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.:	**321-8353**
SRP Section:	**12.02 radiation Sources**
Application Section:	**12.2**
Date of RAI Issue:	**11/25/2015**

Question No. 12.02-21

This is a follow-up to RAI 7998, Question 12.02-12 (27043)

In the response to Question 12.02-12, the applicant indicates that since all of the components for the boric acid concentrator (BAC) package are within the same room (room 078-A04B), the source term for all of the components for the BAC package are conservatively added together and considered to be within the BAC flash tank for radiation shielding and zoning purposes. SRP 12.2 indicates that the FSAR should describe how the source terms are used in the shielding analysis. Therefore, please update the FSAR to provide this information, so that it is clear how the source terms in FSAR Table 12.2-14 are used in the shielding analysis and how the shielding for room 078-A04B was determined.

Response

The components of the boric acid concentrator (BAC) are conservatively modeled with the combined total source term based on the maximum design basis source terms in order to determine the minimum required shield wall thicknesses for Room 078-A40B to maintain the dose rates in the adjacent rooms and areas below their respective radiation zone limits.

The BAC is composed of the following components: concentrate heater, concentrate cooler, flash tank, vapor separator, concentrate pump, and concentrate transfer pump. The BAC model for the shielding analysis includes the source of each of these components using the maximum design basis source terms as listed in DCD Table 12.2-14, which are based on 0.25% fuel failure and no gas stripping. The model used for the shielding and radiation zoning calculation involves dividing the source for the BAC into two regions, one in the vapor phase and the other in the liquid phase. Accordingly, the shielding analyses for the vapor and liquid phases for the BAC components are performed separately and the final dose rate results are calculated by summing the results for both phases.

The volumes modeled for the liquid phase include the sources from the concentrate heater, concentrate cooler, concentrate pump, concentrate transfer pump, half of the flash tank volume, and a very small portion of the separator volume. The volumes modeled for the vapor phase include the other half of the flash tank volume as well as the majority of the separator volume. The vapor phase includes the noble gas nuclides as well as tritium, and the liquid phase includes the remaining nuclides in the identified components as listed in Table 12.2-14. A cylindrical model for each phase was created using the MicroShield code and results were compiled for dose points within the cubicle at a distance of 1 foot from the source as well as for dose points outside of the cubicle at a distance of 1 inch from the shield wall. For each dose point, the results from the vapor phase and the liquid phase are summed to yield the total dose rate value.

A graphical representation of the dose rate results from the varied shield wall thickness runs allows for the interpolation of the required shield wall thicknesses needed to maintain the dose rate contributions to adjacent rooms and areas within the upper limits of the designated radiation zones. Following this shielding methodology and analysis, the minimum shield wall thicknesses and corresponding radiation zone for the BAC Room (078-A40B) were determined.

DCD Subsection 12.2.1.1.5.1.e will be updated to indicate the description discussed above.

Impact on DCD

DCD Subsection 12.2.1.1.5.1.e will be updated as indicated in Attachment.

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 Environment Report.

e. Boric acid concentrator

The maximum values for BAC radionuclide inventories are presented in Table 12.2-14. Insert A

The total radioactivity inventories in the BAC package are based on a concentration factor of 100.

12.2.1.1.5.2 Steam Generator Blowdown System

Radiation sources in the steam generator blowdown system (SGBDS) are shown in Table 12.2-18. The sources are based on the assumed design basis primary-to-secondary (PTS) leakage rate and the assumed fuel defect percentage described in Subsection 12.2.1.1.3. The blowdown rate is assumed to be 0.2 percent of the maximum steaming rate.

12.2.1.1.5.3 Condensate Polishing System

Radiation sources in the condensate polishing system (CPS) are shown in Table 12.2-18. The sources are based on the design basis PTS leakage and the assumed fuel defect percentage described in Subsection 12.2.1.1.3. It is assumed that 65 percent of the condensate flows through the CPS and that one out of six CPS demineralizers is used to process the condensate during normal operation.

12.2.1.1.6 Gamma Sources of Irradiated Components

The components in the reactor vessel are irradiated by the fission neutrons during the core power operation and are activated. The in-core instrument (ICI) assembly, which consists of five rhodium detectors, one background detector, one core-exit thermocouple, and a central member assembly, is enclosed in a protective sheath. Activated gamma sources of the irradiated ICI assembly are estimated assuming 6 years of irradiation. The activated gamma sources of the irradiated control element assembly (CEA) and the irradiated neutron source assembly (NSA) are estimated assuming 10 years of irradiation. In CEA, the neutron absorbing material is B_4C and the cladding material is Inconel 625. The NSA contains the primary neutron source of Cf^{252} and the secondary neutron source of Sb-Be. The activated gamma source of the irradiated surveillance capsule assembly (SCA) is

A

The components of the boric acid concentrator (BAC) are conservatively modeled with the combined total source term based on the maximum design basis source terms in order to determine the minimum required shield wall thicknesses for the BAC room to maintain the dose rates in the adjacent rooms and areas below their respective radiation zone limits. The shielding analyses are performed for the vapor phase and liquid phase for the BAC components using their corresponding source terms as listed in Table 12.2-14. The dose rate results calculated for the two phases are summed for the determination of the minimum shield wall thicknesses and corresponding radiation zone for the BAC room.