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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 335 Related to ESBWR Design Certification Application ESBWR RAI Number 14.3-405 S01**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) dated April 30, 2009 (Reference 1).

The GEH response to RAI Number 14.3-405 S01 is in Enclosure 1. The DCD markups associated with these responses are included in Enclosure 2. Previous RAIs and responses were transmitted in References 2 and 3.

Verified DCD changes associated with this RAI response are identified in the enclosed DCD markups by enclosing the text within a black box. The marked-up pages may contain unverified changes in addition to the verified changes resulting from this RAI response. Other changes shown in the markup(s) may not be fully developed and approved for inclusion in DCD Revision 6.

If you have any questions or require additional information, please contact me.

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

Reference:

1. MFN 09-309, Letter from the U.S. Nuclear Regulatory Commission to Jerald G. Head, Request for Additional Information Letter No. 335,Related To ESBWR Design Certification Application, dated April 30,2009

2. MFN 08-650, Letter from the U.S. Nuclear Regulatory Commission to Robert E. Brown, Request for Additional Information Letter No. 241,Related To ESBWR Design Certification Application, dated August 15,2008

3. MFN 09-079, *Response to Portion of NRC Request for Additional Information Letter No. 241 Related to ESBWR Design Certification Application – RAI Number 14.3-40*, dated February 27, 2009

Enclosures:

1. Response to Portion of NRC Request for Additional Information Letter No. 335 Related to ESBWR Design Certification Application DCD Tier 1 RAI Number 14.3-405 S01

2. MFN 09-071, DCD Tier 2 Revision 6 Markups

cc:	AE Cubbage	USNRC (with enclosure)
	JG Head	GEH/Wilmington (with enclosure)
	DH Hinds	GEH/Wilmington (with enclosure)
	eDRF	0000-0103-9250

Enclosure 1

MFN 09-079, Supplement 1

Response to Portion of NRC Request for

Additional Information Letter No. 335

Related to ESBWR Design Certification Application

INSPECTIONS, TESTS, ANALYSES AND ACCEPTANCE CRITERIA

RAI Number 14.3-405 S01

*Verified DCD changes associated with this RAI response are identified in the enclosed DCD markups by enclosing the text within a black box. The marked-up pages may contain unverified changes in addition to the verified changes resulting from this RAI response. Other changes shown in the markup(s) may not be fully developed and approved for inclusion in DCD Revision 6.

*Original Responses previously submitted are included without DCD updates to provide historical continuity during review.

NRC RAI 14.3-405 (original):

ITAAC roadmap

SRP 14.3, Section III, Review Procedures, as well as Appendix C, Detailed Review Guidance, discuss the need for the staff to review cross-references in DCD Tier 2, Section 14.3, showing where key parameters from safety analyses for the design, including, analyses of design-basis accidents, severs accidents, flooding, overpressure protection, containment, core cooling, fire protection, transients, shutdown risk, anticipated transient without scram, Three Mile Island (TMI) items, PRAs, regulatory treatment of nonsafety-related systems (RTNSS), or other analyses as specified by the staff. The applicant did not provide these roadmaps in Tier 2 of the ESBWR DCD, Rev. 5. The applicant is requested to provide these cross-references/roadmaps in Tier 2, Section 14.3 of the ESBWR DCD. Guidance on the format and content for these cross-references may be gleaned by referring to Tables 14.3-1 through 14.3-8 in the AP1000 Design Control Document.

GEH Response(original):

NRC guidance in NUREG-0800, Section 14.3 (March 2007), discusses including in Section 14.3 of Tier 2 information regarding the critical assumptions from transient and accident analyses and PRA and severe accident insights (see, e.g., NUREG-0800, Section 14.3, Appendix C, p. 14.3-30). It also discusses a cross-reference being useful for review of the key parameters for analyses such as those listed in the RAI (see, e.g., p. 14.3-5). The ESBWR DCD Section 14.3 (Rev. 5) contains a description of the process for determining the content of Tier 1 and the ITAAC. The selection for the material in Tier 1, as described in NRC Regulatory Guide 1.206 and Tier 2, Section 14.3, is based on addressing "the most safety-significant aspects of each of the systems of the design, and derived from the detailed design information contained in Tier 2. The applicant should put the top-level design features and performance characteristics that were the most significant to safety in the Tier 1 design descriptions." In addition, as the guidance further explains, the "design descriptions serve as binding requirements for the lifetime of a facility to assure that the plant does not deviate from the certified design." Accordingly, Tier 2, Section 14.3, explains the significance of ensuring that the right level of information is included in Tier 1. See Tier 2, Section 14.3 for the full description of all of the factors considered in selecting the material for Tier 1.

