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.:	**368-8470**
SRP Section:	**14.03.08 – Radiation Protection Inspections, Tests, Analyses, and Acceptance Criteria**
Application Section:	**Tier 1**
Date of RAI Issue:	**01/19/2016**

Question No. 14.03.08-14

This is a follow-up to the response to RAI 8054, Questions 14.03.08-4 and 14-03.08-5.

BASIS

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, 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 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.

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."

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.

ISSUES

1. In the response to Question 14.03.08-4, the applicant removed the instrument calibration facility area radiation monitor (referred to as RE-286) from Tier 1, Table 2.7.6.5-1 and Tier 2, Table 12.3-6, although the monitor is still shown in Tier 2, Figure 11.5-2R. However, no information was provided in the response regarding why this monitor was being removed from the design.

   The instrument calibration facility is identified as a potential very high radiation area (exceeding 500 Rad/hour) when unshielded radiation sources are present. Since the area is normally a low radiation area when unshielded sources are not present, monitor RE-286 was in place to alert plant personnel of high radiation levels in the area to ensure that appropriate actions are being taken. Therefore, it would appear that monitor RE-286 is necessary in accordance with the aforementioned regulations and guidance documents.

   As a result, please;

   a) Retain monitor RE-286 in Tier 1, Table 2.7.6.5-1 and Tier 2, Table 12.3-6; or

   b) Provide an explanation for why monitor RE-286 is being removed from the design and justify why monitor RE-286 is not necessary to comply with the aforementioned regulations and to conform to the aforementioned guidance. If this option is chosen, please remove monitor RE-286 from FSAR Figure 11.5-2R, for consistency.

2. With the changes made in the response to Question 14.03.08-4, the application now includes two truck bay monitors (RE-288 and RE-289), however, only one truck bay monitor (RE-289) is shown in FSAR Figure 11.5-2T. Please update the figure to include RE-288, as appropriate.

3. 10 CFR 50.34(f)(xvii) requires that instrumentation be provided that measure containment high level radiation intensity and NUREG-0737 specifies that the monitors be widely separated and view a large fraction of the containment volume. In response to item 5 in Question 14.03.08-4, the applicant proposed adding ITAAC 7 to Tier 1, Table 2.7.6.5-3, to indicate that the containment radiation monitors will be located in an unimpeded location. However, the acceptance criteria for this ITAAC is subjective, which could lead to disagreement to if the criteria is met or not. Please revise this ITAAC so that it specifies the minimum percent unimpeded exposure path of the containment atmosphere free volume for each high range radiation monitor, sufficient to access post LOCA containment radiation conditions, consistent with 10 CFR

50.34(f)(xvii) and the guidance of NUREG-0737 II.F.1, or to reference a figure which clearly shows the vertical and horizontal locations of the monitors and ensures that it has an unimpeded view.

4. In response to item 4 in Question 14.03.08-4, the applicant indicated which ITAAC are used to ensure that when the monitors with emergency safety features (ESF) detect high radiation levels that the appropriate ESF are actuated. Regarding this response, please resolve the following;

   a. During the pre-application review, the applicant indicated that these monitors would be tested with an actual radiation check source and not some type of artificial signal. In order to remove any ambiguity, please include the word “radiation” in front of “check source” in ITAAC 3 and 6 in Table 2.7.6.5-3 and ITAAC 4 and 5 in Table 2.7.6.4-3.

   b. The applicant indicates that the tests from detection of the radiation signal to actuation of the ESF functions are overlap tests, however, this does not appear to be the case. As an example, ITAAC 6 in Table 2.7.6.5-3 states that the ESF initiation signals are sent to the ESF-CCS group control cabinet. If the test was an overlap test, it would also ensure that the ESF-CCS group control cabinet receives the signal appropriately. Then, ITAAC 5 in Table 2.5.4-4 would overlap with ITAAC 6 in Table 2.7.6.5-3, because ITAAC 5 in Table 2.5.4-4 begins with the signal being received by the ESF-CCS group control cabinet. Therefore, please update all ITAAC associated with testing from sensor to actuator to ensure that the tests for radiation monitors with ESF functions are performed with appropriate overlap testing. In lieu of revising multiple ITAAC, the applicant may elect to include a new or separate ITAAC that appropriately tests the monitors with ESF functions from sensor (with a radiation source) to ESF function actuation, in one ITAAC.

   c. The purpose of the ITAAC is to ensure the facility is constructed and operates as referenced in the design certification. In ITAAC Table 2.7.3.2-3, it is unclear why ITAAC 10 would have an acceptance criteria indicating that it is met based on the conclusions reached in a report. It would appear that the isolation of dampers and the start of emergency ventilation would be something that should be physically tested to ensure that everything functions properly. Please revise the acceptance criteria for this ITAAC and other ITAAC associated with actuation functions from radiation monitors so that they ensure that the proper dampers physically close and that the emergency exhaust ventilation physically starts properly (or other action is appropriately performed) or explain and provide justification for why it is appropriate to rely on the conclusions reached in a report for these ITAAC.

   d. In addition, ITAAC 10 in Table 2.7.3.2-3 does not provide any minimum timeframe for damper closure or the start of the emergency ventilation. Please update ITAAC 10 in Table 2.7.3.2-3 or provide a new ITAAC to include this information.

5. In the response to item 1 of Question 14.03.08-5, the applicant proposed adding new information to Tier 1, Table 2.7.6.4-1. The following questions are a result of the proposed changes:

a. Staff notes that the seismic category of monitors PR-RE-111 and PR-RE-104 is listed as “A.” Since there is no definition for seismic category A in the design, please correct this apparent error.

b. For the CVCS Letdown Line monitor (CV-RE-036), the class and range information is blank. In addition, staff cannot find any information in Tier 2 Chapters 11 and 12 regarding this monitor. Please provide additional information regarding this monitor and its purpose and resolve these issues.

c. The proposed addition of Note (4) to the table states, “Q = Quality Class: Q, A, S” however, there is no relevant information provided in Table 2.7.6.4-1 corresponding to this note. In addition, Tier 2 Tables 11.5-1 and 12.3-6 include the same note and the tables include a quality class column with each monitor listed as either Q, A, S, or T. Please provide information defining quality class and describing what the different designations mean and either remove the designation from Tier 1 or provide the column listing the information. Provide FSAR updates to describe quality class, delete unnecessary information or resolve inconsistencies, as appropriate.

6. In item 4 of Question 14.03.08-5, staff requested that the applicant provide information on the overlap testing ITAAC in place for the main control room air intake monitors to ensure that the appropriate ESF function of isolating normal ventilation and starting emergency ventilation occurs (beginning with Tier 1 Table 2.7.6.4-3). Instead of providing this information the applicant provided information on the testing provided for the radiation monitors associated with containment purge isolation and fuel handling emergency ventilation. However, staff believes the correct set of ITAAC for testing the main control room radiation monitors for emergency actuation are ITAAC 5 in Table 2.7.6.4-3, ITAAC 5 in Table 2.5.4-4, and several ITAAC in Table 2.7.3.1-3 (including items 10 and 12).

a. Similar to item “4.b” above, (this time for main control room air intake monitors associated with Table 2.7.6.4-3), please ensure that sufficient overlap testing is provided to test the monitors from sensor to the completion of the ESF functions or provide a separate individual ITAAC testing the function from the detection of high radiation levels (with a radiation check source) to completion of actuation of the ESF function (e.g. altering appropriate dampers and activating emergency ventilation).

b. ITAAC 9 in Table 2.7.3.1-3 indicates that upon detection of radiation in the outside air intakes, the air intake isolation dampers in the air intake having the higher radiation level close automatically. When one air intake is closed, the radiation readings on the associated radiation monitor will likely greatly decrease because there is no longer air being drawn in the intake. During an accident, please indicate if the intake that initially has the higher radiation is closed and will remain closed regardless of radiation levels, or if the closed intake will automatically open if higher radiation levels are detected in the open intake. If the design is such that the open intake could continually change automatically based on radiation levels, please discuss why this design is appropriate.

Response – (Rev. 3)

Subquestion 1

According to the response to RAI 235-8275-Question 12.03-34 Rev. 3 (reference KHNP submittal MKD/NW-17-0095L, dated April 12, 2017), the name of the Instrument Calibration Facility (ICF) will be changed to “Future Use” since it will no longer be designated for calibration of portable radiation instruments in the APR1400 design certification. Therefore the instrument calibration facility area monitor (RE-286) will be removed from DCD Tier 1 and Tier 2.

