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Subject: **Response to NRC Request for Additional Information Letter No. 383 Related to ESBWR Design Certification Application - Tier 1-RAI Number 14.3-449 S02**

Enclosure 1 contains the GE Hitachi Nuclear Energy (GEH) response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) 14.3-449 S02 (Reference 1).

ESBWR Design Control Document (DCD) markups are provided in Enclosure 2.

If you have any questions about the information provided, please contact me.

Sincerely,

Lee F. Dougherty for

Richard E. Kingston
Vice President, ESBWR Licensing

Reference:

1. MFN 09-687, Letter from the U.S. Nuclear Regulatory Commission to Jerald G. Head, Request for Additional Information Letter No. 383, Related To ESBWR Design Certification Application, dated November 2, 2009

Enclosures:

1. Response to NRC Request for Additional Information Letter No. 383 Related to ESBWR Design Certification Application - Tier 1 - RAI Number 14.3-449 S02.
2. Response to NRC Request for Additional Information Letter No. 383 Related to ESBWR Design Certification Application - Tier 1 - RAI Number 14.3-449 S02 – DCD Markups

| | | |
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**Enclosure 1**

**MFN 09-739**

**Partial Response to NRC Request for**

**Additional Information Letter No. 383**

**Related to ESBWR Design Certification Application**

**Tier 1**

**RAI Number 14.3-449 S02**

**<u>NRC RAI 14.3-449 S02</u>**

*Functional Arrangement and other inspection related issues*

*GEH has implemented substantive improvements related to the "functional arrangement" ITAAC, however, the NRC staff still found problems with the DCD revision 6 application of the "functional arrangement" definition to specific ITAAC. The staff also identified other issues during the review of DCD revision that could pose a problem with implementation and inspection of ITAAC. The staff request GEH to address the staff concerns with functional arrangement and other issues identified below:*

A. *Tier 1 Table 2.2.3-4, ITAAC #1 addresses functional arrangement for the feedwater control system (FWCS). The design commitment (DC) and acceptance criteria (AC) references Table 2.2.3-1. Referencing table 2.2.3-1 alone does not comport with the definitions and represents an incomplete and incorrectly written ITAAC. GEH should revise the ITAAC in table 2.2.3-4 by referencing both the table and the design description in Tier 1 subsection 2.2.3. The ITAAC should be written similarly to the functional arrangement ITAAC for the remote shutdown system (RSS) in Tier 1 Table 2.2.6-3. The functional arrangement ITAAC in Tables 2.2.6-3 for remote shutdown system and Table 2.2.4-6 for standby liquid control system are examples that illustrate proper implementation of functional arrangement. GEH should review all functional arrangement ITAAC for consistency and revise the functional arrangement ITAAC appropriately.*

B. *The staff identified examples of ITAAC where the acceptance criteria (AC) contains incorrect information or lacks specificity. The examples include:*

   1. *AC 5ii in Table 2.2.2-7 references incorrect table number*

   2. *In ITAAC #17 &18 in Table 2.2.2-7, the valves open or close in response to an unidentified signal*

   3. *ITAAC 11 in Table 2.2.14-4, ITAAC 16ii in Table 2.6.2-2, and ITAACs 11a, 11d, 12a, 12d in Table 2.13.1-2 do not provide criteria for required separation*

   4. *There is no criteria to define the term "inclined sufficiently" associated with as-built piping for ITAAC 29d in Table 2.4.2-3*

   5. *The table referenced by the acceptance criteria in Table 2.16.2-3, ITAAC 8 as identifying emergency filter unit (EFU) controls/indications, identifies neither control or indications*

   6. *The electrical isolation criteria in the acceptance for ITAAC 3b in Table 2.13.1-2 and ITAAC 6 in Table 2.13.3-3 ITAAC 6 is not addressed in the design commitment.*

*C. The staff identified examples of ITAACs where the inspections, test, analyses (ITA) is incorrect or unsuitable for the associated AC. The examples include:*

*1. ITAAC 4iii in Table 2.13.3-3 and ITAAC 3iii in Table 2.13.5-2 the ITA refers to as-installed while the AC refers to as-built*

*2. ITAAC 29a in Table 2.4.2-3, ITAAC 15 in Table 2.6.2-2, and ITAAC 6 in 2.11.1-1 the ITA is an inspection while the AC specifies design aspects that must be met. The ITA should include both an analysis and inspection.*

*3. ITAAC 25 in Table 2.4.1-3, ITAACs 9&10 in Table 2.5.5-1 the ITA refers to inspection of records and not verification of construction activities or tests*

*D. Since the ITA inspection needs to be complemented with analysis for ITAAC 6 in Table 2.11.1-1, which itself may or may not require redesign or rework of the subject "non-seismically designed" SSC, it is recommended this population of potentially re-worked items be included in the population of SSC to which the acceptance criteria applies. Taken literally, as written, the current acceptance criteria would not include any redesigned/reworked SSC that could result from proper implementation of the ITA.*

*E. The staff identified examples of ITAACs where the design commitment (DC) contains commitments that are not included in either the ITA or AC. The examples include:*

*1. ITAAC 2b in Table 2.13.4-2 the DC specifies that the diesel generators (DGs) are sized for expected loads while the ITA and AC only requires the DGs are capable of attaining nameplate loads*

*2. ITAAC 16B in Table 2.15.1-2 the DC specifies that bypass leakage indication is available in the main control room. This attribute is not included in either the ITA or the AC*

*F. In ITAACs 2a1-3, 2b, 2b2, 9a-9c, 10a and 10b in Table 2.11.1-1 the DC, ITA, and AC do not specify which components or piping is included in the ITAAC. Regulatory Guide (RG) 1.26 indicates that "those portions of the steam systems of boiling-water reactors from the outermost containment isolation valve up to but not including the turbine stop and bypass valves" should be treated as Quality Group B (which translates to ASME Section III, Code Class 2) requirements.*

*The sections of piping from the outermost containment isolation valves up to and including the seismic restraints are included in the Nuclear Boiler System. The remainder of the piping and components that run from the seismic interface restraints to the main turbine stop valves are defined in DCD section 2.11.1 as the Turbine Main Steam System (TMSS). Therefore, in accord with the guiding provisions of RG 1.26, the TMSS system itself should be classified as ASME*

*Section III, Code Class 2. ITAAC 2.11.1.5 illustrates an example of ITAAC wording that could define the ASME scope, even though it does so only for the TMSS piping when it should also require this ITAAC to apply to the TMSS components as well.*

*It is not suggested that the wording of ITAAC 2.11.1.5 be repeated in each and every ITAAC where the ASME scope is not clearly stated. However, it is recommended that since the ASME scope of the TMSS system has been pre-defined by RG 1.26, this level of detail (possibly by reference to some defining scope; e.g., a drawing or some other means) be communicated in the applicable TMSS ITAAC for both piping and components. This comment aligns with one of the general principles espoused for "inspectability" -- that the population of SSC that pertain to a specific ITAAC should be clearly specified (even if only by reference) in the ITAAC wording.*

G. *Revise Tier 1 Section 3.8 as indentified below:*

1. *The list of equipment in Tier 2, Table 3.11.1-1 should be included in Tier 1 Section 3.8*
2. *The phrase "equipment qualification program" should be removed from the design descriptions and ITAACs in Section 3.8*
3. *The acceptance criteria should be revised to include reference to equipment qualification document (EQD) or dynamic qualification report (DQR). Tier 1 should also define the EQD and DQR.*
4. *The acceptance criteria 1ii should be revised as follows, "Type tests, or type tests and analyses will be…," this is consistent with the definition of environmental qualification in Tier Section 1.1 and 10 CFR 50.49. The current wording in revision 6 is not consistent with the regulations and the definition of environmental qualification in Tier 1.*
5. *The ITA and AC 1i, 2i, 3i, and 4i should be deleted from the ITAAC*
6. *The first sentence in the ITA for ITAACs 1, 2 3 should be deleted*
7. *ITAAC 3 which deals with digital I &C equipment should be labeled as design acceptance criteria (DAC)*

*Verify that equipment for seismic qualification is covered in existing ITAACs. If not, a list of equipment for seismic qualification should be included in Tier 1.*

**<u>GEH Response</u>**

Table 14.3-449 S02-1 provides a summary of the changes made to address each of the items in RAI 14.3-449 S02. The items are organized by location in Tier 1, generally by section number, except where certain generic changes are combined in one or more items. The specific RAI item is identified in the “Item” column with a letter and number corresponding to the RAI format of the issues.

***<u>Electrical Independence/isolation/separation:</u>*** As shown on the table, GEH has incorporated NRC comments. Most of the changes are self-explanatory in how the NRC issue is addressed. However, GEH addresses the issue regarding the ITAAC treatment for electrical independence, electrical isolation, and physical separation based on consideration of NRC guidance related to electrical independence, for which certain of the more pertinent points are quoted below. GEH reviewed the ITAAC that involve electrical independence and makes certain modifications as described in the table below and as shown on the mark-up pages attached.

**NUREG-0800, SRP 14.3:**

**INDEPENDENCE FOR ELECTRICAL AND I&C SYSTEMS**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 11. In the System, independence is provided between Class 1E Divisions, and between Class 1E Divisions and non-Class 1E equipment. | 11.1. Tests will be performed on the System by providing a test signal in only one Class 1E Division at a time. | 11.1. The test signal exists only in the Class 1E Division under test in the System. |
| | 11.2. Inspection of the as-installed Class 1E Divisions in the ___ System will be performed. | 11.2. In the ___ System, physical separation or electrical isolation exists between these Class 1E Divisions. Physical separation or electrical isolation exists between Class 1E Divisions and non-Class 1E equipment. |

**NUREG-0800, Section 14.3.6:**

2. Redundancy and independence

To ensure that the Class 1E electric systems meet the single failure requirements of GDC 17 (and other GDC), ITAAC may be established to verify the redundancy and independence of the Class 1E portion of the electrical design. For the electrical systems, ITAAC should verify the Class 1E divisional assignments and independence of electric power by both inspections and tests. The independence may be established by both electrical isolation and physical separation. Identification of the Class 1E divisional equipment should be included to aid in demonstrating the separation. (The detailed requirements are specified in Tier 2. For example, separation distances and identification are outlined in Tier 2). These attributes should be verified all the way to the electrically powered loads by a combination of the electrical system ITAAC and the ITAAC of the individual fluid, I&C, and heating, ventilation and air conditioning (HVAC) systems which also cover the electrical independence and divisional power supply requirements.

**Regulatory Guide (RG) 1.75** defines electrical independence in its purpose statement as being ensured by physical separation and electrical isolation as follows:

> This standard provides criteria and requirements for establishing and maintaining the independence of safety-related equipment and circuits, and auxiliary supporting features by physical separation and electrical isolation.

Tier 2 of the ESBWR Design Control Document (DCD) explains electrical independence in Section 8.3.1.4. Because that explanation forms the basis for the completion of detailed design, and as suggested by NRC guidance (quoted above), the acceptance criteria in Tier 1 ITAAC need not be specific to the criteria. However, to clarify that certain ITAAC include verification of as-built systems against detailed design that implements the basis for electrical independence through physical separation and electrical isolation described in Tier 2, GEH adds to the ITAAC acceptance criteria "according to design" to ensure that the verification clearly compares the final construction and installation details to the final detailed design, which implements the certified design descriptions. Also, in most of the ITAAC that involve inspections to verify physical separation and electrical isolation, NRC RG 1.75 is referenced as providing the acceptance criteria, consistent with the ESBWR DCD Tier 2, Section 8.3.1.4, descriptions of features for ensuring electrical independence. For nonsafety-related systems, IEEE-384 is referenced for the acceptance criteria for electrical isolation and physical separation, which is consistent with DCD Tier 2, Chapter 8, and is conservative for nonsafety-related electrical equipment.

**Table 14.3-449 S02-1**

**Summary of Changes**

| Item | Location in Tier 1 | Description of Change |
|---|---|---|
| G.3 | S1.1.1 | Added definitions for "Environmental Qualification Documentation" and "Dynamic Qualification Documentation" based on RAI 14.3-449 S02 associated changes to Section 3.8. This definition is based on information in Tier 2, Sections 3.10 and 3.11, which discusses documentation for EQ testing and analyses for dynamic and environmental qualification. |
| G.7 | S1.1.1 | Modified the definition of "Equipment Qualification" to reflect associated changes in Section 3.8 based on RAI 14.3-449 S02. This definition is based on information in Tier 2, Section 3.11. |
| A. | Various Subsections in Section 2 | For the following subsections, the functional arrangement ITAAC and associated Design Description Items are changed based on 14.3-449 S02 to reflect that the functional arrangement includes the system description in the Design Description:<br><br>Subsection 2.2.1 and ITAAC #1.<br>Subsection 2.2.2 and ITAAC #1.<br>Subsection 2.2.3 and ITAAC #1.<br>Subsection 2.2.4 and ITAAC #1.<br>Subsection 2.2.5 and ITAAC #1.<br>Subsection 2.2.7 and ITAAC #1.<br>Subsection 2.2.9 and ITAAC #1.<br>Subsection 2.2.13 and ITAAC #1.<br>Subsection 2.2.14 and ITAAC #1.<br>Subsection 2.2.16 and ITAAC #1.<br>Subsection 2.3.2 and ITAAC #1.<br>Subsection 2.4.2 and ITAAC #1. |
| G. | Various Sections | Statements of references to Section 3.8 in system-based sections are revised to clarify that the electrical and mechanical equipment environmental qualification is addressed in Section 3.8 and the environmental and seismic qualification for digital |

| Item | Location in Tier 1 | Description of Change |
|---|---|---|
| | | I&C equipment is addressed in Section 3.8. This change is based on RAI 14.3-449 S02. |
| B.2 | S2.2.2, Design Description, Item #17 | Added “signal to close” based on RAI 14.3-449 S02 as a clarifying consistency change. |
| B.2 | S2.2.2, Design Description, Item #18 | Added “signal to open” based on RAI 14.3-449 S02 as a clarifying consistency change. |
| B.1 | T2.2.2-7, ITAAC #5iii | Corrected table numbers in AC column based on RAI 14.3-449 S02 as a clarifying consistency change. |
| B.2 | T2.2.2-7, ITAAC #17 | Added “signal to close” to both DC and AC columns based on RAI 14.3-449 S02 as a clarifying consistency change. |
| B.2 | T2.2.2-7, ITAAC #18 | Added “signal to open” to both DC and AC columns based on RAI 14.3-449 S02 as a clarifying consistency change. |
| B.3 | T2.2.14-4, ITAAC #11 | Modified ITA and AC to define the fire protection separation criteria to match the DC by reflecting that the cabinets are in separate fire areas. See RAI 14.3-449 S02. |
| B.3<br>B.6 | S2.3.1, Design Description | Based on RAI 14.3-449 S02, Item 2b is revised to reflect that the PRMS subsystems are physically separated for electrical divisional separation. |
| B.3<br>B.6 | T2.3.1-1, ITAAC #2b | Based on RAI 14.3-449 S02, ITAAC 2b is revised to reflect that the PRMS subsystems are physically separated for electrical divisional separation and for consistency with the acceptance criteria. |
| C.3 | T2.4.1-3, ITAAC #25 | Removed “of the documentation” and added “test, type test, and analysis” to the ITA column based on RAI 14.3-449 S02 as a clarifying consistency change. |
| B.5 | S2.4.1, Design Description | Item #8 is deleted because it relates to indications and controls that will be addressed by the HFE process in Section 3.3. See RAI 14.3-449 S02. This is a consistency item. |
| B.5 | T2.4.1-3, ITAAC #8 | ITAAC #8 is deleted because it relates to indications and controls that will be addressed by the HFE process in Section 3.3. See RAI 14.3-449 S02. This is a consistency item. |

| Item | Location in Tier 1 | Description of Change |
|---|---|---|
| B.5 | S2.4.2, Design Description | Item #11 is deleted because it relates to indications and controls that will be addressed by the HFE process in Section 3.3. See RAI 14.3-449 S02. This is a consistency item. |
| C.2 | S2.4.2, Design Description | Item 29a is deleted based on RAI 14.3-449 S02 and discussion with NRC staff. |
| B.5 | T2.4.2-3, ITAAC #11 | ITAAC #11 is deleted because it relates to indications and controls that will be addressed by the HFE process in Section 3.3. See RAI 14.3-449 S02. This is a consistency item. |
| C.2 | T2.4.2-3, ITAAC #29a | This ITAAC has been deleted based on RAI 14.3-449 S02 and discussion with NRC staff. |
| B.4 | T2.4.2-3, ITAAC #29d | In the AC column, deleted “sufficiently” and added “according to analyzed value” based on RAI 14.3-449 S02. This change was also discussed with NRC staff. The actual value is proprietary, but was reviewed by the NRC as part of design certification reviews. |
| C.3 | T2.5.5-1, ITAAC #9 | Based on RAI 14.3-449 S02, the following changes are made in the ITA column:<br><br>Deleted: “Inspection of the as-built RB refueling machine hoist (the mast and fuel grapple) design documents will be performed for completion of the following inspections and tests:”<br><br>Replaced with: “The following tests, type tests, and inspections will be performed:”<br><br>This is considered a clarifying consistency change so that the wording of the ITAAC does not refer simply to the documents, but refers to the testing and inspection directly. |
| C.3 | T2.5.5-1, ITAAC #10 | Based on RAI 14.3-449 S02, the following changes are made in the ITA column:<br><br>Deleted: “Inspection of the FB fuel handling machine hoist (the mast and fuel grapple) design documents will be performed for completion of the following inspections and tests:” |

| Item | Location in Tier 1 | Description of Change |
|---|---|---|
| | | Replaced with: “The following tests, type tests, and inspections will be performed:”<br><br>This is considered a clarifying consistency change so that the wording of the ITAAC does not refer simply to the documents, but refers to the testing and inspection directly. |
| C.2 | S2.6.2, Design Description | In response to RAI 14.3-449 S02, in Item 15, changed “All” to “For all” and “are designed to” to “the ultimate rupture strength can” to reflect that this is an inspection of as-built components and to clarify the requirements for withstanding reactor system pressure.<br><br>This is considered a clarifying consistency change. |
| B.3 | S2.6.2, Design Description | In response to RAI 14.3-449 S02, Item 16 is split out into two separate items, with Item 17 being added. Item 16 applies to electrical independence testing and Item 17 applies to physical separation. These changes relate back to RAI 14.3-443 S01, which noted, as an example, that DCD Tier 2 Section 9A.4.1 identifies that FAPCS has redundant nonsafety-related pumps that are powered from separate diesel generator backed electrical load groups for the nonsafety-related functions. Startup testing described in DCD Tier 2 Section 14.2.8.1.14 1 identifies that there is proper redundancy and electrical independence of the safety-related FAPCS controls and instrumentation that comes from Q-DCIS. |
| C.2 | T2.6.2-2, ITAAC #15 | In response to RAI 14.3-449 S02, the following changes are made:<br><br>In the DC column, changed “are designed to” to “the ultimate rupture strength can” to reflect that this is an inspection of as-built components and to clarify the requirements for withstanding reactor system pressure.<br><br>In the ITA column, changed “Inspection” to “Inspection and analysis to verify the ultimate |

| Item | Location in Tier 1 | Description of Change |
|---|---|---|
| | | rupture strength" to clarify that inspection and analysis will be performed to demonstrate ultimate rupture strength. Note that any ASME requirements for the subject components are covered in separate ITAAC.<br><br>In the AC column, changed "The" to "For the" and "are designed to" to "the ultimate rupture strength can" to reflect that this is an inspection of as-built components and to clarify the requirements for withstanding reactor system pressure.<br><br>This is considered a clarifying consistency change. |
| B.3 | T2.6.2-2, ITAAC #16 and 17 | In response to RAI 14.3-449 S02, ITAAC 16 is split out into two separate items, with ITAAC 17 being added. ITAAC 16 applies to electrical independence testing and ITAAC 17 applies to physical separation inspection. Separation criteria are added to the AC column for ITAAC 17. These changes relate back to RAI 14.3-443 S01.<br><br>The change in the AC column for ITAAC 17 reflects that the physical separation for the cables will be in accordance with the acceptance criteria for physical separation of electrical equipment and cables as described in IEEE-384, as discussed in Tier 2, Section 8.3.1.1.5 (which applies to safety-related electrical equipment), but which is conservatively applied here for nonsafety-related cables.<br><br>As discussed in response to RAI 14.3-443 S01, DCD Tier 2 Section 9A.4.1 identifies that FAPCS has redundant nonsafety-related pumps that are powered from separate diesel generator backed electrical load groups for the nonsafety-related functions. The power cables to these pump motors and the associated instrumentation cables are routed via train A and train B raceways in the Electric Building and then to the Reactor building in the seismic Category II raceway tunnels. The Electrical Building is a nonsafety-related structure but the train A and B raceways are routed in separate fire zones to the tunnel access. The |

| Item | Location in Tier 1 | Description of Change |
|---|---|---|
| | | Reactor building cabling, safety-related and nonsafety-related, is routed using a program that is Appendix B audited, approved, and Part 21 reportable for both physical/electrical and fire separation (reference RAI 9.5-92 MFN 08-761). The same cable routing program is also used for the balance of the nonsafety-related plant to maintain physical and electrical separation and fire separation as required. |
| C.2<br><br>D. | S2.11.1, Design Description | In response to RAI 14.3-449 S02, the following consistency changes are made:<br><br>In Item 2b1, "identified in Table 2.11.1-1" is deleted for consistency with the associated ITAAC DC column.<br><br>In Item 6, changed "non-seismically designed" to "non-seismic" to reflect that this is associated with as-built components and piping.  Also, added "as shown in Figure 2.11.1-1." |
| F. | S2.11.1, Design Description | In response to RAI 14.3-449 S02, the following is added to clarify the scope of Quality Group B/ASME Code portions of the TMSS:<br><br>"The Regulatory Guide 1.26 Quality Group B portions of the TMSS are those portions of the Main Steam Lines that extend from the seismic interface restraint (or seismic guide) to the turbine stop valves (non-inclusive), turbine bypass valves (non-inclusive) and the connecting branch lines (nominal 6.35 cm. (2.5 in) and larger) up to and including the first isolation valve which is either normally closed or capable of automatic closure during all modes of normal reactor operation.  This defines the portions of the TMSS subject to ASME Code Section III Class 2 requirements.  .  Figure 2.11.1-1 shows the functional arrangement and class changes to identify the scope equipment within the TMSS." |
| F. | S2.11.1, Design Description | Based on 14.3-449 S02, Item #1 is modified to refer to new Figure 2.11.1-1 for the functional arrangement of the TMSS layout:  "and as shown on Figure 2.11.1-1." |

| Item | Location in Tier 1 | Description of Change |
|---|---|---|
| F. | T2.11.1-1, ITAAC #1 | Based on 14.3-449 S02, ITAAC #1 is modified to refer to new Figure 2.11.1-1 for the functional arrangement of the TMSS layout: "and as shown on Figure 2.11.1-1." This is added to both the DC and AC columns. |
| D. | T2.11.1-1, ITAAC #6 | In response to RAI 14.3-449 S02, the following consistency changes are made:<br><br>In the DC column, changed "non-seismically designed" to "non-seismic" to reflect that this is associated with as-built components and piping, and added "as shown on Figure 2.11.1-1."<br><br>In the ITA column, added "and analysis" and changed "non-seismically designed" to "non-seismic" and added "The as-built non-seismic systems, structures, and components will be reconciled through inspection and analysis with the results of the initial inspection and analysis." These changes reflect that there is an initial inspection and analysis, followed by "reconciliation" before the as-built SSCS are inspected and analyzed again.<br><br>In the AC column, added "as-built" and changed "non-seismically designed" to "non-seismic" to reflect that this is associated with the final as-built components and piping after the reconciliation inspections and analysis so that the final inspections and analysis include any redesigned or reworked SSC from the initial inspections and analysis. |
| F. | F2.11.1-1 | Based on RAI 14.3-449 S02, new Figure 2.11.1-1, TMSS Functional Arrangement, is added to show the layout of the TMSS and to identify the scope of equipment and piping within the TMSS for purposes of performing the ITAAC. The new figure is based on DCD Tier 2 Figures 3.2-1 and 10.3-1. |
| B.3<br>B.6 | S2.13.1, Design Description | In Item 3a, "required by" is changed to "defined in" to reflect that a regulatory guide does not establish requirements. In Item 3b, "Separation is" is changed to "Physical separation and electrical isolation are" to reflect that the item covers both physical separation and electrical isolation, and "required by" |

| Item | Location in Tier 1 | Description of Change |
|---|---|---|
| | | is changed to “defined in” to reflect that a regulatory guide does not establish requirements. These consistency changes are based on RAI 14.3-449 S02. |
| B.3<br>B.6 | S2.13.1, Design Description | Added a new Item #11e based on RAI 14.3-449 S02 to move the UAT and RAT physical separation from ITAAC #11a, which is related physical separation of circuits. |
| B.3<br>B.6 | T2.13.1-2, ITAAC #3a | In ITAAC 3a, “required by” is changed to “defined in” to reflect that a regulatory guide does not establish requirements. The change is a consistency item based on RAI 14.3-449 S02. |
| B.3<br>B.6 | T2.13.1-2, ITAAC #3b | In ITAAC 3b, DC column, “Separation is” is changed to “Physical separation and electrical isolation are” to reflect that the ITAAC covers both physical separation and electrical isolation, and “required by” is changed to “defined in” to reflect that a regulatory guide does not, itself, establish requirements. In the AC column, “required by” is changed to “defined in” to reflect that a regulatory guide does not establish requirements. In the ITA column, added “and analysis” to reflect that an engineering evaluation may be necessary to verify the acceptance criteria are met for electrical isolation. These consistency changes are based on RAI 14.3-449 S02. |
| B.3<br>B.6 | T2.13.1-2, ITAAC #11a | Added the following to the AC column based on RAI 14.3-449 S02:<br><br>“in accordance with IEEE-384”<br><br>as per Tier 2, Table 8.1-1, which shows the applicability of IEEE-384 to the onsite power supplies.<br><br>This change reflects that the physical separation will be in accordance with the acceptance criteria for physical separation of electrical equipment as described in Table 2 of IEEE-384.<br><br>The previous first bullet on UAT and RAT separation is moved to a new ITAAC #11e. |

| Item | Location in Tier 1 | Description of Change |
|---|---|---|
| B.3<br>B.6 | T2.13.1-2, ITAAC #11d | Added the following to the AC column based on RAI 14.3-449 S02:<br><br>“as defined in IEEE-384.”<br><br>This change reflects that the physical separation will be in accordance with the acceptance criteria for physical separation of electrical equipment defined in Table 2 of IEEE-384, as per Tier 2, Table 8.1-1, for onsite power supplies. |
| B.3<br>B.6 | T2.13.1-2, ITAAC #11e | Added a new ITAAC based on RAI 14.3-449 S02 to move the UAT and RAT physical separation from ITAAC #11a, which relates to physical separation circuits. The method of verification includes both inspection and analysis. Inspection will verify either the existence of barriers or spatial distance, or both. The analysis will evaluate the type of barrier and spatial distance to ensure that the physical separation is adequate to minimize to the extent practical the likelihood of their simultaneous failure under design basis conditions, according to the criteria stated in Tier 2, Section 8.3.1.1, and in RG 1.189, as discussed in Tier 2, Sections 9.5.1.10 and 9.5.1.12.1. RG 1.189 is referenced because it provides the regulatory position for the first protection features. Also, RG 1.189, Section 8.4, refers to NFPA 804 as guidance for advanced reactors, but states “the NRC has not formally endorsed NFPA 804, and some of the guidance in the NFPA standard may conflict with regulatory requirements. When conflicts occur, the applicable regulatory requirements and guidance, including the guidance in this regulatory guide, will govern.” Therefore, NFPA 804 guidance may be applicable through RG 1.189, but with any specific exceptions that the NRC guidance may address. |
| B.3<br>B.6 | T2.13.1-2, ITAAC #12a | Added the following to the AC column based on RAI 14.3-449 S02:<br><br>“as defined in IEEE-384.”<br><br>This change reflects that the physical separation will |

| Item | Location in Tier 1 | Description of Change |
|---|---|---|
| | | be in accordance with the acceptance criteria for physical separation of electrical equipment defined in Table 2 of IEEE-384, as per Tier 2, Table 8.1-1, for onsite power supplies. |
| B.3<br>B.6 | T2.13.1-2, ITAAC #12d | Added the following to the AC column based on RAI 14.3-449 S02:<br><br>“as defined in IEEE-384.”<br><br>This change reflects that the physical separation will be in accordance with the acceptance criteria for physical separation of electrical equipment defined in Table 2 of IEEE-384, as per Tier 2, Table 8.1-1, for onsite power supplies. |
| B.3<br>B.6 | S2.13.3, Design Description | In Item 6, “Separation is” is changed to “Physical separation” to reflect that the item covers physical separation, and “required by” is changed to “defined in” to reflect that a regulatory guide does not, itself, establish requirements. These consistency changes are based on RAI 14.3-449 S02. |
| C.1 | T2.13.3-3, ITAAC #4iii | In the ITA column, “as-installed” is changed to “as-built” based on RAI 14.3-449 S02 as a consistency change. |
| B.3<br>B.6 | T2.13.3-3, ITAAC #6 | In ITAAC 6, DC column, “Separation is” is changed to “Physical separation is” to reflect that the ITAAC covers only physical separation, as consistent with the AC column, and “required by” is changed to “defined in” to reflect that a regulatory guide does not, itself, establish requirements (except that Tier 1 will establish requirements based on RG 1.75). In the AC column, “required by” is changed to “defined in” to reflect that a regulatory guide does not, itself, establish requirements. In the ITA column, added “and analysis” to reflect that an engineering evaluation may be necessary to verify the acceptance criteria are met. These consistency changes are based on RAI 14.3-449 S02. |
| E.1 | S2.13.4, Design Description | Based on RAI 14.3-449 S02, the following consistency change is made:<br><br>Item 2b is modified by adding: “is capable of |

| Item | Location in Tier 1 | Description of Change |
|---|---|---|
| | | operating at its nameplate rated load and". |
| E.1 | S2.13.4, Design Description | Based on RAI 14.3-449 S02, the following consistency change is made:<br><br>Item 2c is modified by adding: "based on expected SDG load." |
| E.1 | S2.13.4, Design Description | Based on RAI 14.3-449 S02, the following consistency change is made:<br>Item 5c is modified by adding: "is capable of operating at its nameplate rated load and". |
| E.1 | S2.13.4, Design Description | Based on RAI 14.3-449 S02, the following consistency change is made:<br><br>Item 5d is modified by adding: "based on expected ADG load." Changed "7" to "seven" for consistency. |
| E.1 | T2.13.4-2, ITAAC #2b | Based on RAI 14.3-449 S02, the following consistency changes are made so that the DC and the AC column are clear and consistent with each other:<br><br>The DC column is changed to address the testing described in the ITA and now reads as follows:<br><br>"Each standby diesel generator is capable of operating at its nameplate rated load and is sized to accommodate its expected loads."<br><br>The AC column now reads as follows: "Each as-built standby diesel generator provides power at generator terminal rated voltage and frequency when at operated at rated load, and expected loads are within the rated nameplate load."<br><br>Also, the ITA column is changed to reflect that analysis of test results will be necessary to compare to expected loads and verify that the acceptance criteria are met. The ITA column now includes: "Analysis will be performed to demonstrate that the expected loads are within the nameplate rated load." |
| E.1 | T2.13.4-2, ITAAC #2c | Based on RAI 14.3-449 S02, the following consistency changes are made: |

| Item | Location in Tier 1 | Description of Change |
|---|---|---|
| | | In both the DC and AC columns, added “based on expected SDG load.” In the AC column, changed “7” to “seven” to be consistent with the DC column. |
| E.1 | T2.13.4-2, ITAAC #2d | Based on RAI 14.3-449 S02, the following consistency changes are made:<br>In the AC column, changed “running fully loaded” to “operating between rated and maximum nameplate load” to be consistent with the ITA column. |
| E.1 | T2.13.4-2, ITAAC #2g | Based on RAI 14.3-449 S02, the following changes are made to make the ITA and AC columns consistent with each other and with the DC column:<br>The ITA column is changed to read: “Inspection and testing will be performed to demonstrate that lube oil temperature, pressure and sump level instrumentation is provided and monitors operation of the system.”<br>The AC column is changed for consistency with the DC column to read: “Each standby diesel generator has instrumentation provided to monitor lube oil temperature, pressure and sump level, ensuring proper operation of the system.” |
| E.1 | T2.13.4-2, ITAAC #5c | Based on RAI 14.3-449 S02, the following consistency changes are made:<br>The DC column is changed to address the testing described in the ITA and now reads as follows:<br>“Each ancillary diesel generator is capable of operating at its nameplate rated load and is sized to accommodate its expected loads.”<br>The AC column now reads as follows: “Each as-built ancillary diesel generator provides power at generator terminal rated voltage and frequency when operated at rated load, and expected loads are within the rated nameplate load.”<br>Also, the ITA column is changed to reflect that analysis of test results will be necessary to compare to expected loads and verify that the acceptance |

| Item | Location in Tier 1 | Description of Change |
|---|---|---|
| | | criteria are met. The ITA column now includes: "Analysis will be performed to demonstrate that the expected loads are within the nameplate rated load." |
| E.1 | T2.13.4-2, ITAAC #5d | Based on RAI 14.3-449 S02, the following changes are made to make the DC and AC columns consistent with each other:<br><br>In both the DC and AC columns, added "based on expected ADG load." In the AC column, changed "7" to "seven" to be consistent with the DC column. In the AC column, changed "that is operating at rated load" to "under continuous operation" to be consistent with the corresponding SDG ITAAC #2c. |
| E.1 | T2.13.4-2, ITAAC #5e | Based on RAI 14.3-449 S02, the following consistency changes are made:<br><br>In the AC column, changed "running fully loaded" to "operating between rated and maximum nameplate load" to be consistent with the ITA column. |
| B.3 | S2.13.5, Design Description | In Item 5, "Separation is" is changed to "Physical separation and electrical isolation are" to reflect that the item covers both physical separation and electrical isolation, and "required by" is changed to "defined in" to reflect that a regulatory guide does not establish requirements. These consistency changes are based on RAI 14.3-449 S02. |
| C.1 | T2.13.5-2, ITAAC 3iii | In the ITA column, "as-installed" is changed to "as-built" based on RAI 14.3-449 S02. This is a consistency change to be consistent with other similar ITAAC. |
| B.3<br>B.6 | T2.13.5-2, ITAAC 5 | In ITAAC 5, DC column, "Separation is" is changed to "Physical separation and electrical isolation are" to reflect that the ITAAC covers both physical separation and electrical isolation, and "required by" is changed to "defined in" to reflect that a regulatory guide does not establish requirements. In the AC column, "required" is changed to "defined" to reflect that a regulatory guide does not establish requirements. These consistency changes are based on RAI 14.3-449 S02. |

| Item | Location in Tier 1 | Description of Change |
|---|---|---|
| B.3<br>B.6 | S2.13.8, Design Description | Based on RAI 14.3-449 S02, Item 3 is modified from "electrically independent and physically separated" to "physically separated" in order to reflect that this item is related to physical separation. Item 6 addresses electrical isolation. Also, reference to cables being routed in separate raceways is deleted and addressed as part of the acceptance criteria in the related ITAAC #3. Tier 2, Section 9.5.3.3.3.1, explains this MCR and RSS emergency lighting design configuration. Tier 2, Section 8.3.2.1 discusses the independence of MCR emergency lighting and Figure 8.1-4 shows that the RSS emergency lights are on separate buses. |
| C.2 | T2.13.8-1, ITAAC #3 | Based on RAI 14.3-449 S02, in the DC and AC columns, ITAAC 3 is modified from "electrically independent and physically separated" to "physically separated" in order to reflect that this item is related to physical separation. Item 6 addresses electrical isolation for the safety-related power supply connection to the nonsafety-related cables to the lighting fixtures (see Tier 2, Section 9.5.3.3.3.1). The lighting fixtures themselves are located in the MCR and RSS and are placed according to illumination requirements. Also, reference to cables being routed in separate raceways is deleted and addressed as part of the acceptance criteria in the AC column.<br><br>The following is added to the AC column to indicate that the physical separation will be verified to be in accordance with the separation criteria discussed in Tier 2 and which will be implemented through the detailed design:<br><br>"according to RG 1.75 and IEEE 384, through spatial separation, physical barriers, or separate raceways, conduit or metal troughs, up to the electrical isolation devices. Safety-related cables are routed in respective divisional raceways or conduit. Nonsafety-related cables from the isolation devices to the light fixtures are in separate raceways or conduit." |

| Item | Location in Tier 1 | Description of Change |
|---|---|---|
| | | The power supply for MCR and RSS lighting systems is safety-related up to the connections for the lighting fixtures, where two series electrical isolation devices are installed for separation of the safety-related power from the nonsafety-related lighting fixtures (Tier 2, Section 9.5.3.3.3.1, explains this MCR and RSS emergency lighting design configuration). Separation criteria details for the safety-related power supplies are as described in Tier 2, Section 8.3.1.4.1, which is as suggested by SRP 14.3 for the details of physical separation for electrical equipment. |
| B.3<br>B.6 | T2.13.8-1, ITAAC #6 | Based on RAI 14.3-449 S02, in the ITA column, ITAAC 6 is modified to add “and analysis” because the electrical isolation between the nonsafety-related and safety-related devices may require analysis. Also, “as-built” is added to the AC column to indicate that the inspection and analyses is for the as-built electrical isolation device to verify that the construction is consistent with the design as described in Tier 2.<br><br>Criteria for isolation devices are as defined in IEEE-384, Section 7, which is referenced in Tier 2, Chapter 8, for the DC power system. The details need not be in the ITAAC as per SRP 14.3. As noted above, the power supply for MCR and RSS lighting systems is safety-related up to the connections to the nonsafety-related cables for the lighting fixtures. Two series electrical isolation devices are installed for separation of the safety-related power from the nonsafety-related cable to the lighting fixtures (Tier 2, Section 9.5.3.3.3.1, explains this MCR and RSS emergency lighting design configuration). Section 8.1.5.2.4 and Table 8.1-1 commits to RG 1.75 and IEEE-384, which provide guidance for electrical isolation, for this system. Thus, for the ITAAC, RG 1.75 and IEEE-384, provide the acceptance criteria for the isolation devices, which are safety-related because they are used to isolate safety-related power from nonsafety-related cables for the lighting systems. |

| Item | Location in Tier 1 | Description of Change |
|---|---|---|
| C.2/B.3 | T2.13.8-1, ITAAC #7 | Based on RAI 14.3-449 S02, added to ITA column “and tests (as needed)” to reflect that testing of power supplies may be included in the verification that acceptance criteria are met. Tier 2, Section 9.5.3.3.3.1, describes the MCR and RSS emergency lighting. |
| E.2 | S2.15.1, Design Description | Based on RAI 14.3-449 S02, added the following for consistency with previous changes regarding displays, alarms and controls:<br>“The MCR set of displays, alarms and controls, based on the applicable codes and standards, including Human Factors Engineering (HFE) evaluations and emergency procedure guidelines, for the Containment System is addressed in Section 3.3.”<br>Also, Item 11 is deleted for consistency. |
| E.2 | S2.15.1, Design Description | Based on RAI 14.3-449 S02, added “at design basis accident conditions” to Item 16b. This is a consistency change. |
| E.2 | T2.15.1-2, ITAAC #11 | Based on RAI 14.3-449 S02, added the following for consistency with previous changes regarding displays, alarms and controls, ITAAC 11 is deleted because it is addressed by Section 3.3 of Tier 1. |
| E.2 | T2.15.1-2, ITAAC #16a | Based on RAI 14.3-449 S02, the following change is made:<br>In the ITA column, added: “An inspection will be performed in the MCR.” This is a consistency change. |
| E.2 | T2.15.1-2, ITAAC #16b | Based on 14.3-449 S02, the following changes are made:<br>In the DC column, added: “at design basis accident conditions”.<br>In the ITA column, added: “An inspection will be performed in the MCR.”<br>In the AC column, added: “Indication exists in the |

| Item | Location in Tier 1 | Description of Change |
|---|---|---|
| | | MCR.”<br>These are consistency changes. |
| E.2 | S2.16.2.1, Design Description | Added: “RBVS alarms, displays, controls, and status indications in the MCR are addressed by Section 3.3.”<br>Deleted Item 8 because indications and controls are addressed by HFE in Section 3.3. This is a consistency item based on RAI 14.3-449 S02. |
| E.2 | S2.16.2.3, Design Description | Added: “EFU alarms, displays, controls, and status indications in the MCR are addressed by Section 3.3.”<br>Deleted Item 8 because indications and controls are addressed by HFE in Section 3.3. This is a consistency item based on RAI 14.3-449 S02. |
| E.2 | S2.16.2.5, Design Description | Added: “FBVS alarms, displays, controls, and status indications in the MCR are addressed by Section 3.3.”<br>Deleted Item 6 because indications and controls are addressed by HFE in Section 3.3. This is a consistency item based on RAI 14.3-449 S02. |
| E.2 | T2.16.2-2, ITAAC #8 | Deleted ITAAC 8 because indications and controls are addressed by HFE in Section 3.3. This is a consistency item based on RAI 14.3-449 S02. |
| B.3<br>B.6 | T2.16.2-2, ITAAC #9 | Based on RAI 14.3-449 S02, “as defined by RG 1.75” is added to the AC column for ITAAC 9.ii to indicate that the electrical isolation and physical separation of the as-built dampers will be verified to be as per Tier 2, Section 8.3.1.4. |
| B.3<br>B.6 | T2.16.2-6, ITAAC #4 | Based on RAI 14.3-449 S02, “as defined by RG 1.75” is added to the AC column for ITAAC 4.ii to indicate that the electrical isolation and physical separation of the as-built dampers will be verified to be as per Tier 2, Section 8.3.1.4. |
| E.2 | T2.16.2-6, ITAAC #8 | Deleted ITAAC 8 because indications and controls are addressed by HFE in Section 3.3. This is a |

| Item | Location in Tier 1 | Description of Change |
|---|---|---|
| | | consistency item based on RAI 14.3-449 S02. |
| E.2 | T2.16.2-9, ITAAC #6 | Deleted ITAAC 6 because indications and controls are addressed by HFE in Section 3.3. This is a consistency item based on RAI 14.3-449 S02. |
| G.<br>G.2<br>G.3 | S3.8, Design Description | Revised description of scope of Section 3.8 to change the intent from the programmatic focus. See RAI 14.3-449 S02. This section of Tier 1 is based on the description in Tier 2, Section 3.11. |
| G.1 | T3.8-1 | A new table is added to Section 3.8 to include a list of electrical and mechanical equipment that are within the scope of the associated ITAAC. See RAI 14.3-449 S02. This section of Tier 1 is based on the description in Tier 2, Section 3.11. |
| G.1 | T3.8-2 | The table number is changed from Table 3.8-1 to Table 3.8-2. See RAI 14.3-449 S02. This section of Tier 1 is based on the description in Tier 2, Section 3.11. |
| G.<br>G.2<br>G.4<br>G.5<br>G.6 | T3.8-2, ITAAC #1 | Changed to remove programmatic focus and to reference to Table 3.8-1 for the list of electrical equipment subject to environmental qualification. The first sentence of the ITAAC in the ITA and AC columns is removed. Item i in the ITA column and AC column is deleted. Items ii and iii are modified to reflect the appropriate scope of equipment and remove the programmatic focus. See RAI 14.3-449 S02. In ITAAC subpart ii, “analyses” is removed to reflect that it cannot be used alone as a qualification method. This section of Tier 1 is based on the description in Tier 2, Section 3.11. |
| G.<br>G.2<br>G.4<br>G.5<br>G.6 | T3.8-2, ITAAC #2 | Changed to remove programmatic focus and to reference to Table 3.8-1 for the list of mechanical equipment subject to environmental qualification. The first sentence of the ITAAC in the ITA and AC columns is removed. Item i in the ITA column and AC column is deleted. Items ii and iii are modified to reflect the appropriate scope of equipment and remove the programmatic focus. See RAI 14.3-449 S02. In ITAAC subpart ii, “analyses” is removed to reflect that it cannot be used alone as a qualification method. This section of Tier 1 is based on the |

| Item | Location in Tier 1 | Description of Change |
|---|---|---|
| | | description in Tier 2, Section 3.11. |
| G.<br>G.2<br>G.4<br>G.5<br>G.6 | T3.8-2, ITAAC #3 | Changed to remove programmatic focus and to define the scope of digital I&C equipment subject to environmental qualification. The first sentence of the ITAAC in the ITA and AC columns is deleted. Item i in the ITA column and AC column is changed to be a {{Design Acceptance Criteria}} ITAAC for identifying the scope of equipment subject to the ITAAC. Items ii and iii are modified to reflect the appropriate scope of equipment and remove the programmatic focus. See RAI 14.3-449 S02. In ITAAC subpart ii, “analyses” is removed to reflect that it cannot be used alone as a qualification method. This section of Tier 1 is based on the description in Tier 2, Section 3.11. |
| G./last comment<br>G.3 | T3.8-2, ITAAC #4 | Changed to remove programmatic focus and to define the digital I&C equipment subject to seismic qualification. Item i in the ITA column and AC column is modified to reflect the appropriate scope and to identify it as {{Design Acceptance Criteria}} for the applicable scope of equipment to be seismically qualified. Items ii and iii are modified to reflect the appropriate scope. In ITAAC subpart ii, “analyses” is removed to reflect that it cannot be used alone as a qualification method. This section of Tier 1 is based on the description in Tier 2, Section 3.11. |
| End | | |

**DCD Impact**

DCD Tier 1 will be revised as shown on the marked-up pages.

**Enclosure 2**

**MFN 09-739**

**Response to NRC Request for Additional Information Letter No. 383 Related to ESBWR Design Certification Application**

**Tier 1**

**RAI Number 14.3-449 S02**

**DCD Markups**

# 1. INTRODUCTION

This document provides the Tier 1 material of the ESBWR Design Control Document (DCD).

## 1.1 DEFINITIONS AND GENERAL PROVISIONS

### 1.1.1 Definitions

The definitions below apply to terms which may be used in the Design Descriptions and associated Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC).

**Acceptance Criteria** means the performance, physical condition, or analysis results for a structure, system, or component that demonstrates a Design Commitment is met.

**Analysis** means a calculation, mathematical computation, or engineering or technical evaluation. Engineering or technical evaluations could include, but are not limited to, comparisons with operating experience or design of similar structures, systems, or components.

