

DCD Markups for RAI 7.1-101

2.2.13 Engineered Safety Features Safety System Logic and Control

Design Description

The Safety System Logic and Control for the Engineered Safety Features systems (SSLC/ESF) addressed in this subsection performs the safety-related Emergency Core Cooling System (ECCS) control logic, the isolation logic for the Control Room Habitability System (CRHS), and controls the safety-related video display units (VDUs) for the Q-DCIS.

[Conformance with IEEE Std. 603 requirements by the safety-related control system structures, systems, and components is addressed in Subsection 2.2.15.](#)

[The SSLC/ESF minimum inventory of alarms, displays, and status indications in the main control room \(MCR\) are addressed in Section 3.3.](#)

[The equipment qualification of SSLC/ESF components described in Table 2.2.13-1 is addressed in Section 3.8.](#)

[The SSLC/ESF software is developed in accordance with the software development program described in Section 3.2.](#)

Functional Arrangement

(1) The SSLC/ESF functional arrangement is described in Table 2.2.13-1.

Functional Requirements

(2) The SSLC/ESF automatic functions, initiators, and associated interfacing systems are described in Table 2.2.13-2.

(3) The SSLC/ESF controls, interlocks, and bypasses in the main control room (MCR) are described in Table 2.2.13-3.

(4) ~~Conformance with IEEE Std. 603 requirements by the safety-related control system structures, systems, and components is addressed in Subsection 2.2.15.~~ Deleted

(5) ~~The SSLC/ESF minimum inventory of alarms, displays, and status indications in the main control room (MCR) are addressed in Section 3.3.~~ Deleted

(6) ~~The equipment qualification of SSLC/ESF components described in Table 2.2.13-1 is addressed in Section 3.8.~~ Deleted

(7) ~~The SSLC/ESF software is developed in accordance with the software development program described in Section 3.2.~~ Deleted

(8) [SSLC/ESF logic is designed to provide a trip initiation by requiring a coincident trip of at least two divisions to cause the trip output.](#)

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.2.13-4 defines the inspections, tests, and/or analyses, together with associated acceptance criteria for the SSLC/ESF system.

Table 2.2.13-1
SSLC/ESF Functional Arrangement

<p>SSLC/ESF comprises four redundant, safety-related, Seismic Category I, divisions of trip logics and trip actuators.</p>
<p><u>SSLC/ESF video display units (VDUs) comprise two redundant sets of four divisions of safety-related, Seismic Category I, VDUs, housed in two separate main control room panels.</u></p>
<p>SSLC/ESF receives inputs from, and sends outputs to interfacing systems as described in Tables 2.2.13-2 and 2.2.13-3.</p>
<p>SSLC/ESF logic is designed to provide a trip initiation by requiring a coincident trip of at least two divisions to cause the trip output. Deleted</p>
<p>Redundant safety-related power supplies are provided for each division.</p> <p>SSLC/ESF uses “energized-to-trip” and “fail-as-is” logic.</p> <p>ADS (SRVs and DPVs), ICS, GDCS, and SLC are actuated sequentially and/or in groups.</p> <p>SSLC/ESF transmits and receives safety-related human system interface (HSI) information as described in Table 3.3-34, Item 6, to and from the safety-related VDUs.</p>

Table 2.2.13-4

ITAAC For Safety System Logic and Control/ESF System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
<p>6. The equipment qualification of SSLC/ESF components is addressed in Section 3.8 Deleted.</p>	<p>See Section 3.8.</p>	<p>See Section 3.8.</p>
<p>7. The SSLC/ESF software is developed in accordance with the software development program described in Section 3.2. Deleted</p>	<p>See Section 3.2.</p>	<p>See Section 3.2.</p>
<p>8. <u>SSLC/ESF logic is designed to provide a trip initiation by requiring a coincident trip of at least two divisions to cause the trip output.</u></p>	<p><u>Test(s) will be performed of the as-built SSLC/ESF system using simulated signals and actuators.</u></p>	<p><u>Test report(s) exist and conclude that the as-built SSLC/ESF system performs trip initiation when a coincident trip occurs in at least two divisions.</u></p>

