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MFN 08-086, Supplement 19

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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 126 Related to ESBWR Design Certification Application, DCD Tier 1, RAI Numbers 14.3-155, 14.3-156, 14.3-158, 14.3-161, 14.3-239, 14.3-267, 14.3-365, 14.3-366, 14.3-367 and 14.3-369**

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). RAI Numbers 14.3-155, 14.3-156, 14.3-158, 14.3-161, 14.3-239, 14.3-267, 14.3-365, 14.3-366, 14.3-367 and 14.3-369 are addressed in Enclosure 1.

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 Robert E. Brown, *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 14.3-155, 14.3-156, 14.3-158, 14.3-161, 14.3-239, 14.3-267, 14.3-365, 14.3-366, 14.3-367 and 14.3-369

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	0000-0081-8247	NRC RAI 14.3-155
		0000-0081-8258	NRC RAI 14.3-156
		0000-0081-8274	NRC RAI 14.3-158
		0000-0081-8332	NRC RAI 14.3-161
		0000-0080-4272	NRC RAI 14.3-239
		0000-0080-7365	NRC RAI 14.3-267
		0000-0082-3186	NRC RAI 14.3-365
		0000-0080-8462	NRC RAI 14.3-366
		0000-0080-8462	NRC RAI 14.3-367
		0000-0080-8462	NRC RAI 14.3-369

Enclosure 1

MFN 08-086, Supplement 19

*Response to Portion of NRC Request for

Additional Information Letter No. 126

Related to ESBWR Design Certification Application

DCD Tier 1

RAI Numbers 14.3-155, 14.3-156, 14.3-158, 14.3-161, 14.3-239, 14.3-267, 14.3-365, 14.3-366, 14.3-367 and 14.3-369

***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.**

NRC RAI 14.3-155

NRC Summary:

Descriptions and scope of operational tests do not define "simulated radiation signal" used in confirming the operational functions of the PRMS

NRC Full Text:

In DCD Tier 2, Revision 4, Sections 14.2.2.2, 14.2.8.1.16, 14.2.8.2.1, and DCD Tier 1, Revision 4, Sections 1.1.1, 2.3.1, and 3.5, the descriptions and scope of operational tests do not define "simulated radiation signal" used in confirming the operational functions of the process radiation monitoring system (PRMS). There are many ways in generating a simulated radiation signal, such as using a simple jumper wire to using a pulse generator. In both instances, the simulated signal does not include a functional test of the radiation detector, which is the essential component of the PRMS that responds to radiation or radioactivity. For example, the use of a jumper wire simply trips the circuit logic and the use of a simulated signal does ensure that the artificial pulse matches that of the output of the detector, e.g., such as proper pulse height and duration. It can be shown that a pulse generator might generate a signal that would trip a response (e.g., at control panel alarms and system isolation) of a PRMS subsystem, and yet be inconsistent with the pulse produced by the radiation detector. The use of a simulated radiation signal might not necessarily confirm the proper response from a PRMS subsystem, taking into account various as built conditions, such as actual cabling configuration, onsite power, containment penetrations and connections, signal conversions to/from fiber optic output, ambient background count-rates, etc.

While it is recognized that the PRMS will be supplied with vendor quality assurance test certifications, such certifications do not confirm that PRMS equipment has not been damaged during shipment from the vendor to the construction site, proper installation, and validity of post-construction tests. In the context of the operational testing of the PRMS, the design commitment described in DCD Tier 1, Section 2.3.1 should use the same types of radioactive calibration sources that are called for in DCD Tier 2, Revision 4, Section 14.2.8.1.16, in demonstrating compliance with PRMS ITAACs. This approach would confirm that the PRMS is designed and operates in accordance with design commitments and would provide reasonable assurance in complying with (a) Part 52.47(b)(1); (b) Part 20, Appendix B, Table 2 effluent concentrations limits; (c) Part 20.1301 and 20.1302 dose limits to members of the public; and (d) limiting conditions for operation of Section IV of Appendix I to Part 50.

Accordingly, update the scope of the operational tests described in DCD Tier 2, Section 14.2.8.1.16 and design descriptions and commitments of DCD Tier 1, Section 2.3.1 and Table 2.3.1-2 to confirm that the implementation of PRMS ITAACs will ensure compliance with NRC regulatory requirements.

GEH Response

DCD Tier 1, Revision 4, Table 2.3.1-2, ITAAC #4, will be revised to indicate that a standard radiation source or portable calibration unit will be used for testing. This update requires the same calibration and testing as noted in DCD Tier 2, Revision 4, Section 14.2.8.1.16.

