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.:	**235-8275**
SRP Section:	**12.03 – 12.04 Radiation Protection Design Features**
Application Section:	**12.3 – 12.4**
Date of RAI Issue:	**10/07/2015**

Question No. 12.03-34

10 CFR 20.1602 requires that in addition to the requirements in 10 CFR 20.1601, the licensee shall institute additional measures to ensure that an individual is not able to gain unauthorized or inadvertent access to areas in which radiation levels could be encountered at 500 rads or more in 1 hour at 1 meter from a radiation source or any surface through which the radiation penetrates.

SRP 12.3-12.4 indicates that the staff will review the design features provided to control access to radiologically restricted areas (including potentially very high radiation areas) and that the staff's review will emphasize areas potentially greater than 100 Rad/hour.

In addition SRP 12.5 indicates that the staff will review the description of physical and administrative measures for controlling access to, and work within, radiation areas, high-radiation areas, and very high radiation areas.

In FSAR Table 12.3-5, the applicant lists areas in the plant that could potentially be greater than 100 Rad/hour. Many of these areas are also very high radiation areas (greater than 500 Rad/hour), as indicated in the normal radiation zone figures in FSAR Section 12.3.

While the applicant specifies design features to control access to a few of these significant radiation areas in FSAR Section 12.3.2.3, the applicant does not discuss design features to control access to the other areas. Please update the FSAR to discuss design features to control access for all areas potentially greater than 100 Rad/hour.

Response - (Rev. 2)

As described in DCD Subsection 12.3.2.3 and Table 12.3-5, the APR1400 design contains areas identified to be high radiation areas (areas potentially greater than 100 rad/hr (1 Gy/hr)) and very high radiation areas (areas potentially greater than 500 rad/hr (5 Gy/hr)) which are provided with access control features to prevent inadvertent high radiation exposure to plant

personnel. DCD Subsection 12.3.2.3 addresses the shielding design features for radiation protection, and a Subsection 12.3.2.4 will be added to describe the design features provided for access control for the rooms and areas listed in Table 12.3-5.

Impact on DCD

DCD Subsection 12.3.2.4 will be added, and Table 12.3-5 will be modified 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 Environment Report.

pipe chase. The resin transfer lines are also provided with a flushing capability to minimize the potential for hot spots in the piping.

The ICI chase is potentially a high-radiation area (greater than 1 Gy/hr) during ICI withdrawal. Stringent access control is provided to this area during movement of the ICI. A lockable access door is provided with a warning light. During withdrawal of the ICI, the warning light illuminates, providing indication that the ICI is being moved. An area radiation monitor is located in the ICI chase to provide indication of radiation levels and to alarm the personnel when the ICI is being withdrawn. Emergency egress from the area is also provided from the ICI chase.

Components that handle a significant amount of radioactive materials, such as LWMS floor drain tanks and equipment waste tanks, are located in shielded cubicles separated from the pump and valve galleries that are provided with labyrinths for access to the galleries. This design approach minimizes radiation streaming and scattering but permits inspection and maintenance access and removal of smaller items such as pumps, valves, and instruments for repair in lower-radiation areas. This design approach meets the requirements of NRC RG 8.8 2.b(4). The plant shielding is designed not only to maintain personnel occupational exposure ALARA, but also to maintain exposure to the general public ALARA.

The APR1400 shielding design has target dose rates that are below the limits for radiation zone designations provided in Table 12.3-2 to provide a sufficient margin in maintaining radiation exposure to plant personnel and the public ALARA.

