HITACHI

GE Hitachi Nuclear Energy

James C. Kinsey
Vice President, ESBWR Licensing

PO Box 780 M/C A-55
Wilmington, NC 28402-0780
USA

T 910 675 5057
F 910 362 5057
jim.kinsey@ge.com

MFN 08-086, Supplement 17

Docket No. 52-010

March 26, 2008

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Subject: **Response to Portion of NRC Request for Additional Information Letter No. 126 Related to ESBWR Design Certification Application ESBWR RAI Numbers 14.3-157, 14.3-159, 14.3-248, 14.3-322, 14.3-358, 14.3-359, 14.3-360, 14.3-371 and 14.3-372**

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) sent by NRC letter dated December 20, 2007 (Reference 1).

Enclosure 1 contains the GEH response to each of the subject RAIs. The enclosed changes will be incorporated in the upcoming DCD Revision 5 submittal.

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 5.

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

Sincerely,

James C. Kinsey

James C. Kinsey
Vice President, ESBWR Licensing

D068
NRO

Reference:

1. MFN 07-718, Letter from U.S. Nuclear Regulatory Commission to James C. Kinsey, GEH, *Request For Additional Information Letter No. 126 Related To ESBWR Design Certification Application*, dated December 20, 2007.

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 126 Related to ESBWR Design Certification Application DCD Tier 1 RAI Numbers 14.3-157, 14.3-159, 14.3-248, 14.3-322, 14.3-358, 14.3-359, 14.3-360, 14.3-371 and 14.3-372

cc:	AE Cubbage	USNRC (with enclosure)
	GB Stramback	GEH/San Jose (with enclosure)
	RE Brown	GEH/Wilmington (with enclosure)
	DH Hinds	GEH/Wilmington (with enclosure)
	eDRF	0000-0081-8270 (RAI) 14.3-157
		0000-0081-8327 (RAI) 14.3-159
		0000-0080-8837 (RAI) 14.3-248
		0000-0081-7681 (RAI) 14.3-358, 14.3-359, 14.3-360
		0000-0080-4821 (RAI) 14.3-322, 14,3-371, 14.3-372

Enclosure 1

MFN 08-086, Supplement 17

Response to Portion of NRC Request for Additional Information Letter No. 126 Related to ESBWR Design Certification Application DCD Tier 1 RAI Numbers 14.3-157, 14.3-159, 14.3-248, 14.3-322, 14.3-358, 14.3-359, 14.3-360, 14.3-371 and 14.3-372

***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 5.**

RAI 14.3-157

NRC Summary:

Summary:Address inconsistency in the descriptions of acceptance criteria

NRC Full Text:

A review of DCD Tier 2, Revision 4, Sections 14.2.8.1.48 against DCD Tier 1, Revision 4, Section 2.10.3, and DCD Tier 2, Revision 4, Section 11.5.3.2.2 reveals an inconsistency in the descriptions of acceptance criteria.

Specifically, the test methods and acceptance criteria do not identify a test to demonstrate the proper closure of the isolation valve on high radioactivity levels. Accordingly, revise the acceptance criteria listed in DCD Tier 2, Revision 4, Section 14.2.8.1.48, to include a confirmation of system isolation on high radioactivity level signals.

GEH Response

DCD Tier 2, Revision 4, Section 14.2.8.1.48, General Test Methods and Acceptance Criteria, 4th bullet, notes that isolation features will be tested under expected operating conditions. This bullet will be revised as shown in the attached markup to be more specific concerning the high radiation output function.

DCD Impact

DCD Tier 2, Revision 4, Section 14.2.8.1.48, General Test Methods and Acceptance Criteria, 4th bullet, will be revised as shown on the attached markup.

RAI 14.3.159

NRC Summary:

Address inconsistency in the ITAAC applicability matrix and design description

NRC Full Text:

A review of DCD Tier 1, Revision 4, Section 2.2.15 and Table 2.2.15-1 against DCD Tier 2, Revision 4, Sections 11.5 and 14.2.8.1.16 reveals an inconsistency in the ITAAC applicability matrix and design description.

Specifically, Table 2.2.15-1 does not include IEEE Std 603 Criteria 6.1 and 7.1 for the PRMS as an applicable Tier 1 system. Criteria 6.1 and 7.1 address automatic controls, such as valve actuation and/or termination of releases on high radiation signals, required for safety-related equipment or in complying with Part 20 effluent concentration limits. Accordingly, revise DCD Tier 1, Table 2.2.15-1 to include Criteria 6.1 and 7.1 as being applicable to the PRMS system.