Subquestion 2

Truck bay monitor RE-288 will be added to Figure 11.5-2T. In this Figure, the location of RE-284 and RE-289 has been changed to the correct location.

Subquestion 3

It is difficult to present spatial location information using 2D design drawings. Therefore, an attempt is made for the ITAAC to reflect the following description that the locations of the monitors are located to provide unimpeded communication of the entire containment representative free volume, as follows

The containment area monitors consist of four total. The upper monitors (RE-233A and 234B) are designed and comply with NUREG-0737.II.F.1 and NRC RG 1.97 Type C requirements.

In accordance with RG 1.97 Type C, these two monitors are designed to meet Category I requirements, which means that they are Electrical Class 1E, Seismic Category I and environmentally qualified to withstand the post-accident LOCA environment. The measurement range is commensurate with the range given in RG 1.97.

The upper two monitors are azimuthally 180° apart with each other. RE-234B is located just below the containment polar crane rail support girder near EL. 230’ while RE-233A is at EL. 200’. RE-234B has a wide open, unobstructed communication with the entire containment free air volume. Access to RE-234B is relatively easy because of an intermediate maintenance platform, thus requiring only a short extension of a caged ladder to reach the monitor.

RE-233A was initially located at EL. 228’ at the reference plant; however, access to this monitor was severely limited. The only way to access to the monitor was either by climbing down from the polar crane operator cab or climbing up from EL. 158’ with a ladder. Both means were dangerous and as a result, it was decided at the reference plant to relocate and lower the monitor to an elevation that cleared the nearby structures. The closet location was the pressurizer compartment concrete wall approximately 35’ away to EL. 200’. This structure partially blocked the upper left hand quadrant of the containment air volume, but the monitor has a clear open, unobstructed communication with the lower two containment quadrants free air volume. RE-234B provided coverage of the upper left hand quadrant.

The lower monitors (RE-231A and 232B) are located at El. 160’ directly above the refueling pool. These two monitors serve a different function than those of the upper monitors. These lower ones monitor the refueling operation to detect a fuel handling accident condition. Therefore, these monitors are not intended to serve the functions specified by NUREG-0737 or

RG 1.97. These monitors generate a Containment Purge Isolation Actuation Signal (CPIAS) should a fuel handling accident occur. The measurement range reflects the purpose and intended function.

Since these lower monitors perform balance of plant (BOP) ESFAS function, they are Class 1E, seismic Category I and environment qualified to maintain functional integrity in a fuel handling accident environment. These two lower monitors utilize a one-out-of-two coincident logic and comply with the single failure criteria of IEEE Std.603. Even though not required, the two upper monitors can be used in a redundant capacity to the lower monitors. Therefore, the signals from the upper monitors are fed into the CPIAS coincidence logic to take advantage of this capability and the one-out-of-two coincident logic is taken twice to improve the overall functional reliability and to increase the availability.

ITAAC Item 7 of Table 2.7.6.5-3 will be revised to be more specific on the verification of the unimpeded location to ensure that the as-built monitors' intended functions will be as designed.

Subquestion 4.a

Use of a radiation check source will replace the integral activated check source in described in Subsection 11.5.2.1 of DCD Tier 2.

The integral activated check source is an uncalibrated radioactive source or equivalent that is used to confirm the continuing satisfactory operation of the radiation monitoring assembly, when exposed to the detector. A check source is exposed to the detector on demand with an upscale measurement indication being a pass/fail criterion. The radioactive check source consists of a small amount of radioactive material chosen to provide a signal in the lower range of detection for verification of detector function. For this reason, the integral activated check source cannot be used to verify the setpoint for the alarm and radiation level. Verification of the setpoint for the alarm and radiation level will normally be carried out periodically using the appropriate calibration source.

Therefore, a simulated radiation signal will be used where necessary to produce the radiation level required to test the BOP ESFAS signals and RMS alarm functionality discussed in ITAAC items 3 and 6 of Table 2.7.6.5-3 and ITAAC items 4 and 5 of Table 2.7.6.4-3.

The term "channel" used here is a generic terminology to designate instrument sensing channel. The Tier 1 definition of channel similarly designates the instrument sensing portion. The definition in Tier 1 emphasizes the difference between the sensing channel against the actuation train after the one-out-of-two or two-out-of-four coincidence logic. Therefore, the channel used here is not intended to limit or be applicable only to those channels performing an ESF function.

Subquestion 4.b

The use of the term "overlap testing" in the response to RAI 8054, Questions 14.03.08-4 item 4 was a misnomer and not accurate per the definition given in IEEE Std. 338. The segmented subsystems described in the response were to outline the signal path from the sensor to the actuated component and was not intended to indicate that each segmented section could be separately tested. In actuality, each of the three BOF ESFAS loops is tested by injecting a simulated test signal at the detector end and making an observation that the associated component (e.g. fan, damper, etc.) is actuated in one continuous sequence. The BOP ESFAS is a test type equivalent to a “GO” test defined in IEEE Std. 338; which means the system can be tested during normal plant operation and would not lead to a plant upset condition.

The response RAI 8054, Questions 14.03.08-4 item 4 should have stated that BOP ESFAS-FHEVAS and CPIAS initiation from the actuation signal generation to physical activation of the engineered safety feature (ESF) components is tested using a simulated signal in one continuous actuation through the segmented sections detailed in ITAAC Table 2.7.6.5-3 Item 6, 2.5.4-4 Item 5, 2.7.3.2-3 Item 10, and 2.11.3-2 Item 7.a.

The segmented sections delineated in the ITAAC tables are to merely outline the signal path from the sensor to the actuated components and it is not intended to indicate that each section would be separately tested requiring overlap testing between sections. The verification testing of BOP ESFAS-FHEVAS and CPIAS is done continuously from the actuation signal generation to physical actuation of the ESF components.

Table 2.7.6.5-3, Item 6 is to verify that an ESFAS signal is sent through the ESF-CCS group control cabinet to the final actuated component if the simulated radiation signal exceeds predetermined setpoints for the FHEVAS and CPIAS.

Table 2.5.4-4, Item 5 is to verify that the ESF-CCS group control cabinet receives the ESFAS initiation signal from safety-related divisionalized cabinet (SRDC) of the RMS and performs a 1-out-of-2 logic to perform the BOP ESF actuation functions identified in Table 2.5.4-2, Item 7 and 8. The control signals are then sent to the ESF components.

Table 2.7.3.2-3, Items 10.a and 10.b are to verify that the fuel handling area emergency exhaust ACU starts and the air intake isolation dampers and the normal exhaust ACU isolation dampers close in response to BOP ESFAS-FHEVAS signal.

Table 2.11.3-2, Item 7.a is to verify that the containment purge isolation valves (VQ-0011 ~ VQ-0014 and VQ-0031 ~ VQ-0034) close in response to BOP ESFAS-CPIAS signal.

ITAAC Tables 2.7.6.5-3 Item 6 and Table 2.5.4-4, Item 5 will be revised to make it clear that the testing is done continuously rather than giving a misleading impression of segmented sectionalized testing requiring overlap between sections.

Subquestion 4.c

The ITAAC items 9 and 10 in Table 2.7.3.1-3, ITAAC item 10 in Table 2.7.3.2-3 and ITAAC item 10 in Table 2.7.3.5-3 which are associated with actuation functions from radiation monitors will be revised to have acceptance criteria to ensure that the associated isolation dampers physically close and the emergency exhaust ACU physically starts properly.

Subquestion 4.d

The air intake isolation dampers and the normal exhaust isolation dampers of the fuel handling area HVAC system are designed to be closed within 8.4 seconds after receiving an engineered safety features-fuel handling area emergency ventilation actuation signal (ESF-FHEVAS). The applicant will divide ITAAC 10 in Table 2.7.3.2-3 into ITAAC 10.a for the fuel handling area emergency exhaust ACU and ITAAC 10.b for the isolation dampers. ITAAC 10.b will include the 8.4 seconds for the isolation damper closure time.

Subquestion 5.a

The seismic category for PR-RE-111 and PR-RE-104 will be corrected to II in Tier 1, Table 2.7.6.4-1.