12.3.3 Ventilation

The spread of airborne contamination within the plant is minimized by the design of the plant HVAC systems to provide airflow from areas of lower potential for airborne contamination to areas of greater potential for airborne contamination. For building compartments with the potential for contamination, the exhaust from the areas is designed with pressure and flow balances to minimize the amount of uncontrolled exfiltration from these areas. These design features provide reasonable assurance that the average concentration of radioactive material in the air in the areas that are normally occupied is less than the small fraction of DAC prescribed in 10 CFR Part 20 Appendix B. Therefore,

DCD subsection 12.3.2.4 will be added to include "A" in next page

"A"

12.3.2.4 Access Control to High Radiation and Very High Radiation Areas.

The high radiation and very high radiation areas, areas potentially greater than 1 Gy/hr and 5Gy/hr, respectively, as identified in Table 12.3-5, which are located in the containment building have multiple features of access control to prevent inadvertent radiation exposure to plant personnel. These very high radiation areas include the ICI cavity, the hold-up volume tank, the core debris chamber, the reactor cavity, the steam generator cavity, and the reactor drain tank room. Access to the containment building is strictly controlled and built-in design features to prevent inadvertent access include a secure air lock as the only point of entry for personnel, the door to which is locked and equipped with a security alarm. In addition to the access control provided at the point of entry into the containment building, separate barriers with individual locked doors are provided for each of these very high radiation areas in accordance with the guidance of RG 8.38 (Reference 18).

The high radiation areas on Elevations 78' and 86' of the auxiliary building are located within a block where thick concrete walls are provided as shielding to the surrounding areas. There are no doors provided to allow access to the high radiation cubicles within this block. These cubicles include the pre-holdup ion exchanger pit, the purification ion exchanger pit, the purification filter pit, and the filter area. This block of filters and ion exchangers can only be accessed from the elevation 100' level via manway, which are locked at all times and are further under administrative controls to prevent unauthorized access. Also on Elevations 100' and 120' of the auxiliary building is the volume control tank cubicle, which is a potentially high radiation area. This cubicle, which is not normally accessed by personnel, is locked and can only be opened by key from the outside.

The areas listed in Table 12.3-5 at the Elevation 120' level of the auxiliary building, which are high radiation areas during refueling operations, include the transfer tube inspection area, the cask loading pit, the refueling canal, and the spent fuel pool. The cask loading pit and refueling canal, and the spent fuel pool do not allow for inadvertent personnel access as these areas do not have an entrance for personal entry, and since the transfer tube access area is locked normally, the transfer tube inspection area cannot be accessed.

The areas listed in Table 12.3-5 as high and very high radiation areas within the compound building are all provided with access control in the form of locked doors. These rooms are provided with a latch bolt operated by key from the outside or by a rotating inside knob/lever. The two exceptions to this form of access control are the hot pipe way on Elevation 77' and the charcoal delay bed room. The hot pipe way and the charcoal delay bed room are not provided with a door for personnel access. The only accesses to these areas are via the hatches provided on Elevation 85' and 120', respectively. Since these hatches are intended for maintenances or equipment removal, and are equipped with heavy concrete blocks, unauthorized access is not possible.

Table 12.3-5 (1 of 2)

Areas Potentially Greater than 1 Gy/hr(1)

Auxiliary and Containment Building El. 55ft; see Figure 12.3-1

Area	Coordinates
ICI Cavity	AF-AG, 18-19

Auxiliary and Containment Building El. 78ft; see figures 12.3-2 and 3

Area	Coordinates
Hold-Up Volume Tank	AE-AG, 20-21
Core Debris Chamber	AE-AG, 17-18
Pre-Holdup Ion Exchanger Pit	AC-AD, 23-24
Purification Ion Exchanger Pit	AB-AC, 23-24
Purification Filter Pit	AC-AD, 24-25
Filter Area	AA-AB, 24-25

Auxiliary and Containment Building El. 100ft; see Figure 12.3-4

Area	Coordinates
Reactor Cavity	AE-AG, 18-20
Steam Generator Cavity	AD-AE & AG-AH, 19
Reactor Drain Tank Room	AE-AF, 16-17
Volume Control Tank Room	AD-AE, 24-25

Auxiliary and Reactor Containment Building El. 120.0 ft; see Figure 12.3-5

Area	Coordinates
Refueling Pool Area	AE-AG, 17-21
Fuel Transfer Tube(2)	AF-AG, 21-23
Spent Fuel Pool(2)	AG-AH, 23-25
Cask Loading Pit(2)	AH-AI, 23-24
Refueling Canal(2)	AF-AG, 23-25

