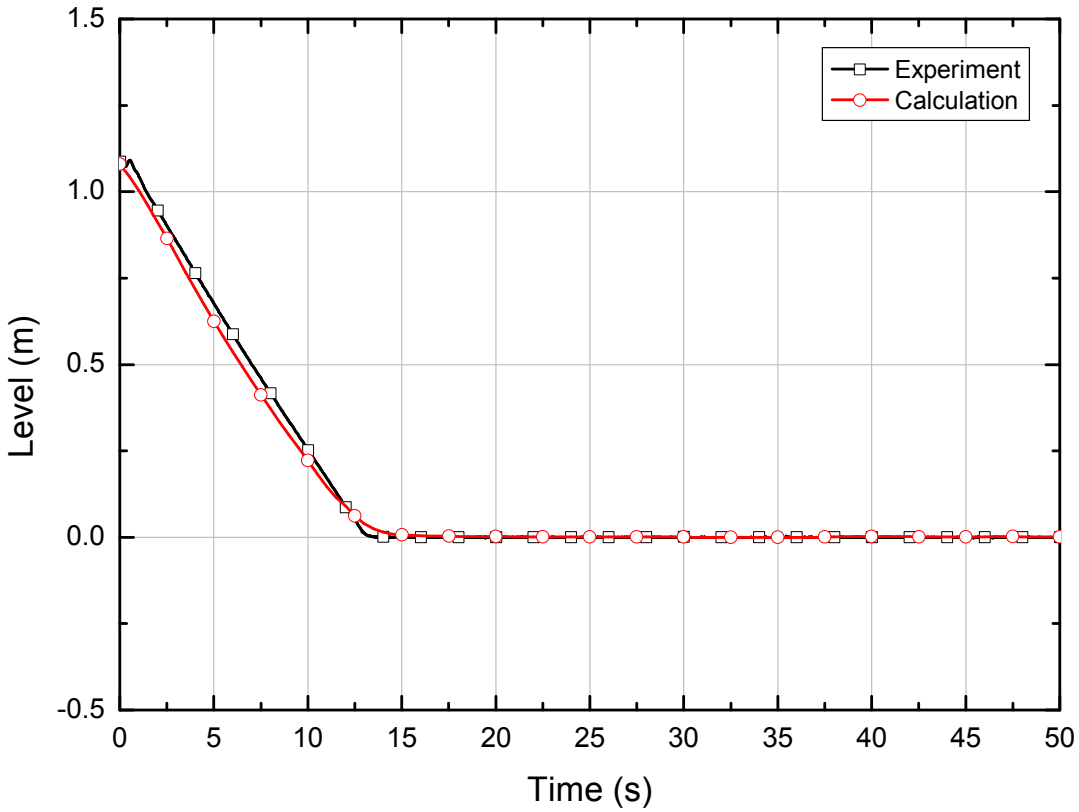


Figure 2. Pressurizer Level

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Figure 3. Drawings of Pressurizer Surge Line for APR1400

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Figure 4. Schematics of Pressurizer Surge Line Nodalization

