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.:	**116-8054**
SRP Section:	**14.03.08 - Radiation Protection Inspections, Tests, Analyses, and Acceptance Criteria**
Application Section:	**9.1.2, Tier 1 2.7.4.1**
Date of RAI Issue:	**07/27/2015**

Question No. 14.03.08-2

10 CFR 50, GDC 61, requires that the fuel storage and handling, radioactive waste, and other systems which may contain radioactivity shall be designed to assure adequate safety under normal and postulated accident conditions. These systems shall be designed (1) with a capability to permit appropriate periodic inspection and testing of components important to safety, (2) with suitable shielding for radiation protection, (3) with appropriate containment, confinement, and filtering systems, (4) with a residual heat removal capability having reliability and testability that reflects the importance to safety of decay heat and other residual heat removal, and (5) to prevent significant reduction in fuel storage coolant inventory under accident conditions.

RG 1.13 states that the minimum depth for shielding over fuel assemblies stored in the SFP is 10 feet. There should be no drains, piping, or other systems installed that would allow coolant levels to drain below the adequate shielding depth of 10 feet. It also indicates that gates and weirs that isolate the spent fuel storage pool from the adjacent fuel-handling areas should be designed to prevent coolant inventory from being drained to levels less than 10 feet above the top of the fuel assemblies in the event of a failure of the seals of a single gate.

SRP Section 14.3 indicates that the purpose of inspections, tests, analysis, and acceptance criteria (ITAAC), is to verify that a facility referencing the design certification is built and operates in accordance with the design certification and applicable regulations.

In addition, SRP Section 14.3.8 indicates that the reviewer should ensure that Tier 1 identifies and describes, commensurate with their safety significance, those SSCs that provide radiation shielding, confinement or containment of radioactivity, ventilation of airborne contamination, or radiation (or radioactivity concentration) monitoring for normal operations and during accidents.

Tier 2 Section 9.1.2.2.2 indicates that there will be no piping penetrations in the spent fuel pool lower than 10 feet above the top of the fuel assemblies. It also states that the bottom of the gates that lead from the SFP to the fuel transfer canal and the spent fuel cask loading pit are

above the top of the stored fuel assemblies. Neither section 9.1.2.2.2 nor 9.1.3.3.3, which discusses spent fuel pool dewatering, indicate if water will remain 10 feet above the stored fuel if one of the gates fails.

1. Please provide information demonstrating that, in the event of a failure of any one of the gates that lead from the SFP to the fuel transfer canal and the spent fuel cask loading pit, there will be at least 10 feet of water above fuel stored in the racks. Update Tier 2 of the FSAR to include this information, as appropriate.

2. Provide an ITAAC to verify that there will be no piping penetrations in the SFP lower than 10 feet over the top of fuel assemblies stored in the pool.

3. Provide an ITAAC which verifies the minimum distance between the top of the fuel assemblies and any other openings in the spent fuel pool, besides piping penetrations.

4. Provide an ITAAC that verifies that, in the event of a failure of the gate between the SFP and the fuel transfer canal or the gate between the SFP the spent fuel cask loading pit, the water level in the pool remains 10 feet above the top of fuel assemblies. It may be appropriate for this ITAAC to include the maximum volume of water that could be transferred to the fuel transfer canal and spent fuel cask loading pit, in the event of a single failure of a gate.

Response

KHNP received similar requested information in RAI 98-8051 Question No. 09.01.02-8 and RAI 79-7990 Question No. 09.01.02-7. KHNP has provided the related descriptions and markups in response to these RAIs in transmittals MKD/NW-15-0212L, dated October 26, 2015 for RAI 98-8051, and MKD/NW-15-0209L, dated October 28, 2015 for RAI 79-7990. Below details the specific requested information and the associated RAI response.

1. The spent fuel pool (SFP) water level in the event of a single gate failure is described and provided in response to 09.01.02-8 of RAI 98-8051. The response also includes the related markup for Tier 2 of the DCD.

2. For the location of piping penetration in the SFP, the markup for the related ITAAC is provided in response to 09.01.02-7 of RAI 79-7990.

3. For the distance between the top of the fuel assemblies and any other openings, gate, drains and connections, besides piping penetrations, the markup for the related ITAAC is provided in response to 09.01.02-7 of RAI 79-7990.

4. For the event of a failure of gate, the description and the markup for the related ITTAC is provided in response to 09.01.02-7 of RAI 79-7990.

Impact on DCD

There is no impact on the DCD.

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.

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Docket No. 52-046

RAI No.:	**116-8054**
SRP Section:	**14.03.08 - Radiation Protection Inspections, Tests, Analyses, and Acceptance Criteria**
Application Section:	**Tier 1, Various Sections**
Date of RAI Issued:	**07/27/2015**

Question No. 14.03.08-4

10 CFR 50, GDC 61, requires that the fuel storage and handling, radioactive waste, and other systems which may contain radioactivity shall be designed to assure adequate safety under normal and postulated accident conditions. These systems shall be designed (1) with a capability to permit appropriate periodic inspection and testing of components important to safety, (2) with suitable shielding for radiation protection, (3) with appropriate containment, confinement, and filtering systems, (4) with a residual heat removal capability having reliability and testability that reflects the importance to safety of decay heat and other residual heat removal, and (5) to prevent significant reduction in fuel storage coolant inventory under accident conditions.

SRP Section 14.3 indicates that the purpose of inspections, tests, analysis, and acceptance criteria (ITAAC), is to verify that a facility referencing the design certification is built and operates in accordance with the design certification and applicable regulations.

In addition, SRP Section 14.3.8 indicates that the reviewer should ensure that Tier 1 identifies and describes, commensurate with their safety significance, those SSCs that provide radiation shielding, confinement or containment of radioactivity, ventilation of airborne contamination, or radiation (or radioactivity concentration) monitoring for normal operations and during accidents.

Staff has the following questions related to Area Radiation monitors as they relate to Tier 1 Section 2.7.6.5.

1. A review of Tier 1, Table 2.7.6.5-1, reveals numerous inconsistencies between Tier 1 Table 2.7.6.5-1 and Tier 2 Table 12.3-6 (which both provide information on area radiation monitors). For example, Tier 1 Table 2.7.6.5-1 lists monitors RE-241A and 242B as non-nuclear safety and seismic category 2, while Tier 2 Table 12.3-6 lists them as safety class 3 and seismic category 1. The information associated with monitor RE-236 is also inconsistent between the two tables. Ensure that all information for all

monitors listed in these two tables is consistent and accurate, including tag numbers, safety class, seismic category, electrical class, ranges, etc.

2. The following information in Tier 1, Table 2.7.6.5-1 appears incomplete and is confusing. Please explain or correct this information:

   a. It is unclear why the fuel handling and high range monitors are grouped together in Tier 1, Table 2.7.6.5-1. They are not grouped together in Tier 2, Table 12.3-6.

   b. There is missing information associated with monitors RE-233A and RE-234B in Tier 1, Table 2.7.6.5-1. Please include this missing information.

   c. It is unclear which monitors in Tier 1, Table 2.7.6.5-1 provide the engineered safety features provided in Tier 1, Table 2.7.6.5-2. Please clarify to make this information in these tables consistent with each other.