(1) During normal operating conditions and AOOs

(2) Only when fuel is in the area

Replace this table with "B"

Table 12.3-5 (2 of 2)

Compound Building El. 63ft; see Figure 12.3-10

Area	Coordinates
GRS Header Drain Tank Room	PB-PC, 38-39
Spent Resin Long Term Storage Tank Room	PC-PD, 38-39
Future Use	PD-PE, 38-39
Hot Pipe Chase	PI-PJ, 38-39

Compound Building El. 77ft; see Figure 12.3-11

Area	Coordinates
Hot Pipe Way	PA-PI, 33-39

Compound Building El. 85ft; see Figure 12.3-12

Area	Coordinates
R/O Membrane Module & Valve Skid Room	PI-PJ, 37-39

Compound Building El. 100ft; see Figure 12.3-13

Area	Coordinates
Charcoal Delay Bed Room	PB-PC, 38-39
Spent Filter Drum Storage Area	PI-PJ, 38-39
Truck Bay(3)	PF-PG, 37-39
Future Extension Area(3)	PE-PF, 37-39

(3) Only during transfer and drumming of spent filter and spent resin

Replace this table with "B"

B

Table 12.3-5 (1 of 2)

Areas Potentially Greater than 1 Gy/hr(1)

Auxiliary and Containment Building El. 55ft; see Figure 12.3-1

Area	Coordinates	HRA / VHRA(3)	Access Control
ICI Cavity	AF-AG, 18-19	VHRA	Locked Door

Auxiliary and Containment Building El. 78ft; see figures 12.3-2 and 3

Area	Coordinates	HRA / VHRA	Access Control
Hold-Up Volume Tank	AE-AG, 20-21	HRA	Locked Door
Core Debris Chamber VH	AE-AG, 17-18	VHRA	Locked Door
Pre-Holdup Ion Exchanger Pit	AC-AD, 23-24	HRA	Hatch
Purification Ion Exchanger Pit VH	AB-AC, 23-24	VHRA	Hatch
Purification Filter Pit VH	AC-AD, 24-25	VHRA	Hatch
Filter Cartridge Storage VH	AA-AB, 24-25	VHRA	Hatch

Auxiliary and Containment Building El. 100ft; see Figure 12.3-4

Area	Coordinates	HRA / VHRA	Access Control
Reactor Cavity VH	AE-AG, 18-20	VHRA	Locked Door
Steam Generator Cavity	AD-AE & AG-AH, 19	HRA	Locked Door
Reactor Drain Tank Room	AE-AF, 16-17	HRA	Locked Door
Volume Control Tank Room VH	AD-AE, 24-25	VHRA	Locked Door

Auxiliary and Reactor Containment Building El. 120.0 ft; see Figure 12.3-5

Area	Coordinates	HRA / VHRA	Access Control
Refueling Pool Area(2)	AE-AG, 17-21	VHRA	No Entrance
Transfer Tube Inspection Area(2)	AF-AG, 21-23	VHRA	Locked Door
Spent Fuel Pool(2)	AG-AH, 23-25	VHRA	No Entrance
Cask Loading Pit(2)	AH-AI, 23-24	VHRA	No Entrance
Refueling Canal(2)	AF-AG, 23-25	VHRA	No Entrance

(1) During normal operating conditions and AOOs

(2) Only when fuel is in the area

(3) HRA : High Radiation Area,
VHRA : Very High Radiation Area (Greater than 5 Gy/hr)

B

Table 12.3-5 (2 of 2)

Compound Building El. 63ft; see Figure 12.3-10

Area	Coordinates	HRA / VHRA	Access Control
GRS Header Drain Tank Room	PB-PC, 38-39	HRA	Locked Door
Spent Resin Long Term Storage Tank Room	PC-PD, 38-39	VHRA	Locked Door
Future Use	PD-PE, 38-39	VHRA	Locked Door
Hot Pipe Chase	PI-PJ, 38-39	HRA	Locked Door
Instrument Calibrator Facility(4)	PB-PC, 32-33	VHRA	Locked Door

