

**2.4.22 Radiation Monitoring System**

**Design Description**

**1.0 System Description**

The radiation monitoring system (RMS) provides surveillance of ionizing radiation comprising all provisions dealing with the occurrence of ionizing radiation within the plant and measures related to the health control of personnel who could be exposed to radiation.

The radiation monitoring system provides the following safety-related function:

- Provides safety-related signals to the SCDS.

The radiation monitoring system provides the following non-safety related function:

- Provides non-safety-related signals to the SCDS.

**2.0 Arrangement**

2.1 The location of the RMS equipment is as listed in Table 2.4.22-1—Radiation Monitoring System Equipment.

**3.0 Mechanical Design Features**

3.1 Equipment identified as Seismic Category I in Table 2.4.22-1 can withstand seismic design basis loads without a loss of safety function(s).

**4.0 I&C Design Features, Displays, and Controls**

4.1 The RMS provides output signals to the recipients listed in Table 2.4.22-2—Radiation Monitoring System Output Signals.

4.2 Locking mechanisms are provided on the RMS cabinet doors. RMS cabinet doors that are not closed are indicated on the PICS operator workstations in the MCR.

4.3 The RMS is designed so that safety-related functions required for an anticipated operational occurrence (AOO) or postulated accident (PA) are performed in the presence of the following:

- Single detectable failures within the RMS concurrent with identifiable but non-detectable failures.
- Failures caused by the single failure.
- Failures and spurious system actions that cause or are caused by the AOO or PA requiring the safety function.

- 4.4 Class 1E RMS equipment listed in Table 2.4.22-1 can perform its safety function when subjected to electromagnetic interference (EMI), radio-frequency interference (RFI), electrostatic discharges (ESD), and power surges.
- 4.5 Display of radioactivity level from the radiation monitors listed in Table 2.4.22-1 is indicated on the PICS operator workstations in the main control room (MCR).
- 4.6 The RMS records the radioactivity level from the radiation monitors listed in Table 2.4.22-1.

## **5.0 Electrical Power Design Features**

- 5.1 Equipment designated as Class 1E in Table 2.4.22-1 are powered from the Class 1E division as listed in Table 2.4.22-1 in a normal or alternate feed condition.

## **6.0 Environmental Qualifications**

- 6.1 Equipment designated as harsh environment in Table 2.4.22-1 can perform their function under normal environmental conditions, containment test conditions, anticipated operational occurrences, and accident and post-accident environmental conditions.
- 6.2 Equipment designated as mild environment in Table 2.4.22-1 can perform their function under normal environmental conditions, anticipated operational occurrences, and accident and post-accident environmental conditions.

## **7.0 Equipment and System Performance**

- 7.1 Deleted.

### **Inspections, Tests, Analyses, and Acceptance Criteria**

Table 2.4.22-3 lists the RMS ITAAC.

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<b>Description</b>	<b>Tag Number<sup>(1)</sup></b>	<b>Location</b>	<b>Seismic Category</b>	<b>IEEE Class 1E<sup>(2)</sup></b>	<b>Environment</b>
Radiation Monitoring Cabinet Division 1	30CLE20GH001/002	Safeguard Building 1	I	1 <sup>N</sup> 2 <sup>A</sup>	Mild
Radiation Monitoring Cabinet Division 2	30CLF20GH001/002	Safeguard Building 2	I	2 <sup>N</sup> 1 <sup>A</sup>	Mild
Radiation Monitoring Cabinet Division 3	30CLG20GH001/002	Safeguard Building 3	I	3 <sup>N</sup> 4 <sup>A</sup>	Mild
Radiation Monitoring Cabinet Division 4	30CLH20GH001/002	Safeguard Building 4	I	4 <sup>N</sup> 3 <sup>A</sup>	Mild
Containment High Range Dose Rate Monitor	30JYK15CR101	Containment Building	I	1 <sup>N</sup> 2 <sup>A</sup>	Harsh
Containment High Range Dose Rate Monitor	30JYK15CR102	Containment Building	I	2 <sup>N</sup> 1 <sup>A</sup>	Harsh
Containment High Range Dose Rate Monitor	30JYK15CR103	Containment Building	I	3 <sup>N</sup> 4 <sup>A</sup>	Harsh
Containment High Range Dose Rate Monitor	30JYK28CR101	Containment Building	I	4 <sup>N</sup> 3 <sup>A</sup>	Harsh
Main Steam Line Radiation Monitors Division 1 (R-55)	30LBA10CR811	Main Steam Valve Room	I	1 <sup>N</sup> 2 <sup>A</sup>	Harsh
Main Steam Line Radiation Monitors Division 1 (R-55)	30LBA10CR821	Main Steam Valve Room	I	2 <sup>N</sup> 1 <sup>A</sup>	Harsh
Main Steam Line Radiation Monitors Division 1 (R-55)	30LBA10CR831	Main Steam Valve Room	I	3 <sup>N</sup> 4 <sup>A</sup>	Harsh
Main Steam Line Radiation Monitors Division 1 (R-55)	30LBA10CR841	Main Steam Valve Room	I	4 <sup>N</sup> 3 <sup>A</sup>	Harsh