3. While area radiation monitors RE-321, RE-322, RE-323, RE-324, and RE-325 are listed in Tier 2, Table 12.3-6, they are not listed in Tier 1, Table 2.7.6.5-1. In addition, these monitors have parentheses around them in Tier 2 Table 12.3-6. Please explain why these monitors were excluded from Tier 1, Table 2.7.6.5-1 and why they have parenthesis around them in Tier 2, Table 12.3-6.

4. Table 2.7.6.5-3, item 6, verifies that an ESF initiation signal will be sent to the ESF group control cabinet upon detection of high radiation in the containment operating area and the fuel handling area, using a radiation check source. However, it does not test to verify that the appropriate ESF actually actuates.

   RG 1.118 references IEEE standard 338-1987, IEEE 338-1987 indicates that testing from sensor to actuated equipment is the preferred method of testing. However, where this is not practical, IEEE 338-1987 indicates that the system designshall provide overlap testing capability. IEEE 338-1987 states that overlap testing consists of channel, train, or load group verification by performing individual tests on the various components and subsystems of the channel, train, or load group. The individual component and subsystem tests check common parts of adjacent subsystems, such that the entire channel, train, or load group is verified by testing of individual components or subsystems and by repetitive testing of common parts of adjacent subsystems.

   It is unclear to staff if the ITAAC testing provided for the area radiation monitors provides sufficient overlap testing from the ESF group control cabinet to initiate physical actuation of the emergency safety feature. Please provide information justifying that sufficient overlap testing is provided in accordance with IEEE 338-1987, or justify an alternative approach.

5. NUREG-0737 item II.F.1, attachment 3 specifies that the containment high range monitors be located in containment to view a large segment of the containment atmosphere in order to accurately reflect and monitor accident conditions. However, the application contains no ITAAC verifying that containment monitors are located in an unimpeded location. Please include this ITAAC or justify why it is not needed.

Response

1. The consistency between Tier 1 Table 2.7.6.5-1 and Tier 2 Table 12.3-6 has been reviewed and the information for the radiation monitors contained in these tables will be revised to ensure that the tables are accurate and consistent. In addition, Subsection 12.3.4.1.5 will be revised where necessary to align with the information in the tables.

2. a. Monitors Re-231A and 232B will be listed separately from 233A and 234B in Tier 1 Table 2.7.6.5-1 since they are for different Accident Monitoring Instrument functions; Re-231A and 232B are the containment operating area and Re-233A and 234B are the containment upper operating area monitors.

   b. The classification information associated with monitors RE-233A and RE-234B will be added to Table 2.7.6.5-1.

   c. The radiation signals for actuating engineered safety features, shown in Tier 1, Table 2.7.6.5-2 will be revised to reference the monitor in order to be consistent with Table 2.7.6.5-1.

3. The indicated area radiation monitors, RE-321, RE-322, RE-323, RE-324, and RE-325, are to be used in a site-specific Interim Radwaste Storage Facility (IRSF) that is determined by and the responsibility of the COL applicant, as stated in COL 11.4(7). The detailed information on these radiation monitors will be determined depending on the site specific condition during the COL application phase and will be considered a design provision of a site-wide IRSF. For clarity, these monitors will be deleted in Tier 2, Table 12.3-6 so that it aligns with Tier 1, Table 2.7.6.5-1.

4. For verification testing from the ESFAS-FHEVAS and CPIAS initiation signals to physical actuation of the emergency safety feature (ESF) components, the overlap testing is performed as follows:

   Table 2.7.6.5-3, item 6, verifies that an ESFAS initiation signal is sent to the ESF-CCS group control cabinet upon detection of high radiation in the containment operating area and spent fuel pool area as shown in Table 2.7.6.5-2 for ESFAS initiation condition.

   Table 2.5.4-4, item 5, verifies that the ESF-CCS group control cabinet receives the ESFAS initiation signal from SRDC of the RMS and performs a 1-out-of-2 logic to perform the BOP ESF actuation functions identified in the Table 2.5.4-2, item No. 7 and 8 ,and sends control signals to the ESF components.

   Table 2.7.3.2-3, item 10, verifies that in response to a simulated ESFAS-FHEVAS, the isolation dampers in the air inlet and exhaust ductwork close and the emergency exhaust ACU start.

   Table 2.11.3-2, item 7.a, verifies that in response to a simulated ESFAS-CPIAS, the containment purge isolation valves close. These valves (VQ-0011~0014, VQ-0031~0034) are indicated in Table 2.11.3-1(21 and 22 of 23).

5. The location of containment monitors will be added to item 7 of Subsection 2.7.6.5.1 and ITAAC Table 2.7.6.5-3 as follows:

   The area radiation monitors in the containment are located in an unimpeded location.

Impact on DCD

Tier 1, Subsection 2.7.6.5, Tables 2.7.6.5-1, 2 and 3, and Tier 2, Subsection 12.3.4.1.5 and Table 12.3-6 will be revised as indicated in the attached markup.

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 Report.

2.7.6.5 Area Radiation Monitoring System

2.7.6.5.1 Design Description

The area radiation monitoring system (ARMS) monitors the radiation levels in selected areas throughout the plant. The area monitors warn operators and station personnel of the visible and audible alarm when unusual radiological events occur.

Components of the ARMS are located in the containment building, the auxiliary building, and the compound building.

1. The functional arrangement of the ARMS is described in the Design Description of Subsection 2.7.6.5.1 and in Table 2.7.6.5-1.

2. The ARMS provides operating personnel with an indication and record of radiation levels in the MCR.

3. The monitors provide local readout and alarm units at the detector locations.

4. Separation is provided between Class 1E channels, and between Class 1E division and non-Class 1E division.

5. The seismic Category I monitors of the ARMS identified in Table 2.7.6.5-1 can withstand seismic design basis loads without loss of safety function.

6. The safety-related divisional cabinet (SRDC) of the ARMS provides an automatic ESF initiation signals, as shown in Table 2.7.6.5-2.

2.7.6.5.2 Inspections, Tests, Analyses, and Acceptance Criteria

The ITAAC for the area radiation monitoring system is described on Table 2.7.6.5-3.

7. The containment monitors are located in an unimpeded location.

(mSv/hr)