Because the information in Tier 1 constitutes the certified material and is binding for the lifetime of a facility, future licensees of ESBWRs will use the information in Tier 1 when evaluating any temporary or permanent design changes under the change process that will be outlined in the ESBWR design certification rule. However, because of the standard design-centered approach, it is expected that most changes would be evaluated on a fleet-wide basis, unless site specific. Tier 2 is also important in evaluating changes that might affect Tier 1, as it provides further explanation for those elements of the design in Tier 1 for a better understanding of the basis for the design information contained in Tier 1. Thus, both Tier 1 and Tier 2 information will be

important when evaluating whether a change would be one which requires NRC approval or not.

The information contained in Tier 1 is based on information derived from Tier 2. While Tier 1 is not formatted in the same order as Tier 2, corresponding chapters of Tier 2 generally relate to a specific section of Tier 1. Although Tier 1 represents the certified design material for the standard ESBWR, Tier 2 provides the more detailed design bases descriptions.

In response to questions raised in meetings regarding Tier 1, GEH and the NRC discussed including a table in Tier 2, Section 14.3, that would list the key design features in the areas of design basis accident analysis and PRA/severe accident. GEH has developed two tables that address these key design features. The first, Table 14.3-1B, includes those design features that are related to specific transient and accident analyses, such as ATWS, overpressure protection, containment, and emergency core cooling. The second, Table 14.3-1C addresses the design features key to PRA and severe accident insights, including core cooling, flooding, fire, management of molten debris, and RTNSS. GEH also is including a listing of the Tier 1 contents with an indication of which systems have ITAAC, Table 14.3-1A. These tables address the key design features discussed in Tier 1 meetings, as well as the information requested in the RAI.

GEH has included a paragraph in Section 14.3.2.1 to explain the purpose of the added tables. The tables will be included in Revision 6 Section 14.3 of Tier 2 and are included in the attachment herein. The RAI suggested that the format be similar to tables in the AP1000 DCD, Section 14.3, and GEH has used those tables as a template. However, as a matter of practice in preparing the DCD, GEH did not include values in the tables in order that no discrepancies will be created between these tables and other portions of Tier 2 where the analytical values are contained.

Additionally, during the development of Table 14.3-1c, PRA and Severe Accident Insights, GEH determined that additional ITAACs are necessary or exiting ITAAC needed to be changed in Tier 1 to address the key design features. The following provides the affected Tier 1 sections:

- Section 2.1.2 Nuclear Boiler System, Table 2.1.2-3, ITAAC 23

- Section 2.2.2 Control Rod Drive System, Design Description and Table 2.2.2-7, ITAAC 16a and 16b

- Section 2.2.4 Standby Liquid Control System, Design Description and Table 2.2.4-6, ITAAC 24 and 24b

- Section 2.2.14 Diverse Instrumentation and Controls, Design Description, Table 2.2.14-1 and Table 2.2.14-4, ITAAC 8

- Section 2.4.1 Isolation Condenser System, Design Description and Table 2.4.1-3, ITAAC 29a and 29b
- Section 2.4.2 Gravity Driven Cooling System, Design Description and Table 2.4.2-3, ITAAC 28a, 28b, 29a, 29b, 29c, and 29d
- Section 2.6.1 Reactor Water Cleanup/Shutdown Cooling System, Design Description and Table 2.6.1-2, ITAAC 10a and 10b
- Section 2.11.1 Turbine Main Steam System, Design Description and Table 2.11.1 1, ITAAC 11a and 11b
- Section 2.11.2 Condensate and Feedwater System, Design Description and Table 2.11.2-1, ITAAC 9a and 9b
- Section 2.13.8 Lighting Power Supply, Design Description and Table 2.13.8-1, ITAAC 7 and 9
- Section 2.15.1 Containment System, Table 2.15.1-2, ITAAC 9
- Section 2.15.3 Containment Internal Structure, Design Description and Table 2.15.3-2, ITAAC 9
- Section 2.16.3.1, Fire Barriers, Design Description and Table 2.16.3.1-1, ITAAC 5

DCD Impact (original):

The changes to the DCD, Tier 2 and Tier 1, are shown in the attached marked-up pages, in Enclosure 2.

NRC RAI 14.3-405 S01

Question Summary: ITAAC Road Map

Full Text

The staff reviewed GEH response to RAI 14.3-405 and identified issues below that still need to be addressed by GEH.

