REVISED 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.: **225-8254**

SRP Section: **12.03-12.04 - Radiation Protection Design Features**

Application Section:

Date of RAI Issue: **09/24/2015**

Question No. 12.03-21

REGULATIONS AND GUIDANCE

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.

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 12.2 indicates that shielding and ventilation design fission product source terms will be acceptable if developed based on 0.25-percent fuel cladding defects for PWRs.

RG 8.8 indicates that the basis for design should be based on 0.25-percent fuel cladding defects for PWRs.

INFORMATION NEEDED

FSAR Section 12.2.1.6 indicates that plant areas storing radioactive wastes are shielded based on maximum stored waste volumes and average expected source strengths so that the radiation level outside the storage area is below the limit of the designated radiation zone.

Since the above guidance indicates that shielding and zoning should be based on an assumed 0.25-percent fuel failure. Please provide justification and update the FSAR to justify why it is acceptable to base shielding and zoning for radwaste storage areas on the expected average source strength, instead of design basis (0.25-percent fuel failure) source strengths or modify the FSAR as appropriate to base shielding and zoning for these areas on the design basis source strengths.

Response – (Rev.2)

KHNP performed a review of the source terms used for the determination of the radiation zones and the minimum shield wall thicknesses for the two waste storage areas: the spent filter drum storage and HIC storage area (the high activity storage area) and the waste drum storage area (the low activity storage area) in the compound building and have confirmed that the design for the spent filter drum storage and HIC storage area (high activity storage area) is based on the assumed 0.25% fuel failure for spent filters and spent resin. 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. The source terms for the waste drum storage area (the low activity storage area) are based on the R/O concentrate from liquid waste derived from 0.25% fuel failure. These source terms for the R/O concentrate waste are based on those calculated from the liquid radwaste system (LRS), which are higher than those calculated for the solid radwaste system; thus, the input source terms are more conservative for the shielding design basis. For DAW (dry active waste), the maximum values measured in the Korean domestic nuclear power plants were used as a basis due to the diversity of contamination levels in the DAW category of waste. DCD Subsection 12.2.1.6 is revised to correctly reflect the design basis for these two waste storage areas.

The shielding analysis for the waste drum storage area (the low activity storage area) is comprised of LRS R/O concentrate (21 drums) and dry active waste (305 drums) for a total of 326 drums. This number of drums for the shielding design bounds the number of drums generated in a 6-month period of normal operation, which is expected to be 290 drums total. The expected and maximum generation volumes and their shipped volumes are summarized and presented in DCD Tier 2 Table 11.4-1. This approach is also consistent with the requirement specified in ANSI/ANS-55.1 for the provision of a storage area for at least 30 days of generated waste. Please note that the original R/O sludge in the response to CQ-20160324 and 0325 (39 drums) includes 21 drums of R/O concentrate and 18 drums of spent R/O membrane. The revised shielding calculation includes the 21 drums of R/O concentrate packaged in drums with the balance of 18 drums of R/O membrane included as DAW drums, which was increased from 251 drums to 305 drums in the analysis and the source term was increased accordingly.

The shielding analysis model is represented by a 3-stacking configuration of 326 drums for storage in the waste drum storage area. The bottom layer has a 10 x 13 drum array (130 drums), the middle layer has a 9 x 12 drum array (108 drums), and the top layer has an 8 x 11 drum array (88 drums). The higher activity drums are stored on the interior of each layer with the lower activity drums located on the exterior, thus providing additional shielding for the higher activity waste.

The changes to the shielding analysis for the waste drum storage area reflect this quantity (326 solid waste drums) and the configuration for the LRS R/O concentrate and dry active waste. In addition, the density of the solid waste source contained in the drums was

changed from 2.26 g/cc to 1 g/cc. This value is more conservative for these two types of waste.

The results of the revised shielding analysis, using 0.25% fuel failure source terms and the expected waste quantities generated (326 drums), yielded an increase in the contact dose rate from 12.67 mSv/hr to approximately 60 mSv/hr. However, the dose rates for areas outside of the storage area with the existing radiation zoning are met with the existing minimum shield wall thickness requirements for this area as shown in DCD Table 12.3-4.

Impact on DCD

DCD Section 12.2.1.6 will be revised as indicated in the 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 Environmental Reports.

Spent fuel is stored in the SFP until it is placed in the spent fuel shipping cask for transport to an onsite interim storage facility or to an offsite storage facility.

~~Storage space is allocated in the compound building for the storage of spent filter cartridges, dewatered spent resins, and R/O concentrates from the LWMS. Plant areas storing radioactive wastes are shielded based on maximum stored waste volumes and average expected source strengths so that the radiation level outside the storage area is below the limit of the designated radiation zone.~~

The COL applicant is to provide any additional contained radiation sources, such as instrument calibration radiation sources, that are not identified in Subsection 12.2.1 (COL 12.2(1)).

12.2.1.7 Pipe Routing

Piping carrying radioactive materials is routed in pipe chases to the extent practicable when routed through low-radiation and low-contamination areas to maintain radiation exposure to plant personnel ALARA and reduce the spread of contamination.

Criteria for routing radioactive piping include:

a. Piping containing radioactive material is routed through shielded pipe chases to the extent practicable.

b. Systems containing radioactive liquids, gases, or slurries are physically located close to interfacing systems to reduce pipe length and minimize the need for routing radioactive piping through personnel access corridors.

c. Stagnant runs of piping are avoided to minimize the potential for crud traps. Flushing and decontamination capabilities are provided as necessary.

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Storage space is allocated in the compound building for the storage of spent filter cartridges and dewatered spent resin in the spent filter drum and HIC storage area as well as for solidified R/O concentrates and dry active waste (DAW) in drums in the waste drum storage area. The shielding design for the spent filter drum and HIC storage area is based on using the expected stored waste volumes for normal operation and the design basis source term (0.25% fuel failure) for the activity of wastes. The shielding design for the waste drum area is based on the use of the design basis source term for the solidified R/O concentrate and the source term for the DAW is based on a waste drum with the highest activity at Korean domestic nuclear power plants to ensure that the shielding design is sufficiently conservative. Some of the drummed waste, such as R/O concentrate, are expected to have higher activity, and ~~can be~~ are 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.

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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.