GEH Response

DCD Tier 1, Revision 4, Table 2.2.15-1, will be revised to include IEEE Std 603 Criteria 6.1 and 7.1 as being applicable to the PRMS system. Compliance with IEEE Std 603 is limited to PRMS functions required to limit dose to the public below accident level limits in 10CFR100 and does not apply to 10CFR20 dose rate limits to the public for normal operation. Transient and accident analyses establish the radiation monitoring functions that are required to limit doses to the public below 10CFR100 limits.

In addition, since some manual control functions may be performed as a result of PRMS alarms, DCD Tier 1, Revision 4, Table 2.2.15-1, will be revised to include IEEE Std 603 Criteria 6.2 and 7.2 as being applicable to the PRMS system.

DCD Impact

DCD Tier 1, Revision 4, Table 2.2.15-1, will be revised to include IEEE Std 603 Criteria 6.1 and 7.1 as being applicable to the PRMS system.

DCD Tier 1, Revision 4, Table 2.2.15-1, will be revised to include IEEE Std 603 Criteria 6.2 and 7.2 as being applicable to the PRMS system.

NRC RAI 14.3-248

NRC Summary:

Environmental qualification level of electrical equipment (including I&C)

NRC Full Text:

Per NRC guidance NUREG-0800, Section 14.3, it is stated that "Tier 1 should only deal with electrical equipment in harsh environments" Therefore it should be identified that the field equipment listed here should be harsh environmentally qualified.

GEH Response

NUREG-0800, Section 14.3 notes that qualification of SSCs for seismic and harsh environment is covered by the basic configuration ITAAC. Tier 1 should only deal with electrical equipment in harsh environments. Electrical equipment in a "mild" environment should be treated in Tier 2 only. An exception is made for I&C state-of-the-art digital equipment in "other than harsh" environment, which the I&C ITAAC should cover. Since some of this type equipment may be utilized in the electrical distribution systems, the I&C ITAAC should cover this potential.

GEH EQ process is consistent with NUREG-0800, Section 14.3. The ESBWR safety-related functions are integrated with safety-related electrical, I&C state-of-the-art digital equipment and mechanical equipment. The EQ process is also integrated. The EQ ITAAC therefore includes safety-related equipment in harsh environments and only the I&C state-of-the-art digital equipment located in mild environments.

DCD Impact

No DCD changes will be made in response to this RAI.

NRC RAI 14.3-322

NRC Summary:

TBV capacity

RC Full Text:

In Table 2.11.6-1, for clarity in ITAAC #3, the staff requests the applicant to clarify whether the analysis report in the AC includes review of TBV test data to confirm capacity is not greater than 15%. If so, the ITA should be revised to include testing or type testing (as applicable). The bracketed info should be explained.

GEH Response

Relevant TBV test data will be reviewed as part of the AC for item #6. The AC has been revised to show that these data will be reviewed.

Table 2.11.6-1 ITAAC AC #6 will be revised to state that no single TBV has a capacity greater than 15% of rated steam flow. AC #4 through #7 will be revised to eliminate bracketed material. DCD Tier 2 Section 10.4.4.1.2 will also be revised to incorporate this information.

DCD Impact

DCD Tier 1, Table 2.11.6-1 will be revised as shown on the attached markup.
DCD Tier 2, Section 10.4.4.1.2 “Non-Safety Power Generation Design Bases” will be revised as shown on the attached markup.

NRC RAI 14.3-358

NRC Summary:

RB refueling machine load capability

NRC Full Text:

For ITAAC Table 2.5.5-1, Item 3, the staff requests that the applicant provide clear criteria for successful performance of a load test (i.e., is there an industry standard that provides such criteria?)

GEH Response

The auxiliary hoist(s) on the refueling machine have the potential to lift "heavy" loads. Therefore, they will be load tested, as recommended by NUREG-0612 Section 5.1.1 "Special Lifting Devices". DCD Tier 1 Table 2.5.5-1item 3 will be revised to refer to the acceptance criteria of ANSI N14.6, 1993 "Standard for Special Lifting Devices for Shipping Containers Weighing (5 tons) or More for Nuclear Materials".

DCD Impact

DCD Tier 1 Table 2.5.5-1 item 3 will be revised as shown on the attached markup.

