RESPONSE TO AUDIT ISSUES

APR1400 Topical Reports

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

Docket No. PROJ0782

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-d

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

d. RG 1.157 states that "…one-dimensional approximations to three-dimensional phenomena will be considered if those approximations are properly justified." [

]^{TS} The lower power peripheral fuel assemblies are also not represented separately. It is unclear how this nodalization was selected over other options and how it can model multidimensional phenomena (e.g., "upper plenum to core counter-current flows (CCF)" in topical report Table 3-2). Provide the basis for the selected nodalization with respect to capturing the multidimensional phenomena occurring in the core.

Response

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]TS

Multidimensional flows can be broadly classified into two phenomena. First, higher vapor velocities and liquid entrainment occur in the higher power region of the core. The entrained liquid from the core is carried into the upper plenum, where it is de-entrained, forming a two phase pool. The liquid from the pool can reenter the lower power region of the core due to the lower vapor velocities in those regions. [

]TS The modeling of the core is not intended to consider the multidimensional phenomena of the core, but to consider the harsh condition that may occur in the nearest region of the hottest rod. In case of APR1400 plant, multidimensional phenomena is not significant from the following reasons.

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Figure 1 shows the mass flow rate at the hot channel exit and it can be seen that some down flow occurs during reflood period. In order to confirm the effect of the down flow, sensitivity calculation was performed by limiting the down flow. For the limitation of the down flow, the reverse K-factor of the junction connecting the hot channel exit and upper plenum was assumed to be very large value. Figure 2 through 4 compare the mass flow rate at the core exit, heat transfer mode and cladding surface temperature at the PCT node respectively. During the reflood period, the heat transfer mode is film boiling until core quench. During film boiling period, heat transfer between wall and liquid is very low because the liquid does not contact directly to the wall. Therefore, even though there is some down flow at the upper region of the hot channel, it does not affect the cladding temperature as shown in Figure 4.