~~2.7 CONTROL PANELS~~DELETED

~~The following subsections describe the different types of control panels and systems for the ESBWR.~~

~~2.7.1 Main Control Room Panels~~

~~Design Description~~

~~The main control room (MCR) is comprised of an integrated set of operator interface panels.~~

- ~~(1) The functional arrangement of the MCR Panels is as described in this Section 2.7.1.~~
- ~~(2) The safety-related MCR Panels conform to seismic Category I requirements, and are housed in a Seismic Category I structure.~~
- ~~(3) a. Independence is provided between safety-related divisions.
b. Separation is provided between safety-related divisions, and between safety-related divisions and nonsafety-related equipment.~~
- ~~(4) Human factors engineering principles are incorporated into all aspects of the MCR panel design.~~
- ~~(5) MCR Panel software is developed in accordance with the software development program described in Section 3.2.~~

~~Inspections, Tests, Analyses and Acceptance Criteria~~

~~Table 2.7.1-1 provides a definition of the inspections, tests and/or analyses, together with associated acceptance criteria for the MCRP.~~

**Table 2.7.1-1
ITAAC For Main Control Room Panels**

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
<p>1. The functional arrangement of the MCR Panels is as described in this Section 2.7.1.</p>	<p>Inspections of the as-built MCR Panels will be conducted.</p>	<p>Inspection report(s) document that the as-built MCR Panels conform with the functional arrangement as described in Section 2.7.1.</p>
<p>2. The safety-related MCR Panel a. conform to Seismic Category I requirements; and b. are housed in a seismic Category I structure.</p>	<p>i) Type tests and/or analyses of the safety-related MCR Panels will be performed.</p> <p>ii) Inspections of the as-built safety-related MCR Panels will be performed to verify that the equipment is installed in accordance with the configurations specified in the type tests and/or analyses.</p> <p>iii) Inspections of the as-built safety-related MCR Panels will be performed to verify that the equipment is housed in a seismic Category I structure.</p>	<p>i) A report exists and concludes that the safety-related MCR Panels conform to seismic Category I requirements.</p> <p>ii) Inspection report(s) document that the as-built safety-related MCR Panels are installed in accordance with the configurations specified by the type tests and/or analyses.</p> <p>iii) Inspection report(s) document that the as-built safety-related MCR Panels are housed in a seismic Category I structure.</p>

Table 2.7.1-1
ITAAC For Main Control Room Panels

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
3a.—Independence is provided between safety-related divisions.	Tests will be performed on the as-built safety-related MCR Panels by providing a test signal in only one safety-related division at a time and checking for a test signal in all divisions.	Test report(s) document that a test signal exists only in the as-built safety-related division under test in the MCR Panels.
b.—Separation or electrical isolation is provided between safety-related divisions, and between safety-related divisions and nonsafety-related equipment.	Inspection of the as-built safety-related MRC Panels will be performed.	Inspection report(s) document that, for the as-built safety-related MCR Panels, physical separation or electrical isolation exists between safety-related divisions. Physical separation or electrical isolation exists between safety-related divisions and nonsafety-related equipment.
4.—Human factors engineering principles are incorporated into the MCR panel design	See Section 3.3.	See Section 3.3.
5.—MCR Panel software is developed in accordance with the software development program described in Section 3.2.	See Section 3.2.	See Section 3.2.

~~2.7.2 Radioactive Waste Control Panels~~

~~No ITAAC are required for this system.~~

~~2.7.3 Local Control Panels And Racks~~

~~Design Description~~

~~Local Control Panels and Instrument Racks are provided as protective housings and/or support structures for electrical and electronic equipment to facilitate system operations at the local level. Because of the Reactor Protection System's fail-safe design, no potential sources of missiles or pipe breaks prevent modules from performing their safety-related reactor shutdown function.~~

- ~~(1) The functional arrangement of the Local Control Panels and Instrument Racks is as described in this Section 2.7.3.~~
- ~~(2) The safety-related Local Control Panels and Instrument Racks conform to seismic Category I requirements.~~
- ~~(3) a. Independence is provided between safety-related divisions.
b. Separation is provided between safety-related divisions, and between safety-related divisions and nonsafety-related equipment.~~

