

2.4.19 Incore Instrumentation System

Design Description

1.0 System Description

The incore instrumentation system (ICIS) provides information about the conditions inside the reactor core.

The ICIS has the following safety-related functions:

- Provides self powered neutron detector (SPND) output signals to signal conditioning and distribution system (SCDS).
- Provides core outlet temperature signals to SCDS.

2.0 Arrangement

2.1 The location of the ICIS equipment is as listed in Table 2.4.19-1—Incore Instrumentation System Equipment.

3.0 Mechanical Design Features

3.1 Equipment identified as Seismic Category I in Table 2.4.19-1 can withstand seismic design basis loads without loss of safety function.

4.0 I&C Design Features, Displays, and Controls

4.1 Class 1E ICIS equipment listed in Table 2.4.19-1 can function when subjected to electromagnetic interference (EMI), radio-frequency interference (RFI), electrostatic discharges (ESD), and power surges.

4.2 The ICIS provides output signals to the recipients listed in Table 2.4.19-2—Incore Instrumentation System Output Signals.

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

4.4 The ICIS 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 ICIS 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.

5.0 Environmental Qualifications

- 5.1 Equipment designated as harsh environment in Table 2.4.19-1 can perform their function under normal environmental conditions, containment test conditions, anticipated operational occurrences, and accident and post-accident environmental conditions.
- 5.2 Equipment designated as mild environment in Table 2.4.19-1 can perform their function under normal environmental conditions, AOOs, and accident and post-accident environmental conditions.

Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.4.19-3 lists the ICIS ITAAC.

Table 2.4.19-1—Incore Instrumentation Equipment
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Description	Tag Number ⁽¹⁾	Location	Seismic Category	IEEE Class 1E ⁽²⁾	Environment
SPND Division 1	30JKS41CX811 30JKS41CX812 30JKS41CX813 30JKS41CX814 30JKS41CX815 30JKS41CX816 30JKS16CX811 30JKS16CX812 30JKS16CX813 30JKS16CX814 30JKS16CX815 30JKS16CX816 30JKS21CX811 30JKS21CX812 30JKS21CX813 30JKS21CX814 30JKS21CX815 30JKS21CX816	Reactor Building	I	Yes	Harsh
SPND Division 2	30JKS11CX821 30JKS11CX822 30JKS11CX823 30JKS11CX824 30JKS11CX825 30JKS11CX826 30JKS13CX821 30JKS13CX822 30JKS13CX823 30JKS13CX824 30JKS13CX825 30JKS13CX826 30JKS15CX821 30JKS15CX822 30JKS15CX823 30JKS15CX824 30JKS15CX825 30JKS15CX826	Reactor Building	I	Yes	Harsh

Table 2.4.19-1—Incore Instrumentation Equipment
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Description	Tag Number ⁽¹⁾	Location	Seismic Category	IEEE Class 1E ⁽²⁾	Environment
SPND Division 3	30JKS42CX831 30JKS42CX832 30JKS42CX833 30JKS42CX834 30JKS42CX835 30JKS42CX836 30JKS31CX831 30JKS31CX832 30JKS31CX833 30JKS31CX834 30JKS31CX835 30JKS31CX836 30JKS22CX831 30JKS22CX832 30JKS22CX833 30JKS22CX834 30JKS22CX835 30JKS22CX836	Reactor Building	I	Yes	Harsh
SPND Division 4	30JKS14CX841 30JKS14CX842 30JKS14CX843 30JKS14CX844 30JKS14CX845 30JKS14CX846 30JKS32CX841 30JKS32CX842 30JKS32CX843 30JKS32CX844 30JKS32CX845 30JKS32CX846 30JKS12CX841 30JKS12CX842 30JKS12CX843 30JKS12CX844 30JKS12CX845 30JKS12CX846	Reactor Building	I	Yes	Harsh
Core Outlet Thermocouples (NR) Division 1	30JKS16CT812 30JKS21CT812 30JKS41CT812 30JKS16CT813 30JKS21CT813 30JKS41CT813	Reactor Building	I	Yes	Harsh