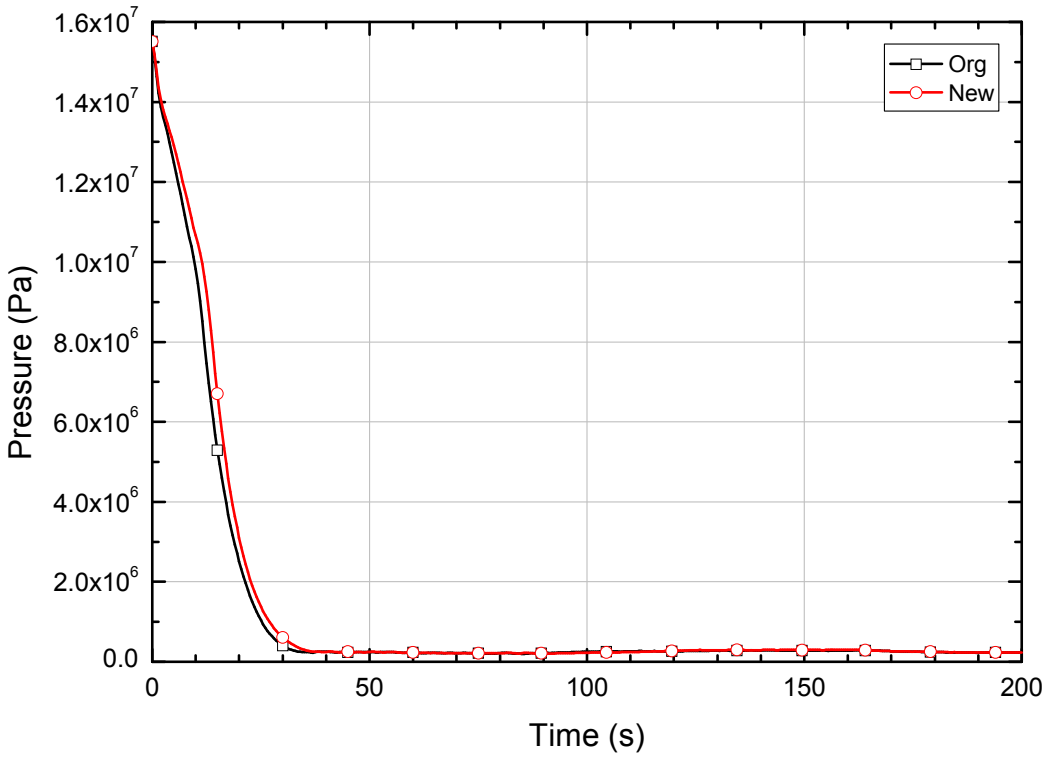


Figure 5. Nodalization Sensitivity – Pressurizer Pressure

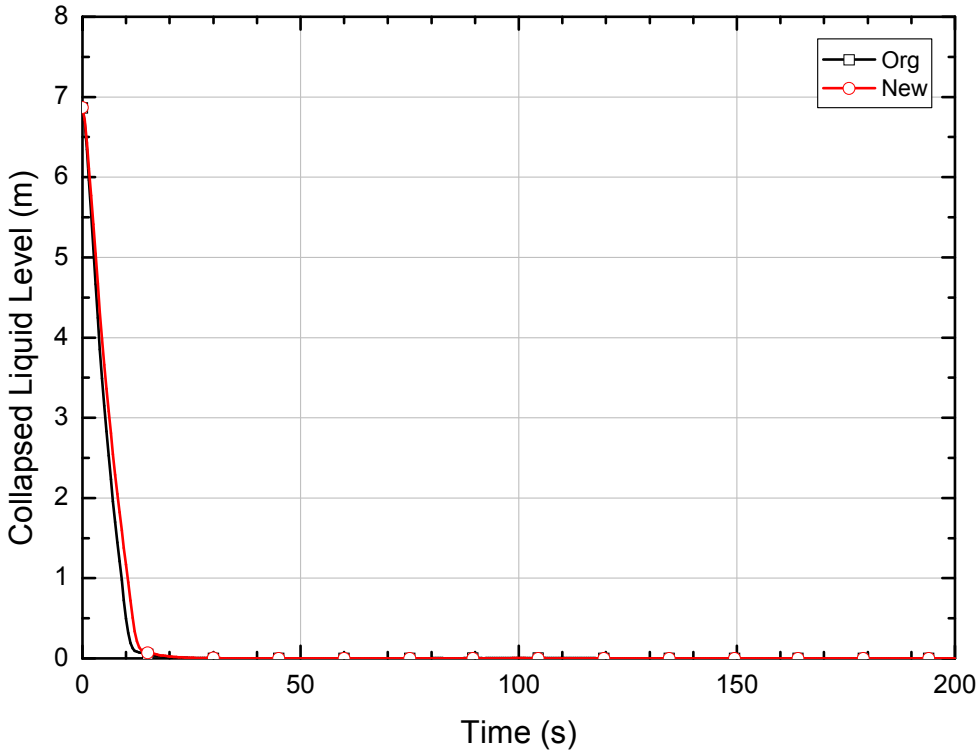


Figure 6. Nodalization Sensitivity – Pressurizer Level

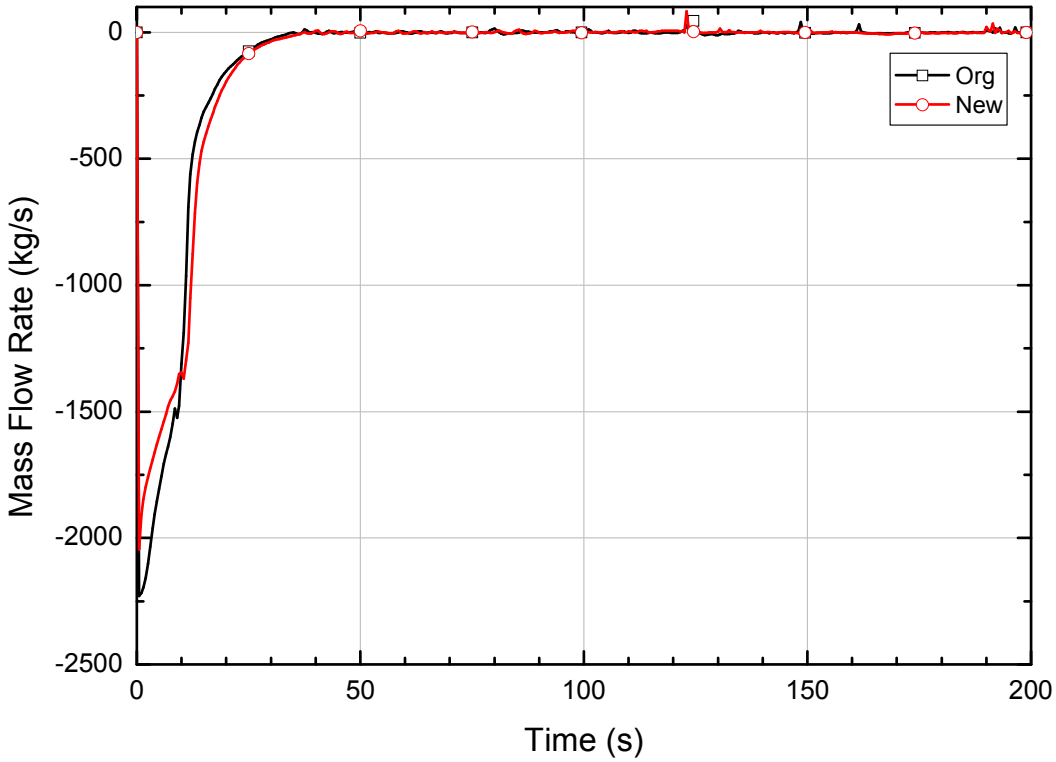


