Question regarding the response to RAI 8254, Question 12.03-17, Revision 1

Regarding the revised response to RAI 8254, Question 12.03-17. Regarding the 1.55 peaking factor issue. During the initial teleconference on this issue, the applicant indicated that the 1.55 peaking factor was the peaking factor for the maximum fuel rod. Since this would be a higher value than the peaking factor for the maximum assembly, this would be a conservative value, which was therefore acceptable. In the feedback provided May 18th, the applicant indicated that the 1.55 value was the maximum expected radial peaking factor for an individual fuel rod at full power for unrodded condition. Then in the revised response to RAI 8254, Question 12.03-17, the proposed DCD markup states that the 1.55 factor is the ratio of the average power per unit length (and the response adds that, it is the ratio of the average power per unit length produced by a particular fuel rod to the average power per unit length produced by the average-powered fuel rod in the core).

The 1.55 value used in Chapter 12 is used to represent the peaking factor for the maximum assembly during fuel transfer operations. The intent is to model the maximum fuel assembly during transfer to ensure that shielding and dose rates are adequate. If the model does not represent or exceed the maximum fuel assembly than the shielding and dose rate analysis is inadequate. It is now unclear to staff that the peaking factor of 1.55 used for the shielding and zoning analysis and for the doses to operators during fuel transfer are an adequate or conservative representation of the maximum dose rate fuel assembly. Please provide justification that the peaking factor of 1.55 is an adequate or conservative multiplication factor to represent the maximum dose rate fuel assembly or redo the shielding and dose rate analysis with the appropriate peaking factor for the maximum dose rate fuel assembly.

KHNP Response) KHNP has already provided the justification that the peaking factor of 1.55 is an adequate and conservative multiplication factor to represent the maximum dose rate fuel assembly since the peak assembly power of 1.2353 is the maximum assembly power. Conservatively, KHNP has applied the peaking factor of 1.55 for an individual fuel rod instead of the maximum assembly peaking factor even if the assemblies are transferred during the refueling period. For clarity, DCD markup will be revised as indicated in Attachment 1.

Questions regarding the Response to RAI 8353, Question 12.02-20.

1. In the response to RAI 8353, Question 12.02-20, regarding airborne calculations outside containment, the applicant indicates that nothing goes airborne besides halogens, noble gases, and tritium, based on Korean guidance (which was not provided to staff) and because the effect of other isotopes is negligible. However, staff can't base their regulatory finding on Korean guidance and the applicant does not provide any relevant information supporting the claim that the contribution from other isotopes is negligible. In addition, SRP 12.2 specifies that the source terms used to develop the airborne concentration values should be comparable to estimates from other applicants with similar designs. However, other PWR new reactor designs consider other airborne radionuclides besides halogens, noble gases, and tritium.

Finally, staff notes that while the applicant is attempting to show that all areas of the plant are below a DAC fraction of 1 during normal operation. It is not necessary to show that every individual room of the plant is below 1.0 DAC fraction. If a few selected areas are above 1.0 DAC fraction it can be acceptable, as long as those areas are areas that are expected to be accessed infrequently and that airborne activity is limited to the extent practicable. In addition, the ventilation design should be adequate to ensure that frequently accessed (such as hallways and access ways), are not airborne radioactivity areas and that the requirements of 10 CFR 20.1701 are met.

Therefore, please update the calculations to consider contributions for the other radionuclides or provide an analysis indicating why they are not radiologically significant.

KHNP Response)
Unlike the guidance described in the Korean Design Criteria Manual, the airborne activity in containment building is more conservatively calculated considering the other radionuclides besides halogens, noble gases, and tritium. Because the temperature of reactor coolant is relatively higher than other systems in the auxiliary and compound buildings, flashing fraction described in RG 1.183 is applied to calculate the airborne activity of the other particulate radionuclides. Also, since the blowdown and the condensate are continuously treated by filtration and ion exchange to remove the contamination, especially the particulate, the airborne activity from the leakage of these systems in the auxiliary building contains little or no contaminated particulates. Therefore, the airborne activities in the auxiliary and compound buildings, the particulate radionuclides are not considered as indicated in the Korean Design Criteria Manual.

