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## 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: 12.3-12.4  
Date of RAI Issue: 09/24/2015

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### **Question No. 12.03-14**

10 CFR 50.2 defines safety-related structures, systems, and components (SSCs), as those components that are relied upon to remain functional during and following design basis events to assure: (1) The integrity of the reactor coolant pressure boundary; (2) The capability to shut down the reactor and maintain it in a safe shutdown condition; or (3) The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the applicable guideline exposures set forth in 10 CFR 50.34(a)(1) or 10 CFR 100.11, as applicable.

The main steam line radiation monitors are listed as non-safety related, non-seismic, and non-class 1E radiation monitors for the APR1400 design. However, in some new reactor applications the main steam line monitors are safety-related as they provide indication of a steam generator tube rupture, thus mitigating offsite releases.

In addition, FSAR Table 7.5-1 lists the main steam line monitors as variable Type E monitors in accordance with RG 1.97 and IEEE Std. 497-2002, which is referenced in RG 1.97. Since the main steam line monitors are used to indicate a breach of the reactor coolant pressure boundary it is unclear why a higher classification than Type E would not be appropriate for the main steam line monitors, provided the guidance in IEEE Std. 497-2002.

Also, IEEE 497-2002, Section 6.6, provides information on power supply requirements for different type variables. In reviewing paragraph 2 of Section 6.6, it is unclear if it is appropriate for the main steam line monitors to be connected to a non-class 1E power supply which may not be available during accident conditions.

Please provide justification for why it is appropriate for the main steam line monitors to be classified as non-safety related, non-class 1E, and non-seismic Category 1 or update the FSAR as appropriate. If justification is provided, please indicate if other safety-related equipment is being relied on to detect a steam generator tube rupture.

**Response**

The applicant's explanation provided for Item 3 of RAI 116-8054 Question No. 14.03.08-5 points out that the main steam line monitor is designed to detect the primary to secondary leakage. Even though it can be used to detect an SG tube rupture event, its main function is to detect the amount of SG tube leakage. Therefore it is not necessary for the monitor to have a safety function. This is consistent with the information provided in Table 7.5-1.

The explanation provided for Item 3 of RAI 116-8054 further identifies the following three safety related instruments to monitor the SG tube rupture accident:

- RCS pressure
  - Pressurizer level
  - SG level
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**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 Report.

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### **Question No. 12.03-15**

SRP 12.3-12.4 indicates that, the applicant's area radiation monitoring system is designed to (1) monitor the radiation levels in areas where radiation levels could become significant and where personnel may be present, (2) alarm when the radiation levels exceed preset levels to warn of increased radiation levels, and (3) provide a continuous record of radiation levels at key locations throughout the plant.

Main steam line area radiation monitors RE-217 through RE-220 are shown in FSAR Figures 11.5-2K and 11.5-2L as being located on the opposite side of a wall from the main steam lines. Since it would seem that the purpose of these monitors would be to monitor for primary to secondary leakage, it is unclear why they would be located on the opposite side of a wall from the main steam lines.

1. Please indicate if the locations where the monitors are shown in FSAR Figures 11.5-2K and 11.5-2L are the actual locations of the radiation detectors will be located or if that is where the electronics and monitor display is located. Also indicate if the monitors are direct radiation monitors, as eluded to in the FSAR or if the monitors are measuring radiation levels from fluid samples.
2. If the radiation monitors are direct radiation monitors with the detectors located on the opposite side of walls from the main steam lines, please discuss why the locations are appropriate for detecting primary to secondary leakage. In the discussion, discuss the wall thicknesses of the walls separating the detectors from the main steam lines.
3. Update the FSAR, as appropriate, to more accurately describe these monitors and their functions.