~~Inspections, Tests, Analyses and Acceptance Criteria~~

~~Table 2.7.3-1 provides a definition of the inspections, tests and/or analyses, together with associated acceptance criteria for the Local Control Panels and Instrument Racks.~~

Table 2.7.3-1

ITAAC For Local Control Panels and Instrument Racks

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
<p>1. The functional arrangement of the Local Control Panels and Instrument Racks is described in this Section 2.7.3.</p>	<p>Inspections of the as-built Local Control Panels and Instrument Racks will be conducted.</p>	<p>Inspection report(s) document that the as-built Local Control Panels and Instrument Racks conform with the functional arrangement as described in Section 2.7.3.</p>
<p>2. The safety-related Local Control Panels and Instrument Racks conform to Seismic Category I requirements.</p>	<p>i) Type tests and/or analyses of the safety-related Local Control Panels and Instrument Racks will be performed.</p> <p>ii) Inspections of the as-built safety-related Local Control Panels and Instrument Racks will be performed to verify that the equipment is installed in accordance with the configurations specified in the type tests and/or analyses.</p>	<p>i) A report exists and concludes that the safety-related Local Control Panels and Instrument Racks conform to seismic Category I requirements.</p> <p>ii) Inspection report(s) document that the as-built safety-related Local Control Panels and Instrument Racks are installed in accordance with the configurations specified by the type tests and/or analyses.</p>

Table 2.7.3-1

ITAAC For Local Control Panels and Instrument Racks

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
<p>3a. Independence is provided between safety-related divisions.</p>	<p>Tests will be performed on the as-built safety-related Local Control Panels and Instrument Racks by providing a test signal in only one safety-related division at a time and checking for a test signal in all divisions.</p>	<p>Test report(s) document that a test signal exists only in the as-built safety-related division under test in the Local Control Panels and Instrument Racks.</p>
<p>b. Separation or electrical isolation is provided between safety-related divisions, and between safety-related divisions and nonsafety-related equipment.</p>	<p>Inspection of the as-built safety-related Local Control Panels and Instrument Racks will be performed.</p>	<p>Inspection report(s) document that, for the as-built safety-related Local Control Panels and Instrument Racks, physical separation or electrical isolation exists between safety-related divisions. Physical separation or electrical isolation exists between safety-related divisions and nonsafety-related equipment.</p>

Table 2.15.1-1c
Electrical Equipment

Equipment Name (Description)	Equipment Identifier See Figure 2.15.1-1	Control Q-DCIS/ DPS	Seismic Category I	Safety-Related	Safety-Related Display	Active Safety Function	Remotely Operated	Containment Isolation Valve Actuator
Vacuum Breaker	11(A)	-	Yes	Yes	Yes	Open/Close	No	No
Vacuum Breaker Isolation Valve	11a(A)	<u>Yes/No</u> Note ‡	Yes	Yes	Yes	Open/Close	Yes	No
Vacuum Breaker	11(B)	-	Yes	Yes	Yes	Open/Close	No	No
Vacuum Breaker Isolation Valve	11a(B)	<u>Yes/No</u> Note ‡	Yes	Yes	Yes	Open/Close	Yes	No
Vacuum Breaker	11(C)	-	Yes	Yes	Yes	Open/Close	No	No
Vacuum Breaker Isolation Valve	11a(C)	<u>Yes/No</u> Note ‡	Yes	Yes	Yes	Open/Close	Yes	No
<u>Vacuum Breaker Isolation Function Independent Control Platform</u> <u>Containment System Logic Controllers</u>	-	<u>Yes/No</u> Note ‡	Yes	Yes	Yes	Open/Close Vacuum Breaker Isolation Valves on <u>signals demand</u>	Yes	No

Notes:

‡. Safety related control provided by control system independent of Q-DCIS and DPS

3.8 ENVIRONMENTAL AND SEISMIC QUALIFICATION OF MECHANICAL AND ELECTRICAL EQUIPMENT

The equipment qualification (~~EQ~~) program includes safety-related electrical and mechanical equipment located in harsh and mild environments. The electrical equipment identified in 10 CFR 50.49 as electric equipment important to safety covered by (b)(1), (b)(2), and (b)(3) are included in the equipment qualification program.