Table 2.7.6.5-1

Display & Alarm at MCR/RSR/Local

Radiochemistry Lab

Area Radiation Monitoring System Components List

Description	Tag No (1)	Class (2) S	SE	E	Range	Display/ Alarm at MCR/RSR
Post Accident Primary Sample Room	RE-205	N	III	N	10^{-3}~10^{2}	Yes/Yes/Yes
Normal Primary Sample Room	RE-285	N	III	N	10^{-3}~10^{2}	Yes/Yes/Yes
Main Steam & FW Containment Piping Penetration Area	RE-237 RE-238	N	II	N	10^{0}~10^{5}	Yes/Yes/Yes
Fuel Handling ACC & POST-ACC High Range Monitor In Containment	RE-231A RE-232B	3	I	A B A B	10^{-3}~10^{2}	Yes/Yes/Yes
	RE-233A RE-234B				10^{1}~10^{8}	Yes/Yes/Yes
Incore Instrument	RE-235	N	II	N	10^{-3}~10^{2}	Yes/Yes/Yes
Containment Personnel Access Hatch Area	RE-236	3	I	A B	10^{-3}~10^{2}	Yes/Yes/Yes
Spent Fuel Pool Area	RE-241A RE-242B	N	II	N	10^{-3}~10^{2}	Yes/Yes/Yes
New Fuel Storage Area	RE-245	N	III	N	10^{-3}~10^{2}	Yes/Yes/Yes
Hot Machine Shop	RE-293	N	III	N	10^{-3}~10^{2}	Yes/Yes/Yes
Low Level Lab	RE-257	N	III	N	10^{-3}~10^{2}	Yes/Yes/Yes
Instrument Calibration Facility	RE-286	N	II	N	10^{-3}~10^{2}	Yes/Yes/Yes
Main Control Room Area	RE-275	N	III	N	10^{-3}~10^{2}	Yes/Yes/Yes
TSC Area	RE-279	N	III	N	10^{-3}~10^{2}	Yes/Yes/Yes
Truck Bay	RE-289	N	III	N	10^{-3}~10^{2}	Yes/Yes/Yes
Waste Drum Storage Area	RE-292	N	III	N	10^{-3}~10^{2}	Yes/Yes/Yes
Compound Building Dry Active Waste Storage Area	RE-284	N	III	N	10^{-3}~10^{2}	Yes/Yes/Yes

II

II

Deleted

(1) The column "Tag No" is information only (not part of certified design).

(2) S : Safety Class per ANSI/ANS-51.1; 1=SC-1, 2=SC-2, 3=SC-3, N=NNS

SE : Seismic Category; I, II, III

E : Electrical Class ; A, B, C, D=Class 1E Separation Division, N=Non-Class 1E

RE-288
RE-289

N	II	N
3	I	A B

Truck Bay Area

Containment Operating Area	RE-231A RE-232B	3	I	A B	10^{-3} ~ 10^{2}	Yes/Yes/Yes
Containment Upper Operating Area	RE-233A RE-234B	3	I	A B	10^{1} ~ 10^{8}	Yes/Yes/Yes

Table 2.7.6.5-2

Engineered Safety Features Actuation System Initiation Conditions

Containment Purge Isolation Actuation Signal

- High Radiation of the Containment Operation Area (RE-231A, 232B)

Fuel Handling area Emergency Ventilation Actuation Signal

- High Radiation of Spent Fuel Pool Area (RE-241A, 242B)

· High Radiation of the Containment Upper Operating Area (RE-233A, 234B)

Table 2.7.6.5-3 (2 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5. The seismic Category I monitors of the ARMS identified in Table 2.7.6.5-1 can withstand seismic design basis loads without loss of safety function.	5.a. Inspections will be performed to verify that the as-built seismic Category I monitor identified in Table 2.7.6.5-1 is located in a seismic Category I structure(s).	5.a. The as-built seismic Category I monitor identified in Table 2.7.6.5-1 is located in a seismic Category I structure(s).
	5.b. Type test, analyses, or a combination of type tests and analyses of seismic Category I monitor identified in Table 2.7.6.5-1 will be performed.	5.b. A report exists and concludes that the seismic Category I monitor identified in Table 2.7.6.5-1 withstands seismic design basis loads without loss of safety function.
	5.c. Inspections and analyses will be performed to verify that the as-built seismic Category I monitor identified in Table 2.7.6.5-1 including anchorages is seismically bounded by the tested or analyzed conditions.	5.c. A report exists and concludes that the seismic Category I monitor identified in Table 2.7.6.5-1 including anchorages is seismically bounded by the tested or analyzed conditions.
6. The safety-related divisional cabinet (SRDC) of the ARMS provides an automatic ESF initiation signals, as shown in Table 2.7.6.5-2.	6. A Testing of the as-built SRDC will be performed using an integral activated check source.	6. Each as-built ESF initiation signal is sent to ESF-CCS group control cabinet upon detection of high radiation of containment operating area and fuel handling area defined in Table 2.7.6.5-2, if plant's radiation monitors exceed predetermined setpoints for containment purge isolation actuation signal (CPIAS) and fuel handling area emergency ventilation actuation signal (FHEVAS).
7. The containment monitors are located in an unimpeded location.	7.Inspections will be performed to verify that containment monitors are located in an unimpeded location.	7. As-built containment monitors are located in an unimpeded location.

containment away from the influence of the reactor coolant system to measure high-range gamma radiation. This monitor gives operators a seismically and environmentally qualified indication of containment airborne activity. These monitors conform with the requirements of 10 CFR 50.34(f)(2)(xvii) and the criteria in Attachment 3 to Item II.F.1 of NUREG-0737 and NRC RG 1.97.

One of the spent fuel pool area monitors is located on a wall and the other near the SFP bridge area.

288, and 293 236,

b. Non-safety-related area monitors (RE-205, 235, 237, 238, 245, 257, 275, 279, 284, 285, 286, 289, 292, 293, and 242B)

A post-accident primary sampling room area monitor (PR-RE-205) is provided in the auxiliary building and a normal primary sampling room area monitor (PR-RE-285) is provided in the compound building.

Two area monitors (RE-237, 238) are provided in the main steam/feedwater piping penetration area and one area monitor (RE-236) is provided in the containment personnel access hatch.

radiochemistry lab area

An area monitor is provided for the main control room (RE-275) and Technical Support Center (PR-RE-279) to measure gross gamma dose rates.

Other areas where an area monitor is provided are the in-core instrument area (RE-235), hot machine shop area (RE-293), new fuel storage area (RE-245), low-level lab area (RE-257), calibration facility area (RE-286), waste drum storage area (RE-292), compound building truck bay area (RE-289), and dry active waste storage area (RE-284) in compound building.

(RE-288, 289)

12.3.4.1.6 Range and Alarm Setpoints

The ranges of the ARMS are shown on Table 12.3-6. Alarm setpoints for safety-related monitors are determined by plant procedures and the Offsite Dose Calculation Manual (ODCM). The setpoint methodology includes the relationship between the analytical limit, setpoint, and channel uncertainty. The setpoint methodology also provides channel

Function and Remarks

Display & Alarm at MCR/RSR/Local

Yes/Yes/Yes

Table 12.3-6 (1 of 3)

Area Radiation Monitors

Description	Tag No.	Class[1]				Range					Function and Remarks
		S	SE	Q	E	Airborne Particulate	Iodine	Gas	Liquid	Area[2] (mSv/hr)	
Post-accident primary sample room	RE-205	N	III	S	N	N/A	N/A	N/A	N/A	10^{-3}~10^{2}	Alarm (MCR, local)
Normal primary sample room	RE-285	N	III	S	N	N/A	N/A	N/A	N/A	10^{-3}~10^{2}	Alarm (MCR, local)
Main steam and FW containment piping penetration area	RE-237 RE-238	N	II	A	N	N/A	N/A	N/A	N/A	10^{0}~10^{5}	Alarm (MCR, local)
Containment operating area	RE-231A RE-232B	3	I	Q	A B	N/A	N/A	N/A	N/A	10^{-3} ~ 10^{2}	• Alarm (MCR, local) CPIAS
Contaiment upper operating area	RE-233A RE-234B	3	I	Q	A B	N/A	N/A	N/A	N/A	10^{1} ~ 10^{8}	• Alarm (MCR, local) CPIAS
In-core instrument	RE-235	N	II	A	N	N/A	N/A	N/A	N/A	10^{-3} ~ 10^{2}	Alarm (MCR, local)