Compound Building El. 77ft; see Figure 12.3-11

Area	Coordinates	HRA / VHRA	Access Control
Hot Pipe Way	PA-PI, 33-39	HRA	Hatch

Compound Building El. 85ft; see Figure 12.3-12

Area	Coordinates	HRA / VHRA	Access Control
R/O Membrane Module & Valve Skid Room	PI-PJ, 37-39	HRA	Locked Door

Compound Building El. 100ft; see Figure 12.3-13

Area	Coordinates	HRA / VHRA	Access Control
Charcoal Delay Bed Room	PB-PC, 38-39	VHRA	Hatch
Spent Filter Drum Storage Area	PI-PJ, 38-39	VHRA	Locked Door
Truck Bay(5)	PF-PG, 37-39	HRA	Locked Door
Future Extension Area(5)	PE-PF, 37-39	HRA	Locked Door

(4) Only when the calibration is performed

(5) Only during transfer and drumming of spent filter and spent resin

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.:	**235-8275**
SRP Section:	**12.03 – 12.04 Radiation Protection Design Features**
Application Section:	**12.3 – 12.4**
Date of RAI Issue:	**10/07/2015**

Question No. 12.03-41

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 12.3-12.4 indicates that the plant shielding design and normal operation radiation zoning should consider conditions of normal operation, refueling, and anticipated operational occurrences (AOOs), including fuel handling and storage and radioactive material handling, processing, use, storage, and disposal.

ISSUE

FSAR Table 12.3-4 provides design basis minimum radiation shield thicknesses for the plant. However, while in the response to RAI 7930, Question 12.03-6, the applicant provided shielding information for the refueling canal (room 119-A01B), the applicant does not provide clear shielding information for the fuel transfer tube. In addition, it is unclear if the radiation zones account for radiation dose rates during fuel transfer.

Information Needed

1. Please update FSAR Table 12.3-4 to provide the minimum radiation shield thicknesses for the fuel transfer tube based on transferring of the maximum source term (maximum two fuel assemblies at the earliest time transfer would be allowed by technical specifications) that could be contained within the tube.

2. Please ensure that zoning for the areas surrounding the fuel transfer tube in FSAR Figures 12.3-4 through 12.3-8 include dose contributions from the maximum source term that would be expected within the fuel transfer tube during fuel transfer operations (considering the required minimum shielding to be provided in FSAR Table 12.3-4).

Response – (Rev. 2)

1. The fuel transfer tube inspection area is surrounded by the plant north and south walls, while the west side is adjoining to the containment, and the east side is connected to the refueling canal. The ceiling above is a controlled access area leading to a pipe chase. The floor below the transfer tube inspection area contains another pipe chase. Please refer to Figures 1 and 2 for locations of these cubicles. The radiation zonings during normal power operation are as follows;

   - Cubicle beyond north wall is the mechanical penetration room (cubicle 120-A16B): Zone 6
   - Cubicle beyond south wall is another mechanical penetration room (cubicle 120-A16A): Zone 6
   - West end is connected to the refueling pool area (cubicle 130-C01) inside containment building: Zone 8 during power and refueling operations
   - East end is connected to the refueling canal (cubicle 119-A01B) Zone 2 during power operation and Zone 8 during refueling operations
   - Cubicle immediately above the ceiling is the fuel transfer tube inspection area at 113'-10" elevation (cubicle 113-A01B) are Zone 2 during power operation and Zone 3 during refueling operation
   - Cubicle below the transfer tube inspection area is a pipe chase (078-A21B): Zone 6

   The minimum radiation shield wall thicknesses for the transfer tube inspection area are determined based on the maximum source terms of two spent fuel assemblies at the earliest time during transfer. The wall thicknesses are summarized as follows and will be added into Table 12.3-4 accordingly.