A. *In Table 14.3-1a, item 12 - Distributed Control and Information System (safety-related) refers to ITAAC Table 2.2.10-1, and item 13 - Distributed Control and Information System (nonsafety-related) refers to ITAAC Table 2.2.11-1. Both Tables 2.2.10-1 and 2.2.11-1 are not providing ITAAC information. These Tables only provide "software project" of related "Platform". The actual ITAAC information for these software projects are documented in Table 3.2-1, "ITAAC For Software Development." Table 14.3-1a should provide a note to direct the reader to ITAAC Table 3.2-1.*

B. *In Table 14.3-1a, item 34 - Main Control Room Panel refers to ITAAC Table 2.2.13-1. Table 2.2.13-1, "SSLC/ESF Functional Arrangement" does not provide ITAAC information. Table 14.3-1a for this item should provide a note that the development of safety-related VDU is the ITAAC for Main Control Room Panel.*

C. *In Table 14.3-1a, item 36 - Local Control Panels and Racks refers to ITAAC Table 2.2.6-1, "RSS Functional Arrangement, "Table 2.3.2-1, "ARM locations," and Table 2.5.10-1, "ITAAC for Fuel Transfer System." A note should be provided what is the intended ITAAC for Local Control Panels and Racks.*

D. *In Table 14.3-1b, "Design Basis Accident Analysis Critical Parameters," many parameters listed in Tier 2 Table 15.2-1, "Input Parameters, Initial Conditions and Assumptions" need to be verified by Tier 1, ITAAC Table 2.2.15-2, "ITAAC for IEEE Std. 603 Compliance Confirmation." Table 2.2.15-2 is a very large table that involves 46 ITAAC items. Any design feature, that needs to be verified by ITAAC Table 2.2.15-2, should specifically identified which item in the Table 2.2.15-2 is relevant to that design feature.*

E. *The reference on page 14.3-48 (Table 14.3-1c) for PSWS, DCD Tier 1 reference should be Item 2 and not Item 1.*

F . *It is not clear what "the valve" refers to in the following item from Table 14.3-1c.*

> *"A pneumatic accumulator and check valve are required to support the remote-manual and ADS activated functions of the valve. The accumulator and check valve ensures that the valve*

opens via the pneumatic operator following a failure of the pneumatic pressure source."

G. The tier 1 reference (i.e., Table 2.2.2-3) in Rev. 6 for the following item appears to be for something unrelated to the item:

"Power operated equipment and valves on lines attached to the RPV that require maintenance have maintenance valves installed such that freeze seals will not be required."

GEH Response

A. A note has been added to Table 14.3-1a referring to Table 3.2-1 for the ITAAC information for the software projects listed in Tables 2.10-1 and 2.10-2.

   Table 14.3-1a has also been revised to refer to Table 2.10-1 in indentifying systems that "Conformance with IEEE Std. 603 requirements by the safety-related control system structures, systems, and components defined in Tier 1 Tables 2.2.10-1 and addressed in Subsection 2.2.15."

   An additional reference to section 2.2.6 HP CRD Isolation Bypass Function Independent Control Platform has also been added to the table.

B. Subsection 2.7.1, Main Control Room Panels, has been deleted because the qualification of the main control room panels is performed as part of the qualification process of the SSLC/ESF software project in Section 3.2, the SSLC/ESF VDUs described in Subsection 2.2.13, and the IEEE Std. 603 Compliance ITAAC for the SSLC/ESF in Subsection 2.2.15. The deleted subsection 2.7.1 only referred to the steel cabinetry and did not include qualification of the equipment housed in the cabinetry. Subsection 2.7.1 became redundant to the equipment qualification process because the equipment housed within the cabinetry has to be qualified while mounted in the cabinetry per IEEE Std. 323.

C. Subsection 2.7.3, "Local Control Panels and Racks", has been deleted because the qualification of local control panels and racks is performed as part of the qualification process of the SSLC/ESF software project as described in Section 3.2. The SSLC/ESF VDUs are described, in Subsection 2.2.13, the RSS panels are described in Subsection 2.2.6. Compliance to IEEE Std. 603 and the ITAAC describing the software project for the SSLC/ESF are described in Subsection 2.2.15.

   Deleted subsection 2.7.3 only referred to the steel cabinetry and did include qualification of the equipment housed by the cabinetry. Subsection 2.7.3 became

redundant to the equipment qualification process because the equipment housed within the cabinetry has to be qualified while mounted in the cabinetry per IEEE Std. 323.

D. Note 1 to Table 14.3-1b was modified to include a reference to the ITAAC Table 2.2.15-2 Item number as requested.

E The reference in Table 14.3-1c for PSWS has been changed to item 2 from item 1.

