

KHNPDCRAIsPEm Resource

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Sent: Friday, May 22, 2015 10:23 AM
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Subject: APR1400 Design Certification Application RAI 13-7856 (12.2 Radiation Sources)
Attachments: APR1400 DC RAI 13 RPAC 7856.pdf; image001.jpg

KHNP

The attachment contains the subject request for additional information (RAI). This RAI was sent to you in draft form. Your licensing review schedule assumes technically correct and complete responses within 30 days of receipt of RAIs. However, KHNP requests and we grant 60 days to respond to the RAI. We may adjust the schedule accordingly.

Please submit your RAI response to the NRC Document Control Desk.

Thank you,

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Issue Date: 05/22/2015
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 12.02 - Radiation Sources
Application Section: 12.2

QUESTIONS

12.02-2

REQUIREMENTS

10 CFR 52.47(a)(5) requires that the FSAR contain the kinds and quantities of radioactive materials expected to be produced in the operation and the means for controlling and limiting radioactive effluents and radiation exposures within the limits set forth in 10 CFR 20.

10 CFR 50, Appendix A, Criterion 61, requires that the fuel storage and handling, radioactive waste, and other systems which may contain radioactivity be designed to assure adequate safety under normal and postulated accident conditions, with suitable shielding for radiation protection, and with appropriate containment, confinement, and filtering systems.

SRP Section 12.2 indicates that radiation sources should be determined and provided for all radiation sources that require (1) shielding, (2) special ventilation systems, (3) special storage locations and conditions, (4) traffic or access control, (5) special plans or procedures, or (6) monitoring equipment. The source descriptions should include all pertinent information required for (1) input to shielding codes used in the design process, (2) establishment of related facility design features, (3) development of plans and procedures, (4) assessment of occupational exposure and (5) determination of radiation dose to electrical equipment important to safety as described in 10 CFR 50.49.

SRP Section 12.2 also indicates that source descriptions should include the methods, models and assumptions used as the bases for all values provided in SAR Section 12.2. A listing of isotope, quantity, form, and use of all required radiation sources containing byproduct, source, and special nuclear material exceeding $3.7 \text{ E}+9 \text{ Bq}$ (100 millicuries) that may warrant shielding design consideration, should be provided.

ISSUE

Source terms for numerous significant radiation sources in the plant are not provided in FSAR Section 12.2 and for many of the sources, the description of the basis for the source term is incomplete.

INFORMATION NEEDED

1. Staff cannot locate any source term information on the following radiation sources in FSAR Section 12.2;
 - the hold-up volume tank (listed as an area possibly exceeding 1 Gy/hr, in FSAR Section 12.3),
 - pressurizer, and
 - in-containment refueling water storage tank (IRWST).

These sources would likely each contain a liquid and gaseous phase source term. In accordance with 10 CFR 52.47(a)(5) staff requests the following:

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- a) Please include the liquid and gaseous phase 0.25% failed fuel percentage source term for each of these sources in the FSAR, or provide justification for not including them.
 - b) Include the methods, models, and assumptions used in calculating these sources in the FSAR, or provide justification otherwise.
 - c) Include the relevant dimensions and parameters used in the shielding analysis of these sources in FSAR Table 12.2-25.
 - d) Include any other missing significant discrete sources of radiation which meet the criteria in SRP Section 12.2 of sources that should be provided, as well as the methods, models, and assumptions used for determining the source terms, in the FSAR.
2. Typically, the volume control tank (VCT) contains a significant radioactive source term for both the gaseous and liquid phase with different isotopic composition and activities for each phase. FSAR Table 12.2-13 contains only one source term for the VCT, and it does not indicate if that source term represents the gas or liquid phase. FSAR Table 12.2-25 indicates that the VCT is 60% vapor, but again, it does not indicate what the source term in Table 12.2-13 represents.
- a. Please calculate and provide in the FSAR the liquid and gaseous (vapor) source term for the VCT. This source terms should be based on the worst case operating source term for the VCT (i.e. the physical conditions that result in the largest total source term (including both liquid and gaseous) that would be anticipated during normal operation of the VCT with 0.25% failed fuel). The source terms should be provided in Section 12.2. Table 12.2-25 should provide source characteristics (percent liquid and gaseous), based on the maximum source term. Providing the maximum source term allows staff to verify the adequacy of the shielding design.
 - b. Update the text of FSAR 12.2 to provide the methods, models, and assumptions used to calculate the VCT source term.
 - c. Ensure that the ratios provided in Table 12.2-25 for the liquid and vapor phases are adequate for the maximum source term.
3. For many of the sources in FSAR Section 12.2 the applicant does not provide all the methods, models, and assumptions used as the basis for the source terms provided. Therefore, please ensure that the methods, models, and assumptions used as the basis for the source terms in FSAR Section 12.2 are provided within FSAR Section 12.2, or justify an alternative to the SRP. Sources needing a more detailed description of how they were calculated include each individual CVCS tank and each component in the boric acid concentrator package. For example, the information provided should include all assumptions made in calculating the source terms, such as, all inputs and flow rates into each tank, dilution rates, removal rates, etc. and all processing parameters, including any pertinent equations or factors needed to perform the calculations of the source terms in FSAR Section 12.2.