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<b>Description</b>	<b>Tag Number<sup>(1)</sup></b>	<b>Location</b>	<b>Seismic Category</b>	<b>IEEE Class 1E<sup>(2)</sup></b>	<b>Environment</b>
Main Steam Line Radiation Monitors Division 2 (R-56)	30LBA20CR811	Main Steam Valve Room	I	1 <sup>N</sup> 2 <sup>A</sup>	Harsh
Main Steam Line Radiation Monitors Division 2 (R-56)	30LBA20CR821	Main Steam Valve Room	I	2 <sup>N</sup> 1 <sup>A</sup>	Harsh
Main Steam Line Radiation Monitors Division 2 (R-56)	30LBA20CR831	Main Steam Valve Room	I	3 <sup>N</sup> 4 <sup>A</sup>	Harsh
Main Steam Line Radiation Monitors Division 2 (R-56)	30LBA20CR841	Main Steam Valve Room	I	4 <sup>N</sup> 3 <sup>A</sup>	Harsh
Main Steam Line Radiation Monitors Division 3 (R-57)	30LBA30CR811	Main Steam Valve Room	I	1 <sup>N</sup> 2 <sup>A</sup>	Harsh
Main Steam Line Radiation Monitors Division 3 (R-57)	30LBA30CR821	Main Steam Valve Room	I	2 <sup>N</sup> 1 <sup>A</sup>	Harsh
Main Steam Line Radiation Monitors Division 3 (R-57)	30LBA30CR831	Main Steam Valve Room	I	3 <sup>N</sup> 4 <sup>A</sup>	Harsh
Main Steam Line Radiation Monitors Division 3 (R-57)	30LBA30CR841	Main Steam Valve Room	I	4 <sup>N</sup> 3 <sup>A</sup>	Harsh
Main Steam Line Radiation Monitors Division 4 (R-58)	30LBA40CR811	Main Steam Valve Room	I	1 <sup>N</sup> 2 <sup>A</sup>	Harsh
Main Steam Line Radiation Monitors Division 4 (R-58)	30LBA40CR821	Main Steam Valve Room	I	2 <sup>N</sup> 1 <sup>A</sup>	Harsh
Main Steam Line Radiation Monitors Division 4 (R-58)	30LBA40CR831	Main Steam Valve Room	I	3 <sup>N</sup> 4 <sup>A</sup>	Harsh
Main Steam Line Radiation Monitors Division 4 (R-58)	30LBA40CR841	Main Steam Valve Room	I	4 <sup>N</sup> 3 <sup>A</sup>	Harsh

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<b>Description</b>	<b>Tag Number<sup>(1)</sup></b>	<b>Location</b>	<b>Seismic Category</b>	<b>IEEE Class 1E<sup>(2)</sup></b>	<b>Environment</b>
Main Control Room Vent Duct Radiation Monitor (R-29)	30KLLK65CR001	CRACS Supply Air Duct	I	4 <sup>N</sup> 3 <sup>A</sup>	Mild
Main Control Room Vent Duct Radiation Monitor (R-29)	30KLLK65CR002	CRACS Supply Air Duct	I	2 <sup>N</sup> 1 <sup>A</sup>	Mild
Main Control Room Vent Duct Radiation Monitor (R-30)	30KLLK66CR001	CRACS Supply Air Duct	I	1 <sup>N</sup> 2 <sup>A</sup>	Mild
Main Control Room Vent Duct Radiation Monitor (R-30)	30KLLK66CR002	CRACS Supply Air Duct	I	3 <sup>N</sup> 4 <sup>A</sup>	Mild
Containment Building Refueling Bridge Area Dose Rate Monitor	30JYK15CR003	Containment Building	NSC	4 <sup>N</sup> 3 <sup>A</sup> (Non-1E)	N/A
Fuel Building Spent Fuel Mast Bridge Area Dose Rate Monitor	30JYK28CR002	Fuel Building	NSC	1 <sup>N</sup> 2 <sup>A</sup> (Non-1E)	N/A
Fuel Building Equipment Hatch Dose Area Rate Monitor	30JYK28CR004	Fuel Building	NSC	4 <sup>N</sup> 3 <sup>A</sup> (Non-1E)	N/A
Vent System for Air Removal Radiation Monitor (R-3)	30MAQ90CR001	Turbine Building	NSC	NA	NA
Containment Building Low Flow Purge Subsystem Radiation Monitor (R-7)	30KLLK10CR001 30KLLK10CR031 30KLLK10CR071	Safeguard Building	NSC	NA	NA
Containment Building Low Flow Purge Subsystem Radiation Monitor (R-8)	30KLLK12CR041	Safeguard Building	NSC	NA	NA