F The Design Feature description in Table 14.3-1c has been revised to read

"A pneumatic accumulator and check valve are required to support the remote-manual and ADS-activated functions of the *SRV* valve. The accumulator and check valve ensure that the *SRV…*

G. Table 14.3-1c was revised to correct the reference to item 16 of Section 2.2.2. The other entries on this line were revised to show the item number of Tier 1 Design Description. This makes this line consistent with the other lines in Table 14.3-1c. Other references to specific item numbers were also added to Table 14.3-1c for clarity

DCD Impact

DCD Tier 2, Table 14.3-1a, 14.3-1b and 14.3-1c will be revised as noted in the attached markup.

Enclosure 2

MFN 09-079, Supplement 1

DCD Tier 2 Revision 6 Markups

Table 14.3-1a
ITAAC Screening Summary

Structure/System/Equipment Description	ITAAC Table
Reactor Pressure Vessel and Internals	2.1.1-3
Nuclear Boiler System	2.1.2-3
Rod Control and Information System	2.2.1-6
Control Rod Drive System	2.2.2-7
Feedwater Control System	2.2.3-4
Standby Liquid Control System	2.2.4-6 Note 2
Neutron Monitoring System	2.2.5-4 Note 2
Remote Shutdown System	2.2.6-3
Reactor Protection System	2.2.7-4
Plant Automation System (nonsafety-related)	-
Steam Bypass and Pressure Control System	2.2.9-3
Distributed Control and Information System (safety-related)	2.2.10-1 Note 1
Distributed Control and Information System (nonsafety-related)	2.2.11-1 Note 1
Leak Detection and Isolation System	2.2.12-5
Safety System Logic and Control System	2.2.13-4 Note 2
Diverse Instrumentation and Controls	2.2.14-4
HP CRD Isolation Bypass Function Independent Control Platform	2.2-16 Note 2
Process Radiation Monitoring System	2.3.1-2
Area Radiation Monitoring System	2.3.2-2
Isolation Condenser System	2.4.1-3
Emergency Core Cooling System — Gravity-Driven Cooling System	2.4.2-3
Fuel Service Equipment	-
Miscellaneous Service Equipment	-
Reactor Pressure Vessel Servicing Equipment	-
RPV Internals Servicing Equipment	-

Table 14.3-1a
ITAAC Screening Summary

Structure/System/Equipment Description	ITAAC Table
Refueling Equipment	2.5.5-1
Fuel Storage Facility	2.5.6-1
Under-Vessel Servicing Equipment	Note 4
FMCRD Maintenance Area	Note 4
Fuel Cask Cleaning	Note 4
Fuel Transfer System	2.5.10-1
Reactor Water Cleanup/Shutdown Cooling System	2.6.1-2
The Fuel and Auxiliary Pools Cooling System	2.6.2-2
Radwaste Control Panels	Note 4
Liquid Waste Management System	2.10.1-2
Solid Waste Management System	2.10.2-2
Gaseous Waste Management System	2.10.3-1
Turbine Main Steam System	2.11.1-1
Condensate and Feedwater System	2.11.2-1
Condensate Purification System	Note 4
Main Turbine	2.11.4-1
Turbine Gland Seal System	2.11.5-1
Turbine Bypass System	2.11.6-1
Main Condenser	2.11.7-1
Circulating Water System	Note 4
Power Cycle Auxiliary Systems	Note 4
Makeup Water System	2.12.1-1 Note 3
Condensate Storage and Transfer System	Note 4
Reactor Component Cooling Water System	2.12.3-1
Turbine Component Cooling Water System	Note 4

Table 14.3-1a
ITAAC Screening Summary

Structure/System/Equipment Description	ITAAC Table
Chilled Water System	2.12.5-1
Oxygen Injection System	Note 4
Plant Service Water System	2.12.7-1
Service Air System	2.12.8-1 Note 3
Instrument Air System	Note 4
High Pressure Nitrogen Supply System	2.12.10-1 Note 3
Auxiliary Boiler System	Note 4
Potable and Sanitary Water	Note 4
Hydrogen Water Chemistry System	Note 4
Process Sampling System	Note 4
Zinc Injection System	Note 4
Freeze Protection	Note 4
Station Water System	Note 4
Electrical Power Distribution System	2.13.1-2
Direct Current Power Supply	2.13.3-3
Standby On-site AC Power Supply	2.13.4-2
Uninterruptible AC Power Supply	2.13.5-2
Communication System	Note 4
Lighting Power Supply	2.13.8-1
Power Transmission	Note 4
Containment System	2.15.1-2
Containment Vessel	Note 4
Containment Internal Structures	2.15.3-2
Passive Containment Cooling System	2.15.4-2
Containment Inerting System	2.15.5-2
Drywell Cooling System	Note 4
Containment Monitoring System	2.15.7-2