Subquestion 5.b

Monitor CV-RE-036 has been deleted from the Table 2.7.6.4-1 as provided in the mark up for response to RAI 116-8054, Question 14.03.08-5 (ref. KHNP submittal MKD/NW-0204L dated October 30, 2016; ML15303A426).

Subquestion 5.c

Monitor classification using Quality Class designation is not applicable to APR1400 and is a classification only used for Korean nuclear power plants. Reference to Quality Class will be deleted from Tables 11.5-1, 11.5-2, and 12.3.6 in DCD Tier 2 and Table 2.7.6.4-1 in DCD Tier 1.

Subquestion 6.a

The response provided to Item 4 of Question 14.03.08-5 for RAI 116-8054 erroneously repeated the same response given for BOP ESFAS-FHEVAS and CPIAS; although the contents of the response are similar. The previous response to Item 4 of Question 14.03.08-5 should have stated that similar to the verification testing of BOP ESFAS-FHEVAS and CPIAS, BOP ESFAS-CREVAS initiation from the actuation signal generation to physical activation of the engineered safety feature (ESF) components is tested using a simulated signal in one continuous actuation through the segmented sections detailed in ITAAC Table 2.7.6.4-3 Item 5, 2.5.4-4 Item 5 and 2.7.3.1-3 Item 10.

The segmented sections delineated in the ITAAC Tables are to merely outline the signal path from the sensor to the actuated components and it is not intended to indicate that each section would be separately tested requiring overlap testing between sections. The verification testing of BOP ESFAS-CREVAS is done continuously from the actuation signal generation to physical actuation of the ESF components.

Table 2.7.6.4-3, Item 5 is to verify that an ESFAS signal is sent through the ESF-CCS group control cabinet to the final actuated component if the simulated radiation signal exceeds predetermined setpoints for the CREVAS.

Table 2.5.4-4, Item 5 is to verify 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 Table 2.5.4-2, Item 9. The control signals are then sent to the ESF components.

Table 2.7.3.1-3, Item 10 is to verify that in response to a NSSS ESFAS-SIAS and BOP ESFAS-CREVAS signal, the control room emergency makeup ACU starts and the ACU inlet isolation damper, the ACU discharge flow control damper, and the ACU return air isolation dampers open.

ITAAC Tables 2.7.6.4-3 Item 5 and Table 2.5.4-4, Item 5 will be revised to make them consistent with other BOP ESFAS actuation verification testing and to make it clear that the testing is done continuously rather than giving a false impression of segmented sectionalized testing requiring overlap between sections.

Subquestion 6.b

Upon detection of a high radiation in the outside air intakes, the outside air intake isolation dampers in the outside air intake having the higher radiation level close automatically. When one outside air intake is closed, the radiation monitors in the closed outside air intake will no longer read radiation levels because there is no longer air being drawn in the outside air intake. As a result, the circuitry for the radiation monitors can no longer compare the radiation levels in both outside air intakes, and the initially closed outside air intake will remain closed.

However, the control room HVAC system has a control logic that automatically reopens the closed isolation dampers at a preset interval by automatically resetting the closed isolation dampers to ensure that the operators are only exposed to the lowest dose possible. After reopening, the outside air is drawn through both outside air intakes again and the control room HVAC system automatically closes the outside air intake isolation dampers in the intake having the higher radiation level by comparing radiation levels. The Chapter 15 DBA dose analysis modeling of the control room ventilation system accounts for the additional outside air filtered intake if both air intakes are sequentially opened.

The control room HVAC system automatically repeats reopening the closed isolation dampers at the preset interval of the control logic in order to automatically change to the intake that has the lowest radiation levels. The interval time will be determined by considering the durability of the isolation damper and the site-specific meteorological data from radiological aspects defined by the COL applicant. ITAAC Table 2.7.3.1-3 and Tier 2 Subsection 9.4.1.2 will be revised to indicate that the closed outside air intake isolation dampers are automatically reset and reopened, and the outside air intake isolation dampers having the higher radiation level automatically close within an interval after they are initially closed upon receipt of a high radiation signal. DCD Tier 2 Table 1.8-2 and Subsection 9.4.9 will also be revised to add a COL Item 9.4(2) which indicates that the COL applicant is to provide the interval.

In calculating the MCR doses, the re-opening of the MCR intake dampers was not considered based on the following justification:

The total time required to open and close an MCR air intake damper is established as follows:

<u>Opening and closing damper time</u>:

- Open intake damper: 5 seconds
- RMS detection: 3 seconds
- RMS signal process time: Approximately 2 seconds
- Control cabinet processing time: 30 seconds (Additional time delay for determining which air intake area is higher [higher air intake area can be determined only when input signal has been continuously present for 30 seconds]) + 0.03 seconds (Additional

time for comparison of radiation signal and considered insignificant) + 0.3 seconds (Typical control processing time for closing damper) = 30.3 seconds

- Close intake damper: 5 seconds
- Total time: 45.3 seconds

- Considering an interval time of intake re-assessment to be 1 hour, the evaluation of the relative impact of the MCR intake with the higher radioactivity during opening of the intake dampers is performed. For conservatism, the total opening/closing time is increased to 60 seconds, and consequently the percent of increase can be simply calculated as follows:

$$\text{Ratio of Increase} = \frac{Opening\ Time}{Interval\ Time} \times \frac{Reduction\ Factor\ for\ Autoselection}{Reduction\ Factor\ for\ Dual\ Intakes}$$

$$= \frac{60\ seconds}{3600\ seconds} \times \frac{10}{2} \cong 0.083$$

Based on the above results, the consideration of re-opening of dampers can be expected to lead to an increased dose (e.g., filter loading) of 8.3% compared to the current MCR calculated dose.

However, in calculating the radiological consequence and MCR filter loading, a χ/Q reduction factor of 8 for the auto-selection function was conservatively applied instead of 10 as specified in Section 3.3.2.4 of the RG 1.194 guidance. Use of the χ/Q reduction factor of 8 provided an additional 20% margin.

Therefore, since the impact of potentially higher radioactivity resulting from the opening of the closed intake damper was bounded by the 20% margin, it was not included in this analysis.

The 1 hour interval time of damper re-opening will be re-evaluated by the COL applicant to show that it is reasonable and conservative in evaluating the impact of damper re-opening based on the site-specific meteorological data and the radiological impacts compared against the established calculations.

The information on determining the total time required to open, and after confirming the intake damper with the higher radioactivity subsequently closing the applicable MCR air intake damper, will be added to the associated section of DCD Chapter 9.

In the DCD markup relating to RAI 368-8470-Question 14.03.08-14, the COL item COL 9.4 (5) indicated that the COL applicant is to provide the interval of reopening the closed outside air intake isolation dampers by considering the durability of the isolation dampers and the site-specific meteorological data from radiological aspects. However the COL number was revised in DCD Rev.1 and the proper COL reference is now COL 9.4(2).

Supplemental Information in Response to Clarification Question

KHNP was requested to verify that the MCR Emergency filter loading source term is based on the correct X/Q values or to revise the calculations of MRC Emergency filter loading based on the correct X/Q values and update the response to Question 12.02-16, as appropriate.

The effect of radioactive decay is conservatively not taken into account in calculating the buildup activity in the MCR Emergency Makeup ACU filter. However, it was found that the discrepancy of the values between DCD Table 12.2-24 and the NRC's confirmatory calculations resulted from not using the corrected on-site χ/Qs, which was provided in response to RAI 7912, Question 02.03.04-1, Revision 2. In response to RAI 108-7973 Question 15.00.03-21, (ref. MKD/NW-16-0483L submitted May 12, 2016), the re-analysis of the radiological consequence was performed based on the updated onsite χ/Qs; however, the MCR Emergency Makeup ACU filter inventory in DCD Table 12.2-24 (Sheets 13 and 14) were not revised. Therefore, the values in DCD Table 12.2-24 (Sheets 13 and 14) was updated to incorporate the corrected onsite χ/Qs, which was provided in the response to RAI 207-8247 Question 12.02-16, Revision 2 (ref. MKD/NW-16-0770L submitted Nov 1,2016)

Impact on DCD

DCD Revision 1 incorporated changes that were to the following Subsections, Tables, and Figure that were included in the initial response to this RAI.