**As-built** means the physical properties of the structure, system, or component, following the completion of its installation or construction activities at its final location at the plant site. Determination of physical properties of the as-built structure, system, or component may be based on measurements, inspections, or tests that occur prior to installation provided that subsequent fabrication, handling, installation, and testing do not alter the properties. Many ITAAC require verification of “as-built” structures, systems, or components (SSCs). However, some of these ITAAC will involve measurements and/or testing that can only be conducted at the vendor site due to the configuration of equipment or modules or the nature of the test (e.g., measurements of reactor vessel internals). For these specific items where access to the component for inspection or test is impractical after installation in the plant, the ITAAC closure documentation (e.g., test or inspection record) will be generated at the vendor site and provided to the licensee.

**ASME Code Report** means a report required by the ASME Code and whose content requirements are stipulated by the ASME Code. Each such ASME Code report is final, and when required is certified in accordance with the Code.

**Cold shutdown** means a Safe Shutdown with the average reactor coolant temperature ≤ 93.3°C (200°F).

**Component** as used in Tier 1 for reference to ASME components means that subset of equipment that does not include piping.

**Containment** means the Reinforced Concrete Containment Vessel (RCCV) and the Passive Containment Cooling System (PCCS) Heat Exchangers, unless explicitly stated otherwise.

**Design Commitment** means that portion of the Design Description that is verified by ITAAC.

**Design Description** means that portion of the design that is certified.

**Division** is the designation applied to a given safety-related system or set of components that enables the establishment and maintenance of physical, electrical, and functional independence from other redundant sets of components.

**Dynamic Qualification Documentation** (DQD), as used in Tier 1, means the documentation that summarizes the qualification results for seismic qualification of equipment.

**Environmental Qualification Documentation** (EQD), as used in Tier 1, means the documentation that summarizes the qualification results for environmental qualification of equipment. The EQD includes the following:

- The environmental parameters and the methodology used to qualify the equipment for harsh and mild environments.
- The System Component Evaluation Work sheets which include a summary of environmental conditions and qualified conditions.

**Equipment** as used in Tier 1 as related to ASME Code and Seismic Category I requirements means both components and piping.

**Equipment Identification Number** or **Equipment Identifier** as used in Tier 1 means the designation on a Tier 1 figure and is not representative of an actual equipment number or tag number.

**Equipment Qualification**

For purposes of ITAAC:

***Environmental Qualification:*** Type tests, or type tests and analyses, of the safety-related electrical equipment demonstrate qualification to applicable normal, abnormal and design basis accident conditions without loss of the safety-related function for the time needed during and following the conditions to perform the safety-related function. These harsh environmental conditions, as applicable to the bounding design basis accident(s), are as follows: expected time-dependent temperature and pressure profiles, humidity, chemical effects, radiation, aging, submergence, and their synergistic effects which have a significant effect on equipment performance.

As used in the associated ITAAC, the term "safety-related electrical equipment" constitutes the equipment itself, connected instrumentation and controls, connected electrical components (such as cabling, wiring, and terminations), and the lubricants necessary to support performance of the safety-related functions of the safety-related electrical components identified as being subject to the environmental qualification requirements.

Type tests, or type tests and analyses, of the safety-related mechanical equipment demonstrate qualification to applicable normal, abnormal and design basis accident conditions without loss of the safety-related function for the time needed during and following the conditions to perform the safety-related function considering the applicable harsh environmental conditions. As used in this paragraph, "safety-related mechanical components" refers to mechanical parts, subassemblies or assemblies that are categorized as Quality Group A, B, or C. Mechanical components qualification also may be by type tests, type tests and analyses, or a combination of type tests and analyses of individual parts or subassemblies or of complete assemblies rather than by type testing the individual parts or subassemblies separately. ITAAC address analyses of material data for safety-related mechanical equipment located in a harsh environment.

Safety-related equipment located in a mild environment will be qualified for ~~their~~ its environmental conditions through specifications and certifications to the environments; however, for a mild environment, only safety-related digital instrumentation and control equipment will be addressed by ITAAC. ~~Additionally,~~ Electromagnetic Interference (EMI) and Radio Frequency Interference (RFI) susceptibility and emissions qualification is performed by type testing for the safety-related digital instrumentation and control equipment ~~and is not specifically addressed in an ITAAC~~.

~~ITAAC address analyses of material data for safety-related mechanical equipment located in a harsh environment.~~ ITAAC are located in Section 3.8. to cover environmental qualification for digital instrumentation and control equipment (including digital components in the safety-related electrical distribution system) located in a mild environment. Environmental qualification of safety-related electrical (including I&C equipment) and mechanical equipment in a harsh environment is covered in Section 3.8 ITAAC. Equipment inside containment that supports RTNSS functions is covered in Section 3.8 ITAAC. The scope of equipment located in a harsh environment subject to environmental qualification is identified in a table in Section 3.8. The scope of digital I&C equipment located in a mild environment subject to environmental qualification is determined through the completion of Design Acceptance Criteria ITAAC in Section 3.8.

***Seismic Qualification:*** Type tests, analyses, or a combination of type tests and analyses of the Seismic Category I mechanical and electrical equipment (including connected instrumentation and controls) may be used to demonstrate that the as-built equipment, including associated anchorage, is qualified to withstand design basis dynamic loads without loss of its safety function. Seismic qualification for digital instrumentation and controls equipment is addressed in Section 3.8 ITAAC, with the determination of the scope of equipment being designated as Design Acceptance Criteria. Seismic qualification for mechanical and electrical equipment is ~~covered by Section 3.8, but is also~~ addressed in system ITAAC throughout Tier 1. Seismic qualification results are documented in DQDs for both system-based ITAAC and the Section 3.8 ITAAC for digital instrumentation and controls equipment. System-based ITAAC address performance of inspections and analyses to verify equipment seismic qualification is bounded by the testing or analyzed conditions. The "inspections and analyses" include verification that the associated DQD exists and concludes that the as-built equipment is seismically qualified.

**Exists,** when used in Acceptance Criteria, means that the item is present and meets the design description.

**Functional Arrangement/Physical Arrangement (for a Building)** means the arrangement of the building features (e.g., floors, ceilings, walls, basemat and doorways) and of the structures, systems, or components within, as specified in the building Design Descriptions.

**Functional Arrangement (for a System)** means the physical arrangement of systems and components to provide the service for which the system in intended, and which is described in the system Design Description.

**Hot shutdown** means a Safe Shutdown with the average reactor coolant temperature > 215.6°C (420°F).

**Inspect** or **Inspection** means visual observations, physical examinations, or review of records based on visual observation or physical examination that compare the structure, system, or component condition to one or more Design Commitments. Examples include, but are not limited to, walk-downs, configuration checks, measurements of dimensions, and non-destructive examinations. Inspections also may include review of design and construction documents including drawings, calculations, analyses, test procedures and results, certificates of compliance, purchase records, and other documents that may verify that the acceptance criteria of a particular ITAAC are met.

**Inspect for Retrievability** of a display means to visually observe that the specified information appears on a monitor when summoned by the operator.

**Operate** means the actuation, control, running, or shutting down (*e.g.,* closing, turning off) of equipment.

**Reactor Pressure Vessel (RPV) Water Level** means the various levels used as reference points for instrumentation ranges. Figure 1.1.1-1 shows the relative location of the defined water levels and the overlap in the level measurement ranges.

**Report** means, as used in the Acceptance Criteria, a document created by or for the licensee that verifies that the acceptance criteria of the subject ITAAC have been met and references the supporting documentation. Reports typically include but are not limited to: results of walkdowns, results of visual inspections, field measurements, and reviews of design and construction documents. The Functional Arrangement verification report, for ASME Code Section III components or systems, may be or may include an ASME Code report.

**Safe Shutdown** (generic definition) is a shutdown with:

(1) The reactivity of the reactor kept to a margin below criticality consistent with Technical Specifications;

(2) The core decay heat being removed at a controlled rate sufficient to prevent core or reactor coolant system thermal design limits from being exceeded;

(3) Components and systems necessary to maintain these conditions operating within their design limits; and

(4) Components and systems, necessary to keep doses within prescribed limits, operating properly.

**Safe Shutdown for Station Blackout** means bringing the plant to those shutdown conditions specified in plant Technical Specifications as Hot Shutdown or Stable Shutdown.

**Stable Shutdown** means a Safe Shutdown with the average reactor coolant temperature ≤ 215.6°C (420°F) and > 93ºC (200ºF) (see “safe stable condition” in SECY-94-084 and stable shutdown in ESBWR Generic Technical Specifications).

**Test** or **Testing** means the actuation, operation, or establishment of specified conditions, to evaluate the performance or integrity of as-built structures, systems, or components, unless explicitly stated otherwise.

**Train** means a redundant, identical mechanical function within a system. For nonsafety-related systems, redundant trains may share passive components (e.g., piping, supports, manual shutoff valves).

**Type Test** means a test on one or more sample components of the same type and manufacturer to qualify other components of that same type and manufacturer. A type test is not necessarily a test of the as-built structures, systems, or components.

**Verification of the Functional Arrangement** of a system, as used in an ITAAC, means verifying that the system is constructed as depicted in the Tier 1 Design Description and figures, including equipment and instrument locations, if applicable.

## 2.1.2 Nuclear Boiler System

### Design Description

The Nuclear Boiler System (NBS) generates steam from feedwater and transports steam from the RPV to the main turbine.

The combined steamline volume from the RPV to the main steam turbine stop valves and steam bypass valves is sufficient to validate the assumptions in Anticipated analyses (see Table 2.11.1-1, Item 8).

The ~~equipment~~ environmental qualification of the NBS components is addressed in Section 3.8; and the environmental and seismic qualification of digital instrumentation and controls equipment is addressed in Section 3.8.

The containment isolation requirements for the NBS are addressed in Subsection 2.15.1.

NBS software is developed in accordance with the software development program described in Section 3.2.

NBS alarms, displays, controls, and status indications in the MCR are addressed by Section 3.3.

Conformance with IEEE Standard 603 requirements by the safety-related control system, structures, systems, or components is addressed in Subsection 2.2.15.

(1) The functional arrangement of the NBS is as described in the Design Description of this Subsection 2.1.2, Tables 2.1.2-1 and 2.1.2-2, and as shown on Figures 2.1.2-1, 2.1.2-2, and 2.1.2-3.

(2) a1. The components identified in Table 2.1.2-1 as ASME Code Section III are designed in accordance with ASME Code Section III requirements.

a2. The components identified in Table 2.1.2-1 as ASME Code Section III shall be reconciled with the design requirements.

a3. The components identified in Table 2.1.2-1 as ASME Code Section III are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

b1. The piping identified in Table 2.1.2-1 as ASME Code Section III is designed in accordance with ASME Code Section III requirements.

b2. The as-built piping identified in Table 2.1.2-1 as ASME Code Section III shall be reconciled with the piping design requirements.

b3. The piping identified in Table 2.1.2-1 as ASME Code Section III is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

(3) a. Pressure boundary welds in components identified in Table 2.1.2-1 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements.

b. Pressure boundary welds in piping identified in Table 2.1.2-1 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements.

(4) a. The components identified in Table 2.1.2-1 as ASME Code Section III retain their pressure boundary integrity at their design pressure.

## 2.2 INSTRUMENTATION AND CONTROL SYSTEMS

The following subsections describe the major instrumentation and control (I&C) systems for the ESBWR.

### 2.2.1 Rod Control and Information System

**Design Description**

The Rod Control and Information System (RC&IS) automatically controls and monitors, and provides manual control capability for, positioning of the control rods in the reactor by the Control Rod Drive (CRD) System.

RC&IS alarms, displays, and status indications in the MCR are addressed in Section 3.3.

(1) RC&IS functional arrangement is as described in Subsection 2.2.1 and Table 2.2.1-1.

(2) RC&IS is divided into major functional groups as defined in Table 2.2.1-2.

(3) RC&IS provides automatic functions and initiators as defined in Table 2.2.1-3.

(4) RC&IS provides rod block functions as defined in Table 2.2.1-4.

(5) RC&IS provides controls, interlocks, and bypasses as defined in Table 2.2.1-5.

(6) (Deleted)

(7) RC&IS has a dual redundant architecture.

(8) RC&IS equipment is powered by separate, non-divisional AC power sources.

(9) RC&IS has at least one power source being a nonsafety-related uninterruptible power supply.

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

Table 2.2.1-6 defines the inspections, tests, and analyses, together with associated acceptance criteria for the RC&IS.

**Table 2.2.1-6**

**ITAAC For The Rod Control and Information System**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. RC&IS functional arrangement is as described in Subsection 2.2.1 and Table 2.2.1-1. | Inspection(s) of the as-built system will be performed. | The as-built system conforms with the functional arrangement defined in Subsection 2.2.1 and Table 2.2.1-1. |
| 2. RC&IS is divided into major functional groups as defined in Table 2.2.1-2. | Inspection(s) of the as-built system will be performed. | Test and inspection report(s) document that the as-built system is divided into major functional groups as defined in Table 2.2.1-2. |
| 3. RC&IS provides automatic functions and initiators, as defined in Table 2.2.1-3. | Test(s) will be performed for the initiators on the as-built RC&IS using simulated signals and actuators for the automatic functions defined in Table 2.2.1-3. | Test and type test report(s) document that the RC&IS is capable of performing the automatic functions as defined in Table 2.2.1-3. |
| 4. RC&IS provides rod block functions as defined in Table 2.2.1-4. | Test(s) will be performed using simulated signals and manual actions to confirm that the rod withdrawal and insertion commands are blocked as defined in Table 2.2.1-4. | The rod block functions defined in Table 2.2.1-4 are performed in response to simulated signals and manual actions. |
| 5. RC&IS provides controls, interlocks, and bypasses as defined in Table 2.2.1-5. | Test(s) will be performed on the as-built system using simulated signals and manual actions. | The system controls, interlocks, and bypasses exist, can be retrieved in the main control room, or are performed in response to simulated signals and manual actions as defined in Table 2.2.1-5. |
| 6. (Deleted) | | |

## Table 2.2.1-6

## ITAAC For The Rod Control and Information System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 7. RC&IS has a dual redundant architecture. | Test(s) will be performed on the as-built system that simulate failure of each redundant channel. | The surviving channel continues to execute system functions with one failed channel. |
| 8. RC&IS equipment is powered by separate, non-divisional AC power sources. | Test(s) will be performed on the as-built system by simulating a failure of AC power. | A test signal exists only in the channel under test. |
| 9. RC&IS has at least one power source being a nonsafety-related uninterruptible power supply. | Test(s) will be performed on the as-built system by providing a test signal in only one channel at a time. | The test signal exists from at least one nonsafety-related uninterruptible AC power supply only in the channel under test. |

## 2.2.2 Control Rod Drive System

### Design Description

The control rod drive (CRD) system, manually and automatically upon signal from the RPS, DPS, and RC&IS, provides rapid control rod insertion (scram), performs fine control rod positioning (reactivity control), detects control rod separation (prevent rod drop accident), limits the rate of control rod ejection due to a break in the control rod pressure boundary (prevent fuel damage), and supplies high pressure makeup water to the reactor during events in which the feedwater system is unable to maintain reactor water level.

CRD system alarms, displays, controls, and status indications in the MCR are addressed by Section 3.3.

Conformance with IEEE Std. 603 requirements by the safety-related control system structures, systems, or components defined in Table 2.2.2-6 is addressed in Subsection 2.2.15.

The environmental ~~and seismic~~ qualification of CRD system components defined in Tables 2.2.2-5 and 2.2.2-6 is addressed in Section 3.8; and the environmental and seismic qualification of digital instrumentation and controls equipment is addressed in Section 3.8.

CRD system software is developed in accordance with the software development program described in Section 3.2 as part of the Plant Investment Protection (PIP) software projects.

(1) The functional arrangement of the CRD System comprises three major functional groups: fine motion control rod drive (FMCRD), hydraulic control unit (HCU), and CRD hydraulic subsystem, as ~~defined~~ described in Subsection 2.2.2 and Table 2.2.2-1 and shown in Figure 2.2.2-1.

(2) a1. The components identified in Table 2.2.2-5 as ASME Code Section III are designed in accordance with ASME Code Section III requirements.

a2. The components identified in Table 2.2.2-5 as ASME Code Section III shall be reconciled with the design requirements.

a3. The components identified in Table 2.2.2-5 as ASME Code Section III are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

b1. The piping identified in Table 2.2.5-5 as ASME Code Section III is designed in accordance with ASME Code Section III requirements.

b2. The as-built piping identified in Table 2.2.2-5 as ASME Code Section III shall be reconciled with the piping design requirements.

b3. The piping identified in Table 2.2.2-5 as ASME Code Section III is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

(3) a. Pressure boundary welds in components identified in Table 2.2.2-5 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements.

b. Pressure boundary welds in piping identified in Table 2.2.2-5 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements.

(4) a. The components identified in Table 2.2.2-5 as ASME Code Section III retain their pressure boundary integrity at their design pressure.

b. The piping identified in Table 2.2.2-5 as ASME Code Section III retains its pressure boundary integrity at its design pressure.

(5) The equipment identified in Table 2.2.2-5 and Table 2.2.2-6 as Seismic Category I can withstand Seismic Category I loads without loss of safety function.

(6) The FMCRD is capable of positioning control rod incrementally and continuously over its entire range.

(7) Valves defined in Table 2.2.2-5 and 2.2.2-6 open and close under differential pressure, fluid flow, and temperature conditions.

(8) a. The CRD hydraulic subsystem has a high-pressure makeup mode of operation that injects water to the RPV via the Reactor Water Cleanup/Shutdown Cooling RWCU/SDC return path.

b. The CRD hydraulic subsystem has a safety-related isolation capability terminating injection into the RPV.

c. The CRD hydraulic subsystem has an isolation bypass capability allowing injection to the RPV.

(9) The PIP software project for the CRD system provides automatic functions, initiators, and associated interfacing systems as defined in Table 2.2.2-3.

(10) The PIP software project for the CRD system provides controls and interlocks as defined in Table 2.2.2-4.

(11) (Deleted)

(12) The CRD system provides rapid control rod insertion in response to a scram signal.

(13) (Deleted)

(14) (Deleted)

(15) The FMCRD has an electro-mechanical brake with a minimum required holding torque on the motor drive shaft.

(16) a. Valves on lines attached to the RPV system that require maintenance have maintenance valves such that freeze seals will not be required.

b. The as-built location of valves on lines attached to the CRD system that require maintenance shall be reconciled to design requirements.

(17) High Pressure (HP) CRD makeup water isolation valves are normally open and close on a signal to close and on loss of air.

(18) HP CRD makeup water isolation bypass valves are normally closed and open on a signal to open.

(19) FMCRDs have continuous control rod position indication sensors that detect control rod position based on motor rotation.

(20) FMCRDs have scram position indication switches that detect intermediate and scram completion control rod positions.

(21) FMCRDs have a bayonet control rod coupling mechanism that requires a minimum rotation to decouple.

(22) FMCRDs have spring-loaded latches in the hollow piston that engage slots in the guide tube to prevent rotation of the bayonet coupling except at predefined positions.

(23) FMCRDs have redundant safety-related rod separation switches that detect separation of the FMCRD from the control rod.

(24) Each FMCRD has a magnetic coupling that connects the associated drive motor to the drive shaft through the associated CRD housing.

(25) FMCRDs have safety-related scram inlet port check valves that are installed to close under reverse flow.

(26) HCU scram pilot solenoid valves transfer open to vent on loss of power to both solenoids.

(27) Backup scram solenoid valves are closed on loss of power and transfer open to vent when energized.

(28) ARI valves are closed on loss of power and transfer open to vent when energized.

(29) Each HCU contains a nitrogen-water scram accumulator that can be charged to a sufficiently high pressure and with the necessary valves and components to fully insert two CRs.

(30) Scram accumulators are continuously monitored for water leakage by level instruments.

(31) Divisional safety-related power supplies power safety-related FMCRD and HCU equipment.

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

Table 2.2.2-7 defines the inspections, tests, and analyses, together with associated acceptance criteria for the CRD system.

**Table 2.2.2-7**

**ITAAC For The Control Rod Drive System**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The functional arrangement of the CRD System comprises three major functional groups: fine motion control rod drive (FMCRD), hydraulic control unit (HCU), and CRD hydraulic subsystem, as described in Subsection 2.2.2 and Table 2.2.2-1 and as shown in Figure 2.2.2-1. | Inspection(s) of the as-built CRD system will be conducted. | The CRD system conforms to the functional arrangement as described in Subsection 2.2.2 and Table 2.2.2-1 and as shown in Figure 2.2.2-1. |
| 2a1. The components identified in Table 2.2.2-5 as ASME Code Section III are designed in accordance with ASME Code Section III requirements | Inspection of ASME Code Design Reports (NCA-3550) and required documents will be conducted. | ASME Code Design Reports (NCA-3550) (certified, when required by ASME Code) exist and conclude that the design of the components identified in Table 2.2.2-5 as ASME Code Section III complies with the requirements of ASME Code Section III including those stresses applicable to loads related to fatigue (including environmental effects), thermal expansion, seismic, and combined. |

## Table 2.2.2-7

## ITAAC For The Control Rod Drive System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 2a2. The components identified in Table 2.2.2-5 as ASME Code Section III shall be reconciled with the design requirements. | A reconciliation analysis of the components identified in Table 2.2.2-5 as ASME Code Section III using as-designed and as-built information and ASME Code Design Reports (NCA-3550) will be performed. | ASME Code Design Report(s) (NCA-3550) (certified, when required by ASME Code) exist and conclude that design reconciliation has been completed, in accordance with ASME Code, for as-built reconciliation of the components identified in Table 2.2.2-5 as ASME Code Section III. The report documents the results of the reconciliation analysis. |
| 2a3. The components identified in Table 2.2.2-5 as ASME Code Section III are fabricated, installed, and inspected in accordance with ASME Code Section III requirements. | Inspection of the components identified in Table 2.2.2-5 as ASME Code Section III will be conducted. | ASME Code Data Report(s) (including N-5 Data Reports, where applicable) (certified, when required by ASME Code) and inspection reports exist and conclude that the components identified in Table 2.2.2-5 as ASME Code Section III are fabricated, installed, and inspected in accordance with ASME Code Section III requirements. |

## Table 2.2.2-7

## ITAAC For The Control Rod Drive System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 2b1. The piping identified in Table 2.2.5-5 as ASME Code Section III is designed in accordance with ASME Code Section III requirements. | Inspection of ASME Code Design Reports (NCA-3550) and required documents will be conducted.<br>{{Design Acceptance Criteria}} | ASME Code Design Report(s) (NCA-3550) (certified, when required by ASME Code) exist and conclude that the design of the piping identified in Table 2.2.2-5 as ASME Code Section III complies with the requirements of ASME Code Section III, including those stresses applicable to loads related to fatigue (including environmental effects), thermal expansion, seismic, and combined.<br>{{Design Acceptance Criteria}} |
| 2b2. The as-built piping identified in Table 2.2.2-5 as ASME Code Section III shall be reconciled with the piping design requirements. | A reconciliation analysis of the piping identified in Table 2.2.2-5 as ASME Code Section III using as-designed and as-built information and ASME Code Design Reports (NCA-3550) will be performed. | ASME Code Design Report(s) (NCA-3550) (certified, when required by ASME Code) exist and conclude that design reconciliation has been completed, in accordance with ASME Code, for as-built reconciliation of the piping identified in Table 2.2.2-5 as ASME Code Section III. The report documents the results of the reconciliation analysis. |

**Table 2.2.2-7**

**ITAAC For The Control Rod Drive System**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 2b3. The piping identified in Table 2.2.2-5 as ASME Code Section III is fabricated, installed, and inspected in accordance with ASME Code Section III requirements. | A reconciliation analysis of the piping identified in Table 2.2.2-5 as ASME Code Section III using as-designed and as-built information and ASME Code Design Reports (NCA-3550) will be performed. | ASME Code Design Report(s) (NCA-3550) (certified, when required by ASME Code) exist and conclude that design reconciliation has been completed, in accordance with ASME Code, for as-built reconciliation of the piping identified in Table 2.2.2-5 as ASME Code Section III. The report documents the results of the reconciliation analysis. |
| 3a. Pressure boundary welds in components identified in Table 2.2.2-5 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements. | Inspection of the as-built pressure boundary welds in components identified in Table 2.2.2-5 as ASME Code Section III will be performed in accordance with ASME Code Section III. | ASME Code report(s) exist and conclude that ASME Code Section III requirements are met for non-destructive examination of pressure boundary welds in components identified in Table 2.2.2-5 as ASME Code Section III. |
| 3b. Pressure boundary welds in piping identified in Table 2.2.2-5 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements. | Inspection of the as-built pressure boundary welds in piping identified in Table 2.2.2-5 as ASME Code Section III will be performed in accordance with ASME Code Section III. | ASME Code report(s) exist and conclude that ASME Code Section III requirements are met for non-destructive examination of pressure boundary welds in piping identified in Table 2.2.2-5 as ASME Code Section III. |
| 4a. The components identified in Table 2.2.2-5 as ASME Code Section III retain their pressure boundary integrity at their design pressure. | A hydrostatic test will be conducted on those code components identified in Table 2.2.2-5 as ASME Code Section III that are required to be hydrostatically tested by ASME Code Section III. | ASME Code Data Report(s) exist and conclude that the results of the hydrostatic test of components identified in Table 2.2.2-5 as ASME Code Section III comply with the requirements of ASME Code Section III. |

## Table 2.2.2-7

## ITAAC For The Control Rod Drive System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 4b. The piping identified in Table 2.2.2-5 as ASME Code Section III retains its pressure boundary integrity at its design pressure. | A hydrostatic test will be conducted on the code piping identified in Table 2.2.2-5 as ASME Code Section III that is required to be hydrostatically tested by ASME Code Section III. | ASME Code Data Report(s) exist and conclude that the results of the hydrostatic test of piping identified in Table 2.2.2-5 as ASME Code Section III comply with the requirements in ASME Code Section III. |
| 5. The equipment identified in Table 2.2.2-5 and Table 2.2.2-6 as Seismic Category I can withstand Seismic Category I loads without loss of safety function. | i. Inspection will be performed to verify that the Seismic Category I equipment identified in Table 2.2.2-5 and Table 2.2.2-6 are located in a Seismic Category I structure. | i. The equipment identified as Seismic Category I in Table 2.2.2-5 and Table 2.2.2-6 is located in a Seismic Category I structure. |
| | ii. Type tests, analyses, or a combination of type tests and analyses, of equipment identified in Table 2.2.2-5 and Table 2.2.2-6 as Seismic Category I, will be performed using analytical assumptions, or will be performed under conditions which bound the Seismic Category I equipment design requirements. | ii. The equipment identified in Table 2.2.2-5 and Table 2.2.2-6 as Seismic Category I can withstand Seismic Category I loads without loss of safety function. |
| | iii. Inspections and analyses will be performed to verify that the as-built equipment identified in Table 2.2.2-5 and Table 2.2.2-6, including anchorage, is bounded by the testing or analyzed conditions. | iii. The as-built equipment identified in Table ~~2.4.2-1~~2.2.2-5 and Table ~~2.4.2-2~~2.2.2-6 as Seismic Category I, including anchorage, can withstand Seismic Category I loads without loss of safety function. |

## Table 2.2.2-7

## ITAAC For The Control Rod Drive System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 6. The FMCRD is capable of positioning control rod incrementally and continuously over its entire range. | Type test(s) will be performed of the motor run-in and withdrawal function on the FMCRD using a simulated control rod. | The FMCRD is capable of positioning control rod incrementally and continuously over its entire range. |
| 7. Valves defined in Table 2.2.2-5 and 2.2.2-6 open and close under differential pressure, fluid flow, and temperature conditions. | Tests of installed valves will be performed for opening and closing under system preoperational differential pressure, fluid flow, and temperature conditions. | Upon receipt of the actuating signal, each valve changes position under differential pressure, fluid flow, and temperature conditions. |
| 8a. The CRD hydraulic subsystem has a high pressure makeup mode of operation that injects water to the RPV via the RWCU/SDC return path. | Test(s) of the CRD hydraulic subsystem high pressure makeup mode of operation will be conducted on the as-built system verifying that water is injected to the RPV via the RWCU/SDC return path. | The CRD hydraulic subsystem high pressure makeup mode of operation injects water to the RPV via the RWCU/SDC return path. |
| 8b. The CRD hydraulic subsystem has a safety-related isolation capability terminating water injection into the RPV. | Test(s) of the CRD hydraulic subsystem high pressure makeup mode of operation will be conducted on the as-built system verifying that water injection is terminated to the RPV via the safety-related isolation. | The CRD hydraulic subsystem high pressure makeup mode of operation terminates water injection to the RPV via the safety-related isolation. |
| 8c. The CRD hydraulic subsystem has an isolation bypass capability allowing water injection to the RPV. | Test(s) of the CRD hydraulic subsystem high pressure makeup mode of operation will be conducted on the as-built system verifying that water is injected to the RPV via the isolation bypass. | The CRD hydraulic subsystem high pressure makeup mode of operation injects water to the RPV via the isolation bypass. |

## Table 2.2.2-7

## ITAAC For The Control Rod Drive System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 9. The PIP software project for the CRD system provides automatic functions, initiators, and associated interfacing systems as defined in Table 2.2.2-3. | Test(s) will be performed on the as-built system using simulated signals initiated from all of the associated interfacing as-built systems as defined in Table 2.2.2-3. | The PIP network segments for the CRD system are capable of performing the automatic functions defined in Table 2.2.2-3 using simulated signals initiated from all of the associated interfacing as-built systems as defined in Table 2.2.2-3. |
| 10. The PIP software project for the CRD system provides controls and interlocks as defined in Table 2.2.2-4. | Test(s) will be performed on the as-built system using simulated signals. | The PIP network segments for the CRD system controls and interlocks exist, can be retrieved in the main control room, and perform in response to simulated signals and manual actions as defined in Table 2.2.2-4. |
| 11. (Deleted) | | |
| 12. The CRD system provides rapid control rod insertion in response to a scram signal. | Test(s) will be performed of each CRD control rod pair scram function using simulated signals. | The scram insertion time for each control rod pair is less than or equal to the maximum allowable scram times as defined in Table 2.2.2-2. |
| 13. (Deleted) | | |
| 14. (Deleted) | | |
| 15. The FMCRD has an electro-mechanical brake with a minimum required holding torque on the motor drive shaft. | Tests of each FMCRD brake will be conducted in a test facility | The FMCRD electro-mechanical brake has a minimum required holding torque of 49 N-m (36 ft-lbf) on the motor drive shaft. |

## Table 2.2.2-7

## ITAAC For The Control Rod Drive System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 16a. Valves on lines attached to the RPV that require maintenance have maintenance valves such that freeze seals will not be required. | Inspections of piping design isometric drawings will be conducted.<br>{{Design Acceptance Criteria}} | A review piping design isometric drawings, confirms that maintenance valves are included such that freeze seals will not be required.<br>{{Design Acceptance Criteria}} |
| 16b. The as-built location of valves on lines attached to the CRD system that require maintenance shall be reconciled to design requirements. | A reconciliation analysis of valves on lines attached to the RPV system that require maintenance using as-designed and as-built information will be performed. | Design reconciliation has been completed for the as-built location of valves relative to the design requirements. A report documents the results of the reconciliation analysis. |
| 17. HP CRD makeup water isolation valves are normally open and close on a signal to close and on loss of air. | Tests of the as-built HP CRD makeup water isolation valves will be performed | The as-built HP CRD makeup water isolation valves are normally open and close on a signal to close and on loss of air. |
| 18. HP CRD makeup water isolation bypass valves are normally closed and open on a signal to open. | Tests of the as-built HP CRD makeup water isolation bypass valves will be performed. | The as-built HP CRD makeup water isolation bypass valves are normally closed and open on a signal to open. |
| 19. FMCRDs have continuous control rod position indication sensors that detect control rod position based on motor rotation. | Test(s) will be performed on the FMCRD continuous control rod position indication sensors by simulating motor run-in of each control rod. | FMCRDs have continuous control rod position indication in the MCR based on motor rotation. |
| 20. FMCRDs have scram position indication switches that detect intermediate and scram completion control rod positions. | Test(s) will be performed on the FMCRD scram position indication switches by simulating motor run-in of each control rod. | FMCRDs have scram position indication in the MCR for intermediate and scram completion control rod positions. |

## Table 2.2.2-7

## ITAAC For The Control Rod Drive System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 21. FMCRDs have a bayonet control rod coupling mechanism that requires a minimum rotation to decouple. | Test(s) will be performed on each FMCRD control rod coupling mechanism. | After being rotated at least one-eighth turn the control rod coupling mechanism uncouples the FMCRD from the control rod. |
| 22. FMCRDs have spring-loaded latches in the hollow piston that engage slots in the guide tube to prevent rotation of the bayonet coupling except at predefined positions. | Type test(s) will be performed on the FMCRD latches by rotating the bayonet coupling. | The FMCRD bayonet coupling rotates less than one-eighth turn when the spring-loaded latches in the hollow piston are engaged in slots in the guide tube. |
| 23. FMCRDs have safety-related redundant rod separation switches that detect separation of the FMCRD from the control rod. | Test(s) will be performed on each FMCRD safety-related rod separation switch. | Each redundant safety-related rod separation switch detects separation of the FMCRD from the control rod and indicates the separation status in the MCR. |
| 24. Each FMCRD has a magnetic coupling that connects the associated drive motor to the drive shaft through the associated CRD housing. | Type test(s) will be performed on the FMCRD magnetic coupling. | For each FMCRD, the associated drive motor that is outside the CRD housing rotates the associated drive shaft that is inside the associated CRD housing up to the torque rating required for the FMCRD operation. |
| 25. FMCRDs have safety-related scram inlet port check valves that are installed to close under reverse flow. | Inspection(s) will be performed of the as-built inlet port check valve installation. | Safety-related scram inlet port check valves are installed with normal flow direction going into the reactor. |
| 26. HCU scram pilot solenoid valves transfer open to vent on loss of power to both solenoids. | Test(s) will be performed on each HCU scram pilot solenoid valve. | Each HCU scram pilot solenoid valve transfers open to vent on loss of power to both solenoids. |

## Table 2.2.2-7

## ITAAC For The Control Rod Drive System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 27. Backup scram solenoid valves are closed on loss of power and transfer open to vent when energized. | Test(s) will be performed on each backup scram solenoid valve. | Each backup scram solenoid valve closes on loss of power and transfers open to vent when energized. |
| 28. ARI valves are closed on loss of power and transfer open to vent when energized. | Test(s) will be performed on each ARI valve. | Each ARI valve closes on loss of power and transfers open to vent when energized. |
| 29. Each HCU contains a nitrogen-water scram accumulator that can be charged to a sufficiently high pressure and with the necessary valves and components to fully insert two CRs. | Test(s) will be performed on each HCU and control rod pair, as applicable, with the reactor unpressurized, using simulated scram signals. | With each accumulator fully charged, each HCU fully inserts both control rod in the pair as applicable. |
| 30. Scram accumulators are continuously monitored for water leakage by level instruments. | Test(s) will be performed on the level instruments in each scram accumulator. | Low scram accumulator water level is detected by each level instrument and is indicated in the MCR. |
| 31. Divisional safety-related power supplies power safety-related FMCRD and HCU equipment. | Test(s) will be performed on the as-built system by providing a test signal in only one divisional safety-related power supply at a time. | A test signal exists only in the FMCRD and HCU equipment powered by the divisional power supply under test. |

## 2.2.3 Feedwater Control System

### Design Description

The Feedwater Control System (FWCS), automatically or manually, controls RPV water level by modulating the supply of feedwater flow to the RPV, the low flow control valve (LFCV), individual reactor feed pump Adjustable Speed Drive (ASD), or the RWCU/SDC system overboard control valve (OBCV).

The FWCS changes reactor power by automatically or manually controlling FW temperature by modulating the seventh FW heater steam heating valves or the high-pressure FW heater bypass valves.

FWCS alarms, displays, controls and status indications in the MCR are addressed by Section 3.3.

(1) FWCS functional arrangement is described in Subsection 2.2.3 and Table 2.2.3-1.

(2) FWCS provides automatic functions and initiators as described in Table 2.2.3-2.

(3) FWCS provides controls as described in Table 2.2.3-3.

(4) (Deleted)

(5) FWCS controllers are triple redundant fault tolerant.

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

Table 2.2.3-4 defines the inspections, tests, and analyses, together with associated acceptance criteria for the FWCS.

## Table 2.2.3-4

## ITAAC For The Feedwater Control System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The FWCS functional arrangement is as described in Subsection 2.2.3 and Table 2.2.3-1. | Inspections of the as-built system will be performed. | The FWCS functional arrangement is as defined in Subsection 2.2.3 and Table 2.2.3-1. |
| 2. FWCS provides automatic functions and initiators as described in Table 2.2.3-2. | Test(s) will be performed on the as-built system using simulated signals. | The system performs the functions defined in Table 2.2.3-2. |
| 3. FWCS provides controls as defined in Table 2.2.3-3. | Test(s) will be performed on the as-built system using simulated signals and manual actions. | The FWCS controls and interlocks exist, can be retrieved in the main control room, and are performed in response to simulated signals and manual actions as defined in Table 2.2.3-3. |
| 4. (Deleted) | | |

## Table 2.2.3-4

## ITAAC For The Feedwater Control System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 5. FWCS controllers are triple redundant and fault tolerant. | i. Test(s) will be performed simulating failure of each FWCS temperature controller.<br>ii. Test(s) will be performed simulating failure of each FWCS level controller.<br>iii. Test(s) will be performed simulating discrepancy between field voter output and the control signal actually sent to the ASDs.<br>iv. Test(s) will be performed simulating discrepancy between field voter output and the control signal actually sent to the modulating steam admission valves.. | i. Failure of any one FWCS temperature controller does not affect FWCS output.<br>ii. Failure of any one FWCS level controller does not affect FWCS output.<br>iii. "Lock-up" signal is sent to feed pump ASDs following discrepancy between field voter output and control signal actually sent.<br>iv. "Lock-Up" signal is sent to the modulating steam admission valves of the seventh stage feedwater heater and the modulating heater bypass valves, following discrepancy between field voter output and control signal actually sent. |

## 2.2.4 Standby Liquid Control System

### Design Description

The Standby Liquid Control (SLC) System is an alternative means to reduce core reactivity to ensure complete shutdown of the reactor core from the most reactive conditions at any time in core life, and provides makeup water to the RPV to mitigate the consequences of a Loss-of-Coolant-Accident (LOCA).

The SLC alarms, displays, and status indications in the MCR are addressed by Section 3.3.

Conformance with IEEE Std. 603 requirements by the safety-related control system structures, systems, or components defined in Tables 2.2.4-4 and 2.2.4-5 is addressed in Subsection 2.2.15.

The environmental qualification of SLC System components defined in Tables 2.2.4-4 and 2.2.4-5 are addressed in Section 3.8; and the environmental and seismic qualification of digital instrumentation and controls equipment is addressed in Section 3.8.

SLC software is developed in accordance with the software development program described in Section 3.2 as part of the ATWS/SLC software projects and SSLC/ESF software projects.

(1) The functional arrangement of the SLC System is as described in Subsection 2.2.4 and shown in Figure 2.2.4-1.

(2) The SLC System provides automatic functions and initiators are as defined in Table 2.2.4-2.

(3) The SLC System provides controls and interlocks as defined in Table 2.2.4-3.

(4) (Deleted)

(5) (Deleted)

(6) (Deleted)

(7) During an ATWS, the SLC System shall be capable of injecting borated water into the RPV at flow rates that assure rapid power reduction.

(8) The SLC System shall be capable of injecting borated water for use as makeup water to the RPV in response to a Loss-of-Coolant-Accident (LOCA).

(9) The redundant injection shut-off valves shown in Figure 2.2.4-1 as V1, V2, V3, and V4 are automatically closed by low accumulator level signals from the respective accumulator level monitors.

(10) a1. The components identified in Table 2.2.4-4 as ASME Code Section III are designed in accordance with ASME Code Section III requirements.

a2. The components identified in Table 2.2.4-4 as ASME Code Section III shall be reconciled with the design requirements.

a3. The components identified in Table 2.2.4-4 as ASME Code Section III are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

b1. The piping identified in Table 2.2.4-4 as ASME Code Section III is designed in accordance with ASME Code Section III requirements.

b2. The as-built piping identified in Table 2.2.4-4 as ASME Code Section III shall be reconciled with the piping design requirements.

b3. The piping identified in Table 2.2.4-4 as ASME Code Section III is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

(11) a. Pressure boundary welds in components identified in Table 2.2.4-4 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements.

b. Pressure boundary welds in piping identified in Table 2.2.4-4 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements.

(12) a. The components identified in Table 2.2.4-4 as ASME Code Section III retain their pressure boundary integrity at their design pressure.

b. The piping identified in Table 2.2.4-4 as ASME Code Section III retains its pressure boundary integrity at its design pressure.

(13) The equipment identified in Table 2.2.4-4 and Table 2.2.4-5 as Seismic Category I can withstand Seismic Category I loads without loss of safety function.

(14) (Deleted).

(15) Each of the SLC System divisions and safety-related loads/components identified in Tables 2.2.4-4 and 2.2.4-5 is powered from its respective safety-related division.

(16) In the SLC System, independence is provided between safety-related divisions, and between safety-related divisions and nonsafety-related equipment.

(17) a. Each mechanical train of the SLC System located outside the containment is physically separated from the other train(s) so as to preclude damage to both trains.

b. Each mechanical train of the SLC System located inside the containment is physically separated from the other train(s) so as to preclude damage to both trains.

(18) Re-positionable (not squib) valves listed in Table 2.2.4-4 open, close, or both open and close under differential pressure, fluid flow, and temperature conditions.

(19) The pneumatically operated valve(s) designated in Table 2.2.4-4 fail in the mode listed if either electric power to the valve actuating solenoid is lost, or pneumatic pressure to the valve(s) is lost.

(20) Check valves designated in Table 2.2.4-4 as having a safety-related function open and close under system pressure, fluid flow, and temperature conditions.

(21) The SLC System injection squib valve will open as designed.

(22) The equivalent natural boron concentration at cold shutdown conditions for the total solution injection volume is based on the liquid inventory in the RPV at the main steam line nozzle elevation plus the liquid inventory in the reactor shutdown cooling piping and equipment of the RWCU/SDC system.

(23) (Deleted)

(24) a. Valves on lines attached to the RPV that require maintenance have maintenance valves such that freeze seals will not be required.

b. The as-built location of valves on lines attached to the RPV in the SLC System that require maintenance shall be reconciled to design requirements.

(25) Each accumulator tank has an injectable liquid volume of at least 7.80 $m^3$ (2060 gal).

(26) Each accumulator tank has a cover gas volume above the liquid of at least 14.8 $m^3$ (523 $ft^3$).

(27) Each accumulator tank is capable of maintaining an initial nitrogen cover gas absolute pressure of least 14.82 MPa (2150 psia).

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

Table 2.2.4-6 defines the inspections, tests, and analyses, together with associated acceptance criteria for the SLC system.