Function and Remarks

Display & Alarm at MCR/RSR/Local

Yes/Yes/Yes

Radiochemistry lab

Table 12.3-6 (2 of 3)

Description	Tag No.	Class[1]				Range					Function and Remarks
		S	SE	Q	E	Airborne Particulate	Iodine	Gas	Liquid	Area[2] (mSv/hr)	
Containment personnel access hatch area	RE-236	N	II	A	N	N/A	N/A	N/A	N/A	$10^{-3} \sim 10^{2}$	Alarm (MCR, local)
Spent fuel pool area	RE-241A RE-242B	3	I	Q	A B	N/A	N/A	N/A	N/A	$10^{-3} \sim 10^{2}$	• Alarm (MCR, local) • FHEVAS
New fuel storage area	RE-245	N	II	A	N	N/A	N/A	N/A	N/A	$10^{-3} \sim 10^{2}$	Alarm (MCR, local)
Hot machine shop	C-RE-293	N	III	S	N	N/A	N/A	N/A	N/A	$10^{-3} \sim 10^{2}$	Alarm (MCR, local)
Low-level lab	RE-257	N	III	S	N	N/A	N/A	N/A	N/A	$10^{-3} \sim 10^{2}$	Alarm (MCR, local)
Instrument calibration facility	C-RE-286	N	III	S	N	N/A	N/A	N/A	N/A	$10^{-3} \sim 10^{2}$	Alarm (MCR, local)
Main control room area	RE-275	N	II	A	N	N/A	N/A	N/A	N/A	$10^{-3} \sim 10^{2}$	Alarm (MCR, local)
TSC area	RE-279	N	III	S	N	N/A	N/A	N/A	N/A	$10^{-3} \sim 10^{2}$	Alarm (MCR, local)
Truck bay	C-RE-289	N	III	S	N	N/A	N/A	N/A	N/A	$10^{-3} \sim 10^{2}$	Alarm (MCR, local)
Waste drum storage area	C-RE-292	N	III	S	N	N/A	N/A	N/A	N/A	$10^{-3} \sim 10^{2}$	Alarm (MCR, local)
Compound building dry active waste storage area	C-RE-284	N	III	S	N	N/A	N/A	N/A	N/A	$10^{-3} \sim 10^{2}$	Alarm (MCR, local)

Deleted

Truck bay area

C-RE-288
C-RE-289

Deleted

Table 12.3-6 (3 of 3)

Description	Tag No.	Class(1)				Range					Function and Remarks
		S	SE	Q	E	Airborne Particulate	Iodine	Gas	Liquid	Area(2) (mSv/hr)	
[Low radioactive waste storage area]	RE-321	N	III	S	N	N/A	N/A	N/A	N/A	$10^{-3} \sim 10^{5}$	Alarm (MCR, local)
[Medium radioactive waste storage area]	RE-322	N	III	S	N	N/A	N/A	N/A	N/A	$10^{-3} \sim 10^{2}$	Alarm (MCR, local)
[Medium radioactive waste storage area]	RE-323	N	III	S	N	N/A	N/A	N/A	N/A	$10^{-3} \sim 10^{3}$	Alarm (MCR, local)
[Truck bay area]	RE-324	N	III	S	N	N/A	N/A	N/A	N/A	$10^{-3} \sim 10^{5}$	Alarm (MCR, local)
[Crane control room]	RE-325	N	III	S	N	N/A	N/A	N/A	N/A	$10^{-3} \sim 10^{5}$	Alarm (MCR, local)

(1) S: safety Class per ANSI/ANS-51.1; 1=SC-1, 2=SC-2, 3=SC-3, N=NNS
SE: seismic Category I, II, III
E: Electrical Class A, B, C, D=Class 1E Separation Division, N=Non-Class 1E
Q: Quality Class Q, A, S
Refer to Section 3.2 for the definition.

(2) Detector type for area radiation monitor is GM tube or ionization chamber

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APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:	**116-8054**
SRP Section:	**14.03.08 – Radiation Protection Inspection, Tests, Analyses, and Acceptance Criteria**
Application Section:	**Tier 1, Various Sections**
Date of RAI Issue:	**07/27/2015**

Question No. 14.03.08-5

10 CFR 50, GDC 61, requires that the fuel storage and handling, radioactive waste, and other systems which may contain radioactivity shall be designed to assure adequate safety under normal and postulated accident conditions. These systems shall be designed (1) with a capability to permit appropriate periodic inspection and testing of components important to safety, (2) with suitable shielding for radiation protection, (3) with appropriate containment, confinement, and filtering systems, (4) with a residual heat removal capability having reliability and testability that reflects the importance to safety of decay heat and other residual heat removal, and (5) to prevent significant reduction in fuel storage coolant inventory under accident conditions.

10 CFR 50, GDC 64, requires that a means be provided for monitoring the reactor containment atmosphere, spaces containing components for recirculation of loss-of-coolant accident fluids, effluent discharge paths, and the plant environs for radioactivity that may be released from normal operations, including anticipated operational occurrences, and from postulated accidents.

SRP Section 14.3 indicates that the purpose of inspections, tests, analysis, and acceptance criteria (ITAAC), is to verify that a facility referencing the design certification is built and operates in accordance with the design certification and applicable regulations.

In addition, SRP Section 14.3.8 indicates that the reviewer should ensure that Tier 1 identifies and describes, commensurate with their safety significance, those SSCs that provide radiation shielding, confinement or containment of radioactivity, ventilation of airborne contamination, or radiation (or radioactivity concentration) monitoring for normal operations and during accidents.

In reviewing Tier 1, Section 2.7.6.4 and associated Tier 2, Section 11.5, staff has the following questions related to the plant process and effluent radiation monitors and their associated Tier 1 information and ITAAC.

1. While the range and electrical class of the area radiation monitors are provided in Tier 1, Table 2.7.6.5-1, the range and electrical class are not provided for the process and effluent monitors in Table 2.7.6.4-1. Please provide this information in Tier 1 Table 2.7.6.4-1 to ensure that the appropriate range of monitor and electrical class are provided when the facility is designed or provide justification for not including this information.

2. GDC 19 requires that the dose within the main control room not exceed 5 rem during the duration of the accident. Many other applicants' main control room air intake lines monitor for particulates, iodines, and noble gas and emergency control room ventilation is initiated if high particulates, iodines, or noble gas levels are detected. Please justify why noble gas monitors alone are sufficient for main control room emergency ventilation actuation in the APR1400 design and provide information in the FSAR supporting this justification.

3. The main steam line monitors (RE-217, RE-218, RE-219, and RE-220) monitor primary to secondary leakage. For some reactor designs these monitors are safety related. Please indicate why these monitors are not safety related in the APR1400 design. Include reference to applicable information in the FSAR, as appropriate. As part of the response, indicate what instrumentation is being relied upon to detect 150 gallons per day primary to secondary leakage in accordance with technical specification 3.4.12 and if there is an ITAAC associated with that instrumentation and its leakage detection capabilities.