DCD Tier 1

Subsections 2.5.4.1, 2.7.3.2.1, 2.7.3.5.1.3

Tables 2.5.4-4, 2.7.3.1-3, 2.7.3.2-3, 2.7.3.5-3, 2.7.6.4-1, 2.7.6.4-3, 2.7.6.5-1, and 2.7.6.5-3

DCD Tier 2

Subsections 9.4.1.2, 9.4.9, and 11.5.2.1

Tables 1.8-2, 11.5-1, 11.5-2, and 12.3-6

Figure 11.5-2T

The following DCD Rev. 1 Subsections, Tables, and Figure will be revised as a result of this revised response.

DCD Tier 1

Subsections 2.7.6.4.1, 2.7.6.5.1, 2.7.3.1.1, and 2.7.6.4.1

Tables2.7.3.1-3, 2.7.6.4-3, 2.7.6.5-1, and 2.7.6.5-3

DCD Tier 2

Subsections 9.4.1.2, 9.4.9, 14.2.12.1.106, 14.2.12.1.107, 15.0.3.5, and 15.0.4.

Tables 1.8-2 and 12.3-6

Figure 11.5-2R

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.

4.a ESR dampers, PSR dampers, check dampers and tornado dampers identified in Table 2.7.3.1-1 perform an active safety function to change position as indicated in the table.

4.b After loss of motive power, ESR dampers and PSR dampers identified in Table 2.7.3.1-1 assume the indicated loss of motive power position.

5.a All controls required by the design exist in the MCR to start and stop the ACUs and AHUs, and to open and close ESR dampers and PSR dampers identified in Table 2.7.3.1-1.

5.b All controls required by the design exist in the RSR to start and stop the ACUs and AHUs, and to open and close ESR dampers and PSR dampers identified in Table 2.7.3.1-1.

5.c All displays and alarms required by the design exist in the MCR as defined in Tables 2.7.3.1-1 and 2.7.3.1-2.

5.d All displays and alarms required by the design exist in the RSR as defined in Tables 2.7.3.1-1 and 2.7.3.1-2.

6. The two mechanical divisions of the control room HVAC system are physically separated.

7. The control room HVAC system provides the conditioned air that is required to maintain the room temperature within the design limits for the CRE except non safety-related rooms during plant normal, abnormal and accident conditions.

8. The control room HVAC system removes particulate matter and iodine, and provides system flow as required in the safety analysis.

9.a The outside air intake isolation dampers in the outside air intake having the higher radiation level close upon receipt of a high radiation signal.

9.b After the outside air intake isolation dampers are initially closed upon receipt of a high radiation signal, the closed outside air intake isolation dampers are automatically reset and ~~reopened at an interval.~~

reopened, and the outside air intake isolation dampers having the higher radiation level automatically close within a predetermined interval.

Table 2.7.3.1-3 (4 of 5)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9.a The outside air intake isolation dampers in the outside air intake having the higher radiation close upon receipt of a high radiation signal.	9.a Tests of the as-built outside air intake isolation dampers will be performed using a simulated high radiation signal.	9.a The as-built outside air intake isolation dampers in the outside air intake having the higher radiation level close upon receipt of a simulated high radiation signal.
9.b After the outside air intake isolation dampers are initially closed upon receipt of a high radiation signal, the closed outside air intake isolation dampers are automatically reset and ~~reopened at an interval.~~ reopened, and the outside air intake isolation dampers having the higher radiation level automatically close within a predetermined interval.	9.b Tests of the as-built outside air intake isolation dampers will be performed under the condition that they are initially closed after receiving a simulated high radiation signal.	9.b The as-built outside air intake isolation dampers are automatically reset and ~~reopened at an interval after~~ reopened, and the outside air intake isolation dampers having the higher radiation level automatically close within an interval after they are initially closed upon receipt of a simulated high radiation signal.
10. The control room emergency makeup ACU starts and the ACU inlet isolation damper, the ACU discharge flow control damper, and the ACU return air isolation dampers open upon receipt of ESFAS-SIAS or ESFAS-CREVAS.	10. Tests of the as-built control room emergency makeup ACU, the ACU inlet isolation damper, the ACU discharge flow control damper, and the ACU return air isolation damper will be performed using a simulated ESFAS-SIAS or ESFAS-CREVAS.	10. The as-built control room emergency makeup ACU starts and the as-built ACU inlet isolation damper, the ACU discharge flow control damper, and the ACU return air isolation damper open upon receipt of a simulated high radiation signal.
11. The unfilterd inleakage is within the performance value limit as specified in the safety analysis.	11. Tests and analyses will be performed to verify that as-built unfiltered inleakage is within limits in accordance with ASTM E741-2000.	11. A report exists and concludes that the as-built unfiltered inleakage is less than 170 cmh (100 cfm) in the emergency mode. The 170 cmh (100 cfm) unfiltered inleakage value includes an assumed value of 17 cmh (10 cfm) for CRE ingress/egress.
12. The AHU inlet isolation dampers (PSR) listed in Table 2.7.3.1-1 close within their closure time before the airborne radioactive material passes through the isolation dampers.	12. Test of the as-built AHU inlet isolation dampers (PSR) will be performed using a simulated isolation signal.	12. The AHU inlet isolation dampers (PSR) listed in Table 2.7.3.1-1 close within the 8.4 seconds after receiving a simulated isolation signal.

2.7.6.4 Process and Effluent Radiation Monitoring and Sampling System

2.7.6.4.1 Design Description

The process and effluent radiation monitoring and sampling system (PERMSS) provide components to monitor liquid and gaseous effluents prior to release to unrestricted areas, and to monitor in-plant radioactivity.

The PERMSS is non safety-related with the exception of the following, each of which is safety-related and Class 1E:

a. Main control room (MCR) air intake radiation monitors

b. Containment building operating area and upper operating area radiation monitors

c. Fuel handling area monitors

d. Containment air radiation monitors

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

1. The functional arrangement of the PERMSS is as described in the Design Description of Subsection 2.7.6.4.1 and in Table 2.7.6.4-1.

2. The PERMSS has components that provide radiation monitoring of gaseous and liquid processing systems.

3. All displays and alarms required by the design exist in the MCR and RSR as defined in Table 2.7.6.4-1.

4. Each PERMSS ~~radiation monitor~~ channel monitors the radiation level in its assigned area, and indicates its respective MCR alarm and local audible and visual alarm when the radiation level reaches a preset level.

5. The safety-related divisionalized cabinet (SRDC) of the PERMSS provides an automatic ESFAS initiation signals for each ~~the entire actuated~~ loop including the final component, as shown on Table 2.7.6.4-2.

6. The seismic Category I monitors identified in Table 2.7.6.4-1 can withstand seismic design basis loads without loss of safety function.

7. Separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E divisions.

8. The moderate-energy piping systems are reconciled with pipe rupture hazards analyses report to ensure that the safety-related SSCs are protected against or are qualified to withstand the environmental effects associated with postulate failures of these piping systems.

9. The steam generator blowdown radiation monitor provides an alarm in the MCR of high radioactive contamination and isolation signal to blowdown valve.

~~10. Each monitor channel function of PERMSS is functioning.~~

2.7.6.4.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.6.4-3 specifies the inspections, tests, analyses, and associated acceptance criteria for the process and effluent radiation monitoring and sampling system.

10. Each monitor channel function of PERMSS identified in Table 2.7.6.4-1 is functioning.

Table 2.7.6.4-3 (1 of 2)