**Table 2.2.4-6**

**ITAAC For The Standby Liquid Control System**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The functional arrangement of the SLC system is as described in Subsection 2.2.4 and shown in Figure 2.2.4-1. | Inspection(s) of the as-built system will be performed. | The as-built system conforms to the functional arrangement described in Subsection 2.2.4 and shown in Figure 2.2.4-1. |
| 2. The SLC System provides automatic functions and initiators are as defined in Table 2.2.4-2. | Test(s) will be performed on the as-built SLC system Train A and Train B Logic Controllers using simulated signals and actuators for the automatic functions defined in Table 2.2.4-2. | The SLC system Train A and Train B Logic Controllers are capable of performing the automatic functions described in Table 2.2.4-2. |
| 3. The SLC system provides controls and interlocks as described in Table 2.2.4-3. | Test(s) will be performed on the as-built SLC system Train A and Train B Logic Controllers using simulated signals and actuators for the controls and interlocks defined in Table 2.2.4-3. | The SLC system Train A and Train B Logic Controllers controls and interlocks exist, can be retrieved in the main control room, and perform in response to simulated signals and manual actions as described in Table 2.2.4-3. |
| 4. (Deleted) | | |
| 5. (Deleted) | | |
| 6. (Deleted) | | |

## Table 2.2.4-6

## ITAAC For The Standby Liquid Control System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 7. During an ATWS, the SLC system shall be capable of injecting borated water into the RPV at flow rates that assure rapid power reduction. | Tests are conducted to measure injection time of the as-built SLC system by injecting demineralized water from both accumulators into the open RPV. The initial differential pressure (6.21 MPa) between the accumulators and the RPV are set to that expected at the beginning of an ATWS by adjusting the accumulator pressures. Analyses are performed to correlate test results to as-built SLC system performance during postulated ATWS conditions. | During an ATWS the as-built SLC system (both accumulators) injects borated water into the RPV within the following time frames:<br>• The first 5.4 $m^3$ (190 $ft^3$)of solution injects in ≤ 196 seconds.<br>• The first and second 5.4 m3 (190 $ft^3$)of solution injects in ≤ 519 seconds. |
| 8. The SLC system shall be capable of injecting borated water for use as makeup water to the RPV in response to a Loss-of-Coolant-Accident (LOCA). | Tests are conducted with the as-built SLC system to measure the total volume of demineralized water injected from both accumulators into the open RPV. These tests utilize the continuation of the tests conducted in ITAAC #7. Analyses are performed to correlate test results to as-built SLC system performance during postulated actual LOCA conditions. | The as-built SLC system (both accumulators) injects a total volume of ≥15.6 $m^3$ (551 $ft^3$)of borated water in response to a postulated LOCA. |
| 9. The redundant injection shut-off valves shown in Figure 2.2.4-1 as V1, V2, V3, and V4 are automatically closed by low accumulator level signals from their respective accumulator level monitors. | Test(s) will be performed using a simulated low accumulator level signal to close the injection shut-off valves V1, V2, V3, and V4. | The as-built injection shut-off valves identified in Figure 2.2.4-1 as V1, V2, V3, and V4 close upon receipt of a simulated low accumulator level signal |

## Table 2.2.4-6

## ITAAC For The Standby Liquid Control System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 10a1. The components identified in Table 2.2.4-4 as ASME Code Section III are designed in accordance with ASME Code Section III requirements. | Inspection of ASME Code Design Reports (NCA-3550) and required documents will be conducted. | ASME Code Design Reports (NCA-3550) (certified, when required by ASME Code) exist and conclude that the design of the components identified in Table 2.2.4-4 as ASME Code Section III complies with the requirements of ASME Code Section III including those stresses applicable to loads related to fatigue (including environmental effects), thermal expansion, seismic, and combined. |
| 10a2. The components identified in Table 2.2.4-4 as ASME Code Section III shall be reconciled with the design requirements. | A reconciliation analysis of the components identified in Table 2.2.4-4 as ASME Code Section III using as-designed and as-built information and ASME Code Design Reports (NCA-3550) will be performed. | ASME Code Design Report(s) (NCA-3550) (certified, when required by ASME Code) exist and conclude that design reconciliation has been completed, in accordance with ASME Code, for as-built reconciliation of the components identified in Table 2.2.4-4 as ASME Code Section III. The report documents the results of the reconciliation analysis. |

## Table 2.2.4-6

## ITAAC For The Standby Liquid Control System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 10a3. The components identified in Table 2.2.4-4 as ASME Code Section III are fabricated, installed, and inspected in accordance with ASME Code Section III requirements. | Inspection of the components identified in Table 2.2.4-4 as ASME Code Section III will be conducted. | ASME Code Data Report(s) (including N-5 Data Reports, where applicable) (certified, when required by ASME Code) and inspection reports exist and conclude that the components identified in Table 2.2.4-4 as ASME Code Section III are fabricated, installed, and inspected in accordance with ASME Code Section III requirements. |
| 10b1. The piping identified in Table 2.2.4-4 as ASME Code Section III is designed in accordance with ASME Code Section III requirements. | Inspection of ASME Code Design Reports (NCA-3550) and required documents will be conducted.<br>{{Design Acceptance Criteria}} | ASME Code Design Report(s) (NCA-3550) (certified, when required by ASME Code) exist and conclude that the design of the piping identified in Table 2.2.4-4 as ASME Code Section III complies with the requirements of the ASME Code, Section III, including those stresses applicable to loads related to fatigue (including environmental effects), thermal expansion, seismic, and combined.<br>{{Design Acceptance Criteria}} |

## Table 2.2.4-6

## ITAAC For The Standby Liquid Control System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 10b2. The as-built piping identified in Table 2.2.4-4as ASME Code Section III shall be reconciled with the piping design requirements. | A reconciliation analysis of the piping identified in Table 2.2.4- as ASME Code Section III using as-designed and as-built information and ASME Code Design Reports (NCA-3550) will be performed. | ASME Code Design Report(s) (NCA-3550) (certified, when required by ASME Code) exist and conclude that design reconciliation has been completed, in accordance with ASME Code, for as-built reconciliation of the piping identified in Table 2.2.4 -4 as ASME Code Section III. The report documents the results of the reconciliation analysis. |
| 10b3. The piping identified in Table 2.2.4-4 as ASME Code Section III is fabricated, installed, and inspected in accordance with ASME Code Section III requirements. | Inspections of the piping identified in Table 2.2.4-1 as ASME Code Section III will be conducted. | ASME Code Data Report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the piping identified in Table 2.2.4-1 as ASME Code Section III is fabricated, installed, and inspected in accordance with ASME Code Section III requirements. |
| 11a. Pressure boundary welds in components identified in Table 2.2.4-4 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements. | Inspection of the as-built pressure boundary welds in components identified in Table 2.2.4-4 as ASME Code Section III will be performed in accordance with ASME Code Section III. | ASME Code report(s) exist and conclude that ASME Code Section III requirements are met for non-destructive examination of pressure boundary welds in components identified in Table 2.2.4-4 as ASME Code Section III. |

## Table 2.2.4-6

## ITAAC For The Standby Liquid Control System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 11b. Pressure boundary welds in piping identified in Table 2.2.4-4 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements. | Inspection of the as-built pressure boundary welds in piping identified in Table 2.2.4-4 as ASME Code Section III will be performed in accordance with ASME Code Section III. | ASME Code report(s) exist and conclude that ASME Code Section III requirements are met for non-destructive examination of pressure boundary welds in piping identified in Table 2.2.4-4 as ASME Code Section III. |
| 12a. The components identified in Table 2.2.4-4 as ASME Code Section III retain their pressure boundary integrity at their design pressure. | A hydrostatic test will be conducted on those code components identified in Table 2.2.4-4 as ASME Code Section III that are required to be hydrostatically tested by ASME Code Section III. | ASME Code Data Report(s) exist and conclude that the results of the hydrostatic test of components identified in Table 2.2.4-4 as ASME Code Section III comply with the requirements of ASME Code Section III. |
| 12b. The piping identified in Table 2.2.4-4 as ASME Code Section III retains its pressure boundary integrity at its design pressure. | A hydrostatic test will be conducted on the code piping identified in Table 2.2.4-4 as ASME Code Section III that is required to be hydrostatically tested by ASME Code Section III. | ASME Code Data Report(s) exist and conclude that the results of the hydrostatic test of piping identified in Table 2.2.4-4 as ASME Code Section III comply with the requirements in ASME Code Section III. |
| 13. The equipment identified in Tables 2.2.4-4 and Table 2.2.4-5 as Seismic Category I can withstand Seismic Category I loads without loss of safety function. | i. Inspection will be performed to verify that the Seismic Category I equipment identified in Table 2.2.4-54and Table 2.2.4-5 are located in a Seismic Category I structure. | i. The equipment identified as Seismic Category I in Table 2.2.4-4 and Table 2.2.4-5 is located in a Seismic Category I structure. |

## Table 2.2.4-6

## ITAAC For The Standby Liquid Control System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| | ii. Type tests, analyses, or a combination of type tests and analyses, of equipment identified in Table 2.2.4-4 and Table 2.2.4-5 as Seismic Category I, will be performed using analytical assumptions, or will be performed under conditions which bound the Seismic Category I equipment design requirements.<br>iii. Inspections and analyses will be performed to verify that the as-built equipment identified in Table 2.2.4-4 and Table 2.2.4-5, including anchorage, is bounded by the testing or analyzed conditions. | ii. The equipment identified in Table 2.2.4-4 and Table 2.2.4-5 as Seismic Category I can withstand Seismic Category I loads without loss of safety function.<br>iii. The as-built equipment identified in Table 2.2.4-4 and Table 2.2.4-5 as Seismic Category I, including anchorage, can withstand Seismic Category I loads without loss of safety function |
| 14. (Deleted) | | |
| 15. Each of the SLC System divisions and safety-related loads/components identified in Tables 2.2.4-4 and 2.2.4-5 is powered from its respective safety-related division. | Testing will be performed on the SLC System by providing a test signal in only one safety-related division at a time. | A test signal exists in the safety-related division and at the equipment identified in Table 2.2.4-4 and Table 2.2.4-5 powered from the safety-related division under test in the SLC System. |
| 16. In the SLC System, independence is provided between safety-related divisions, and between safety-related divisions and nonsafety-related equipment. | i. Tests will be performed on the SLC System by providing a test signal in only one safety-related division at a time. | i. The test signal exists only in the safety-related division under test in the System. |

## Table 2.2.4-6

## ITAAC For The Standby Liquid Control System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| | ii. Inspection of the as-built safety-related divisions in the SLC System will be performed. | ii. For the as-built safety-related divisions in the SLC System:<br>• Physical separation or electrical isolation exists between these safety-related divisions in accordance with RG 1.75.<br>• Physical separation or electrical isolation exists between safety-related Divisions and nonsafety-related equipment in accordance with RG 1.75. |
| 17a. Each mechanical train of the SLC System located outside the containment is physically separated from the other train(s) so as to preclude damage to both trains. | Inspections and analysis will be conducted for each of the SLC System mechanical trains located outside the containment. | Each mechanical train of SLC System located outside containment is protected against design basis events and their direct consequences by spatial separation, barriers, restraints, or enclosures so as to preclude damage to both trains. |
| 17b. Each mechanical train of the SLC System located inside the containment is physically separated from the other train(s) so as to preclude damage to both trains. | Inspections and analysis will be conducted for each of the SLC System mechanical trains located inside the containment. | Each mechanical train of SLC System located inside containment is protected against design basis events and their direct consequences by spatial separation, barriers, restraints, or enclosures so as to preclude damage to both trains. |

## Table 2.2.4-6

## ITAAC For The Standby Liquid Control System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 18. Re-positionable (not squib) valves listed in Table 2.2.4-4 open, close, or both open and close under differential pressure, fluid flow, and temperature conditions. | Tests of installed valves will be performed for opening, closing, or both opening and closing under system preoperational differential pressure, fluid flow, and temperature conditions. | Upon receipt of the actuating signal, each valve opens, closes, or both opens and closes, depending upon the valve's safety function. |
| 19. The pneumatically operated valve(s) listed in Table 2.2.4-4 fail in the mode listed if either electric power to the valve actuating solenoid is lost, or pneumatic pressure to the valve(s) is lost. | Tests will be conducted on the as-built valve(s). | The pneumatically operated valve(s) identified in Table 2.2.4-4 fail in the listed mode when either electric power to the valve actuating solenoid is lost, or pneumatic pressure to the valve(s) is lost. |
| 20. Check valves listed in Table 2.2.4-4 open and close under system pressure, fluid flow, and temperature conditions | Tests of installed valves for opening and closing will be conducted under system preoperational pressure, fluid flow, and temperature conditions. | Based on the direction of the differential pressure across the valve, each check valve opens and closes. |
| 21. The SLC System injection squib valve opens as designed. | A vendor type test will be performed on a squib valve to open as designed. | Records of vendor type test conclude SLC injection squib valves used in the injection and equalization will open as designed. |

## Table 2.2.4-6

## ITAAC For The Standby Liquid Control System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 22. The equivalent natural boron concentration at cold shutdown conditions for the total solution injection volume is based on the liquid inventory in the RPV at the main steam line nozzle elevation plus the liquid inventory in the reactor shutdown cooling piping and equipment of the RWCU/SDC system. | An analysis of the as-built system will be performed to determine the equivalent natural boron concentration at cold shutdown conditions for the total solution injection volume. | The equivalent natural boron concentration at cold shutdown conditions for the total solution injection volume is > 1100 ppm. |
| 23. (Deleted) | | |
| 24a. Valves on lines attached to the RPV that require maintenance have maintenance valves such that freeze seals will not be required. | Inspections of piping design isometric drawings will be conducted.<br>{{Design Acceptance Criteria}} | A review of piping design isometric drawings confirms that maintenance valves are included such that freeze seals will not be required.<br>{{Design Acceptance Criteria}} |
| 24b. The as-built location of valves on lines attached to the RPV in the SLC System that require maintenance shall be reconciled to design requirements. | A reconciliation evaluation of valves on lines attached to the RPV that require maintenance using as-designed and as-built information will be performed. | Design reconciliation has been completed for the as-built location of valves relative to the design requirements. |
| 25. Each accumulator tank has an injectable liquid volume of at least 7.80 $m^3$ (2060 gal). | Analysis of each as-built accumulator tank will be performed. | Each accumulator tank has an injectable volume of at least 7.80 $m^3$ (2060 gal). |
| 26. Each accumulator tank has a cover gas volume above the liquid of at least 14.8 $m^3$ (523 $ft^3$). | Analysis of each as-built accumulator tank will be performed. | Each accumulator tank has a cover gas volume above the liquid of at least 14.8 $m^3$ (523 $ft^3$). |

## Table 2.2.4-6

## ITAAC For The Standby Liquid Control System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 27. Each accumulator tank is capable of maintaining an initial nitrogen cover gas absolute pressure of least 14.82 MPa (2150 psia). | Analysis of each as-built accumulator tank will be performed. | Each accumulator tank is capable of maintaining an initial nitrogen cover gas absolute pressure of least 14.82 MPa (2150 psia). |

## 2.2.5 Neutron Monitoring System

### Design Description

The Neutron Monitoring System (NMS) monitors thermal neutron flux and supports the Reactor Protection System (RPS).

NMS alarms, displays, and status indications in the MCR are addressed by Section 3.3.

Conformance with IEEE Std. 603 requirements by the safety-related control system structures, systems, or components defined in Table 2.2.5-1 is addressed in Subsection 2.2.15.

The environmental and seismic qualification of NMS components defined in Table 2.2.5-1 is addressed in Section 3.8.

NMS software is developed in accordance with the software development program described in Section 3.2 as part of the NMS software projects.

(1) NMS functional arrangement is as described in Subsection 2.2.5 and Table 2.2.5-1.

(2) NMS provides automatic functions and initiators as defined in Table 2.2.5-2.

(3) NMS provides controls, interlocks, and bypasses as defined in Table 2.2.5-3.

(4) (Deleted)

(5) (Deleted)

(6) (Deleted)

(7) (Deleted)

(8) NMS divisions fail-safe to a trip condition on critical hardware failure, power failure, or loss of communication.

(9) The Startup Range Neutron Monitor (SRNM) subsystem monitors neutron flux from the source range to 15% of the reactor rated power.

(10) The Local Power Range Monitor (LPRM) subsystems monitor neutron flux from 1 % to 125 % of reactor rated power.

(11) Each NMS division is powered by its divisional safety-related uninterruptible power supply.

(12) LPRM provides signals that are proportional to the local neutron flux.

(13) The LPRM detector assemblies have a design pressure of 8.62 MPaG (1250 psig).

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

Table 2.2.5-4 provides a definition of the inspections, tests, and analyses, together with associated acceptance criteria for the NMS.

**Table 2.2.5-4**

**ITAAC For The Neutron Monitoring System**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. NMS functional arrangement is as described in Subsection 2.2.5 and Table 2.2.5-1. | Inspection(s) of the as-built system will be performed | The system conforms to the functional arrangement as ~~defined~~ described in Subsection 2.2.5 and Table 2.2.5-1. |
| 2. NMS provides automatic functions and initiators as described in Table 2.2.5-2. | Test(s) will be performed on the as-built NMS using simulated signals and actuators for the automatic functions defined in Table 2.2.5-2. | The NMS performs the automatic functions defined in Table 2.2.5-2. |
| 3. NMS provides controls, interlocks, and bypasses as described in Table 2.2.5-3. | Test(s) will be performed on the as-built NMS and MCRP SSLC/ESF VDUs using simulated signals and actuators for the controls, interlocks, and bypasses defined in Table 2.2.5-3. | The NMS controls, interlocks and bypasses exist, can be retrieved in the main control room, and are performed in response to simulated signals and manual actions as defined in Table 2.2.5-3. |
| 4. (Deleted) | | |
| 5. (Deleted) | | |
| 6. (Deleted) | | |
| 7. (Deleted) | | |
| 8. NMS divisions fail-safe to a trip condition on critical hardware failure, power failure, or loss of communication. | Test(s) will be performed using simulated signals. | The NMS divisions fail-safe to a trip condition on critical hardware failure, power failure, or loss of communication failure. |

## Table 2.2.5-4

## ITAAC For The Neutron Monitoring System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 9. The Startup Range Neutron Monitor (SRNM) subsystem monitors neutron flux from the source range to 15% of the reactor rated power. | Test(s) will be performed using simulated signals. | The SRNM subsystem monitors neutron flux from the source range to 15% of the reactor rated power. |
| 10. The Local Power Range Monitor (LPRM) subsystems monitor neutron flux from 1 % to 125 % of reactor rated power. | Test(s) will be performed using simulated signals. | The LPRM subsystems monitor neutron flux from 1 % to 125 % of reactor rated power. |
| 11. Each NMS division is powered by its divisional safety-related uninterruptible power supply. | Test(s) will be performed on the NMS by providing a test signal in only one safety-related division at a time. | The test signal exists only in the safety-related division under test in the NMS. |
| 12. LPRM provides signals that are proportional to the local neutron flux. | Test(s) will be performed on the NMS by providing test signals to each LPRM. | The test signal exists and can be retrieved in the MCR. |
| 13. The LPRM detector assemblies have a design pressure of 8.62 MPaG (1250 psig). | Test(s) will be performed on each LPRM detector assembly. | The LPRM detector assembly withstands a pressure greater than 8.62 MPaG (1250 psig). |

## 2.2.7 Reactor Protection System

### Design Description

The Reactor Protection System (RPS) initiates a reactor trip (scram) automatically whenever selected plant variables exceed preset limits or by manual operator action.

Conformance with IEEE Std. 603 requirements by the safety-related control system structures, systems, or components is addressed in Subsection 2.2.15.

RPS alarms, displays, and status indications in the MCR are addressed by Section 3.3.

The environmental and seismic qualification of RPS components is addressed in Section 3.8.

RPS software is developed in accordance with the software development program described in Section 3.2 as part of the RTIF software projects.

(1) RPS functional arrangement is as described in Subsection 2.2.7 and Table 2.2.7-1 and as shown on Figure 2.2.7-1.

(2) RPS provides automatic functions and initiators as described in Table 2.2.7-2.

(3) RPS provides controls, interlocks (system interfaces), and bypasses as described in Table 2.2.7-3.

(4) (Deleted)

(5) (Deleted)

(6) (Deleted)

(7) (Deleted)

(8) The RPS logic is designed to provide a trip initiation by requiring a coincident trip of like, unbypassed parameters in at least two divisions to cause the trip output.

(9) The RPS is fail-safe such that on loss of redundant divisional electrical power supplies the load drivers of that division change to the tripped state.

(10) Redundant safety-related power supplies are provided for each division of the RPS.

(11) Automatic and manual scram initiation logic systems are independent of each other.

(12) The RPS initiates a backup scram whenever an automatic scram is initiated in two-out-of four divisions or whenever a manual scram is initiated.

(13) The backup scram is not implemented through software.

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

Table 2.2.7-4 provides a definition of the inspections, tests, and analyses, together with associated acceptance criteria, which will be performed for the RPS.

**Table 2.2.7-4**

**ITAAC For The Reactor Protection System**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. RPS functional arrangement is as described in Subsection 2.2.7 and Table 2.2.7-1 and as shown on Figure 2.2.7-1. | Inspection(s), will be performed on the as-built RPS. | The RPS conforms to the functional arrangement as described in Subsection 2.2.7 and Table 2.2.7-1 and as shown in Figure 2.2.7-1. |
| 2. RPS provides automatic functions and initiators as described in Table 2.2.7-2. | Test(s) will be performed on the as-built RPS using simulated signals and actuators for the automatic functions defined in Table 2.2.7-2. | RPS provides automatic functions, initiators and associated interfacing systems as described in Table 2.2.7-2. |
| 3. RPS provides controls, interlocks (system interfaces), and bypasses as described in Table 2.2.7-3. | Test(s) will be performed on the as-built RPS and SSLC/ESF VDUs using simulated signals and actuators for the controls, interlocks (system interfaces), and bypasses described in Table 2.2.7-3. | The RPS controls and interlocks (system interfaces), and bypasses exist, can be retrieved in the main control room SSLC/ESF VDUs, and are performed in response to simulated signals and manual actions as described in Table 2.2.7-3. |
| 4. (Deleted) | | |
| 5. (Deleted) | | |
| 6. (Deleted) | | |
| 7. (Deleted) | | |
| 8. The RPS logic is designed to provide a trip initiation by requiring a coincident trip of like, unbypassed parameters in at least two divisions to cause the trip output. | Test(s) of the RPS functions will be performed on the as-built RTIF platform of the RPS functions. | The RTIF platform performs the RPS function trip outputs when a coincident trip of like, unbypassed parameters in at least two divisions occurs. |

## Table 2.2.7-4

## ITAAC For The Reactor Protection System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 9. The RPS is fail-safe such that on loss of redundant divisional electrical power supplies the load drivers of that division change to the tripped state. | Test(s) of the RPS functions will be performed on the as-built RTIF platform of the RPS functions by de-energizing the RTIF platform by division. | The RTIF platform de-energizes the RPS trip outputs when a coincident de-energization of at least two divisions occurs. |
| 10. Redundant safety-related power supplies are provided for each division of the RPS. | Test(s) will be performed on the RPS by providing a test signal in only one safety-related division at a time. | The test signal exists only in the safety-related division under test in the RPS. |
| 11. Automatic and manual scram initiation logic systems are independent of each other. | Analysis(es) will be performed on the automatic and manual scram initiation logic systems. | Single failures in an automatic scram initiation logic system do not propagate to the manual scram initiation logic system and single failures in a manual scram initiation logic system do not propagate to the automatic scram initiation logic system. |
| 12. The RPS initiates a backup scram whenever an automatic scram is initiated in two-out-of four divisions or whenever a manual scram is initiated. | Test(s) will be performed on the as-built RTIF platform of the backup scram function. | The RTIF platform performs the backup scram outputs when either a coincident scram in at least two divisions or a manual scram occurs. |
| 13. The backup scram is not implemented through software. | Analysis(es) and inspections will be performed on the backup scram circuitry. | No software is used to implement the backup scram function. |

## 2.2.9 Steam Bypass and Pressure Control System

### Design Description

The Steam Bypass and Pressure Control (SB&PC) System, is a non-safety related system that controls the reactor pressure during reactor startup, power generation, and reactor shutdown by control of the turbine bypass valves and signals to the Turbine Generator Control System (TGCS), which controls the turbine control valves.

The SB&PC System alarms, displays, and status indications in the MCR are addressed by Section 3.3.

(1) The SB&PC System functional arrangement is as described in Subsection 2.2.9 and Table 2.2.9-1.

(2) The SB&PC System provides functions and initiating conditions as described in Table 2.2.9-2.

(3) (Deleted)

(4) SB&PC controllers are triple redundant fault tolerant.

(5) SB&PC System has three redundant nonsafety-related uninterruptible AC power supplies.

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

Table 2.2.9-3 defines the inspections, tests, and analyses, together with associated acceptance criteria for the SB&PC system.

## Table 2.2.9-3

## ITAAC For The Steam Bypass and Pressure Control System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The SB&PC System functional arrangement is as described in Subsection 2.2.9 and Table 2.2.9-1. | Inspections of the as-built SB&PC System will be conducted. | The as-built SB&PC System conforms to the functional arrangement as described in Subsection 2.2.9 and Table 2.2.9-1. |
| 2. SB&PC System provides functions and initiating conditions as defined in Table 2.2.9-2. | Tests will be performed on the SB&PC System using simulated signals. | The SB&PC system performs the functions as described in Table 2.2.9-2. |
| 3. (Deleted) | | |
| 4. SB&PC controllers are triple redundant fault tolerant. | i. Test(s) will be performed simulating failure of any one SB&PC controller.<br>ii. Test(s) will be performed simulating failure of any two SB&PC controllers. | i. Failure of any one SB&PC controller has no effect on SB&PC valve position demand signal.<br>ii. Failure of any two SB&PC controllers generates a turbine trip signal. |

## Table 2.2.9-3

## ITAAC For The Steam Bypass and Pressure Control System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 5. SB&PC System has three redundant nonsafety-related uninterruptible AC power supplies. | i. Test(s) will be performed on the SB&PC system by providing a test signal in only one power supply channel at a time. | i. The test signal exists only in the power channel under test. |
| | ii. Test(s) will be performed on the SB&PC system power supply configuration simulating failure of any one power supply. | ii. Loss of any one power supply at a time has no effect on SB&PC valve position demand signal. |
| | iii. Test(s) will be performed on the SB&PC system power supply configuration simulating failure of any two power supplies. | iii. Loss of any two power supplies at a time has no effect on SB&PC valve position demand signal. |

## 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, or components is addressed in Subsection 2.2.15.

The SSLC/ESF alarms, displays, and status indications in the MCR are addressed by Section 3.3.

The environmental and seismic 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 as part of the SSLC/ESF software projects.

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

(2) The SSLC/ESF provides automatic functions and initiators as described in Table 2.2.13-2.

(3) The SSLC/ESF provides controls, interlocks, and bypasses in the MCR as described in Table 2.2.13-3.

(4) (Deleted)

(5) (Deleted)

(6) (Deleted)

(7) (Deleted)

(8) SSLC/ESF logic is designed to provide a trip initiation by requiring a coincident trip of like, unbypassed parameters in at least two divisions to cause the trip output.

(9) SSLC/ESF uses “energized-to-trip” and “fail-as-is” logic.

(10) Redundant safety-related power supplies are provided for each division.

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

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

## Table 2.2.13-4

## ITAAC For The Engineered Safety Features Safety System Logic and Control (SSLC/ESF)

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The SSLC/ESF functional arrangement is as described in Subsection 2.2.13 and Table 2.2.13-1. | Inspections will be conducted of the as-built configuration. | The system conforms to the functional arrangement as described in Subsection 2.2.13 and Table 2.2.13-1. |
| 2. The SSLC/ESF provides automatic functions and initiators as described in Table 2.2.13-2. | Test(s) will be performed on the as-built system using simulated signals. | The system is capable of performing the functions as described in Table 2.2.13-2. |
| 3. The SSLC/ESF provides controls, interlocks, and bypasses in the MCR as described in Table 2.2.13-3. | Test(s) will be performed on the as-built system using simulated signals. | The system controls, interlocks and bypasses exist, can be retrieved in the main control room, and are performed in response to simulated signals and manual actions as described in Table 2.2.13-3. |
| 4. (Deleted). | | |
| 5. (Deleted) | | |
| 6. (Deleted). | | |
| 7. (Deleted) | | |
| 8. SSLC/ESF logic is designed to provide a trip initiation by requiring a coincident trip of like, unbypassed parameters in at least two divisions to cause the trip output. | Test(s) of the as-built SSLC/ESF system will be performed using simulated signals and actuators. | The as-built SSLC/ESF system performs trip initiation when a coincident trip of like, unbypassed parameters occurs in at least two divisions. |
| 9. SSLC/ESF uses “energized-to-trip” and “fail-as-is” logic. | Test(s) of the as-built SSLC/ESF system will be performed using simulated signals and actuators. | The as-built SSLC/ESF system uses “energized-to-trip” and “fail-as-is” logic. |

## Table 2.2.13-4

## ITAAC For The Engineered Safety Features Safety System Logic and Control (SSLC/ESF)

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 10. Redundant safety-related power supplies are provided for each division of the SSLC/ESF System. | Test(s) will be performed on the SSLC/ESF System by providing a test signal in only one safety-related division at a time. | The test signal exists only in the safety-related division under test in the SSLC/ESF System. |

## 2.2.14 Diverse Instrumentation and Controls

### Design Description

The diverse instrumentation and control systems comprise the safety-related Anticipated Transients Without Scram Standby Liquid Control (ATWS/SLC) system and the nonsafety-related Diverse Protection System (DPS).

The ATWS/SLC and DPS alarms, displays, controls, and status indications in the MCR are addressed by Section 3.3.

The environmental and seismic qualification of ATWS/SLC and DPS components described in Table 2.2.14-1 is addressed in Section 3.8.

The containment isolation components that correspond to the DPS isolation functions are addressed in Subsection 2.15.1.

Conformance with IEEE Std. 603 requirements by the safety-related control system structures, systems, or components defined in Table 2.2.14-1 are addressed in Subsection 2.2.15.

ATWS/SLC hardware and software is developed in accordance with the software development program described in Section 3.2 as part of the ATWS/SLC software projects.

DPS hardware and software is developed in accordance with the software development program described in Section 3.2 as part of the DPS software projects.

(1) The ATWS/SLC and DPS diverse instrumentation and control systems functional arrangement as described in Subsection 2.2.14 and Table 2.2.14-1.

(2) The ATWS/SLC and DPS diverse instrumentation and control systems provide automatic functions and initiators as described in Table 2.2.14-2.

(3) The ATWS/SLC and DPS diverse instrumentation and control systems provide controls, interlocks and bypasses in the MCR as described in Table 2.2.14-3.

(4) (Deleted)

(5) (Deleted)

(6) (Deleted)

(7) (Deleted)

(8) Confirmatory analyses support and validate the DPS design scope and the fire separation criteria.

(9) (Deleted)

(10) (Deleted)

(11) DPS controller cabinets are in fire areas separate from the other N-DCIS, Remote Multiplier Unit (RMU), and Q-DCIS cabinets.

(12) ATWS/SLC system logic is designed to provide a trip initiation by requiring coincident trip of like, unbypassed parameters in at least two divisions to cause the trip output.

(13) Each ATWS/SLC System division is powered from its respective safety-related power supply.

(14) DPS is powered from nonsafety-related load group power supplies.

(15) DPS triple redundant digital controllers require agreement in at least two channels out of three channels for a coincident trip actuation.

(16) DPS logic is “energize-to-actuate”.

(17) DPS process variable sensors are diverse from those used by the RPS and SSLC/ESF.

(18) The DPS network segment uses diverse hardware and software from that used by the RPS and SSLC/ESF.

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

Table 2.2.14-4 defines the inspections, tests, and analyses, together with associated acceptance criteria for the ATWS/SLC and DPS.

**Table 2.2.14-4**

**ITAAC For The Diverse Instrumentation and Controls**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The ATWS/SLC and DPS diverse instrumentation and control systems functional arrangement is as described in Subsection 2.2.14 and Table 2.2.14-1. | Inspection(s) will be conducted on the as-built system configuration., as described in Table 2.2.14-1. | The system's conformance to the functional arrangement as described in Subsection 2.2.14 and Table 2.2.14-1. |
| 2. The ATWS/SLC and DPS diverse instrumentation and control systems provide automatic functions and initiators as described in Table 2.2.14-2. | Tests will be conducted on the ATWS/SLC and DPS safety-related and nonsafety-related components on the as-built system configuration using simulated signals. | The ATWS/SLC and DPS are capable of performing the functions as described in Table 2.2.14-2. |
| 3. The ATWS/SLC and DPS diverse instrumentation and control systems provide controls, interlocks and bypasses in the MCR as described in Table 2.2.14-3. | Test(s) will be performed on the ATWS/SLC and DPS safety-related and nonsafety-related logic using simulated signals and actuators for controls, interlocks, and bypasses, as described in Table 2.2.14-3. | The ATWS/SLC and DPS logic controls, interlocks and bypasses exist, can be retrieved in the main control room, and are performed in response to simulated signals and manual actions as described in Table 2.2.14-3. |
| 4. (Deleted) | | |
| 5. (Deleted) | | |
| 6. (Deleted) | | |
| 7. (Deleted) | | |
| 8. Confirmatory analyses support and validate the DPS design scope and the fire separation criteria. | i. Complete Failure Modes and Effects Analysis (FMEA) per NUREG/CR-6303 of the Q-DCIS to validate the DPS protection functions. | i. The FMEA completed per NUREG/CR-6303 of the Q-DCIS has addressed in the DPS design scope. |

## Table 2.2.14-4

## ITAAC For The Diverse Instrumentation and Controls

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| | ii. Inspection of the DPS platform requirements phase summary baseline review report will be performed.<br>iii. Inspection(s) of the DPS platform test phase summary baseline review report(s) will be performed.<br>iv. Inspections will be performed to confirm the control logic cabinets for each of the containment vacuum breaker isolation valves meet their fire protection separation criteria. | ii. The platform requirements phase summary baseline review report contains the validated DPS design scope.<br>iii. The DPS platform(s) test phase summary baseline review report(s)<br>• Identify and reconcile changes, deletions, and additions to the applicable DPS design scope.<br>• Confirm that tests show that the DPS performs in accordance with the applicable DPS design scope.<br>iv. The as-built location of the control logic cabinets for the containment vacuum breaker isolation valves are separated according to fire protection separation criteria for the various locations. |
| 9. (Deleted) | | |
| 10. (Deleted) | | |
| 11. DPS controller cabinets are in fire areas separate from the other N-DCIS, RMU, and Q-DCIS cabinets. | Inspections will be performed to confirm as-built location of the DPS cabinets ~~meet their fire protection separation criteria~~. | The as-built physical location of the DPS cabinets are in fire areas separate~~d~~ from the other N-DCIS, RMU, and Q-DCIS cabinets ~~according to fire protection separation criteria for the various locations~~. |

## Table 2.2.14-4

## ITAAC For The Diverse Instrumentation and Controls

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 12. ATWS/SLC System logic is designed to provide a trip initiation by requiring coincident trip of like, unbypassed parameters in at least two divisions to cause the trip output. | Test(s) will be performed on the ATWS/SLC system logic. | The as-built ATWS/SLC system logic provides trip initiation signals when a coincident trip signal exists in like, unbypassed parameters in at least two unbypassed divisions. |
| 13. Each ATWS/SLC System division is powered from its respective safety-related power supply. | Test(s) will be performed on the ATWS/SLC System by providing a test signal in only one safety-related division at a time. | A test signal exists in the safety-related division under test in the ATWS/SLC System. |
| 14. DPS is powered from nonsafety-related load group power supplies. | Test(s) will be performed on the DPS by providing a test signal in only one DPS load group at a time. | A test signal exists in the load group under test in the DPS. |
| 15. DPS triple redundant digital controllers require agreement in at least two channels out of three channels for a coincident trip actuation. | Test(s) will be performed on the DPS by providing simulated signals to each DPS channel. | Trip actuation signals exist only when at least two channels are in coincident agreement. |
| 16. DPS logic is "energize-to-actuate". | Test(s) will be performed on the DPS system logic. | Trip actuation signals are "energize-to-actuate". |
| 17. DPS process variable sensors are diverse from those used by the RPS and SSLC/ESF. | Analysis(es) will be performed on the DPS sensor failure modes and effects. | The DPS sensors are diverse from the RPS and SSLC/ESF sensors. |
| 18. The DPS network segment uses diverse hardware and software from that used by the RPS and SSLC/ESF. | Analysis(es) will be performed on the DPS network segment failure modes and effects. | The DPS network segment is diverse from the RPS and SSLC/ESF hardware and software. |

## 2.2.16 High Pressure Control Rod Drive Isolation Bypass Function Independent Control Platform

### Design Description

The HP CRD Isolation Bypass Function Independent Control Platform (ICP) automatically bypasses the CRD hydraulic subsystem high pressure makeup water injection isolation function by using isolation bypass valves.

HP CRD Isolation Bypass Function ICP alarms, displays, and status indications in the MCR are addressed by Section 3.3.

The environmental and seismic qualification of HP CRD Isolation Bypass Function ICP components defined in Table 2.2.16-1 are addressed in Section 3.8.

Conformance with IEEE Std. 603 requirements by the safety-related control system structures, systems, or components defined in Table 2.2.16-1 is addressed in Subsection 2.2.15.

HP CRD Isolation Bypass Function ICP software is developed in accordance with the software development program described in Section 3.2 as part of the HP CRD Isolation Bypass Function software projects.

(1) HP CRD Isolation Bypass Function ICP functional arrangement is as described in Subsection 2.2.16 and Table 2.2.16-1.

(2) HP CRD Isolation Bypass Function ICP provides automatic functions and initiators as described in Table 2.2.16-2.

(3) HP CRD Isolation Bypass Function ICP provides controls, interlocks, and bypasses as described in Table 2.2.16-3.

(4) Divisional HP CRD Isolation Bypass Function ICP safety-related power supplies power the HP CRD Isolation Bypass Function ICP divisional loads.

(5) PIP power supplies power their respective HP CRD isolation bypass valves.

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

Table 2.2.16-4 defines the inspections, tests, and analyses, together with associated acceptance criteria for the HP CRD Isolation Bypass Function ICP.

**Table 2.2.16-4**

**ITAAC For The HP CRD Isolation Bypass Function ICP**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. HP CRD Isolation Bypass Function ICP functional arrangement is as described in Subsection 2.2.16 and Table 2.2.16-1. | Inspection(s) will be performed on the as-built configuration ~~as defined in Table 2.2.16-1~~. | The system conforms to the functional arrangement as ~~defined~~ described in Subsection 2.2.16 and Table 2.2.16-1. |
| 2. HP CRD Isolation Bypass Function ICP provides automatic functions and initiators as described in Table 2.2.16-2. | Test(s) will be performed on the as-built HP CRD Isolation Bypass Function ICP using simulated signals and actuators for the automatic functions defined in Table 2.2.16-2. | The HP CRD Isolation Bypass Function ICP performs the automatic functions defined in Table 2.2.16-2. |
| 3. HP CRD Isolation Bypass Function ICP provides controls, interlocks, and bypasses as described in Table 2.2.16-3. | Test(s) will be performed on the as-built HP CRD Isolation Bypass Function ICP using simulated signals and actuators for the controls, interlocks, and bypasses defined in Table 2.2.16-3. | The system controls, interlocks and bypasses exist, can be retrieved in the main control room, and are performed in response to simulated signals. |
| 4. Divisional HP CRD Isolation Bypass Function ICP safety-related power supplies power the HP CRD Isolation Bypass Function ICP divisional loads. | Test(s) will be performed on each as-built HP CRD Isolation Bypass Function ICP division by providing a test signal in only one safety-related division at a time | The test signal exists only at the terminals of the respective divisional HP CRD Isolation Bypass Function loads. |
| 5. PIP power supplies power their respective HP CRD isolation bypass valves. | Test(s) will be performed on the power supply to each as-built HP CRD isolation bypass valve by introducing a test signal. | The test signal exists only at the respective PIP power supply. |

## 2.3 RADIATION MONITORING SYSTEMS

The following subsections describe the major radiation monitoring systems for the ESBWR.

### 2.3.1 Process Radiation Monitoring System

**Design Description**

The Process Radiation Monitoring System (PRMS) monitors and provides for indication of radioactivity levels in process and effluent gaseous and liquid streams, initiates protective actions, and activates alarms in the MCR on high radiation signals. Alarms are also activated when a monitor becomes inoperative or goes upscale/downscale. The PRMS safety-related channel trip signals are provided as inputs to the Safety System Logic and Control/Engineered Safety Features (SSLC/ESF) for generation of protective action signals.

PRMS subsystem software is developed in accordance with the software development program described in Section 3.2.

The environmental qualification of PRMS equipment is addressed in Section 3.8.

Refer to Subsection 2.2.15 for "Instrumentation and Controls Compliance with IEEE Standard 603."

(1) The PRMS functional arrangement is as described in the Design Description of this Subsection 2.3.1, Figure 2.3.1-1, and Table 2.3.1-1.

(2) a. The safety-related PRMS subsystems as identified in Table 2.3.1-1 are powered from uninterruptible safety-related power sources.

b. The safety-related divisions of electric power for the PRMS subsystems identified in Table 2.3.1-1 ~~have electrical divisional separation~~are physically separated.

(3) The safety-related process radiation monitors listed in Table 2.3.1-1 can withstand Seismic Category I loads without loss of safety function.

(4) Safety-related PRMS subsystems provide the following:

- Indications in MCR for radiation levels
- Indications on SCUs for radiation levels
- Alarms in MCR on radiation level exceeding setpoint
- Indications on Signal Conditioning Units (SCUs) on radiation level exceeding setpoint
- Alarms in MCR on upscale/downscale or inoperative conditions
- Initiation of protective actions as noted in Table 2.3.1-1

(5) The nonsafety-related process monitors listed in Table 2.3.1-1 are provided.

(6) Safety-related PRMS subsystems initiate preventive actions to isolate or terminate plant processes or effluent releases as described in Table 2.3.1-1.

(7) The nonsafety-related PRMS subsystem monitors which perform active/automatic control functions in order to control offsite doses below 10 CFR 20 limits provide the following:

- Indications in MCR for radiation levels
- Alarms in MCR on radiation level exceeding setpoint
- Alarms in MCR on upscale/downscale or inoperative conditions.

(8) (Deleted)

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

Table 2.3.1-2 provides a definition of the inspections, tests and analyses, together with the associated acceptance criteria for the PRMS. As appropriate, each of the ITAAC in Section 2.3.1 may be closed on a system-by-system basis throughout construction, in order that the PRMS subsystems may be placed in service. ITAAC for the liquid radwaste discharge radiation monitor and offgas post-treatment radiation monitor also are located in Table 2.10.1-2 and Table 2.10.3-1, respectively.

**Table 2.3.1-2**

**ITAAC For The Process Radiation Monitoring System**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The PRMS functional arrangement is as described in the Design Description of this Subsection 2.3.1, Figure 2.3.1-1, and Table 2.3.1-1. | Inspections shall be conducted on each as-built PRMS subsystem. | The as-built PRMS subsystems conform to the functional arrangement as described in the Design Description of this Subsection 2.3.1 and shown in Figure 2.3.1-1 in conjunction with Table 2.3.1-1. |
| 2a. The safety-related PRMS subsystems as identified in Table 2.3.1-1 are powered from uninterruptible safety-related power sources. | Inspections will be conducted to confirm that the PRMS safety-related subsystems identified in Table 2.3.1-1 are powered from uninterruptible safety-related power sources. | The safety-related PRMS subsystems identified in Table 2.3.1-1 receive electrical power from uninterruptible safety-related buses. |
| 2b. The safety-related divisions of electric power for the PRMS subsystems identified in Table 2.3.1-1 ~~have~~ are physically separated~~electrical divisional separation~~. | Inspections of the as-built divisions will be conducted. | Each subsystem division is physically separated from the other division in accordance with RG 1.75. |
| 3. The equipment identified in Table 2.3.1-1 as Seismic Category I can withstand Seismic Category I loads without loss of safety function. | i. Inspection will be performed to verify that the Seismic Category I equipment identified in Table 2.3.1-1 are located in a Seismic Category I structure. | i. The equipment identified as Seismic Category I in Table 2.3.1-1 is located in a Seismic Category I structure. |

## Table 2.3.1-2

## ITAAC For The Process Radiation Monitoring System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| | ii. Type tests, analyses, or a combination of type tests and analyses, of equipment identified in Table 2.3.1-1 as Seismic Category I, will be performed using analytical assumptions, or will be performed under conditions which bound the Seismic Category I equipment design requirements. | ii. The equipment identified in Table 2.3.1-1 as Seismic Category I can withstand Seismic Category I loads without loss of safety function. |
| | iii. Inspections and analyses will be performed to verify that the as-built equipment identified in Table 2.3.1-1, including anchorage, is bounded by the testing or analyzed conditions. | iii. The as-built equipment identified in Tables 2.3.1-1 including anchorage, can withstand Seismic Category II loads without loss of safety function. |

## Table 2.3.1-2

## ITAAC For The Process Radiation Monitoring System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 4. Safety-related PRMS subsystems provide the following:<br>• Indications in MCR for radiation levels<br>• Indications on SCUs for radiation levels<br>• Alarms in MCR on radiation level exceeding setpoint<br>• Indications on SCUs on radiation level exceeding setpoint<br>• Alarms in MCR on upscale/downscale or inoperative conditions<br>• Initiation of actions described in Table 2.3.1-1 | Tests will be conducted by using a standard radiation source or portable calibration unit that exceeds a setpoint value that is preset for the testing to confirm that the as-built indications, alarms, and automatic initiation functions are met as described in Table 2.3.1-1. | The as-built indications, alarms, and automatic initiation functions are met as described in Table 2.3.1-1, considering the following:<br>• Indications in MCR for radiation levels<br>• Indications on SCUs for radiation levels<br>• Alarms in MCR on radiation level exceeding setpoint<br>• Indications on SCUs on radiation level exceeding setpoint<br>• Alarms in MCR on upscale/downscale or inoperative conditions<br>• Initiation of actions described in Table 2.3.1-1 |
| 5. The nonsafety-related process monitors listed in Table 2.3.1-1 are provided. | Inspection for the existence of the monitors will be performed. | The nonsafety-related monitors exist. |
| 6. Safety-related PRMS subsystems initiate preventive actions to isolate or terminate plant processes or effluent releases as described in Table 2.3.1-1. | Tests will be conducted to confirm that the preventive actions are initiated and proper isolation or termination are secured on simulated high radiation levels. These tests will be performed in conjunction with each subsystem that contains the isolation boundaries. | The preventive actions requirements are met as described in Table 2.3.1-1. |

## Table 2.3.1-2

## ITAAC For The Process Radiation Monitoring System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 7. The nonsafety-related PRMS subsystem monitors which perform active/automatic control functions in order to control offsite doses below 10 CFR 20 limits provide the following:<br>• Indications in MCR for radiation levels<br>• Alarms in MCR on radiation level exceeding setpoint<br>• Alarms in MCR on upscale/downscale or inoperative conditions | Tests will be conducted by using a standard radiation source or portable calibration unit that exceeds a setpoint value that is preset for the testing to confirm that the as-built indication, alarm, and automatic initiation functions are met. | The as-built indication, alarm, and automatic initiation functions are met. |
| 8. (Deleted) | | |

## 2.3.2 Area Radiation Monitoring System

### Design Description

The Area Radiation Monitoring System (ARMS) continuously monitors the gamma radiation levels within the various areas of the plant and provides an early warning to operating personnel when high radiation levels are detected so the appropriate action can be taken to minimize occupational exposure.

(1) The functional arrangement (location) of the ARMS equipment is described in Subsection 2.3.2 and as listed on Table 2.3.2-1.

(2) Each ARM channel listed in Table 2.3.2-1 initiates a MCR alarm and a local audible alarm (if provided) when the radiation level exceeds a preset limit.

(3) Each ARM channel listed in Table 2.3.2-1 is provided with indication of radiation level.

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

Table 2.3.2-2 provides a definition of the inspections, tests, and analyses, together with associated acceptance criteria for the Area Radiation Monitoring System.

**Table 2.3.2-2**

**ITAAC For Area Radiation Monitoring System**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The functional arrangement (location) of the ARMS equipment is as described in Subsection 2.3.2 and as listed on Table 2.3.2-1. | Inspection of the as-built system will be conducted. | The as-built ARM system locations conform to Subsection 2.3.2 and Table 2.3.2-1. |
| 2. Each ARM channel listed in Table 2.3.2-1 initiates a MCR alarm and a local audible alarm (if provided) when the radiation level exceeds a preset limit. | Tests will be conducted using a simulated high radiation level signal to verify that the MCR alarm and local alarm (if provided) are on when the simulated signal exceeds a preset setpoint. | The MCR alarm and local audible alarm (if provided) are initiated when the simulated radiation level exceeds a preset limit. |
| 3. Each ARM channel listed in Table 2.3.2-1 is provided with indication of radiation level. | Tests will be conducted using a simulated high radiation signal to verify that the indications for each ARM channel responds to the simulated high radiation signal. | The indications for each ARM channel responds to the simulated high radiation signal. |

## 2.4 CORE COOLING SYSTEMS USED FOR ABNORMAL EVENTS

The following subsections describe the core cooling systems in response to Abnormal Operating Occurrences (AOOs) and accidents.

### 2.4.1 Isolation Condenser System

**Design Description**

The Isolation Condenser System (ICS) removes decay heat from the RPV when the reactor is isolated. Decay heat removal keeps the RPV pressure below the SRV pressure setpoint. ICS consists of four independent trains, each containing a heat exchanger that condenses steam on the tube side and transfers heat by heating and boiling water in the Isolation Condenser/Passive Containment Cooling System (IC/PCCS) pools, which is then vented to the atmosphere. The ICS is as shown in Figure 2.4.1-1.

The ~~equipment~~ environmental qualification of ICS components is addressed in Section 3.8; and the environmental and seismic qualification of digital instrumentation and controls equipment is addressed in Section 3.8.

The containment isolation portions of the ICS are addressed in Subsection 2.15.1.

ICS software is developed in accordance with the software development program described in Section 3.2.

Conformance with IEEE Standard 603 requirements by the safety-related control system structures, systems, or components is addressed in Subsection 2.2.15.

The ICS alarms, displays, controls, and status indications in the main control room are addressed in Section 3.3.

(1) The functional arrangement of the ICS is as described in the Design Description of this ~~Section~~ Subsection 2.4.1, Table 2.4.1-1, Table 2.4.1-2, and as shown in Figure 2.4.1-1.