Table 1 Minimum Required Shield Thickness for Fuel Transfer Tube Area

Room Number	Room Name	Minimum Required Shield Thickness (inches)					
		North	South	East	West	Floor	Ceiling
113-A01B	Transfer Tube Inspection Area	44	44	No walls		62	60

It is noted that the transfer tube inspection area at Elevation 113'-10" is not to be accessed during refueling operations. This area can only be accessed through a hatch from cubicle 137-A40B. Cubicle 137-A40B is equipped with administratively locked doors and will have radiation signage posted to prevent inadvertent entry.

TS

Figure 1 The Location of the Fuel Transfer Tube Area (El. 120')

TS

Figure 2 The Location of the Transfer Tube Inspection Area (El. 137'-6")

2. As discussed in item #1 above, the transfer tube inspection area at Elevation 137'-6" will be increased to zone 3 during refueling operation, and additionally, the refueling pool area, the transfer tube inspection area, and the refueling canal at Elevation 120'-0" will be increased to zone 8 during refueling operations. The notes to restrict entrance to the transfer inspection area and to inform the radiation zone increase will be added in Figure 12.3-6 and 12.3-5, respectively. For clarity the room names were revised in Figures 12.3-5 and 6 to be consistent with those indicated in Figures 1 and 2.

Impact on DCD

Table 12.3-4, Figure 12.3-5 and 12.3-6 will be updated as indicated in Attachment 1 and 2.

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.

RAI 141-8098 - Question 12.03-08

RAI 235-8275 -Question 12.03-41

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Table 12.3-4 (4 of 7)

Room Number	Room Name	Minimum Required Shield Thickness (inches)					
		North	South	East	West	Floor	Ceiling
Auxiliary Building (cont.)							
078-A37A	Deborating IX Room	15	12	10	24	24	24
078-A38A	SFP Cleanup Pump Room	23	23	23	10	23	32
078-A39A	Gas Stripper Effluent Radiation Monitor Room	23	23	23	10	16	35
078-A40B	Boric Acid Concentrator Room	16	23	23	14	16	16
086-A01A	Filter Area	-	-	18	21	13	10
100-A32B	SFP Cooling HX Room	10	10	10	10	10	10
100-A29B	Pipe and HVAC Chase	10	12	10	66	10	10
100-A13A	Mechanical Penetration Room	48	48	48	48	34	13
100-A13B	Mechanical Penetration Room	48	10	48	48	36	10
100-A16D	Pipe Chase	48	48	48	48	10	23
100-A16C	Pipe Chase	48	48	48	48	13	10
100-A24A	SFP Cooling HX Room	12	10	12	40	24	10
100-A26A	Valve Room	28	41	21	28	32	10
100-A25A	Volume Control Tank Room	42	42	42	47	48	53
111-A01B	Cask Loading Pit	48	14	48	48	42	-
114-A01B	Spent Fuel Pool	62	60	59	68	71	-
119-A01B	Refueling Canal	60	59	62	48	62	-
120-A16B	Mechanical Penetration Room	29	27	33	48	18	29
120-A16A	Mechanical Penetration Room	20	24	20	48	17	19
120-A23A	Valve Room	18	25	18	18	10	18
120-A14A	SG Blowdown Regen. HX Room	12	10	10	21	14	21
137-A19A	SG Blowdown Flash Tank Room	18	18	18	21	18	18
156-A14A	Aux. Bldg Controlled Area (I) Normal Exhaust ACU Room	18	18	18	18	18	18
174-A15B	Containment High- and Low-volume Purge ACU Room	21	21	21	21	15	10
195-A08B	Aux. Bldg. Controlled Area (II) Normal Exhaust ACU Room	18	18	18	18	18	18

Insert RAI 235-8275 - Question 12.03-41_Rev.1

	~~Fuel Transfer Tube Area~~	44	44	No walls	62	60

113-A01B Fuel Transfer Tube Inspection Area

Figure 12.3-5 Radiation Zones(Normal) Auxiliary/Containment Building El.120'-0"

Figure 12.3-6 Radiation Zones(Normal) Auxiliary/Containment Building El.137'-6"