4. Table 2.7.6.4-3, item 5, verifies that an ESF initiation signal will be sent to the ESF group control cabinet upon detection of high radiation in the main control room intake, using a radiation check source. However, it does not test to verify that the ESF function of initiating control room emergency ventilation actually occurs.

   RG 1.118 references IEEE standard 338-1987, IEEE 338-1987 indicates that testing from sensor to actuated equipment is the preferred method of testing. However, where this is not practical, IEEE standard 338-1987 indicates that the system design shall provide overlap testing capability. IEEE 338-1987 states that overlap testing consists of channel, train, or load group verification by performing individual tests on the various components and subsystems of the channel, train, or load group. The individual component and subsystem tests check common parts of adjacent subsystems, such that the entire channel, train, or load group is verified by testing of individual components or subsystems and by repetitive testing of common parts of adjacent subsystems.

   It is unclear to staff if the ITAAC testing provided for the area radiation monitors provides sufficient overlap testing from the ESF group control cabinet to initiate physical actuation of the emergency safety feature. Please provide information justifying that sufficient overlap testing is provided in accordance with IEEE 338-1987, or justify an alternative approach.

Response

1. The additional information for range and class of process and effluent monitors will be provided in the Tier 1 Table 2.7.6.4-1.

2. Since the noble gases are chemically stable and thus the amount of radioactivity that reaches to the MCR intakes are not reduced during and after the accident releases, the detection of noble gases is the most sensitive method to generate the ESFAS-CREVAS by high radiation of MCR intake radiation monitor. Compared to the noble gases, the amount of halogens and particulates released from the core or primary coolant are significantly reduced by various removal mechanisms such as containment sprays and natural deposition in the containment, scrubbing in steam generator or spent fuel pool, condensation after flashing, trapping in the unflashed liquid, dry and wet deposition during transport from release points to MCR air intakes, etc. Therefore, the amount of iodines and particulates at the location of MCR air intakes are relatively low compared to the amount of noble gases. In some cases, the activity of iodines or particulates at the MCR intakes are negligible compared to the noble gas activity. This is the reason why the MCR intake radiation monitors for the APR1400 provide only the noble gas channel.

   Table 1 below shows the activity release rates of particulates, iodines, and noble gases during the first 2.16 seconds after onset of various DBAs. The time of 2.16 seconds is the time for the noble gas activity at the MCR intake monitor to reach the CREVAS setpoint of 0.52 Bq/cc as addressed in the response to RAI 59-7970 (ref. KHNP letter MKD/NW-15-0115L dated 8/31/2015). As shown in Table 1, the amount of iodine and particulate activities released to the environment are significantly lower or even negligible than that for noble gases. It should be noted that since the release rates for iodines and particulates in Table 1 were calculated with conservative assumptions to maximize the releases, the actual values would be much less than the values in Table 1, which would not ensure actuation of CREVAS even if the particulate and iodine channels are provided.

Table 1. Release Rate to the Environment for 2.16 seconds after Accident

Postulated Accident		Radionuclide[1)]	Release Rate [μCi/sec]	Fraction [%]
Steam Line Breaks Outside Containment	Pre-accident Iodine Spike Case	P	1.162E-03	0.0
		I	6.204E+02	30.4
		G	1.424E+03	69.6
	Event-generated Iodine Spike Case	P	1.162E-03	0.0
		I	6.203E+02	30.3
		G	1.424E+03	69.7
	1% Fuel Failure Case	P	3.121E+00	0.0
		I	5.897E+03	29.2
		G	1.429E+04	70.8
Feedwater Line Break		P	5.165E-03	0.0
		I	1.879E+01	2.6
		G	7.111E+02	97.4
Reactor Coolant Pump Rotor Seizure		P	2.196E+01	0.0
		I	1.951E+01	0.0
		G	8.805E+04	100.0
CEA Ejection	Containment Leakage Case	P	4.645E+00	0.0
		I	2.238E+04	54.9
		G	1.838E+04	45.1
	Steam System Release Case	P	5.681E+01	0.0
		I	3.472E+01	0.0
		G	2.248E+05	100.0
Double-Ended Break of the Letdown Line Outside Containment		P	4.112E+00	0.0
		I	0.000E+00	0.0
		G	5.661E+05	100.0
SGTR with a LOOP	Pre-accident Iodine Spike Case	P	2.448E+00	0.0
		I	4.620E+01	0.0
		G	3.370E+05	100.0
	Event-generated Iodine Spike Case	P	2.448E+00	0.0
		I	3.809E+01	0.0
		G	3.370E+05	100.0
LOCA		P	3.161E+01	0.0
		I	9.423E+03	0.9
		G	1.037E+06	99.1
Fuel Handling Accident		P	6.375E+05	0.7
		I	0.000E+00	0.0
		G	9.719E+07	99.3

Note

1) P: Particulate, I : Iodine, G : Noble Gas

3. According to Regulatory Position (3) of RG 1.97, it is required that the most direct indication of the integrity of the three fission product barriers, (i.e., fuel, Reactor Coolant System (RCS) and Containment), and the capability for monitoring beyond the normal operating range be provided. As a primary indication of a rupture of SG tubes, which is a part of the RCS integrity, APR1400 provides the following accident monitoring instrumentation variables that are designed as safety-related systems as given in DCD Table 7.5-1:

   - RCS Pressure
   - Pressurizer Level
   - Steam Generator Level

   The N-16 monitors mounted on the main steam lines are designed to detect the primary to secondary leakage to provide the operator with an indication of SG leakage during normal operation. Even though the N-16 monitors can be used to inform the operator of a SG tube rupture, its main function is to detect the amount of SG tube leakage for verification that the plant is operating within the SG leakage LCO of 150 gal/day per SG allowed in the Technical Specifications Section 3.4.12 and to detect SG leakrate of 30 gal/day as required by NEI 97-06. Therefore, it is not necessary for the N-16 monitors to have a safety function such as initiating a reactor trip or actuating ESF systems since these safety functions are provided by the above safety related accident monitoring instrumentation.

   The main steam line N-16 monitors (RE-217, RE-218, RE-219, and RE-220) are designed to have the capability to detect a SG leakrate of 4.73 L/day (30 gal/day) per SG. Descriptions on the capability of the N-16 monitors are provided in detail in Appendix 11B of the DCD Tier 2.

   The main steam line monitors are provided in Table 2.7.6.4-1 and the corresponding ITAAC, Table 2.7.6.4-3, item 3, verifies that all display and alarms are received in the MCR and RSR as defined in Table 2.7.6.4-1.

4. For verification testing from the ESFAS-FHEVAS and CPIAS initiation signals to physical actuation of the emergency safety feature (ESF) components, the overlap testing are performed as follows:

   Table 2.7.6.5-3, item 6, verifies that an ESFAS initiation signal is sent to the ESF-CCS group control cabinet upon detection of high radiation in the containment operating area and spent fuel pool area as shown in Table 2.7.6.5-2 for ESFAS initiation condition.

   Table 2.5.4-4, item 5, verifies that the ESF-CCS group control cabinet receives the ESFAS initiation signal from SRDC of the RMS and performs a1-out-of-2 logic to perform the BOP ESF actuation functions identified in the Table 2.5.4-2, item No. 7 and 8, and sends control signals to the ESF components.

