GE Hitachi
Nuclear Energy

ESBWR Design Certification

Tier 1
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Tier 1 Preliminary Rev 6 Submittals

June 11 – Snapshot "rev bar only" version sent on docket

Included all RAI responses up to that date

July 7 – Courtesy "redline" version and change list sent

Included additional RAI responses

Change list identifies the differences between versions


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Change List Example

Item	Location	Description of Change
35.	T2.1.2-3, ITAAC #36	Added main steam line and SRV/SV branch piping ITAAC in response to RAI 3.9-134.
36.	S2.2.1, Functional Requirements #3, 4, and 5	Updated RC&IS automatic functions and initiators; rod block functions; and controls, interlocks and bypasses entries in response to RAI 14.3-450.
37.	S2.2.1, New Functional Requirements #7, 8 and 9	Added Functional Requirements in response to RAI 14.3-449 S01.
38.	T2.2.1-1, 1st, 4th, 5th and 6th entries	Deleted rows 1, 4, 5 and 6 in response to RAIs 14.3-449 and 14.3-449 S01.

June 11 File

July 7 File

Shaded markup pages submitted on docket separately in RAI response

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Improvements in Consistency, Format, and Content

Consistency of groups of ITAAC

- ASME
- Seismic
- Human Factors Engineering
- Software

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ASME ITAAC

(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 and Seismic Category I 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 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 requirements.

b. Pressure boundary welds in piping identified in Table 2.4.2-1 as ASME Code Section III meet ASME Code Section III 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 design pressure.*

GDCS Example

Generic Design Description

Same list is used, as applicable, for mechanical systems

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ASME ITAAC continued

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
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 and Seismic Category I 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 GDCS components identified in Table 2.4.2-1 as ASME Code Section III complies with the requirements of the ASME Code, Section III, including for those stresses and loads related to fatigue (including environmental effects), thermal expansion, seismic, and combined.
2.a2. 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 using as-design and as-built information and ASME Code certified 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 GDCS components identified in Table 2.4.2-1 as ASME Code Section III. The report documents the results of the reconciliation analysis.
2.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.	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 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.

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ASME ITAAC

continued

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
2.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.	Inspection of ASME Code certified Design Reports (NCA-3550) and required documents will be conducted. {{Design Acceptance Criteria}}	ASME Code certified Design Report(s) (NCA-3550) (certified, when required by ASME Code) exist and conclude that the design of the GDCS piping identified in Table 2.4.2-1 as ASME Code Section III complies with the requirements of the ASME Code, Section III, including for those stresses and loads related to fatigue (including environmental effects), thermal expansion, seismic, and combined. {{Design Acceptance Criteria}}
2.b2. The as-built piping identified in Table 2.4.2-1 as ASME Code Section III shall be reconciled with the with the piping design requirements.	A reconciliation analysis of the piping using the as-designed and as-built information and ASME Code certified 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 GDCS piping identified in Table 2.4.2-1 as ASME Code Section III. The report documents the results of the reconciliation analysis.
2.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.	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 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.

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ASME ITAAC

continued

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
3a. Pressure boundary welds in components identified in Table 2.4.2-1 as ASME Code Section III meet ASME Code Section III 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 GDCS.
3b. Pressure boundary welds in piping identified in Table 2.4.2-1 as ASME Code Section III meet ASME Code Section III 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 GDCS.
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 of the GDCS 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 components of the GDCS comply with the requirements of the 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 design pressure.	A hydrostatic test will be conducted on the code piping of the GDCS 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 GDCS comply with the requirements in the ASME Code Section III.