Figure 7. Nodalization Sensitivity – Mass Flow Rate between Surge Line and Hot Leg

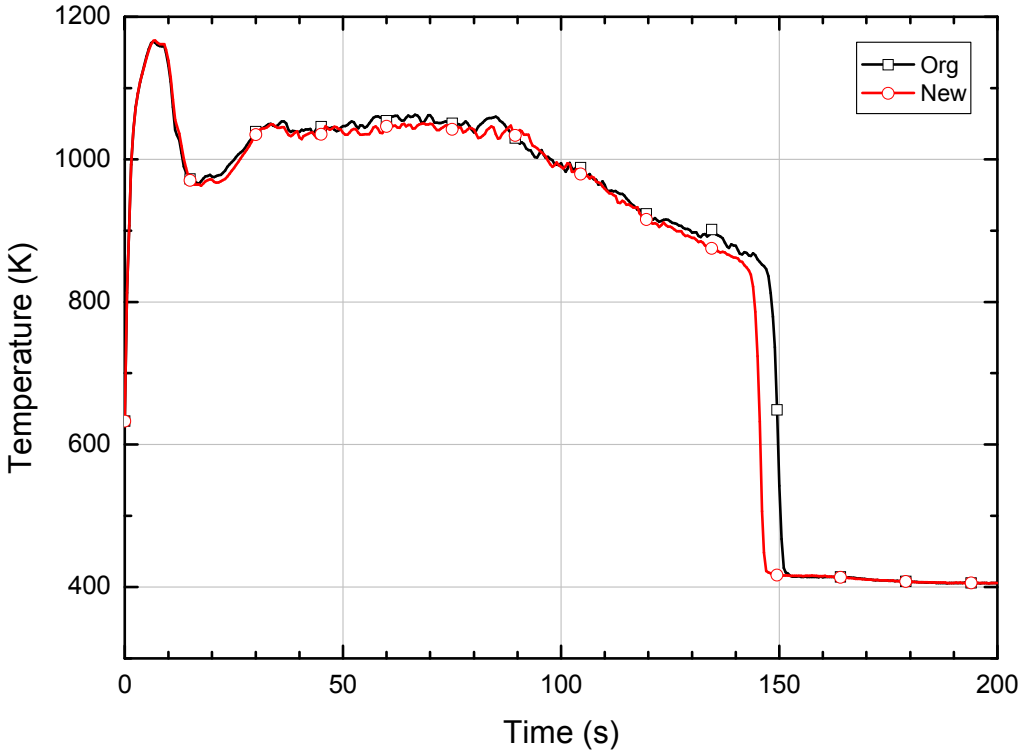


Figure 8. Nodalization Sensitivity – Cladding Temperature at PCT Node

## 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 Report

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