   Table 2.7.3.2-3, item 10, verifies that in response to a simulated ESFAS-FHEVAS, the isolation dampers in the air inlet and exhaust ductwork close and the emergency exhaust ACU start. Table 2.11.3-2, item 7.a, verifies that in response to a simulated

ESFAS-CPIAS, the containment purge isolation valves close. These valves (VQ-0011~0014, VQ-0031~0034) are indicated in Table 2.11.3-1 (21 and 22 of 23).

Impact on DCD

DCD Tier 1 Table 2.7.6.4-1 will be revised as indicated in the attached markup.

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.

APR1400 DCD TIER 1

Table 2.7.6.4-1 (1 of 5)

Format changed and safety class information added

Range information added

Display & Alarm at MCR/RSR/

No/No/No

Process and Effluent Radiation Monitoring and Sampling System Components List

Description	Tag No (1)	Monitor Type (3)	Location	Class (4)			Range (μCi/cc) (5)				~~Display/ Alarm at MCR/RSR~~
				S	SE	E	Particulate Gross β	I-131 γ	Gas Gross β	Liquid Gross γ	
High Energy Line Break Area Exhaust ACU Effluent	PR-RE-006	Sampler (P,I)	Auxiliary Building	N	III	N	Sampler	Sampler	N/A	N/A	~~Yes/Yes/Yes~~
High Energy Line Break Area Exhaust ACU Inlet	PR-RE-007	P, I, G	Auxiliary Building	N	III	N	1.0×10^{-11} to 1.0×10^{-3}	1.0×10^{-11} to 1.0×10^{-3}	1.0×10^{-6} to 1.0×10^{3}	N/A	Yes/Yes/Yes
Aux BLDG Controlled Area I Exhaust ACU Inlet	PR-RE-013	P, I, G	Auxiliary Building	N	II	N	1.0×10^{-11} to 1.0×10^{2}	1.0×10^{-11} to 1.0×10^{2}	1.0×10^{-6} to 1.0×10^{3}	N/A	Yes/Yes/Yes
Aux BLDG Controlled Area II Exhaust ACU Inlet	PR-RE-014	P, I, G	Auxiliary Building	N	II	N	1.0×10^{-11} to 1.0×10^{2}	1.0×10^{-11} to 1.0×10^{2}	1.0×10^{-6} to 1.0×10^{3}	N/A	Yes/Yes/Yes
Aux BLDG Controlled Area I Normal Exhaust ACU Effluent	PR-RE-015	Sampler (P,I)	Auxiliary Building	N	II	N	Sampler	Sampler	N/A	N/A	~~Yes/Yes/Yes~~
Aux BLDG Controlled Area II Normal Exhaust ACU Effluent	PR-RE-016	Sampler (P,I)	Auxiliary Building	N	II	N	Sampler	Sampler	N/A	N/A	~~Yes/Yes/Yes~~
Aux BLDG Controlled Area I Emergency Exhaust ACU Inlet	PR-RE-017	P, I, G	Auxiliary Building	N	II	N	1.0×10^{-11} to 1.0×10^{2}	1.0×10^{-11} to 1.0×10^{2}	1.0×10^{-6} to 1.0×10^{3}	N/A	Yes/Yes/Yes
Aux BLDG Controlled Area II Emergency Exhaust ACU Effluent	PR-RE-018	~~Sampler (P,I)~~	Auxiliary Building	N	II	N	1.0×10^{-11} to 1.0×10^{2}	1.0×10^{-11} to 1.0×10^{2}	1.0×10^{-6} to 1.0×10^{3}	N/A	Yes/Yes/Yes
Aux BLDG Controlled Area I Emergency Exhaust ACU Effluent	PR-RE-019	Sampler (P,I)	Auxiliary Building	N	II	N	Sampler	Sampler	N/A	N/A	~~Yes/Yes/Yes~~

P, I, G

No/No/No

APR1400 DCD TIER 1

Format changed and safety class information added

Table 2.7.6.4-1 (2 of 5)

Range information

Display & Alarm at MCR/RSR/Local

No/No/No

Description	Tag No (1)	Monitor Type (3)	Location	Class (4)			Range (μCi/cc) (5)				~~Display/ Alarm at MCR/RSR~~
				S	SE	E	Particulate Gross β	I-131 γ	Gas Gross β	Liquid Gross γ	
Aux BLDG Controlled Area II Emergency Exhaust ACU Effluent	PR-RE-020	Sampler (P,I)	Auxiliary Building	N	II	N	Sampler	Sampler	N/A	N/A	~~Yes/Yes/Yes~~
Containment Purge Effluent	PR-RE-037	P, I, G	Auxiliary Building	N	II	N	1.0×10^{-11} to 1.0×10^{2}	1.0×10^{-11} to 1.0×10^{2}	1.0×10^{-6} to 1.0×10^{5}	N/A	Yes/Yes/Yes
Containment Air	PR-RE-039A	P, I, G	Auxiliary Building	3	I	B	1.0×10^{-9} to 1.0×10^{-3}	1.0×10^{-9} to 1.0×10^{-3}	1.0×10^{-6} to 1.0×10^{1}	N/A	Yes/Yes/Yes
Containment Air	PR-RE-040B	P, I, G	Auxiliary Building	3	I	B	1.0×10^{-9} to 1.0×10^{-3}	1.0×10^{-9} to 1.0×10^{-3}	1.0×10^{-6} to 1.0×10^{1}	N/A	Yes/Yes/Yes
Fuel Handling Area HVAC Effluent	PR-RE-043	P, I, G	Auxiliary Building	N	II	N	1.0×10^{-11} to 1.0×10^{-5}	1.0×10^{-11} to 1.0×10^{-5}	1.0×10^{-6} to 1.0×10^{3}	N/A	Yes/Yes/Yes
Condenser Vacuum Vent Effluent	PR-RE-063	Gas & Sampler (P, I)	Turbine Building	N	III	N	Sampler	Sampler	1.0×10^{-6} to 1.0×10^{-1}	N/A	Yes/Yes/Yes
Main Control Room Air Intake	PR-RE-071A	Gas	Auxiliary Building	3	I	A	N/A	N/A	1.0×10^{-6} to 1.0×10^{-1}	N/A	Yes/Yes/Yes
Main Control Room Air Intake	PR-RE-072B	Gas	Auxiliary Building	3	I	B	N/A	N/A	1.0×10^{-6} to 1.0×10^{-1}	N/A	Yes/Yes/Yes
Main Control Room Air Intake	PR-RE-073A	Gas	Auxiliary Building	3	I	A	N/A	N/A	1.0×10^{-6} to 1.0×10^{-1}	N/A	Yes/Yes/Yes
Main Control Room Air Intake	PR-RE-074B	Gas	Auxiliary Building	3	I	B	N/A	N/A	1.0×10^{-6} to 1.0×10^{-1}	N/A	Yes/Yes/Yes

APR1400 DCD TIER 1

Format changed and safety class information added

Table 2.7.6.4-1 (3 of 5)

