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.:	**111-7971**
SRP Section:	**06.05.02 - Containment Spray as a Fission Product Cleanup System**
Application Section:	**6.5.2 and 15.6.5.5.1.1**
Date of RAI Issue:	**07/24/2015**

Question No. 06.05.02-1

QUESTIONS

The design basis accident (DBA) loss of coolant accident (LOCA) dose analysis discussed in DCD 15.6.5 was performed to show compliance with the design and siting dose criteria in 10 CFR 52.47(a)(2)(iv) and control room habitability dose criteria in GDC 19. With respect to the modeling of iodine removal by containment sprays in the LOCA dose analysis, DCD page 15.6-46 states that there is no recirculation mode of the containment spray system (CSS), because the CSS takes suction on the in-containment refueling water storage tank (IRWST) for the entire duration of CSS operation. The calculation of elemental iodine removal by containment sprays described in DCD 6.5.2.3.3 is consistent with the assumption that there is no recirculation of water. However, in DCD 6.5.2.3.2 and DCD 6.8.2.2.1 (page 6.8-9), the description of water movement in the containment during containment spray operation includes spillage into the holdup volume tank (HVT) which includes tri-sodium phosphate (TSP) in baskets for pH control and subsequent flow into the IRWST. If you continue to use methods that are consistent with SRP 6.5.2, would accounting for this flow of water from the containment to the IRWST change the calculated elemental iodine removal coefficient or the time to reach the maximum iodine decontamination factor of 200?

Response

High containment pressure or low reactor coolant system (RCS) pressure due to a loss of coolant accident (LOCA) initiates the containment spray system (CSS). Following the initiation of the CSS, the fresh water stored in the in-containment refueling water storage tank (IRWST) is sprayed and removes the iodine atoms in the containment atmosphere. As the sprayed water runs through lower locations in containment, the water is collected in the hold-up volume tank (HVT), in which the tri-sodium phosphate (TSP) is stored in baskets. The sprayed water, which

contains iodines removed from the containment atmosphere, dissolves the TSP. When the HVT is filled with water, it flows into the IRWST through the spillways. Then, the high pH water containing the TSP is mixed with the lower pH water in the IRWST. Therefore, this high pH water with TSP raises the pH of the IRWST to maintain the pH of the IRWST greater than 7.0.

The sentence in DCD Page 15.6-46 (‘The APR1400 does not have a recirculation mode of operation during the CSS operation period...’) intends to communicate that the plant does not change the operation mode of the CSS from injection to recirculation, because the CSS takes suction on the IRWST for the entire duration of CSS operation in the APR1400 design.

As for the impact on the elemental iodine removal coefficient and the time to reach a decontamination factor (DF) of 200, the APR1400 analysis does not take into account the re-evolution of elemental iodines from the IRWST. Since the sprayed water, which contains iodines removed from the containment atmosphere, is collected in the HVT, and it also dissolves the TSP, the water contains both the iodines and TSP in very high pH water. When this water flows into the IRWST, both the iodines and TSP are transported together such that the re-evolution of iodine is minimized. DCD Subsection 6.5.2.3.2 estimates the time to reach a pH of 7.0 in the IRWST to be 157 minutes, but the calculation did not account for the distribution of iodine concentrations in the IRWST. Therefore, the amount of re-evolution of iodines which takes place in the IRWST until the pH of the IRWST reaches 7.0 is assumed to be negligible. Thus, the impact of the dissolved iodines in the IRWST water on the elemental iodine removal coefficient and the time to reach a DF of 200 by using the CSS is not considered.

Impact on DCD

The sentence in DCD Page 15.6-46 will be revised as indicated in the attachment associated with this response.

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.

inventories are listed in Appendix 15A, Table 15A-1. The remaining isotopes are not accounted in the analysis. The dose analysis is based on a core thermal power of 4,062.66 MWt including the 2 percent power level measuring instrument uncertainty. The following evaluation models of radioactive materials are applied to evaluate radiological consequence due to a LOCA.

15.6.5.5.1.1 Containment Leakage

Containment Air Mixing

The APR1400 containment spray covers 75 percent of the containment volume, and the remaining 25 percent of containment free volume is considered to be unsprayed volume. Because the reactor containment fan coolers (RCFCs) are non-safety-related, the forced mixing between the sprayed and unsprayed regions due to the RCFCs is not credited. Instead, consistent with NRC RG 1.183, the mixing rate attributed to natural convection between the sprayed and unsprayed regions of the containment building is assumed to be two turnovers of the unsprayed region per hour. This containment mixing rate is used in the analysis to transport the post-LOCA activity between the sprayed and unsprayed regions.

Containment Spray Operation

Although the APR1400 containment spray system (CSS) is designed to operate throughout the design basis event, the spray operation period is assumed to be 4 hours. Containment spray removal of iodine and aerosols is assumed to be initiated at 110 seconds after the start of the LOCA event. The CSS is automatically initiated by a safety injection actuation signal (SIAS) or a containment spray actuation signal (CSAS) to conform with the SRP, Subsection 6.5.2, Acceptance Criterion 1.A. ~~The APR1400 does not have a recirculation mode of operation~~ during the CSS operation period because the CSS takes suction from IRWST for the entire duration of the design basis event.

The containment spray elemental iodine removal coefficient λ_E is calculated to be 20 hr^{-1} using the APR1400 plant-specific containment spray parameters, which meets the SRP Subsection 6.5.2 limitation of 20 hr^{-1}. Consistent with the SRP, Subsection 6.5.2, the effectiveness of the spray in removing elemental iodine is presumed to end when the maximum elemental iodine DF value of 200 is reached. The total elemental iodine atoms when a DF of 200 is reached in the sprayed region are calculated by using the elemental

APR1400 does not change the operation mode from injection to recirculation mode