Process and Effluent Radiation Monitoring and Sampling System ITAAC

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the PERMSS is as described in the Design Description of Subsection 2.7.6.4.1 and in Table 2.7.6.4-1.	1. Inspection of the as-built PERMSS will be conducted.	1. The as-built PERMSS conforms with the functional arrangement as described in the Design Description of Subsection 2.7.6.4.1 and in Table 2.7.6.4-1.
2. The PERMSS has components that provide radiation monitoring of gaseous and liquid processing systems.	2. Inspections will be performed to verify that the as-built gaseous and liquid processing systems are provided with radiation monitoring.	2. The components of radiation monitoring exist in gaseous and liquid processing systems of the as-built PERMSS.
3. All displays and alarms required by the design exist in the MCR and RSR as defined in Table 2.7.6.4-1.	3. ~~Tests~~ Test of as-built PERMSS will be performed on the displays and alarms in the MCR and RSR.	3. All displays and alarms exist and can be retrieved in the as-built MCR and RSR as defined in Table 2.7.6.4-1.
4. Each ~~radiation monitor~~ PERMSS channel monitors the radiation level in its assigned area, and indicates its respective MCR alarm and local audible and visual alarm when the radiation level reaches a preset level.	4. Testing of each channel of ~~the radiation monitors~~ the as-built PERMSS will be conducted using simulated input signals for an alarm setpoint check.	4. MCR and local alarms are initiated when the simulated radiation level reaches a preset limit.
5. The safety-related divisionalized cabinet (SRDC) of the PERMSS provides an automatic ESFAS signals for each loop including the final component, as shown on Table 2.7.6.4-2.	5. A testing of the each loop including the final component ~~SRDC~~ and the SRDC of the as-built PERMSS will be performed using a simulated signal by observing the final actuated component at the actuation set point to verify that the SRDC and the system function as required.	5. ~~Each as-built ESFAS signals are~~ As-built ESFAS initiation signal from SRDC is sent through ESF-CCS group controller cabinet to the final actuated component upon detection of high radiation of the MCR intake defined in Table 2.7.6.4-2, if ~~plant's radiation monitors exceed~~ the simulated radiation level exceeds predetermined setpoints for control room emergency ventilation actuation signal (CREVAS).
6. The seismic Category I monitors identified in Table 2.7.6.4-1 can withstand seismic design basis loads without loss of safety function.	6.a. Inspections will be performed to verify that the as-built seismic Category I monitor identified in Table 2.7.6.4-1 is located in seismic Category I structure	6.a. The as-built seismic Category I monitor identified in Table 2.7.6.4-1 is located in a seismic Category I structure.

Table 2.7.6.4-3 (2 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6. (cont.)	6.b. Type test, analyses, or a combination of type tests and analyses of seismic Category I monitor identified in Table 2.7.6.4-1 will be performed.	6.b. A report exists and concludes that the seismic Category I monitor identified in Table 2.7.6.4-1 withstands seismic design basis loads without loss of safety function.
	6.c. Inspections and analyses will be performed to verify that the as-built seismic Category I monitor identified in Table 2.7.6.4-1 including anchorages is seismically bounded by the tested or analyzed conditions.	6.c. A report exists and concludes that the seismic Category I monitor identified in Table 2.7.6.4-1 including anchorages is seismically bounded by the tested or analyzed conditions.
7. Separation is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E divisions.	7. Inspection of the as-built Class 1E divisions will be performed.	7. Physical separation and electrical isolation exists in accordance with NRC RG 1.75 between these Class 1E divisions, and also between class 1E divisions and non-class 1E divisions.
8. The moderate-energy piping systems are reconciled with pipe rupture hazards analyses report to ensure that the safety-related SSCs are protected against or are qualified to withstand the environmental effects associated with postulate failures of these piping systems.	8. Inspections and analyses of the as-built moderate-energy piping and safety-related SSCs will be performed.	8. Pipe rupture hazard analysis report exists and concludes that the as-built safety-related SSCs are protected against or are qualified to withstand the effects of postulated pipe failures of the as-built moderate-energy piping system.
9. The steam generator blowdown radiation monitor provides an alarm in the MCR of high radioactive contamination and isolation signal to blowdown valve	9. A signal test is conducted to verify the radiation monitor setpoint and alarm and isolation functions in the MCR.	9. Upon detection of high radiation levels above the predetermined setpoint, the steam generator blowdown monitor provides an alarm in the MCR and closes the blowdown valve, isolating the blowdown system.
Add 10. Each monitor channel function of PERMSS identified in Table 2.7.6.4-1 is functioning.	10. Testing of each channel of the as-built PERMSS will be conducted using a radiation check source with fixed source strength to activate the channel.	10. Each monitor channel is functioning (alive) when the built-in radiation check source is remotely activated by the operator.

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~~ ~~, alarm~~ ~~and record of radiation levels in the MCR and the RSR~~.

2. The ARMS identified in table 2.7.6.5-1 provides for the indication, alarm, and recording of the defined plant area radiation levels within the MCR and RSR for operating personnel

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 divisions and non-Class 1E divisions.

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 divisionalized cabinet (SRDC) of the ARMS provides an automatic ESFAS initiation signals for each loop including the final component, as shown in Table 2.7.6.5-2.

7. The containment monitors are located in ~~an unimpeded~~ a location for each intended function as follows:

   - Upper area ~~monitors (RE-233A and 234B) are~~ monitor (RE-234B) is located level just below the containment polar crane for a ~~wide open,~~ direct, unimpeded exposure path of the entire containment free air volume. RE-233A is located to accommodate operator's easy access, but still at an elevation that provides observation of a large fraction of the containment free air volume. ~~unobstructed communication with the entire containment free air volume~~.

   - Lower area monitors (RE-231A and 232B) are located directly ~~above~~ overhead with an unimpeded view of the refueling pool to detect ~~a~~ fuel handling accident condition.

8. The Class 1E components and instruments identified in Table 2.7.6.5-1 as being qualified for a harsh environment are capable of withstanding the environmental conditions that would exist before, during, and following a design basis accident without loss of safety function for the time required to perform the safety function.

~~9. Each monitor channel of ARMS is functioning.~~

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.

9. Each monitor channel of ARMS identified in table 2.7.6.5-1 is functioning.

Table 2.7.6.5-1

Area Radiation Monitoring System Components List

Description	Tag No	Class (1) S	Class (1) SE	Class (1) E	Harsh Environment Qualified	Range (mSv/hr)	Display & Alarm at MCR/RSR/Local
Post Accident Primary Sample Room	RE-205	N	III	N	No	10^{-3}~10^{2}	Yes/Yes/Yes
Normal Primary Sample Room	RE-285	N	III	N	No	10^{-3}~10^{2}	Yes/Yes/Yes
Main Steam & FW Containment Piping Penetration Area	RE-237 RE-238	N	II	N	No	10^{0}~10^{5}	Yes/Yes/Yes
Containment Operating Area	RE-231A RE-232B	3	I	A B	Yes	10^{-3}~10^{2}	Yes/Yes/Yes
Containment Upper Operating Area	RE-233A RE-234B	3	I	A B	Yes	10^{1}~10^{8}	Yes/Yes/Yes
Incore Instrument	RE-235	N	II	N	No	10^{-3}~10^{2}	Yes/Yes/Yes
Containment Personnel Access Hatch Area	RE-236	N	II	N	No	10^{-3}~10^{2}	Yes/Yes/Yes
Spent Fuel Pool Area	RE-241A RE-242B	3	I	A B	No	10^{-3}~10^{2}	Yes/Yes/Yes
New Fuel Storage Area	RE-245	N	II	N	No	10^{-3}~10^{2}	Yes/Yes/Yes
Hot Machine Shop	RE-293	N	III	N	No	10^{-3}~10^{2}	Yes/Yes/Yes
Radiochemistry Lab	RE-257	N	III	N	No	10^{-3}~10^{2}	Yes/Yes/Yes
~~Instrument Calibration Facility~~	~~RE-286~~	~~N~~	~~II~~	~~N~~	~~No~~	$\cancel{10^{-3}\sim10^{2}}$	~~Yes/Yes/Yes~~
Main Control Room Area	RE-275	N	II	N	No	10^{-3}~10^{2}	Yes/Yes/Yes
TSC Area	RE-279	N	III	N	No	10^{-3}~10^{2}	Yes/Yes/Yes
Truck Bay Area	RE-288 RE-289	N	III	N	No	10^{-3}~10^{2}	Yes/Yes/Yes
Waste Drum Storage Area	RE-292	N	III	N	No	10^{-3}~10^{2}	Yes/Yes/Yes
Compound Building Dry Active Waste Storage Area	RE-284	N	III	N	No	10^{-3}~10^{2}	Yes/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

Table 2.7.6.5-3 (1 of 3)

