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.:	**132-8088**
SRP Section:	**11.05 - Process and Effluent Radiological Monitoring Instrumentation and Sampling System**
Application Section:	**11.05**
Date of RAI Issue:	**08/07/2015**

Question No. 11.05-2

11.5 - SRP 11.5.2.2, Description of the PERMSS

Liquid PERMSS

Information contained in DCD section 11.5.2.3 does not include the level of detail SRP section 11.5 details in the description for the PERMSS. Inspection of Tier 1 Section 2.7.6.4 the staff observes that there are indications not described in Section 11.5 that are seen in Tier 1 Table 2.7.6.4-1. This Tier 1 table has a column to describe if there is a Display/Alarm in the MCR/ or RSR indication. Each detector in this table has a "Yes" marked down for all three indications, however DCD Section 11.5 does not fully include a description of all indications in either the text or DCD Tables 11.5-2.

As a result the staff requests that the applicant provide the following complete information:

- Each monitor should contain a description of its functions and safety related requirements in meeting redundancy or independence (where applicable)
- Each monitor should contain a discussion on radiation detection ranges
- Each monitor should contain a discussion on the process configuration of the detector
- Each monitor should contain a discussion on its specific location
- Discussions of applicable regulatory guides should be used
- Provide a discussion concerning the alarms and interlocks established for each detector.
- Each monitor should contain information on the associated sampling stations if applicable, especially effluent monitors.

- Provisions for purging of sample lines and minimizing process and effluent volumes should be indicated

- Each monitor should contain a discussion of the safety classification associated with the monitor

- There should be a discussion on the calibration and quality assurance for each detector

Please address these items and provide a mark up for the proposed DCD changes.

Response – (Rev. 2)

- Each monitor should contain a description of its functions and safety related requirements in meeting redundancy or independence (where applicable)

  Each monitor function will be described in the revised “Function and Remark” column of Tier 2 Table 11.5-2. All safety related radiation monitors are classified to the Safety Class 3 conforming to ANSI/ANS-51.1 and Electrical Class A/B/C/D per Class 1E separation division as identified in “Class” column of Tier 2 Table 11.5-2.These monitors are designed to meet the requirements of redundancy and independence in accordance with IEEE603 and IEEE 308 as described in the Tier 2 Section 3.2.3 “Safety Class”.

  Subsection 11.5.2.3.5 will be added to describe the function of each monitor and the redundancy of the safety related monitor.

- Additional Clarification on the Liquid PERMSS with relation to ODCM and REMP are discussed in the response to RAI 131-8087_Question 11.05-1.

- Each monitor should contain a discussion on radiation detection ranges

  The engineering unit(Bq/cc) provided as a radiation range will be changed to μCi/cc and the updated detection ranges of each monitors will be provided in the Table 11.5-2.

  In the newly added Subsection 11.5.2.3.5 a pointer is provided to state that the measuring range of each monitor is specified in Table 11.5-2.

- Each monitor should contain a discussion on the process configuration of the detector

  The liquid PERMS local unit extracts, transports, and retains a representative sample of the monitored process medium. Each local unit consists of off-line samplers, a local skid, and a local panel. The local skid contains detector sensors, sample pump, and associated piping/tubing and valves. Off-line samplers are connected in parallel with the monitored system piping. The differential head of the sampler inlet and outlet are designed on the basis of allowing flow of 3 to 4 gpm through the sampler. The sampler chamber is designed with sufficient volume of the sampled stream to meet the sensitivity requirements. Protective devices such as pressure relief and reverse flow check valves are provided to prevent damage to the detectors, pumps, and accessories. The sampler is designed to have the inlet arranged so that a swirling action occurs, the bottom portion is hemispherical, and the outlet is at the bottom so that a self-flushing minimizes deposition of contaminants.

Coolers are provided to cool down the off-line process samples if the process conditioning is required.

The local panel contains local microprocessors, local operator controls and displays, and a local audible/visual alarm. Each local unit is designed to have stand-alone operation capability.

For purging provision, please refer to the discussion below.

Subsection 11.5.2.3.1 and Figure 11.5-3B will be added to describe the process configuration of the liquid PERMSS.

- Each monitor should contain a discussion on its specific location

  The locations of each monitor are described in Subsection 11.5.2.3 and the physical locations are shown in the Figure 11.5-2.

  The liquid PERMSS monitors listed in Table 11.5-2 have been thoroughly reviewed to correct the discrepancies and omissions of the monitor location.

  Figures 11.5-2 will be revised to show the correct location of the radiation detectors (RE) and the monitor electronics/displays (RT). In the figures, RE/RT means that the detector and electronic/display are installed together adjacent to each other. The location of some RE and RT have been changed to the correct location. Subsection 11.5.2.3.5 will be added to describe that the location of each monitor is shown in Figures 11.5-2.

  Condenser pit sump water monitor (RE-165) is newly added to Subsection 11.5.2.3.5.e and Table 11.5-2 to incorporate the design change described in the response to RAI 244-8326, Question 09.03.03-4.

- Discussions of applicable regulatory guides should be used

  The applicable regulatory guides in Section 11.5 are described in the Subsection 11.5.6 “References” as follows: RG 1.97 classification and related requirements are discussed and referenced in 11.5.2.1.

  - Regulatory Guide 1.21, “Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste,” U.S. Nuclear Regulatory Commission, June 2009 (Reference 5).

  - Regulatory Guide 1.45, “Reactor Coolant Pressure Boundary Leakage Detection Systems,” Rev. 1, U.S. Nuclear Regulatory Commission, May 2008 (Reference 7).