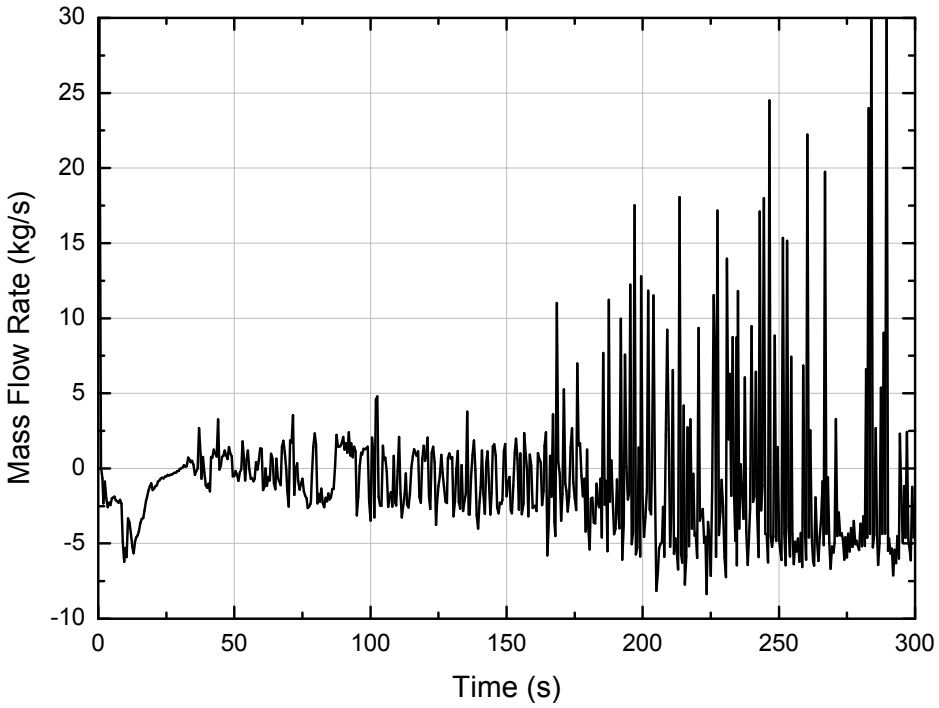

Figure 1. Mass Flow Rate at Hot Channel Exit – Original Calculation

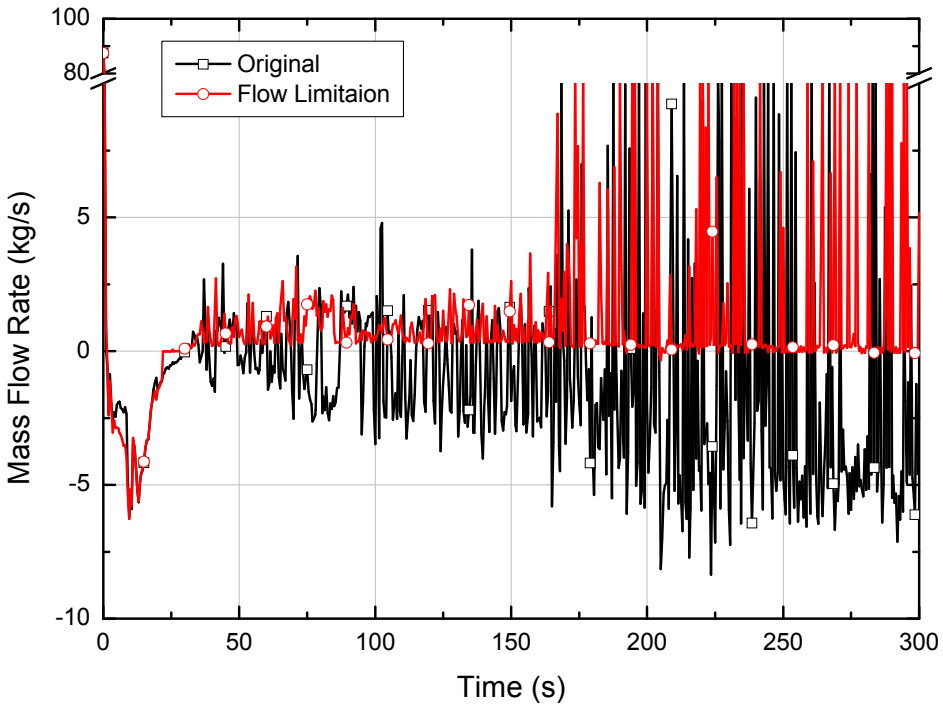

Figure 2. Comparison of Mass Flow Rate – Original vs. Flow Limitation

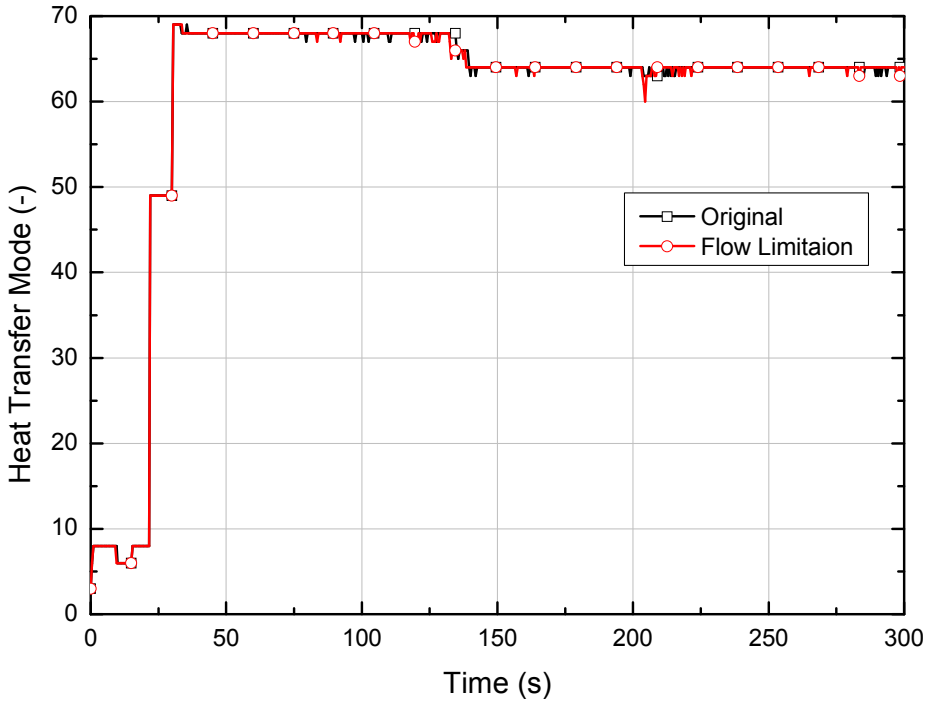

Figure 3. Comparison of Heat Transfer Mode – Original vs. Flow Limitation

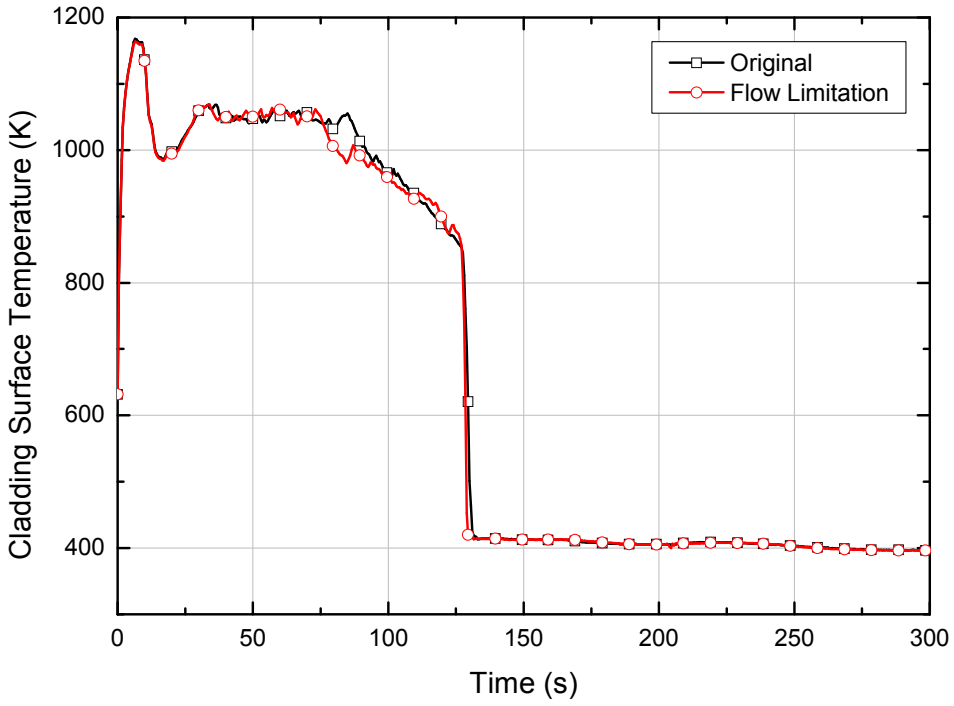

Figure 4. Comparison of Cladding Surface Temperature – Original vs. Flow Limitation

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.