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Description	Tag Number <sup>(1)</sup>	Location	Seismic Category	IEEE Class 1E <sup>(2)</sup>	Environment
Containment Building Low Flow Purge Subsystem Radiation Monitor (R-9)	30KLLK13CR001 30KLLK13CR002	Safeguard Building	II	NA	NA
Nuclear Sampling System Monitor (R-41)	30KUA66CR001	Fuel Building	II	NA	NA
Solid Waste Management System Radiation Monitors (R-43)	30KPC90CR501 30KPC90CR502 30KPC90CR503 30KPC90CR504 30KPC90CR505 30KPC90CR506 30KPC90CR507 30KPC90CR508	Radioactive Waste Processing Building	NSC	NA	NA

1. Equipment tag numbers are provided for information only and are not part of the certified design.
2. <sup>N</sup> denotes the division the equipment is normally powered from. <sup>A</sup> denotes the division the equipment is powered from when alternate feed is implemented.

**Table 2.4.22-2—Radiation Monitoring System Output Signals**

<b>Item No.</b>	<b>Output Signal</b>	<b>Recipient</b>	<b>No. of Divisions</b>
1	Containment High Range Dose Rate Monitor Signal	SCDS	4
2	Main Steam Line Radiation Monitor Signal	SCDS	4
3	Main Control Room Vent Duct Radiation Monitor Signal	SCDS	4

**Table 2.4.22-3—Radiation Monitoring System ITAAC  
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Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
2.1	The location of the RMS equipment is as listed in Table 2.4.22-1.	An inspection of the location of the as-built RMS equipment will be performed.	The RMS equipment listed in Table 2.4.22-1 is located as listed in Table 2.4.22-1.
3.1	Equipment identified as Seismic Category I in Table 2.4.22-1 can withstand seismic design basis loads without a loss of safety function(s).	<ul style="list-style-type: none"> <li>a. Type tests, analyses, or a combination of type tests and analyses will be performed on the equipment identified as Seismic Category I in Table 2.4.22-1 using analytical assumptions, or under conditions, which bound the Seismic Category I design requirements.</li> <li>b. An inspection will be performed of the as-built equipment identified as Seismic Category I in Table 2.4.22-1 to verify that the equipment, including anchorage, are installed in a condition bounded by the tested or analyzed condition.</li> </ul>	<ul style="list-style-type: none"> <li>a. Test/analysis reports conclude that the equipment identified as Seismic Category I in Table 2.4.22-1 can withstand seismic design basis loads without a loss of safety function(s).</li> <li>b. Inspection reports conclude that the equipment identified as Seismic Category I in Table 2.4.22-1, including anchorage, are installed in a condition bounded by the tested or analyzed condition.</li> </ul>
4.1	The RMS provides output signals to the recipients listed in Table 2.4.22-2.	A test will be performed to verify that the RMS provides output signals to the recipients listed in Table 2.4.22-2.	The RMS provides output signals to the recipients listed in Table 2.4.22-2.
4.2	Locking mechanisms are provided on the RMS cabinet doors. RMS cabinet doors that are not closed are indicated on the PICS operator workstations in the MCR.	<ul style="list-style-type: none"> <li>a. A test will be performed to verify that the locking mechanisms on the RMS cabinet doors operate properly.</li> <li>b. A test will be performed to verify that RMS cabinet doors that are not closed are indicated on the PICS operator workstations in the MCR.</li> </ul>	<ul style="list-style-type: none"> <li>a. The locking mechanisms on the RMS cabinet doors operate properly.</li> <li>b. RMS cabinet doors that are not closed are indicated on the PICS operator workstations in the MCR.</li> </ul>