Regulatory Treatment of Non-Safety Systems (RTNSS) equipment located in harsh environments is also included in the ~~EQ~~-equipment qualification program.

Dynamic and seismic qualification is included in the equipment qualification program.

~~The equipment in the EQ program is referred to as EQ equipment.~~

Design Description

(1) The ~~EQ~~-equipment qualification program's electrical equipment located in a harsh environment can perform its safety-related function under normal, abnormal and design bases accident environmental conditions.

(2) The ~~EQ~~-equipment qualification program's mechanical equipment located in a harsh environment can perform its safety-related function under normal, abnormal and design bases accident environmental conditions.

(3) The ~~EQ~~-equipment qualification program's safety-related digital I&C equipment (including digital components in the safety-related electrical distribution system) located in a mild environment is designed to perform its safety-related function under normal and AOO environmental conditions.

(4) The equipment qualification program's equipment can perform its safety-related function under dynamic and seismic Design Basis Event conditions.

Inspections, Tests, Analyses, and Acceptance Criteria

Table 3.8-1 specifies the equipment qualification inspections, test, analyses, and associated acceptance criteria for ~~EQ~~-equipment qualification program mechanical and electrical equipment.

Table 3.8-1

ITAAC for Environmental and Seismic Qualification of Mechanical and Electrical Equipment

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
<p>1. <u>The EQ equipment qualification program's</u> electrical equipment, 10 CFR 50.49 (b)(1), (b)(2), and (b)(3) equipment, located in a harsh environment can perform its safety-related function under normal, abnormal and design bases accident environmental conditions.</p>	<p>EQ <u>The equipment qualification program's</u> electrical equipment, 10 CFR 50.49 (b)(1), (b)(2), and (b)(3) equipment, located in a harsh environment is identified and:</p> <p>i. Analysis will be performed to identify the environmental design bases including the definition of anticipated operational occurrences and normal, accident, and post-accident environments.</p>	<p>i. Report(s) document exist and <u>conclude</u> the analyses results identifying the environmental design bases including the definition of anticipated operational occurrences and normal, accident, and post-accident environments for <u>the EQ equipment qualification program's</u> electrical equipment, 10 CFR 50.49 (b)(1), (b)(2), and (b)(3) equipment, located in a harsh environment.</p>

Table 3.8-1

ITAAC for Environmental and Seismic Qualification of Mechanical and Electrical Equipment

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	<p>ii. Type tests, analyses, or a combination of type tests and analyses will be performed on <u>the</u> as-built <u>EQequipment qualification- program's</u> electrical equipment, 10 CFR 50.49 (b)(1), (b)(2), and (b)(3) equipment, identified as located in a harsh environment.</p> <p>iii. Inspection will be performed of the <u>as-installed EQequipment qualification program's</u> electrical equipment, 10 CFR 50.49 (b)(1), (b)(2), and (b)(3) equipment, and the associated wiring, cables, and terminations located in a harsh environment.</p>	<p>ii. Report(s) exist and conclude that the <u>as-built EQequipment qualification program's</u> equipment, 10 CFR 50.49 (b)(1), (b)(2), and (b)(3) equipment, identified in the analyses as being qualified for a harsh environment can withstand 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.</p> <p>iii. Report(s) exist and conclude that the <u>as-installed EQequipment qualification program's</u> electrical equipment, 10 CFR 50.49 (b)(1), (b)(2), and (b)(3) equipment, and the associated wiring, cables, and terminations identified in the analyses as being qualified for a harsh environment are bounded by type tests, analyses, or a combination of type tests and analyses.</p>

Table 3.8-1

ITAAC for Environmental and Seismic Qualification of Mechanical and Electrical Equipment