Table 14.3-1a
ITAAC Screening Summary

Structure/System/Equipment Description	ITAAC Table
Passive Autocatalytic Recombiner	2.15.8-1
Cranes, Hoists and Elevators	2.16.1-1
Reactor Building HVAC	2.16.2-2
Control Building Habitability HVAC Subsystem	2.16.2-4
Emergency Filter Units	2.16.2-6
Turbine Building Ventilation System	2.16.2-7
Fuel Building HVAC System	2.16.2-9
Radwaste Building HVAC System	Note 4
Electrical Building Ventilation System	2.16.2-10
Other Building HVAC Systems	Note 4
Fire Protection	2.16.3-2
Fire Barriers	2.16.3.1-1
Equipment and Floor Drain System	2.16.4-1
Reactor Building	2.16.5-2
Control Building	2.16.6-2
Fuel Building	2.16.7-2
Turbine Building	2.16.8-1
Radwaste Building	2.16.9-1
Service Building	2.16.10-1
Ancillary Diesel Building	2.16.11-1
Fire Water Service Complex	2.16.12-1
Electrical Building	2.16.13-1
Service Water Building	2.16.14-1
Intake and Discharge Structure	Note 4
Oil Storage and Transfer Systems	Note 4
Site Security	Note 4
Plant Security	2.19-1

Table 14.3-1a
ITAAC Screening Summary

Structure/System/Equipment Description	ITAAC Table
Plant Service Water System	Interface Material
Off-site Electrical Power	Interface Material

Tier 1 contains non-system based ITAAC for the following:

- Design of Piping Systems and Components Table 3.1-1
- Software Development Table 3.2-1
- Human Factors Engineering Table 3.3-2
- Radiation Protection Table 3.4-1
- Design Reliability Assurance Program Table 3.6-1
- Post Accident Monitoring Instrumentation Table 3.7-1
- Equipment Qualification of Mechanical and Electrical Equipment Table 3.8-1

Notes:
(1) The ITAAC information for these software projects are provided in Table 3.2-1.
(2) Conformance with IEEE Std. 603 requirements by the safety-related control system structures, systems, and components defined in Tier 1 Tables 2.2.10-1 and addressed in Subsection 2.2.15.
(3) For these systems, the only ITAAC relate to containment isolation valves. Refer to Table 2.15-1.
(4) ITAAC not required for these systems.

Table 14.3-1b

Design Basis Accident Analysis Critical Parameters

References		Design Feature
Tier 2	Tier 1	
Reactor Power		
Table 15.2-1	Table 2.2.15-2(1)	APRM High Flux Scram
Table 15.2-1	Table 2.2.15-2(1)	APRM High STP Scram
Table 15.2-1	Section 1.1.2.5(2)	Thermal Power Level
Reactor Water Level		
Table 15.2-1	Table 2.2.15-2(1)	Low Level Scram (L3)
Table 15.2-1	Table 2.2.15-2(1)	High Level Scram (L8)
Table 15.2-1	Table 2.2.15-2(1)	Water Level Trips (L2, L1, L0.5)
Reactor Pressure		
Table 15.2-1	Table 2.2.15-2(1)	High Pressure Scram
MSIV Closure		
Table 15.2-1	Table 2.2.15-2(1)	MSIV Closure Scram (Position of 2 or more MSIVs)
Table 15.2-1	Table 2.1.2-3	MSIV Closure Time Minimum/Maximum
Suppression Pool Temperature		
Table 15.2-1	Table 2.2.15-2(1)	High SP Temperature Scram
Table 15.2-1	Table 2.6.2-2	Initiate FAPCS
TSV Closure		
Table 15.2-1	Table 2.2.15-2(1)	TSV Closure Scram, (Position of 2 or more TSV)
TCV Closure		
Table 15.2-1	Table 2.2.15-2(1)	TCV Fast Closure SCRAM Trip
Control Rod Drive Scram Time		
Table 15.2-2	Table 2.2.2-7 and Table 2.2.2-2	Maximum Scram Time of all rods for Vessel Bottom Pressures below 7.481 MPaG
Table 15.2-3	N/A(3)	Scram Times for Vessel Bottom Pressures between 7.481 and 8.618 MPaG