(2) a1. The components identified in Table 2.4.1-1 as ASME Code Section III are designed in accordance with ASME Code Section III requirements.

a2. The components identified in Table 2.4.1-1 as ASME Code Section III shall be reconciled with the design requirements.

a3. The components identified in Table 2.4.1-1 as ASME Code Section III are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

b1. The piping identified in Table 2.4.1-1 as ASME Code Section III is designed in accordance with ASME Code Section III requirements.

b2. The as-built piping identified in Table 2.4.1-1 as ASME Code Section III shall be reconciled with the piping design requirements.

b3. The piping identified in Table 2.4.1-1 as ASME Code Section III is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

(3) a. Pressure boundary welds in components identified in Table 2.4.1-1 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements.

b. Pressure boundary welds in piping identified in Table 2.4.1-1 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements.

(4) a. The components identified in Table 2.4.1-1 as ASME Code Section III retain their pressure boundary integrity at their design pressure.

b. The piping identified in Table 2.4.1-1 as ASME Code Section III retains its pressure boundary integrity at its design pressure.

(5) The equipment identified in Table 2.4.1-1 and Table 2.4.1-2 as Seismic Category I can withstand Seismic Category I loads without loss of safety function.

(6) a. Each of the ICS divisions (or safety-related loads/components) identified in Table 2.4.1-2 is powered from its respective safety-related division.

b. In the ICS, independence is provided between safety-related divisions, and between safety-related divisions and non-safety related equipment.

(7) a. Each mechanical train of the ICS located outside the containment is physically separated from the other train(s) so as not to preclude accomplishment of the intended safety-related function.

b. Each mechanical train of the ICS located inside the containment is physically separated from the other train(s) so as not to preclude accomplishment of the intended safety-related function.

(8) (Deleted)~~Control Room displays provided for the ICS are defined in Table 2.4.1-2.~~

(9) Re-positionable (NOT squib) valves designated in Table 2.4.1-1 open, close, or both open and close, under differential pressure, fluid flow, and temperature conditions.

(10) The pneumatically operated valve(s) designated in Table 2.4.1-1 fail in the mode listed if either electric power to the valve actuating solenoid is lost, or pneumatic pressure to the valve(s) is lost.

(11) (Deleted)

(12) (Deleted)

(13) Each condensate return valve, listed in Table 2.4.1-1, opens to initiate the ICS.

(14) The normally open ICS isolation valves in the steam supply and condensate return lines, listed in Table 2.4.1-1, close automatically on receipt of high vent line radiation from the Process Radiation Monitoring System (PRMS).

(15) The normally open ICS isolation valves in the steam supply and condensate return lines, listed in Table 2.4.1-1, close automatically on receipt of signals from the LD&IS.

(16) Each ICS train normally closed condensate return valve, listed in Table 2.4.1-1, opens upon receipt of the following automatic actuation signals:

- RPV high pressure following a time delay
- RPV water level below level 2 following a time delay
- RPV water level below level 1

- Loss of power to 2 of 4 reactor feed pumps with the reactor mode switch in RUN
- MSIVs in 2 of 4 steam lines less than fully open with the reactor mode switch in RUN

(17) Each ICS train normally closed condensate return bypass valve, listed in Table 2.4.1-1, opens upon receipt of the following automatic actuation signals:

- RPV high pressure following a time delay
- RPV water level below level 2 following a time delay
- RPV water level below level 1
- Loss of power to 2 of 4 reactor feed pumps with the reactor mode switch in RUN
- MSIVs in 2 of 4 steamlines less than fully open with the reactor mode switch in RUN.

(18) The two-series, solenoid-operated lower vent line valves, listed in Table 2.4.1-1, open on high RPV pressure after time delay following condensate return or condensate bypass valve opening signals.

(19) The three vent lines with two-series, solenoid-operated upper and lower vent line valves, listed in Table 2.4.1-1, open on manual actuation only if condensate return or condensate bypass valve is not closed.

(20) The accumulators for the pneumatic isolation valves, shown in Table 2.4.1-1, in the ICS steam supply and condensate return valves have the capacity to close the valves three times with the DW at the DW design pressure.

(21) Upon loss of pneumatic pressure to the condensate bypass valve (V-6), the valve strokes to the fully open position.

(22) Each ICS train has at least the minimum heat removal capacity assumed in analysis of Abnormal Events with reactor at or above normal operating pressure.

(23) Each ICS train provides at least the minimum drainable liquid volume available for return to the RPV assumed in analysis of Abnormal Events.

(24) The Equipment Pool and Reactor Well provide sufficient makeup water volume to the IC/PCCS expansion pool to support operation of the ICS and PCCS for the first 72 hours.

(25) The IC/PCCS pools are safety-related and Seismic Category I.

(26) Each ICS flow path is constrained to a maximum flow area at transitions between Class 1 piping from containment to Class 2 piping outside containment in order to limit flow in the event of a break.

(27) (Deleted)

(28) (Deleted)

(29) a. Valves on lines attached to the RPV that require maintenance have maintenance valves such that freeze seals will not be required.

b. The as-built location of valves on lines attached to the RPV that require maintenance shall be reconciled to design requirements.

## Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.4.1-3 provides a definition of the inspections, test and analyses, together with associated acceptance criteria for the Isolation Condenser System.

## Table 2.4.1-3

## ITAAC For The Isolation Condenser System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The functional arrangement of the ICS is as described in the Design Description of this ~~Section~~ Subsection 2.4.1, Table 2.4.1-1, Table 2.4.1-2, and as shown in Figure 2.4.1-1. | Inspection of the as-built system will be performed. | The as-built ICS conforms with the functional arrangement described in the Design Description of this ~~Section~~ Subsection 2.4.1, Table 2.4.1-1, Table 2.4.1-2, and as shown in Figure 2.4.1-1. |
| 2a1. The components identified in Table 2.4.1-1 as ASME Code Section III are designed in accordance with ASME Code Section III requirements. | Inspection of ASME Code Design Reports (NCA-3550) and required documents will be conducted. | ASME Code Design Reports (NCA-3550) (certified, when required by ASME Code) exist and conclude that the design of the components identified in Table 2.4.1-1 as ASME Code Section III complies with the requirements of ASME Code Section III including those stresses applicable to loads related to fatigue (including environmental effects), thermal expansion, seismic, and combined. |
| 2a2. The components identified in Table 2.4.1-1 as ASME Code Section III shall be reconciled with the design requirements. | A reconciliation analysis of the components identified in Table 2.4.1-1 as ASME Code Section III using as-designed and as-built information and ASME Code Design Reports (NCA-3550) will be performed. | ASME Code Design Report(s) (NCA-3550) (certified, when required by ASME Code) exist and conclude that design reconciliation has been completed, in accordance with ASME Code, for as-built reconciliation of the components identified in Table 2.4.1-1 as ASME Code Section III. The report documents the results of the reconciliation analysis. |

## Table 2.4.1-3

## ITAAC For The Isolation Condenser System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 2a3. The components identified in Table 2.4.1-1 as ASME Code Section III are fabricated, installed, and inspected in accordance with ASME Code Section III requirements. | Inspection of the components identified in Table 2.4.1-1 as ASME Code Section III will be conducted. | ASME Code Data Report(s) (including N-5 Data Reports, where applicable) (certified, when required by ASME Code) and inspection reports exist and conclude that the components identified in Table 2.4.1-1 as ASME Code Section III are fabricated, installed, and inspected in accordance with ASME Code Section III requirements. |
| 2b1. The piping identified in Table 2.4.1-1 as ASME Code Section III is designed in accordance with ASME Code Section III requirements. | Inspection of ASME Code Design Reports (NCA-3550) and required documents will be conducted.<br>{{Design Acceptance Criteria}} | ASME Code Design Report(s) (NCA-3550) (certified, when required by ASME Code) exist and conclude that the design of the piping identified in Table 2.4.1-1 as ASME Code Section III complies with the requirements of the ASME Code, Section III, including those stresses applicable to loads related to fatigue (including environmental effects), thermal expansion, seismic, and combined.<br>{{Design Acceptance Criteria}} |

## Table 2.4.1-3

## ITAAC For The Isolation Condenser System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 2b2. The as-built piping identified in Table 2.4.1-1 as ASME Code Section III shall be reconciled with the piping design requirements. | A reconciliation analysis of the piping identified in Table 2.4.1-1 as ASME Code Section III using as-designed and as-built information and ASME Code Design Reports (NCA-3550) will be performed. | ASME Code Design Report(s) (NCA-3550) (certified, when required by ASME Code) exist and conclude that design reconciliation has been completed, in accordance with ASME Code, for as-built reconciliation of the piping identified in Table 2.4.1-1 as ASME Code Section III. The report documents the results of the reconciliation analysis. |
| 2b3. The piping identified in Table 2.4.1-1 as ASME Code Section III is fabricated, installed, and inspected in accordance with ASME Code Section III requirements. | Inspections of the piping identified in Table 2.4.2-1 as ASME Code Section III will be conducted. | ASME Code Data Report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the piping identified in Table 2.4.2-1 as ASME Code Section III is fabricated, installed, and inspected in accordance with ASME Code Section III requirements. |
| 3a. Pressure boundary welds in components identified in Table 2.4.1-1 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements. | Inspection of the as-built pressure boundary welds in components identified in Table 2.4.1-1 as ASME Code Section III will be performed in accordance with ASME Code Section III. | ASME Code report(s) exist and conclude that ASME Code Section III requirements are met for non-destructive examination of pressure boundary welds in components identified in Table 2.4.1-1 as ASME Code Section III. |

## Table 2.4.1-3

## ITAAC For The Isolation Condenser System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 3b. Pressure boundary welds in piping identified in Table 2.4.1-1 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements. | Inspection of the as-built pressure boundary welds in piping identified in Table 2.4.1-1 as ASME Code Section III will be performed in accordance with ASME Code Section III. | ASME Code report(s) exist and conclude that ASME Code Section III requirements are met for non-destructive examination of pressure boundary welds in piping identified in Table 2.4.1-1 as ASME Code Section III. |
| 4a. The components identified in Table 2.4.1-1 as ASME Code Section III retain their pressure boundary integrity at their design pressure. | A hydrostatic test will be conducted on those code components identified in Table 2.4.1-1 as ASME Code Section III that are required to be hydrostatically tested by ASME Code Section III. | ASME Code Data Report(s) exist and conclude that the results of the hydrostatic test of components identified in Table 2.4.1-1 as ASME Code Section III comply with the requirements of ASME Code Section III. |
| 4b. The piping identified in Table 2.4.1-1 as ASME Code Section III retains its pressure boundary integrity at its design pressure. | A hydrostatic test will be conducted on the code piping identified in Table 2.4.1-1 as ASME Code Section III that is required to be hydrostatically tested by ASME Code Section III. | ASME Code Data Report(s) exist and conclude that the results of the hydrostatic test of piping identified in Table 2.4.1-1 as ASME Code Section III comply with the requirements in ASME Code Section III. |
| 5. The equipment identified in Table 2.4.1-1 and Table 2..4.1-2 as Seismic Category I can withstand Seismic Category I loads without loss of safety function. | i. Inspection will be performed to verify that the Seismic Category I equipment identified in Table 2.4.1-1 and Table 2.4.1-2 are located in a Seismic Category I structure. | i. The equipment identified as Seismic Category I in Table 2.4.1-1 and Table 2.4.1-2 is located in a Seismic Category I structure. |

## Table 2.4.1-3

## ITAAC For The Isolation Condenser System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| | ii. Type tests, analyses, or a combination of type tests and analyses, of equipment identified in Table 2.4.1-1 and Table 2.4.1-2 as Seismic Category I, will be performed using analytical assumptions, or will be performed under conditions which bound the Seismic Category I equipment design requirements.<br>iii. Inspections and analyses will be performed to verify that the as-built equipment identified in Table 2.4.1-1 and Table 2.4.1-2, including anchorage, is bounded by the testing or analyzed conditions. | ii. The equipment identified in Table 2.4.1-1 and Table 2.4.1-2 as Seismic Category I can withstand Seismic Category I loads without loss of safety function.<br>iii. The as-built equipment identified in Table 2.4.1-1 and Table 2.4.1-2 as Seismic Category I, including anchorage, can withstand Seismic Category I loads without loss of safety function. |
| 6a. Each of the ICS divisions (or safety-related loads/components) identified in Table 2.4.1-2 is powered from its respective safety-related division. | Testing will be performed on the ICS by providing a simulated test signal in only one safety-related division at a time. | A simulated test signal exists in the safety-related division (or at the equipment identified in Table 2.4.1-2 powered from the safety-related division) under test in the ICS. |
| 6b. In the ICS, independence is provided between safety-related divisions, and between safety-related divisions and non-safety related equipment. | i. Tests will be performed on the ICS by providing a test signal in only one safety-related division at a time. | i. The test signal exists only in the safety-related Division under test in the ICS. |

## Table 2.4.1-3

## ITAAC For The Isolation Condenser System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| | ii. Inspection of the as-built safety-related divisions in the ICS will be performed. | ii. The as-built safety-related divisions in the ICS are separated:<br>• Physical separation or electrical isolation exists between these safety-related divisions in accordance with RG 1.75.<br>• Physical separation or electrical isolation exists between safety-related divisions and non-safety related equipment in accordance with RG 1.75. |
| 7a. Each mechanical train of the ICS located outside the containment is physically separated from the other train(s) so as not to preclude accomplishment of the intended safety-related function. | Inspections and analysis will be conducted for each of the ICS mechanical trains located outside the containment. | Each mechanical train of ICS located outside containment is protected against design basis events and their direct consequences by spatial separation, barriers, restraints, or enclosures so as not to preclude accomplishment of the intended safety-related function. |
| 7b. Each mechanical train of the ICS located inside the containment is physically separated from the other train(s) so as not to preclude accomplishment of the intended safety-related function. | Inspections or analysis will be conducted for each of the ICS mechanical trains located inside the containment. | Each mechanical train of ICS located inside containment is protected against design basis events and their direct consequences by spatial separation, barriers, restraints, or enclosures so as not to preclude accomplishment of the intended safety-related function. |

Table 2.4.1-3

ITAAC For The Isolation Condenser System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 8. (Deleted)~~Control Room displays provided for the ICS are defined in Table 2.4.1-2~~ | ~~Inspections will be performed on the Control Room displays for the ICS.~~ | ~~Displays exist or can be retrieved in the Control Room as defined in Table 2.4.1-2.~~ |
| 9. Re-positionable (NOT squib) valves designated in Table 2.4.1-1 open, close, or both open and close, under differential pressure, fluid flow, and temperature conditions. | Tests of installed valves will be performed for opening, closing, or both opening and also closing under system preoperational differential pressure, fluid flow, and temperature conditions. | Upon receipt of the actuating signal, each valve opens, closes, or both opens and closes, depending upon the valve's safety function. |
| 10. The pneumatically operated valve(s) designated in Table 2.4.1-1 fail in the mode listed if either electric power to the valve actuating solenoid is lost, or pneumatic pressure to the valve(s) is lost. | Tests will be conducted on the as-built valve(s). | The pneumatically operated valve(s) identified in Table 2.4.1-1 fail in the listed mode when either electric power to the valve actuating solenoid is lost, or pneumatic pressure to the valve(s) is lost. |
| 11. (Deleted) | | |
| 12. (Deleted) | | |
| 13. Each condensate return valve, listed in Table 2.4.1-1, opens to initiate the ICS. | Opening test of valves will be conducted under pre-operational differential pressure, fluid flow and temperature conditions. | Each condensate return valve opening time is no less than 7.5 seconds and no greater than 31 seconds under pre-operational differential pressure, fluid flow, and temperature conditions. |

## Table 2.4.1-3

## ITAAC For The Isolation Condenser System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 14. The normally open ICS isolation valves in the steam supply and condensate return lines, listed in Table 2.4.1-1, close automatically on receipt of high vent line radiation from the Process Radiation Monitoring System (PRMS). | An isolation valve closure test will be performed using simulated signals. | The ICS isolation valves close upon receipt of signals from the PRMS. |
| 15. The normally open ICS isolation valves in the steam supply and condensate return lines, listed in Table 2.4.1-1, close automatically on receipt of signals from the LD&IS. | An isolation valve closure test will be performed using simulated signals. | The ICS isolation valves close upon receipt of signals from the LD&IS. |
| 16. Each ICS train normally closed condensate return valve, listed in Table 2.4.1-1, opens upon receipt of the following automatic actuation signals:<br>• RPV high pressure following a time delay<br>• RPV water level below level 2 following a time delay<br>• RPV water level below level 1<br>• Loss of power to 2 of 4 reactor feed pumps with the reactor mode switch in RUN<br>• MSIVs in 2 of 4 steam lines less than fully open with the reactor mode switch in RUN | Valve opening tests will be performed using simulated automatic actuation signals. | The condensate return valves open upon receipt of automatic actuation signals. |

## Table 2.4.1-3

## ITAAC For The Isolation Condenser System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 17. Each ICS train normally closed condensate return bypass valve, listed in Table 2.4.1-1, opens upon receipt of the following automatic actuation signals:<br>• RPV high pressure following a time delay<br>• RPV water level below level 2 following a time delay<br>• RPV water level below level 1<br>• Loss of power to 2 of 4 reactor feed pumps with the reactor mode switch in RUN<br>• MSIVs in 2 of 4 steamlines less than fully open with the reactor mode switch in RUN. | Valve opening tests will be performed using simulated automatic actuation signals. | The condensate return valves open upon receipt of automatic actuation signals. |
| 18. The two-series, solenoid-operated lower vent line valves, listed in Table 2.4.1-1, open on high RPV pressure after time delay following condensate return or condensate bypass valve opening signals. | A valve-opening test will be performed using simulated high reactor pressure after a time delay following condensate return or condensate bypass valve opening signals. | The two-series, solenoid-operated vent line valves open on a simulated high RPV pressure signal after a time delay following condensate return or condensate bypass valve opening signals. |
| 19. The three vent lines with two-series, solenoid-operated upper and lower vent line valves, listed in Table 2.4.1-1, open on manual actuation only if condensate return or condensate bypass valve is not closed. | A test(s) will be performed that manually opens the vent valves during pre-operational testing following condensate return or condensate bypass valve opening signals. | The three vent lines with two-series, solenoid-operated vent line valves each, opens on a manual initiation following condensate return or condensate bypass valve opening signals only if the condensate return or condensate bypass valve is not closed. |

## Table 2.4.1-3

## ITAAC For The Isolation Condenser System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 20. The accumulators for the pneumatic isolation valves, listed in Table 2.4.1-1, in the ICS steam supply and condensate return valves have the capacity to close the valves three times with the DW at the DW design pressure. | A test and analysis or test will be performed to demonstrate the capacity of the isolation valve accumulators. | Isolation valve accumulators have the capacity to close the valves three times with the DW pressure at the design pressure. |
| 21. Upon loss of pneumatic pressure to the condensate bypass valve (V-6), the valve strokes to the fully open position. | Tests will be performed to demonstrate that the condensate bypass valve will stroke to the full open position upon the loss of pneumatic pressure to the condensate bypass valve accumulator. | The condensate bypass valve fully opens when pneumatic pressure is removed from the condensate bypass valve. |
| 22. Each ICS train has at least the minimum heat removal capacity assumed in analysis of Abnormal Events with reactor at or above normal operating pressure. | Using prototype test data and as-built IC unit information, an analysis will be performed to establish the heat removal capacity of the IC unit with IC pool at atmospheric saturated conditions. | The ICS train unit heat removal capacity is greater than or equal to 33.75 MWt (assumed in the analysis of Abnormal Events) with the reactor at or above normal operating pressure. |
| 23. Each ICS train provides at least the minimum drainable liquid volume available for return to the RPV assumed in analysis of Abnormal Events. | An analysis will be performed for the as-built isolation condenser system. | The as-built ICS train provides at least 13.88m$^3$ (490.1 ft$^3$) (assumed in the analysis of Abnormal Events) of the liquid volume available for return to the RPV. |
| 24. The Equipment Pool and Reactor Well provide sufficient makeup water volume to the IC/PCCS expansion pool to support operation of the ICS and PCCS for the first 72 hours. | i. A valve-opening test will be performed using simulated low-level water signal from the IC/PCCS expansion pool. | i. The two-series, valves open on a simulated low-level water signal from the IC/PCCS expansion pool. |

**Table 2.4.1-3**

**ITAAC For The Isolation Condenser System**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| | ii. A physical measurement will be performed on the dimensions and water level in the IC/PCCS pools, Equipment Pool, and Reactor Well to demonstrate that the required water volume is achieved. | ii. Measurements show that the combined water volume of the IC/PCCS pools, Equipment Pool, and Reactor Well is no less than 6,290 $m^3$ (222,000 $ft^3$). |
| 25. The IC/PCCS pools are safety-related and Seismic Category I. | Inspections, tests, type tests, and analyses ~~of the documentation~~ for the IC/PCCS pools confirm that they are safety-related and Seismic Category I. | The IC/PCCS pools are safety-related and Seismic Category I. |
| 26. Each ICS flow path is constrained to a maximum flow area at transitions between Class 1 piping from containment to Class 2 piping outside containment in order to limit flow in the event of a break. | Inspection will be performed to confirm that the flow area at these transition locations is limited. | Each steam supply branch line contains a flow limiter which is no greater than 76.2 mm (3 in) in diameter, and that the condensate branch lines are no greater than 101.6 mm (4 in) in diameter. |
| 27. (Deleted) | | |
| 28. (Deleted) | | |
| 29a. Valves on lines attached to the RPV that require maintenance have maintenance valves such that freeze seals will not be required. | Inspections of piping design isometric drawings will be conducted.<br>{{Design Acceptance Criteria}} | A review of piping design isometric drawings confirms that maintenance valves are included such that freeze seals will not be required.<br>{{Design Acceptance Criteria}} |

**Table 2.4.1-3**

**ITAAC For The Isolation Condenser System**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 29b. The as-built location of valves on lines attached to the RPV that require maintenance shall be reconciled to design requirements. | A reconciliation evaluation of valves on lines attached to the RPV using as-designed and as-built information will be performed. | A design reconciliation has been completed for the as-built location of valves relative to the design requirements. |

## 2.4.2 Emergency Core Cooling System - Gravity-Driven Cooling System

### Design Description

Emergency core cooling is provided by the Gravity-Driven Cooling System (GDCS) located within containment in conjunction with the ADS in case of a LOCA.

The GDCS alarms, displays, controls, and status indications in the main control room are addressed by Section 3.3.

The ~~equipment~~ environmental qualification of GDCS components is addressed in Section 3.8; and the environmental and seismic qualification of digital instrumentation and controls equipment is addressed in Section 3.8.

The GDCS software is developed in accordance with the software development program described in Section 3.2.

Refer to Subsection 2.2.15 for "Instrumentation and Control Compliance with IEEE Standard 603."

(1) The functional arrangement of the GDCS is as described in Subsection 2.4.2 and as listed in Table 2.4.2-1 and as shown on Figure 2.4.2-1.

(2) a1. The components identified in Table 2.4.2-1 as ASME Code Section III are designed in accordance with ASME Code Section III requirements.

a2. The components identified in Table 2.4.2-1 as ASME Code Section III shall be reconciled with the design requirements.

a3. The components identified in Table 2.4.2-1 as ASME Code Section III are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

b1. The piping identified in Table 2.4.2-1 as ASME Code Section III is designed in accordance with ASME Code Section III requirements.

b2. The as-built piping identified in Table 2.4.2-1 as ASME Code Section III shall be reconciled with the piping design requirements.

b3. The piping identified in Table 2.4.2-1 as ASME Code Section III is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

(3) a. Pressure boundary welds in components identified in Table 2.4.2-1 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements.

b. Pressure boundary welds in piping identified in Table 2.4.2-1 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements.

(4) a. The components identified in Table 2.4.2-1 as ASME Code Section III retain their pressure boundary integrity at their design pressure.

b. The piping identified in Table 2.4.2-1 as ASME Code Section III retains its pressure boundary integrity at its design pressure.

(5) The equipment identified in Table 2.4.2-1 and Table 2.4.2-2 as Seismic Category I can withstand Seismic Category I loads without loss of safety function.

(6) (Deleted)

(7) (Deleted)

(8) a. The GDCS injection lines provide sufficient flow to maintain water coverage above (Top of Active Fuel) TAF for 72 hours following a design basis LOCA.

b. The GDCS equalizing lines provide sufficient flow to maintain water coverage above TAF for 72 hours following a design basis LOCA.

(9) The GDCS squib valves used in the injection and equalization lines open as designed.

(10) a. Check valves shown on Figure 2.4.2-1 open and close under system pressure, fluid flow, and temperature conditions.

b. The GDCS injection line check valves meet the criterion for maximum fully open flow coefficient in the reverse flow direction.

(11) (Deleted) ~~Control Room indications and controls are provided for the GDCS.~~

(12) GDCS squib valves maintain RPV backflow leak tightness and maintain reactor coolant pressure boundary integrity during normal plant operation.

(13) Each GDCS injection line includes a nozzle flow limiter to limit break size.

(14) Each GDCS equalizing line includes a nozzle flow limiter to limit break size.

(15) Each of the GDCS divisions is powered from its respective safety-related power division.

(16) Each GDCS mechanical train located inside the containment is physically separated from the other train(s) so as not to preclude accomplishment of the intended safety-related function.

(17) The GDCS pools A, B/C, and D are sized to hold a minimum drainable water volume.

(18) The GDCS pools A, B/C, and D are sized to hold a specified minimum water level.

(19) The elevation change between low water level of GDCS pools and the centerline of GDCS injection line nozzles is sufficient to provide gravity-driven flow.

(20) The minimum drainable volume from the suppression pool to the RPV is sufficient to meet long-term post-LOCA core cooling requirements.

(21) The long-term GDCS minimum equalizing driving head is based on RPV Level 0.5.

(22) The GDCS Deluge squib valves open as designed.

(23) (Deleted)

(24) The GDCS injection piping is installed to allow venting of non-condensable gases to GDCS pools and to RPV, to prevent collection in the GDCS injection pipes.

(25) Deluge system has redundant nonsafety-related Programmable Logic Controllers (PLCs) that are connected to thermocouples in each cell of the lower drywell Basemat-Internal Melt Arrest Coolability (BiMAC) system.

(26) When temperatures exceed the setpoint at one set of thermocouples coincident with setpoints being exceeded at a second set of thermocouples in adjacent cells, each PLC starts a deluge squib valve timer.

(27) The GDCS deluge valve squib initiation signals are inhibited when either of the safety-related deluge system lower drywell temperature switches sense temperatures lower than a preset value coincident with the presence of both deluge squib valve timer signals.

(28) a. Valves on lines attached to the RPV that require maintenance have maintenance valves such that freeze seals will not be required.

b. The as-built location of valves on lines attached to the RPV in the GDCS that require maintenance shall be reconciled to design requirements.

(29) a. (Deleted)~~The BiMAC has an available volume, up to a height of the vertical segments of the BiMAC pipes, sized to contain approximately 400% of the full-core debris.~~

b. The BiMAC has a material located on top of the BiMAC pipes to protect against melt impingement during the initial corium relocation event.

c. The BiMAC is designed with a cover so that debris will penetrate it in a short period of time while providing protection for the BiMAC from CRD housings falling from the vessel.

d. The BiMAC piping is inclined from horizontal to permit natural circulation flow.

e. The material located on top of the BiMAC pipes does not generate non-condensable gases in quantities that would result in exceeding the containment ultimate pressure.

## Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.4.2-3 provides a definition of the inspections, test and analyses, together with associated acceptance criteria for the Gravity-Driven Cooling System.

## Table 2.4.2-3

## ITAAC For The Emergency Core Cooling System – Gravity-Driven Cooling System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
| --- | --- | --- |
| 1. The functional arrangement of the GDCS is as described in Subsection 2.4.2 and as listed in Table 2.4.2-1 and as shown on Figure 2.4.2-1. | Inspections of the as-built system will be conducted. | The as-built GDCS conforms to the functional arrangement as described in Subsection 2.4.2 and as listed in Table 2.4.2-1 and as shown in Figure 2.4.2-1 |
| 2a1. The components identified in Table 2.4.2-1 as ASME Code Section III are designed in accordance with ASME Code Section III requirements. | Inspection of ASME Code Design Reports (NCA-3550) and required documents will be conducted. | ASME Code Design Reports (NCA-3550) (certified, when required by ASME Code) exist and conclude that the design of the components identified in Table 2.4.2-1 as ASME Code Section III complies with the requirements of ASME Code Section III including those stresses applicable to loads related to fatigue (including environmental effects), thermal expansion, seismic, and combined. |
| 2a2. The components identified in Table 2.4.2-1 as ASME Code Section III shall be reconciled with the design requirements. | A reconciliation analysis of the components identified in Table 2.4.2-1 as ASME Code Section III using as-designed and as-built information and ASME Code Design Reports (NCA-3550) will be performed. | ASME Code Design Report(s) (NCA-3550) (certified, when required by ASME Code) exist and conclude that design reconciliation has been completed, in accordance with ASME Code, for as-built reconciliation of the components identified in Table 2.4.2-1 as ASME Code Section III. The report documents the results of the reconciliation analysis. |

## Table 2.4.2-3

## ITAAC For The Emergency Core Cooling System – Gravity-Driven Cooling System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 2a3. The components identified in Table 2.4.2-1 as ASME Code Section III are fabricated, installed, and inspected in accordance with ASME Code Section III requirements. | Inspection of the components identified in Table 2.4.2-1 as ASME Code Section III will be conducted. | ASME Code Data Report(s) (including N-5 Data Reports, where applicable) (certified, when required by ASME Code) and inspection reports exist and conclude that the components identified in Table 2.4.2-1 as ASME Code Section III are fabricated, installed, and inspected in accordance with ASME Code Section III requirements. |
| 2b1. The piping identified in Table 2.4.2-1 as ASME Code Section III is designed in accordance with ASME Code Section III requirements. | Inspection of ASME Code Design Reports (NCA-3550) and required documents will be conducted.<br>{{Design Acceptance Criteria}} | ASME Code Design Report(s) (NCA-3550) (certified, when required by ASME Code) exist and conclude that the design of the piping identified in Table 2.4.2-1 as ASME Code Section III complies with the requirements of the ASME Code, Section III, including those stresses applicable to loads related to fatigue (including environmental effects), thermal expansion, seismic, and combined.<br>{{Design Acceptance Criteria}} |

**Table 2.4.2-3**

**ITAAC For The Emergency Core Cooling System – Gravity-Driven Cooling System**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 2b2. The as-built piping identified in Table 2.4.2-1 as ASME Code Section III shall be reconciled with the piping design requirements. | A reconciliation analysis of the piping identified in Table 2.4.2-1 as ASME Code Section III using as-designed and as-built information and ASME Code Design Reports (NCA-3550) will be performed. | ASME Code Design Report(s) (NCA-3550) (certified, when required by ASME Code) exist and conclude that design reconciliation has been completed, in accordance with ASME Code, for as-built reconciliation of the piping identified in Table 2.4.2-1 as ASME Code Section III. The report documents the results of the reconciliation analysis. |
| 2b3. The piping identified in Table 2.4.2-1 as ASME Code Section III is fabricated, installed, and inspected in accordance with ASME Code Section III requirements. | Inspections of the piping identified in Table 2.4.2-1 as ASME Code Section III will be conducted. | ASME Code Data Report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the piping identified in Table 2.4.2-1 as ASME Code Section III is fabricated, installed, and inspected in accordance with ASME Code Section III requirements. |
| 3a. Pressure boundary welds in components identified in Table 2.4.2-1 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements. | Inspection of the as-built pressure boundary welds in components identified in Table 2.4.2-1 as ASME Code Section III will be performed in accordance with ASME Code Section III. | ASME Code report(s) exist and conclude that ASME Code Section III requirements are met for non-destructive examination of pressure boundary welds in components identified in Table 2.4.2-1 as ASME Code Section III. |

## Table 2.4.2-3

## ITAAC For The Emergency Core Cooling System – Gravity-Driven Cooling System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 3b. Pressure boundary welds in piping identified in Table 2.4.2-1 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements. | Inspection of the as-built pressure boundary welds in piping identified in Table 2.4.2-1 as ASME Code Section III will be performed in accordance with ASME Code Section III. | ASME Code report(s) exist and conclude that ASME Code Section III requirements are met for non-destructive examination of pressure boundary welds in piping identified in Table 2.4.2-1 as ASME Code Section III. |
| 4a. The components identified in Table 2.4.2-1 as ASME Code Section III retain their pressure boundary integrity at their design pressure. | A hydrostatic test will be conducted on those code components identified in Table 2.4.2-1 as ASME Code Section III that are required to be hydrostatically tested by ASME Code Section III. | ASME Code Data Report(s) exist and conclude that the results of the hydrostatic test of components identified in Table 2.4.2-1 as ASME Code Section III comply with the requirements of ASME Code Section III. |
| 4b. The piping identified in Table 2.4.2-1 as ASME Code Section III retains its pressure boundary integrity at its design pressure. | A hydrostatic test will be conducted on the code piping identified in Table 2.4.2-1 as ASME Code Section III that is required to be hydrostatically tested by ASME Code Section III. | ASME Code Data Report(s) exist and conclude that the results of the hydrostatic test of piping identified in Table 2.4.2-1 as ASME Code Section III comply with the requirements in ASME Code Section III. |
| 5. The equipment identified in Tables 2.4.2-1 and Table 2.4.2-2 as Seismic Category I can withstand Seismic Category I loads without loss of safety function. | i. Inspection will be performed to verify that the Seismic Category I equipment identified in Table 2.4.2-1 and Table 2.4.2-2 are located in a Seismic Category I structure. | i. The equipment identified as Seismic Category I in Table 2.4.2-1 and Table 2.4.2-2 is located in a Seismic Category I structure. |

**Table 2.4.2-3**

**ITAAC For The Emergency Core Cooling System – Gravity-Driven Cooling System**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| | ii. Type tests, analyses, or a combination of type tests and analyses, of equipment identified in Table 2.4.2-1 and Table 2.4.2-2 as Seismic Category I, will be performed using analytical assumptions, or will be performed under conditions which bound the Seismic Category I equipment design requirements.<br>iii. Inspections and analyses will be performed to verify that the as-built equipment identified in Table 2.4.2-1 and Table 2.4.2-2, including anchorage, is bounded by the testing or analyzed conditions. | ii. The equipment identified in Table 2.4.2-1 and Table 2.4.2-2 as Seismic Category I can withstand Seismic Category I loads without loss of safety function.<br>iii. The as-built equipment identified in Table 2.4.2-1 and Table 2.4.2-2 as Seismic Category I, including anchorage, can withstand Seismic Category I loads without loss of safety function. |
| 6. (Deleted) | | |
| 7. (Deleted) | | |
| 8a. The GDCS injection lines provide sufficient flow to maintain water coverage above Top of Active Fuel (TAF) for 72 hours following a design basis LOCA. | For each loop of the GDCS, an open reactor vessel test will be performed utilizing two test valves in place of the parallel squib valves in the GDCS injection line and connected to the GDCS actuation logic. Flow measurements will be taken on flow into the RPV. An analysis of the test configuration will be performed. | Based on analysis and test data, the flow rate, in conjunction with vessel depressurization and other modes of GDCS operation, maintains water coverage above TAF for 72 hours following the design basis LOCA. |

## Table 2.4.2-3

## ITAAC For The Emergency Core Cooling System – Gravity-Driven Cooling System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 8b. The GDCS equalizing lines provide sufficient flow to maintain water coverage above TAF for 72 hours following a design basis LOCA. | For each loop of the GDCS, open reactor vessel testing will be performed utilizing one test valve in place of the squib valve in the GDCS equalizing line and connected to the GDCS actuation logic. Flow measurements will be taken on flow into the RPV. An analysis of the test configuration will be performed. | Based on analysis and test data, that the flow rate, in conjunction with vessel depressurization and other modes of GDCS operation, will maintain water coverage above TAF for 72 hours following the design basis LOCA. |
| 9. The GDCS squib valves used in the injection and equalization lines open as designed. | A vendor type test will be performed on a squib valve. | GDCS squib valves used in the injection and equalization lines open as designed. |
| 10a. Check valves designated on Figure 2.4.2-1 open and close under system pressure, fluid flow, and temperature conditions. | Type tests of valves for opening and closing will be conducted. | Based on the direction of the differential pressure across the valve, each check valve opens and closes. |
| 10b. The GDCS injection line check valves meet the criterion for maximum fully open flow coefficient in the reverse flow direction. | Type tests of the GDCS check valves to determine the fully open flow coefficient in the reverse flow direction will be conducted. | The fully open flow coefficient for the GDCS injection line check valves in the reverse flow direction is less than the value assumed in the LOCA analysis. |
| 11. (Deleted)~~Control Room indications and controls are provided for the GDCS.~~ | ~~Inspections will be performed on the Control Room indications and controls for the GDCS.~~ | ~~Indications and controls exist or can be retrieved in the control room.~~ |

## Table 2.4.2-3

## ITAAC For The Emergency Core Cooling System – Gravity-Driven Cooling System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 12. GDCS squib valves maintain RPV backflow leak tightness and maintain reactor coolant pressure boundary integrity during normal plant operation. | A test will be performed to demonstrate the squib valves are leak tight during normal plant conditions. | Testing concludes GDCS squib valves have zero leakage at normal plant operating pressure. |
| 13. Each GDCS injection line includes a nozzle flow limiter to limit break size. | Inspections of the as-built GDCS injection flow limiters will be performed. | Each GDCS injection nozzle flow limiter is less than or equal to 4.562E-3 $m^2$ (0.0491 $ft^2$) and a nominal reactor-side outlet length to diameter ratio of 4.41. |
| 14. Each GDCS equalizing line includes a nozzle flow limiter to limit break size. | Inspections of the as-built GDCS equalizing flow limiters will be taken. | Each GDCS equalizing line nozzle flow limiter is less than or equal to 2.027E-3 $m^2$ (0.0218 $ft^2$) and a nominal reactor-side outlet length to diameter ratio of 6.59. |
| 15. Each of the GDCS divisions is powered from its respective safety-related power division. | Tests will be performed on the GDCS by providing a test signal in only one safety-related power division at a time. | Testing confirms the signal exists only in the safety-related power division under test in the GDCS. |
| 16. Each GDCS mechanical train located inside the containment is physically separated from the other train(s) so as not to preclude accomplishment of the intended safety-related function. | Inspections and analysis will be conducted for each of the GDCS mechanical trains located inside the containment. | Each GDCS mechanical train located inside containment is protected against design basis events and their direct consequences by spatial separation, barriers, restraints, or enclosures so as not to preclude accomplishment of the intended safety-related function. |
| 17. The GDCS pools A, B/C, and D are sized to hold a minimum drainable water volume. | An analysis of combined minimum drainable volume for GDCS pools A, B/C, and D will be performed. | Analysis confirms the combined minimum drainable water volume for GDCS pools A, B/C, and D is 1636 $m^3$ (57770 $ft^3$). |

## Table 2.4.2-3

## ITAAC For The Emergency Core Cooling System – Gravity-Driven Cooling System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 18. The GDCS pools A, B/C, and D are sized to hold a specified minimum water level. | An analysis of minimum water level in GDCS pools A, B/C, and D will be performed. | Analysis confirms the minimum water level in GDCS pools A, B/C, and D can be at least 6.5 m (21.3 ft). |
| 19. The elevation change between low water level of GDCS pools and the centerline of GDCS injection line nozzles is sufficient to provide gravity-driven flow. | An analysis of elevation change between low water level of GDCS pools and the centerline of GDCS injection line nozzles will be performed. | Analysis confirms the elevation change between low water level of GDCS pools and the centerline of GDCS injection line nozzles is 13.5 m (44.3 ft). |
| 20. The minimum drainable volume from the suppression pool to the RPV is sufficient to meet long-term post-LOCA core cooling requirements. | An analysis of minimum drainable volume from the suppression pool to the RPV will be performed. | Analysis confirms the minimum drainable volume from the suppression pool to the RPV is 799 $m^3$ (28,200 $ft^3$). |
| 21. The long-term GDCS minimum equalizing driving head is based on RPV Level 0.5. | An analysis of the minimum equalizing driving head will be performed. | Analysis confirms the minimum equalizing driving head is 1.0 m (3.28 ft). |
| 22. The GDCS Deluge squib valves open as designed. | A vendor type test will be performed on a squib valve. | GDCS Deluge squib valves used open as designed. |
| 23. (Deleted) | | |
| 24. The GDCS injection piping is installed to allow venting of non-condensable gases to GDCS pools and to RPV, to prevent collection in the GDCS injection pipes. | Inspection(s) will be conducted of as-built GDCS injection piping installation to ensure there are no elevated piping loops or high-point traps in piping run from squib valves to GDCS pools and to RPV inlet nozzles. | Based on inspection(s) of as-built GDCS injection piping, the as-built piping conforms to design that allows venting of non-condensable gases to GDCS pools and to RPV. |

## Table 2.4.2-3

## ITAAC For The Emergency Core Cooling System – Gravity-Driven Cooling System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 25. Deluge system has redundant nonsafety-related Programmable Logic Controllers (PLCs) that are connected to thermocouples in each cell of the lower drywell Basemat-Internal Melt Arrest Coolability (BiMAC) system. | Inspections and tests will be performed to confirm the connection of the thermocouples to the PLCs. | One thermocouple from each cell is monitored in one PLC, while the other thermocouple from each cell is monitored in a second PLC. |
| 26. When temperatures exceed the setpoint at one set of thermocouples coincident with setpoints being exceeded at a second set of thermocouples in adjacent cells, each PLC starts a deluge squib valve timer. | i. Tests will be performed to confirm timer initiation using simulated signals. | i. The timers are initiated when the temperature setpoint is exceeded. |
| | ii. Type tests will be performed of the thermocouples to confirm detection of simulated core melt debris in the BiMAC cells. | ii. The thermocouples are capable of detecting simulated core melt debris in the BiMAC cells. |
| 27. The GDCS deluge valve squib initiation signals are inhibited when either of the safety-related deluge system lower drywell temperature switches sense temperatures lower than a preset value coincident with the presence of both deluge squib valve timer signals. | Tests will be performed using simulated signals to confirm that the GDCS deluge valve squib initiation signals are inhibited when either of the safety-related deluge system lower drywell temperature switches sense temperatures lower than a preset value coincident with the presence of both deluge squib valve timer signals. | The GDCS deluge valve squib initiation signals are inhibited when either of the safety-related deluge system lower drywell temperature switches sense temperatures lower than a preset value coincident with the presence of both deluge squib valve timer signals. |

## Table 2.4.2-3

## ITAAC For The Emergency Core Cooling System – Gravity-Driven Cooling System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 28a. Valves on lines attached to the RPV that require maintenance have maintenance valves such that freeze seals will not be required. | Inspections of piping design isometric drawings will be conducted.<br>{{Design Acceptance Criteria}} | A review of piping design isometric drawings confirms that maintenance valves included such that freeze seals will not be required.<br>{{Design Acceptance Criteria}} |
| 28b. The as-built location of valves on lines attached to the RPV in the GDCS that require maintenance shall be reconciled to design requirements. | A reconciliation evaluation of valves on lines attached to the RPV using as-designed and as-built information will be performed. | A design reconciliation has been completed for the as-built location of valves relative to the design requirements. |
| 29a. (Deleted)~~The BiMAC has an available volume, up to a height of the vertical segments of the BiMAC pipes, sized to contain approximately 400% of the full-core debris.~~ | ~~Inspections of the as-built system will be conducted.~~ | ~~The as-built BiMAC is sized to contain 350%-450% of the full-core debris.~~ |
| 29b. The BiMAC has a material located on top of the BiMAC pipes to protect against melt impingement during the initial corium relocation event. | Inspections of the as-built system will be conducted. | The as-built BiMAC contains a material located on top of the BiMAC pipes to protect against melt impingement during the initial corium relocation event. |
| 29c. The BiMAC is designed with a cover so that debris will penetrate it in a short period of time while providing protection for the BiMAC from CRD housings falling from the vessel. | Inspections of the as-built system will be conducted. | The as-built BiMAC includes a cover plate providing protection for the BiMAC from CRD housings falling from the vessel while allowing debris to penetrate it in a short period of time. |

## Table 2.4.2-3

## ITAAC For The Emergency Core Cooling System – Gravity-Driven Cooling System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 29d. The BiMAC piping is inclined from horizontal to permit natural circulation flow. | Inspections of the as-built system will be conducted. | The as-built BiMAC includes piping inclined ~~sufficiently~~ from horizontal, according to the analyzed value, to permit natural circulation flow. |
| 29e. The material located on top of the BiMAC pipes does not generate non-condensable gases in quantities that would result in exceeding the containment ultimate pressure. | Analyses of the as-built system will be conducted. | The as-built BiMAC contains a material located on top of the BiMAC pipes that does not generate non-condensable gases in quantities that would result in exceeding the containment ultimate pressure. |

## Table 2.5.5-1

## ITAAC For The Refueling Equipment

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The functional arrangement of the RB refueling machine is as described in the Design Description of this Subsection 2.5.5. | Inspections of the as-built RB refueling machine will be performed. | The as-built RB refueling machine conforms to the functional arrangement as described in the Design Description of Subsection 2.5.5. |
| 2. The RB refueling machine is classified as nonsafety-related, but is designed as Seismic Category I. | Inspections and analyses of the as-built RB refueling machine will be performed. | The as-built RB refueling machine can withstand seismic dynamic loads without loss of load carrying or structural integrity functions. |
| 3. The RB refueling machine has an auxiliary hoist with sufficient load capability. | Load tests on the as-built auxiliary hoists will be conducted in accordance with ANSI N14.6, 1993. | A successful load test of each as-built auxiliary hoist has been performed in accordance with ANSI N14.6, 1993. |
| 4. The RB refueling machine is provided with controls interlocks | Testing will be performed with actual or simulated signals to demonstrate that the as-built interlocks function as required. | The as-built interlocks function as follows:<br>• Prevent hoisting a fuel assembly over the vessel with a control rod removed;<br>• Prevent collision with fuel pool walls or other structures;<br>• Limit travel of the fuel grapple;<br>• Interlock grapple hook engagement with hoist load and hoist up power; and<br>• Ensure correct sequencing of the transfer operation in the automatic or manual mode. |

## Table 2.5.5-1

## ITAAC For The Refueling Equipment

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 5. The functional arrangement of the FB fuel handling machine is as described in the Design Description of this Subsection 2.5.5. | Inspections and analyses of the as-built FB fuel handling machine system will be performed. | The as-built FB fuel handling machine conforms to the functional arrangement as described in the Design Description of the Subsection 2.5.5. |
| 6. The FB fuel handling machine is classified as nonsafety-related, but is designed as Seismic Category I. | Inspections and analyses of the as-built FB fuel handling machine system will be performed. | The as-built FB fuel handling machine can withstand seismic dynamic loads without loss of load carrying or structural integrity functions. |
| 7. The FB fuel handling machine has an auxiliary hoist with sufficient load capability. | Load tests on the as-built auxiliary hoists will be conducted. | A successful load test of the as-built auxiliary hoist has been performed at 125% of rated load capacity. |
| 8. The FB fuel handling machine is provided with controls and interlocks. | Test will be performed with actual or simulated signals to demonstrate that the as-built interlocks function as required. | The required interlocks function as follows:Prevent collision with fuel pool walls or other structures;<br>• Limit travel of the fuel grapple;<br>• Interlock grapple hook engagement with hoist load and hoist up power; and<br>• Ensure correct sequencing of the transfer operation in the automatic or manual mode. |

## Table 2.5.5-1

## ITAAC For The Refueling Equipment

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 9. The RB refueling machine hoist (the mast and fuel grapple) is designed such that a single failure will not result in the loss of the capability to safely retain the load. | ~~Inspection of the as-built RB refueling machine hoist (the mast and fuel grapple) design documents will be performed for completion of the following inspections and tests:~~The following tests, type tests, and inspections will be performed: | The following tests have been successfully completed for the as-built RB refueling machine hoist (the mast and fuel grapple) so that a single failure will not result in the loss of the capability to safely retain the load: |
| | i. Nondestructive Examination on the welded structural connections of the RB refueling machine will be performed in accordance with ASME NOG-1, 2004, Paragraph 4251.4. | i. Nondestructive Examination on the welded structural connections of the RB refueling machine performed in accordance with ASME NOG-1, 2004, Paragraph 4251.4. |
| | ii. The RB refueling machine hoist will be static load-tested to 125% of the manufacturer's rated load. | ii. The RB refueling machine hoist has been static load-tested to 125% of the manufacturer's rated load. |
| | iii. A Full-Load Test on the RB refueling machine hoist will be performed in accordance with ASME NOG-1, 2004, Paragraph 7422. | iii. A Full-Load Test on the RB refueling machine hoist performed in accordance with ASME NOG-1, 2004, Paragraph 7422. |
| | iv. A No-Load Test on the RB refueling machine hoist will be performed in accordance with ASME NOG-1, 2004, Paragraphs 7421 and 7421.1. | iv. A No-Load Test on the RB refueling machine hoist performed in accordance with ASME NOG-1, 2004, Paragraphs 7421 and 7421.1. |

**Table 2.5.5-1**

**ITAAC For The Refueling Equipment**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| | v. Inspection of the rope drum, sheeve blocks, and hook component dimensions and material composition has been completed. | v. Inspection records show the rope drum, sheeve blocks, and hook component dimensions and material compositions match design specifications. |
| | vi. Inspection of the wire rope(s) for proper reeving has been completed. | vi. Inspection records show the wire rope (s) are correctly reeved. |
| 10. The FB fuel handling machine hoist (the mast and fuel grapple) is designed such that a single failure will not result in the loss of the capability to safely retain the load. | ~~Inspection of the FB fuel handling machine hoist (the mast and fuel grapple) design documents will be performed for completion of the following inspections and tests:~~The following tests, type test, and inspections will be performed: | The following tests have been successfully completed for the as-built FB fuel handling machine hoist (the mast and fuel grapple) so that a single failure will not result in the loss of the capability to safely retain the load: |
| | i. Nondestructive Examination on the welded structural connections of the FB fuel handling machine will be performed in accordance with ASME NOG-1, 2004, Paragraph 4251.4. | i. Nondestructive Examination on the welded structural connections of the FB fuel handling machine performed in accordance with ASME NOG-1, 2004, Paragraph 4251.4. |
| | ii. The FB fuel handling machine hoist will be static load-tested to 125% of the manufacturer's rated load. | ii. The FB fuel handling machine hoist has been static load-tested to 125% of the manufacturer's rated load. |
| | iii. A Full-Load Test on the FB fuel handling machine hoist will be performed in accordance with ASME NOG-1, 2004, Paragraph 7422. | iii. A Full-Load Test on the FB fuel handling machine hoist performed in accordance with ASME NOG-1, 2004, Paragraph 7422. |

## Table 2.5.5-1

## ITAAC For The Refueling Equipment

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| | iv. A No-Load Test on the FB fuel handling machine hoist will be performed in accordance with ASME NOG-1, 2004, Paragraphs 7421 and 7421.1.<br>v. Inspection of the rope drum, sheeve blocks, and hook component dimensions and material composition has been completed.<br>vi. Inspection of the wire rope(s) for proper reeving has been completed. | iv. A No-Load Test on the FB fuel handling machine hoist performed in accordance with ASME NOG-1, 2004, Paragraphs 7421 and 7421.1.<br>v. Inspection records show the rope drum, sheeve blocks, and hook component dimensions and material composition match design specifications.<br>vi. Inspection records show the wire rope (s) are correctly reeved. |
| 11. The FB fuel handling machine passes over the centers of gravity of heavy loads included in the certified design that are to be lifted. | Tests will be conducted of the as-built FB fuel handling machine. | The FB fuel handling machine passes over the centers of gravity of heavy loads included in the certified design that are to be lifted. |
| 12. The RB refueling machine passes over the centers of gravity of heavy loads included in the certified design that are to be lifted. | Tests will be conducted of the as-built RB refueling machine. | The RB refueling machine passes over the centers of gravity of heavy loads included in the certified design that are to be lifted. |

## 2.6 REACTOR AND CONTAINMENT AUXILIARY SYSTEMS

The following subsections describe the auxiliary systems for the ESBWR.