  - Regulatory Guide 1.97, “Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident,” Rev. 4, U.S. Nuclear Regulatory Commission, June 2006 (Reference 8).

- Regulatory Guide 1.143, “Design Guide for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants,” Rev. 2, U.S. Nuclear Regulatory Commission, November 2001(Reference 12).

- Regulatory Guide 1.109, “Calculation of Annual Doses to Man from Routine Release of Reactor Effluents for the Purpose of Evaluating Compliance with 10 Code of Federal Regulations Part 50, Appendix I,” Rev. 1, U.S. Nuclear Regulatory Commission, October 1977 (Reference 22).

- Regulatory Guide 1.111, “Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors,” Rev. 1, U.S. Nuclear Regulatory Commission, July 1977(Reference 23).

- Regulatory Guide 1.113, “Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I,” Rev. 1, U.S. Nuclear Regulatory Commission, April 1997(Reference 24).

- Regulatory Guide 1.33, “Quality Assurance Program Requirements (Operation),” U.S. Nuclear Regulatory Commission, February 1978(Reference 25).

- Regulatory Guide 4.15, “Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination) - Effluent Streams and the environment,” Rev. 2, U.S. Nuclear Regulatory Commission, July 2007(Reference 26).

- Regulatory Guide 8.8, “Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable,” Rev. 3, U.S. Nuclear Regulatory Commission, June 1978 (Reference 28).

- Regulatory Guide 8.10, “Operating Philosophy for Maintaining Occupational Radiation Exposures as low as Is Reasonably Achievable,” Rev. 1, U.S. Nuclear Regulatory Commission, May 1977 (Reference 29).

- Regulatory Guide 4.21, “Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning,” U.S. Nuclear Regulatory Commission, June 2008 (Reference 31).

• Provide a discussion concerning the alarms and interlocks established for each detector.

  The updated information of the alarms will be provided in the Table 11.5-2. The interlock function can be divided into isolation and diversion functions. These are tabulated in the Table 11.5-2. Two functions for each detector are described in note 3 of the same Table as applicable.

  Subsection 11.5.2.3.5 will be added to describe the alarms and interlocks of each monitor.

• Each monitor should contain information on the associated sampling stations if applicable, especially effluent monitors.

Subsection 11.5.2.3.3 will be added to describe the equipment and instrument for the liquid effluent monitoring and process monitoring.

- Provisions for purging of sample lines and minimizing process and effluent volumes should be indicated

  Each local skid has a provision for purging the sample line with demineralized water for liquid monitors. Each stainless steel sample chamber is designed to be decontaminated by flushing with demineralized water without removal from the process or sample line. Solenoid valves are provided at the sampler inlet so that flushing operation can be performed locally from the local unit or remotely from the Operator Interface Unit (OIU) keyboard. The sample chamber liner is designed to be easily replaced in the field.

  Demineralized water used in purging the sample line will be returned back to the sample line, which will be rerouted to the Liquid Radwaste System, when high radiation is detected, thus minimizing the amount of liquid effluent discharged to the environment.

  Subsection 11.5.2.3.2 will be added to describe the purging of sample lines.

- Each monitor should contain a discussion of the safety classification associated with the monitor

  The safety classification in accordance with ANSI/ANS-51.1-1983 (Reference 32) is provided in the “Class” column of Table 11.5-2 and the details of each classification is given in note 1 at the end of the table.

  Subsection 11.5.2.3.5 will be added to describe the safety classification of each monitor.

- There should be a discussion on the calibration and quality assurance for each detector

  The calibration procedures are developed in accordance with NRC RG 1.33 (Reference 25) and NRC RG 4.15 (Reference 26) (COL 11.5 (6)) as described in the Subsection 11.5.1.2 “Design Criteria”. The methodology to determine the calibration methods and frequency of the PERMSS and ARMS is provided by the offsite dose calculation manual (ODCM) based on plant procedures as described in the Subsection 12.3.4.1.7 “Calibration Methods and Frequency”.

  The quality assurance (QA) program for the design, installation, procurement, and fabrication of PERMSS components conforms to Regulatory Position C.7 of NRC RG 1.143 (Reference 12) as described in the Subsection 11.5.1.2 “Design Criteria”.

  Post-accident radiation monitors conform to NRC RG 1.97 including equipment qualification, quality assurance testing and calibration as described in the Subsection 11.5.2.1 “Monitor Design and Configuration”.

- The CCW heat exchanger building sump monitor (RE-166) is added for consistency with DCD Chapter 9.

Impact on DCD

DCD Tier 1, Table 2.7.6.4-1 will be revised.

DCD Tier 2, Subsections 11.5.2.3, 11.5.5, Table 11.5-2, Figures 11.5-2B, 11.5-2C, 11.5-2D, 11.5-2E, 11.5-2R, 11.5-2S, 11.5-2X, 11.5-2Y, and 11.5-2AA will be revised.

The markup for Figure 11.5-2E is not attached to this response because the markup is included in the revised response to RAI 131-8087, Question 11.05-1.

Figure 11.5-3B will be added.