Area Radiation Monitoring System ITAAC

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the ARMS is as described in the Design Description of Subsection 2.7.6.5.1 and in Table 2.7.6.5-1.	1. Inspection of the as-built ARMS will be conducted.	1. The as-built ARMS conforms with the functional arrangement as described in the Design Description of Subsection 2.7.6.5.1 and in Table 2.7.6.5-1.
2. ~~The ARMS~~ ~~identified in table 2.7.6.5-1~~ ~~provides operating personnel with an indication~~ ~~, alarm~~ ~~and record of radiation levels in the MCR and the RSR.~~ 2. The ARMS identified in table 2.7.6.5-1 provides for the indication, alarm, and recording of the defined plant area radiation levels within the MCR and RSR for operating personnel	2. ~~Inspection of the ARMS~~ Test of the as-built ARMS components will be performed using a simulated radiation signal. ~~the MCR and RSR~~	2. ~~It provides operating personnel with an~~ ~~, alarm~~ ~~indication and record of radiation levels at selected locations within the various plant buildings to warn of excessive gamma radiation levels in areas where~~ ~~the MCR and RSR~~ ~~nuclear fuel is stored or handled.~~ 2. Each of the area radiation monitors identified in Table 2.7.6.5-1 provides operating personnel with an indication and record of the radiation level which corresponds to the simulated radiation signal. MCR and RSR alarms are initiated when the simulated radiation signal reaches a preset limit.
3. The monitors provide local readout and alarm units at the detector locations.	3. Testing of local readout and alarm units at the as-built detectors will be conducted.	3. Local alarms are initiated when the simulated radiation level reaches a preset limit. Both audible and visual alarms are included for each local readout/alarm unit.
4. Separation is provided between Class 1E division, and between Class 1E divisions and non-Class 1E divisions.	4. Inspection of the as-built Class 1E divisions will be performed.	4. Physical separation and electrical isolation exists in accordance with NRC RG 1.75 between these Class 1E divisions, and also between Class 1E divisions and non-Class 1E divisions.
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).

Table 2.7.6.5-3 (2 of 3)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5. (cont.)	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 divisionalized cabinet (SRDC) of the ARMS provides an automatic ESFAS signals for each loop including the final component, as shown in Table 2.7.6.5-2.	6. A Testing of the each loop including the final component ~~SRDC~~ and the SRDC of the as-built ARMS will be performed using a simulated signal by observing the final actuated component at the actuation setpoint to verify that the SRDC and the system function as required.	6. Each as-built ESFAS ~~signal~~ initiation signal from SRDC is sent through ESF-CCS group controller cabinet to the final actuated component 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~~ the simulated radiation level exceeds predetermined setpoints for containment purge isolation actuation signal (CPIAS) and fuel handling area emergency ventilation actuation signal (FHEVAS).

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Table 2.7.6.5-3 (3 of 3)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7. ~~The containment monitors are located in an unimpeded location for each intended function as follows:~~ - ~~Upper area monitors (RE-233A and 234B) are located just below the containment polar crane for a wide open, unobstructed communication with the entire containment free air volume.~~ - ~~Lower area monitors (RE-231A and 232B) are located directly above the refueling pool to detect a fuel handling accident condition.~~	7. ~~Inspections well be performed to verify that containment monitors are located in an unimpeded location for each intended function.~~	7. ~~As-built containment monitors are located in an unimpeded location for each intended function described in the design commitment.~~
8. The Class 1E components and instruments identified in Table 2.7.6.5-1 as being qualified for a harsh environment are capable of withstanding the environmental conditions that would exist before, during, and following a design basis accident without loss of safety function for the time required to perform the safety function.	8.a Type tests, analyses or a combination of type tests and analyses will be performed on Class 1E components and instruments located in a harsh environment.	8.a A report exists and concludes that the Class 1E components and instruments identified in Table 2.7.6.5-1 as being qualified for a harsh environment are capable of withstanding the environmental conditions that would exist before, during, and following a design basis accident without loss of safety function for the time required to perform the safety function.
	8.b Inspections will be performed on the as-built Class 1E components and instruments and the associated wiring, cables, and terminations located in a harsh environment.	8.b A report exists and concludes that the as-built Class 1E components and instruments and the associated wiring, cables, and terminations identified in Table 2.7.6.5-1 as being qualified for a harsh environment are bounded by type tests, analyses, or a combination of type tests and analyses.

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7. The containment monitors are located in an unimpeded location for each intended function as follows: - Upper area monitor (RE-234B) is located level just below the containment polar crane for a direct, unimpeded exposure path of the entire containment free air volume. RE-233A is located to accommodate operator's easy access, but still at an elevation that provides observation of a large fraction of containment free air volume. - Lower area monitors (RE-231A and 232B) are located directly overhead with an unimpeded view of the refueling pool to detect a fuel handling accident condition.	7. Inspections will be performed to verify that containment monitors are located in an unimpeded location for each intended function.	7. As-built containment monitors are located in an unimpeded location for each intended function described in the design commitment.

"B"

as-built

9. Each monitor channel of ARMS identified in table 2.7.6.5-1 is functioning.	9. Testing of each channel of the ARMS will be conducted using the radiation check source with fixed source strength to activate the channel.	9. Each monitor channel is functioning (alive) when the built-in radiation check source is remotely activated by the operator.

Table 1.8-2 (19 of 38)

Item No.	Description
COL 9.2(37)	The COL applicant is to develop the following procedures for the water system: filling, venting, keeping it full, and operating it to minimize the potential for water hammer. The COL applicant is also to analyze the system for water hammer impacts, design the piping system to withstand potential water hammer forces, and analyze inadvertent water hammer events in the ECWS in accordance with NUREG-0927.
COL 9.2(38)	The COL applicant is to confirm that there are no departures and shall meet the interface requirements (i.e., cooling duties and temperature requirements, piping and control interface)
COL 9.2(39)	The COL applicant is to provide operational procedures and maintenance programs as related to leak detection and contamination control in accordance with RG 4.21.
COL 9.2(40)	The COL applicant is to include a site-wide radiological environmental monitoring program to monitor both the horizontal and vertical variability of the onsite hydrogeology and the potential effects of the construction and operation of the plant.
COL 9.2(41)	The COL applicant is to maintain complete documentation of system design and any site specific design modifications during the COL application, for the features for contamination control, in accordance with RG 4.21, Subsection A-3 to facilitate decommissioning.
COL 9.3(1)	The COL applicant is to provide the supply systems of the nitrogen gas subsystem, the hydrogen subsystem, the carbon dioxide subsystem, and the breathing air systems.
COL 9.3(2)	The COL applicant is to provide operational procedures and maintenance programs as related to leak detection and contamination control.
COL 9.3(3)	The COL applicant is to maintain complete documentation of system design, construction, design modifications, field changes, and operations.
COL 9.3(4)	The COL applicant is to provide the flow diagram of turbine generator building drain system and the interconnection from the auxiliary boiler building sump, and the flow diagram of CCW heat exchanger building drain system to LWMS or turbine generator building (TGB) sump.
COL 9.3(5)	The COL applicant is to provide connection provisions at the nearest accessible area to the valve and sight glass room of the IRWST leakage pipe line for detecting and cleaning blockage due to crystallized boron inside the leakage collection channel and pipes.
COL 9.3(6)	The COL applicant is to prepare the site radiological environmental monitoring program.
COL 9.3(7)	The COL applicant is to provide primary side water chemistry threshold values and recommended operator actions for chemistry excursions in compliance with the latest version of the EPRI PWR Primary Water Chemistry Guidelines in effect at the time of COLA submittal. The COL applicant is to establish the operational water chemistry program six months before fuel load.
COL 9.4(1)	The COL applicant is to provide the capacities of heating coils in the safety-related air handling units and cooling and heating coils in the non safety-related air handling units affected by site-specific conditions.
COL 9.4(2)	The COL applicant is to provide the interval of reopening the closed outside air intake isolation dampers by considering the durability of the isolation dampers and the site-specific meteorological data ~~from radiological aspects.~~ and to consider the radiological impacts if a higher frequency is determined

Table 1.8-2 (32 of 38)