NRC RAI 14.3-359

NRC Summary:

FB fuel handling machine seismic qualification

NRC Full Text:

For ITAAC Table 2.5.5-1, Item 6, the staff requests the applicant to include a DC for seismic qualification of FB fuel handling machine. In addition, the staff requests that the applicant modify the ITA to clearly state that "inspections and analyses...will be performed."

GEH Response

DCD Tier 1 Table 2.5.5-1, DC items 2 and 6 and the corresponding design descriptions in Section 2.5.5 will be revised to show that both the FB fuel handling machine and the RB refueling machine are Seismic Category I. The ITA for items 2 and 6 will be revised to state that "inspections and analyses of the as-built system will be performed".

DCD Impact

DCD Tier 1 Table 2.5.5-1, items 2 and 6 and Section 2.5.5 will be revised as shown on the attached markup.

NRC RAI 14.3-360

NRC Summary:

FB fuel handling machine load capability

NRC Full Text:

For ITAAC Table 2.5.5-1, Item 7, the staff requests that the applicant provide clear criteria for successful performance of a load test (i.e., is there an industry standard that provides such criteria?)

GEH Response

There is no industry standard that is completely applicable to the auxiliary hoist(s) on the FB fuel handling machine. These hoists will not have the potential to handle heavy loads. The fuel handling machine auxiliary hoist(s) will be load tested to 125% of rated capacity in accordance with GEH practice.

DCD Impact

DCD Tier 1 Table 2.5.5-1 item 7 will be revised as noted in the attached markup

NRC RAI 14.3-371

NRC Summary:

Pressure boundary integrity for LWMS

NRC Full Text:
For ITAAC Table 2.10.1-2 Item 2: The staff requests that the applicant revise the AC report to (1) identify the components omitted from the test including the reason why the component was omitted from testing, and (2) document the reason the component was omitted from hydrostatic testing (e.g., the test would damage or interfere with a system component) and whether an alternative test (alternative to hydrostatic testing) was conducted to verify pressure boundary integrity. Otherwise, some components will be excluded from verification that they retain pressure boundary integrity.

GEH Response

DCD Tier 1 Table 2.10.1-2 will be revised to clarify that the LWMS piping systems will be hydrostatically pressure tested in conformance to the requirements in the API or ASME Code per Regulatory Guide 1.143, Revision 2. The ITAAC meets the recommendations of RG 1.143 Section 4.4 which states:

> *Piping systems should be hydrostatically tested in their entirety except (1) at atmospheric tanks where no isolation valves exist, (2) when such testing would damage equipment, and (3) when such testing could seriously interfere with other system or component testing. For (2) and (3), pneumatic testing should be performed. Pressure testing should be performed on as large a portion of the in-place systems as practicable. Testing of piping systems should be performed in accordance with applicable ASME or ANSI codes listed in Table 1.*

An assessment of any components that might be omitted from the hydrostatic test would be made when developing the test procedure for hydrotesting the system since the determination of appropriate alternate testing could only be made based on the specific system design configuration.

Pneumatic or manufacturer type testing would be examples of alternative testing that could be used to demonstrate system leak integrity.

DCD Impact

DCD Tier 1 Table 2.10.1-2 will be revised as noted in the attached markup.

NRC RAI 14.3-372

NRC Summary:

Treat mode alignment for LWMS

NRC Full Text:

For ITAAC Table 2.10.3-1 Item 4b: The staff requests that the applicant modify the AC to specifically define that the "treat mode alignment" means activation of an MCR alarm and gas will flow through the charcoal beds. An alternative is to provide a definition of the "treat mode alignment" in the design description for LWMS.

GEH Response

DCD Tier 1 Section 2.10.3 Design Description and Table 2.10.3-1 DC will be revised to define the "treat mode". DCD Tier 2 will also be revised to describe the treat mode as shown on the attached markup.

DCD Impact

DCD Tier 1 Section 2.10.3 Design Description and Table 2.10.3-1 DC will be revised as noted on the attached markup.

DCD Tier 2, Section 11.3.7 will be revised as noted on the attached markup.