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	<b>Commitment Wording</b>	<b>Inspections, Tests, Analyses</b>	<b>Acceptance Criteria</b>
4.3	<p>The RMS is designed so that safety-related functions required for an AOO or PA are performed in the presence of the following:</p> <ul style="list-style-type: none"> <li>● Single detectable failures within the RMS concurrent with identifiable but non-detectable failures.</li> <li>● Failures caused by the single failure.</li> <li>● Failures and spurious system actions that cause or are caused by the AOO or PA requiring the safety function.</li> </ul>	<p>A failure modes and effects analysis will be performed on the RMS at the level of replaceable modules and components.</p>	<p>A report concludes that the RMS is designed so that safety-related functions required for an AOO or PA are performed in the presence of the following:</p> <ul style="list-style-type: none"> <li>● Single detectable failures within the RMS concurrent with identifiable but non-detectable failures.</li> <li>● Failures caused by the single failure.</li> <li>● Failures and spurious system actions that cause or are caused by the AOO or PA requiring the safety function.</li> </ul>
4.4	<p>Class 1E RMS equipment listed in Table 2.4.22-1 can perform its safety function when subjected to EMI, RFI, ESD, and power surges.</p>	<p>Type tests or type tests and analyses will be performed to demonstrate that the Class 1E RMS equipment listed in Table 2.4.22-1 can perform its safety function when subjected to EMI, RFI, ESD, and power surges.</p>	<p>Equipment identified as Class 1E in Table 2.4.22-1 can perform its safety function when subjected to EMI, RFI, ESD, and power surges.</p>
4.5	<p>Display of radioactivity level from the radiation monitors listed in Table 2.4.22-1 is indicated on the PICS operator workstations in the MCR.</p>	<p>A test will be performed to verify that the radioactivity level is indicated on the PICS operator workstations in the MCR.</p>	<p>Display of radioactivity level from the radiation monitors listed in Table 2.4.22-1 is indicated on the PICS operator workstations in the MCR.</p>
4.6	<p>The RMS records the radioactivity level from the radiation monitors listed in Table 2.4.22-1.</p>	<p>A test will be performed to verify that the RMS records radioactivity levels.</p>	<p>The RMS records radioactivity level from the radiation monitors listed in Table 2.4.22-1.</p>

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<b>Commitment Wording</b>		<b>Inspections, Tests, Analyses</b>	<b>Acceptance Criteria</b>
5.1	Equipment designated as Class 1E in Table 2.4.22-1 are powered from the Class 1E division as listed in Table 2.4.22-1 in a normal or alternate feed condition.	<ul style="list-style-type: none"> <li>a. Testing will be performed by providing a test input signal in each normally aligned division.</li> <li>b. Testing will be performed by providing a test input signal in each division with the alternate feed aligned to the divisional pair.</li> </ul>	<ul style="list-style-type: none"> <li>a. The test input signal provided in the normally aligned division is present at the respective Class 1E equipment identified in Table 2.4.22-1.</li> <li>b. The test input signal provided in each division with the alternate feed aligned to the divisional pair is present at the respective Class 1E equipment identified in Table 2.4.22-1.</li> </ul>
6.1	Equipment designated as harsh environment in Table 2.4.22-1 can perform their function under normal environmental conditions, containment test conditions, anticipated operational occurrences, and accident and post-accident environmental conditions.	<ul style="list-style-type: none"> <li>a. Type tests or type tests and analysis will be performed to demonstrate the ability of the equipment designated as harsh environment in Table 2.4.22-1 to perform their function under normal environmental conditions, containment test conditions, anticipated operational occurrences, and accident and post-accident environmental conditions.</li> <li>b. An inspection will be performed of the as-built equipment designated as harsh environment in Table 2.4.22-1 to verify that the equipment, including the associated cables, wiring, and terminations located in a harsh environment, are bounded by the type test or combination of type tests and analyses.</li> </ul>	<ul style="list-style-type: none"> <li>a. EQDPs conclude that the equipment designated as harsh environment in Table 2.4.22-1 can perform their function under normal environmental conditions, containment test conditions, anticipated operational occurrences, and accident and post-accident environmental conditions, including the time required to perform the listed function.</li> <li>b. A report exists and concludes that the equipment designated as harsh environment in Table 2.4.22-1, including the associated cables, wiring, and terminations located in a harsh environment, are bounded by the type test or combination of type tests and analyses.</li> </ul>

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<b>Commitment Wording</b>		<b>Inspections, Tests, Analyses</b>	<b>Acceptance Criteria</b>
6.2	Equipment designated as mild environment in Table 2.4.22-1 can perform their function under normal environmental conditions, anticipated operational occurrences, and accident and post-accident environmental conditions.	<p>a. Type tests or type tests and analysis will be performed to demonstrate the ability of the equipment designated as mild environment in Table 2.4.22-1 to perform their function under normal environmental conditions, anticipated operational occurrences, and accident and post-accident environmental conditions.</p> <p>b. An inspection will be performed of the as-built equipment designated as mild environment in Table 2.4.22-1 to verify that the equipment, including the associated cables, wiring, and terminations located in a mild environment, are bounded by the type test or combination of type tests and analyses.</p>	<p>a. EQDPs conclude that the equipment designated as mild environment in Table 2.4.22-1 can perform their function under normal environmental conditions, anticipated operational occurrences, and accident and post-accident environmental conditions, including the time required to perform their function.</p> <p>b. A report exists and concludes that the equipment designated as mild environment in Table 2.4.22-1, including the associated cables, wiring, and terminations located in a mild environment, are bounded by the type test or combination of type tests and analyses.</p>
7.1	Deleted.	Deleted.	Deleted.