Range information added

Display & Alarm at MCR/RSR/Local

No/No/No

Description	Tag No (1)	Monitor Type (3)	Location	Class (4)			Range (μCi/cc) (5)				~~Display/ Alarm at MCR/RSR~~
				S	SE	E	Particulate Gross β	I-131 γ	Gas Gross β	Liquid Gross γ	
Gaseous Radwaste System Exhaust	PR-RE-080	Gas	Compound Building	N	III	N	N/A	N/A	1.0×10^{-3} to 1.0×10^{2}	N/A	Yes/Yes/Yes
Comp. BLDG HVAC Effluent	PR-RE-082	Sampler (P,I)	Compound Building	N	III	N	Sampler	Sampler	N/A	N/A	~~Yes/Yes/Yes~~
Comp. BLDG Exhaust ACU Inlet	PR-RE-083	P, I, G	Compound Building	N	III	N	1.0×10^{-11} to 1.0×10^{-5}	1.0×10^{-11} to 1.0×10^{-5}	1.0×10^{-6} to 1.0×10^{2}	N/A	Yes/Yes/Yes
Comp. BLDG Hot Machine Shop ACU outlet	PR-RE-084	P, I, G	Compound Building	N	III	N	1.0×10^{-11} to 1.0×10^{-5}	1.0×10^{-11} to 1.0×10^{-5}	1.0×10^{-6} to 1.0×10^{-1}	N/A	Yes/Yes/Yes
Condensate Receiver Tank	PR-RE-103	Liquid	Auxiliary Building	N	III	N	N/A	N/A	N/A	1.0×10^{-6} to 1.0×10^{-1}	Yes/Yes/Yes
CCW Supply Header (TRN A)	PR-RE-111	Liquid	Auxiliary Building	N	A	N	N/A	N/A	N/A	1.0×10^{-6} to 1.0×10^{-1}	Yes/Yes/Yes
CCW Supply Header (TRN B)	PR-RE-112	Liquid	Auxiliary Building	N	II	N	N/A	N/A	N/A	1.0×10^{-6} to 1.0×10^{-1}	Yes/Yes/Yes
ESW PUMP Discharge Header (TRN A)	PR-RE-113	Liquid	CCW HX Building	N	II	N	N/A	N/A	N/A	1.0×10^{-6} to 1.0×10^{-1}	Yes/Yes/Yes
ESW PUMP Discharge Header (TRN B)	PR-RE-114	Liquid	CCW HX Building	N	II	N	N/A	N/A	N/A	1.0×10^{-6} to 1.0×10^{-1}	Yes/Yes/Yes

APR1400 DCD TIER 1

Format changed and safety class information added

Table 2.7.6.4-1 (4 of 5)

Range information added

Display & Alarm at MCR/RSR/Local

Monitor deleted

Description	Tag No (1)	Monitor Type (3)	Location	Class (4)			Range (μC/cc) (5)				~~Display/ Alarm at MCR/RSR~~
				S	SE	E	Particulate Gross β	I-131 γ	Gas Gross β	Liquid Gross γ	
Condensate Polishing Area Sump Water	PR-RE-164	Liquid	Turbine Building	N	III	N	N/A	N/A	N/A	1.0×10^{-6} to 1.0×10^{-1}	Yes/Yes/Yes
Liquid Radwaste System Effluent	PR-RE-183	Liquid	Compound Building	N	III	N	N/A	N/A	N/A	1.0×10^{-6} to 1.0×10^{-1}	Yes/Yes/Yes
Liquid Radwaste System Effluent	PR-RE-184	Liquid	Compound Building	N	III	N	N/A	N/A	N/A	1.0×10^{-6} to 1.0×10^{-1}	Yes/Yes/Yes
Steam Generator Blowdown Line	PR-RE-104	Liquid	Auxiliary Building	N	A	N	N/A	N/A	N/A	1.0×10^{-6} to 1.0×10^{-1}	Yes/Yes/Yes
CVCS Letdown Line	CV-RE-036	Liquid	Auxiliary Building								Yes/Yes/Yes
CVCS letdown	CV-RE-204	Liquid	Auxiliary Building	N	II	N	N/A	N/A	N/A	1.0×10^{-4} to 1.0×10^{2}	Yes/Yes/Yes
CVCS gas stripper effluent	CV-RE-265	Liquid	Auxiliary Building	N	II	N	N/A	N/A	N/A	1.0×10^{-4} to 1.0×10^{1}	Yes/Yes/Yes
~~Process Sample Panel~~	PR-RE-185	Liquid	Compound Building	N	III	N	N/A	N/A	N/A	1.0×10^{-6} to 1.0×10^{-1}	Yes/Yes/Yes
~~Process Sample Panel~~	PR-RE-186	Liquid	Compound Building	N	III	N	N/A	N/A	N/A	1.0×10^{-6} to 1.0×10^{-1}	Yes/Yes/Yes
~~FP & Water /Waster Water Treatment BLDG~~	PR-RE-190	Liquid	Waste Water Treatment Building	N	III	N	N/A	N/A	N/A	1.0×10^{-7} to 1.0×10^{-1}	Yes/Yes/Yes

Collective sewage treatment sump

Steam Generator 1 Downcomer

Monitor added

Steam Generator 2 Downcomer

APR1400 DCD TIER 1

Format changed and safety class information added

Table 2.7.6.4-1 (5 of 5)

Range information added

Display & Alarm at MCR/RSR/Local

Description	Tag No (1)	Monitor Type (3)	Location	Class (4)			Range (μCi/cc) (5)				~~Display/ Alarm at MCR/RSR~~
				S	SE	E	Particulate Gross β	I-131 γ	Gas Gross β	Area	
Main Steam Line	PR-RE-217	Gas(2)	Auxiliary Building	N	II	N	N/A	N/A	N/A	2.7×10^{-9} to 2.7×10^{-3}	Yes/Yes/Yes
Main Steam Line	PR-RE-218	Gas(2)	Auxiliary Building	N	II	N	N/A	N/A	N/A	2.7×10^{-9} to 2.7×10^{-3}	Yes/Yes/Yes
Main Steam Line	PR-RE-219	Gas(2)	Auxiliary Building	N	II	N	N/A	N/A	N/A	2.7×10^{-9} to 2.7×10^{-3}	Yes/Yes/Yes
Main Steam Line	PR-RE-220	Gas(2)	Auxiliary Building	N	II	N	N/A	N/A	N/A	2.7×10^{-9} to 2.7×10^{-3}	Yes/Yes/Yes

(1) The column "Tag No" is information only (not part of certified design).

(2) N-16 monitoring function is embedded in the Main Steam Line Area Radiation Monitor.

(3) Monitor Type

P : Particulate, I : Iodine, G : Noble gas, Liquid

Notes added

(4) S = Safety Class per ANSI/ANS 51.1 (Reference 32): 1 = SC-1, 2 = SC-2, 3 = SC-3, N = NNS

SE = Seismic Category: I, II, III

E = Electrical Class: A, B, C, D = Class 1E Separation Division, N = Non-Class 1E

Q = Quality Class: Q, A, S

(5) Detector type and calibration nuclide for each measurement:

Particulate Gross β = β scintillator with Cs-137

Gas Gross β = β scintillator with Kr-85

Liquid Gross γ = γ scintillator with Cs-137

Iodine γ = γ scintillator with Ba-133

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.:	**116-8054**
SRP Section:	**14.03.08 - Radiation Protection Inspections, Tests, Analyses, and Acceptance Criteria**
Application Section:	**Tier 1, Various Sections**
Date of RAI Issued:	**07/27/2015**

Question No. 14.03.08-8

10 CFR 50, GDC 61, requires that the fuel storage and handling, radioactive waste, and other systems which may contain radioactivity shall be designed to assure adequate safety under normal and postulated accident conditions. These systems shall be designed (1) with a capability to permit appropriate periodic inspection and testing of components important to safety, (2) with suitable shielding for radiation protection, (3) with appropriate containment, confinement, and filtering systems, (4) with a residual heat removal capability having reliability and testability that reflects the importance to safety of decay heat and other residual heat removal, and (5) to prevent significant reduction in fuel storage coolant inventory under accident conditions.