Table 14.3-1b

Design Basis Accident Analysis Critical Parameters

References		Design Feature
Tier 2	Tier 1	
Overpressure Protection		
Subsection 15.5.1.3	T2.1.2-3	Ten SRVs and eight SVs are included in the ESBWR design.
Table 15.2-1 and Table 15.5-3	Table 2.1.2-3	Analytical Limit Setpoint: 8.618 MPaG (SRV) 8.756 MPaG (SV)
Table 15.2-1	Table 2.1.2-3	SRV Capacity @ 8.618 MPa
Table 15.2-1	Table 2.1.2-3	SRV Capacity @ 8.765 MPa
Table 15.2-1	Table 2.1.2-3	DPV Capacity @ 7.481 MPa
Isolation Condenser		
Table 6.3-1	Table 2.4.1-3	Initiation Signals MSIV Closure (2 of 4) High RPV Dome Pressure Low RPV Water Level Loss of Feedwater
Table 15.2-1	Table 2.4.1-3	Minimum capacity (each) 4 IC, MW / % NBR
Table 15.2-1	N/A(4)	Minimum Initial Temperature
Table 15.2-1	Table 2.4.1-3	Injection valve stroke
Table 6.3-1	Table 2.4.1-3	IC Volume (4 units) minimum drainable liquid volume per unit
Main Steam		
Table 15.2-1	Table 2.11.1-1	Total Steamline Volume (vessel to TSVs/TBVs)
Table 15.2-1	Table 2.11.6-1	TBV Total Capacity
Table 15.2-1	Table 2.11.6-1	Delay Response Time from TSV or TCV to 80% of Total Bypass Valve Capacity
Table 15.2-1	Table 2.11.6-1 and Table 2.11.7-1	TBV Sustained Operation on loss of preferred power

Table 14.3-1b

Design Basis Accident Analysis Critical Parameters

References		Design Feature
Tier 2	Tier 1	
Section 15.2.2	Table 2.11.6-1	On TSV closure or TCV fast closure, to prevent an increase in system pressure, sufficient bypass capacity is provided to pass steam flow diverted from the turbine.
Table 15.2-1	Table 2.11.4-1	TSV closing stroke time
Table 15.2-1	Table 2.11.4-1	TCV closing stroke time (fast)
Table 15.2-1	Table 2.11.4-1	TCV closure stroke time (minimum servo)
Table 15.2-1	Table 2.11.4-1	% rated through 3 TCVs
Table 5.2-6	Table 2.1.2-3	MSIV Isolation Signals: L2 Water Level + Time Delay L1 Water Level Low Turbine Inlet Pressure Low Condenser Vacuum
Core Flow		
Reference 4.4-12	N/A(5)	Core Flow measurement accuracy
Feedwater		
Section 7.7.3	Table 2.2.15-2(1)	L 0.5 Equalization Line Trip
Table 15.2-1	Table 2.11.2-1	Runout Capacity (3 pumps)
Table 15.2-1	Table 2.11.2-1	Runout Capacity (1 pump)
Table 15.2-1	Table 2.11.2-1	Feedwater Temperature (rated)
Table 15.2-1	Table 2.11.2-1	Feedwater heater temperature loss (Δ)
Table 15.2-1	Table 2.2.1-6	Loss of feedwater heating setpoint (Δ) (SCCRRI/SRI Initiation)
Ref. 4.4-12	Table 2.2.3-4	Feedwater flow measurement (1 σ)
Anticipated Transient Without Scram		
Table 15.5-3	Table 2.2.3-4	Feedwater runback on ATWS signal

Table 14.3-1b

Design Basis Accident Analysis Critical Parameters

References		Design Feature
Tier 2	Tier 1	
Standby Liquid Control		
Section 15.5.4	Table 2.2.4-6	System Initiation Signals High RPV Press + SRNM not downscale for 3 min L2 + SRNM not downscale for 3 min SRNM not downscale for 3 min with manual ARI / FMCRD run-in
Section 9.3.5	Table 2.2.4-6	Boron concentration
Section 9.3.5	Table 2.2.4-6	Total Volume
Section 9.3.5; Table 15.5-2	Table 2.2.4-6	Average flowrate: first half of volume second half of volume
Section 9.3.5	Table 2.2.4-6	RPV injection pressure
Containment		
Table 6.2-1	Table 2.15.1-2	Design Pressure
Table 6.2-1	Table 2.15.1-2	Design Temperature
Table 6.2-1	Table 2.15.1-2	Maximum Differential Pressure
Table 6.2-1	Table 2.15.1-2	Maximum DP (DW>WW)
Table 6.2-1	Table 2.15.1-2	Leakage Rate
Table 6.2-1; Table 6.2-8	Table 2.15.1-2	Vacuum Breakers (DW>WW) – 3 each Opening DP (WW - DW) Closing DP (WW - DW) Loss Coefficient (K/A2)
Table 6.2-3	Table 2.15.1-2	Containment Volume Upper DW free gas volume Lower DW free gas volume Wetwell free gas space volume Suppression Pool Volume