Item No.	Description
COL 14.2(11)	The COL applicant is to provide a schedule for the development of plant procedures, as well as a description of how, and to what extent, the plant operating, emergency, and surveillance procedures are use-tested during the initial test program.
COL 14.2(12)	The COL applicant that references the APR1400 design certification is to identify the specific operator training to be conducted as part of the low-power testing program related to the resolution of TMI Action Plan Item I.G.1, as described in (1) NUREG-0660 – NRC Action Plans Developed as a Result of the TMI-2 Accident, Revision 1, August 1980 and (2) NUREG-0737 – Clarification of TMI Action Plan Requirements.
COL 14.2(13)	The COL applicant is to develop a sequence and schedule for the development of the plant operating and emergency procedures should allow sufficient time for trial use of these procedures during the Initial Test Program. The sequence and schedule for plant startup is to be developed by the COL applicant to allow sufficient time to systematically perform the required testing in each phase.
COL 14.2(14)	The COL applicant is to perform the appropriate interface testing of the gaseous PERMSS monitors with ERDS.
COL 14.2(15)	The COL applicant is to prepare the preoperational test of cooling tower and associated auxiliaries, and raw water and service water cooling systems.
COL 14.2(16)	The COL applicant is to develop the test program of personnel monitors, radiation survey instruments, and laboratory equipment used to analyze or measure radiation levels and radioactivity concentrations.
COL 14.2(17)	The COL applicant is to prepare the site-specific preoperational and startup test specification and test procedure and/or guideline for plant and offsite communication system.
COL 14.2(18)	The COL applicant is to prepare the pre-operational test of ultimate heat sink pump house.
COL 14.2(19)	The COL applicant is to prepare the testing and verification of ultimate heat sink cooling chains.
COL 14.3(1)	The COL applicant is to provide the ITAAC for the site-specific portion of the plant systems specified in Subsection 14.3.3.
COL 14.3(2)	The COL applicant is to provide a design ITAAC closure schedule for implementing the V&V design ITAAC as addressed in Subsection 14.3.2.9.
COL 14.3(3)	The COL applicant is to provide the proposed ITAAC for the facility's emergency planning not addressed in the DCD in accordance with RG 1.206.
COL 14.3(4)	The COL applicant is to provide the proposed ITAAC for the site specific facility's physical security hardware not addressed in the DCD in accordance with RG 1.206.
COL 15.0(1)	The COL applicant is to perform the radiological consequence analysis using site-specific χ/Q values, unless the χ/Q values used in the DCD envelop the site-specific short-term or long-term χ/Q values of the DCD, and to show that the resultant doses are within the guideline values of 10 CFR 50.34 for EAB and LPZ and that of 10 CFR Part 50, Appendix A, GDC 19 for the MCR and TSC.
COL 16.1(1)	The choice of units is a COL information to be resolved by COL applicant
COL15.0(2)	The COL applicant is to perform the radiological consequence analysis and demonstrate that the related dose limits specified in 10 CFR Part 50, Appendix A GDC 19 are not exceeded, if the interval value of re-opening the closed outside air intake isolation dampers is less than that specified in Subsection 15.0.3.5.

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"D"

COL15.0(3)	The COL applicant is to perform the radiological consequence analysis and demonstrate that the related dose limits specified in 10 CFR Part 50, Appendix A GDC 19 are not exceeded, if the intake damper re-opening and closing time exceeds that specified in Subsection 15.0.3.5 or there are any other aspects of the design of the dampers that are non-conservative compared to what is used in Subsection 15.0.3.5.

e. The other AHUs (HV01B through HV01D) are kept in standby and the associated isolation dampers (Y0013C and Y0015C, Y0014B and Y0016B, and Y0014D and Y0016D) and discharge airflow control dampers (Y0021C, Y0022B, and Y0022D) are closed.

f. The kitchen and toilet exhaust fan operates continuously, and the associated isolation dampers (Y0027 and Y0028) are open.

g. Two isolation dampers (Y0029 and Y0030) for the smoke removal fan remain closed.

h. The non-safety-related humidifiers are controlled by a humidity controller located in the MCR.

i. Two computer room PACUs operate automatically when the computer room temperature rises above or drops below the setpoints of the temperature switch to maintain the room temperature within the design room temperature range.

When the other AHUs (HV01B through HV01D) operate, the normal mode operation is the same as those for above AHU (HV01A) except the equipment and component numbers are different, as shown on Figure 9.4.1-1.

<u>Emergency Mode</u>

Upon receipt of an engineered safety features actuation system – safety injection actuation signal (ESFAS-SIAS) or an engineered safety feature actuation system – control room emergency ventilation actuation signal (ESFAS-CREVAS), all AHU inlet isolation dampers in the outside normal makeup air duct to the AHUs are automatically closed. Additionally, one of the two sets of outside air intake isolation dampers closes to isolate the higher radioactivity air supply from the two available outside air intakes. The closed outside air intake isolation dampers are automatically reset and reopened at an interval after the outside air intake isolation dampers are initially closed upon receipt of an ESFAS-SIAS or an ESFAS-CREVAS. After reopening, one set of outside air intake isolation dampers having higher radioactivity air automatically closes based on the radiation levels and the control room HVAC system automatically repeats reopening the closed outside air intake isolation dampers at the interval. The COL applicant is to provide the interval of reopening the closed outside air intake isolation dampers by considering the durability of the isolation dampers and the site-specific meteorological data ~~from radiological aspects~~ and to consider the radiological impacts if a higher frequency is determined

Operations and documentation

a. Adequate work space between mounting frames for the ACUs is provided to facilitate maintenance and minimize the potential for the spread of contamination.

b. Carbon removal from the carbon adsorber is facilitated by the use of portable pneumatic carbon removal equipment to minimize spillage.

c. ACUs, the reactor cavity AHU, cubicle coolers, low volume purge supply fans, and RCFCs are designed with adequate instrumentation to be remotely operated with manual initiation and stopped from the MCR and the RSR.

d. The COL applicant is to establish operational procedures and maintenance programs as related to leak detection and contamination control (COL 9.4(5)). Procedures and maintenance programs are to be completed before fuel is loaded for commissioning.

Site Radiological Environmental Monitoring Program

The air quality around the plant is sampled and analyzed routinely for contamination levels and migration pathways as part of the Site Radiological Environmental Monitoring Program. Potentially contaminated HVAC systems are expected to be included in this program.

9.4.9 Combined License Information

COL 9.4(1) The COL applicant is to provide the capacities of heating coils in the safety-related air handling units and cooling and heating coils in the non-safety-related air handling units affected by site-specific conditions.

COL 9.4(2) The COL applicant is to provide the interval of reopening the closed outside air intake isolation dampers by considering the durability of the isolation dampers and the site-specific meteorological data ~~from radiological aspects.~~ and to consider the radiological impacts if a higher frequency is determined.

COL 9.4(3) The COL applicant is to provide the system design information of ESW building and CCW heat exchanger building HVAC system including flow diagram, if the ESW building and CCW heat exchanger building requires the HVAC system.

Table 12.3-6 (2 of 2)

Description	Tag No.	Class(1)			Range					Function and Remarks
		S	SE	E	Airborne Particulate	Iodine	Gas	Liquid	Area(2) (mSv/hr)	Display & Alarm at MCR/RSR/Local
Hot machine shop	C-RE-293	N	III	N	N/A	N/A	N/A	N/A	$10^{-3} \sim 10^{2}$	Yes/Yes/Yes
Radiochemistry lab	RE-257	N	III	N	N/A	N/A	N/A	N/A	$10^{-3} \sim 10^{2}$	Yes/Yes/Yes
~~Instrument calibration facility~~	~~C-RE-286~~	~~N~~	~~III~~	~~N~~	~~N/A~~	~~N/A~~	~~N/A~~	~~N/A~~	~~$10^{-3} \sim 10^{2}$~~	~~Yes/Yes/Yes~~
Main control room area	RE-275	N	II	N	N/A	N/A	N/A	N/A	$10^{-3} \sim 10^{2}$	Yes/Yes/Yes
TSC area	RE-279	N	III	N	N/A	N/A	N/A	N/A	$10^{-3} \sim 10^{2}$	Yes/Yes/Yes
Truck bay area	C-RE-288 C-RE-289	N	III	N	N/A	N/A	N/A	N/A	$10^{-3} \sim 10^{2}$	Yes/Yes/Yes
Waste drum storage area	C-RE-292	N	III	N	N/A	N/A	N/A	N/A	$10^{-3} \sim 10^{2}$	Yes/Yes/Yes
Compound building dry active waste storage area	C-RE-284	N	III	N	N/A	N/A	N/A	N/A	$10^{-3} \sim 10^{2}$	Yes/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
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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Figure 11.5-2R Location of Radiation Monitors at Plant (Compound Building El. 63′-0″)

1.8 To verify the alarm verification functions of RMS computer & SRDC

1.9 To verify the RMS computer hand over function

1.10 To verify the interface between RMS computer and Perimeter computer

1.11 To verify the manual/automatic operation & closure time of all Monitor sample containment isolation valves

1.12 To demonstrate the operation of ESFAS-CREVAS at specified monitors

2.0 PREREQUISITES

2.1 Construction activities on the process and effluent radiological monitoring system have been completed and system software is installed.