Table 2.2.15-1

ITAAC Applicability Matrix [1]

	Applicable System (Tier 1 Subsection) [2]															
IEEE Std. 603 Criterion	NBS (2.1.2)	CRDS (2.2.2)	SLC System (2.2.4)	NMS (2.2.5)	RSS (2.2.6)	RPS (2.2.7)	LD&IS (2.2.12)	SSLC/ESF (2.2.13)	PRMS (2.3.1)	ICS (2.4.1)	GDCS (2.4.2)	CMS (2.15.7)	SPTM (2.15.7)	RBHVS (2.16.2.1)	CBHVS (2.16.2.2)	EFU (2.16.2.3)
5.1	-	-	-	X	-	X	X	X	-	X	X	-	-	X	X	X
5.2 and 7.3	-	-	-	-	-	X	X	X	-	-	-	-	-			
5.3	X	X	X	X	X	X	X	X	X	X	X	X	X	(3)	(3)	(3)
5.4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5.5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5.6 and 6.3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5.7 and 6.5	X	X	X	X	-	X	X	X	-	X	X	X	X	X	X	X
5.8	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5.9	-	-	-	X	X	X	X	X	-	-	-	-	-	-	-	-
5.10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5.11	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5.12	-	-	-	X	-	X	X	X	-	X	X	-	-	X	X	X
5.13	-	-	-	X	-	X	X	X	-	X	X	-	-	-	-	-
5.14	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5.15	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6.1 and 7.1	-	-	-	~~-~~X	-	X	~~-~~X	X	~~-~~X	-	-	-	-	X	X	X
6.2 and 7.2	-	-	-	~~-~~X	-	X	~~-~~X	X	~~-~~X	-	-	-	-	X	X	X
6.4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6.6 and 7.4	-	-	-	X	-	X	-	X	-	-	-	-	-	-	-	-
6.7, ~~and~~ 7.5, and 8.3	-	-	-	X	-	X	-	X	-	-	-	-	-	X	X	X
6.8	X	-	X	X	-	X	X	X	X	-	-	X	X	-	-	-
8.1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
8.2	-	X	-	-	-	-	X	-	-	X	X	-	-	X	X	X

(1) A dash means not-applicable.

(2) Safety-related portions only.

(3) No ITAAC is required for this criterion. See the description of the 10 CFR 50, Appendix B, Quality Assurance Program that is applied to the design, fabrication, construction, and test of the safety-related structures, systems, and components provided as part of the preliminary safety evaluation report as required by 10 CFR 50.34(a)(7).

2.5.5 Refueling Equipment

The ESBWR is supplied with a Reactor Building (RB) refueling machine for fuel movement and a fuel handling machine used for fuel servicing and transporting tasks in the Fuel Building (FB).

Design Description

The functional arrangement of the RB refueling machine is that it is a gantry-type crane that spans the reactor vessel cavity and fuel and storage pools to handle fuel and perform other ancillary tasks. It is equipped with a traversing trolley on which is mounted a telescoping mast and integral fuel grapple. The machine is a rigid structure built to ensure accurate and repeatable positioning during the refueling process.

The functional arrangement of the FB fuel handling machine is that it is equipped with a traversing trolley on which is mounted a telescoping mast and integral fuel grapple. The machine is a rigid structure built to ensure accurate and repeatable positioning while handling fuel.

(1) The functional arrangement of the RB refueling machine is as described in the Design Description of this Subsection 2.5.5.

(2) The RB refueling machine is classified as nonsafety-related, but is designed as seismic Category ~~II~~I.

(3) The RB refueling machine has an auxiliary hoist with sufficient load capability.

(4) The RB refueling machine is provided with controls interlocks.

(5) The functional arrangement of the FB fuel handling machine is as described in the Design Description of this Subsection 2.5.5.

(6) The FB fuel handling machine is classified as nonsafety-related, but is designed as seismic Category ~~II~~I.

(7) The FB fuel handling machine has an auxiliary hoist with sufficient load capability.

(8) The FB fuel handling machine is provided with controls interlocks.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.5.5-1 provides a definition of the inspection, test, and/or analyses, together with associated acceptance criteria for the refueling machine.

Table 2.5.5-1 ITAAC for Refueling Machine		
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 system will be performed.	Report(s) document that the as-built RB refueling machine conforms to the functional arrangement as described in the Design Description of the Subsection 2.5.5.
2. The RB refueling machine is classified as nonsafety-related, but is designed as seismic Category ~~II~~I.	Inspections and/~~or~~ analyses of the as-built system will be performed.	Report(s) document that 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.	Report(s) document that a successful load test of each as-built auxiliary hoist has been performed in accordance with ANSI N14.6, 1993..