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 1

Table 2.7.6.4-1 (4 of 5)

Format changed and safety class information added

Range information added

Display & Alarm at MCR/RSR/Local

Monitor deleted

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

Yes/No/No

Collective sewage treatment sump

Monitor added

Steam Generator 1 Downcomer

Steam Generator 2 Downcomer

i. Gaseous radwaste system exhaust monitor (RE-080)

A monitor with gas channels is provided to monitor the radiation level of gaseous radwaste system exhaust to the compound building vent stack.

j. Compound building HVAC effluent monitor (RE-082)

One monitor with air particulate and iodine sampler is provided to monitor compound building HVAC effluent.

k. Compound building exhaust ACU inlet monitor (RE-083)

A monitor with air particulate, iodine, and gas channels is provided to monitor the compound building plant area.

l. Compound building hot machine shop monitor (RE-084)

One monitor with air particulate, iodine, and gas channels is provided to monitor the compound building hot machine shop.

m. Main steam line area and N-16 radiation monitors (RE-217, 218, 219, and 220)

These monitors are located near the main steam safety valves and main steam atmospheric dump valves. Alarms are provided in the MCR to alert the operator when these monitors detect the PTS leakage due to a steam generator leakage. The method of detecting the SG leak rate is described in Appendix 11B.

The RMS for the release point in the high-energy line break (HELB) area, auxiliary building, and compound building is described in Subsection 9.4.

Replace with "A"

~~11.5.2.3 Liquid PERMSS~~

~~Each liquid process and effluent monitor is described in the following paragraphs. A list of each monitor and associated parameters is given in Table 11.5-2.~~

a. Component cooling water supply header monitors (RE-111 and 112)

Homogeneous isokinetic sampling is considered in the sample location and flow rate in accordance with ANSI/HPS N13.1.

Component cooling water is sampled downstream of the component cooling water pumps and is continuously monitored by a gamma scintillation detector mounted in a shielded liquid sampler. After passing through the monitor, the sample is returned to the component cooling water system.

Activity detected above a predetermined setpoint is indicative of a leak into the component cooling water system from the RCS or one of the other systems containing radioactive fluids.

b. Liquid radwaste system effluent monitors (RE-183 and 184)

Two radiation monitors for waste monitor tank effluent, are installed. In the event that radioactivity in excess of a preset limit is detected in the waste liquid discharge flow, the liquid radwaste system effluent monitors actuate an alarm in the MCR/radwaste control room and terminate the discharge.

The LWMS is designed with dual radiation monitors on the treated effluent discharge line. A radiation level in any portion of the flow that exceeds the predetermined setpoint will trigger alarms in the MCR and the remote shutdown room for operator actions, simultaneously turn off the monitor tank pump, and close the effluent discharge valve that is under supervisory control. The status of the pumps and the position of the valve are indicated in the MCR and remote shutdown room for verification. The LWMS is designed with no release bypass.

In the event of failure of one or both radiation monitors, a failure (inoperable) signal will generate an alarm in the MCR. The discharge of the treated effluent will be terminated through operator action until the radiation monitor(s) is/are repaired or replaced.

Replace with "A"

~~A set of inspections, tests, analyses, and acceptance criteria is included in the Tier 1 Table 2.7.6.1-2, sub-item 6, to inspect, test, and verify the installation of the as-built dual radiation monitors and isolation valve on the sole LWMS discharge line. A report is to be prepared to confirm the installation, functionality, operability testing, and calibration of the dual radiation monitors and isolation valve.~~

c. ~~Steam generator blowdown and downcomer monitors (RE-104, 185, and 186)~~

~~These offline monitors sample the SG blowdown and downcomer for radioactivity, which is indicative of PTS leakage. Samples from each of the SGs are continuously monitored by a detector mounted in a shielded liquid sampler. Samples are cooled down through secondary sample cooler rack, which is a part of the secondary sampling system described in Subsection 9.3.2.2.3, before being transferred to a local unit. After being monitored, the sample is passed back to the SG blowdown and downcomer systems.~~

d. ~~Condensate polishing area sump water monitor (RE-164)~~

~~This monitor is an offline monitor that continuously monitors the condensate polishing area sump water for gross gamma activity. Upon receipt of a high-radiation signal, the discharge flow is automatically diverted to the liquid waste management system (LWMS) prior to release to the environment~~.

e. ~~Condensate receiver tank monitor (RE-103)~~

~~This monitor uses an offline shielded liquid sampler and a gamma scintillation detection system to continuously monitor the effluent from the condensate receiver tank in the auxiliary steam system. Detection of high activity automatically terminates releases from the system; the effluent is routed to the equipment waste tank in the LWMS and initiates alarms to plant operators.~~

f. ~~Collective sewage treatment sump area monitor (RE-109)~~

~~This is an offline monitor to detect gross gamma activity at the outlet of the collective sewage treatment sump area. Upon receipt of a high-radiation signal,~~

Replace with "A"

~~the discharge flow is automatically diverted to the LWMS prior to release to the environment, and the high-radiation alarm is provided to the operator. This monitor is also used to detect gross gamma activity at the outlet of the condenser pit sumps.~~

~~g. Miscellaneous process liquid monitors (RE-204 and 265)~~

~~Two monitors are provided to continuously monitor the radiation levels of the letdown and gas stripper outlets in the CVCS. Detailed information for these monitors is presented in Subsection 9.3.4.5.5.~~

~~h. Essential service water pump discharge header monitors (RE-113 and 114)~~

~~Two monitors for essential service water discharge header are installed. The essential service water is sampled downstream of the component cooling water heat exchangers and is continuously monitored by a gamma scintillation detector mounted in a shielded liquid sampler. After passing through the monitor, the sample is returned to the essential service water system. Activity detected above background is indicative of a leak into the essential service water system from the ultimate heat sink basins or one of the other systems containing radioactive fluids.~~

The sample lines for gaseous PERMSS are sloped down toward the monitor skid, and the use of sample line fittings such as unions, elbows, and tees are avoided to the extent practical. Setpoints, the calibration method, and the frequency for safety-related monitors are described in Subsections 12.3.4.1.6 and 12.3.4.1.1.