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Seismic ITAAC

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5. The safety-related equipment identified in Table 2.4.2-1 and Table 2.4.2-2 can withstand Seismic Category I loads without loss of safety-related function.	i. Inspection will be performed to verify that the safety-related Seismic Category I equipment identified in Tables 2.4.2-1 and.4.2-2 is located in a Seismic Category I structure.	i. Report(s) exist and conclude that the Seismic Category I equipment identified in Tables 2.4.2-1 and 2.4.2-2 is located in a Seismic Category I structure.
	ii. Type tests, analyses, or a combination of type tests and analyses of Seismic Category I equipment identified in Tables 2.4.2-1 and 2.4.2-2, will be performed using analytical assumptions, or under conditions which bound the Seismic Category I equipment design requirements.	ii. Report(s) exist and conclude that the Seismic Category I equipment identified in Tables 2.4.2-1 and 2.4.2-2 can withstand Seismic Category I loads without loss of safety-related function.
	iii. Inspection and analyses will be performed to verify that the as-installed equipment, including anchorage, identified in Tables 2.4.2-1 and 2.4.2-2 is bounded by the testing or analyzed conditions	iii. Report(s) exist and conclude that the as-installed equipment, including anchorage, identified in Tables 2.4.2-1 and 2.4.2-2 has been tested or analyzed under the conditions necessary to ensure compliance with Seismic Category I design requirements.

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HFE ITAAC

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. Operating Experience Review (OER) is performed in accordance with the ESBWR HFE Operating Experience Review Implementation Plan.	An inspection is performed on the OER results summary report(s). {{Design Acceptance Criteria}}	A results summary report(s) exists that concludes that the OER activity was conducted in accordance with the implementation plan and contains: • The scope of the OER. • The list of sources of operating experience reviewed and summary of documented results. • List of risk-important human actions and their resolutions from predecessor plants. • A description of the process for issue analysis, tracking, and review. {{Design Acceptance Criteria}}

ITAAC 1, 2, 3 & 12 are DAC only
No as-built verification

1. Operating Experience Review
2. Functional Requirements Analyses
3. Task Analyses
12. V & V Scenario Development

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HFE ITAAC

continued

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4. Staffing and Qualifications (S&Q) is performed in accordance with the ESBWR HFE Staffing and Qualifications Implementation Plan.	i. An inspection is performed on the S&Q results summary report(s). {{Design Acceptance Criteria}}	i. A results summary report(s) exists that concludes that the S&Q design activity was conducted in accordance with the implementation plan and contains: • The scope of the S&Q activity. • A summary of design requirements and inputs to the S&Q. {{Design Acceptance Criteria}}
	ii. An inspection is performed on the final S&Q results summary report(s).	ii. A final results summary report(s) exists that concludes that the S&Q process was conducted in accordance with the implementation plan and contains: • Final staffing levels and qualifications. • The basis for the S&Q concluding that issues and concerns raised in other HFE activities are addressed.

ITAAC 4 through 8 have DAC and as-built components

4. Staffing and Qualifications
5. Human Reliability Analyses
6. Human System Interface
7. Procedure Development
8. Training Development

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HFE ITAAC

continued

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
11. The strategy for the Human Performance Monitoring (HPM) process is developed in accordance with the ESBWR HFE Human Performance Monitoring Implementation Plan.	An inspection is performed on the HPM results summary report(s).	A results summary report(s) exists that concludes that the HPM strategy was developed in accordance with the implementation plan and contains: • A description of the HPM strategy including the scope, structure, and provisions for specific cause determination, trending of performance degradation and failures, and corrective actions. • A description of the database to track activities and corrective actions.

ITAAC 9 through 11 have are as-built verification only

9. Human Factors V & V
10. Design Implementation
11. Human Performance Monitoring

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Software ITAAC

(1) Develop the platform and network segment software plans and cyber security programs for each platform. {{Design Acceptance Criteria}}

(2) Implement the software project for each platform and network segment in accordance with the approved platform and network segment software plans and cyber security programs to ensure the process produces adequate software products at the conclusion of each software life-cycle phase baseline as documented by the life-cycle phase Summary Baseline Review Records (BRR).

(3) Perform a multiple-phase test process as part of the installation phase to confirm that the as-built platform and network segment performs as designed.

