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

- 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-15.1 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”.

- 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.

- 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.

- 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.

- 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:

  - 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 1.33, “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.

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

  For all off-line process monitors, grab sampling provision is provided on the local sampling system skid.

- 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.

- 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.

- 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” referenced in the Subsection 11.5.1.3.

  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”.

Impact on DCD

DCD Tier 2 Table 11.5-2 will be revised as indicated on the attached markup.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.

Table 11.5-2 (1 of 2)

Liquid Process and Effluent Radiation Monitors

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}~~	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}~~	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}~~	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

μCi/cc

1.0×10^{-4} to 1.0×10^{2}

Function and Remarks (3)

Display & Alarm at MCR/RSR/Local

Yes/Yes/Yes

1.0×10^{-4} to 1.0×10^{1}

Yes/Yes/Yes

1.0×10^{-6} to 1.0×10^{-1}

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

APR1400 DCD TIER 2

μCi/cc

1.0 x 10^{-6} to 1.0 x 10^{-1}

Function and Remarks (3)

Display & Alarm at MCR/RSR/Local

Table 11.5-2 (2 of 2)

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

Yes/Yes/Yes

1.0 x 10^{-7} to 1.0 x 10^{-1}

(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.