Replace with "A"

11.5.2.4 Design Features for Minimization of Contamination

The APR1400 is designed with specific features to meet the requirements of 10 CFR 20.1406 and Regulatory Guide 4.21. The basic principles of RG 4.21, and the methods of control suggested in the regulations, are specifically delineated in four design objectives and two operational objectives described in Subsection 12.4.2 of this DCD. The following evaluation summarizes the primary features to address the design and operational objectives for the RMS.

A

11.5.2.3 Liquid PERMSS

11.5.2.3.1 Process configuration

The liquid PERMS local unit extracts, transports, and retains a representative sample of the monitored process medium. Each local unit consists of off-line samplers, a local skid, and a local panel. The local skid contains detector sensors, sample pump, and associated piping/tubing and valves. Off-line samplers are connected in parallel with the monitored system piping. The differential head of the sampler inlet and outlet are designed on the basis of allowing flow of 3 to 4 gpm through the sampler. The sampler chamber is designed with sufficient volume of the sampled stream to meet the sensitivity requirements. Protective devices such as pressure relief and reverse flow check valves are provided to prevent damage to the detectors, pumps, and accessories. The sampler is designed to have the inlet arranged so that a swirling action occurs, the bottom portion is hemispherical, and the outlet is at the bottom so that a self-flushing minimizes deposition of contaminants. Coolers are provided to cool down the off-line process samples if the process conditioning is required.

The local panel contains local microprocessors, local operator controls and displays, and a local audible/visual alarm. Each local unit is designed to have stand-alone operation capability.

Generic process configuration for the liquid PERMS is shown in Figure 11.5-3B.

11.5.2.3.2 Purging of sample lines

Each local skid has a provision for purging the sample line with demineralized water for liquid monitors. Each stainless steel sample chamber is designed to be decontaminated by flushing with demineralized water without removal from the process or sample line. Solenoid valves are provided at the sampler inlet so that flushing operation can be performed locally from the local unit or remotely from the Operator Interface Unit (OIU) keyboard. The sample chamber liner is designed to be easily replaced in the field.

Demineralized water used in purging the sample line will be returned back to the sample return line, which will be rerouted to the Liquid Radwaste System, when high radiation is detected, thus minimizing the amount of liquid effluent discharged to the environment.

11.5.2.3.3 Monitoring of liquid effluent discharge and process stream

Monitoring provision for liquid PERMSS is similar to the monitoring provision for the gaseous PERMSS which is described in Subsection 11.5.2.2.3.

11.5.2.3.4 Calibration

Calibration procedure is described in Subsection 11.5.1.2.m.

11.5.2.3.5 Liquid PERMSS monitor component description

Liquid PERMSS are classified as non-safety-related. Table 11.5-2 lists the measuring range, safety class, seismic category, quality class, electrical class, and other associated design information for each monitor. Liquid PERMSS monitor takes a direct sample without a sample probe. After passing through the monitor, the sample is returned to the system sampled.

a. Component cooling water supply header monitors (RE-111 and 112)

The sample line inlets of RE-111 and 112 are located at the component cooling water supply header. These offline monitors have a gamma scintillation detector.

The monitors have measuring range specified in Table 11.5-2 and provide indication and alarm to the MCR, RSR, and local RMS skid. Activity detected above a predetermined setpoint is indicative of a leak into the component cooling water system from the RCS and/or the other systems containing radioactive fluids. There is no automatic action initiated by RE-111 and RE-112.

The monitors are located in Auxiliary Building as shown in Figure 11.5-2C (RE-111) and Figure 11.5-2B (RE-112).

b. Liquid radwaste system effluent monitors (RE-183 and 184)

The sample line inlet of RE-183 and 184 are located at liquid radwaste system effluent discharge. These offline monitors have a gamma scintillation detector. The monitors have measuring range specified in Table 11.5-2 and provide indication and alarm to the MCR, RSR, and local RMS skid.

The monitors are located in Compound Building as shown in Figure 11.5-2R.

In the event that radioactivity in excess of a preset limit is detected in the waste liquid discharge flow, the liquid radwaste system effluent monitors terminate the discharge.

These monitors are designed to provide alarm to operator not to exceed the dose limits in 10 CFR 50, Appendix I and the effluent concentration limits in 10 CFR 20, Appendix B.

The LWMS is designed with two radiation monitors on the treated effluent discharge line. A radiation level in any portion of the flow that exceeds the predetermined setpoint turns off the monitor tank pump, and closes the effluent discharge valve. The status of the pumps and the position of the valve are indicated in the MCR and RSR for verification. The LWMS is designed with no release bypass.

In the event of failure of one or both radiation monitors, a failure (inoperable) signal will generate an alarm in the MCR. The discharge of the treated effluent will be terminated by an operator action until the radiation monitor(s) is/are repaired or replaced.

A set of inspections, tests, analyses, and acceptance criteria is included in the Tier 1 Table 2.7.6.1-2, sub-item 6, to inspect, test, and verify the installation of the as-built two radiation monitors and isolation valve on the sole LWMS discharge line. A report is to be

prepared to confirm the installation, functionality, operability testing, and calibration of the two radiation monitors and isolation valve.

c. Steam generator blowdown and downcomer monitors (RE-104, 185, and 186)

The sample line inlet of RE-104 is located at the discharge of the steam generator blowdown system. The sample line inlet of RE-185 and RE-186 is located at individual steam generator downcomer sample line in the process sampling system. These offline monitors have a gamma scintillation detector.