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
<p>2. <u>The EQequipment qualification program's</u> mechanical equipment located in a harsh environment can perform its safety-related function under normal, abnormal and design bases accident environmental conditions.</p>	<p><u>The EQequipment qualification program's</u> mechanical equipment located in a harsh environment is identified and:</p> <ul style="list-style-type: none"> i. Analysis will be performed to identify the environmental design bases including the definition of anticipated operational occurrences and normal, accident, and post-accident environments. ii. Type tests and/or analyses of material data will be performed on <u>the EQequipment qualification program's</u> mechanical equipment identified as located in a harsh environment. 	<ul style="list-style-type: none"> i. Reports document the analyses results identifying the environmental design bases including the definition of anticipated operational occurrences and normal, accident, and post-accident environments for the <u>EQequipment qualification program's</u> mechanical equipment located in a harsh environment. ii. Reports exists and concludes that the material data ensure that the as-built <u>EQequipment qualification program's</u> mechanical equipment identified in the type tests and/or analyses as qualified for a harsh environment can withstand 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.

Table 3.8-1

ITAAC for Environmental and Seismic Qualification of Mechanical and Electrical Equipment

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	iii. Inspection will be performed to verify proper non-metallic materials of the as-installed <u>EEquipment qualification program's</u> mechanical equipment located in a harsh environment.	iii. Reports exist and conclude that all non-metallic materials of <u>the EEquipment qualification program's</u> mechanical equipment has been installed per the qualification requirements.
3. <u>The EEquipment qualification program's</u> safety-related digital I&C equipment (including digital components in the safety-related electrical distribution system) located in a mild environment is designed to perform its safety-related function under normal and AOO environmental conditions.	<p><u>The EEquipment qualification program's</u> safety-related digital I&C equipment (including digital components in the safety-related electrical distribution system) located in a mild environment is identified and:</p> <p>i. Analysis will be performed to identify the environmental design bases including the definition of anticipated operational occurrences and normal environments.</p>	<p>i. Report(s) document-exist and <u>conclude</u> the analyses results identifying the environmental design bases including the definition of anticipated operational occurrences and normal environments for <u>the EEquipment qualification program's</u> digital I&C equipment (including digital components in the safety-related electrical distribution system) located in a mild environment:</p>

Table 3.8-1

ITAAC for Environmental and Seismic Qualification of Mechanical and Electrical Equipment

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	<p>ii. Type tests, analyses, or a combination of type tests and analyses will be performed on <u>the EQequipment qualification program's digital I&C equipment located in a mild environment.</u></p> <p>iii. Inspection will be performed to verify <u>the as-installed EQequipment qualification program's digital I&C equipment located in a mild environment</u></p>	<p>ii. Report(s) exist and conclude that all <u>EQequipment qualification program's</u> digital I&C equipment (including digital components in the safety-related electrical distribution system) located in a mild environment is qualified to perform its safety function during the applicable normal and abnormal environmental conditions by type tests, analyses, or a combination of type tests and analyses for the time required to perform the safety function.</p> <p>iii. Report(s) exist and conclude that all <u>EQequipment qualification program's</u> digital I&C equipment located in a mild environment has been installed per the qualification requirements.</p>
<p><u>4. The equipment qualification program's equipment can perform its safety-related function before, during and after dynamic and seismic design bases event conditions.</u></p>	<p><u>i. Analysis will be performed to identify the dynamic and seismic design bases.</u></p>	<p><u>i. Report(s) exist and conclude the analyses results identifying the dynamic and seismic design bases.</u></p>

Table 3.8-1

ITAAC for Environmental and Seismic Qualification of Mechanical and Electrical Equipment

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	<p><u>ii. Dynamic and seismic type tests, analyses, or a combination of type tests and analyses will be performed on as-built equipment qualification equipment program.</u></p> <p><u>iii. Inspection will be performed of the as-installed equipment qualification equipment program.</u></p>	<p><u>ii. Report(s) exist and conclude that the as-built equipment qualification program's equipment can withstand the dynamic and seismic conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.</u></p> <p><u>iii. Report(s) exist and conclude that the as-installed equipment qualification program's equipment dynamic and seismic type tests, analyses, or a combination of type tests and analyses are bounding.</u></p>