In addition, monitors RE-237 and RE-238, which are listed as main steam and feed line containment penetration monitors are located in a near direct radiation streaming path from the main steam line penetrations from containment. Main steam line monitors are identified in FSAR

Table 7.5-1 as being monitors relied on to monitor accident conditions (although it is unclear which monitors are being relied on for this function (RE-217 through RE-220, RE-237, or RE-238) or if all of them are). In a design basis LOCA, it is unclear if monitors RE-237 and RE-238 would be capable of detecting primary to secondary leakage, if that is their purpose, because of the potential of high radiation streaming from containment.

4. Please discuss why the locations of monitors RE-237 and RE-238 are appropriate for these monitors, considering the discussion above.
5. Update the FSAR, including FSAR Appendix 11B and Table 7.5-1, to clarify which monitors are being credited for conforming to NEI 97-06 and post-accident monitoring.

### **Response**

1. The locations shown on Figures 11.5-2K and 11.5-2L are the locations for the electronics and the local display units. The figures will be revised to show the detectors which are directly mounted on the main steam lines.
2. The locations shown on figures 11.5-2K and 11.5-2L are for the electronic portion of the detectors. The sensors are the direct mount type attached to the main steam lines. Please refer to the explanation above and revised marked-up figures.
3. The DCD figure will be revised.
4. RE-237 and RE-238 are located behind a concrete column and, therefore, are not in a direct streaming path from the main steam piping penetrations. The main feedwater piping penetrations are at a different elevation. DCD figures will be revised to show accurate and updated locations.

These two monitors are RG 1.97 Type E variable to assist the operator in determining the accessibility to the containment penetration areas. Their function is not for detection of an accident, so their location is adequate for their assigned function. It is explained in RAI 116-8054 Question No. 14.03.08-5 that RE-217 through 220 is for accident monitoring and the accident considered for these monitors are SG tube leaks.

5. Two postulated accidents need to be considered involving the SG tube, one is the SG tube rupture and the other is the SG tube leak. These two cases were reviewed and explained in detail for how APR1400 design detects and monitors the accidents in the response to RAI 116-8054 Question 14.03.08-5 Item 3.

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### **Impact on DCD**

Tier 2, Figures 11.5-2K, Figures 11.5-2L, and Figures 11.5-2M 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 Report.

APR1400 DCD TIER 2

**Security-Related Information – Withheld Under 10 CFR 2.390**

**Figure 11.5-2K Location of Radiation Monitors at Plant (Auxiliary Building El. 137'-6")**

APR1400 DCD TIER 2

**Security-Related Information – Withheld Under 10 CFR 2.390**

**Figure 11.5-2L Location of Radiation Monitors at Plant (Auxiliary Building El. 137'-6")**

APR1400 DCD TIER 2

**Security-Related Information – Withheld Under 10 CFR 2.390**

**Figure 11.5-2M Location of Radiation Monitors at Plant (Auxiliary Building El. 137'-6")**



**APR1400 DCD TIER 2**

**Security-Related Information – Withheld Under 10 CFR 2.390**

**Figure 11.5-2M+1 Location of Radiation Monitors at Plant (Auxiliary Building El. 137'-6")**

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SRP Section: 12.03-12.04 – Radiation Protection Design Features  
Application Section: 12.3-12.4  
Date of RAI Issue: 09/24/2015

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### **Question No. 12.03-16**

10 CFR 50, Appendix A, GDC 64 requires that, a “means shall 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.”

FSAR Tables 7.5-1, 11.5-1, 11.5-2, and 12.3-6 provide information on radiation monitors. There are apparent inconsistencies and clarification required regarding these tables. Issues identified are as follows:

1. Table 12.3-6, provides main steam and feed water containment piping penetration area, area radiation monitors (RE-237 and RE-238), with a range from  $10^0$  to  $10^5$  mSv/hour; Table 11.5-1 provides main steam line area radiation monitors (RE-217 through RE-220) with a range of  $10^{-4}$  to  $10^2$  mSv/hour, shown on FSAR Figures 11.5-2K and 11.5-2L, as being located in rooms adjacent to the main steam line enclosure; and Table 7.5-1 provides main steam line radiation monitors with a range of  $10^{-3}$  to  $10^2$  mSv/hour.