Table 2.5.5-1

ITAAC for Refueling Machine

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4. The RB refueling machine is provided with controls interlocks	Test shall be performed with actual or simulated signals to demonstrate that the as-built interlocks function as required.	Report(s) document that the tests have been completed and results demonstrate that the as-built interlocks function as follows:a. Prevent hoisting a fuel assembly over the vessel with a control rod removed; b. Prevent collision with fuel pool walls or other structures; c. Limit travel of the fuel grapple; d. Interlock grapple hook engagement with hoist load and hoist up power; and e. Ensure correct sequencing of the transfer operation in the automatic or manual mode
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/or analyses of the as-built system will be performed.	Report(s) document that the as-built FB fuel handling machine conforms with 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~~I.	Inspections and/~~or~~ analyses of the as-built system will be performed.	Report(s) document that the as-built FB fuel handling machine can withstand seismic dynamic loads without loss of load carrying or structural integrity functions.

Table 2.5.5-1

ITAAC for Refueling Machine

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
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.	Report(s) document that 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 interlocks.	Test will be performed with actual or simulated signals to demonstrate that the as-built interlocks function as required.	Report(s) document that the tests have been completed and results demonstrate that the required interlocks function as follows: a. Prevent collision with fuel pool walls or other structures; b. Limit travel of the fuel grapple; c. Interlock grapple hook engagement with hoist load and hoist up power; and d. Ensure correct sequencing of the transfer operation in the automatic or manual mode.

Table 2.10.1-2

ITAAC For The Liquid Waste Management System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the LWMS is as described in Subsection 2.10.1.	Inspections of the as-built system will be performed.	Reports document that the as-built LWMS conforms to the functional arrangement description in the Design Description of this Subsection 2.10.1.
2. The LWMS piping systems retain their pressure boundary integrity under internal pressures that will be experienced during service.	A hydrostatic test in accordance with ASME/ANSI B31.3 will be conducted on those Code components of the LWMS piping systems, except (1) at atmospheric tanks where no isolation valves exist, (2) when such testing would damage equipment, and (3) when such testing could seriously interfere with other system or component required to be hydrostatically tested by the API or ASME Code per Regulatory guide 1.143 Revision 2.	The reports document- that the results of the hydrostatic test of the ASME Code components of the LWMS piping systems in accordance with ASME/ANSI B31.3 conform with the requirements in the API or ASME Code per Regulatory Guide 1.143 Revision 2 indicate no unacceptable pressure boundary leakage.
3. LWMS discharge flow ~~to circulating water~~ is monitored for high radiation. A radiation monitor provides an automatic closure signal to the discharge line isolation valve. Discharge flow is terminated on receipt of a high radiation signal from this monitor.	a. 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. b. Inspections will be conducted to confirm that the as-built indication, alarm, and automatic initiation functions are met. ~~Tests will be conducted on the as-built LWMS using a simulated high radiation signal~~.	Reports document that the discharge flow terminates upon receipt of a simulated high radiation signal.

2.10.3 Gaseous Waste Management System

Design Description

The gaseous waste management system processes and controls the release of gaseous radioactive effluents to the environs. The OGS system is designed to process gaseous wastes and ensuring compliance with Part 20 effluent concentration and dose limits, and Part 50, Appendix I dose objectives for gaseous effluents when the plant is operational. The Offgas System (OGS) is the principal gaseous waste management subsystem. The various building HVAC systems perform other gaseous waste functions.

The functional arrangement of the OGS is that the process equipment is housed in a reinforced-concrete structure to provide adequate shielding. Charcoal absorbers are installed in a temperature monitored and controlled vault. The facility is located in the Turbine Building. The OGS provides for holdup, and thereby, decay of radioactive gases in the offgas from the main condenser air removal system and consists of process equipment along with monitoring instrumentation and control components. The OGS includes redundant hydrogen/oxygen catalytic recombiners and ambient temperature charcoal beds to provide for process gas volume reduction and radionuclide retention/decay. The OGS processes the main condenser air removal system discharge during plant startup and normal operation before discharging the air flow to the plant stack.

Control and monitoring of the OGS process equipment is performed both locally and remotely from the main control room.

(1) The functional arrangement of the OGS is as described in Subsection 2.10.3.

(2) The OGS is designed to withstand internal hydrogen explosions.

(3) Leakage from the process through purge or tap lines to external atmospheric pressure is sufficiently low so it is undetectable by "soap bubble" test.