2. In the response to RAI 8353, Question 12.02-20, the applicant indicates that Iodines in cold fluid (Iodines outside containment), have a partition factor of 0.001, based on Korean guidance (which was not provided to staff) and other documents related to iodine partition factors for steam generator tube ruptures, partition factors for Iodine when considering the effects of containment spray, and effluent releases, none of which appear relevant to calculating airborne concentrations inside the plant from leaks and spills. In addition, the applicant uses RG 1.183 to calculate the airborne concentrations of tritium outside containment and the airborne concentrations inside containment. RG 1.183, which is intended to calculate airborne activity for the purposes of evaluating airborne activity from accident source terms, including cold fluid outside containment, indicates that the partition factor of iodine in cold fluid should be assumed to be 0.1.

   In addition, SRP 12.2 specifies that the source terms used to develop the airborne concentration values should be comparable to estimates from other applicants with similar designs. Other PWR new reactor designs assume an airborne partition factor for Iodines of 0.1.

   Finally, staff notes that while the applicant is attempting to show that all areas of the plant are below a DAC fraction of 1 during normal operation. It is not necessary to show that every individual room of the plant is below 1.0 DAC fraction. If a few selected areas are above 1.0 DAC fraction it can be acceptable, as long as those areas are areas that are expected to be accessed infrequently and that airborne activity is limited to the extent practicable. In addition, the ventilation design should be adequate to ensure that

frequently accessed (such as hallways and access ways), are not airborne radioactivity areas and that the requirements of 10 CFR 20.1701 are met.

Therefore, please provide an appropriate basis for assuming a partition factor of 0.001 for Iodines in cold fluid or update the calculations as appropriate.

KHNP Response) The partition factor of 0.001 is based on WASH 1258 [page A-6]. Please refer to the Attachment 2.

3. In the response to RAI 8353, Question 12.02-20, the applicant specified the room numbers for the different rooms with airborne activity. However, it's unclear why some rooms were chosen over others. For example, the applicant provides an airborne activity source term for filter and demin valve area (068-A10A), but does not provide one for filter and valve areas 068-A11A and 068-A12A. Please explain why the rooms selected for providing airborne activity values were selected and provide this information in the DCD. (For example, are the rooms provided the rooms with the highest expected airborne activity source term? If so, how do you know that they are the rooms with the highest source term?)

   KHNP Response) The airborne activity calculations are performed for all the rooms with valves or flanges where leakage may occur. Although the calculation includes the results for all rooms, since the number of rooms is too many, some of the rooms are not listed in Table 12.2-26 of DCD. For example, the filter and demin valve area (068-A10A) is chosen as representative room because it has the highest expected airborne activity source term compared to 068-A11A and 068-A12A

Comment regarding the Response to RAI 8254, Question 12.03-21

1. In the proposed DCD markup, when describing how the shielding design was calculated, it states for the waste drum storage area it states that, "Some of the drummed waste, such as R/O concentrate, are expected to have higher activity, and <u>can be</u> stored at the interior of the drum layers within a stacking configuration, with lower activity waste drums at the exterior of each layer, to provide additional shielding." Please replace "can be" with "are" so that it is clear how the source term was modeled.

   (KHNP Response) KHNP agrees with the staff comment. DCD description and the Response to RAI 8254, Question 12.03-21 will be revised to replace the words of "can be" with "are"

2. Please include more information on what the Spent Filter Drum Storage Area source term is based on in the DCD description. Similar to the information provided in the final two paragraphs in the response to question A.2. in CQ-20160324 & 0325 & 0330.

   (KHNP Response) DCD description will be revised to add following paragraph as indicated in Attachment 3.

“For the source term of HICs, the volume and the associated source term of spent resin (not decayed) is increased by a factor of 1.656 (=Volume of 16 HICs / 1-cycle volume of spent resin) for conservatism. The zoning for this area is determined by summing the dose rates from the HIC and the spent filter drums. However, in determining the minimum shield wall thicknesses, the two dose rates are calculated individually since the impact of shield wall thicknesses is dominated by the close proximity of the individual sources (HIC or spent filter drum) to the walls around the designated storage areas.”

If it is acceptable, the Response to RAI 8254, Question 12.03-21 will be revised again.