### 2.6.1 Reactor Water Cleanup/Shutdown Cooling System

**Design Description**

The Reactor Water Cleanup/Shutdown Cooling (RWCU/SDC) system purifies reactor coolant during normal operation and shutdown, provides shutdown cooling to bring the reactor to cold shutdown, and removes core decay heat to maintain cold shutdown. The RWCU/SDC system also provides long term post-LOCA shutdown cooling in the unlikely event there has been fuel failure. The RWCU/SDC system is as shown in Figure 2.6.1-1.

The containment isolation portions of the RWCU/SDC System are addressed in Subsection 2.15.1.

The environmental qualification of RWCU/SCS equipment is addressed in Section 3.8.

MCR alarms and remote operation features of mechanical equipment provided for the RWCU/SDC System are defined in Table 2.6.1-1.

(1) The functional arrangement of the RWCU/SDC system is as described in the Design Description of Subsection 2.6.1, Table 2.6.1-1, and as shown in Figure 2.6.1-1.

(2) (Deleted)

(3) a. The components identified in Table 2.6.1-1 as ASME Code Section III retain their pressure boundary integrity at their design pressure.

b. The piping identified in Table 2.6.1-1 as ASME Code Section III retains its pressure boundary integrity at its design pressure.

(4) (Deleted)

(5) Manual closure of the RPV bottom head isolation valve can be accomplished remotely.

(6) Each of the RWCU/SDC system containment isolation valves identified in Table 2.6.1-1 is powered from its respective safety-related division.

(7) The equipment identified in Table 2.6.1-1 as Seismic Category I can withstand Seismic Category I loads without loss of safety function.

(8) a1. The components identified in Table 2.6.1-1 as ASME Code Section III are designed in accordance with ASME Code Section III requirements.

a2. The components identified in Table 2.6.1-1 as ASME Code Section III shall be reconciled with the design requirements.

a3. The components identified in Table 2.6.1-1 as ASME Code Section III are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

b1. The piping identified in Table 2.6.1-1 as ASME Code Section III is designed in accordance with ASME Code Section III requirements.

b2. The as-built piping identified in Table 2.6.1-1 as ASME Code Section III shall be reconciled with the piping design requirements.

b3. The piping identified in Table 2.6.1-1 as ASME Code Section III is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

(9) a. Pressure boundary welds in components identified in Table 2.6.1-1 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements.

b. Pressure boundary welds in piping identified in Table 2.6.1-1 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements.

(10) a. Valves on lines attached to the RPV system that require maintenance have maintenance valves such that freeze seals will not be required.

b. The as-built location of valves on lines attached to the RPV system of the RWCU/SDC system that require maintenance shall be reconciled to design requirements.

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

Table 2.6.1-2 provides the inspections, tests, and analyses that will be undertaken for the RWCU/SDC system.

## 2.6.2 Fuel And Auxiliary Pools Cooling System

### Design Description

The Fuel and Auxiliary Pools Cooling System (FAPCS) provides cooling and cleaning of pools located in the containment, reactor building and fuel building during normal plant operation. The FAPCS provides flow paths for filling and makeup of these pools during normal plant operation and under post-accident conditions. The FAPCS provides suppression pool cooling and Low Pressure Coolant Injection (LPCI) as active backup of the passive containment heat removal systems.

The FAPCS is as shown in Figure 2.6.2-1.

The containment isolation portions of the FAPCS are addressed in Subsection 2.15.1.

The FAPCS alarms, displays, and status indications in the MCR are addressed by Section 3.3.

~~Equipment~~ Environmental qualification for the FAPCS equipment is addressed in Section 3.8.

(1) The functional arrangement of the FAPCS is as described in the Design Description of this Subsection 2.6.2 and as shown in Figure 2.6.2-1.

(2) a1. The components identified in Table 2.6.2-1 as ASME Code Section III are designed in accordance with ASME Code Section III requirements.

a2. The components identified in Table 2.6.2-1 as ASME Code Section III shall be reconciled with the design requirements.

a3. The components identified in Table 2.6.2-1 as ASME Code Section III are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

b1. The piping identified in Table 2.6.2-1 as ASME Code Section III is designed in accordance with ASME Code Section III requirements.

b2. The as-built piping identified in Table 2.6.2-1 as ASME Code Section III shall be reconciled with the piping design requirements.

b3. The piping identified in Table 2.6.2-1 as ASME Code Section III is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

(3) a. Pressure boundary welds in components identified in Table 2.6.2-1 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements.

b. Pressure boundary welds in piping identified in Table 2.6.1-1 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements.

(4) a. The components identified in Table 2.6.2-1 as ASME Code Section III retain their pressure boundary integrity at their design pressure.

b. The piping identified in Table 2.6.2-1 as ASME Code Section III retains its pressure boundary integrity at its design pressure.

(5) The equipment identified in Table 2.6.2-1 as Seismic Category I can withstand Seismic Category I loads without loss of safety function.

(6) (Deleted)

(7) a. The FAPCS performs the nonsafety-related suppression pool cooling functions.

b. The FAPCS performs the nonsafety-related low-pressure coolant injection function.

c. The FAPCS provides the nonsafety-related external connection for emergency water to IC/PCCS pool and Spent Fuel Pool functions.

(8) (Deleted)

(9) Safety-related Llevel instruments with adequate operating ranges are provided for the Spent Fuel Pool, buffer pool, and IC/PCCS pools.

(10) (Deleted)

(11) Following a loss of active cooling without makeup that persists for 72 hours, the water level in the Spent Fuel Pool remains above the top of active fuel.

(12) Following a loss of active cooling without makeup that persists for 72 hours, the water level in the Buffer Pool remains above the top of active fuel.

(13) a. Valves on lines attached to the RPV that require maintenance have maintenance valves such that freeze seals will not be required.

b. The as-built location of valves on lines attached to the RPV in the FAPCS that require maintenance shall be reconciled to design requirements

(14) Lines that are submerged in the spent fuel pool or buffer pool are equipped with redundant anti-siphon holes that will preserve the a water inventory above TAF sufficient for safe shielding in the event of a break at a lower elevation.

(15) For allAll low-pressure coolant injection piping and components between the RWCU/SDC System and the FAPCS, including the check valves and motor operated valves, are designed tothe ultimate rupture strength can withstand the full reactor pressure.

(16) The nonsafety-related control cables, instrument cables and power cables for equipment in the FAPCS trains A and B are physically separated and electrically independent.

(17) The nonsafety-related control cables, instrument cables and power cables for equipment in the FAPCS trains A and B are physically separated.

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

Table 2.6.2-2 provides a definition of the inspections, tests and analyses, together with associated acceptance criteria for the FAPCS.

## Table 2.6.2-2

## ITAAC For The Fuel and Auxiliary Pools Cooling System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The functional arrangement of the FAPCS is as described in the Design Description of Subsection 2.6.2 and as shown in Figure 2.6.2-1. | Inspections of the as-built system will be conducted. | The as-built FAPCS conforms to the functional arrangement described in Subsection 2.6.2 and as shown on Figure 2.6.2-1. |
| 2a1. The components identified in Table 2.6.2-1 as ASME Code Section III are designed in accordance with ASME Code Section III requirements. | Inspection of ASME Code Design Reports (NCA-3550) and required documents will be conducted. | ASME Code Design Reports (NCA-3550) (certified, when required by ASME Code) exist and conclude that the design of the components identified in Table 2.6.2-1 as ASME Code Section III complies with the requirements of ASME Code Section III including those stresses applicable to loads related to fatigue (including environmental effects), thermal expansion, seismic, and combined. |
| 2a2. The components identified in Table 2.6.2-1 as ASME Code Section III shall be reconciled with the design requirements. | A reconciliation analysis of the components identified in Table 2.6.2-1 as ASME Code Section III using as-designed and as-built information and ASME Code Design Reports (NCA-3550) will be performed. | ASME Code Design Report(s) (NCA-3550) (certified, when required by ASME Code) exist and conclude that design reconciliation has been completed, in accordance with ASME Code, for as-built reconciliation of the components identified in Table 2.6.2-1 as ASME Code Section III. The report documents the results of the reconciliation analysis. |

## Table 2.6.2-2

## ITAAC For The Fuel and Auxiliary Pools Cooling System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 2a3. The components identified in Table 2.6.2-1 as ASME Code Section III are fabricated, installed, and inspected in accordance with ASME Code Section III requirements. | Inspection of the components identified in Table 2.6.2-1 as ASME Code Section III will be conducted. | ASME Code Data Report(s) (including N-5 Data Reports, where applicable) (certified, when required by ASME Code) and inspection reports exist and conclude that the components identified in Table 2.6.2-1 as ASME Code Section III are fabricated, installed, and inspected in accordance with ASME Code Section III requirements. |
| 2b1. The piping identified in Table 2.6.2-1 as ASME Code Section III is designed in accordance with ASME Code Section III requirements. | Inspection of ASME Code Design Reports (NCA-3550) and required documents will be conducted.<br>{{Design Acceptance Criteria}} | ASME Code Design Report(s) (NCA-3550) (certified, when required by ASME Code) exist and conclude that the design of the piping identified in Table 2.6.2-1 as ASME Code Section III complies with the requirements of the ASME Code, Section III, including those stresses applicable to loads related to fatigue (including environmental effects), thermal expansion, seismic, and combined.<br>{{Design Acceptance Criteria}} |
| 2b2. The as-built piping identified in Table 2.6.2-1 as ASME Code Section III shall be reconciled with the piping design requirements. | A reconciliation analysis of the piping identified in Table 2.6.2-1 as ASME Code Section III using as-designed and as-built information and ASME Code Design Reports (NCA-3550) will be performed. | ASME Code Design Report(s) (NCA-3550) (certified, when required by ASME Code) exist and conclude that design reconciliation has been completed, in accordance with ASME Code, for as-built reconciliation of the piping identified in Table 2.6.2-1 as ASME Code Section III. The report documents the results of the reconciliation analysis. |

## Table 2.6.2-2

## ITAAC For The Fuel and Auxiliary Pools Cooling System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 2b3. The piping identified in Table 2.6.2-1 as ASME Code Section III is fabricated, installed, and inspected in accordance with ASME Code Section III requirements. | Inspections of the piping identified in Table 2.6.2-1 as ASME Code Section III will be conducted. | ASME Code Design Report(s) (NCA-3550) (certified, when required by ASME Code) exist and conclude that design reconciliation has been completed, in accordance with ASME Code, for as-built reconciliation of the piping identified in Table 2.6.2-1 as ASME Code Section III. The report documents the results of the reconciliation analysis. |
| 3a. Pressure boundary welds in components identified in Table 2.6.2-1 as ASME Code Section III meet ASME Code Section III non-destructive requirements. | Inspection of the as-built pressure boundary welds in components identified in Table 2.6.2-1 as ASME Code Section III will be performed in accordance with ASME Code Section III. | ASME Code report(s) exist and conclude that ASME Code Section III requirements are met for non-destructive examination of pressure boundary welds in components identified in Table 2.6.2-1 as ASME Code Section III. |
| 3b. Pressure boundary welds in piping identified in Table 2.6.2-1 as ASME Code Section III meet ASME Code Section III non-destructive requirements. | Inspection of the as-built pressure boundary welds in piping identified in Table 2.6.2-1 as ASME Code Section III will be performed in accordance with ASME Code Section III. | ASME Code report(s) exist and conclude that ASME Code Section III requirements are met for non-destructive examination of pressure boundary welds in piping identified in Table 2.6.2-1 as ASME Code Section III. |
| 4a. Pressure boundary welds in piping identified in Table 2.6.2-1 as ASME Code Section III meet ASME Code Section III requirements. | A hydrostatic test will be conducted on those code components identified in Table 2.6.2-1 as ASME Code Section III that are required to be hydrostatically tested by ASME Code Section III. | ASME Code Data Report(s) exist and conclude that the results of the hydrostatic test of components identified in Table 2.6.2-1 as ASME Code Section III comply with the requirements of ASME Code Section III. |

**Table 2.6.2-2**

**ITAAC For The Fuel and Auxiliary Pools Cooling System**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 4b. The piping identified in Table 2.6.2-1 as ASME Code Section III retains its pressure boundary integrity at its design pressure. | A hydrostatic test will be conducted on the code piping identified in Table 2.6.2-1 as ASME Code Section III that is required to be hydrostatically tested by ASME Code Section III. | ASME Code Data Report(s) exist and conclude that the results of the hydrostatic test of piping identified in Table 2.6.2-1 as ASME Code Section III comply with the requirements in ASME Code Section III. |
| 5. The equipment identified in Table 2.6.2-1 as Seismic Category I can withstand Seismic Category I loads without loss of safety function. | i. Inspection will be performed to verify that the Seismic Category I equipment identified in Table 2.6.2-1 are located in a Seismic Category I structure.<br>ii. Type tests, analyses, or a combination of type tests and analyses, of equipment identified in Table 2.6.2-1 as Seismic Category I, will be performed using analytical assumptions, or will be performed under conditions which bound the Seismic Category I equipment design requirements.<br>iii. Inspections and analyses will be performed to verify that the as-built equipment identified in Table 2.6.2-1, including anchorage, is bounded by the testing or analyzed conditions. | i. The equipment identified as Seismic Category I in Table 2.6.2-1 is located in a Seismic Category I structure.<br>ii. The equipment identified in Table 2.6.2-1 as Seismic Category I can withstand Seismic Category I loads without loss of safety function.<br>iii. The as-built equipment identified in Table 2.6.2-1 including anchorage, can withstand Seismic Category I loads without loss of safety function. |

**Table 2.6.2-2**

**ITAAC For The Fuel and Auxiliary Pools Cooling System**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 6. (Deleted) | | |
| 7a. The FAPCS performs the nonsafety-related suppression pool cooling functions. | i. Perform a test to confirm the flow path and minimum flow rate between the FAPCS and the suppression pools.<br>ii. Perform a type test to confirm the heat transfer capacity of the FAPCS heat exchanger.<br>iii. Inspection of as-built FAPCS suppression pool suction intake will be performed to confirm the presence of a suction strainer with perforated plate hole sizes of ≤ 2.508 mm (0.0988 inches). | i. The cooling flow path is demonstrated and confirmed by operation of the function. The flow rate is ≥ 567.8 $m^3$/hr (2500 gal/min).<br>ii. The design heat removal capacity of a single FAPCS train is ≥ 8.3 MW under the following conditions:<br>• Primary and secondary side flow rate ≤ 567.8 $m^3$/hr (2500 gpm)<br>• Process inlet temperature ≤ 48.9ºC (120ºF)<br>• Cooling water inlet temperature of ≥ 35ºC (95ºF)<br>iii. A suction strainer with perforated plate hole sizes of ≤ 2.508 mm (0.0988 inches) is present on FAPCS suppression pool suction intake. |
| 7b. The FAPCS performs the nonsafety-related low-pressure coolant injection functions. | Perform a test to confirm the flow path and minimum flow rate from the FAPCS to the RWCU/SDC system. | The injection flow path is demonstrated and confirmed by operation of the function. The flow rate is ≥ 340 m3/hr (1500 gal/min) at a differential pressure > 1.03 MPa (150 psi) and < 1.05 MPa (152 psi). |

## Table 2.6.2-2

## ITAAC For The Fuel and Auxiliary Pools Cooling System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 7c. The FAPCS provides the nonsafety-related external connection for emergency water to IC/PCCS pool and Spent Fuel Pool functions. | Perform a test to confirm flow path and flow capacity from the Fire Protection System and offsite water sources to the pools. | The makeup water flow path is demonstrated and confirmed by operation of the function. |
| 8. (Deleted) | | |
| 9. Safety-related ~~L~~level instruments with adequate operating ranges are provided for the Spent Fuel Pool, buffer pool, and IC/PCCS pools. | Inspections of the FAPCS will be conducted to verify that level instruments with adequate operating ranges are provided for the Spent Fuel Pool and IC/PCCS pools. | The as-built FAPCS provides Spent Fuel Pool, buffer pool, and IC/PCCS pool level instrumentation with adequate operating ranges.<br>• Instruments for the SFP and buffer pool accurately indicate pool level over the range from normal water level to the top of the active fuel.<br>• Instruments for the IC/PCCS pools accurately indicated pool level over the range normal water level to the midpoint of the IC heat exchanger tube. |
| 10. (Deleted) | | |
| 11. Following a loss of active cooling without makeup that persists for 72 hours, the water level in the Spent Fuel Pool remains above the top of active fuel. | Inspection of the Spent Fuel Pool as-built dimensions will be performed to determine the elevation of the pool weir relative to the bottom of the pool and the free volume between the top of the active fuel and the weir elevation. | The elevation of the Spent Fuel Pool weir relative to the bottom of the pool is at least 14.35 m (47 ft) and that there is at least 1690 $m^3$ (59681 $ft^3$) of free volume above the top of the active fuel that can be filled with water. |

## Table 2.6.2-2

## ITAAC For The Fuel and Auxiliary Pools Cooling System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 12. Following a loss of active cooling without makeup that persists for 72 hours, the water level in the Buffer Pool remains above the top of active fuel. | Inspection of the Buffer Pool as-built dimensions will be performed to determine the elevation of the pool weir relative to the bottom of the pool and the free volume between the top of the active fuel and the weir elevation. | The elevation of the Buffer Pool weir relative to the bottom of the pool is at least 6.7 m (22 ft) and that there is at least 288 $m^3$ (10,100 $ft^3$) of free volume above the top of the active fuel that can be filled with water. |
| 13a. Valves on lines attached to the RPV that require maintenance have maintenance valves such that freeze seals will not be required. | Inspections of piping design isometric drawings will be conducted.<br>{{Design Acceptance Criteria}} | A review of piping design isometric drawings confirms that maintenance valves are included such that freeze seals will not be required.<br>{{Design Acceptance Criteria}} |
| 13b. The as-built location of valves on lines attached to the RPV in the FAPCS that require maintenance shall be reconciled to design requirements. | A reconciliation evaluation of valves on lines attached to the RPV that require maintenance using as-designed and as-built information will be performed | A design reconciliation has been completed for the as-built location of valves relative to the design requirements. The report documents the results of the reconciliation evaluation. |
| 14. Lines that are submerged in the spent fuel pool or buffer pool are equipped with redundant anti-siphon holes that will preserve ~~the~~ a water inventory above TAF sufficient for safe shielding in the event of a break at a lower elevation. | Inspection of as-built submerged piping in the Spent Fuel Pool and Buffer Pool will be performed to confirm the presence of redundant anti-siphon holes. | Redundant anti-siphon holes are present on all submerged piping in the Spent Fuel Pool and Buffer Pool to preserve the water inventory to a minimum of 3.05 m (10.0 ft) above TAF in the event of a break at a lower elevation. |

## Table 2.6.2-2

## ITAAC For The Fuel and Auxiliary Pools Cooling System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 15. For all~~All~~ low-pressure coolant injection piping and components between the RWCU/SDC System and the FAPCS, including the check valves and motor operated valves, ~~are designed to~~the ultimate rupture strength can withstand the full reactor pressure. | Inspection and analysis to verify the ultimate rupture strength of the as-built low-pressure coolant injection piping between the RWCU/SDC System and the nonsafety-related motor operated valves will be performed. | ~~The~~ For the as-built low-pressure coolant injection piping and components between the RWCU/SDC System and the FAPCS, including the check valves and motor operated valves, ~~are designed to~~the ultimate rupture strength can withstand the full reactor pressure. |
| 16. The nonsafety-related control cables, instrument cables and power cables for equipment in the FAPCS trains A and B are ~~physically separated and~~ electrically independent. | ~~i.~~ Tests of the nonsafety-related control cables, instrument cables and power cables for equipment in the FAPCS trains A and B will be performed to show electrical independence. | ~~i.~~ The nonsafety-related control cables, instrument cables and power cables for equipment in the FAPCS trains A and B are electrically independent. |
| 17. The nonsafety-related control cables, instrument cables and power cables for equipment in the FAPCS trains A and B are physically separated | ~~ii.~~ Inspections of the nonsafety-related control cables, instrument cables and power cables for equipment in the FAPCS trains A and B will be performed to show physical separation. | ~~ii.~~ The nonsafety-related control cables, instrument cables and power cables for equipment in the FAPCS trains A and B are physically separated as defined by IEEE-384. |

## 2.11 POWER CYCLE

The following subsections describe the major power cycle (i.e., generation) systems for the ESBWR.

### 2.11.1 Turbine Main Steam System

**Design Description**

The Turbine Main Steam System (TMSS) supplies steam generated in the reactor to the Turbine Generator, moisture separator reheaters, steam auxiliaries and turbine bypass system. The TMSS does not include the seismic interface restraint, main turbine stop valves or bypass valves.

The TMSS consists of four lines from the seismic interface restraint to the main turbine stop valves. The TMSS is nonsafety-related. Regulatory Guide 1.26 Quality Group B portions of the TMSS are designed in accordance with ASME Boiler and Pressure Vessel Code, Section III, Class 2 requirements. The TMSS is located in the Reactor Building steam tunnel and Turbine Building.

The Regulatory Guide 1.26 Quality Group B portions of the TMSS are those portions of the Main Steam Lines that extend from the seismic interface restraint (or seismic guide) to the turbine stop valves (non-inclusive), turbine bypass valves (non-inclusive) and the connecting branch lines (nominal 6.35 cm. (2.5 in) and larger) up to and including the first isolation valve which is either normally closed or capable of automatic closure during all modes of normal reactor operation. This defines the portions of the TMSS subject to ASME Code Section III Class 2 requirements. Figure 2.11.1-1 shows the functional arrangement and class changes to identify the scope equipment within the TMSS.

(1) The TMSS functional arrangement is as described in Subsection 2.11.1 and as shown on Figure 2.11.1-1.

(2) a1. The ASME Code Section III components of the TMSS are designed in accordance with ASME Code Section III requirements.

a2. The ASME Code Section III components of the TMSS shall be reconciled with the design requirements.

a3. The ASME Code Section III components of the TMSS are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

b1. The ASME Code Section III components ~~identified in Table 2.11.1-1~~ of the TMSS retain their pressure boundary integrity at their design pressure.

b2. The ASME Code Section III piping of the TMSS retains its pressure boundary integrity at its design pressure.

(3) Upon receipt of an MSIV closure signal, the Steam Auxiliary Isolation Valve(s) close(s) and required MSIV fission product leakage path TMSS drain valve(s) open(s).

(4) The Steam Auxiliary Isolation Valve(s) fail(s) closed and required MSIV fission product leakage path TMSS drain valve(s) fail(s) open on loss of electrical power to the valve actuating solenoid or on loss of pneumatic pressure.

(5) TMSS piping, which consists of the piping (including supports) for the MSL from the seismic interface restraint (or seismic guide) to the turbine stop valves (non-inclusive), turbine bypass valves (non-inclusive) and the connecting branch lines (nominal 6.35 cm. (2.5 in.) and larger up to and including the first isolation valve which is either normally closed or capable of automatic closure during all modes of normal reactor operation, is classified as Seismic Category II.

(6) The integrity of the as-built MSIV leakage path to the condenser (main steam piping, bypass piping, required drain piping, and main condenser as shown on Figure 2.11.1-1) is not compromised by non-seismically designed systems, structures and components.

(7) The non-seismic portion of the MSIV leakage path to the condenser (main steam piping from the stop valve (inclusive) to turbine nozzle, bypass piping, required drain piping, and main condenser) maintains structural integrity under SSE loading conditions.

(8) The TMSS piping is sized to ensure that reactor pressure vessel (RPV) dome to turbine stop valve pressure drop, total main steam system volume, and steamline length are consistent with assumptions in AOO analyses.

(9) a. The TMSS piping portion designated as ASME Code Section III is designed in accordance with ASME Code Section III requirements and Seismic Category II requirements.

b. The as-built TMSS piping portion designated as ASME Code Section III shall be reconciled with the piping design requirements.

c. The TMSS piping portion designated as ASME Code Section III is fabricated, installed, and inspected in accordance with ASME Code Section III requirements..

(10) a. Pressure boundary welds in the ASME Code Section III components of TMSS meet ASME Code Section III non-destructive examination requirements.

b. Pressure boundary welds in the ASME Code Section III piping of the TMSS meet the ASME Code Section III non-destructive examination requirements.

(11) a. Valves on lines attached to the RPV that require maintenance have maintenance valves installed such that freeze seals will not be required.

b. The as-built location of valves on lines attached to the RPV in the TMSS that require maintenance shall be reconciled to design requirements.

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

Table 2.11.1-1 provides a definition of the inspections, tests, and analyses, together with associated acceptance criteria for the TMSS.

**Table 2.11.1-1**

**ITAAC For The Turbine Main Steam System**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The TMSS functional arrangement is as described in Subsection 2.11.1 and as shown on Figure 2.11.1-1. | Inspections of the as-built system will be conducted. | The as-built TMSS conforms to the functional arrangement description in Subsection 2.11.1 and as shown on Figure 2.11.1-1. |
| 2a1. The ASME Code Section III components of the TMSS are designed in accordance with ASME Code Section III requirements. | Inspection of ASME Code Design Reports (NCA-3550) and required documents will be conducted. | ASME Code Design Report(s) (NCA-3550) (certified, when required by ASME Code) exist and conclude that the design of the ASME code components of the TMSS complies with the requirements of the ASME Code Section III. |
| 2a2. The ASME Code Section III components of the TMSS shall be reconciled with the design requirements. | A reconciliation analysis of the components using as-designed and as-built information and ASME Code Design Reports (NCA-3550) will be performed. | ASME Code Design Report(s) (certified, when required by ASME Code) exist and conclude that design reconciliation has been completed in accordance with the ASME Code for as-built reconciliation of the ASME Code Section III components of the TMSS. |
| 2a3. The ASME code components of the TMSS are fabricated, installed, and inspected in accordance with ASME Code Section III requirements. | Inspection of the components will be conducted. | ASME Code Data Report(s) (including N-5 Data reports, where applicable) (certified, when required by ASME code) and inspection reports exist and conclude that the ASME Code Section III components of the TMSS are fabricated, installed, and inspected in accordance with ASME Code Section III requirements. |

**Table 2.11.1-1**

**ITAAC For The Turbine Main Steam System**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 2b1. The ASME Code Section III components of the TMSS retain their pressure boundary integrity at their design pressure. | A hydrostatic test will be conducted on those Code components of the TMSS required to be hydrostatically tested by the ASME Code. | ASME Code Data Report(s) exist and conclude that the results of the hydrostatic test of the ASME ode components of the TMSS comply with the requirements of the ASME Code Section III. |
| 2b2. The ASME Code Section III piping of the TMSS retains its pressure boundary integrity at its design pressure. | A hydrostatic test will be conducted on the code piping of the TMSS required to be hydrostatically tested by the ASME Code. | ASME Code Data Report(s) exist and conclude that the results of the hydrostatic test of the ASME Code piping of the TMSS comply with the requirements of the ASME Code Section III. |
| 3. Upon receipt of an MSIV closure signal, the Steam Auxiliary Isolation Valve(s) close(s) and required MSIV fission product leakage path TMSS drain valve(s) open(s). | Tests will be performed on the Steam Auxiliary Isolation Valves(s) and required MSIV fission product leakage path TMSS drain valve(s) using simulated MSIV closure signals. | The Steam Auxiliary Isolation Valve(s) close(s) and required MSIV fission product leakage path TMSS drain valve(s) open(s) following receipt of a simulated MSIV closure signal. |
| 4. The Steam Auxiliary Isolation Valve(s) fail(s) closed and required MSIV fission product leakage path TMSS drain valve(s) fail(s) open on loss of electrical power to the valve actuating solenoid or on loss of pneumatic pressure. | A functional test will be performed on Steam Auxiliary Isolation Valve(s) and required MSIV fission product leakage path TMSS drain valve(s). | The Steam Auxiliary Isolation Valve(s) fail(s) closed and required MSIV fission product leakage path TMSS drain valve(s) fail(s) open on loss of electrical power to the valve actuating solenoid or on loss of pneumatic pressure. |

**Table 2.11.1-1**

**ITAAC For The Turbine Main Steam System**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 5. TMSS piping, which consists of the piping (including supports) for the MSL from the seismic interface restraint (or seismic guide) to the turbine stop valves (non-inclusive), turbine bypass valves (non-inclusive) and the connecting branch lines (nominal 6.35 cm. (2.5 in) and larger) up to and including the first isolation valve which is either normally closed or capable of automatic closure during all modes of normal reactor operation, is classified as Seismic Category II. | An inspection will be performed to verify that a seismic analysis has been completed for the as-built TMSS piping. | The as-built TMSS piping, which consists of the piping (including supports) for the MSL from the seismic interface restraint (or seismic guide) to the turbine stop valves (non-inclusive), turbine bypass valves (non-inclusive) and the connecting branch lines 6.35 cm. (2.5 in.) and larger up to and including the first isolation valve which is either normally closed or capable of automatic closure during all modes of normal reactor operation, meets Seismic Category II requirements. |
| 6. The integrity of the as-built MSIV leakage path to the condenser (main steam piping, bypass piping, required drain piping, and main condensers as shown on Figure 2.11.1-1) is not compromised by non-seismically designed systems, structures and components. | Inspections and analysis of non-seismically designed systems, structures and components overhead, adjacent to, and attached to the MSIV leakage path (i.e., the main steam piping, bypass piping, required drain piping and main condenser) will be performed. The as-built non-seismic systems, structures, and components will be reconciled through inspection and analysis with the results of the initial inspection and analysis. | The as-built non-seismically designed systems, structures and components overhead, adjacent to, and attached to the MSIV leakage path to the condenser will not compromise the integrity of the main steam piping, bypass piping, required drain piping and main condenser. |

## Table 2.11.1-1

## ITAAC For The Turbine Main Steam System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 7. The non-seismic portion of the MSIV leakage path to the condenser (main steam piping from the stop valve (inclusive) to turbine nozzle, bypass piping, required drain piping, and main condenser) maintains structural integrity under SSE loading conditions | An analysis of the as-built non-seismic portion of the MSIV leakage path to the condenser will be performed to verify that it maintains structural integrity under SSE loading conditions. | The as-built non-seismic portion of the MSIV leakage path to the condenser (main steam piping from the stop valve (inclusive) to turbine nozzle, bypass piping, required drain piping, and main condenser) maintains structural integrity under SSE loading conditions. |
| 8. The TMSS piping is sized to ensure that RPV dome to turbine stop valve pressure drop, total main steam system volume, and steamline length are consistent with assumptions in Abnormal Event analyses. | Inspection and analysis of the as-built TMSS piping will be performed to confirm RPV to turbine calculated pressure drop, total main steam system volume, and steamline length are consistent with assumptions in Abnormal Events analyses. | The TMSS piping is sized to be consistent with these Abnormal Events analyses inputs:<br>• Minimum Steamline Pressure Drop from RPV Dome to Turbine Throttle at rated conditions: 0.179 MPa (26 psi)<br>• Minimum Main Steam System Volume: 103.3 $m^3$ (3648 $ft^3$)<br>• Minimum Steamline Length: 65.26 m (214.1 ft) |

## Table 2.11.1-1

## ITAAC For The Turbine Main Steam System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 9a. The TMSS piping portion designated as ASME Code Section III is designed in accordance with ASME Code Section III requirements and Seismic Category II requirements. | Inspection of ASME code Design Reports (NCA-3550) and required documents will be conducted.<br>{{Design Acceptance Criteria}} | ASME Code Design Report(s) (NCA-3550) (certified, when required by ASME Code) exist and conclude that the design of the TMSS piping portion designated as ASME Code Section III complies with the requirements of the ASME Code, Section III, and meets Seismic Category II requirements.<br>{{Design Acceptance Criteria}} |
| 9b. The as-built TMSS piping portion designated as ASME Code Section III shall be reconciled with the piping design requirements. | A reconciliation analysis of the piping using the as-designed and as-built information and ASME code Design Reports (NCA-3550) will be performed. | ASME Code Design Report(s) (certified, when required by ASME Code) exist and conclude that design reconciliation has been completed in accordance with the ASME code for as-built reconciliation of the TMSS piping portion designated as ASME Code Section III. The report documents the results of the reconciliation analysis. |
| 9c. The TMSS piping portion designated as ASME Code Section III is fabricated, installed, and inspected in accordance with ASME Code Section III requirements. | Inspections of the piping will be conducted. | ASME Code Data Report(s) (certified, when required by ASME code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the TMSS piping portion designated as ASME Code Section III is fabricated, installed, and inspected in accordance with ASME Code Section III requirements. |

## Table 2.11.1-1

## ITAAC For The Turbine Main Steam System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 10a. Pressure boundary welds in the ASME Code Section III components of TMSS meet ASME Code Section III non-destructive examinations requirements. | Inspection of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III. | ASME Code Report(s) exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of pressure boundary welds in the TMSS components. |
| 10b. Pressure boundary welds in the ASME Code Section III piping of the TMSS meet the ASME Code Section III non-destructive examinations requirements. | Inspection of the as-built pressure boundary welds will be performed in accordance with the ASME Code Section III. | ASME Code Report(s) exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of pressure boundary welds in the TMSS piping. |
| 11a. Valves on lines attached to the RPV that require maintenance have maintenance valves installed such that freeze seals will not be required. | Inspections of piping design isometric drawings will be conducted.<br>{{Design Acceptance Criteria}} | A review of piping design isometric drawings confirms that maintenance valves are included such that freeze seals will not be required.<br>{{Design Acceptance Criteria}} |
| 11b. The as-built location of valves on lines attached to the RPV in the TMSS that require maintenance shall be reconciled to design requirements. | A reconciliation evaluation of valves on lines attached to the RPV that require maintenance using as-designed and as-built information will be performed. | A design reconciliation has been completed for the as-built location of valves relative to the design requirements. The report documents the results of the reconciliation evaluation. |

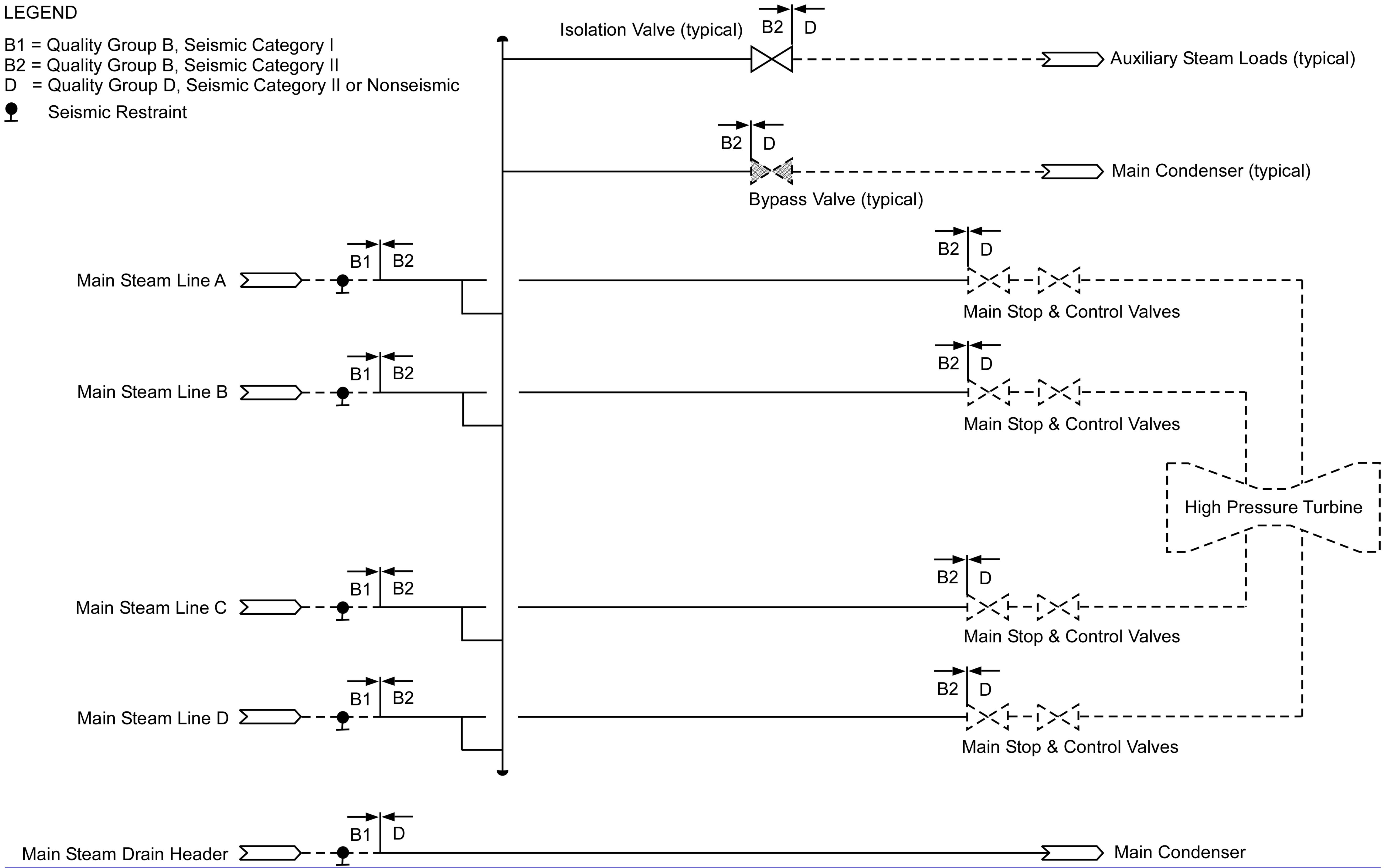


**Figure 2.11.1-1. TMSS Functional Arrangement**

## Table 2.12.3-1

## ITAAC For The Reactor Component Cooling Water System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The RCCWS functional arrangement is as described in the Design Description of ~~Section~~ Subsection 2.12.3 and as shown on Figure 2.12.3-1. | Inspection of the as-built system will be performed. | The as-built RCCWS System conforms to the functional arrangement described in the Design Description of this ~~Section~~ Subsection 2.12.3 and as shown on Figure 2.12.3-1. |
| 2. The RCCWS provides the nonsafety-related function to support post-72 hour cooling for nuclear island chillers and standby diesel generators and provides cooling support for FAPCS. | Testing of the RCCWS will be performed to demonstrate flow to the nuclear island chillers, standby diesel generators and FAPCS. | The RCCWS test demonstrates flow to the nuclear island chillers, standby diesel generators, and to support operation of FAPCS. |
| 3. The RCCWS can be operated and controlled from the MCR. | Testing to demonstrate RCCWS flow capability will be performed on the RCCWS components using controls in the MCR. | The MCR controls caused the RCCWS components to operate during the flow test. |
| 4. RCCWS flow indication is provided in the MCR. | Inspection will verify that RCCWS flow indication can be retrieved in the MCR. | The RCCWS flow indication can be retrieved in the MCR. |

## Table 2.12.5-1

## ITAAC For The Chilled Water System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The NICWS functional arrangement is described in the Design Description of Subsection 2.12.5 and as shown on Figure 2.12.5-1. | Inspection of the as-built system will be performed. | The as-built NICWS System conforms to the functional arrangement as described in the Design Description of this ~~Section~~ Subsection 2.12.5 and as shown on Figure 2.12.5-1. |
| 2. The NICWS provides the nonsafety-related function to support post-72 hour cooling for RCCWS and HVAC systems. | Testing of the NICWS will be performed to demonstrate flow to the RCCWS and HVAC systems. | The NICWS test demonstrates flow to the RCCWS and HVAC systems. |
| 3. The NICWS can be operated and controlled from the MCR. | Testing will be performed to demonstrate NICWS flow capability will be performed on the NICWS components using controls in the MCR. | The MCR controls caused the NICWS components to operate during the flow test. |
| 4. NICWS flow indication is provided in the MCR. | Inspection will verify that NICWS flow indication can be retrieved in the MCR. | The NICWS flow indication can be retrieved in the MCR. |
| 5. (Deleted) | | |

## 2.12.7 Plant Service Water System

### Design Description

The Plant Service Water System (PSWS) does not perform or ensure any safety-related function, is not required to achieve or maintain safe shutdown, and has no interface with any safety-related component.

The functional arrangement of the PSWS is shown on Figure 2.12.7-1.

(1) The PSWS functional arrangement is as described in the Design Description of ~~Section~~ Subsection 2.12.7 and as shown on Figure 2.12.7-1.

(2) The PSWS provides the nonsafety-related functions to support post-72 hour cooling for RCCWS.

(3) The PSWS can be initiated and controlled from the MCR.

(4) PSWS flow indication is provided in the MCR.

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

Table 2.12.7-1 provides definitions of the inspections, tests, and analyses, together with associated acceptance criteria for the PSWS.

**Table 2.12.7-1**

**ITAAC For The Plant Service Water System**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The PSWS functional arrangement is as described in the Design Description of ~~Section~~ Subsection 2.12.7 and as shown on Figure 2.12.7-1. | Inspection of the as-built system will be performed. | The as-built PSWS System conforms to the functional arrangement as described in the Design Description of ~~Section~~ Subsection 2.12.7 and as shown on Figure 2.12.7-1. |
| 2. The PSWS provides the nonsafety-related functions to support post-72 hour cooling for RCCWS. | Testing of the PSWS will be performed to demonstrate flow to the RCCWS. | The test of PSWS demonstrates flow to the RCCWS. |
| 3. The PSWS can be initiated and controlled from the MCR. | Testing will be performed to demonstrate flow capability on the PSWS components using controls in the MCR. | The MCR controls caused the PSWS components to initiate and control flow during the test. |
| 4. PSWS flow indication is provided in the MCR. | Inspection will verify that PSWS flow indication can be retrieved in the MCR. | The PSWS flow indication can be retrieved in the MCR. |

# 2.13 ELECTRICAL SYSTEMS

## 2.13.1 Electric Power Distribution System

### Design Description

The purpose of the Electric Power Distribution System is to provide power to the power generation nonsafety-related loads and the plant's investment protection (PIP) nonsafety-related loads. The PIP buses also supply power to the four (4) safety-related, 480VAC, Isolation Power Center buses and the two (2) ancillary diesel buses. The nonsafety-related PIP buses and ancillary diesel buses have a function to supply power to RTNSS credited loads.