The monitors have measuring range specified in Table 11.5-2 and provide indication and alarm to the MCR, RSR, and local RMS skid.

Samples are cooled down through secondary sample cooler rack, which is part of the secondary sampling system, before being transferred to a local unit.

High radioactivity detected by these monitors indicates primary-to-secondary leakage. RE-104, RE-185, and 186, and/or grab samples from the primary sampling (PX) system are used to determine which steam generator is the source of the leak. Both of the blowdown line isolation valves and the secondary continuous sample line isolation valves are automatically closed when high radiation is detected.

The monitors are located in Auxiliary Building as shown in Figure 11.5-2E (RE-104) and in Compound Building as shown in Figure 11.5-2S (RE-185 and 186).

d. Condensate polishing area sump water monitor (RE-164)

The sample line inlet of RE-164 is located at the discharge of condensate polishing area sump pump.

This offline monitor has a gamma scintillation detector. The monitor has measuring range specified in Table 11.5-2 and provides indication and alarm to the MCR, RSR, and local RMS skid.

Upon detection of a high-radiation signal, the operating condensate polishing area sump pump is stopped automatically. The discharge valve to the waste water treatment facility (WWTF) is closed, and the discharge valve to the liquid waste management system (LWMS) is opened simultaneously. Then, the sump pump is manually started. The flow is then diverted to the LWMS.

The monitor is designed to provide alarm to operator not to exceed the dose limits in 10 CFR 50, Appendix I and the effluent concentration limits in 10 CFR 20, Appendix B.

The monitor is located in Turbine Generator Building as shown in Figure 11.5-2Y.

e. Condenser pit sump water monitor (RE-165)

The sample line inlet of RE-165 is located at the discharge of condenser pit sump pump.

The monitor provides indication and alarm to the MCR, RSR, and local RMS skid.

Upon detection of a high-radiation signal, the operating sump pumps are stopped automatically. The discharge valve to the WWTF is closed, and the discharge valve to condensate polishing area sump is opened simultaneously. Then, the sump pump is manually started. The flow is then diverted to the LWMS.

The monitor is designed to provide alarm to operator not to exceed the dose limits in 10 CFR 50, Appendix I and the effluent concentration limits in 10 CFR 20, Appendix B.

The monitor type, measuring range, and installed location of the RE-165 are to be determined by the COL applicant (COL 11.5 (10)).

f. Condensate receiver tank monitor (RE-103)

The sample line inlet of RE-103 is located at the outlet of the condensate receiver tank in the auxiliary steam system.

This offline monitor has a gamma scintillation detector and monitors a leak in the boric acid concentrator and gas stripper. The monitor has measuring range specified in Table 11.5-2 and provides indication and alarm to the MCR, RSR, and local RMS skid. Detection of high activity automatically diverts the condensate flow to the equipment waste tank in the LWMS by closing condensate return pump discharge isolation valve to the gland seal water collection tank/underground common tunnel and opening the condensate return pump discharge isolation valve to the LWMS. The sample pump on the condensate receiver tank discharge sample line stops upon the detection of high radiation signal.

The monitor is designed to provide alarm to operator not to exceed the dose limits in 10 CFR 50, Appendix I and the effluent concentration limits in 10 CFR 20, Appendix B.

The monitor is located in Auxiliary Building as shown in Figure 11.5-2D.

g. Fire pump and water/wastewater treatment building monitor (RE-190)

The sample line inlet of RE-190 is located at the outlet of the chemical wastewater treatment ponds. This offline monitor has a gamma scintillation detector. The monitor has measuring range specified in Table 11.5-2 and provides indication and alarm to the MCR, RSR, and local RMS skid.

Upon receipt of a high radiation signal, the chemical wastewater pumps stop. Contaminated wastewater in the chemical wastewater ponds is administratively controlled.

The monitor is designed to provide alarm to operator not to exceed the dose limits in 10 CFR 50, Appendix I and the effluent concentration limits in 10 CFR 20, Appendix B.

The monitor is located in Wastewater treatment facility as shown in Figure 11.5-2AA.

h. CVCS letdown monitor and CVCS gas stripper effluent monitor (RE-204 and 265)

The CVCS letdown line process radiation monitor (RE-204) provides continuous recording in the MCR of reactor coolant gross gamma radiation and specific fission product gamma activity, thus providing a measure of fuel cladding integrity. A high-radiation alarm is annunciated in the MCR. Local and remote samples in the CVCS provide the primary means for determining RCS activity. The process radiation monitor serves only as a trending device to alert the operator of possible fuel cladding failure.

The sample line inlet of the RE-204 is located at the purification filter outlet to purification ion exchanger of CVCS.

The monitors (RE-204) transmit the radiation signals to the licensing entity via emergency response data system (ERDS) link.

The gas stripper effluent radiation monitor (RE-265) provides continuous recording in the MCR of the gross gamma activity leaving the gas stripper and entering the holdup tank. A high radiation alarm indicates improper operation of upstream purification equipment. Normally, however, an increasing activity trend allows the operator to take corrective measures (replace ion exchanger resin or filter cartridges) before significant activity increases in the holdup tank. The radiation monitor consists of a logarithmic ratemeter that processes pulses from a shielded scintillation detector.

The sample line inlet of RE-265 is located at the holdup tank inlet of CVCS.

These monitors have measuring range specified in Table 11.5-2. There is no automatic action initiated by RE-204 and RE-265.