It is unclear which monitors are being credited for the accident monitoring variables in Table 7.5-1 and why the range of the monitors in Table 7.5-1 does not match up with either Table 12.3-6 or Table 11.5-1. Please clarify and update the FSAR as necessary.

2. It is unclear how the ranges for some of the monitors in FSAR Table 7.5-1 correspond to the ranges in the Chapter 11 tables. For example, for the containment purge and auxiliary building controlled area HVAC, the ranges in Table 7.5-1 correspond to the ranges for, gas gross beta in Table 11.5-1, but the containment purge effluent and auxiliary building controlled area HVAC also contain separate ranges for particulate gross beta, and I-131 gammas. Therefore, the ranges provided in Table 7.5-1 for these

monitors need to specify what they are measuring or provide equivalent information to Chapter 11, for monitor range.

In addition, for the Compound Building HVAC effluent monitor in Table 7.5-1, the range does not correspond to either RE-082 or RE-083 in Table 11.5-1.

Please clarify and update the FSAR as necessary.

In responding to the above, it may be easiest to simply delete the ranges from FSAR Table 7.5-1 and refer to the monitor tag numbers and the information in the Chapter 11 and 12 tables. In responding to this question, please consider FSAR changes made in other RAI responses, including the response to RAI 8087, Question 11.05-1.

### **Response**

1. The response to RAI 116-8054, Question No. 14.03.08-5 provides information on primary indication for Steam Generator Tube Rupture accident, which does not involve any of the radiation monitors. In the same response it is stated that the SG tube leakage event, even though not a design basis accident, is monitored by main steam line monitors (RE-217, 218, 219, and 220).

The containment upper and operating area monitors provide primary indication for the fuel handling accident inside containment and the spent fuel pool area monitors provide indication for the fuel handling accident in the fuel handling area outside the containment.

In addition, the containment upper operating area monitors provide supplementary indication of LOCA.

Tables 7.5-1 will be revised to eliminate the range discrepancies and the updated range information of the Table 11.5-1 was provided in the responses to RAI 131-8087, Question No. 11.05-1.

2. The applicant agrees with the suggestion and the range information in Table 7.5-1 will be deleted to eliminate unnecessary discrepancies. FSAR will be revised accordingly.

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### **Impact on DCD**

Tier 2, Table 7.5-1 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 Report.

## APR1400 DCD TIER 2

Table 7.5-1 (2 of 5)

Variable	Range	Monitored Function or System	Channel Number	Type	Ambiguity (Division)
IRWST Temperature	10 to 177 °C (50 to 350 °F)	IRWST	4	B	C,D (ESCM)
Holdup Volume Tank Level	0 to 100 %	IRWST	4	B	C,D (ESCM)
Containment Level	0 to 100 %	Containment monitoring system	2	B	C,D (ESCM)
Containment Pressure (Wide Range)	-400 to 5,600 cmH <sub>2</sub> O (-5.7 to 79.5 psig)	Maintaining containment integrity	2	B	C,D (PPS OM)
Reactor Cavity Level	0 to 100%	Maintaining containment integrity	4	B	C,D (ESCM)
Containment Isolation Valve Position	N/A	Maintaining containment integrity	1 pair/valve	B, D	Validation (QIAS-P)
Logarithmic Reactor Power	$2 \times 10^{-8}$ to 200 % power	Reactor power	2	B	C,D (PPS OM)
Control Rod Position	0 to 381 cm (0 to 150 in)	Reactivity control	1/rod	B	C,D (CPCS OM)
Containment Pressure (Extended Wide Range)	-500 to 14,500 cmH <sub>2</sub> O (-7.1 to 206.2 psig)	Fission product release	2	C	PPS Containment pressure A,B,C,D (PPS OM)
Containment Operating Area Radiation	<del><math>10^{-3}</math> to <math>10^2</math> mSv/hr</del>	Monitoring fueling handling accident	2	C	C,D (ESCM)
Spent Fuel Pool radiation	<del><math>10^{-3}</math> to <math>10^2</math> mSv/h</del>	Monitoring fueling handling accident	2	C	C,D (ESCM)
Containment Upper Operating Area Radiation	<del><math>10^{-3}</math> to <math>10^8</math> mSv/hr</del>	Monitoring LOCA	2	C	C,D (ESCM)