The Electric Power Distribution System alarms, displays, controls, and status indications in the main control room are addressed by Section 3.3.

~~Equipment~~ Environmental qualification of safety-related 480 VAC Isolation Power Center equipment is addressed in Section 3.8.

(1) The functional arrangement of Electric Power Distribution System is as described in the Design Description of Subsection 2.13.1 and Table 2.13.1-1, and as shown on Figure 2.13.1-1.

(2) The 480 VAC Isolation Power Center equipment identified as Seismic Category I in Table 2.13.1-1 can withstand Seismic Category I loads without loss of safety function.

(3) a. Independence is provided between safety-related divisions as ~~required by~~ defined in Regulatory Guide 1.75.

b. ~~Separation is~~ Physical separation and electrical isolation are provided between safety-related divisions, and between safety-related divisions and nonsafety-related equipment as ~~required by~~ defined in Regulatory Guide 1.75.

(4) Each safety-related Isolation Power Center supplies power to safety-related loads in its respective division.

(5) Isolation Power Centers and their associated loads are protected against under voltage, degraded voltage and under-frequency conditions.

(6) a. The Electric Power Distribution System provides the capability for distributing nonsafety-related AC power from onsite sources to nonsafety-related RTNSS loads.

b. The Electric Power Distribution System provides a PIP bus under voltage signal to trip the PIP bus normal and alternate preferred power supply breakers.

(7) (Deleted)

(8) (Deleted)

(9) Equipment within the onsite portion of the Preferred Power Supply (PPS) is rated to supply necessary load requirements, including power, voltage, and frequency, during design basis operating modes.

(10) Equipment within the onsite portion of the PPS is rated to interrupt analyzed fault currents, including the fault current contribution from the offsite portion of the PPS.

(11) a. The onsite portions of the normal preferred power supply circuits are physically separate from the onsite portions of the alternate preferred power supply circuits from the Unit Auxiliary Transformer (UAT) and Reserve Auxiliary Transformer (RAT) to the PIP bus incoming line breakers.

b. The onsite portions of the normal preferred power supply circuits are electrically independent from the onsite portions of the alternate preferred power supply circuits from the UAT and RAT to the PIP bus incoming line breakers.

c. The onsite portions of the normal preferred power supply circuit breaker control power, instrumentation, and control circuits are electrically independent from the alternate preferred power supply circuit breaker control power, instrumentation, and control circuits from the UAT and RAT to the PIP bus incoming line breakers.

d. The onsite portions of the normal preferred power supply circuit breaker control power, instrumentation, and control circuits are physically separated from the alternate preferred power supply circuit breaker control power, instrumentation, and control circuits from the UAT and RAT to the PIP bus incoming line breakers.

e. The UAT and RAT are physically separated to minimize the likelihood of their simultaneous failure under design basis conditions to the extent practical.

(12) a. The normal power supply circuits are physically separate from the alternate power supply circuits from the PIP buses to the Isolation Power Center bus incoming line breakers.

b. The normal power supply circuits are electrically independent from the alternate power supply circuits from the PIP buses to the Isolation Power Center bus incoming line breakers.

c. The normal power supply circuit breaker control power, instrumentation, and control circuits are electrically independent from the alternate power supply circuit breaker control power, instrumentation, and control circuits from the PIP buses to the Isolation Power Center bus incoming line breakers.

d. The onsite portions of the normal power supply circuit breaker control power, instrumentation, and control circuits are physically separated from the alternate power supply circuit breaker control power, instrumentation, and control circuits from the PIP buses to the Isolation Power Center bus incoming line breakers.

(13) Interrupting devices for the Electric Power Distribution Preferred Power System are coordinated so as to isolate faulted equipment or circuits of the Plant Investment Protection Buses from the Preferred Power System, prevent damage to equipment, protect personnel, minimize system disturbances, and maintain continuity of the Preferred Power Supply System from the PIP buses to all safety-related loads and designated RTNSS B and C loads.

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

Table 2.13.1-2 provides a definition of the inspections, tests, and analyses, together with associated acceptance criteria for the Electric Power Distribution System.

**Table 2.13.1-2**

**ITAAC For The Electric Power Distribution System**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The functional arrangement of Electric Power Distribution System is as described in the Design Description of Subsection 2.13.1 and Table 2.13.1-1, and as shown on Figure 2.13.1-1. | Inspections of the as-built Electric Power Distribution System will be performed. | The as-built Electric Power Distribution System conforms to the functional arrangement as described in the design description of Subsection 2.13.1 and shown in Table 2.13.1-1 and, as shown on Figure 2.13.1-1. |
| 2. The 480 VAC Isolation Power Center equipment identified as Seismic Category I in Table 2.13.1-1 can withstand Seismic Category I loads without loss of safety function. | i. Inspections will be performed to verify that the 480 VAC Isolation Power Center equipment identified as Seismic Category I in Table 2.13.1-1 is located in a Seismic Category I structure. | i. The Seismic Category I 480 VAC Isolation Power Center equipment identified in Table 2.13.1-1 is housed in a Seismic Category I structure. |
| | ii. Type tests, analyses, or a combination of type test and analyses of the Seismic Category I 480 VAC Isolation Power Center equipment identified in Table 2.13.1-1, will be performed using analytical assumptions, or under conditions which bound the Seismic Category I equipment design requirements. | ii. The Seismic Category I 480 VAC Isolation Power Center equipment identified in Table 2.13.1-1 can withstand Seismic Category I loads without loss of safety function. |
| | iii. Inspection and analyses will be performed to verify that the equipment identified as Seismic Category I in Table 2.13.1-2, including associated anchorage, is bound by the test or analyzed conditions. | iii. The as-built 480 VAC Isolation Power Center equipment identified in Table 2.13.1-2 including associated anchorage can withstand Seismic Category I loads without loss of safety function. |

## Table 2.13.1-2

## ITAAC For The Electric Power Distribution System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 3a. Independence is provided between safety-related divisions as ~~required by~~defined in Regulatory Guide 1.75. | Tests will be performed on the as-built safety-related 480 VAC Isolation Power Centers by providing a test signal in only one safety-related division at a time. | A test signal exists only in the as-built safety-related division under test in the 480 VAC Isolation Power Center. |
| 3b. ~~Separation is~~Physical separation and electrical isolation are provided between safety-related divisions, and between safety-related divisions and nonsafety-related equipment as ~~required by~~defined in Regulatory Guide 1.75. | Inspection of the as-built safety-related 480 VAC Isolation Power Centers will be performed. | For the as-built safety-related 480 VAC Isolation Power Centers, physical separation and electrical isolation as ~~required by~~defined in Regulatory Guide 1.75 exists between safety-related divisions. Physical separation and electrical isolation as ~~required by~~defined in Regulatory Guide 1.75 exists between safety-related divisions and nonsafety-related equipment. |
| 4. Each safety-related Isolation Power Center supplies power to safety-related loads in its respective division. | Tests will be performed using a test signal to confirm that an electrical path exists from the as-built safety-related Isolation Power Center to its divisional safety-related loads. Each test may be a single test or a series of over-lapping tests. | A test signal originating from the as-built divisional Isolation Power Center exists at the terminals of its divisional safety-related loads. |
| 5. Isolation Power Centers and their associated loads are protected against under voltage, degraded voltage and under-frequency conditions. | Testing will be performed using real or simulated signals. | The Isolation Power Centers are protected against under voltage, degraded voltage and under-frequency conditions by applying a real or simulated signal and verifying that the as-built Isolation Power Center bus isolates from the nonsafety-related system. |

## Table 2.13.1-2

## ITAAC For The Electric Power Distribution System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 6a. The Electric Power Distribution System provides the capability for distributing nonsafety-related AC power from onsite sources to their designated RTNSS loads. | Tests will be performed using a test signal to confirm that an electrical path exists for each RTNSS load from its associated as-built bus. Each test may be a single test or a series of over-lapping tests. | A test signal originating from the as-built bus exists at the terminals of each associated RTNSS load. |
| 6b. The Electric Power Distribution System provides a PIP bus under voltage signal to trip the PIP bus normal and alternate preferred power supply breakers. | Testing will be performed using real or simulated PIP bus under voltage signals. | The as-built PIP bus normal and alternate preferred power supply breakers trip after receiving a real or simulated PIP bus under voltage signal. |
| 7. (Deleted) | | |
| 8. (Deleted) | | |
| 9. Equipment within the onsite portion of the Preferred Power Supply (PPS) is rated to supply necessary load requirements, including power, voltage, and frequency, during design basis operating modes. | Analysis of the as-built onsite portion of the PPS will be performed to determine load requirements during design basis operating modes. This analysis will, in part, specify required power, voltage, and frequency at the interface between the onsite and offsite portions of the PPS in order to provide adequate power, voltage, and frequency to the safety-related Isolation Power Center buses to support safety-related load operation. | The as-built equipment within the onsite portion of the PPS, as determined by its ratings, exceeds the analyzed load requirements, including power, voltage, and frequency, during design basis operating modes. |

**Table 2.13.1-2**

**ITAAC For The Electric Power Distribution System**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 10. Equipment within the onsite portion of the PPS is rated to interrupt analyzed fault currents, including the fault current contribution from the offsite portion of the PPS. | Analysis of the as-built onsite portion of the PPS will be performed to determine the fault current interrupting requirements during design basis operating modes including the fault current contribution from the offsite portion of the PPS. | The as-built equipment within the onsite portion of the PPS, as determined by its ratings, exceeds the analyzed fault currents, including the fault current contribution from the offsite portion of the PPS. |
| 11a. The onsite portions of the normal preferred power supply circuits are physically separate from the onsite portions of the alternate preferred power supply circuits from the Unit Auxiliary Transformer (UAT) and Reserve Auxiliary Transformer (RAT) to the PIP bus incoming line breakers. | Inspections of the as-built onsite normal preferred power supply circuits and alternate preferred power supply circuits will be performed. | For the as-built onsite portion of the PPS:<br>• ~~The UAT and RAT are physically separated by distance or physical barriers so as to minimize to the extent practical the likelihood of their simultaneous failure under design basis conditions.~~<br>• The non-segregated phase bus ducts provided for the electrical interconnection between the RAT and 6.9 kV switchgear buses are physically separated from the bus ducts provided for the interconnection of the UAT and the switchgear by distance or physical barriers so as to minimize, to the extent practical, the likelihood of their simultaneous failure under design basis conditions in accordance with IEEE-384. |

## Table 2.13.1-2

## ITAAC For The Electric Power Distribution System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 11b. The onsite portions of the normal preferred power supply circuits are electrically independent from the onsite portions of the alternate preferred power supply circuits from the UAT and RAT to the PIP bus incoming line breakers. | Tests of the as-built onsite portions of the PPS normal preferred and alternate preferred power supply circuits will be conducted by providing a test signal in only one preferred power circuit at a time. | A test signal exists in only the circuit under test. |
| 11c. The onsite portions of the normal preferred power supply circuit breaker control power, instrumentation, and control circuits are electrically independent from the alternate preferred power supply circuit breaker control power, instrumentation, and control circuits from the UAT and RAT to the PIP bus incoming line breakers. | Tests of the as-built onsite portions of the normal preferred and alternate preferred power supply circuit breaker control power, instrumentation, and control circuits will be conducted by providing a test signal in only one circuit at a time. | A test signal exists in only the circuit under test. |
| 11d. The onsite portions of the normal preferred power supply circuit breaker control power, instrumentation, and control circuits are physically separated from the alternate preferred power supply circuit breaker control power, instrumentation, and control circuits from the UAT and RAT to the PIP bus incoming line breakers. | Inspections of the as-built onsite portions of the normal preferred and alternate preferred power supply circuit breaker control power, instrumentation, and control circuits will be performed. | The as-built onsite portions of the normal preferred power supply circuit breaker control power, instrumentation, and control circuits are physically separated from the alternate preferred power supply circuit breaker control power, instrumentation, and control circuits by distance or physical barriers so as to minimize to the extent practical the likelihood of their simultaneous failure under design basis conditions as defined in IEEE-384. |

**Table 2.13.1-2**

**ITAAC For The Electric Power Distribution System**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 11e. The UAT and RAT are physically separated to minimize the likelihood of their simultaneous failure under design basis conditions to the extent practical. | Inspection and analysis of the as-built UAT and RAT physical separation will be performed. | The UAT and RAT are physically separated by physical barriers, or are separated by distance, to minimize the likelihood of their simultaneous failure under design basis conditions to the extent practical, according to RG 1.189 separation criteria. |
| 12a. The normal power supply circuits are physically separate from the alternate power supply circuits from the PIP buses to the Isolation Power Center bus incoming line breakers. | Inspections of the as-built normal power supply circuits and alternate power supply circuits will be performed. | The normal power supply circuits are physically separate from the alternate power supply circuits by distance or physical barriers so as to minimize to the extent practical the likelihood of their simultaneous failure under design basis conditions as defined in IEEE-384. |
| 12b. The normal power supply circuits are electrically independent from the alternate power supply circuits from the PIP buses to the Isolation Power Center bus incoming line breakers. | Tests of the as-built normal and alternate power supply circuits will be conducted by providing a test signal in only one power circuit at a time. | A test signal exists in only the circuit under test. |
| 12c. The normal power supply circuit breaker control power, instrumentation, and control circuits are electrically independent from the alternate power supply circuit breaker control power, instrumentation, and control circuits from the PIP buses to the Isolation Power Center bus incoming line breakers. | Tests of the as-built normal and alternate power supply circuit breaker control power, instrumentation, and control circuits will be conducted by providing a test signal in only one circuit at a time. | A test signal exists in only the circuit under test. |

**Table 2.13.1-2**

**ITAAC For The Electric Power Distribution System**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 12d. The onsite portions of the normal power supply circuit breaker control power, instrumentation, and control circuits are physically separated from the alternate power supply circuit breaker control power, instrumentation, and control circuits from the PIP buses to the Isolation Power Center bus incoming line breakers. | Inspections of the as-built normal and alternate power supply circuit breaker control power, instrumentation, and control circuits will be performed. | The as-built normal power supply circuit breaker control power, instrumentation, and control circuits are physically separated from the alternate power supply circuit breaker control power, instrumentation, and control circuits by distance or physical barriers so as to minimize to the extent practical the likelihood of their simultaneous failure under design basis conditions as defined in IEEE-384. |
| 13. Interrupting devices for the Electric Power Distribution Preferred Power System are coordinated so as to isolate faulted equipment or circuits of the Plant Investment Protection Buses from the Preferred Power System, prevent damage to equipment, protect personnel, minimize system disturbances, and maintain continuity of the Preferred Power Supply System from the PIP buses to all safety-related loads and designated RTNSS B and C loads. | Analysis will be performed for all voltage levels to ensure that interrupting devices are properly coordinated. | Interrupting devices at all voltage levels are properly coordinated and the interrupter closest to a fault opens before other devices and isolate only the faulted equipment and or circuit. |

### 2.13.3 Direct Current Power Supply

**Design Description**

Completely independent safety-related and nonsafety-related DC power systems are provided.

Nonsafety-related DC power systems are not part of the plant safety-related design basis, and are independent and separate from the safety-related DC power supplies.

The 250 V Safety-Related DC systems provide four divisions of power to operate safety-related loads for at least 72 hours following a design basis accident. The 250V safety-related DC systems are also adequately sized for the station blackout conditions.

The Direct Current Power Supply alarms, displays, controls, and status indications in the main control room are addressed in Section 3.3.

~~Equipment~~ <u>Environmental</u> qualification of the 250 V safety-related DC systems is addressed in Section 3.8.

(1) The functional arrangement of the 250 V safety-related DC systems is as described in Subsection 2.13.3 Design Description and Table 2.13.3-1 and as shown on Figure 2.13.3-1.

(2) The functional arrangement of the 125 V and 250V nonsafety-related DC systems is as shown on Figure 2.13.3-2 and as described in Subsection 2.13.3.

(3) Two 250 V safety-related batteries in each division are together sized to supply their design loads, at the end of installed life, for a minimum of 72 hours without recharging.

(4) The 250 V safety-related DC systems equipment identified as Seismic Category I in Table 2.13.3-1 can withstand Seismic Category I loads without loss of safety function.

(5) The 250 V safety-related DC systems provide four independent and redundant safety-related divisions.

(6) ~~Separation~~ <u>Physical separation</u> is provided between safety-related divisions, and between safety-related divisions and nonsafety-related equipment as ~~required by~~<u>defined in</u> Regulatory Guide 1.75.

(7) Each battery charger associated with each 250 VDC safety-related battery is capable of restoring its battery after a bounding design basis event discharge to a state that the battery can perform its design basis function for subsequent postulated operational and design basis functions, while at the same time supplying the largest combined demands associated with the battery, within the time stated in the design basis, consistent with the requirement given in IEEE 308.

(8) The 250 V safety-related DC battery and battery charger circuit breakers, and DC distribution panels and their circuit breakers and fuses, are sized to supply their load requirements.

(9) The battery chargers are designed to prevent their AC source from becoming a load on the 250 VDC safety-related batteries when the AC power source is de-energized or has degraded voltage.

(10) (Deleted)

(11) (Deleted)

(12) Electrical cables for the safety-related 250 VDC system are rated to withstand fault current for the time required to clear the fault from their power source.

(13) Protective devices for the safety-related 250 VDC system are rated to interrupt analyzed fault currents and are coordinated to only trip the protective device closest to the fault.

(14) Raceway for safety-related 250 VDC system circuits are sized in accordance with design requirements.

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

Table 2.13.3-3 provides a definition of the inspections, tests, and analyses, together with associated acceptance criteria for the Direct Current Power Supply.

**Table 2.13.3-3**

**ITAAC For The Direct Current Power Supply**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The functional arrangement of the 250 V safety-related DC systems is as described in Subsection 2.13.3 Design Description and Table 2.13-1 and as shown on Figure 2.13.3-1. | Inspections of the as-built 250 V safety-related DC systems will be performed. | The as-built 250 V safety-related DC systems conform with the functional arrangement as shown in Figure 2.13.3-1 and as described in ~~section~~ Subsection 2.13.3 and component locations are as shown in Table 2.13.3-1. |
| 2. The functional arrangement of the 125 V and 250V nonsafety-related DC systems is as shown on Figure 2.13.3-2 and as described in Subsection 2.13.3. | Inspections of the as-built 125 V and 250 V nonsafety-related DC systems will be performed. | The as-built 125 V and 250 V nonsafety-related DC systems conform with the functional arrangement as shown in Figure 2.13.3-2 and as described in ~~section~~ Subsection 2.13.3 |
| 3. Two 250V safety-related batteries in each division are together sized to supply their design loads, at the end of installed life, for a minimum of 72 hours without recharging. | i. Analyses for the as-built safety-related batteries to determine battery capacities will be performed based on the design duty cycle for each battery. | i. The as-built batteries in each division together have the capacity, as determined by the vendor performance specification, to supply their rated constant current for a minimum of 72 hours without recharging. |
| | ii. Tests of each as-built safety-related battery will be conducted by simulating loads which envelope the analyzed battery design duty cycle. | ii. The capacity of each as-built safety-related battery equals or exceeds the analyzed battery design duty cycle capacity. |

## Table 2.13.3-3

## ITAAC For The Direct Current Power Supply

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 4. The 250 V safety-related DC systems equipment identified as Seismic Category I in Table 2.13.3-1 can withstand Seismic Category I loads without loss of safety function. | i. Inspections will be performed to verify that the 250V DC system equipment identified in Table 2.13.3-1 is located in a Seismic Category I structure.<br><br>ii. Type test, analyses, or a combination of type test and analyses of the 250V DC systems equipment identified in Table 2.13.3-1 as Seismic Category I will be performed using analytical assumption, or under conditions which bound the Seismic Category I design requirements. | i. The Seismic Category I 250V DC system equipment is located in a Seismic Category I structure.<br><br>ii. The Seismic Category I 250V DC system equipment can withstand Seismic Category I loads without loss of safety function. |
| | iii. Inspections and analyses will be performed to verify that the ~~as-installed~~as-built 250V DC systems equipment, including anchorage, identified as Seismic Category I in Table 2.13.3-1 are seismically bounded by the tested or analyzed conditions. | iii. The as-built 250V DC system equipment, including anchorage, identified as Seismic Category I in Table 2.13.1-1 can withstand Seismic Category I loads without loss of safety function. |
| 5. The 250 V safety-related DC systems provide four independent and redundant safety-related divisions. | Tests will be performed on the as-built 250 V safety-related DC systems by providing a test signal in only one safety-related division at a time. | A test signal exists only in the as-built safety-related division under test in the 250 V safety-related DC systems; and a test signal originating from the as-built divisional safety-related 250 VDC distribution panel exists at the terminals of its divisional safety-related loads. |

**Table 2.13.3-3**

**ITAAC For The Direct Current Power Supply**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 6. ~~Separation~~ Physical Separation is provided between safety-related divisions, and between safety-related divisions and nonsafety-related equipment as ~~required by~~defined in Regulatory Guide 1.75. | Inspection of the as-built 250 V safety-related DC systems will be performed. | In the as-built 250 V safety-related DC systems, physical separation ~~and electrical isolation as required by~~as defined in Regulatory Guide 1.75 exists between safety–related divisions. Physical separation ~~and electrical isolation as required by~~as defined in Regulatory Guide 1.75 exists between safety-related divisions and nonsafety-related equipment. |
| 7. Each battery charger associated with each 250 VDC safety-related battery is capable of restoring its battery after a bounding design basis event discharge to a state that the battery can perform its design basis function for subsequent postulated operational and design basis functions, while at the same time supplying the largest combined demands associated with the battery, within the time stated in the design basis, consistent with the requirement given in IEEE 308. | Testing of each 250 VDC safety-related battery charger will be performed. | Following a bounding design basis event discharge, the battery charger is capable of restoring its associated battery to a state that the battery can perform its design basis function for subsequent postulated operational and design basis functions while at the same time supplying the largest combined demands associated with the battery, within the time stated in the design basis, consistent with the requirement given in IEEE 308. |

## Table 2.13.3-3

## ITAAC For The Direct Current Power Supply

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 8. The 250 V safety-related DC battery and battery charger circuit breakers, and DC distribution panels and their circuit breakers and fuses, are sized to supply their load requirements. | Analyses of the as-built 250V safety-related DC electrical distribution system will be performed to determine the capacities of the battery and battery charger circuit breakers, and DC distribution panels and their circuit breakers and fuses. | The capacities of safety-related battery and battery charger circuit breakers, and DC distribution panels and their circuit breakers and fuses, as determined by their nameplate ratings, exceed their analyzed load and DC interrupting current requirements. |
| 9. The battery chargers are designed to prevent their AC source from becoming a load on the 250 VDC safety-related batteries when the AC power source is de-energized or has degraded voltage. | Testing of each 250 VDC safety-related battery charger will be performed to demonstrate that there is no power feedback from a loss of AC input power. | The 250 VDC safety-related battery chargers prevent the AC input source from becoming a load on the 250 VDC safety-related batteries during a loss of AC power condition. |
| 10. (Deleted) | | |
| 11. (Deleted) | | |

## Table 2.13.3-3

## ITAAC For The Direct Current Power Supply

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 12. Electrical cables for the safety-related 250 VDC system are rated to withstand fault current for the time required to clear the fault from their power source. | Analyses of the as-built safety-related 250 VDC system will be performed to determine possible fault currents. | For the as-built safety-related 250 VDC system, electrical cables will withstand the analyzed fault currents, as determined by manufacturer's ratings, for the time required to clear the fault from its power source. |
| 13. Protective devices for the safety-related 250 VDC system are rated to interrupt analyzed fault currents and are coordinated to only trip the protective device closest to the fault. | Analyses of the as-built safety-related 250 VDC system will be performed to determine possible fault currents and the required size of protective devices to ensure that they are coordinated to only trip the protective device closest to the fault. | For the as-built safety-related 250 VDC system, that the protective devices for the safety-related 250 VDC system loads are sized to only trip the protective device closest to the fault. |
| 14. Raceway for safety-related 250 VDC system circuits are sized in accordance with design requirements. | Analyses of the as-built safety-related 250 VDC system will be performed to determine required raceway sizing. | For the as-built safety-related 250 VDC system, raceway sizing is in accordance with design requirements and raceway loading is within that assumed in the electrical analyses. |

## 2.13.4 Standby Onsite AC Power Supply

### Design Description

There are two systems capable of supplying onsite AC power. They are the standby diesel generators (SDG) and the ancillary diesel generators (ADG).

Two independent nonsafety-related SDG, including their support systems, provide separate sources of onsite power for the nonsafety-related Plant Investment Protection (PIP) load groups when the normal and alternate preferred 6.9kV power supplies are not available. The nonsafety-related standby diesel generators have a Regulatory Treatment of Non-Safety Systems (RTNSS) function to provide power to the PIP buses that supply RTNSS loads.

Two nonsafety-related, seismic category II ADG, including their support systems, provide 480 VAC power for post accident support loads when the normal and alternate preferred 6.9 kV power supplies and the SDG are not available. The nonsafety-related ancillary diesel generators have a RTNSS function to provide power to the ancillary diesel buses that supply RTNSS loads.

The Standby Onsite Power Supply System alarms, displays, controls, and status indications in the main control room are addressed by Section 3.3.

The Ancillary Diesel Onsite Power Supply System alarms, displays, controls, and status indications are addressed by Section 3.3.

(1) The functional arrangement of Standby Onsite Power System is as described in Subsection 2.13.4 and in Table 2.13.4-1.

(2) a. Upon receipt of an under voltage signal from the Electric Power Distribution System, the standby diesel generator starts and achieves rated speed and voltage and sequences its designed loads while maintaining voltage and frequency within design limits.

b. Each standby diesel generator is capable of operating at its nameplate rated load and is sized to accommodate its expected loads.

c. Each standby diesel generator fuel oil storage tank contains adequate fuel oil capacity for seven days of standby diesel generator operation based on expected SDG load.

d. Each of the standby diesel generator fuel oil transfer pumps (two pumps per engine) starts automatically and transfer fuel oil from the standby fuel oil storage tank to the standby diesel generator day tank at a rate greater than or equal to the usage rate of the standby diesel generator.

e. Each of the standby diesel generator starting air receivers (two receivers per engine) is capable of starting the engine at its low pressure alarm setpoint.

f. Each of the standby diesel generator jacket cooling water systems controls the flow of water to maintain required water temperature.

g. Each standby diesel generator has instrumentation provided to monitor lube oil temperature, pressure and sump level, ensuring proper operation of the system.

h. Each standby diesel generator is provided with a separate intake and exhaust system.

i. Each standby diesel generator can be remotely operated from the MCR.

(3) (Deleted)

(4) The functional arrangement of the Ancillary Diesel Onsite Power Supply System is as described in the Subsection 2.13.4 and in Table 2.13.4-1.

(5) a. Upon receipt of an under voltage signal from the ancillary diesel 480 VAC bus, the ancillary diesel generator starts, achieves rated speed and voltage, and supplies power to the ancillary diesel bus.

b. Upon receipt of a low ancillary diesel room temperature signal, the ancillary diesel generator starts and achieves rated speed and voltage, and supplies power to the ancillary diesel bus.

c. Each ancillary diesel generator is capable of operating at its nameplate rated load and is sized to accommodate its expected loads.

d. Each ancillary diesel generator fuel oil storage tank contains adequate fuel oil capacity for seven days of ancillary diesel generator operation based on expected ADG load.

e. Each of the ancillary diesel generator fuel oil transfer pumps start automatically and transfer fuel oil from the ancillary fuel oil storage tank to the ancillary diesel generator day tank at a rate greater than or equal to the usage rate of the ancillary diesel generator.

(6) (Deleted)

(7) Each ancillary diesel generator and its associated auxiliaries, buses, fuel tanks, and fuel oil transfer pumps conform to Seismic Category II requirements.

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

Table 2.13.4-2 provides a definition of the inspections, tests, and analyses, together with associated acceptance criteria for the Standby Onsite Power Supply System and the Ancillary Diesel Onsite Power Supply System.

## Table 2.13.4-2

## ITAAC For The Standby On-site AC Power Supply

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The functional arrangement of the Standby Onsite Power Supply is as described in Subsection 2.13.4 and in Table 2.13.4-1. | Inspections of the as-built system will be conducted. | The as-built Standby Onsite Power Supply system conform with the functional arrangement as described in the Design Description of Subsection 2.13.4 and Table 2.13.4-1. |
| 2a. Upon receipt of an under voltage signal from the Electric Power Distribution System, the standby diesel generator starts and achieves rated speed and voltage and sequences its designed loads while maintaining voltage and frequency within design limits. | Tests of the as-built Standby Onsite Power Supply system will be conducted by providing a real or simulated under voltage signal to start the standby diesel generators. Subsequently generated signals will start load sequencing. | The as-built standby diesel generator starts upon receipt of a real or simulated under voltage signal on its associated PIP bus, achieves rated speed and voltage, and sequences its designed loads while maintaining voltage and frequency within design limits. |
| 2b. Each standby diesel generator is capable of operating at its nameplate rated load and is sized to accommodate its expected loads. | Testing will be performed to demonstrate that each as-built standby diesel generator will operate between rated and maximum nameplate load, and nameplate power factor for a time period required to reach engine temperature equilibrium. Analysis will be performed to demonstrate that the expected loads are within the nameplate rated load. | Each as-built standby diesel generator provides power at generator terminal rated voltage and frequency when operated at rated load~~ed~~, and expected loads are within the rated nameplate load. |
| 2c. Each standby diesel generator fuel oil storage tank contains adequate fuel oil capacity for seven days of standby diesel generator operation based on expected SDG load. | The as-built standby fuel oil storage tank capacity will be calculated based on expected SDG load. | The as-built standby fuel oil storage tank capacity is adequate to supply seven days of fuel oil to the standby diesel generator under continuous operation based on expected SDG load. |

## Table 2.13.4-2

## ITAAC For The Standby On-site AC Power Supply

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 2d. Each of the standby diesel generator fuel oil transfer pumps (two pumps per engine) starts automatically and transfers fuel oil from the standby fuel oil storage tank to the standby diesel generator day tank at a rate greater than or equal to the usage rate of the standby diesel generator. | Testing will be performed to demonstrate that each as-built fuel oil transfer pump starts automatically and transfers fuel oil from the standby fuel oil storage tank to the standby diesel generator day tank at a rate greater than or equal to the usage rate of the standby diesel generator when operating between rated and maximum nameplate load. | Each as-built fuel oil transfer pump starts automatically and transfers fuel oil from the standby fuel oil storage tank to the standby diesel generator day tank at a rate greater than or equal to the usage rate of the standby diesel generator when running operating between rated and maximum nameplate loadfully loaded. |
| 2e. Each of the standby diesel generator starting air receivers (two receivers per engine) is capable of starting the engine at its low pressure alarm setpoint. | Testing will be performed for each as-built starting air receiver. | Each as-built starting air receiver is capable of starting the engine at its low pressure alarm setpoint. |
| 2f. Each of the standby diesel generator jacket cooling water systems controls the flow of water to maintain required water temperature. | Testing of standby diesel generator jacket cooling water system will be performed to demonstrate flow of water to maintain required water temperature. | The standby diesel generator jacket cooling water system demonstrates flow of water to maintain required water temperature. |
| 2g. Each standby diesel generator has instrumentation provided to monitor lube oil temperature, pressure and sump level, ensuring proper operation of the system. | Inspection and testing will be performed to demonstrate that Monitoring lube oil temperature, pressure and sump level during testing will demonstrate proper operation of the systeminstrumentation is provided and monitors operation of the system. | Each standby diesel generator has instrumentation provided to monitor lube oil temperature, pressure and sump level, ensuring proper operation of the system.Monitoring lube oil temperature, pressure and sump level during testing demonstrates proper operation of the system. |

## Table 2.13.4-2

## ITAAC For The Standby On-site AC Power Supply

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 2h. Each standby diesel generator is provided with a separate intake and exhaust system. | Inspection of the as-built intake and exhaust system will be conducted. | Each as-built DG is provided with a separate intake and exhaust system. |
| 2i. Each standby diesel generator can be remotely operated from the MCR. | Each standby diesel generator will be started and stopped using manually initiated signals from the MCR. | Each standby diesel generator starts and stops when manually initiated signals are sent from the MCR. |
| 3. (Deleted) | | |
| 4. The functional arrangement of the Ancillary Diesel Onsite Power Supply System is as described in Subsection 2.13.4 and in Table 2.13.4-2. | Inspections of the as-built system will be conducted. | The as-built Ancillary Diesel Onsite Power Supply System conforms to the functional arrangement as described in Subsection 2.13.4 and Table 2.13.4-2. |
| 5a. Upon receipt of an under voltage signal from the ancillary diesel 480 VAC bus, the ancillary diesel generator starts, achieves rated speed and voltage, and supplies power to the ancillary diesel bus. | Tests of the as-built Ancillary Diesel Onsite Power Supply System will be conducted by providing a real or simulated under voltage signal to start the ancillary diesel generators. | The as-built ancillary diesel generator starts upon receipt of a real or simulated under voltage signal on its associated bus, achieves rated speed and voltage, and supplies power to the ancillary diesel bus. |
| 5b. Upon receipt of a low ancillary diesel room temperature signal, the ancillary diesel generator starts and achieves rated speed and voltage and supplies power to the ancillary diesel bus. | Tests of the as-built Ancillary Diesel Onsite Power Supply System will be conducted by providing a real or simulated low ancillary diesel room temperature signal to start the ancillary diesel generators. | The as-built ancillary diesel generator starts upon receipt of a real or simulated low ancillary diesel room temperature signal, achieves rated speed and voltage, and supplies power to the ancillary diesel bus. |

**Table 2.13.4-2**

**ITAAC For The Standby On-site AC Power Supply**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 5c. Each ancillary diesel generator is capable of operating at its nameplate rated load and is sized to accommodate its expected loads. | Each as-built ancillary diesel generator will be operated between rated and maximum nameplate load, and nameplate power factor for a time period required to reach engine temperature equilibrium. Analysis will be performed to demonstrate that the expected loads are within the nameplate rated load. | Each as-built ancillary diesel generator provides power at generator terminal rated voltage and frequency when operated at rated load, and expected loads are within the rated nameplate loadloaded. |
| 5d. Each ancillary diesel generator fuel oil storage tank contains adequate fuel oil capacity for seven days of ancillary diesel generator operation based on expected ADG load. | The as-built fuel oil storage tank capacity will be calculated based on expected ADG load. | The as-built fuel oil storage tank capacity is adequate to supply seven days of fuel oil to the ancillary diesel generator that is operating at rated load under continuous operation based on expected ADG load. |
| 5e. Each of the ancillary diesel generator fuel oil transfer pumps start automatically and transfer fuel oil from the ancillary fuel oil storage tank to the ancillary diesel generator day tank at a rate greater than or equal to the usage rate of the ancillary diesel generator. | Testing will be performed to demonstrate that each as-built fuel oil transfer pump starts automatically and transfers fuel oil from the ancillary fuel oil storage tank to the ancillary diesel generator day tank at a rate greater than or equal to the usage rate of the ancillary diesel generator when operating between rated and maximum nameplate load. | Each as-built fuel oil transfer pump starts automatically and transfers fuel oil from the ancillary fuel oil storage tank to the ancillary diesel generator day tank at a rate greater than or equal to the usage rate of the ancillary diesel generator when operating between rated and maximum nameplate loadrunning fully loaded. |
| 6. (Deleted) | | |

## Table 2.13.4-2

## ITAAC For The Standby On-site AC Power Supply

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 7. Each ancillary diesel generator and its associated auxiliaries, buses, fuel tanks, and fuel oil transfer pumps conform to Seismic Category II requirements. | i. Type tests and analyses of the ancillary diesel generators, their associated auxiliaries, buses, fuel tanks, and fuel oil transfer pumps will be performed. | i. Each as-built ancillary diesel generator and its associated auxiliaries, buses, fuel tanks, and fuel oil transfer pumps conform to Seismic Category II requirements. |
| | ii. Inspections of the as-built ancillary diesel generators, their associated auxiliaries, buses, fuel tanks, and fuel oil transfer pumps will be performed to verify that the equipment is installed in accordance with the configurations specified in the type tests and analyses. | ii. Each ancillary diesel generator and its associated auxiliaries, buses, fuel tanks, and fuel oil transfer pumps are installed in accordance with the configurations specified by the type tests and analyses. |

## 2.13.5 Uninterruptible AC Power Supply

### Design Description

The Uninterruptible AC Power Supply (UPS) is divided into two subsystems, the safety-related UPS and the nonsafety-related UPS.

The nonsafety-related UPS system and the nonsafety-related Technical Support Center UPS system are not part of the plant safety design basis, and are independent and separated from the safety-related UPS system.

The safety-related UPS system provides four divisions of 120 VAC power to safety-related loads during normal, upset and accident conditions.

The Uninterruptible AC Power Supply alarms, displays, controls, and status indications in the main control room are addressed by Section 3.3.

~~Equipment~~ Environmental qualification of the safety-related UPS system is addressed in Section 3.8.

(1) The functional arrangement of the safety-related UPS system is as described in Subsection 2.13.5 and Table 2.13.5-1 and is as shown on Figure 2.13.5-1.

(2) The functional arrangement of the nonsafety-related UPS system is as described in Subsection 2.13.5 and as shown on Figure 2.13.5-2.

(3) The UPS system equipment identified as Seismic Category I in Table 2.13.5-1 can withstand Seismic Category I loads without loss of safety function.

(4) The safety-related UPS system provides four independent and redundant safety-related divisions.

(5) ~~Separation is~~Physical separation and electrical isolation are provided between safety-related divisions, and between safety-related divisions and nonsafety-related equipment, as ~~required by~~defined in Regulatory Guide 1.75.

(6) Each safety-related UPS inverter is capable of supplying its AC load at both minimum and maximum battery terminal voltages.

(7) (Deleted)

(8) (Deleted)

(9) The safety-related UPS rectifiers are designed to prevent their AC source from becoming a load on the 250 VDC safety-related batteries when the AC power source is de-energized or has degraded voltage.

(10) The safety-related UPS inverter high DC input voltage trip setpoint and time delay are greater than the associated battery charger and UPS rectifier high DC output voltage trip setpoint and time delay.

(11) The safety-related UPS system supplies a voltage at the terminals of the safety-related utilization equipment that is within the equipment voltage tolerance limits.

(12) Electrical cables for the safety-related UPS system are rated to withstand fault current for the time required to clear the fault from their power source.

(13) Protective devices for the safety-related UPS system are rated to interrupt analyzed fault currents and are coordinated to only trip the protective device closest to the fault.

(14) Raceway for safety-related UPS system circuits are sized in accordance with design requirements.

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

Table 2.13.5-2 provides a definition of the inspections, tests, and analyses, together with associated acceptance criteria for the Uninterruptible AC Power Supply.

**Table 2.13.5-2**

**ITAAC For The Uninterruptible AC Power Supply**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The functional arrangement of the safety-related UPS system is as described in Subsection 2.13.5 and Table 2.13.5-1 and is as shown on Figure 2.13.5-1. | Inspections of the as-built safety-related UPS system will be performed. | The as-built safety-related UPS system conforms with the functional arrangement as described in Subsection 2.13.5 and as shown in Figure 2.13.5-1. |
| 2. The functional arrangement of the nonsafety-related UPS system is as described in Subsection 2.13.5 and as shown on Figure 2.13.5-2. | Inspections of the as-built nonsafety-related UPS system will be performed. | The as-built nonsafety-related UPS system conforms with the functional arrangement as described in Subsection 2.13.5 and as shown in Figure 2.13.5-2. |
| 3. The UPS system equipment identified as Seismic Category I in Table 2.13.5-1 can withstand Seismic Category I loads without loss of safety function. | i. Inspections will be performed to verify that the UPS system equipment identified as Seismic Category I in Table 2.13.5-1 is located in a Seismic Category I structure. | i. The Seismic Category I equipment identified in Table 2.13.5-1 is located in a Seismic Category I structure. |
| | ii. Type tests, analyses, or a combination of type tests and analyses of the UPS system safety-related Seismic Category I equipment will be performed using analytical assumptions, or under conditions which bound the Seismic Category I design requirements. | ii. The as-built UPS system can withstand Seismic Category I loads without loss of safety function. |

**Table 2.13.5-2**

**ITAAC For The Uninterruptible AC Power Supply**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| | iii Inspections and analyses of the ~~as-installed~~as-built UPS system equipment, including anchorage, identified in Table 2.13.5-1 are seismically bounded by the tested or analyzed conditions. | iii. The as-built UPS system equipment, including anchorage, identified as Seismic Category I in Table 2.13.5-1 can withstand Seismic Category I loads without loss of safety function. |
| 4. The safety-related UPS system provides four independent and redundant safety-related divisions. | Tests will be performed on the as-built safety-related UPS system by providing a test signal in only one safety-related division at a time. | A test signal exists only in the safety-related division under test in the as-built safety-related UPS system; and a test signal originating from the as-built divisional safety-related UPS distribution panel exists at the terminals of its divisional safety-related loads. |
| 5. ~~Separation is~~Physical separation and electrical isolation are provided between safety-related divisions, and between safety-related divisions and nonsafety-related equipment, as ~~required by~~defined in Regulatory Guide 1.75. | Inspection of the as-built safety-related UPS system will be performed. | The as-built safety-related UPS system, physical separation and electrical isolation exist between safety-related divisions, as ~~required by~~defined in Regulatory Guide 1.75. Physical separation and electrical isolation exists between safety-related divisions and nonsafety-related equipment, as ~~required by~~defined in Regulatory Guide 1.75. |

## Table 2.13.5-2

## ITAAC For The Uninterruptible AC Power Supply

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 6. Each safety-related UPS inverter is capable of supplying its AC load at both minimum and maximum battery terminal voltages. | Testing of each as-built safety-related UPS inverter will be performed by applying a combination of simulated or real loads with DC input at both minimum and maximum battery terminal voltages. | The as-built safety-related UPS inverter supplies its rated load while maintaining its rated voltage at its rated frequency, within tolerances acceptable for its AC loads. |
| 7. (Deleted) | | |
| 8. (Deleted) | | |
| 9. The safety-related UPS rectifiers are designed to prevent their AC source from becoming a load on the 250 VDC safety-related batteries when the AC power source is de-energized or has degraded voltage. | Testing of the each safety-related rectifier will be performed to demonstrate that there is no power feedback from a loss of AC input power. | The safety-related rectifiers prevent the AC input source from becoming a load on the 250 VDC safety-related batteries during a loss of AC power condition. |

**Table 2.13.5-2**

**ITAAC For The Uninterruptible AC Power Supply**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 10. The safety-related UPS inverter high DC input voltage trip setpoint and time delay are greater than the associated battery charger and UPS rectifier high DC output voltage trip setpoint and time delay. | Tests will be performed using simulated signals of the UPS trips. | The safety-related UPS inverter high DC input voltage trip setpoint and time delay are greater than the associated battery charger and UPS rectifier high DC output voltage trip setpoint and time delay as demonstrated by applying test signals and verifying that:<br>• The inverter high DC input voltage trip setpoint is greater than the battery charger and UPS input rectifier high DC output voltage trip, and;<br>• The inverter high DC input voltage trip time delay is greater than the associated battery charger and UPS input rectifier high DC output voltage trip time delay. |
| 11. The safety-related UPS system supplies a voltage at the terminals of the safety-related utilization equipment that is within the equipment voltage tolerance limits. | i. Analyses of the as-built safety-related UPS 120 volt distribution system are performed to determine the voltage at the safety-related utilization equipment terminals.<br>ii. Type tests will be performed to confirm the safety-related utilization equipment functions properly at the established maximum and minimum terminal voltage tolerance limits. | i. The as-built safety-related UPS system supplies a voltage at the terminals of the safety-related utilization equipment that is within the utilization equipment voltage tolerance limits.<br>ii. The safety-related utilization equipment functions properly at the established maximum and minimum terminal voltage tolerance limits. |

## Table 2.13.5-2

## ITAAC For The Uninterruptible AC Power Supply

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 12. Electrical cables for the safety-related UPS system are rated to withstand fault current for the time required to clear the fault from their power source. | Analyses of the as-built safety-related UPS system will be performed to determine possible fault currents. | For the as-built safety-related UPS system, electrical cables can withstand the analyzed fault currents, as determined by manufacturer's ratings, for the time required to clear the fault from its power source. |
| 13. Protective devices for the safety-related UPS system are rated to interrupt analyzed fault currents and are coordinated to only trip the protective device closest to the fault. | Analyses of the as-built safety-related UPS system will be performed to determine possible fault currents and the required size of protective devices to ensure that they are coordinated to only trip the protective device closest to the fault. | For the as-built safety-related UPS system, the protective devices for the safety-related UPS system loads are sized to only trip the protective device closest to the fault. |
| 14. Raceway for safety-related UPS system circuits are sized in accordance with design requirements. | Analyses of the as-built safety-related UPS system will be performed to determine required raceway sizing. | For the as-built safety-related UPS system, raceway sizing is in accordance with design requirements and raceway loading is within that assumed in the electrical analyses. |

## 2.13.8 Lighting Power Supply

### Design Description

The plant lighting systems furnish the illumination required for safe performance of plant operation, security, shutdown, and maintenance activities. The lighting systems include the Control Room and Remote Shutdown Station Emergency Lighting, normal, standby, and DC self-contained battery operated emergency lighting. The security lighting is described in separate security documents.

(1) The functional arrangement of Control Room and Remote Shutdown Station Emergency Lighting is as described in the Design Description of this Subsection 2.13.8.

(2) The Control Room and Remote Shutdown Station Emergency Lighting meets Seismic Category I requirements for mountings.

(3) The Control Room and Remote Shutdown Station Emergency Lighting equipment and cables are ~~electrically independent and~~ physically separated.~~ Cables are routed in the respective divisional raceways.~~

(4) The Control Room and Remote Shutdown Station Emergency Lighting provides illumination levels equal to or greater than those recommended by the Illuminating Engineering Society of North America (IESNA) for at least 72 hours following a design basis accident and a loss of all AC power sources.

(5) The DC Self-Contained Battery-Operated Lighting Units provide illumination levels equal to or greater than those recommended by the IESNA in the remote shutdown rooms and in those areas of the plant required for power restoration and recovery from a fire, for at least eight hours.

(6) Electrical isolation of the nonsafety-related Control Room and Remote Shutdown Station emergency lighting circuits from the safety-related Uninterruptible AC power supply is accomplished by the use of two series isolation devices.