The monitors are located in Auxiliary Building as shown in Figure 11.5-2D (RE-204) and Figure 11.5-2E (RE-265).

i. Essential service water pump discharge header monitors (RE-113 and 114)

Two monitors for essential service water discharge header are installed. The sample line inlet of RE-113 and RE-114 is located at the downstream of the component cooling water heat exchangers in the essential service water system.

These offline monitors have a gamma scintillation detector. The monitors have measuring range specified in Table 11.5-2 and provide indication and alarm to the MCR, RSR, and local RMS skid. There is no automatic action initiated by RE-113 and RE-114. Activity detected above background is indicative of a leak into the essential service water system from the component cooling water system.

The monitors are located in CCW HX Building as shown in Figure 11.5-2X.

j. CCW heat exchanger building sump monitor (RE-166)

The sample line inlet of RE-166 is located at the discharge of condenser pit sump pump.

The monitor provides indication and alarm to the MCR, RSR, and local RMS skid.

Upon detection of a high-radiation signal, the discharge valve of the CCW heat exchange building sump pump to non-radioactive liquid release is closed and the discharge valve to the LWMS is opened simultaneously. The flow is then diverted to the LWMS.

The monitor is designed to provide alarm to operator not to exceed the dose limits in 10 CFR 50, Appendix I and the effluent concentration limits in 10 CFR 20, Appendix B.

The monitor type, measuring range, and installed location of the RE-166 are to be determined by the COL applicant (COL 11.5 (10)).

COL 11.5(2) The COL applicant is to develop an annual report that specifies the quantity of each principal radionuclide released to unrestricted areas in liquid and gaseous effluents.

COL 11.5(3) The COL applicant is to provide site-specific procedures that conform with the numerical guides of 10 CFR 50.34a and 10 CFR 50, Appendix I.

COL 11.5(4) The COL applicant is to prepare an ODCM that contains a description of the methodology and parameters for calculation of the offsite doses for the gaseous and liquid effluents. The COL applicant is to follow NEI 07-09A as an alternative to providing an offsite dose calculation manual.

COL 11.5(5) The COL applicant is to provide analytical procedures and sensitivity for selected radioanalytical methods and types of sampling media for site-specific matter.

COL 11.5(6) The COL applicant is to develop the calibration procedures in accordance with NRC RG 1.33 and 4.15.

COL 11.5(7) The COL applicant is to develop detailed location and tubing installation and provide the sampling method including the sampling time to acquire representative sampling.

COL 11.5(8) The COL applicant is to provide operational procedures and maintenance programs related to leak detection and contamination control.

COL 11.5(9) The COL applicant is to develop a radiological and environmental monitoring program, taking into consideration local land use and census data in identifying all potential radiation exposure pathways. The COL applicant is to follow NEI 07-09A as an alternative to providing a radiological and environmental monitoring program.

COL 11.5 (10) The COL applicant is to determine the monitor type, safety class, measuring range, and installed location of the RE-165.

and RE-166.

Table 11.5-2 (1 of 2)

Liquid Process and Effluent Radiation Monitors

μCi/cc

Function and Remarks (3)

Display & Alarm at MCR/RSR/Local

Location	Tag No.	Class (1)				Range (~~Bq/cc~~) (2)					Function and ~~Remarks~~
		S	SE	Q	E	Particulate Gross β	I-131 γ	Gas Gross β	Liquid Gross γ	Area	
CVCS letdown	CV-RE-204	N	II	A	N	N/A	N/A	N/A	~~3.7×10^0 to 3.7×10^6~~ 1.0×10^{-4} to 1.0×10^2	N/A	~~Alarm (MCR)~~
CVCS gas stripper effluent	CV-RE-265	N	II	A	N	N/A	N/A	N/A	~~3.7×10^0 to 3.7×10^5~~ 1.0×10^{-4} to 1.0×10^1	N/A	~~Alarm (MCR)~~
Condensate receiver tank	RE-103	N	III	S	N	N/A	N/A	N/A	~~3.7×10^{-2} to 3.7×10^3~~ 1.0×10^{-6} to 1.0×10^{-1}	N/A	~~Alarm (MCR),~~ diversion interlock
~~Steam generator blowdown and downcomer~~	~~RE-104 RE-185 RE-186~~	~~N~~	~~II III III~~	A	N	N/A	N/A	N/A	~~3.7×10^{-2} to 3.7×10^3~~	N/A	~~Alarm (MCR),~~ leak detection isolation interlock
CCW supply header	RE-111 RE-112	N	II	A	N	N/A	N/A	N/A	~~3.7×10^{-2} to 3.7×10^3~~	N/A	~~Alarm (MCR),~~ leak detection isolation of inlet/outlet valve of heat exchanger
Essential service water (ESW) pump discharge headers	RE-113 RE-114	N	II	A	N	N/A	N/A	N/A	~~3.7×10^{-2} to 3.7×10^3~~	N/A	~~Alarm (MCR),~~ leak detection

Yes/No/No

Yes/Yes/Yes

Steam Generator blowdown	RE-104	N	II
Steam Generator 1 and 2 downcomer	RE-185 RE-186	N	III

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Table 11.5-2 (1 of 2)

Liquid Process and Effluent Radiation Monitors

μCi/cc

Function and Remarks (3)