SRP Section 14.3 indicates that the purpose of inspections, tests, analysis, and acceptance criteria (ITAAC), is to verify that a facility referencing the design certification is built and operates in accordance with the design certification and applicable regulations.

In addition, SRP Section 14.3.8 indicates that the reviewer should ensure that Tier 1 identifies and describes, commensurate with their safety significance, those SSCs that provide radiation shielding, confinement or containment of radioactivity, ventilation of airborne contamination, or radiation (or radioactivity concentration) monitoring for normal operations and during accidents.

Tier 1 Table 2.4.7-1, item 1.e, indicates that a containment airborne particulate radioactivity monitor will be used to detect reactor coolant leakage. It is unclear to staff which monitor is being credited to do this. Please provide the monitor tag number of the monitor in Table 2.4.7-1, item 1.e, so that it is clear which monitor is being credited for detecting RCS leakage.

Response

The credited containment airborne particulate radioactivity monitors used to detect reactor coolant leakage are PR-RE-039A and PR-RE-040B. A new table, Table 2.4.7-2, will be added to

subsection 2.4.7.1 that provides all of the monitors used for the Leakage Detection System including the containment airborne particulate radioactivity monitors.

Impact on DCD

DCD Tier 1, Subsection 2.4.7.1 and Table 2.4.7-1 will be revised and Table 2.4.7-2 will be added as indicated in the attached markup.

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 Report.

Table 2.4.2-3 In-containment Water Storage System Instrument List 2.4-25

Table 2.4.2-4 In-containment Water Storage System ITAAC 2.4-26

Table 2.4.3-1 Safety Injection System Equipment and Piping Location/Characteristics 2.4-37

Table 2.4.3-2 Safety Injection System Component List 2.4-39

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Table 2.4.4-1 Shutdown Cooling System Equipment and Piping Location/Characteristics 2.4-56

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Table 2.4.5-1 Reactor Coolant Gas Vent System Equipment and Piping Location/Characteristics 2.4-72

Table 2.4.5-2 Reactor Coolant Gas Vent System Component List 2.4-73

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Table 2.4.6-1 Chemical and Volume Control System Equipment and Piping Characteristics 2.4-84

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Table 2.4.7-1 Leakage Detection System ITAAC 2.4-97

Table 2.5.1-1 Reactor Trip System and Engineered Safety Features Initiation Equipment Location and Classification 2.5-5

Table 2.5.1-2 Reactor Trip System Variables 2.5-6

Table 2.5.1-3 Engineered Safety Features Initiation Variables 2.5-7

Table 2.5.1-4 Reactor Trip System and Engineered Safety Features Initiation Bypasses 2.5-8

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Table 2.4.7-2 Leak Detection System Component List 2.4-98

2.4.7 Leakage Detection System

2.4.7.1 Design Description

The leak detection system for reactor coolant pressure boundary (RCPB) provides a means of detecting and, to the extent practical, identifying the source of reactor coolant leakage and monitoring leakage from the reactor coolant system and associated systems.

1. Indications of unidentified coolant leakage into the containment are provided by containment sump level, containment airborne particulate radioactivity, and containment atmosphere humidity. These instrumentations for leak detection system provide alarms and displays in the MCR indicating reactor coolant pressure boundary leakage. listed in Table 2.4.7-2

2.4.7.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.4.7-1 describes the ITAAC for reactor coolant pressure boundary leakage detection system.

Table 2.4.7-1

Leakage Detection System ITAAC

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. Indications of unidentified coolant leakage into the containment are provided by containment sump level monitor, containment airborne particulate radioactivity monitor, and containment atmosphere humidity monitor. These instrumentations for leak detection system provide alarms and displays in the MCR indicating reactor coolant pressure boundary leakage. listed in Table 2.4.7-2	1.a Inspection will be performed on the as-built VDU in the MCR for retrievability of the reactor coolant pressure boundary leakage detection alarms from the as-built containment sump level instruments, the containment airborne particulate radioactivity monitor, and the containment atmosphere humidity monitor.	1.a Alarms from the as-built reactor coolant pressure boundary leakage detection containment sump level instruments, the containment airborne particulate radioactivity monitor, and containment atmosphere humidity monitor can be retrieved on the as-built VDU in the MCR.
	1.b Inspection will be performed on the as-built VDU in the MCR for retrievability of the displays of containment sump level, containment airborne particulate radioactivity, and the containment atmosphere humidity.	1.b Displays of containment sump level, containment airborne particulate radioactivity, and the containment atmosphere humidity can be retrieved on the as-built VDU in the MCR.
	1.c Testing, by adding water to the as-built containment sump, and analysis, will be performed.	1.c A report exists and concludes that the as-built containment sump level have the capability to detect a change in leakage rate of 1.89 L/min (0.5 gpm) or greater within an hour.
	1.d Testing and analysis of the as-built containment atmosphere humidity monitor will be performed.	1.d A report exists and concludes that the as-built containment atmosphere humidity monitor has the capability to detect a change in leakage rate of 1.89 L/min (0.5 gpm) or greater within an hour.
	1.e Tests and analyses of the as-built containment airborne particulate radioactivity monitor will be performed.	1.e A report exists and concludes that the as-built containment airborne particulate radioactivity monitor has the required sensitivity and response time, which corresponds to the capability for detecting a change in leakage rate of 1.89 L/min (0.5 gpm) or greater within an hour.

Insert Table 2.4.7-2 shown on the next page

Table 2.4.7-2

Leakage Detection System Monitors List

Description	Tag No	Location	Class (1)			Display & Alarm at MCR/RSR
			S	SE	E	
Containment Airborne Particulate	PR-RE-039A	Containment	3	I	A	Yes/Yes
Containment Airborne Particulate	PR-RE-040B	Containment	3	I	B	Yes/Yes
Containment Atmosphere Humidity	VP-ME-3013	Containment	N	II	N	Yes/Yes
Containment Atmosphere Humidity	VP-ME-3014	Containment	N	II	N	Yes/Yes
Containment Atmosphere Humidity	VP-ME-3015	Containment	N	II	N	Yes/Yes
Containment Atmosphere Humidity	VP-ME-3016	Containment	N	II	N	Yes/Yes
Containment Building Sump Level	DE-LE-006	Containment	N	II	N	Yes/Yes
Containment ICI Cavity Sump Level	DE-LE-007	Containment	N	II	N	Yes/Yes

(1) S : Safety Class per ANSI/ANS-51.1; 1=SC-1, 2=SC-2, 3=SC-3, N=NNS
SE : Seismic Category ; I, II, III
E : Electrical Class ; A, B, C, D=Class 1E Separation Division, N=Non-Class 1E