Refer to range information for Tag No. RE-241A and RE-242B in Table 12.3-6.

Refer to range information for Tag No. RE-231A and RE-232B in Table 12.3-6.

Refer to range information for Tag No. RE-233A and RE-234B in Table 12.3-6.

**APR1400 DCD TIER 2**

Table 7.5-1 (5 of 5)

Refer to range information for Tag No. RE-083 in Table 11.5-1.

Refer to range information for Tag No. RE-037 in Table 11.5-1.

Variable	Range	Monitored Function or System	Channel Number	Type	Ambiguity (Division)
Containment Purge Effluent	<del><math>3.7 \times 10^{-2}</math> to <math>3.7 \times 10^9</math> Bq/ce</del>	Monitoring gaseous effluent in containment building	1	E	N/A
Auxiliary Building Controlled Area HVAC Effluent	<del><math>3.7 \times 10^{-2}</math> to <math>3.7 \times 10^7</math> Bq/ce</del>	Monitoring gaseous effluent of controlled area in AUX. building	2	E	N/A
Compound Building HVAC Effluent	<del><math>3.7 \times 10^{-2}</math> to <math>3.7 \times 10^3</math> Bq/ce</del>	Monitoring gaseous effluent in compound building	1	E	N/A
Liquid Radwaste System Radiation	<del><math>3.7 \times 10^{-2}</math> to <math>3.7 \times 10^3</math> Bq/ce</del>	Monitoring liquid radwaste system radiation	2	E	N/A
Condenser Vacuum Vent Effluent Radiation	<del><math>3.7 \times 10^{-2}</math> to <math>3.7 \times 10^3</math> Bq/ce</del>	Monitoring SG tube leakage	1	E	N/A
MCR and TSC Area Radiation	<del><math>10^{-3}</math> to <math>10^2</math> mSv/hr</del>	Monitoring area radiation level	1	E	N/A
Primary Sampling Room Area Radiation	<del><math>10^{-3}</math> to <math>10^2</math> mSv/hr</del>	Monitoring area radiation level	1	E	N/A
Chemistry Lab. Area Radiation	<del><math>10^{-3}</math> to <math>10^2</math> mSv/hr</del>	Monitoring area radiation level	1	E	N/A
Wind Direction	0 to 360°	Release assessment	1	E	N/A
Wind Speed	0 to 50 mph	Release assessment	1	E	N/A
Atmosphere Stability Temperature Difference	-22.78 to -7.78°C (-9 to +18°F) Delta-T	Release assessment	2	E	N/A
Main Steam Line Radiation	<del><math>10^{-3}</math> to <math>10^2</math> mSv/hr</del>	Monitoring leakage of steam generator	4	E	N/A

Refer to range information for Tag No. RE-183 and RE-184 in Table 11.5-1.

Refer to range information for Tag No. RE-063 in Table 11.5-1.

Refer to range information for Tag No's. RE-217 through RE-220 in Table 11.5-1.

Refer to range information for Tag No. RE-015, 016, 019, and 020 in Table 11.5-1.

Refer to range information for Tag No. RE-275 and RE-279 in Table 12.3-6.

Refer to range information for Tag No. RE-285 in Table 12.3-6.

Refer to range information for Tag No. RE-257 in Table 12.3-6.