Display & Alarm at MCR/RSR/Local

Location	Tag No.	Class (1)				Range (~~Bq/cc~~) (2)					~~Function and Remarks~~
		S	SE	Q	E	Particulate Gross β	I-131 γ	Gas Gross β	Liquid Gross γ	Area	
CVCS letdown	CV-RE-204	N	II	A	N	N/A	N/A	N/A	~~3.7×10^0 to 3.7×10^6~~ 1.0×10^{-4} to 1.0×10^2	N/A	~~Alarm (MCR)~~
CVCS gas stripper effluent	CV-RE-265	N	II	A	N	N/A	N/A	N/A	~~3.7×10^0 to 3.7×10^5~~ 1.0×10^{-4} to 1.0×10^1	N/A	~~Alarm (MCR)~~
Condensate receiver tank	RE-103	N	III	S	N	N/A	N/A	N/A	~~3.7×10^{-2} to 3.7×10^3~~ 1.0×10^{-6} to 1.0×10^{-1}	N/A	~~Alarm (MCR),~~ diversion interlock
~~Steam generator blowdown and downcomer~~	~~RE-104 RE-185 RE-186~~	~~N~~	~~II III III~~	A	N	N/A	N/A	N/A	~~3.7×10^{-2} to 3.7×10^3~~	N/A	~~Alarm (MCR),~~ leak detection isolation interlock
CCW supply header	RE-111 RE-112	N	II	A	N	N/A	N/A	N/A	~~3.7×10^{-2} to 3.7×10^3~~	N/A	~~Alarm (MCR),~~ leak detection isolation of inlet/outlet valve of heat exchanger
Essential service water (ESW) pump discharge headers	RE-113 RE-114	N	II	A	N	N/A	N/A	N/A	~~3.7×10^{-2} to 3.7×10^3~~	N/A	~~Alarm (MCR),~~ leak detection

Yes/No/No

Yes/Yes/Yes

Delete from the table

Steam Generator blowdown	RE-104	N	II
Steam Generator 1 and 2 downcomer	RE-185 RE-186	N	III

Table 11.5-2 (2 of 2)

μCi/cc

Function and Remarks (3)
Display & Alarm at MCR/RSR/Local

Location	Tag No.	Class(1)				Range (~~Bq/cc~~)(2)					~~Function and Remarks~~
		S	SE	Q	E	Particulate Gross β	I-131 γ	Gas Gross β	Liquid Gross γ	Area	
CPP area sump water	RE-164	N	III	S	N	N/A	N/A	N/A	~~3.7×10^{-2}~~ to ~~3.7×10^{3}~~	N/A	~~Alarm (MCR),~~ pump stop signal
Liquid radwaste system effluent	RE-183 RE-184	N	III	A	N	N/A	N/A	N/A	~~3.7×10^{-2}~~ to ~~3.7×10^{3}~~	N/A	~~Alarm (MCR),~~ isolation interlock
~~[~~Collective sewage treatment sump~~]~~	RE-190	N	III	A	N	N/A	N/A	N/A	~~3.7×10^{-3}~~ to ~~3.7×10^{3}~~	N/A	~~Alarm,~~ pump stop signal

1.0×10^{-6} to 1.0×10^{-1}

1.0×10^{-7} to 1.0×10^{-1}

Yes/Yes/Yes

(1) S = Safety Class per ANSI/ANS 51.1 (Reference 32): 1 = SC-1, 2 = SC-2, 3 = SC-3, N = NNS
SE = Seismic Category: I, II, III
E = Electrical Class: A, B, C, D = Class 1E Separation Division, N = Non-Class 1E
Q = Quality Class: Q, A, S

(2) Detector type and calibration nuclide for each measurement:
Particulate Gross β = β scintillator with Cs-137
Gas Gross β = β scintillator with Kr-85
Liquid Gross γ = γ scintillator with Cs-137
Iodine γ = γ scintillator with Ba-133

(3) The detector with the isolation function isolates the effluent discharge function when the discharge reaches a preset setpoint value, thus terminating the discharge. The detector with the diversion interlock function diverts the effluent discharge to a safe hold-up storage or further processing for decontamination when a setpoint is reached. Certain detectors could have both isolation and diversion interlock function depending on the application.

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Table 11.5-2 (2 of 2)

μCi/cc

Function and Remarks (3)

Display & Alarm at MCR/RSR/Local

Location	Tag No.	Class(1)				Range (~~Bq/cc~~)(2)					
		S	SE	Q	E	Particulate Gross β	I-131 γ	Gas Gross β	Liquid Gross γ	Area	~~Function and Remarks~~
CPP area sump water	RE-164	N	III	S	N	N/A	N/A	N/A	~~3.7×10^{-2} to 3.7×10^{3}~~	N/A	~~Alarm (MCR),~~ pump stop signal
Liquid radwaste system effluent	RE-183 RE-184	N	III	A	N	N/A	N/A	N/A	~~3.7×10^{-2} to 3.7×10^{3}~~	N/A	~~Alarm (MCR),~~ isolation interlock
~~[Collective sewage treatment sump]~~	RE-190	N	III	A	N	N/A	N/A	N/A	~~3.7×10^{-3} to 3.7×10^{3}~~	N/A	~~Alarm,~~ pump stop signal

Fire pump and water/ wastewater treatment building

1.0×10^{-6} to 1.0×10^{-1}

1.0×10^{-7} to 1.0×10^{-1}

Yes/Yes/Yes

Note (5)

(1) S = Safety Class per ANSI/ANS 51.1 (Reference 32): 1 = SC-1, 2 = SC-2, 3 = SC-3, N = NNS
SE = Seismic Category: I, II, III
E = Electrical Class: A, B, C, D = Class 1E Separation Division, N = Non-Class 1E
~~Q = Quality Class: Q, A, S~~

Delete from the table

(2) Detector type and calibration nuclide for each measurement:
Particulate Gross β = β scintillator with Cs-137
Gas Gross β = β scintillator with Kr-85
Liquid Gross γ = γ scintillator with Cs-137
Iodine γ = γ scintillator with Ba-133

Delete

(3) The detector with the isolation function isolates the effluent discharge function when the discharge reaches a preset setpoint value, thus terminating the discharge. The detector with the diversion interlock function diverts the effluent discharge to a safe hold-up storage or further processing for decontamination when a setpoint is reached. Certain detectors could have both isolation and diversion interlock function depending on the application.