(4) The OGS automatically controls the OGS flow bypassing or through the charcoal adsorber beds depending on the radioactivity levels in the OGS process gas downstream of the charcoal beds. Normal operation of the OGS shall take place in the treat mode. The treat mode provides for an alignment to send process flow through one guard bed and all the remaining charcoal absorbers.

(5) The OGS minimizes and controls the release of radioactive material into the atmosphere by delaying release of the offgas process stream initially containing radioactive isotopes of krypton, xenon, iodine, nitrogen, and oxygen. This delay, using activated charcoal absorber beds, is sufficient to achieve adequate decay before the process offgas stream is discharged from the plant.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.10.3-1 provides a definition of the inspections, tests, and/or analyses, together with associated acceptance criteria for the Gaseous Waste Management System. ITAAC for the off-gas post-treatment radiation monitor, part of the process radiation monitoring system, also are located in Table 2.3.1-2.

Table 2.10.3-1

ITAAC For The Gaseous Waste Management System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4. The OGS automatically controls the OGS flow bypassing or through the charcoal adsorber beds depending on the radioactivity levels in the OGS process gas downstream of the Charcoal Beds. Normal operation of the OGS shall take place in the treat mode. The treat mode provides for an alignment to send process flow through one guard bed and all the remaining charcoal absorbers.	Tests will be performed as follows: A standard raditation source or portable calibration unit that exceeds a setpoint value that is preset for the testing will provide.	Test reports document that:
	a. A simulated high charcoal gas discharge radioactivity signal that will give a Main Control Room (MCR) alarm.	a. Main Control Room alarm activates on an OGS discharge line high radiation signal.
	b. ~~When the OGS process gas flow is bypassing the main charcoal beds, a~~A simulated high-high charcoal gas discharge radioactivity signal when the OGS process gas flow is bypassing the main charcoal beds and will give a MCR alarm and direct the gas flow through the charcoal beds.	b. The OGS charcoal bed valves operate in the main adsorber "treat" mode alignment on a high-high OGS discharge radioactivity signal.
	c. ~~When~~ Aa simulated OGS gas discharge radioactivity signal that closes the off-gas system discharge valve when the signal reaches a high-high-high level~~, the off-gas system discharge valve will close~~.	c. The OGS discharge valve closes on a high-high-high OGS discharge radioactivity signal.

Table 2.11.6-1

ITAAC For The Turbine Bypass System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement for the TBS is described in Subsection 2.11.6.	Inspections of the as-built TBS will be conducted.	A report exists and concludes that the as-built TBS conforms to the functional arrangement described in Subsection 2.11.6.
2. The TBVs are controlled by signal(s) from the SB&PC System.	Tests will be conducted using a simulated signal(s).	A test report exists and confirms that the TBVs operate upon receipt of simulated signal(s) from the SB&PC System.
3. The TBS steam pressure retaining and structural components are analyzed to demonstrate structural integrity under SSE loading conditions.	An inspection of the as-built TBS will be performed to verify that it conforms with the seismic analysis.	An inspection report exists and concludes that the as-built TBS can withstand a SSE without loss of structural integrity.
4. The TBS accommodates steam flow to mitigate Abnormal Events.	An inspection will be performed to confirm that the as-built TBS accommodates steam flow to mitigate Abnormal Events.	An inspection report exists and concludes that the TBS accommodates at least [110%] of rated main steam flow.
5. The TBS maintains sufficient capacity to mitigate Abnormal Events with a single active failure.	An inspection will be performed to confirm that the as-built TBS maintains sufficient capacity to mitigate Abnormal Events with a single active failure.	An inspection report exists and confirms that the TBS maintains capacity greater than or equal to [50%] of the maximum capacity for a period greater than or equal to [6 seconds] with a single active failure.
6. The TBS design limits the capacity of individual TBVs.	A design analysis of the TBS will be performed to confirm that the TBS design limits the capacity of individual TBVs.	An analysis report <u>and test data</u> exists and concludes that no single TBV has a capacity greater than [15%] of rated steam flow.

Table 2.11.6-1

ITAAC For The Turbine Bypass System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7. The TBS design allows the TBVs to open rapidly to support Abnormal Event mitigation.	Testing and/or analyses of the TBS will be performed to confirm that the as-built TBS design allows the TBVs to open rapidly to support Abnormal Event mitigation.	A test and/or analysis report exists and concludes that the TBS can achieve a flow greater than or equal to {80%} of total bypass capacity in a time period less than or equal to {0.17} seconds after initiation of TBV fast opening function.