(7) The Control Room and Remote Shutdown Station Emergency Lighting shall be capable of being powered by a reliable power source after the first 72 hours of a design basis event.

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

Table 2.13.8-1 provides a definition of the inspections, tests, and analyses, together with associated acceptance criteria for the Control Room and Remote Shutdown Station Emergency Lighting Power Supply.

**Table 2.13.8-1**

**ITAAC For The Lighting Power Supply**

| Design Commitments | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The functional arrangement of Control Room and Remote Shutdown Station Emergency Lighting is as described in the Design Description of this Section Subsection 2.13.8. | Inspections of the as-built Control Room and Remote Shutdown Station Emergency Lighting will be conducted. | The as-built Control Room and Remote Shutdown Station Emergency Lighting conform to the functional arrangement as described in the Design Description of this Section Subsection 2.13.8. |
| 2. The Control Room and Remote Shutdown Station Emergency Lighting meets Seismic Category I requirements for mountings. | Analysis of the Control Room and Remote Shutdown Station Emergency Lighting mountings will be performed. | The Control Room and Remote Shutdown Station Emergency Lighting mountings meet Seismic Category I requirements. |
| 3. The Control Room and Remote Shutdown Station Emergency Lighting equipment and cables are electrically independent and physically separated. Cables are routed in the respective divisional raceways. | Inspection of the as-built Control Room and Remote Shutdown Station Emergency Lighting equipment and cables will be performed. | The as-built Control Room and Remote Shutdown Station Emergency Lighting equipment and cables are electrically independent and physically separated between safety-related divisions and between safety-related divisions and nonsafety-related equipment according to RG 1.75 and IEEE 384, through spatial separation, physical barriers, or separate raceways, conduit or metal troughs, .up to the electrical isolation devices. Safety-related cables are routed in respective divisional raceways or conduit. Nonsafety-related cables from the isolation devices to the light fixtures are in separate raceways or conduit. |

**Table 2.13.8-1**

**ITAAC For The Lighting Power Supply**

| Design Commitments | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 4. The Control Room and Remote Shutdown Station Emergency Lighting provides illumination levels equal to or greater than those recommended by the IESNA for at least 72 hours following a design basis accident and a loss of all AC power sources. | Testing of the as-built Control Room and Remote Shutdown Station Emergency Lighting will be performed. | The as-built Control Room and Remote Shutdown Station Emergency Lighting provides the illumination required by the IESNA for at least 72 hours following a design basis accident and a loss of all AC power sources. |
| 5. The DC Self-Contained Battery-Operated Lighting Units provide illumination levels equal to or greater than those recommended by the IESNA in the remote shutdown rooms and in those areas of the plant required for power restoration and recovery from a fire, for at least eight hours. | Testing of the as-built DC Self-Contained Battery-Operated Lighting Units will be performed. | Each of the as-built DC Self-Contained Battery-Operated Lighting Units provide the illumination required by the IESNA in the remote shutdown rooms and in areas of the plant required for power restoration / recovery from a fire to comply with the requirement of RG 1.189. Each unit will provide 8 hours of continuous illumination without battery recharge. |
| 6. Electrical isolation of the nonsafety-related Control Room and Remote Shutdown Station emergency lighting circuits from the safety-related Uninterruptible AC power supply is accomplished by the use of two series isolation devices. | Inspection and analysis of the as-built lighting circuits will be conducted to verify that the non-safety-related control room and Remote Shutdown Station emergency lighting circuits and the safety-related Uninterruptible AC power supply are isolated by two series isolation devices. | The as-built nonsafety-related Control Room and Remote Shutdown Station emergency lighting circuits and the safety-related Uninterruptible AC Power Supply are isolated by two series isolation devices. |

**Table 2.13.8-1**

**ITAAC For The Lighting Power Supply**

| Design Commitments | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 7. The Control Room and Remote Shutdown Station Emergency Lighting shall be capable of being powered by a reliable power source after the first 72 hours of a design basis event. | Inspections and tests (as needed) will~~shall~~ be performed that confirm the capability of powering the Control Room and Remote Shutdown Station Emergency Lighting from a reliable power source that will be available after the first 72-hours of a design basis event. | The Control Room and Remote Shutdown Station Emergency Lighting is capable of being powered from a reliable power source that will be available after the first 72-hours of a design basis event. |

## 2.15 CONTAINMENT, COOLING AND ENVIRONMENTAL CONTROL SYSTEMS

### 2.15.1 Containment System

**Design Description**

The Containment System confines the potential release of radioactive material in the event of a design basis accident. The Containment System is safety-related and is comprised of a reinforced concrete containment vessel (RCCV), penetrations and DW head.

The Containment System is shown in Figure 2.15.1-1. The RCCV is located in the Reactor Building.

The MCR set of displays, alarms and controls, based on the applicable codes and standards, including Human Factors Engineering (HFE) evaluations and emergency procedure guidelines, for the Containment System is addressed in Section 3.3.

The environmental ~~and seismic~~ qualification of Containment Systems components is addressed in Section 3.8; and the environmental and seismic qualification of digital instrumentation and controls equipment is addressed in Section 3.8.

(1) The functional arrangement of the Containment System is as described in the Design Description of this ~~Section~~ Subsection 2.15.1 and as shown in Figure 2.15.1-1.

(2) a1. The components identified in Table 2.15.1-1 as ASME Code Section III are designed in accordance with ASME Code Section III requirements.

a2. The RCCV and its liners are designed to meet the requirements in Article CC-3000 of ASME Code, Section III, Division 2, and seismic Category I requirements. The steel components of the RCCV are designed to meet the requirements in Article NE-3000 of ASME Code, Section III, Division 1.

a3. The piping identified in Table 2.15.1-1 as ASME Code Section III is designed in accordance with ASME Code Section III requirements.

b1. The design of the components identified in Table 2.15.1-1 as ASME Code Section III will be reconciled with the design requirements.

b2. The RCCV and its liners are designed to meet the requirements in Article CC-3000 of ASME Code, Section III, Division 2, and seismic Category I requirements. The steel components of the RCCV are designed to meet the requirements in Article NE-3000 of ASME Code, Section III, Division 1. The design of these components will be reconciled with the design requirements.

b3. The as-built piping identified in Table 2.15.1-1 as ASME Code Section III shall be reconciled with the piping design requirements.

c1. The components identified in Table 2.15.1-1 as ASME Code Section III are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

c2. The RCCV and its liners are fabricated, installed, and inspected in accordance with the requirements in Article CC-3000 of ASME Code, Section III, Division 2. The steel components of the RCCV are fabricated, installed, and inspected to meet the requirements in Article NE-3000 of ASME Code, Section III, Division 1.

c3. The piping identified in Table 2.15.1-1 as ASME Code Section III is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

(3) a. Pressure boundary welds in components identified in Tables 2.15.1-1a and 2.15.1-1b as ASME Code Section III meet ASME Code Section III non-destructive examination requirements.

b. Pressure boundary welds in piping identified in Tables 2.15.1-1a and 2.15.1-1b as ASME Code Section III meet ASME Code Section III non-destructive examination requirements.

(4) The components and piping identified in Tables 2.15.1-1a and 2.15.1-1b as ASME Code Section III retain their pressure boundary integrity at their design pressure.

(5) The Seismic Category I equipment identified in Tables 2.15.1-1a, 2.15.1-1b and 2.15.1-1c can withstand Seismic Category I loads without loss of safety function.

(6) a. The electrical safety-related components associated with actuation and status monitoring of final control elements of the Containment System equipment listed in Tables 2.15.1-1a, 2.15.1-1b, and 2.15.1-1c receive power from their respective safety-related divisional power supplies.

b. Separate electrical penetrations are provided for circuits of each safety-related division and for nonsafety-related circuits.

c. The circuits of each electrical penetration are of the same voltage class.

(7) The containment system provides a barrier against the release of fission products to the atmosphere.

(8) The containment system pressure boundary retains its structural integrity when subject to design pressure.

(9) The containment system provides the safety function of containment isolation for containment boundary integrity.

(10) Containment electrical penetration assemblies, whose maximum available fault current (including failure of upstream devices) is greater than the continuous rating of the penetration, are protected against currents that are greater than the continuous ratings.

(11) (Deleted)~~The minimum set of displays, alarms and controls, based on the emergency procedure guidelines and important operator actions, related to the contianment system, is available in the main control room.~~

(12) The amount of chlorine bearing cable insulation exposed to the containment atmosphere is limited.

(13) The DW and wetwell (WW) volumes are adequately sized to accommodate the calculated maximum DW temperature and absolute pressure that are postulated to occur as a result of a design basis accident.

(14) The water volume of the WW is adequately sized to condense the steam that is forced into the WW from the DW due to a postulated design basis event.

(15) Each vacuum breaker isolation valve automatically closes if the vacuum breaker does not fully close when required.

(16) a. Each vacuum breaker has proximity sensors to detect open/close position. This indication is available in the main control room.

b. Each vacuum breaker has temperature sensors to detect bypass leakage at design basis accident conditions. This indication is available in the main control room.

(17) The containment penetration isolation design for each fluid piping system requiring isolation meets the single-failure criterion to ensure completion of penetration isolation.

(18) DW to WW bypass leakage is less than the assumed value used in the containment capability design basis containment response analysis.

(19) Total DW to WW vacuum breaker bypass pathway leakage is less than the assumed value used in the containment capability design basis containment response analysis.

(20) Each vacuum breaker opening differential pressure is less than or equal to the required opening differential pressure.

(21) Each vacuum breaker closing differential pressure is greater than or equal to the required closing differential pressure.

(22) a. Containment isolation valves are located as close to the containment as practical, consistent with General Design Criteria 55, 56 and 57.

b. The as-built location of containment isolation valves relative to containment shall be reconciled with design requirements.

(23) a. The containment boundary electric penetration assemblies are designed in accordance with ASME Boiler and Pressure Vessel Code, Division 1, Section III, Subsection NE for Class MC Components and Seismic Category I requirements.

b. The containment boundary electric penetration assemblies shall be reconciled with the design requirements.

c. The containment boundary electric penetration assemblies are fabricated, installed, and inspected in accordance with ASME Boiler and Pressure Vessel Code, Division 1, Section III, Subsection NE for Class MC Components.

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

Table 2.15.1-2 provides a definition of the inspections, tests, and analyses, together with associated acceptance criteria for the Containment System.

## Table 2.15.1-2

## ITAAC For The Containment System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The functional arrangement of the Containment System is as described in the Design Description of this Subsection 2.15.1 and as shown in Figure 2.15.1-1. | Inspections of the as-built system will be conducted. | The as-built Containment System conforms to the functional arrangement as described in Subsection 2.15.1 and Figure 2.15.1-1. |
| 2a1. The components identified in Table 2.15.1-1 as ASME Code Section III are designed in accordance with ASME Code Section III requirements. | Inspection of ASME Code Design Reports (NCA 3550) and required documents will be conducted. | ASME Code Design Report(s) (certified, when required by ASME Code) exist for the components identified in Table 2.15.1-1 as ASME Code Section III and conclude compliance to NCA-3550, including those stresses applicable to loads related to fatigue (including environmental effects), thermal expansion, seismic, and combined. |
| 2a2. The RCCV and its liners are designed to meet the requirements in Article CC-3000 of ASME Code, Section III, Division 2, and seismic Category I requirements. The steel components of the RCCV are designed to meet the requirements in Article NE-3000 of ASME Code, Section III, Division 1. | Inspection of ASME Code Design Report and certified documents for the RCCV and its liners, and for the steel components of the RCCV will be conducted. | ASME Code Design Report(s) (certified, when required by ASME Code) exist for the RCCV and its liners and steel components in accordance with ASME Code Section III, including those stresses applicable to loads related to fatigue (including environmental effects), thermal expansion, seismic, and combined. |

## Table 2.15.1-2

## ITAAC For The Containment System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 2a3. The piping identified in Table 2.15.1-1 as ASME Code Section III is designed in accordance with ASME Code Section III requirements. | Inspection of ASME Code Design Reports (NCA 3550) and required documents for the piping will be conducted.<br>{{Design Acceptance Criteria}} | ASME Code Design Report(s) (certified, when required by ASME Code) exist for the piping identified in Table 2.15.1-1 as ASME Code Section III and demonstrates compliance to NCA-3550, including those stresses applicable to loads related to fatigue (including environmental effects), thermal expansion, seismic, and combined.<br>{{Design Acceptance Criteria}} |
| 2b1. The design of the components identified in Table 2.15.1-1 as ASME Code Section III will be reconciled with the design requirements. | A reconciliation analysis of the components using as-designed and as-built information and ASME Code Design Reports (NCA 3550) will be conducted. | The as-built components are reconciled with the design documents used for design analysis. For ASME Code Components, the reconciliation report includes comparison to the ASME Code Design Report (NCA-3550) (certified, when required by ASME Code) and documents the results of the reconciliation analysis. |

## Table 2.15.1-2

## ITAAC For The Containment System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 2b2. The RCCV and its liners are designed to meet the requirements in Article CC-3000 of ASME Code, Section III, Division 2, and seismic Category I requirements. The steel components of the RCCV are designed to meet the requirements in Article NE-3000 of ASME Code, Section III, Division 1. The design of these components will be reconciled with the design requirements. | A reconciliation analysis of the RCCV and its liners and steel components using as-designed and as-built information and ASME Code Design Reports will be conducted. | The as-built components are reconciled with the design documents used for design analysis. For ASME Code Components, the reconciliation report includes comparison to the ASME Code Design Report (certified, when required by ASME Code) and documents the results of the reconciliation analysis. |
| 2b3. The as-built piping identified in Table 2.15.1-1 as ASME Code Section III shall be reconciled with the piping design requirements. | A reconciliation analysis of the piping using the as-designed and as-built information and ASME Code Design Reports (NCA 3550) will be conducted. | The as-built piping has been reconciled with the design documents used for design analysis. The reconciliation report includes comparison to the ASME Code Design Reports (NCA-3550) (certified, when required by ASME Code) and documents the results of the reconciliation analysis. |

## Table 2.15.1-2

## ITAAC For The Containment System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 2c1. The components identified in Table 2.15.1-1 as ASME Code Section III are fabricated, installed, and inspected in accordance with ASME Code Section III requirements. | Inspections of the components will be conducted. | ASME Code Data Report(s) (including N-5 Data reports, where applicable) (certified, when required by ASME Code) and inspection reports exist and conclude that the components identified in Table 2.15.1-1 as ASME Code Section III are fabricated, installed, and inspected in accordance with ASME Code Section III requirements. |
| 2c2. The RCCV and its liners are fabricated, installed, and inspected in accordance with the requirements in Article CC-3000 of ASME Code, Section III, Division 2. The steel components of the RCCV are fabricated, installed, and inspected to meet the requirements in Article NE-3000 of ASME Code, Section III, Division 1. | Inspection of the ASME Code Section III documents for as-built components and piping, for the RCCV and its liners, and for the steel components of the RCCV will be conducted. | ASME Code Report(s) (certified, when required by ASME Code) exist and conclude that ASME Code Section III stress report(s) exist for the as-built RCCV and its liners and steel components. ASME Code Report(s) exist and conclude that for ASME Section III, Division 2 construction, ASME Code Section III stress reports demonstrate compliance to NCA-3350 through NCA-3380, and NCA-3454. ASME Code Report(s) exist and conclude that for ASME Section III, Division 1 construction, ASME Code Section III stress reports demonstrate compliance to NCA-3350. ASME code inspection reports document results of inspections. |

## Table 2.15.1-2

## ITAAC For The Containment System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 2c3. The piping identified in Table 2.15.1-1 as ASME Code Section III is fabricated, installed, and inspected in accordance with ASME Code Section III requirements. | Inspection of ASME Code Section III documents for as-built will be conducted. | ASME Code Report(s) (certified, when required by ASME Code) exist and conclude that an ASME Code Section III stress report(s) exist for the as-built piping identified in Table 2.15.1-1 as ASME Code Section III. ASME Code Report(s) exist and conclude that for ASME Section III, Division 2 construction, ASME Code Section III stress reports demonstrate compliance to NCA-3350 through NCA-3380, and NCA-3454. ASME Code Report(s) exist and conclude that for ASME Section III, Division 1 construction, ASME Code Section III stress reports demonstrate compliance to NCA-3350. ASME code inspection reports document results of inspections. |
| 3a. Pressure boundary welds in components identified in Tables 2.15.1-1a and 2.15.1-1b as ASME Code Section III meet ASME Code Section III non-destructive examinations requirements. | Inspection of the as-built pressure boundary welds will be performed in accordance with ASME Code Section III. | ASME Code Report(s) exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of pressure boundary welds in the Containment System. |

## Table 2.15.1-2

## ITAAC For The Containment System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 3b. Pressure boundary welds in piping identified in Tables 2.15.1-1a and 2.15.1-1b as ASME Code Section III meet ASME Code Section III non-destructive examination requirements. | Inspection of the as-built pressure boundary welds will be performed in accordance with ASME Code Section III. | ASME Code Report(s) exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of pressure boundary welds in the Containment System. |
| 4. The components and piping identified in Tables 2.15.1-1a and 2.15.1-1b as ASME Code Section III retain their pressure boundary integrity at their design pressure. | i. A hydrostatic pressure test will be performed on the components and piping required by the ASME Code Section III to be tested. | i. ASME Code report exists and concludes that the results of the hydrostatic pressure test of the components and piping identified in Tables 2.15.1-1a and 2.15.1-1b as ASME Code Section III comply with the requirements of the ASME Code Section III. |
| | ii. Impact testing will be performed on the containment and pressure-retaining materials in accordance with the ASME Code Section III to confirm the fracture toughness of the materials. | ii. ASME Code report exists and concludes that the containment and pressure-retaining penetration materials comply with fracture toughness requirements of the ASME Code Section III. |
| 5. The Seismic Category I equipment identified in Tables 2.15.1-1a, 2.15.1-1b, and 2.15.1-1c can withstand Seismic Category I loads without loss of safety-related function. | i. Inspections will be performed to verify that the Seismic Category I equipment identified in Tables 2.15.1-1a, 2.15.1-1b and 2.15.1-1c is located in a Seismic Category I structure. | i. The Seismic Category I equipment identified in Tables 2.15.1-1a, T2.15.1-1b, and 2.15.1-1c is housed in a Seismic Category I structure. |

## Table 2.15.1-2

## ITAAC For The Containment System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| | ii. Type tests, analyses, or a combination of type tests and analyses of Seismic Category I equipment identified in Tables 2.15.1-1a, 2.15.1-1b and 2.15.1-1c, will be performed using analytical assumptions, or under conditions which bound the Seismic Category I design requirements.<br>iii. Inspections and analyses will be performed to verify that the as-built equipment, including anchorage, identified in Tables 2.15.1-1a, 2.15.1-1b and 2.15.1-1c, is bounded by the tested or analyzed conditions. | ii. The Seismic Category I equipment identified in Tables 2.15.1-1a, 2.15.1-1b and 2.15.1-1c can withstand Seismic Category I loads without loss of safety function.<br>iii. The as-built equipment, including anchorage, identified in Tables 2.15.1-1a, 2.15.1-1b, and 2.15.1-1c , can withstand Seismic Category I loads without loss of safety function. |
| 6a. The electrical safety-related components associated with actuation and status monitoring of final control elements of the Containment System equipment listed in Tables 2.15.1-1a, 2.15.1-1b, and 2.15.1-1c receive power from their respective safety-related divisional power supplies. | Test(s) will be performed for the electrical safety-related components for the equipment of the Containment System listed in Tables 2.15.1-1a, 2.15.1-1b, and 2.15.1-1c by providing a test signal in only one safety-related division at a time. | The electrical components in a singular division for the equipment of the Containment System listed in Tables 2.15.1-1a, 2.15.1-1b, and 2.15.1-1c receive power from a safety-related power supply in the same division. |
| 6b. Separate electrical penetrations are provided for circuits of each safety-related division and for nonsafety-related circuits. | Inspection of the as-built electrical containment penetrations will be performed. | Each as-built electrical penetration contains cables of only one division or contains nonsafety-related cables. |

## Table 2.15.1-2

## ITAAC For The Containment System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 6c. The circuits of each electrical penetration are of the same voltage class. | Inspections of the as-built containment electrical penetrations will be performed. | Each as-built circuit of each electrical penetration is of the same voltage class. |
| 7. The containment system provides a barrier against the release of fission products to the atmosphere. | Perform Type A, B and C leak rate tests in accordance with 10 CFR 50 Appendix J. | Leak rates are less than the acceptance criterion established per 10 CFR 50 Appendix J. |
| 8. The containment system pressure boundary retains its structural integrity when subject to design pressure. | A Structural Integrity Test (SIT) of the containment structure is performed in accordance with Article CC-6000 of ASME Code Section III, Division 2 and Regulatory Guide 1.136, after completion of the containment construction. The first prototype containment structure will be instrumented to measure strains per ASME Code Section III, Division 2, CC-6370. | The containment system pressure boundary retains its structural integrity when tested and evaluated in accordance with ASME Code Section III, Division 2 at a test pressure of at least 115% of the design pressure of 310 kPaG (45 psig). |
| 9. The containment system provides the safety function of containment isolation for containment boundary integrity. | i. Tests will be performed to demonstrate that containment isolation valves close within the required response times. | i. The containment isolation valves close within the required response times identified in Table 2.15.1-1d. |

## Table 2.15.1-2

## ITAAC For The Containment System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| | ii. Tests will be performed to demonstrate that remote manual operated containment isolation valves reposition to the required post-accident position using real or simulated containment isolation signals. | ii. The remote manual operated valves identified in Table 2.15.1-1a as having a containment isolation signal reposition to the required post-accident state after receiving a containment isolation signal. |
| | iii. Exercise testing of the process actuated check valves identified in Table 2.15.1-1a will be performed under preoperational test pressure, temperature and fluid flow conditions. | iii. Each as-built process actuated check valve changes position as indicated in Table 2.15.1-1a. |
| | iv. Tests will be performed to demonstrate that the lower drywell equipment and personnel hatches can be closed from outside the drywell. | iv. The lower drywell equipment and personnel hatches are able to be closed from outside the lower drywell, and a program in place to track the status of each hatch while open during MODE 5 and 6 operation. |
| | v. Testing of the as-built valves will be performed under the conditions of loss of motive power. | v. After a loss of motive power, each remote manual valve identified in Table 2.15.1-1a assumes the indicated loss of motive power position. |

## Table 2.15.1-2

## ITAAC For The Containment System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 10. Containment electrical penetration assemblies, whose maximum available fault current (including failure of upstream devices) is greater than the continuous rating of the penetration, are protected against currents that are greater than the continuous ratings. | An analysis of the as-built containment electrical penetration assemblies will be performed to demonstrate either (1) the maximum over current of the circuits does not exceed the continuous current rating of the penetration, or (2) circuits whose maximum available fault currents are greater than the continuous current rating of the penetration are provided with redundant over current interrupting devices. | Analysis exists for the as-built containment electrical penetration assemblies and concludes that the penetrations, whose maximum available fault current (including failure of upstream devices) is greater than the continuous rating of the penetration, are protected against currents that are greater than their continuous ratings. |
| 11. (Deleted)~~The minimum set of displays, alarms and controls, based on the emergency procedure guidelines and important operator actions, as related to the containment system, is available in the main control room.~~ | ~~Inspection of the as-built main control room will verify that the minimum set of displays, alarms and controls for the Containment System is available.~~ | ~~The minimum set of displays, alarms and controls for the Containment System, as defined by the emergency operating procedures and important operator actions exist in the as-built main control room.~~ |
| 12. The amount of chlorine bearing cable insulation exposed to the containment atmosphere is limited. | Analyses and inspection will be used to confirm the final exposed chlorine bearing cable insulation mass. | The amount of chlorine bearing cable insulation exposed to the containment atmosphere (i.e. not within an enclosed cable tray, pipe, conduit, or metal cable jacketing) is ≤ 3400 kg (7500 lbs). |

## Table 2.15.1-2

## ITAAC For The Containment System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 13. The DW and WW volumes are adequately sized to accommodate the calculated maximum DW temperature and absolute pressure that are postulated to occur as a result of a design basis accident. | Using as-built dimensions, the DW and WW volumes will be calculated. | The as-built DW free gas volume is within the analyzed limits of the free gas volume assumed in the containment performance safety analysis; and the as-built WW free gas volume is greater than the analyzed limit of the free gas volume assumed in the containment performance safety-analysis. |
| 14. The water volume of the WW is adequately sized to condense the steam that is forced into the WW from the DW due to a postulated design basis event. | Using as-built dimensions of the WW and a minimum measured suppression pool depth of 5.4 meters (213 inches), the volume of the suppression pool will be calculated. | The calculated suppression pool water volume is equal to or greater than the water volume assumed in the containment performance safety analysis. |
| 15. Each vacuum breaker isolation valve automatically closes if the vacuum breaker does not fully close when required. | A test will be performed by providing a simulated or real not-fully closed vacuum breaker signal originating from the closed position proximity sensor and temperature sensors to close the associated vacuum breaker isolation valve. | Each as-built vacuum breaker isolation valve automatically closes when a simulated or real not-fully closed signal is provided from the closed position proximity sensor of its associated vacuum breaker. |

## Table 2.15.1-2

## ITAAC For The Containment System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 16a. Each vacuum breaker has proximity sensors to detect open/close position. This indication is available in the main control room. | Testing will be performed with each as-built vacuum breaker to demonstrate that the proximity sensors indicate open and closed position. An inspection will be performed in the MCR. | Each as-built vacuum breaker proximity sensor indicates an open position with the vacuum breaker open and indicates a closed position when the vacuum breaker is in the fully closed position. The open and closed position indications of the as-built vacuum breakers are available in the main control room. |
| 16b. Each vacuum breaker has temperature sensors to detect bypass leakage at design basis accident conditions. This indication is available in the main control room. | A type test will be performed on a vacuum breaker to detect bypass leakage at simulated design basis accident conditions. An inspection will be performed in the MCR. | Vacuum breaker temperature sensors discriminate within the range of ≥ 0.3 $cm^2$ and ≤ 0.6 $cm^2$ (A/√K) of bypass leakage area at design basis accident conditions. Indication exists in the MCR. |
| 17. The containment penetration isolation design for each fluid piping system requiring isolation meets the single-failure criterion to ensure completion of penetration isolation. | Single-failure analysis is performed on the isolation design of each fluid system penetration class or penetration, as applicable. | A study of all applicable containment fluid system penetrations demonstrates that, for each penetration or penetration class isolation design, the single-failure criterion is satisfied. |
| 18. DW to WW bypass leakage is less than the assumed value used in the containment capability design basis containment response analysis. | A DW to WW bypass leakage test will be conducted. | The results of the DW to WW bypass leakage is less than or equal to 50% of the assumed value in the containment capability design basis containment response analysis. |

## Table 2.15.1-2

## ITAAC For The Containment System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 19. Total DW to WW vacuum breaker bypass pathway leakage is less than the assumed value used in the containment capability design basis containment response analysis. | A DW to WW bypass leakage test will be conducted for each vacuum breaker and associated vacuum breaker isolation valve. | The results of the total DW to WW vacuum breaker bypass pathway leakage is less than or equal to 35% of the assumed value in the containment capability design basis containment response analysis. |
| 20. Each vacuum breaker opening differential pressure is less than or equal to the required opening differential pressure. | An opening differential pressure test will be conducted for each vacuum breaker. | The results of the opening differential pressure test is less than or equal to 3.07 kPa (0.445 psi). |
| 21. Each vacuum breaker closing differential pressure is greater than or equal to the required closing differential pressure. | A closing differential pressure test will be conducted for each vacuum breaker. | The vacuum breaker closing differential pressure is greater than or equal to 2.21 kPa (0.320 psi). |

**Table 2.15.1-2**

**ITAAC For The Containment System**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 22a. Containment isolation valves are located as close to the containment as practical, consistent with General Design Criteria 55, 56 and 57. | Inspection of piping design isometric drawings will be conducted.<br>{{Design Acceptance Criteria}} | Based on a review of piping design isometric drawings, containment isolation valves are designed to be located as close to containment as practical, considering required access for:<br>• In-service inspection of non-isolable welds,<br>• 10CFR50 Appendix J leak testing,<br>• Cutout and replacement of isolation valves using standard pipe fitting tools and equipment,<br>• Local control, and<br>• Valve seat resurfacing in place.<br>{{Design Acceptance Criteria}} |
| 22b. The as-built location of containment isolation valves relative to containment shall be reconciled with design requirements. | A reconciliation evaluation of containment isolation valve locations relative to containment using as-designed and as-built information will be performed. | A design reconciliation has been completed for the as-built locations of containment isolation valves relative to the design requirements. The report documents the results of the reconciliation evaluation. |

## Table 2.15.1-2

## ITAAC For The Containment System

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 23a. The containment boundary electric penetration assemblies are designed in accordance with ASME Boiler and Pressure Vessel Code, Division 1, Section III, Subsection NE for Class MC Components. | Inspection of ASME Code Certified Design Reports and required documents will be conducted. | ASME Code Certified Design Report(s) exist and conclude that the design of the containment boundary electric penetration assemblies comply with the requirements of the ASME Boiler and Pressure Vessel Code, Division 1, Section III, Subsection NE for Class MC Components, including for those stresses and loads related to seismic and electromagnetic forces produced by rated short-circuit currents. |
| 23b. The containment boundary electric penetration assemblies shall be reconciled with the design requirements. | A reconciliation analysis of the components using as-designed and as-built information and ASME Code Certified Design Reports will be performed. | ASME Code Certified Design Report(s) exist and conclude that design reconciliation has been completed in accordance with the ASME Code for as-built reconciliation of the containment boundary electric penetration assemblies. The report documents the results of the reconciliation analysis. |
| 23c. The containment boundary electric penetration assemblies are fabricated, installed, and inspected in accordance with ASME Boiler and Pressure Vessel Code, Division 1, Section III, Subsection NE for Class MC Components. | Inspection of the components will be conducted. | ASME Code Data Report(s) and Inspection Report(s) exist and conclude that the containment boundary electric penetration assemblies are fabricated, installed, and inspected in accordance with ASME Boiler and Pressure Vessel Code, Division 1, Section III, Subsection NE for Class MC Components. |

## 2.15.4 Passive Containment Cooling System

### Design Description

The Passive Containment Cooling System (PCCS), in conjunction with the suppression pool, maintains the containment within its pressure limits for DBAs such as a LOCA, by condensing steam from the DW atmosphere and returning the condensed liquid to the Gravity Driven Cooling System (GDCS) pools. The system is passive, with no components that must actively function in the first 72 hours after a DBA.

The ~~equipment~~ environmental qualification of PCCS components is addressed in Section 3.8.

(1) The functional arrangement for the PCCS is as described in the Design Description in this Subsection 2.15.4, Table 2.15.4-1 and Figure 2.15.4-1.

(2) a1. The components identified in Table 2.15.4-1 as ASME Code Section III are designed in accordance with ASME Code Section III requirements.

a2. The components identified in Table 2.15.4-1 as ASME Code Section III shall be reconciled with the design requirements.

a3. The components identified in Table 2.15.4-1 as ASME Code Section III are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

b1. The piping identified in Table 2.15.4-1 as ASME Code Section III is designed in accordance with ASME Code Section III requirements.

b2. The as-built piping identified in Table 2.15.4-1 as ASME Code Section III shall be reconciled with the piping design requirements.

b3. The piping identified in Table 2.15.4-1 as ASME Code Section III is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

(3) a. Pressure boundary welds in components identified in Table 2.15.4-1 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements.

b. Pressure boundary welds in piping identified in Table 2.15.4-1 as ASME Code Section III meet ASME Code Section III non-destructive examination requirements.

(4) a. The components identified in Table 2.15.4-1 as ASME Code Section III retain their pressure boundary integrity at their design pressure.

b. The piping identified in Table 2.15.4-1 as ASME Code Section III retains its pressure boundary integrity at its design pressure.

(5) The equipment identified in Table 2.15.4-1 as Seismic Category I can withstand Seismic Category I loads without loss of safety function.

(6) Each mechanical train of the PCCS located inside the containment is physically separated from the other train(s) so as not to preclude accomplishment of the intended safety-related function.

(7) The PCCS together with the pressure suppression containment system will limit containment pressure to less than its design pressure for 72 hours after a LOCA.

(8) (Deleted)

(9) The elevation of the PCCS vent line discharge point is submerged in the suppression pool at an elevation below low water level and above the uppermost horizontal vent.

(10) The PCCS will be designed to limit the fraction of containment leakage through the condensers to an acceptable value.

(11) The PCCS vent fans flow rate is sufficient to meet the beyond 72 hours containment cooling requirements following a design basis LOCA.

(12) The PCCS vent fans can be remotely operated from the MCR.

(13) The PCCS drain piping is installed to allow venting of non-condensable gases from the PCCS drain lines to the PCCS condenser vent lines to prevent collection in the PCCS drain lines.

(14) The elevation of the PCCS vent fan discharge point is submerged within the drain pan located in the GDCS pool at an elevation below the lip of the drain pan.

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

Table 2.15.4-2 provides a definition of the inspections, tests and analyses, together with associated acceptance criteria for the Passive Containment Cooling System.

## 2.15.7 Containment Monitoring System

### Design Description

The Containment Monitoring System (CMS) provides instrumentation listed in Table 2.15.7-1 to monitor the following parameters:

- DW and WW Hydrogen and Oxygen concentrations
- DW and WW Gross Gamma Radiation levels
- DW and WW Pressures
- DW/WW Differential Pressure
- Upper DW Level
- Lower DW Level
- Suppression Pool Water Level
- Suppression Pool Temperature

Refer to Subsection 2.2.15 for "Instrumentation & Controls Compliance With IEEE Std. 603."

The environmental ~~and seismic~~ qualification of CMS components is addressed in Section 3.8; and the environmental and seismic qualification of digital instrumentation and controls equipment is addressed in Section 3.8.

The containment isolation portions of the CMS system are addressed in Subsection 2.15.1.

CMS software is developed in accordance with the software development program described in Section 3.2 as part of the SSLC/ESF software projects.

(1) The functional arrangement for the CMS is as described in the Design Description in this Subsection 2.15.7, Table 2.15.7-1 and Figure 2.15.7-1.

(2) Each of the safety-related components identified in Table 2.15.7-1 is powered from its respective safety-related division.

(3) Each CMS measured parameter in Table 2.15.7-1 will indicate the measured parameter and initiate separate alarms in the control room when values exceed applicable setpoints.

(4) The Hydrogen/Oxygen ($H_2/O_2$) monitoring subsystem of CMS is active during normal operation. Additional sampling capacity is automatically initiated by a LOCA signal for post-accident monitoring of oxygen and hydrogen content in the containment.

(5) In each CMS Suppression Pool Temperature Monitoring (SPTM) division, signals from the CMS SPTM temperature and the CMS suppression pool water narrow range transmitters are provided for the divisional RPS logic processors to calculate the suppression pool average temperature.

(6) The equipment identified in Table 2.15.7-1 as Seismic Category I can withstand Seismic Category I loads without loss of safety function.

(7) (Deleted)

(8) (Deleted)

(9) (Deleted)

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

Table 2.15.7-2 provides the definitions of the inspections, tests, and analyses, together with associated acceptance criteria, which will be undertaken for the Containment Atmospheric Monitoring System and the suppression pool monitoring portions of CMS.

## 2.16.2 Heating, Ventilating and Air Conditioning

### *2.16.2.1 Reactor Building HVAC*

**Design Description**

The Reactor Building HVAC System (RBVS) serves the Reactor Building. The RBVS consists of three subsystems. The Reactor Building Clean Area HVAC Subsystem (CLAVS) serves the clean (non-radiologically controlled) areas of the Reactor Building and is shown in Figure 2.16.2-1. The Reactor Building Contaminated Area HVAC Subsystem (CONAVS) serves the potentially contaminated areas of the Reactor Building and is shown in Figure 2.16.2-2. The Reactor Building Refueling and Pool Area HVAC Subsystem (REPAVS) serves the refueling area of the Reactor Building and is shown in Figure 2.16.2-3.

The RBVS automatically isolates the Reactor Building boundary (CONAVS and REPAVS subsystems) during accidents. The isolation dampers and ducting penetrating the Reactor Building boundary, and associated controls that provide the isolation signal are safety-related. Safety-related components for the RBVS are listed in Table 2.16.2-1.

Mechanical cooling of the Reactor Building rooms is not provided as a safety-related function while the boundary is isolated. Passive means are provided by the ESBWR design to limit the temperature rise in the Reactor Building rooms to acceptable levels for the first 72 hours following a design basis accident.

RBVS software that controls the safety-related RBVS components is developed in accordance with the software development program described in Section 3.2.

RBVS alarms, displays, controls, and status indications in the MCR are addressed by Section 3.3.

The remaining portion of the RBVS is nonsafety-related.

(1) The functional arrangement of the RBVS is as described in the Design Description of this Subsection 2.16.2.1 and as shown in Figures 2.16.2-1, 2.16.2-2 and 2.16.2-3.

(2) The RBVS isolation dampers automatically close upon receipt of a high radiation signal or (CONAVS and REPAVS) or loss of AC power (CONAVS, REPAVS and CLAVS).

(3) The equipment identified in Table 2.16.2-1 as Seismic Category I can withstand Seismic Category I loads without loss of safety function.

(4) The RBVS maintains the hydrogen concentration levels in the battery rooms below 2% by volume.

(5) CONAVS maintains served areas of the reactor building at a slightly negative pressure relative to surrounding clean areas to minimize the exfiltration of potentially contaminated air.

(6) REPAVS maintains served areas of the reactor building at a slightly negative pressure relative to surrounding clean areas to minimize the exfiltration of potentially contaminated air.

(7) The RBVS provides post 72-hour cooling for DCIS, CRD and RWCU pump rooms, electrical cabinet cooling and CRD/RWCU motor cooling.

(8) (Deleted)~~Indications and controls for safety-related components of the RBVS as indicated in Table 2.16.2-1 are available in the MCR.~~

(9) Independence is provided between safety-related divisions, and between safety-related divisions and nonsafety-related equipment.

(10) (Deleted)

(11) The Reactor Building HVAC Online Purge Exhaust Filters are tested to meet RG 1.140 and ASME AG-1 requirements for HEPA and carbon filter efficiency.

(12) a. The Reactor Building HVAC Accident Exhaust Filters maintains the CONAVS served areas of the reactor building at a minimum negative pressure of 62 Pa (-1/4 inch W.G.) relative to surrounding clean areas when operating.

b. The Reactor Building HVAC Accident Exhaust Filters meet RG 1.140 and ASME AG-1 requirements for HEPA and carbon filter efficiency.

(13) The Reactor Building concrete acts as a heat sink that passively maintains the temperature of the Reactor Building rooms within an acceptable range for the first 72 hours following a design basis accident.

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

Table 2.16.2-2 provides the design commitments, inspections, tests, analyses and acceptance criteria for the RBVS system.

### *2.16.2.2 Control Building HVAC System*

**Design Description**

The Control Building HVAC consists of two independent subsystems. The Control Room Habitability Area HVAC Subsystem (CRHAVS) serves the MCR and associated areas bounded by the Control Room Habitability Area (CRHA) envelope. The Control Building General Area HVAC Subsystem (CBGAVS) serves the areas inside the Control Building but outside the CRHA. Table 2.16.2-3 lists the major Control Building HVAC system safety-related components.

Both of these subsystems are nonsafety-related except for that portion of the CRHAVS that forms the CRHA boundary envelope, and the CRHAVS Emergency Filter Units (EFU) and associated components, which are safety-related. This safety-related CRHA boundary envelope consists of the CRHA structure, doors, penetrations, redundant boundary isolation dampers, valves, and that portion of transition ductwork, piping, or tubing that is located between the CRHA boundary structure and the redundant CRHA isolation dampers or valves. The CRHA isolation dampers are the major components discussed in this Subsection. Additional systems, structures, and components (such as EFUs) that are necessary for habitability are discussed in other subsections.

The mechanical cooling of the Control Building General Areas and the CRHA is not provided as a safety-related function during a CRHA boundary isolation. Passive means of limiting CRHA and general area temperature rise to acceptable levels have been provided by the ESBWR design for the first 72 hours following a design basis accident.

The CRHAVS serves the MCR and associated support areas during normal plant operations, plant start-up and plant shutdown and is shown in Figure 2.16.2-4. The CBGAVS serves the areas outside the CRHA and is shown in Figures 2.16.2-5a and 2.16.2-5b.

CRHAVS software that controls the safety-related CRHAVS components is developed in accordance with the software development program described in Section 3.2.

(1) The functional arrangement of the CRHAVS is as described in the Design Description of this Subsection 2.16.2.2 and is as shown in Figure 2.16.2-4.

(2) The CRHA isolation dampers automatically close upon receipt of any of the following signals:

- high radiation in the CRHAVS intake;
- high radiation downstream of an Emergency Filter Unit (EFU) during emergency operation;
- low airflow through an EFU during emergency operation;
- loss of AC power.

(3) The equipment identified in Table 2.16.2-3 as Seismic Category I can withstand Seismic Category I loads without loss of safety function.

(4) The CRHAVS heat sink passively maintains the temperature of the CRHA within an acceptable range for the first 72 hours following a design basis accident.

(5) Independence is provided between safety-related divisions, and between safety-related divisions and nonsafety-related equipment.

(6) CRHA isolation damper and EFU operational status (Open/Closed) indication is provided in the MCR.

(7) The free air volume of the control room envelope is greater than or equal to the volume assumed in safety analyses.

(8) Normal operation intake flow rate is greater than or equal to the flow rate assumed in the safety analyses.

(9) (Deleted)

(10) CRHAVS Air Handling Units and Auxiliary Cooling Units support post-72 hour control room habitability cooling and cooling for post-accident monitoring heat loads.

(11) The CRHA is provided with differential pressure indication for monitoring under normal and emergency operation.

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

Table 2.16.2-4 provides definitions of the inspections, test and analyses, together with associated acceptance criteria for the Control Building HVAC.

### *2.16.2.3 Emergency Filter Units*

**Design Descriptions**

The Emergency Filter Units (EFU) supply pressurized breathing air to the Control Room Habitability Area (CRHA) during isolation of the CRHA boundary envelope. The EFUs are safety-related and maintain habitable conditions in the CRHA to ensure the safety of the control room operators. An EFU is automatically initiated upon CRHA isolation to provide breathing air and pressurization of the CRHA to minimize infiltration. There are two independent, redundant EFU trains capable of supplying sufficient air and CRHA pressurization. The EFUs are part of the CRHAVS, and a simplified system diagram is provided in Figure 2.16.2-4. Design information on safety-related equipment is provided in Table 2.16.2-5.

EFU software that controls the safety-related EFU components is developed in accordance with the software development program described in Section 3.2.

EFU alarms, displays, controls, and status indications in the MCR are addressed by Section 3.3.

(1) The functional configuration of the EFU is as described in the Design Description of this Subsection 2.16.2.3 and as shown in Figure 2.16.2-4.

(2) The selected redundant EFU dampers open upon receipt of a control room habitability envelope isolation signal.

(3) The equipment identified in Table 2.16.2-5 as Seismic Category I can withstand Seismic Category I loads without loss of safety function.

(4) Independence for the EFU trains is provided between safety-related divisions, and between safety-related divisions and nonsafety-related equipment.

(5) a. EFUs maintain the CRHA at the minimum positive pressure with respect to the surrounding areas at the required air addition flow rate.

    b. The in-leakage does not exceed the unfiltered in-leakage assumed by control room operator dose analysis.

(6) The powered EFU dampers can be remotely operated from the MCR.

(7) EFUs meet the in-place leakage testing requirements of ASME AG-1 and RG 1.52.

(8) (Deleted)~~Indications and controls for the safety-related components of the EFU system as indicated in Table 2.16.2-5 are available in the MCR.~~

(9) (Deleted)

(10) EFUs are tested to meet the laboratory test requirements described in ASME AG-1 and RG 1.52 for carbon adsorber efficiency.

(11) The standby EFU starts on a low flow signal from the operating EFU.

(12) EFUs maintain habitable conditions in the CRHA.

(13) (Deleted)

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

Table 2.16.2-6 provides the design commitments, inspections, tests, analyses and acceptance criteria for the EFUs.

### *2.16.2.4 Turbine Building HVAC System*

**Design Description**

The Turbine Building Ventilation System (TBVS) is nonsafety-related. The TBVS includes the Turbine Building supply air fans and associated Air Handling Units (AHUs), and the Turbine Building exhaust fans and associated filter trains.

The Turbine Building Ventilation System is designed to minimize exfiltration of air to adjacent areas by maintaining a slightly negative pressure in the Turbine Building relative to adjacent areas.

(1) The functional arrangement of the Turbine Building Ventilation System (TBVS) is as described in the Design Description of this Subsection 2.16.2.4 and is as shown in Figure 2.16.2-6.

(2) The TBVS provides post 72-hour cooling for DCIS in the Turbine Building and room cooling for the Nuclear Island Chilled Water System and RCCWs pumps.

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

Table 2.16.2-7 provides the design commitments, inspections, tests, analyses and acceptance criteria for the Turbine Building HVAC System.

### *2.16.2.5 Fuel Building HVAC System*

**Design Description**

The Fuel Building HVAC system (FBVS) does not perform any safety-related functions, except for automatic isolation of the Fuel Building ventilation systems to mitigate the consequences of fuel handling accidents with significant radiological releases. The Fuel Building HVAC subsystems include the Fuel Building General Area HVAC Subsystem (FBGAVS) shown in Figure 2.16.2-7 and the Fuel Building Fuel Pool HVAC Subsystem (FBFPVS) shown in Figure 2.16.2-8.

FBVS alarms, displays, controls, and status indications in the MCR are addressed by Section 3.3.

(1) The functional arrangement of the FBVS is as described in the Design Description of this Subsection 2.16.2.5 and as shown in Figures 2.16.2-7 and 2.16.2-8.

(2) The Fuel Building HVAC isolation dampers automatically close upon receipt of a high radiation signal.

(3) The equipment identified in Table 2.16.2-8 as Seismic Category I can withstand Seismic Category I loads without loss of safety function.

(4) The FBVS maintains the fuel building at a slightly negative pressure relative to surrounding areas.

(5) The FBVS provides post 72-hour cooling for FAPCS pump motors and N-DCIS.

(6) (Deleted)~~Indications and controls for the safety-related components of the FBVS as indicated in Table 2.16.2-8 are available in the MCR.~~

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

Table 2.16.2-9 provides the design commitments, inspections, tests, analyses and acceptance criteria for the Fuel Building HVAC.

### *2.16.2.6 Radwaste Building HVAC System*

No ITAAC are required for this system.

### *2.16.2.7 Electrical Building HVAC System*

**Design Description**

The Electrical Building Ventilation System (EBVS) is nonsafety-related and includes three subsystems. The Electric and Electronic Rooms HVAC Subsystem (EERVS), the Technical Support Center HVAC Subsystem (TSCVS), and the Diesel Generators HVAC Subsystem (DGVS).