Each platform is done in 3 stages

Generic Design Description

5 Platforms
8 Projects
12 Plans

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Software ITAAC continued

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1a3. The SMP is developed for the SSLC/ESF software project.	Inspection of the SMP for the SSLC/ESF software project will be performed. {{Design Acceptance Criteria}}	Report(s) exist and conclude that the SMP for SSLC/ESF software project complies with the criteria contained in the SMPM. {{Design Acceptance Criteria}}
1b3. The SDP is developed for the SSLC/ESF software project.	Inspection of the SDP for the SSLC/ESF software project will be performed. {{Design Acceptance Criteria}}	Report(s) exist and conclude that the SDP for SSLC/ESF software project complies with the criteria contained in the SMPM. {{Design Acceptance Criteria}}

ITAAC 1 is associated with the development of software plans
Letter identifies the specific software plan
Number identifies the software project

1. RTIF
2. NMS
3. SSLC/ESF
4. ATWS/SLC
5. VBIF
6. GENE DPS
7. PIP
8. HP CRD Isolation Bypass Function

a. SMP
b. SDP
c. SIntP
d. SIP
e. SOMP
f. STrngP
g. SQAP
h. SSP
i. SVVP
j. SCMP
k. STP
l. CySP

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Software ITAAC

continued

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
2a3. The planning phase activities detailed in the SSLC/ESF software plans and CySP are completed for the SSLC/ESF software project.	The planning phase outputs are inspected and analyzed for the SSLC/ESF software project. {{Design Acceptance Criteria}}	Planning Phase Summary BRR(s) exist and conclude that the SSLC/ESF software project planning phase activities were performed in compliance with the SSLC/ESF software plans and CySP as derived from SMPM, SQAPM, and CySPP. {{Design Acceptance Criteria}}
2b3. The requirements phase activities detailed in the SSLC/ESF software plans and CySP are completed for the SSLC/ESF software project.	The requirements phase outputs are inspected and analyzed for the SSLC/ESF software project. {{Design Acceptance Criteria}}	Requirements Phase Summary BRR(s) exist and conclude that the SSLC/ESF software project requirements phase activities were performed in compliance with the SSLC/ESF software plans and CySP as derived from SMPM, SQAPM, and CySPP. {{Design Acceptance Criteria}}

ITAAC 2 is associated with the implementation
Letter identifies the implementation phase →
Number identifies the software project

a. Planning
b. Requirements
c. Design
d. Implementation
e. Test

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Software ITAAC

continued

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
3c1. The installation phase activities detailed in the SSLC/ESF software plans and CySP are completed for the SSLC/ESF software project.	The installation phase outputs for the SSLC/ESF software project, including SSLC/ESF FAT and SSLC/ESF Cyber Security FAT, are inspected and analyzed.	Installation Phase Summary BRR(s) exist and conclude that the SSLC/ESF software project installation phase activities were performed in compliance with the SSLC/ESF software plans and CySP as derived from SMPM, SQAPM, and CySPP.
3c2. The SSLC/ESF software project performs as designed.	FAT is performed on the SSLC/ESF software project.	SSLC/ESF FAT report(s) exist and conclude that the SSLC/ESF software project is in compliance with the SSLC/ESF software plans as derived from the SMPM, SQAPM, and CySPP.
3c3. The SSLC/ESF software project is cyber secure.	A cyber security FAT will be performed for the SSLC/ESF software project.	SSLC/ESF cyber security FAT report(s) exist and conclude that the SSLC/ESF software project is in compliance with the SSLC/ESF CySP as derived from the SMPM, SQAPM, and CySPP.

ITAAC 3a - 3h are associated with the FAT
Letter identifies the software project →
Number identifies phase of the FAT

1. Planning
2. Requirements
3. Design

j. RTIF
k. NMS
l. SSLC/ESF
m. ATWS/SLC
n. VBIF
o. GENE DPS
p. PIP
q. HP CRD Isolation Bypass Function

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Software ITAAC

continued

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
3l1. The SSLC/ESF software project performs as designed.	A SSLC/ESF software project SAT is performed.	SSLC/ESF SAT report(s) exist and conclude that the SSLC/ESF software project is in compliance with the SSLC/ESF software plans as derived from the SMPM, SQAPM, and CySPP.
3l2. The SSLC/ESF software project is cyber secure.	A SSLC/ESF software project cyber security SAT is performed.	SSLC/ESF cyber security SAT report(s) exist and conclude that the SSLC/ESF software project is in compliance with the SSLC/ESF CySP as derived from the SMPM, SQAPM, and CySPP.

