Enclosure 3

Docket No. 52-046

Revised Response to RAI 2-7371 on Topical Report
"Fluidic Device Design for the APR1400"
APR1400-Z-M-TR-12003-NP, Rev. 0

April 2015

Non-proprietary Version

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.:	**2-7371 Question 16**
SRP Section:	**N/A**
Application Section:	**Fluidic Device Design for the APR1400 (APR1400-Z-M-TR-12003-P, Rev. 0)**
Date of RAI Issued:	**03/11/2014**
Response Date:	**04/23/2015**

Question 16

Section 5.2 discusses the effect of dissolved nitrogen gas on the FD K-factor. It concludes that the maximum mass and volumetric flow rate of nitrogen gas are much smaller than the air discharge flow rate during the period of [ ]TS seconds, and as a result, the evolution of dissolved nitrogen gas does not materially affect the FD K-factor.

Since the air discharge is the discharge of covered air when the standpipe is emptying, which is different from the evolution of the dissolve nitrogen in the SIT water, how can it be used as a comparison for the dissolved nitrogen coming out of SIT water?

Response

In case that the evolution of dissolved nitrogen occurs, it is mixed with SI water and two-phase flow is formed. For the same mass flow rate, we expect that the pressure drop in two-phase flow is higher than that in single-phase flow. In case that a gas quality is low, the pressure drop increases with an increase in the gas quality. In case that a flow path is the same, the pressure drop increases with an increase in the migration length of the two-phase flow in the flow path.

The throat of the FD exit is the place where the pressure reaches its minimum. Therefore, the region near the FD exit is the most vulnerable place to the gaseous cavitation due to the evolution of dissolved nitrogen. On the other hand, in case that the air flows into the FD vortex chamber, two-phase flow starts to be formed from the exits of supply nozzle and control nozzle. That is the two-phase flow migrates whole through the vortex chamber and discharge tube. As a result, the two-phase flow formed by the air through an empty stand pipe has longer migration length. Thus, the air flow causes higher pressure drop than the evolution of dissolved nitrogen when the gas quality is the same for both cases. As described in topical report Section 5.2, the maximum nitrogen gas flow rate is much smaller than the air discharge flow rate during the period of [ ]TS seconds. Therefore, we expect that the evolution of dissolved nitrogen gas does not materially affect the FD K-factor.

In the clarification phone call talking, the NRC figured out errors in Table 5.2-1 and 5.2-2 of the topical report.
The nitrogen solubility numbers in the far right column of Table 5.2-1 are obviously typos. However, we confirmed that the curve fitted equations of 5.2-1 and 5.2-2 were correct, and the nitrogen gas release rate (Fig. 5.2-1 and 5.2-2) were correctly calculated from the equations of 5.2-1~5.2-4. The topical report will be revised replacing Table 5.2-1 and 5.2-2 with corrected tables as shown in attachment.

Impact on DCD

There is no impact on the DCD.

Impact on Technical/Topical/Environmental Report

Topical Report APR1400-Z-M-TR-12003-NP will be revised as indicated on the attached markups.

Attachment to Revised Response to RAI 1091-7447 (1/2)

Table 5.2-1 N_2 Solubility (kg/kg_{water}) in Pure Water at 0 °C (32 °F)

P [MPa(a) (psia)]	Solubility (kg/kg_{water})	
	Sun et al. [7]	Eq. 5.2-1
0.1 (14.5)		
0.5 (72.5)		
1.0 (145)		
2.5 (363)		
5.0 (725)		

Table 5.2-2 N_2 Solubility (kg/kg_{water}) in Pure Water at 40 °C (104 °F)

P [MPa(a) (psia)]	Solubility (kg/kg_{water})	
	Sun et al. [7]	Eq. 5.2-2
0.1 (14.5)		
0.5 (72.5)		
1.0 (145)		
2.5 (363)		
5.0 (725)		

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Table 5.2-1 N_2 Solubility (kg/kg_{water}) in Pure Water at 0 °C (32 °F)

P [MPa(a) (psia)]	Solubility (kg/kg_{water})	
	Sun et al. [7]	Eq. 5.2-1
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0.5 (72.5)		
1.0 (145)		
2.5 (363)		
5.0 (725)		

TS

Table 5.2-2 N_2 Solubility (kg/kg_{water}) in Pure Water at 40 °C (104 °F)

P [MPa(a) (psia)]	Solubility (kg/kg_{water})	
	Sun et al. [7]	Eq. 5.2-2
0.1 (14.5)		
0.5 (72.5)		
1.0 (145)		
2.5 (363)		
5.0 (725)		

TS