In addition to providing this information for the CVCS tanks and boric acid concentrator package, the staff requests that the applicant identify any additional areas where additional information will be needed for staff to perform confirmatory calculations and verify that the assumptions used in calculating the source terms are adequate and provide that information in the FSAR.

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12.02-3 REQUIREMENTS

10 CFR 52.47(a)(5) requires that the FSAR contain the kinds and quantities of radioactive materials expected to be produced in the operation and the means for controlling and limiting radioactive effluents and radiation exposures within the limits set forth in 10 CFR 20.

10 CFR 50, Appendix A, Criterion 61, requires that the fuel storage and handling, radioactive waste, and other systems which may contain radioactivity be designed to assure adequate safety under normal and postulated accident conditions, with suitable shielding for radiation protection, and with appropriate containment, confinement, and filtering systems.

10 CFR 20.1101(b) requires that the licensee use to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA).

SRP Section 12.2 indicates that radiation sources should be determined and provided for all radiation sources that require (1) shielding, (2) special ventilation systems, (3) special storage locations and conditions, (4) traffic or access control, (5) special plans or procedures, or (6) monitoring equipment. The source descriptions should include all pertinent information required for (1) input to shielding codes used in the design process, (2) establishment of related facility design features, (3) development of plans and procedures, (4) assessment of occupational exposure and (5) determination of radiation dose to electrical equipment important to safety as described in 10 CFR 50.49.

SRP Section 12.2 also indicates that source descriptions should include the methods, models and assumptions used as the bases for all values provided in SAR Section 12.2. A listing of isotope, quantity, form, and use of all required radiation sources containing byproduct, source, and special nuclear material exceeding $3.7 \text{ E}+9 \text{ Bq}$ (100 millicuries) that may warrant shielding design consideration, should be provided.

SRP Section 12.3-12.4, indicates that the plant structures, as well as the general plant yard should be subdivided into radiation zones, with maximum design dose rate zones and the criteria used in selecting maximum dose rates identified. SRP Section 12.3-12.4 also indicates that doses to workers and members of the public should be ALARA.

ISSUE

There is a lack of information in FSAR Section 12.2.1.6, "Stored Radioactivity," on

- holdup tanks,
- reactor makeup water tanks (RMWTs), and
- boric acid storage tanks (BASTs)

that are located outdoors, and these tanks are the most significant outdoor radiation sources. The staff has the following information needs regarding these tanks:

1. FSAR Section 12.2.1.6 reads as if there are multiple holdup tanks, RMWTs, and BASTs located outdoors, however in reviewing FSAR Figure 1.2-1, the staff can only identify one holdup tank, one RMWT, and one BAST located outdoors (they are all north of the Auxiliary Building on Figure 1.2-1). Please indicate if there is more than one holdup tank, RMWT, and BAST each and if so, please indicate where they are located. If not, please indicate that there is only one of each type of tank in FSAR Section 12.2.1.6.
2. FSAR Table 12.2-25 provides source dimensions and parameters used in the shielding analysis, for source terms provided within FSAR Section 12.2. While FSAR Section 12.2 provides a

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source term for each of these tanks, there is no information on these tanks in FSAR Table 12.2-25. This information is needed in the FSAR for staff to conduct a shielding review of these tanks.

3. FSAR Section 12.2.1.6 indicates that there will be administrative controls in place to prevent personnel from occupying the immediate vicinity of the outside tanks.
 - a. Please describe these administrative controls or provide a COL item requesting that the COL applicant provide controls to provide the administrative controls ensuring that exposure to workers and members of the public from these tanks will be ALARA.
 - b. Please indicate if there will be any shielding or barriers surrounding the tanks to limit doses to workers and members of the public and update the FSAR accordingly.
4. FSAR Section 12.2.1.6 indicates that the surface dose rate of these tanks will not exceed 2.5 micro Sieverts per hour. While staff cannot perform dose rate calculations without tank dimensions and parameters (as discussed in Question 2, above), the source terms for the holdup tank and BAST provided in FSAR Table 12.2-13, contain fairly significant quantities of radioactive material. It seems unlikely to staff that the dose on the surface of these tanks would not exceed 2.5 micro Sieverts per hour using the 0.25% failed fuel percentage source term provided in Table 12.2-13. Please provide an analysis that shows the dose rate on the surface of these tanks will not exceed 2.5 micro Sieverts per hour on the surface of these tanks using the 0.25% failed fuel percentage source term provided in FSAR Table 12.2-13. If not, please modify FSAR Section 12.2.1.6 accordingly and provide the radiation zoning for these areas.
5. While the source term for the holdup tank is fairly significant, it appears to be significantly lower than the source term provided for a tank which appears to have a very similar function in another new reactor design. Please discuss all potential input paths of radioactive material to the holdup tank. If potential input paths that would result in a significantly higher source term than what is provided in FSAR Table 12.2-13 exist, please discuss why the current source term is adequate. Please provide the methods, models, and assumptions used in calculating the source term for the holdup tank in FSAR Table 12.2-13 in the response.