Table 14.3-1b

Design Basis Accident Analysis Critical Parameters

References		Design Feature
Tier 2	Tier 1	
Table 6.2-3	Table 2.15.1-2	Suppression Pool Volume Pool surface only Vertical vents SP depth (High level) SP depth (Nominal level) SP Depth (Low level)
Table 6.2-4	Table 2.15.1-2	Vertical Vents Total Number Inside diameter
Table 6.2-4	Table 2.15.1-2	Horizontal Vents Vents (per vertical vent) Total number Inside Diameter Submergence Top Row (CL) Middle Row (CL) Bottom Row (CL)
PCCS		
Table 6.2-10	Table 2.15.4-2	Number of PCCS Condensers
Table 6.2-10	Table 2.15.4-2	Heat Removal Capacity (per Condenser)
Table 6.2-10	Table 2.15.4-2	Assumed Pool temperature
Table 6.2-10	Table 2.15.4-2	Design Pressure
Table 6.2-10	Table 2.15.4-2	Design Temperature
Emergency Core Cooling System		
Table 6.3-1	Table 2.2.15-2(1)	RPV Water Level 1 Signal
Table 6.3-1	Table 2.2.15-2(1)	Alternate ADS/GDCS Initiation Signal
Table 6.3-1	Table 2.4.2-3	GDCS line loss coefficient
Table 6.3-2	Table 2.4.2-3	GDCS Divisions
Table 6.3-2	Table 2.4.2-3	Injection Lines / Division

Table 14.3-1b

Design Basis Accident Analysis Critical Parameters

References		Design Feature
Tier 2	Tier 1	
Table 6.3-2	Table 2.4.2-3	Injection line RPV Nozzles (per Division)
Table 6.3-2	Table 2.4.2-3	Equalizing line RPV Nozzles (per Division)
Table 6.3-2	Table 2.4.2-3	Minimum drainable inventory
Table 6.3-2	Table 2.4.2-3	Min. Elevation of GDCS pool above RPV nozzles
Table 6.3-2	Table 2.4.2-3	Minimum flow through deluge lines
Table 6.3-2	Table 2.4.2-3	Minimum GDCS equalizing line head

Notes:

(1) System limits that are based on process analytical limits are verified in Tier 1 by system functionality requirements in combination with the requirements for a control system setpoint control program as required by Table 2.2.15-2, Item 21.

(2) Rated reactor power is included in Tier 1 content, but is not verified through an ITAAC.

(3) Control Rod SCRAM times vary with reactor pressure; therefore, this key parameter cannot be verified prior to fuel load and is not addressed by an ITAAC.

(4) The minimum initial IC temperature is a conservatively assumed value that is equivalent to the minimum reactor building ambient temperature (Tier 2, Table 9.4-8) even though the lines are physically located inside the drywell and the ICII event is assumed to occur at normal power operating conditions. This is an operational parameter limit that cannot be verified by ITAAC prior to fuel load.

(5) The total core flow is calculated by the heat balance core flow methodology. This is a critical parameter that cannot be verified prior to fuel load, thus there is no ITAAC requirement associated with this parameter. This parameter is met provided the input values for the heat balance (e.g. reactor pressure, feedwater flow and temperature) are within their required accuracy ranges.

Table 14.3-1c

PRA and Severe Accident Insights

Design Feature	DCD Tier 2 Reference	DCD Tier 1 Reference
FAPCS, internal and external, injection capability provide adequate core cooling for transients given successful DPV or ADS valve operation, even if containment pressure is at the ultimate containment pressure.	Subsection 9.1.3.2	2.6.2 Table 2.6.2-2 Item 7b
The DPS cabinet is assumed to be located in a separate fire area in the control building. A preliminary fire PRA analysis model with DPS cabinet located inside room 3301 shows that the fire risk in fire area F3301 would be the dominant contributor to all fire risks due to the high failure probability of common cause failure of software for the safety – related system, the failure of DPS, and multiple nonsafety-related systems impacted by a fire in room 3301. With a separate fire area for the proposed DPS cabinet in the detailed design, the fire risk can be significantly reduced.	Section 1.0, Figure 1.2-4	2.2.14 Table 2.2.14-4 Item 11
The exposure of the distributed control and information system (Q-DCIS and N-DCIS) equipment to heat and smoke caused by a fire in a single fire area does not cause spurious actuations that could adversely affect safe shutdown.	Subsection 9.5.1.12	2.16.3.1 Table 2.2.15-2 Item 5
The communication links between the main control room (MCR) and the Q-DCIS and N-DCIS rooms do not include any copper or other wire conductors that could potentially cause fire-induced spurious actuations that could adversely affect safe shutdown.	Subsection 9.5.1.10	2.2.15 Table 2.2.15-2 Items 10a and 10b
Doors that connect the Control and Reactor Buildings with the Electrical Building galleries are watertight, for flooding of the galleries up to the ground level elevation.	Subsection 3.4.1.4.3	2.16.5, 2.16.6 Table 2.16.5-2, Item 8 Table 2.16.6-2, Item 5