10.4.4.1.2 Non-Safety Power Generation Design Bases

- The TBS has a minimum design capacity of greater than or equal to 110% of the rated main steam flow.
- The TBS is designed to bypass steam to the main condenser during plant startup and to permit a normal cooldown of the reactor from a hot shutdown condition to a point appropriate for the transition to shutdown cooling operation.
- The TBS is designed, in conjunction with other reactor systems, to provide for a full load rejection or turbine trip without lifting of the reactor SRVs and without reactor trip.
- No single failure can disable more than 50% of the installed bypass capacity.
- No single turbine bypass valve has a capacity greater than 15% of rated steam flow.
- The TBS is designed for a minimum operation time of 6 seconds after a loss of preferred power.
- The time for bypass flow to achieve 80% of total capacity after the start of turbine stop valve closure or turbine control valve fast closure is less than or equal to 0.17 seconds.

10.4.4.2 Description

10.4.4.2.1 General Description

The TBS in the ESBWR standard plant design comprises Turbine Bypass Valves (TBVs) connected to the TMSS Main Steam Lines via TMSS system piping. The outlets of TBVs are connected to the Main Condenser via pressure reducers. The system and its components are shown in Figure 10.3-1.

The TBS, in combination with the reactor systems, provides the capability to shed 100% of the TG rated load without the operation of SRVs and without reactor trip.

The SB&PC, which controls the TBS, is provided with an uninterruptible redundant power source. The worst case of an AOO with a single failure would result in a loss of no more than 50% of bypass capacity. The TBS has a minimum design capacity of greater than or equal to 110% of rated main steam flow. Failure of a single TBV to open does not result in a system capacity less than 100% of rated main steam flow.

10.4.4.2.2 Component Description

Each bypass valve is operated by hydraulic fluid pressure with spring action to close. The valve assembly includes hydraulic supply and drain piping, hydraulic accumulator(s), servo valve(s), fast acting solenoid valve(s), and valve position transmitters.

The turbine bypass valves are operated by the turbine hydraulic fluid power unit. It is possible to isolate the high pressure fluid to the turbine valves while supplying hydraulic fluid to the bypass valves. High pressure hydraulic fluid is provided to the valve actuators and is drained back to the fluid reservoir.

detailed below to evaluate this accident. The accident parameters are shown in Table 11.3-4. The results are presented in Tables 11.3-6 and 11.3-7 and show the ESBWR design to be compliant with the requirements of the BTP.

The system is designed to be detonation resistant and seismic per Table 3.2-1 and meets all criteria of RG 1.143 (Reference 11.3-3). As such, the failure of a single active component leading to a direct release of radioactive gases to the environment is highly unlikely. Therefore, inadvertent operator action with bypass of the delay charcoal beds is analyzed for compliance to BTP 11-5. A top-level diagram of the ESBWR OGS can be found in Figure 11.3-1 that shows the ESBWR charcoal beds consist of ten charcoal tanks. The first and second, or guard tanks contain charcoal followed by a flow split into two lines, each line of which leads through four massive tanks, each containing charcoal. The normal operation of the OGS shall take place in the treat mode. The treat mode shall provide a valve alignment to send a process flow through one guard bed and all the remaining charcoal adsorbers. Bypass valves exist to direct flow around (1) one active and one standby guard tank, (2) two parallel streams of follow-on tanks, or (3) one guard bed and the two parallel streams of follow-on tanks. To bypass either pathway (1) or (2) above requires the operator to enter a computer command with a required permissive. To bypass all tanks requires the operator to key in the command with two separate permissives. Because the bypass of all tanks would require both inadvertent operation upon the operator (keying in the wrong command) plus getting two specific permissives for the incorrect decisions, it is assumed not likely to occur. Downstream of the charcoal beds shown on Figure 11.3-1 are a series of two redundant radiation monitoring instruments and an air-operated isolation valve. Upon receiving a Hi signal, the system alarms in the MCR. A Hi-Hi signal causes the system to automatically re-align to process offgas flow through both the guard beds and the charcoal beds. Therefore, bypass of the charcoal beds during periods with significant radioactive flow through the OGS are limited and/or automatically terminated by actuation of the downstream sensors. A Hi-Hi-Hi signal isolates flow through the OGS.