**Table 2.4.19-1—Incore Instrumentation Equipment
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Description	Tag Number ⁽¹⁾	Location	Seismic Category	IEEE Class 1E ⁽²⁾	Environment
Core Outlet Thermocouples (NR) Division 2	30JKS11CT822 30JKS13CT822 30JKS15CT822 30JKS11CT823 30JKS13CT823 30JKS15CT823	Reactor Building	I	Yes	Harsh
Core Outlet Thermocouples (NR) Division 3	30JKS22CT832 30JKS31CT832 30JKS42CT832 30JKS22CT833 30JKS31CT833 30JKS42CT833	Reactor Building	I	Yes	Harsh
Core Outlet Thermocouples (NR) Division 4	30JKS12CT842 30JKS14CT842 30JKS32CT842 30JKS12CT843 30JKS14CT843 30JKS32CT843	Reactor Building	I	Yes	Harsh
Core Outlet Thermocouples (WR) Division 1	30JKS16CT811 30JKS21CT811 30JKS41CT811	Reactor Building	I	Yes	Harsh
Core Outlet Thermocouples (WR) Division 2	30JKS11CT821 30JKS13CT821 30JKS15CT821	Reactor Building	I	Yes	Harsh
Core Outlet Thermocouples (WR) Division 3	30JKS22CT831 30JKS31CT831 30JKS42CT831	Reactor Building	I	Yes	Harsh
Core Outlet Thermocouples (WR) Division 4	30JKS12CT841 30JKS14CT841 30JKS32CT841	Reactor Building	I	Yes	Harsh
Incore Instrumentation Cabinets – Division 1	30CLE12GH001 30CLE15GH	Safeguard Building 1	I	1 ^N 2 ^A	Mild

**Table 2.4.19-1—Incore Instrumentation Equipment
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Description	Tag Number ⁽¹⁾	Location	Seismic Category	IEEE Class 1E ⁽²⁾	Environment
Incore Instrumentation Cabinets – Division 2	30CLF12GH002 30CLF15GH	Safeguard Building 2	I	2 ^N 1 ^A	Mild
Incore Instrumentation Cabinets – Division 3	30CLG12GH003 30CLG15GH	Safeguard Building 3	I	3 ^N 4 ^A	Mild
Incore Instrumentation Cabinets – Division 4	30CLH12GH004 30CLH15GH	Safeguard Building 4	I	4 ^N 3 ^A	Mild

1. Equipment tag numbers are provided for information and are not part of the design certification.
2. ^N denotes the division the equipment is normally powered from. ^A denotes the division the equipment is powered from when alternate feed is implemented.

Table 2.4.19-2—Incore Instrumentation System Output Signals

Item #	Output Signal	Recipient	# Divisions
1	Neutron Flux Measurements	SCDS	4
2	Core Outlet Temperature	SCDS	4

**Table 2.4.19-3—Incore Instrumentation System ITAAC
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Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
2.1	The location of the ICIS equipment is as listed in Table 2.4.19-1.	An inspection of the location of the as-built ICIS equipment will be performed.	The ICIS equipment listed in Table 2.4.19-1 is located as listed in Table 2.4.19-1.
3.1	Equipment identified as Seismic Category I in Table 2.4.19-1 can withstand seismic design basis loads without loss of safety function.	<ul style="list-style-type: none"> 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 2.4.19-1 using analytical assumptions, or under conditions, which bound the Seismic Category I design requirements. b. An inspection will be performed of the as-built equipment identified as Seismic Category I in Table 2.4.19-1 to verify that the equipment, including anchorage, are installed per the approved design requirements. 	<ul style="list-style-type: none"> a. Test/analysis reports conclude that the equipment identified as Seismic Category I in Table 2.4.19-1 can withstand seismic design basis loads without a loss of safety function including the time required to perform the listed function. b. Inspection reports conclude that the equipment identified as Seismic Category I in Table 2.4.19-1, including anchorage, are installed per the approved design requirements.
4.1	Class 1E ICIS equipment listed in Table 2.4.19-1 can function when subjected to EMI, RFI, ESD, and power surges.	Type tests or type tests and analyses will be performed to demonstrate that the Class 1E ICIS equipment listed in Table 2.4.19-1 can function when subjected to EMI, RFI, ESD, and power surges.	Equipment identified as Class 1E in Table 2.4.19-1 can function when subjected to EMI, RFI, ESD, and power surges.
4.2	The ICIS provides output signals to the recipients listed in Table 2.4.19-2.	A test will be performed to verify that the ICIS provides the output signals to the recipients listed in Table 2.4.19-2.	The ICIS provides output signals to the recipients listed in Table 2.4.19-2.