(1) The functional arrangement of the Electrical Building Ventilation System (EBVS) is as described in the Design Description of this Subsection 2.16.2.7 and is as shown in Figure 2.16.2-9.

(2) The EBVS provides post 72-hour cooling for Diesel Generators and safety-related electrical distribution and support for electrical power to FAPCS.

(3) The TSCVS air filtration units (AFU) include HEPA filters to provide a habitable work environment for personnel when nonsafety-related power is available.

(4) The TSCVS AFU include charcoal adsorbers to provide a habitable work environment for personnel when nonsafety-related power is available.

(5) The TSCVS AFU maintain the TSC at a slight positive pressure with respect to the surrounding adjacent areas.

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

Table 2.16.2-10 provides the design commitments, inspections, tests, analyses and acceptance criteria for the Electrical Building HVAC System.

## Table 2.16.2-2

## ITAAC For The Reactor Building HVAC

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The functional arrangement of the RBVS is as described in the Design Description of this Subsection 2.16.2.1 and as shown in Figures 2.16.2-1, 2.16.2-2 and 2.16.2-3. | Inspections of the RBVS configuration will be conducted. | The as-built RBVS conforms to the description in Subsection 2.16.2.1 and is as shown in Figures 2.16.2-1, 2.16.2-2 and 2.16.2-3. |
| 2. The RBVS isolation dampers automatically close upon receipt of a high radiation signal (CONAVS and REPAVS) or loss of AC power (CONAVS, REPAVS and CLAVS). | Testing of the RBVS isolation dampers will be performed using simulated signals to close the RBVS isolation dampers. | Upon receipt of a simulated high radiation signal or a simulated loss of AC power signal, the as-built RBVS isolation dampers automatically close. |
| 3. The equipment identified in Table 2.16.2-1 as Seismic Category I can withstand Seismic Category I loads without loss of safety function. | i. Inspection will be performed to verify that the Seismic Category I equipment identified in Table 2.16.2-1 are located in a Seismic Category I structure.<br>ii. Type tests, analyses, or a combination of type tests and analyses, of equipment identified in Table 2.16.2-1 as Seismic Category I, will be performed using analytical assumptions, or will be performed under conditions which bound the Seismic Category I equipment design requirements. | i. The equipment identified as Seismic Category I in Table 2.16.2-1 is located in a Seismic Category I structure.<br>ii. The equipment identified in Table 2.16.2-1 as Seismic Category I can withstand Seismic Category I loads without loss of safety function. |

## Table 2.16.2-2

## ITAAC For The Reactor Building HVAC

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| | iii. Inspections and analyses will be performed to verify that the as-built equipment identified in Table 2.16.2-1, including anchorage, is bounded by the testing or analyzed conditions. | iii. The as-built equipment identified in Table 2.16.2-1 including anchorage, can withstand Seismic Category I loads without loss of safety function. |
| 4. The RBVS maintains the hydrogen concentration levels in the battery rooms below 2% by volume. | Testing and analysis of the system will be performed to demonstrate the air flow capability of the RBVS is adequate to maintain the hydrogen concentration levels in the battery rooms below 2%. | The air flow capability of the as-built RBVS is adequate to maintain the hydrogen concentration levels in the battery rooms below 2%. |
| 5. CONAVS maintains served areas of the reactor building at a slightly negative pressure relative to surrounding clean areas to minimize the exfiltration of potentially contaminated air. | i. Testing will be performed to confirm that the contaminated areas of the reactor building served by CONAVS maintain a minimum negative pressure of 62 Pa (-1/4 in wg) relative to surrounding clean areas when operating CONAVS supply and exhaust fans in the normal system fan lineup. | i. The time average pressure differential in the as-built CONAVS served areas of the reactor building as measured by each of the pressure differential indicators is minimum negative pressure of 62 Pa (-1/4 in wg). |

## Table 2.16.2-2

## ITAAC For The Reactor Building HVAC

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| | ii. Testing will be performed to confirm the ventilation flow rate through the contaminated areas of the reactor building served by CONAVS when operating CONAVS supply and exhaust fans in the normal system fan lineup. | ii. The exhaust flow rate is greater than or equal to the as-built CONAVS supply flow rate. |
| 6. REPAVS maintains served areas of the reactor building at a slightly negative pressure relative to surrounding clean areas to minimize the exfiltration of potentially contaminated air. | i. Testing will be performed to confirm that the refueling area of the reactor building served by REPAVS maintains a minimum negative pressure of 62 Pa (-1/4 in wg) relative to surrounding clean areas when operating REPAVS supply and exhaust fans in the normal system fan lineup.<br>ii. Testing will be performed to confirm the ventilation flow rate through the refueling area of the reactor building served by REPAVS when operating REPAVS supply and exhaust fans in the normal system fan lineup. | i. The time average pressure differential in the as-built REPAVS served areas of the reactor building as measured by each of the pressure differential indicators is minimum negative pressure of 62 Pa (-1/4 in wg).<br>ii. The exhaust flow rate is greater than or equal to the as-built REPAVS supply flow rate. |

**Table 2.16.2-2**

**ITAAC For The Reactor Building HVAC**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 7. The RBVS provides post 72-hour cooling for DCIS , CRD and RWCU pump rooms, electrical cabinet cooling and CRD / RWCU motor cooling. | Testing of the integrated system will be performed to demonstrate the air flow capability of the RBVS to support post-72 hour cooling for DCIS, CRD and RWCU pump rooms, electrical cabinet cooling and CRD / RWCU motor cooling. | The integrated system test demonstrates the air flow capability to support post-72 hour cooling for DCIS, CRD and RWCU pump rooms, electrical cabinet cooling and CRD / RWCU motor cooling. |
| 8. (Deleted)~~Indications and controls for safety-related components of the RBVS as indicated in Table 2.16.2-1 are available in the MCR.~~ | ~~Inspection of the MCR will be performed to verify that the safety-related system functions of the RBVS are available.~~ | ~~Indications and controls for the safety-related components of the RBVS as indicated in Table 2.16.2-1 are available in the MCR.~~ |
| 9. Independence is provided between safety-related divisions, and between safety-related divisions and nonsafety-related equipment. | i. Tests will be performed on the RBVS dampers by providing a test signal in only one safety-related division at a time.<br>ii. Inspection of the as-built safety-related divisions in the system will be performed. | i. The test signal exists only in the safety-related division under test in the as-built RBVS damper.<br>ii. Physical separation and electrical isolation exists between as-built RBVS dampers. Physical separation or electrical isolation exists between safety-related divisions and nonsafety-related equipment as defined by RG 1.75.. |
| 10. (Deleted) | | |

## Table 2.16.2-2

## ITAAC For The Reactor Building HVAC

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
| --- | --- | --- |
| 11. The Reactor Building HVAC Online Purge Exhaust Filters meet RG 1.140 and ASME AG-1 requirements for HEPA and carbon filter efficiency | Each charcoal adsorber will be tested in accordance with RG 1.140. HEPA filters will be tested in accordance with ASME AG-1, Section FC. | The as-built Reactor Building HVAC Online Purge Exhaust filter efficiency meet the acceptance criteria for in place testing in accordance with RG 1.140 and ASME AG-1. |
| 12a. The Reactor Building HVAC Accident Exhaust Filters maintains the CONAVS served areas of the reactor building at a minimum negative pressure of 62 Pa (-1/4 inch W.G.) relative to surrounding clean areas when operating. | Testing will be performed to confirm that the Reactor Building HVAC Accident Exhaust Filters maintain the CONAVS area at a minimum negative pressure of 62 Pa (-1/4 inch W.G.) relative to surrounding clean areas when operating each filter train. | The time average pressure differential in the as-built CONAVS served areas of the reactor building as measured by pressure differential indicators is minimum negative pressure of 62 Pa (-1/4 inch W.G.). |
| 12b. The Reactor Building HVAC Accident Exhaust Filters meet RG 1.140 and ASME AG-1 requirements for HEPA and carbon filter efficiency. | The Reactor Building HVAC Accident Exhaust Filters meet RG 1.140 and ASME AG-1 requirements for HEPA and carbon filter efficiency. | The as-built RB HVAC Accident Exhaust filter efficiencies meet the acceptance criteria for in place testing in accordance with RG 1.140 and ASME AG-1. |
| 13. The Reactor Building concrete acts as a heat sink that passively maintains the temperature of the Reactor Building rooms within an acceptable range for the first 72 hours following a design basis accident. | A Control Building and Reactor Building Environmental Temperature Analysis for ESBWR will be performed using the as-built heat sink dimensions, the as-built heat sink thermal properties, the as-built heat sink exposed surface area, the as-built thermal properties of materials covering parts of the heat sink, and the as-built heat loads. | The bulk average air temperature in the Reactor Building rooms will not exceed the Thermodynamic Environment Conditions Inside Reactor Building for Accident Conditions on a loss of active cooling for the first 72 hours following a design basis accident, given post design basis accident conditions and reconciled to as-built features and heat loads. |

**Table 2.16.2-6**

**ITAAC For The Emergency Filter Units**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The functional arrangement of the EFU is as described in the Design Description of this Subsection 2.16.2.3 and as shown in Figure 2.16.2-4. | Inspections of the EFU configuration will be conducted. | The as-built EFU system conforms with the design description in this Subsection 2.16.2.3 and is as shown in Figure 2.16.2-4. |
| 2. The selected redundant EFU dampers open upon receipt of a control room habitability envelope isolation signal. | Testing of the EFU dampers will be performed using simulated control room habitability envelope isolation signal to open the EFU dampers. | Upon receipt of a simulated control room habitability envelope isolation signal, the as-built EFU dampers automatically open. |
| 3. The equipment identified in Table 2.16.2-5 as Seismic Category I can withstand Seismic Category I loads without loss of safety function. | i. Inspection will be performed to verify that the Seismic Category I equipment identified in Table 2.16.2-5 are located in a Seismic Category I structure.<br>ii. Type tests, analyses, or a combination of type tests and analyses, of equipment identified in Table 2.16.2-5 as Seismic Category I, will be performed using analytical assumptions, or will be performed under conditions which bound the Seismic Category I equipment design requirements. | i. The equipment identified as Seismic Category I in Table 2.16.2-5 is located in a Seismic Category I structure.<br>ii. The equipment identified in Table 2.16.2-5 as Seismic Category I can withstand Seismic Category I loads without loss of safety function. |

**Table 2.16.2-6**

**ITAAC For The Emergency Filter Units**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| | iii. Inspections and analyses will be performed to verify that the as-built equipment identified in Table 2.16.2-5, including anchorage, is bounded by the testing or analyzed conditions. | iii. The as-built equipment identified in Table 2.16.2-5 including anchorage, can withstand Seismic Category I loads without loss of safety function. |
| 4. Independence for the EFU trains is provided between safety-related divisions, and between safety-related divisions and nonsafety-related equipment. | i. Tests will be performed on EFUs by providing a test signal in only one safety-related division at a time. | i. The test signal exists only in the safety-related division under test for the EFU trains. |
| | ii. Inspection of the as-built safety-related divisions in the EFU system will be performed. | ii. For the as-built EFU trains, physical separation or electrical isolation exists between these safety-related divisions. Physical separation or electrical isolation exists between safety-related divisions and nonsafety-related equipment as defined in RG 1.75. |
| 5a. EFUs maintain the CRHA at the minimum positive pressure with respect to the surrounding areas at the required air addition flow rate. | Testing will be performed to measure the differential pressure between the CRHA and surrounding adjacent areas. | The as-built EFUs maintain the CRHA at a positive pressure of > 31 Pa (0.125 in wg) with respect to the surrounding areas at the required air addition flow rate. |
| 5b. The in-leakage does not exceed the unfiltered in-leakage assumed by control room operator dose analysis. | Tracer gas testing in accordance with ASTM E741 will be performed to measure the unfiltered in-leakage into the CRHA with EFUs operating. | The unfiltered in-leakage measured by tracer gas testing does not exceed the unfiltered in-leakage assumed by control room operator dose analysis. |

## Table 2.16.2-6

## ITAAC For The Emergency Filter Units

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 6. The powered EFU dampers can be remotely operated from the MCR. | EFU dampers will be opened and closed using manually initiated signals from the MCR. | The as-built EFU dampers open and close when manually imitated signals are sent from the MCR. |
| 7. EFUs meet the in-place leakage testing requirements of ASME AG-1 and RG 1.52. | EFUs will be in-place leak tested in accordance with ASME AG-1, Section TA, to meet the requirements of RG 1.52. | The as-built EFUs meet the acceptance criteria for in-place testing per RG 1.52, Regulatory Position 6, when tested in accordance with the requirements described in ASME AG-1, Section TA. |
| 8. (Deleted)~~Indications and controls for the safety-related components of the EFU system as indicated in Table 2.16.2-5 are available in the MCR.~~ | ~~Inspection of the MCR will be performed to verify that the safety-related functions of the EFU system are available.~~ | ~~Indications and controls for the safety-related components of the EFU system as indicated in Table 2.16.2-5 are available in the MCR.~~ |
| 9. (Deleted) | | |
| 10. EFUs are tested to meet the laboratory test requirements described in ASME AG-1 and RG 1.52 for carbon adsorber efficiency. | Each charcoal adsorber will be laboratory tested in accordance with the requirements described in ASME AG-1, Section FE. | Charcoal adsorber efficiency meets the acceptance criteria for laboratory testing per RG 1.52, Regulatory Position 7, when tested in accordance with the requirements described in ASME AG-1, Section FE. |
| 11. The standby EFU starts on a low flow signal from the operating EFU. | Testing will be performed to verify that the operating EFU is isolated and the standby EFU is automatically started on a low flow signal from the operating EFU. | A low flow test signal from the operating EFU will start the standby EFU. |

## Table 2.16.2-6

## ITAAC For The Emergency Filter Units

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 12. EFUs maintain habitable conditions in the CRHA. | Testing will ensure that the filtered air supply will not be reduced below the required 220 l/s (466 cfm) when the CRHA is isolated and being maintained at a positive pressure of >31 Pa (0.125 in. wg) with respect to the surrounding areas. | The as-built EFUs provide 220 l/s (466 cfm) of filtered air when the CRHA is isolated and being maintained at a positive pressure of >31 Pa (0.125 in. wg) with respect to the surrounding areas. |
| 13. (Deleted) | | |

**Table 2.16.2-9**

**ITAAC For The Fuel Building HVAC**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The functional arrangement of the FBVS is as described in the Design Description of this Subsection 2.16.2.5 and as shown in Figures 2.16.2-7 and 2.16.2-8. | Inspections of the FBVS configuration will be conducted. | The as-built FBVS system conforms to the design description in this Subsection 2.16.2.5 and as shown in Figures 2.16.2-7 and 2.16.2-8. |
| 2. The Fuel Building HVAC isolation dampers automatically close upon receipt of a high radiation signal. | Using a simulated high radiation signal, tests will be performed on the (Fuel Building HVAC isolation dampers) isolation logic. | Upon receipt of a simulated high radiation signal, the Fuel Building HVAC isolation dampers automatically close. |
| 3. The equipment identified in Table 2.16.2-8 as Seismic Category I can withstand Seismic Category I loads without loss of safety function. | i. Inspection will be performed to verify that the Seismic Category I equipment identified in Table 2.16.2-8 are located in a Seismic Category I structure.<br>ii. Type tests, analyses, or a combination of type tests and analyses, of equipment identified in Table 2.16.2-8 as Seismic Category I, will be performed using analytical assumptions, or will be performed under conditions which bound the Seismic Category I equipment design requirements. | i. The equipment identified as Seismic Category I in Table 2.16.2-8 is located in a Seismic Category I structure.<br>ii. The equipment identified in Table 2.16.2-8 as Seismic Category I can withstand Seismic Category I loads without loss of safety function. |

## Table 2.16.2-9

## ITAAC For The Fuel Building HVAC

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| | iii. Inspections and analyses will be performed to verify that the as-built equipment identified in Table 2.16.2-8, including anchorage, is bounded by the testing or analyzed conditions. | iii. The as-built equipment identified in Table 2.16.2-8 including anchorage, can withstand Seismic Category I loads without loss of safety function. |
| 4. The FBVS maintains the fuel building at a slightly negative pressure relative to surrounding areas. | i. Testing will be performed to confirm that the FBVS maintains a minimum negative pressure of 62 Pa (-1/4 inch W.G.) when operating FBVS supply and exhaust AHUs in the normal system fan lineup.<br>ii. Testing will be performed to confirm the ventilation flow rate through the fuel building area when operating the FBVS supply and exhaust fans in the normal system fan lineup. | i. The average differential pressure in the served areas of the fuel building as measured by the pressure differential indicators is a minimum negative pressure of 62 Pa (-1/4 inch W.G.).<br>ii. The exhaust flow rate is greater than or equal to the FBVS supply flow rate. |
| 5. The FBVS provides post 72-hour cooling for FAPCS pump motors and N-DCIS. | System testing will be performed and cooling air-flow to the specified cubicles will be verified. | The cooling air-flow capability meets the requirements to support post 72-hour cooling for FAPCS pump motors and N-DCIS. |

**Table 2.16.2-9**

**ITAAC For The Fuel Building HVAC**

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 6. (Deleted)~~Indications and controls for the safety-related components of the FBVS as indicated in Table 2.16.2-8 are available in the MCR.~~ | ~~Inspection of the MCR will be performed to verify that the safety-related indication and control functions of the FBVS are available.~~ | ~~Indications and controls for the safety-related components of the FBVS as indicated in Table 2.16.2-8 are available in the MCR.~~ |

## 3.8 ENVIRONMENTAL AND SEISMIC QUALIFICATION OF MECHANICAL AND ELECTRICAL EQUIPMENT

~~The equipment~~Equipment qualification ~~program includes~~applies to safety-related electrical and mechanical equipment located in harsh environments and digital instrumentation and controls (I&C) equipment in 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~~subject to equipment qualification~~ program~~.

Certain equipment that supports Regulatory Treatment of Non-Safety Systems (RTNSS) ~~equipment~~ functions and that is located in harsh environments is also ~~included in the~~subject to equipment qualification~~ program~~.

Table 3.8-1 lists equipment subject to environmental qualification requirements, except that the specific digital I&C equipment subject to environmental qualification requirements are defined through the Design Acceptance Criteria process.

Dynamic and seismic qualification ~~is included in the equipment qualification program.~~for digital I&C is addressed in this section. The specific digital I&C equipment subject to dynamic and seismic qualification are defined through the Design Acceptance Criteria process.

### Design Description

(1) The ~~equipment qualification program's~~ electrical equipment listed in Table 3.8-1 as located in a harsh environment can perform its safety-related or RTNSS function under normal, abnormal and design bases accident environmental conditions.

(2) The ~~equipment qualification program's~~ mechanical equipment listed in Table 3.8-1 as located in a harsh environment can perform its safety-related or RTNSS function under normal, abnormal and design bases accident environmental conditions.

(3) The ~~equipment qualification program's~~ safety-related digital I&C equipment in systems listed in Table 2.2.15-1 (including digital components in the safety-related electrical distribution system) located in a mild environment ~~is designed to~~can perform its safety-related function under normal and AOO environmental conditions.

(4) The ~~equipment qualification program's~~ Seismic Category I digital I&C equipment in systems listed in Table 2.2.15-1 (including digital components in the safety-related electrical distribution system) can perform its safety-related function before, during and after dynamic and seismic design bases event conditions.

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

Table ~~3.8-1~~3.8-2 specifies the equipment qualification inspections, tests, analyses, and associated acceptance criteria for equipment qualification program mechanical and electrical equipment.

## Table 3.8-1

## Electrical and Mechanical Equipment for Environmental Qualification

| Components (note 5) | Quantity | Location (note 1) | Function (note 2) | Required Operation Time (note 3) | Qualification Program (note 4) |
|---|---|---|---|---|---|
| **Nuclear Boiler System** | | | | | |
| Depressurization Valves | 8 | CV | ESF | 72 hr | MH |
| Safety Relief Valves | 10 | CV | ESF | 72 hr | MH |
| Temperature element in DPV/SRV Discharge | 18 | CV | ESF | 72 hr | EH |
| MSIV - Inboard | 4 | CV | PB | 100 Days | MH |
| MSIV - Outboard | 4 | ST | PB | 100 Days | MH |
| MSIV Drain Bypass Valve | 2 | ST | ESF | 72 hr | MH |
| Steam Line Lowpoint Drain Bypass Valve | 1 | TB | ESF | 72 hr | MH |
| Feedwater isolation valve | 8 | ST/CV | PB | 100 Days | MH |
| RPV Level Transmitters | All | RB | ESF | 100 Days | EH |
| RPV Temperature Elements | All | CV | ESF | 100 Days | EH |
| RPV Pressure Transmitter | All | RB | ESF | 100 Days | EH |
| Feed Piping Diff Pressure Transmitter | All | RB | ISOL | 100 Days | EH |
| Steam Line Flow Transmitter | All | RB | ISOL | 100 Days | EH |
| Electrical Modules and Cable | All | CV, RB, ST, TB | ESF | 100 Days | EH |
| **Isolation Condenser System** | | | | | |
| Isolation Valves | 16 | CV | PB | 100 Days | MH |
| Isolation Valves Operator | 16 | CV | ESF | 100 Days | MH |
| Condensate Return Valves | 4 | CV | ESF | 100 Days | MH |
| Condensate Return Valves Operator | 4 | CV | ESF | 100 Days | MH |

## Table 3.8-1

## Electrical and Mechanical Equipment for Environmental Qualification

| Components (note 5) | Quantity | Location (note 1) | Function (note 2) | Required Operation Time (note 3) | Qualification Program (note 4) |
|---|---|---|---|---|---|
| Condensate Return Bypass Valve | 4 | CV | ESF | 100 Days | MH |
| Condensate Return Bypass Valve Operator | 4 | CV | ESF | 100 Days | MH |
| Upper Header Vent Valve | 8 | CV | ESF | 100 Days | MH |
| Upper Header Vent Valve Actuator | 8 | CV | ESF | 100 Days | MH |
| Lower Header Vent Valve | 16 | CV | ESF | 100 Days | MH |
| Lower Header Vent Valve Actuator | 16 | CV | ESF | 100 Days | MH |
| Pool Cross-Connect Valves | 4 | RB | ESF | 100 Days | MH |
| Vent Line Temperature Element | 8 | CV | ESF | 100 Days | EH |
| Condensate Drain Temperature Element | 4 | CV | ESF | 100 Days | EH |
| Steam Piping Diff Pressure Transmitter | 8 | CV | ESF | 100 Days | EH |
| Condensate Drain Diff Pressure Transmitter | 8 | CV | ESF | 100 Days | EH |
| Electrical Modules and Cable | All | CV, RB | ESF | 100 Days | EH |
| **Rod Control and Information System** | | | | | |
| Electrical Modules and Cable | All | CB, RB | ESF | 72 hr | EH |
| **Control Rod Drive System** | | | | | |
| HCU Scram Solenoid Pilot Valve | 135 | RB | ESF | 72 hr | MH |
| FMCRD Passive Holding Brake | 269 | CV | ESF | 72 hr | MH |

**Table 3.8-1**

**Electrical and Mechanical Equipment for Environmental Qualification**

| Components (note 5) | Quantity | Location (note 1) | Function (note 2) | Required Operation Time (note 3) | Qualification Program (note 4) |
|---|---|---|---|---|---|
| FMCRD Separation Switch | 538 | CV | ESF | 72 hr | EH |
| Charging Water Header Pressure Transmitter | 4 | RB | ESF | 72 hr | EH |
| Electrical Modules and Cable | All | CV, RB | ESF | 72 hr | EH |
| High Pressure CRD Makeup Line Isolation Valves | 2 | RB | ESF | 72 hr | MH |
| Backup Scram Valve Solenoids | 2 | RB | ESF | 72 hr | EH |
| **Leak Detection and Isolation System** | | | | | |
| Pressure Transmitters | All | CV, RB, CB | ESF | 100 Days | EH |
| Temperature Sensors | All | CV, RB, CB | ESF | 100 Days | EH |
| Electrical Modules and Cable | All | CV, RB, CB | ESF | 100 Days | EH |
| **Feedwater Control System** | | | | | |
| Electric Modules and Cable | All | CB, RB | ESF | 72 hr | EH |
| **Neutron Monitoring System** | | | | | |
| Detector and Tube Assembly | All | CV | ESF | 72 hr | MH |
| Electrical Modules and Cable | All | CV, RB, CB | ESF | 100 Days | EH |
| **Remote Shutdown System** | | | | | |
| Electrical Panels, Modules and Cable | All | RB | ESF | 100 Days | C |

**Table 3.8-1**

**Electrical and Mechanical Equipment for Environmental Qualification**

| Components (note 5) | Quantity | Location (note 1) | Function (note 2) | Required Operation Time (note 3) | Qualification Program (note 4) |
|---|---|---|---|---|---|
| **Safety-Related Distributed Control and Information System (DCIS)** | | | | | |
| Electrical Modules and Cable | All | RB, CB | ESF | 100 Days | C |
| **Reactor Protection System** | | | | | |
| Electrical Modules and Cable | All | CB, RB | ESF | 100 Days | EH |
| **Diverse Protection System** | | | | | |
| Electrical Modules and Cable | All | CB, RB, TB | ESF, ISOL | 100 Days | EH |
| **Safety System Logic and Control** | | | | | |
| Electrical Modules and Cable | All | CB, RB | ESF | 100 Days | EH |
| **Standby Liquid Control System** | | | | | |
| Isolation Check Valves | 4 | CV/RB | PB | 100 days | MH |
| Squib Injection Valves | 4 | RB | ESF | 72 hr | MH |
| Injection Shut-Off Valves Actuator | 4 | RB | ESF | 100 Days | EH |
| Nitrogen Charging Globe Valve | 2 | RB | ESF | 100 Days | MH |
| Nitrogen Charging Globe Valve Actuator | 2 | RB | ESF | 100 Days | EH |
| Nitrogen Charging Check Valve | 2 | RB | ESF | 72 hr | MH |
| Accumulator Depressurization Valves | 4 | RB | ESF | 100 Days | MH |
| Accumulator Depressurization Valves Actuator | 4 | RB | ESF | 100 Days | EH |
| Accumulator Relief Valve | 2 | RB | PB | 72 hr | MH |

## Table 3.8-1

## Electrical and Mechanical Equipment for Environmental Qualification

| Components (note 5) | Quantity | Location (note 1) | Function (note 2) | Required Operation Time (note 3) | Qualification Program (note 4) |
|---|---|---|---|---|---|
| Injection Shut Off Valves | 4 | RB | ESF | 100 Days | MH |
| Accumulator Level Instrumentation | 8 | RB | ESF | 100 Days | EH |
| Accumulator Pressure Instrumentation | 8 | RB | ESF | 100 Days | EH |
| Electrical Modules and Cable | All | CV/RB | ESF | 100 Days | EH |
| **Process Radiation Monitoring System** | | | | | |
| Isolation Valves | 4 | CV, RB, CB | ESF | 100 Days | MH |
| Radiation Monitors, Sensors, Electrical Modules and Cable | All | CV, RB, CB | ESF | 100 Days | EH |
| **Gravity-Driven Cooling System (GDCS)** | | | | | |
| GDCS Pool Level Instrumentation | 12 | CV | ESF | 100 Days | EH |
| GDCS Squib Valve to GDCS Pool | 8 | CV | ESF | 72 hr | MH |
| GDCS Check Valve to GDCS Pool | 8 | CV | ESF | 72 hr | MH |
| GDCS Squib Valve to Suppression Pool | 4 | CV | ESF | 72 hr | MH |
| GDCS Check Valve to Suppression Pool | 4 | CV | ESF | 72 hr | MH |
| GDCS Squib Valve to Lower Drywell (DW) | 12 | CV | ESF | 72 hr | MH |
| Electrical Modules and Cable | All | CV, RB, CB | ESF | 100 Days | EH |

**Table 3.8-1**

**Electrical and Mechanical Equipment for Environmental Qualification**

| Components (note 5) | Quantity | Location (note 1) | Function (note 2) | Required Operation Time (note 3) | Qualification Program (note 4) |
|---|---|---|---|---|---|
| **Fuel and Auxiliary Pools Cooling System** | | | | | |
| Containment Isolation Valve (CIV) - Drywell Spray - Outboard | 1 | RB | PB | 100 Days | MH |
| CIV - Drywell Spray - Inboard | 1 | CV | PB | 100 Days | MH |
| CIV – Suppression Pool Cooling (SPC) Suction - Outboard | 4 | RB | PB | 100 Days | MH |
| CIV - SPC Return - Outboard | 2 | RB | PB | 100 Days | MH |
| CIV - SPC Return - Inboard | 2 | CV | PB | 100 Days | MH |
| CIV - GDCS Suction - Outboard | 1 | RB | PB | 100 Days | MH |
| CIV - GDCS Suction - Inboard | 1 | CV | PB | 100 Days | MH |
| CIV - GDCS Return - Outboard | 1 | RB | PB | 100 Days | MH |
| CIV - GDCS Return - Inboard | 1 | CV | PB | 100 Days | MH |
| LPCI Isolation | 4 | FB/RB | PB | 100 Days | MH |
| IC/PCCS Pool Level Instrumentation | All | RB | ESF | 100 Days | EH |
| Fuel Pool Level Instruments | 2 | FB | ESF | 100 Days | EH |
| Electrical Modules and Cable | All | CV, FB, RB, CB | ESF | 100 Days | EH |
| **Reactor Water Cleanup/Shutdown Cooling System** | | | | | |
| CIV - Mid Vessel - Inboard | 2 | CV | PB | 100 Days | MH |

**Table 3.8-1**

**Electrical and Mechanical Equipment for Environmental Qualification**

| Components (note 5) | Quantity | Location (note 1) | Function (note 2) | Required Operation Time (note 3) | Qualification Program (note 4) |
|---|---|---|---|---|---|
| CIV - Mid Vessel - Outboard | 2 | RB | PB | 100 Days | MH |
| CIV - Mid Vessel - Inboard Operator | 2 | CV | PB | 72 hr | EH |
| CIV - Mid Vessel - Outboard Operator | 2 | RB | PB | 72 hr | EH |
| CIV - Bottom Drain Inboard | 2 | CV | PB | 100 Days | MH |
| CIV - Bottom Drain Outboard | 2 | RB | PB | 100 Days | MH |
| CIV - Bottom Drain Inboard Operator | 2 | CV | PB | 72 hr | EH |
| CIV - Bottom Drain Outboard Operator | 2 | RB | PB | 72 hr | EH |
| CIV - Process Sampling Line -Inboard | 2 | CV | PB/PAMS | 100 Days | MH |
| CIV - Process Sampling Line -Outboard | 2 | RB | PB/PAMS | 100 Days | MH |
| CIV - Process Sampling Line -Inboard Operator | 2 | CV | PB/PAMS | 100 Days | EH |
| CIV - Process Sampling Line -Outboard Operator | 2 | RB | PB/PAMS | 100 Days | EH |
| Return Line Shutoff Valve | 2 | RB | ISOL | 100 Days | MH |
| Check Valve to Feedwater | 4 | RB | ISOL | 100 Days | MH |
| Mid-vessel Flow Instrumentation | All | CV | ISOL | 100 Days | EH |
| Mid-vessel Temperature Instrumentation | All | CV | ISOL | 100 Days | EH |
| Bottom Drain Flow Instrumentation | All | CV | ISOL | 100 Days | EH |

**Table 3.8-1**

**Electrical and Mechanical Equipment for Environmental Qualification**

| Components (note 5) | Quantity | Location (note 1) | Function (note 2) | Required Operation Time (note 3) | Qualification Program (note 4) |
|---|---|---|---|---|---|
| Bottom Drain Temperature Instrumentation | All | CV | ISOL | 100 Days | EH |
| Return Line Flow Instrumentation | All | RB | ISOL | 100 Days | EH |
| Return Line Temperature Instrumentation | All | RB | ISOL | 100 Days | EH |
| Overboard Flow Instrumentation | All | RB | ISOL | 100 Days | EH |
| Overboard Temperature Instrumentation | All | RB | ISOL | 100 Days | EH |
| Electrical Modules and Cables | All | CV, RB | ESF | 100 Days | EH |
| **Main Control Room (MCR) Panels** | | | | | |
| Panels, Modules and Cables | All | CB | ESF | 100 Days | C |
| **MCR Back Room Panels** | | | | | |
| Panels, Modules and Cable | All | CB | ESF | 100 Days | C |
| **Local Panels and Racks** | | | | | |
| Panels, Modules and Cable | All | ALL | ESF | 100 Days | EH |
| **Condensate and Feedwater System** | | | | | |
| Feed Line Temperature Element | All | ST | ESF | 100 Days | EH |
| Feed Piping Diff Pressure Transmitter | All | ST | ISOL | 100 Days | EH |
| Electrical Modules and Cable | All | ST, CB | ESF | 100 Days | EH |
| **Makeup Water System** | | | | | |
| Isolation Valves | All | CV, RB | ISOL | 100 Days | MH |

**Table 3.8-1**

**Electrical and Mechanical Equipment for Environmental Qualification**

| Components (note 5) | Quantity | Location (note 1) | Function (note 2) | Required Operation Time (note 3) | Qualification Program (note 4) |
|---|---|---|---|---|---|
| **Chilled Water System** | | | | | |
| Isolation Valves | 8 | CV, RB | ISOL | 100 Days | MH |
| **Service Air System** | | | | | |
| Isolation Valves | 4 | CV, RB | ISOL | 100 Days | MH |
| **High Pressure Nitrogen Supply System** | | | | | |
| Isolation Valves | 4 | CV, RB | ISOL | 100 Days | MH |
| **Electrical Power Distribution System (EPDS)** | | | | | |
| Cable and Supports | All | CB, FB, RB | ESF | 100 Days | EH |
| **Uninterruptible AC Power Supply** | | | | | |
| Electrical Modules and Cable | All | CV, CB, RB | ESF | 100 Days | EH |
| **Direct Current Power Supply** | | | | | |
| Divisional 250 VDC Battery | 8 | RB | ESF | 100 Days | E |
| Divisional 250 VDC Normal/Standby Battery Charger | 12 | RB | ESF | 100 Days | E |
| Divisional 250 VDC Power Center | 8 | RB | ESF | 100 Days | E |
| Divisional 250 VDC Transfer Switch Box | 8 | RB | ESF | 100 Days | E |
| Isolation Power Center Normal Main Circuit Breaker | 4 | RB | ISOL | 100 Days | E |
| Isolation Power Center Alternate Main Circuit Breaker | 4 | RB | ISOL | 100 Days | E |

## Table 3.8-1

## Electrical and Mechanical Equipment for Environmental Qualification

| Components (note 5) | Quantity | Location (note 1) | Function (note 2) | Required Operation Time (note 3) | Qualification Program (note 4) |
|---|---|---|---|---|---|
| Isolation Power Center Supply Breaker to Division 250 VDC Normal Battery Charger | 12 | RB | ISOL | 100 Days | E |
| Electrical Modules and Cable | All | CV, CB, RB, TB | ESF | 100 Days | E |
| **Raceway System** | | | | | |
| Electrical Penetrations | All | CV | PB | 100 Days | EH |
| Conduit, Cable Trays and Supports | All | CV, CB, RB, TB, FB | ESF | 100 Days | EH |
| **Containment System** | | | | | |
| Vacuum Breakers | 3 | CV | ESF | 100 Days | MH |
| Vacuum Breaker Isolation Valves | 3 | CV | ESF | 72hr | MH |
| Instrumentation and Cables | All | CV | ESF | 100 Days | EH |
| Basemat Internal Melt Arrest Coolability (BiMAC) Temperature Element | ALL | CV | ESF | 100 Days | EH |
| BiMAC Temperature Switch | ALL | CV | ESF | 100 Days | EH |
| **Passive Containment Cooling System** | | | | | |
| Vent Fan Ball Check Valves | 6 | CV | ESF | 100 Days | MH |
| Passive Containment Cooling System (PCCS) Vent Fan | 6 | CV | ESF | 100 Days | EH |
| **Containment Inerting System** | | | | | |
| Isolation Valve | 10 | CV, RB | ISOL | 100 Days | MH |

**Table 3.8-1**

**Electrical and Mechanical Equipment for Environmental Qualification**

| Components (note 5) | Quantity | Location (note 1) | Function (note 2) | Required Operation Time (note 3) | Qualification Program (note 4) |
|---|---|---|---|---|---|
| Electrical Modules and Cable | All | CB, RB | ESF | 100 Days | EH |
| **Passive Autocatalytic Recombiner System** | | | | | |
| Passive Autocatalytic Recombiners | All | CV | ESF | 100 Days | MH |
| **Containment Monitoring System** | | | | | |
| Containment Isolation Valves | All | CV, RB | ISOL | 100 Days | MH |
| Electrical Modules and Cable | All | CB, CV, RB | ESF | 100 Days | EH |
| Drywell Pressure Transmitters | All | RB | ESF | 100 days | EH |
| Differential Pressure Transmitters | All | RB | ESF | 100 days | EH |
| Suppression Pool Temperature Element | All | CV | ESF | 100 days | EH |
| Lower DW Level Transmitter | All | RB | ESF/PAMS | 100 days | EH |
| Suppression Pool Level Transmitters | All | RB | PAMS | 100 days | EH |
| Suppression Pool Pressure Transmitters | All | RB | PAMS | 100 days | EH |
| Hydrogen Analyzers | All | RB | ESF/PAMS | 100 days | EH |
| Oxygen Analyzers | All | RB | ESF/PAMS | 100 days | EH |
| **Reactor Building HVAC** | | | | | |
| Building Isolation Dampers | All | RB | ESF | 100 Days | EH |
| Electrical Modules and Cable | All | RB | ESF | 100 Days | EH |

**Table 3.8-1**

**Electrical and Mechanical Equipment for Environmental Qualification**

| Components (note 5) | Quantity | Location (note 1) | Function (note 2) | Required Operation Time (note 3) | Qualification Program (note 4) |
|---|---|---|---|---|---|
| **Control Building HVAC** | | | | | |
| Control Room Habitability Area (CRHA) Supply Air Isolation Dampers | All | CB | ESF | 100 Days | E |
| Emergency Filter Unit (EFU) Downstream Isolation Dampers | All | CB | ESF | 100 Days | E |
| CRHA Restroom Exhaust Isolation Dampers | All | CB | ESF | 100 Days | E |
| CRHA Smoke Purge Intake Isolation Dampers | All | CB | ESF | 100 Days | E |
| CRHA Smoke Purge Exhaust Isolation Dampers | All | CB | ESF | 100 Days | E |
| Emergency Filter Unit (EFU) | All | CB | ESF | 100 Days | E |
| Electrical Modules and Cable | All | CB | ESF | 100 Days | E |
| **Fuel Building HVAC** | | | | | |
| Fuel Building General Area HVAC Subsystem (FBGAVS) Building Supply Air Isolation Dampers | All | FB | ESF | 100 Days | EH |
| FBGAVS Building Exhaust Air Isolation Dampers | All | FB | ESF | 100 Days | EH |
| Fuel Building Fuel Pool Area HVAC Subsystem (FBFPVS) Building Supply Air Isolation Dampers | All | FB | ESF | 100 Days | EH |
| FBFPVS Building Exhaust Air Isolation Dampers | All | FB | ESF | 100 Days | EH |

**Table 3.8-1**

**Electrical and Mechanical Equipment for Environmental Qualification**

| Components (note 5) | Quantity | Location (note 1) | Function (note 2) | Required Operation Time (note 3) | Qualification Program (note 4) |
|---|---|---|---|---|---|
| Electrical Modules and Cable | All | FB | ESF | 100 Days | EH |

Note 1: CV – Containment Vessel
ST – Steam Tunnel
RB – Reactor Building
FB – Fuel Building
CB – Control Building
TB – Turbine Building
OO – Outdoors Onsite

Note 2: ESF – Engineered Safety Feature
PAMS – Post Accident Monitoring
ISOL – Isolation
PB – Pressure Boundary

Note 3: Required operation time refers to the period of time which the equipment must remain available or operational.

Note 4: E – Electrical Equipment Program
M – Mechanical Equipment Program
C – Computer Based I&C System Program
H – Harsh Environment (omission of H indicates Mild Environment)

Note 5: Valve operators/actuators are considered to be part of the valve assembly and are generally not listed separately in this table.

Table 3.8-1 3.8-2

ITAAC For Environmental and Seismic Qualification of Mechanical and Electrical Equipment

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 1. The equipment qualification program's electrical equipment listed in Table 3.8-1 as located in a harsh environment can perform its safety-related or RTNSS function under normal, abnormal and design bases accident environmental conditions. | The equipment qualification program's electrical equipment located in a harsh environment is identified and:<br><br>i. (Deleted)Analysis will be performed to identify the environmental design bases including the definition of anticipated operational occurrences and normal, accident, and post-accident environments.<br><br>ii. Type tests, analyses, or a combination of type tests and analyses, will be performed on the equipment qualification program's electrical equipment located in a harsh environment. | i. Analyses identify the environmental design bases for the equipment qualification program's electrical equipment located in a harsh environment.<br><br>ii. The equipment qualification program's electrical equipment listed in Table 3.8-1 as located in a harsh environment is qualified to perform its safety-related or RTNSS function during the applicable normal and abnormal environmental conditions that would exist before, during, and following a design basis accident without loss of safety-related or RTNSS function for the time required to perform the safety function. |

## Table 3.8-13.8-2

## ITAAC For Environmental and Seismic Qualification of Mechanical and Electrical Equipment

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| | iii. Inspection will be performed of the equipment qualification program's EQD for the as-built electrical equipment and the associated wiring, cables, and terminations located in a harsh environment. | iii. The equipment qualification program's EQD exists and concludes that the as-built electrical equipment listed in Table 3.8-1 and the associated wiring, cables, and terminations located in a harsh environment are qualified for a harsh environment and are bounded by type tests, analyses, or a combination of type tests and analyses. |
| 2. The equipment qualification program's mechanical equipment listed in Table 3.8-1 as located in a harsh environment can perform its safety-related or RTNSS function under normal, abnormal and design bases accident environmental conditions. | The equipment qualification program's mechanical equipment located in a harsh environment is identified and:<br>i. (Deleted)Analysis will be performed to identify the environmental design bases including the definition of anticipated operational occurrences and normal, accident, and post-accident environments. | i. Analyses identify the environmental design bases for the equipment qualification program's mechanical equipment located in a harsh environment. |

## Table 3.8-13.8-2

## ITAAC For Environmental and Seismic Qualification of Mechanical and Electrical Equipment

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| | ii. Type tests, analyses, or a combination of type tests and analyses, will be performed on the equipment qualification program's mechanical equipment located in a harsh environment. | ii. The equipment qualification program's mechanical equipment listed in Table 3.8-1 as located in a harsh environment is qualified to perform its safety-related or RTNSS function during the applicable normal and abnormal 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. |
| | iii. Inspection will be performed of the equipment qualification program's EQD for the as-built mechanical equipment located in a harsh environment. | iii. The equipment qualification program's EQD exists and concludes that the as-built mechanical equipment located in a harsh environment are qualified for a harsh environment and are bounded by type tests, analyses, or a combination of type tests and analyses. |

## Table ~~3.8-1~~3.8-2

## ITAAC For Environmental and Seismic Qualification of Mechanical and Electrical Equipment

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 3. The ~~equipment qualification program's~~ safety-related digital I&C equipment in systems listed in Table 2.2.15-1 (including digital components in the safety-related electrical distribution system) located in a mild environment ~~is designed to~~can perform its safety-related function under normal and AOO environmental conditions. | ~~The 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 identified and:~~<br><br>i. ~~Analysis will be performed to identify the environmental design bases including the definition of anticipated operational occurrences and normal environments.~~ Analysis will be performed to identify the environmental design bases of digital I&C equipment in systems listed in Table 2.2.15-1 (including digital components in the safety-related electrical distribution system) to identify the equipment to be environmentally qualified.<br><br>{{Design Acceptance Criteria}} | i. ~~Analyses identify the environmental design bases for the 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..~~ The analyses results identify the environmental design bases for the Seismic Category I digital I&C equipment in systems listed in Table 2.2.15-1 (including digital components in the safety-related electrical distribution system) to identify the equipment to be environmentally qualified.<br><br>{{Design Acceptance Criteria}} |

## Table 3.8-13.8-2

## ITAAC For Environmental and Seismic Qualification of Mechanical and Electrical Equipment

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| | ii. Type tests, analyses, or a combination of type tests and analyses, will be performed on the equipment qualification program's digital I&C equipment located in a mild environment. | ii. The 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 qualified to perform its safety function during the applicable normal and abnormal 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. |
| | iii. Inspection will be performed of the EQD for the to verify the equipment qualification program's as-built digital I&C equipment located in a mild environment | iii. The equipment qualification program's EQD exists and concludes that the as-built safety-related digital I&C equipment (including digital components in the safety-related electrical distribution system) and the associated wiring, cables, and terminations located in a mild environment are qualified for a mild environment and are bounded by type tests, analyses, or a combination of type tests and analyses. |

## Table 3.8-13.8-2

## ITAAC For Environmental and Seismic Qualification of Mechanical and Electrical Equipment

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|
| 4. The equipment qualification program's Seismic Category I digital I&C equipment in systems listed in Table 2.2.15-1 (including digital components in the safety-related electrical distribution system) can perform its safety-related function before, during and after dynamic and seismic design bases event conditions. | i. Analysis will be performed to identify the dynamic and seismic design bases of digital I&C equipment in systems listed in Table 2.2.15-1 (including digital components in the safety-related electrical distribution system) to identify the equipment to be seismically qualified.<br><br>{{Design Acceptance Criteria}}<br><br>ii. Dynamic and seismic type tests, analyses, or a combination of type tests and analyses, will be performed on equipment qualification equipment program. | i. The analyses results identify the dynamic and seismic design bases for the Seismic Category I digital I&C equipment in systems listed in Table 2.2.15-1 (including digital components in the safety-related electrical distribution system) to identify the equipment to be seismically qualified.<br><br>{{Design Acceptance Criteria}}<br><br>ii. The Seismic Category I digital I&C equipment in systems listed in Table 2.2.15-1 (including digital components in the safety-related electrical distribution system) and subject to seismic qualification 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. |

Table 3.8-13.8-2

ITAAC For Environmental and Seismic Qualification of Mechanical and Electrical Equipment

| Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
| --- | --- | --- |
| | iii. Inspection will be performed of the DQD for the equipment qualification program's as-built equipment. | iii. The equipment qualification program's as-built equipment DQD exists and concludes that the as-built Seismic Category I digital I&C equipment in systems listed in Table 2.2.15-1 (including digital components in the safety-related electrical distribution system) and subject to seismic qualification is bounded by dynamic and seismic type tests, analyses, or a combination of type tests and analyses are bounding. |