(4) The COL applicant is to determine the safety class and measuring range (COL 11.5(10)) .

(5) The liquid effluent radiation monitors shall be inspected, calibrated, and tested in accordance with the methodology and criteria specified in the ODCM. The COL applicant may follow NEI 07-09A (Reference 21) as guidance for the preparation of the ODCM (COL 11.5(4)).

Added monitor

Condenser pit sump water	RE-165	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	Yes/Yes/Yes, pump stop signal
CCW heat exchanger building sump	RE-166	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	Yes/Yes/Yes, pump stop signal

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 11.5-2B Location of Radiation Monitors at Plant (Auxiliary Building El. 55′-0″)

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 11.5-2C Location of Radiation Monitors at Plant (Auxiliary Building El. 55′-0″)

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 11.5-2D Location of Radiation Monitors at Plant (Auxiliary Building El. 55′-0″)

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 11.5-2R Location of Radiation Monitors at Plant (Compound Building El. 63′-0″)

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 11.5-2S Location of Radiation Monitors at Plant (Compound Building El. 85′-0″)

Security-Related Information – Withhold Under 10 CFR 2.390

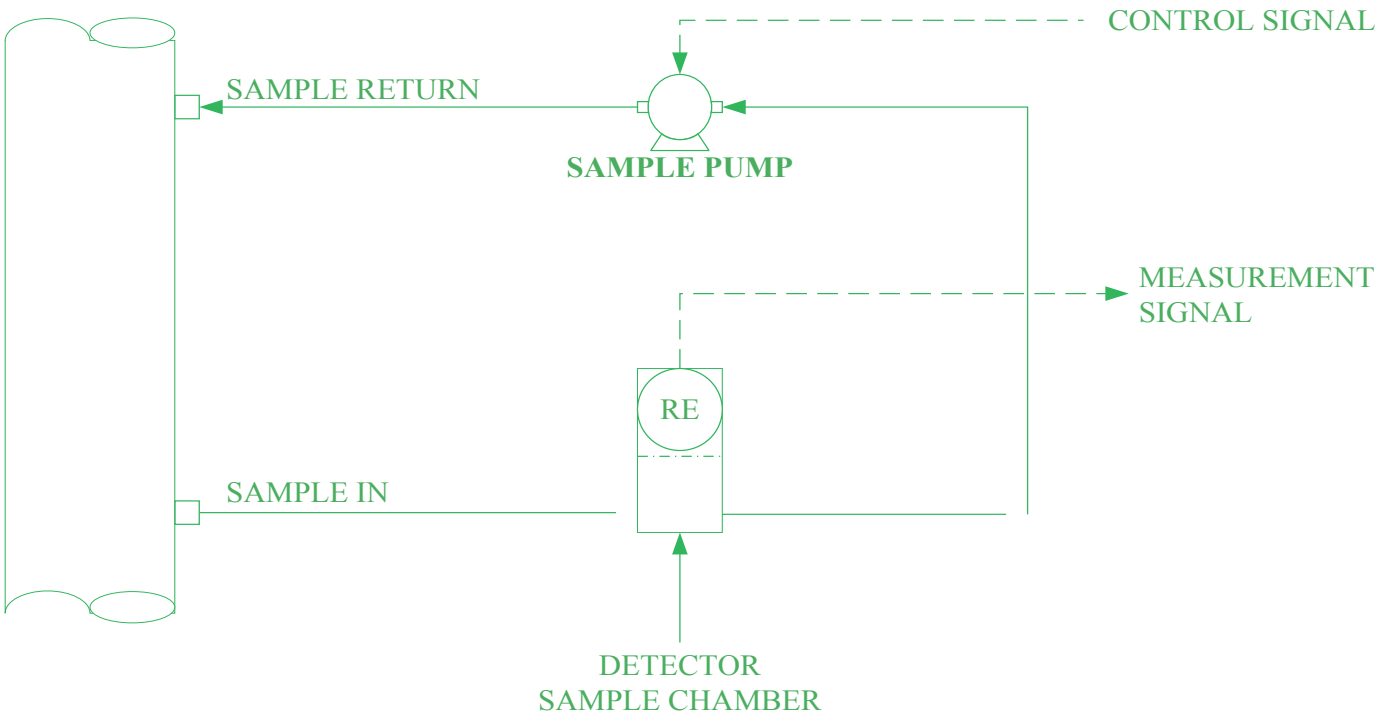
Figure 11.5-2X Location of Radiation Monitors at Plant (CCW HX Building El. 113′-0″ and 127′-5″)

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 11.5-2Y Location of Radiation Monitors at Plant (Turbine Generator Building El. 73′-0″)

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 11.5-2AA Location of Radiation Monitors at Plant (Wastewater Treatment FAC. El. 82′-0″)



Notes:

1. Depending on the temperature of the liquid sample, a sample cooler may be placed upstream of the detector chamber with cooling water supplied from the plant component cooling water.

2. The detector type of the liquid monitor is typically gamma scintillation detector.

3. The liquid monitor local skid is typically provided with demineralized water supply purge provision.

Figure 11.5-3B Typical Liquid Monitor