**Table 2.4.19-3—Incore Instrumentation System ITAAC
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	Commitment Wording	Inspections, Tests, Analyses	Acceptance Criteria
4.3	<p>Locking mechanisms are provided on the ICIS cabinet doors. ICIS cabinet doors that are not closed are indicated on the PICS operator workstations in the MCR.</p>	<p>a. A test will be performed to verify that the locking mechanisms on the ICIS cabinet doors operate properly.</p> <p>b. A test will be performed to verify that ICIS cabinet doors that are not closed are indicated on the PICS operator workstations in the MCR.</p>	<p>a. The locking mechanisms on the ICIS cabinet doors operate properly.</p> <p>b. ICIS cabinet doors that are not closed are indicated on the PICS operator workstations in the MCR.</p>
4.4	<p>The ICIS 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"> ● Single detectable failures within the ICIS 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. 	<p>A failure modes and effects analysis will be performed on the ICIS at the level of replaceable modules and components.</p>	<p>A report concludes that the ICIS 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"> ● Single detectable failures within the ICIS 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.

**Table 2.4.19-3—Incore Instrumentation System ITAAC
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	Commitment Wording	Inspections, Tests, Analyses	Acceptance Criteria
5.1	<p>Equipment designated as harsh environment in Table 2.4.19-1 can perform their function under normal environmental conditions, containment test conditions, anticipated operational occurrences, and accident and post-accident environmental conditions.</p>	<p>a. Type tests or type tests and analysis will be performed to demonstrate the ability of the equipment designated as harsh environment in Table 2.4.19-1 to perform their function under normal environmental conditions, containment test 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 harsh environment in Table 2.4.19-1 to verify that the equipment, including anchorage, are installed per the approved design requirements.</p>	<p>a. EQDPs conclude that the equipment designated as harsh environment in Table 2.4.19-1 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.</p> <p>b. Inspection reports conclude that the equipment designated as harsh environment in Table 2.4.19-1, including anchorage, are installed per the approved design requirements.</p>

**Table 2.4.19-3—Incore Instrumentation System ITAAC
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	Commitment Wording	Inspections, Tests, Analyses	Acceptance Criteria
5.2	Equipment designated as mild environment in Table 2.4.19-1 can perform their function under normal environmental conditions, AOOs, and accident and post-accident environmental conditions.	<ul style="list-style-type: none"> a. Type tests or type tests and analysis will be performed to demonstrate the ability of the equipment designated as mild environment in Table 2.4.19-1 to perform their function normal environmental conditions, AOOs, and accident and post-accident environmental conditions. b. An inspection will be performed of the as-built equipment designated as mild environment Table 2.4.19-1 to verify installation that the equipment, including anchorage, are installed per the approved design requirements. 	<ul style="list-style-type: none"> a. EQDPs conclude that equipment designated as mild environment in Table 2.4.19-1 can perform their function under normal environmental conditions, AOOs, and accident and post-accident environmental conditions, including the time required to perform their function. b. Inspection reports conclude that the installation of equipment designated as mild environment in Table 2.4.19-1, including anchorage, are installed per the approved design requirements.