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**Application Section:** 12.3-12.4  
**Date of RAI Issue:** 09/24/2015

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### **Question No. 12.03-18**

SRP 12.3-12.4 indicates that, the applicant's area radiation monitoring system is designed to monitor the radiation levels in areas where radiation levels could become significant and where personnel may be present.

In addition, ANSI/ANS-HPSSC-6.8.1-1981, which the applicant references and which is referenced in the SRP indicates that, "Detectors shall be located in those areas which require entry or exit, or both, to be monitored or controlled for purposes of occupational radiation protection which are normally accessible, and where changes in plant conditions can cause significant increases in personnel exposure rate above that expected for the area. Detectors shall be located to best measure the representative exposure rates within the specific area so as to assist in minimizing exposure to personnel."

The in-core instrument monitor (RE-235) is shown in FSAR Figure 11.5-2A (the 156 foot elevation of containment). This is high above the in-core instrumentation cavity area which is located at elevations 100 foot and below. In addition, all other monitors in containment are shown at the 156 foot elevation. It is unclear if the monitor is actually anticipated to be located near the 156 foot elevation or if it will be located at a lower elevation.

1. Please ensure that all monitors in containment are shown at an elevation which best represents their location or update the FSAR accordingly.
2. If the monitors are all located near the 156 foot elevation, please explain why it is not necessary to have monitors on other elevations and why it is not necessary to have the in-core instrument monitor at an elevation far above the in-core instrument cavity.

### **Response**

1. Figure 11.5-2A will be revised to show actual location of the radiation monitors.

2. The ICI area monitor, RE-235, is a radiation monitor for the ICI seal table area. The seal table is located at Elevation 130'-0" near the integrated head assembly lift rig. The seal table area is flooded and is submerged under water during refueling operations. For that reason, the monitor is located above the water level (concrete floor level) of 156'-0" and the monitor is 6'-6" off the 156' level. RE-235 is located directly overlooking the seal table. The ICI cavity area underneath the reactor vessel is rarely accessed. When necessary, a health physicist will accompany maintenance crew with portable dose meter.

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**Impact on DCD**

DCD Tier 2, Figure 11.5-2A 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 Report.



APR1400 DCD TIER 2

**Security-Related Information – Withheld Under 10 CFR 2.390**

**Figure 11.5-2A Location of Radiation Monitors at Plant (Reactor Containment Building El. 156'-0")**

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### **Question No. 12.03-19**

10 CFR 50.68(b)(6) requires that radiation monitors are provided in storage and associated handling areas when fuel is present to detect excessive radiation levels and to initiate appropriate safety actions.

SRP 12.3-12.4 indicates that, the applicant's area radiation monitoring system is designed to monitor the radiation levels in areas where radiation levels could become significant and where personnel may be present.

In addition, ANSI/ANS-HPSSC-6.8.1-1981, which the applicant references and which is referenced in the SRP indicates that, "Detectors shall be located in those areas which require entry or exit, or both, to be monitored or controlled for purposes of occupational radiation protection which are normally accessible, and where changes in plant conditions can cause significant increases in personnel exposure rate above that expected for the area. Detectors shall be located to best measure the representative exposure rates within the specific area so as to assist in minimizing exposure to personnel."

The monitor location for the new fuel storage area (RE-245) is shown in FSAR Figure 11.5-2O in general access area 156-AO5B which is on the other side of a wall from where the new fuel storage area is located. Please indicate why this location is appropriate for the new fuel storage monitor.

### **Response**

The correct location for the monitor is directly above overlooking the new fuel storage area. Figure 11.5-2O will be revised to show the correct location of the monitor.

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**Impact on DCD**

Tier 2, Figures 11.5-20 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 Report.

APR1400 DCD TIER 2

**Security-Related Information – Withhold Under 10 CFR 2.390**

**Figure 11.5-20 Location of Radiation Monitors at Plant (Auxiliary Building El. 156'-0")**