ITAAC 3i is the SAT for the sensors and cables
ITAAC 3j - 3q are associated with the SAT
Letter identifies the software project
Number identifies type of SAT

1. Functionality
2. Cyber Security

j. RTIF
k. NMS
l. SSLC/ESF
m. ATWS/SLC
n. VBIF
o. GENE DPS
p. PIP
q. HP CRD Isolation Bypass Function

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Improvements in Consistency, Format, and Content

Acceptance Criteria Consistency

- Consistent use of "Report(s) exist and conclude" to reflect that there will be a report for completion package of each ITAAC, whether inspection, testing, or analyses are used for performing ITAAC
- Consistent use of report terms for Human Factors and Software
- Denoting {{Design Acceptance Criteria}} in ITA and AC columns

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Acceptance Criteria Consistency

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
8a. The GDCS injection lines provide sufficient flow to maintain water coverage above 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.	Report(s) exist and conclude that, based on analysis and test data, the observed 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.
9. The GDCS squib valve used in the injection and equalization open as designed	A vendor type test will be performed on a squib valve to open as designed.	Record(s) of vendor type test exist and conclude GDCS squib valves used in the injection and equalization open as designed.
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 taken.	Report(s) exist and conclude that each GDCS injection nozzle flow limiter is less than or equal to 4.562E-3 m2 (0.0491 ft2) and a nominal reactor-side outlet length to diameter value of 4.41.

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Improvements in Consistency, Format, and Content

Removed ITAAC that only referred to other subsections in Tier 1 and relocated information to Design Description text

GDCS system minimum inventory of alarms, displays, controls, and status indications in the main control room are addressed in Section 3.3.

The equipment qualification of GDCS components is addressed in Tier 1 Section 3.8.

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 Controls Compliance with IEEE Standard 603."

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Changes to Definitions in Tier 1

Defining "Component" and "Equipment" to reflect appropriate use in Tier 1

- **Component** as used in Tier 1 for reference to ASME components means that subset of equipment that does not include piping.
- **Equipment** as used in Tier 1 as related to ASME Code and Seismic Category I requirements means both components and piping.

Adding to definition of Report that the Functional Arrangement report may be or may include an ASME Report. This clarification has been removed from the specific ITAAC in the ITAAC tables

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Changes to Definitions in Tier 1 continued

Changing definition of "Train" to remove clarifying statement about instrumentation trains

- **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).

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Changes to Definitions in Tier 1 continued

Will be adding clarification to "As-built" definition in response to RAI 14.3-454

- **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" 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.

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Incorporation of NRC Comments

Final Rev. 6 of Tier 1 will complete incorporation of NRC comments from Construction Inspection Program Branch and Office of General Counsel

- Preliminary version is not reflective of all comments
- Remaining comments relate to consistencies, while other specific comments in RAIs are already incorporated into the document
- Response to RAI 449, S01, will complete changes to Functional Arrangement ITAAC and tables in I&C sections of Tier 1 (removing other than "inspection" items and creating new ITAAC for tests and analyses)

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Other Items

GEH submitted cross-reference tables for key parameters in Tier 2 to location in Tier 1 (RAI 14.3-405)

Updating Design Commitments to be consistent with approach for certified material and ongoing design features (RAI 14.3-450)

Clarifying ITAAC for demonstrating conformance with IEEE 603 criteria for digital I&C

Updating description of Functional Capability

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Summary Points

Changes have been discussed with NRC

Final revision will include all consistency changes that were not yet incorporated in Preliminary chapter submittal

ITAAC are reflective of key parameters for ESBWR design

Significant changes in Rev. 6 in Digital I&C, software, and human factors to reflect interactions with NRC largely to clarify completion of DAC ITAAC and subsequent testing

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