To evaluate the potential radiological consequences of an inadvertent bypass of the charcoal beds, it was assumed that operator error or computer error has led to the bypass of the eight follow-on beds in addition to the failure of the automated air-operated downstream isolation valve. It is also assumed that during this period, the plant is running at, and continues to run at, the maximum permissible offgas release rate based upon the assumption of 100 μCi/sec/MWt as stipulated in Standard Review Plan 11.3 (Reference 11.3-18) evaluated to a decay time of 30 minutes from the vessel exit nozzle. Even with the failure of the downstream isolation valve, it is not anticipated or assumed that the isolation instrumentation would fail, but would instead alarm the control room with a high radiation alarm, causing the operator to manually isolate the OGS (i.e., close suction valves) within 1 hour of the alarm.

Therefore, this analysis differs from the BTP on the following points:

- There is no motive force to remove any significant inventory from the eight follow-on charcoal tanks while in bypass and, therefore, no activity from these tanks is included in the final release calculations.
- With redundant instrumentation, it is expected that operator intervention to either shut off the bypass or isolate the OGS is predicted to occur within1 hour. Therefore, the total flow from the system is evaluated for 1-hour and not the 2-hour period stipulated in BTP 11-5 (Reference 11.3-18).

- Proper system flow paths, flow rates and pressures; and
- Proper operation of system interlocks and equipment protective devices.

14.2.8.1.47 Condenser Air Removal System Preoperational Test

Purpose

The objective of this test is to verify the ability of the mechanical vacuum pumps and steam jet air ejectors to establish and maintain vacuum in the main condenser as designed. The test of the steam jet air ejectors is performed in conjunction with offgas system described in Subsection 14.2.8.1.48.

Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and approved the initiation of testing. Additionally, instrument air, electrical power, cooling water, turbine gland sealing steam, and other required system interfaces shall be available, as needed, to support the specified testing.

General Test Methods and Acceptance Criteria

Performance shall be observed and recorded during a series of individual component and integrated system tests. The test demonstrate the mechanical vacuum pump operates as designed through the following testing:

- Proper operation of instrumentation and equipment in appropriate design combinations of logic and instrument channel trip;
- Proper functioning of instrumentation and alarms used to monitor system operation and availability;
- Proper operation of the mechanical vacuum pumps, if condenser integrity and auxiliary systems permit, including the ability to establish the required vacuum within the design time frame;
- Proper operation of remote-operated valves, including position indications; and
- Proper operation of the mechanical vacuum pump trip function and its discharge valve closure on simulated main steam line radiation signal.

14.2.8.1.48 Offgas System Preoperational Test

Purpose

The objective of this test is to verify proper operation of the offgas system, including steam jet air ejectors, valves, recombiner, condensers, coolers, filters, and hydrogen analyzers.

Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and approved the initiation of testing. Additionally, instrument air, electrical power, cooling water, turbine gland sealing steam, auxiliary boiler system and other required system interfaces shall be available, as needed, to support the specified testing.

General Test Methods and Acceptance Criteria

Performance shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

- Proper operation of instrumentation and equipment in appropriate design combinations of logic and instrument channel trip;
- Proper functioning of instrumentation and alarms used to monitor system operation and availability;
- Proper operation of the steam jet air ejectors, including their ability to maintain the specified vacuum in the main condenser (while accounting for the source of the driving steam used);
- Proper operation of system valves, including isolation features, under expected operating conditions;, including isolation of the off-gas system discharge valve upon receipt of high radioactivity level signals;
- Proper operation of components in all design operating modes;
- Proper system and component flow paths and flow rates;
- Proper operation of interlocks and equipment protective devices;
- Proper operation of permissive, prohibit, and bypass functions; and
- Proper operation of the isolation valve closure of the offgas system on the simulated low steam flow signal.

14.2.8.1.49 Condensate Storage and Transfer System Preoperational Test

Purpose

The objective of this test is to verify the ability of the Condensate Storage and Transfer System to provide an adequate reserve of condensate quality water for makeup to the condenser, CRD, RWCU/SDC system, Fuel Pool system and for other uses as designed.

Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and approved the initiation of testing. Required interfacing systems shall be available, as needed, to support the specified testing.

General Test Methods and Acceptance Criteria

Performance shall be observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

- Proper operation of instrumentation and equipment in appropriate design combinations of logic;
- Proper functioning of permissive and prohibit interlocks;
- Proper operation of the condensate storage and transfer pumps;