2.2 Process and effluent radiological monitoring system instrumentation has been calibrated. using a calibration source

2.3 Support systems, including heat tracking, required for operation of the process and effluent radiological monitoring system are completed and operational.

2.4 Test instrumentation is available and calibrated.

2.5 Calibration check source is available.

3.0 TEST METHOD

3.1 Using a simulated signal and external test equipment, verify calibration and operation of the monitor.

3.2 Check the self-testing feature of the monitor.

3.3 Where applicable, verify proper control actuation by the monitor and record the response time. Simulate a high-radiation signal to the appropriate radiation monitors to verify proper control actuations.

2.0 PREREQUISITES

2.1 Construction activities on the area radiation monitoring system have been completed and system software is installed.

2.2 Area radiation monitoring system instrumentation has been calibrated using a calibration source.

2.3 Support systems required for operation of the area radiation monitoring system are completed and operational.

2.4 Test instrumentation is available and calibrated.

2.5 Calibration check source is available.

3.0 TEST METHOD

3.1 Using a ~~check source~~ simulated signal and external test equipment, verify the calibration and operation of the monitor.

3.2 Check the self-testing feature of the monitor.

3.3 Compare local and remote indications.

3.4 Verify proper local and remote alarm actuations.

3.5 Simulate automatic initiation signals and verify proper control actuations.

4.0 DATA REQUIRED

4.1 Monitor response to a ~~check source~~ simulated signal

4.2 Technical data associated with the source

4.3 Local and remote responses to test signals

4.4 Signals levels necessary to cause alarm actuation

5.0 ACCEPTANCE CRITERIA

5.1 The area radiation monitors perform as described in Subsection 12.3.4.

$$DDE_{finite} = (DDE_{\infty} \times V^{0.338}) / 1,173$$

For the first 8 hours after the accident, the offsite breathing rate is assumed to be 3.5×10^{-4} m^3/sec. From 8 to 24 hours, the breathing rate is assumed to be 1.8×10^{-4} m^3/sec. Between 24 hours and the end of the accident, the rate is assumed to be 2.3×10^{-4} m^3/sec. For the MCR and TSC, the breathing rate of the individual is assumed to be 3.5×10^{-4} m^3/sec during the entire period of the accident.

15.0.3.5 Atmospheric Dispersion Factor

Accident atmospheric dispersion factors (χ/Q) for the EAB and the LPZ are used to calculate the potential offsite doses. The short-term χ/Q values at the EAB and LPZ are determined as described in Subsection 2.3.4 and are given in Table 2.3-1. The MCR and TSC χ/Q values are described in Subsection 2.3.4 and given in Tables 2.3-2 through 2.3-12. These χ/Q values are used in conjunction with dose conversion factors to calculate TEDE at receptor locations.

The atmospheric releases given in each accident subsection are used in conjunction with the appropriate χ/Q values to calculate the potential offsite and MCR and TSC doses for the corresponding accidents.

The combined license (COL) applicant is to perform the radiological consequence analysis using site-specific χ/Q values, unless the χ/Q values used in the DCD envelop the site-specific short-term or long-term χ/Q values of the DCD, and to show that the resultant doses are within the guideline values of 10 CFR 50.34 for EAB and LPZ and that of 10 CFR Part 50, Appendix A, GDC 19 for the MCR and TSC (COL 15.0(1)).

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15.0.3.6 Analytical Models for Loss-of-Coolant Accidents

This section describes the brief analytical models used in the calculation of radiation doses resulting from a LOCA. Details are presented in Subsection 15.6.5.5. The doses are calculated for the following locations:

a. EAB

b. LPZ outer boundary

c. MCR and TSC

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The followings are taken into account for the calculation of the MCR and TSC

The closed outside air intake isolation dampers are automatically reset and reopened at an interval after the outside air intake isolation dampers are initially closed upon receipt of an ESFAS-SIAS or an ESFAS-CREVAS. After reopening, one set of outside air intake isolation dampers having higher radioactivity air automatically closes based on the radiation levels and the control room HVAC system automatically repeats reopening the closed outside air intake isolation dampers at the interval. The potential increased dose due to the reopening of the closed outside air intake isolation dampers and subsequent closing of the outside intake isolation dampers having higher radioactivity air at the interval should be taken into account.

An evaluation of the impact of the MCR intake with the higher radioactivity during re-opening of the intake dampers was performed. An interval time of 1 hour between opening the closed intake was used in the analysis consistent with the averaging period of the χ/Q calculations and substantiated with meteorological data from previously designed APR1400 plants. The total intake damper opening and closing times were conservatively taken to be 60 seconds. It was evaluated that the consideration of re-opening of dampers led to an increased dose of 8.3% compared to the current MCR calculated dose. However, in calculating the radiological consequence and MCR filter loading, a χ/Q reduction factor of 8 for the auto-selection function was conservatively applied instead of 10 as specified in Section 3.3.2.4 of the RG 1.194 guidance, resulting in an additional 20% margin. Therefore, this dose was not included in the MCR analysis since the impact of potentially higher radioactivity resulting from the opening of the closed intake damper is encompassed by the 20% margin.

The COL applicant is to provide the interval of re-opening the closed outside air intake isolation dampers by considering the durability of the isolation dampers and the site-specific meteorological data and to consider the radiological impacts if a higher frequency is determined ~~(COL 9.4(5))~~. COL 9.4(2)

The COL applicant is to perform the radiological consequence analysis and demonstrate that the related dose limits specified in 10 CFR Part 50, Appendix A GDC 19 are not exceeded, if the interval value of reopening the closed outside air intake isolation dampers is less than that specified in Subsection 15.0.3.5 (COL 15.0(2)).

The COL applicant is to perform the radiological consequence analysis and demonstrate that the related dose limits specified in 10 CFR Part 50, Appendix A GDC 19 are not exceeded, if the intake damper re-opening and closing time exceeds that specified in Subsection 15.0.3.5 or there are any other aspects of the design of the dampers that are non-conservative compared to what is used in Subsection 15.0.3.5 (COL 15.0(3)).

including cooldown, are addressed in plant-specific emergency operating procedures (EOPs). For the radiological consequence analysis, the release to the environment is calculated until the time for release termination. Table 15.0-9 presents the time for release termination for each DBA.

Offsite radiological consequences at the EAB and LPZ following the APR1400 DBAs are summarized in Table 15.0-10. Even with the conservative assumptions on the atmospheric dispersion factors, the offsite dose results for all DBAs are well within the dose limits in 10 CFR 50.34. Radiological consequences to the MCR personnel are summarized in Table 6.4-1. Similarly, the MCR doses for all DBAs meet the criteria of 10 CFR Part 50, Appendix A, GDC 19.

15.0.4 Combined License Information

COL 15.0(1) The COL applicant is to perform the radiological consequence analysis using site-specific χ/Q values, unless the χ/Q values used in the DCD envelop the site-specific short-term or long-term χ/Q values of the DCD, and to show that the resultant doses are within the guideline values of 10 CFR 50.34 for EAB and LPZ and that of 10 CFR Part 50, Appendix A, GDC 19 for the MCR and TSC.

COL15.0(2) The COL applicant is to perform the radiological consequence analysis and demonstrate that the related dose limits specified in 10 CFR Part 50, Appendix A GDC 19 are not exceeded, if the interval value of re-opening the closed outside air intake isolation dampers is less than that ~~specified in Subsection 15.0.3.5.~~

15.0.5 References

1. Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," June 2007.

2. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," U.S. Nuclear Regulatory Commission, various dates and revisions.

3. "APR1400 Standard Safety Analysis Report," Chapter 15, May 7, 2002.

4. "Hanbit Units 3&4 Safety Analyses Report," Appendix 15A: Loss of Primary Coolant Flow Methodology Description, KEPCO, 1993.

5. Letter from G. W. Knighton (NRC) to Arizona Public Service, "Amendment No. 24 to License No. NPF-41," October 21, 1987.

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COL15.0(3) COL applicant is to perform the radiological consequence analysis and demonstrate that the related dose limits specified in 10 CFR Part 50, Appendix A GDC 19 are not exceeded, if the intake damper re-opening and closing time exceeds that specified in Subsection 15.0.3.5 or there are any other aspects of the design of the dampers that are non-conservative compared to what is used in Subsection 15.0.3.5.