Table 14.3-1c

PRA and Severe Accident Insights

Design Feature	DCD Tier 2 Reference	DCD Tier 1 Reference
The Drywell Floor Drain Sump channels, which allow leakage on the lower drywell floor to flow into the sump, will prevent any molten debris, which reaches the inlet, from entering the sump.	Subsection 6.2.1.1.10.2	2.15.3 Table 2.15.3-2, Item 9
Closure of both the equipment hatch and the personnel hatch can be performed from outside the lower drywell/containment.	Section 1.0, Figure 1.2-2	2.15.1 Table 2.15.1-2, Item 9 (iv)
The IC/PCCS Pool valves that provide make-up water from the equipment storage pool have DPS controls and are powered from a reliable source of power, which is capable of long-term support.	Subsection 5.4.6.2.2	2.4.1 Table 2.4.1-3, Item 24
Control logic cabinets for each of the containment vacuum breaker isolation valves must be located in separate fire zones.	Subsection 6.2.1.1.2	2.15.1 Table 2.2.14-4, Item 8(iv)
Because of the high consequence of a RWCU/SDC line break outside containment this system is designed with an additional diverse, nonsafety-related valve that is used for line isolation. This valve is controlled by the nonsafety-related DCIS system and closes on the same signals that provide the safety-related isolation.	Subsection 5.4.8.1.2	2.6.1 Table 2.6.1-2, Item 1

Table 14.3-1c

PRA and Severe Accident Insights

Design Feature	DCD Tier 2 Reference	DCD Tier 1 Reference
Power operated equipment and valves on lines attached to the RPV that require maintenance have maintenance valves installed such that freeze seals will not be required.	Subsection 5.2.3.1.1 Cryogenic Conditions	2.2.2 CRD Item 16 2.2.4 SLCS Item 24 2.4.1 ICS Item 29 2.4.2 GDCS, Item 28 2.6.1 RWCU Item 10 2.6.2 FAPCS Item 13 2.11.1 TMSS Item 11 2.11.2 CFW Item 9
A pneumatic accumulator and check valve are required to support the remote-manual and ADS-activated functions of the SRV valve. The accumulator and check valve ensure that the SRV valve opens via the pneumatic operator following a failure of the pneumatic pressure source.	Subsection 5.2.2.2.2	Table 2.1.2-3, Item 23
The lower drywell water level is monitored to indicate any increases in water level that may occur in the lower drywell following a LOCA condition.	Subsection 7.5.2.1 and Table 7.3-5	2.15.7 Table 2.15.7-2, Item 1
BiMAC temperature indication: Temperature sensors in the BiMAC device provide the actuation signal to open the squib valves from the GDCS pool deluge headers.	Subsections 19.3.2.5 and 19.3.2.6	2.4.2 Table 2.4.2-3, Item 25 Table 2.4.2-3, Item 26

Table 14.3-1c

PRA and Severe Accident Insights

Design Feature	DCD Tier 2 Reference	DCD Tier 1 Reference
Standby Diesel Generators	Subsection 19A.8.4.8	2.13.4 Table 2.13.4-2, Item 2
Standby DG Auxiliaries	Subsection 19A.8.4.8	2.13.4 Table 2.13.4-2, Item 2
RCCWS	Subsection 19A.8.4.9	2.12.3 Table 2.12.3-1, Item 2
Nuclear Island Chilled Water	Subsection 19A.8.4.9	2.12.5 Table 2.12.5-1, Item 2
PSWS	Subsection 19A.8.4.9	2.12.7 Table 2.12.7-1, Item 2
Electrical Building HVAC Area Cooling	Subsection 19A.8.4.9	2.16.2.7 Table 2.16.2-10, Item 2
Fuel Building HVAC Local Cooling	Subsection 19A.8.4.9	2.16.2.5 Table 2.16.2-9, Item 5
Reactor Building HVAC Local Cooling	Subsection 19A.8.4.9	2.16.2.1 Table 2.16.2-2, Item 7
Turbine Building HVAC Local Cooling	Subsection 19A.8.4.9	2.16.2.4 Table 2.16.2-7, Item 2
CRHAVS Air Handling Units	Subsection 19A.8.4.4	2.16.2.2 Table 2.16.2-6, Item 12
CRHAVS Air Handling Unit auxiliary heaters and coolers	Subsection 19A.8.4.4	2.16.2.2 Table 2.16.2-6, Item 10