DCD Impact

DCD Tier 1, Table 2.3.1-2, ITAAC #4, will be revised as shown in the attached markup.

NRC RAI 14.3-156

NRC Summary:

Address inconsistencies in design descriptions and commitments for two radiation monitor subsystems of the PRMS.

NRC Full Text:

In DCD Tier 2, Revision 4, Sections 14.2.8.1.16, 14.2.8.1.40, and 14.2.8.1.48, and DCD Tier 1, Revision 4, Sections 2.3.1, 2.10.1 and 2.10.3, there are inconsistencies in the design descriptions and commitments for two PRMS radiation monitor subsystems. Specifically, address the following:

a. In DCD Tier 1, Revision 4, Section 2.3.1 and Table 2.3.1-1, the ITAAC for this PRMS radiation monitor requires that its presence be confirmed by inspection; however, an ITAAC is included for it in DCD Tier 1, Revision 4, Section 2.10.1 and Table 2.10.1-2 for the liquid waste management system (LWMS). The PRMS liquid radwaste discharge radiation monitor trips an isolation function of the LWMS discharge valve upon detecting high levels of radioactivity in this effluent stream. Given that the liquid radwaste discharge radiation monitor is part of the PRMS and not part of the LWMS, the design descriptions and commitments given in DCD Tier 1, Revision 4, Section 2.3.1 and Table 2.3.1- 1 should identify an operational interface with the ITAACs identified in DCD Tier 1, Section 2.10.1 for the LWMS.

b. A similar operational system interface should be identified for the OGS post-treatment radiation monitor listed in DCD Tier 1, Revision 4, Section 2.3.1, Table 2.3.1-1 with design descriptions and commitments identified for the OGS described in DCD Tier 1, Section 2.10.3. The offgas system (OGS) Post-treatment radiation monitor trips an isolation function of the OGS isolation valve upon detecting high levels of radioactivity in this process gas stream. Given that this radiation monitor is part of the PRMS and not part of the OGS, the design descriptions and commitments given in DCD Tier 1, Revision 4, Section 2.3.1 and Table 2.3.1-1 should identify an operational interface with the ITAACs identified in DCD Tier 1, Section 2.10.3 for the gaseous waste management system (GWMS)/OGS.

Accordingly, identify all applicable PRMS operational system interfaces and revise the scope of design descriptions and commitments of DCD Tier 1, Section 2.3.1 for consistency with that of DCD Tier 1, Sections 2.10.1 and 2.10.3.

GEH Response

a. DCD Tier 1, Revision 4, Figure 2.3.1-1 and Table 2.3.1-1 identify the interface with the Liquid Waste Management System (LWMS). The liquid radwaste discharge radiation monitor is identified as Monitor 11 in the referenced Table and Figure. Table 2.3.1-2 identifies the ITAAC supporting the nonsafety-related process radiation monitors.

Section 2.10.1, Inspections, Tests, Analyses and Acceptance Criteria, will be revised to denote the ITAAC interface with Section 2.3.1, Table 2.3.1-2.

Table 2.10.1-2, ITAAC 3, will be revised to indicate Inspections, Tests, and Analysis requirements consistent with Table 2.3.1-2, ITAAC 7, as noted in our response to *RAI 14.3-161.

b. DCD Tier 1, Revision 4, Figure 2.3.1-1 and Table 2.3.1-1 identify the interface with the Off-Gas System (OGS). This post-treatment OGS radiation monitor is identified as Monitor 9 on the referenced Table and as Monitors 9A/9B on the referenced Figure. Table 2.3.1-2 identifies the ITAAC that supports the nonsafety-related process radiation monitors.

Section 2.10.3, Inspections, Tests, Analyses and Acceptance Criteria, will be revised to denote the ITAAC interface with Section 2.3.1, Table 2.3.1-2.

Table 2.10.3-1, ITAAC 4, Inspections, Tests, Analyses and Acceptance Criteria, will be revised to indicate Inspections, Tests, and Analysis requirements consistent with Table 2.3.1-2, ITAAC 7, as noted in our response to *RAI 14.3-161.

*Please note that RAI 14.3-161 is contained in this letter (MFN 08-086, Supplement 19)

DCD Impact

DCD Tier 1, Sections 2.3.1, 2.10.1, 2.10.3 and Tables 2.10.1-2 and 2.10.3-1 will be revised as shown in the attached markups.

NRC RAI 14.3-158

NRC Summary:

Address inconsistency in the descriptions of the design description

NRC Full Text:

A review of DCD Tier 1, Revision 4, Section 2.3.1 against DCD Tier 2, Revision 4, Sections 11.5 and 14.2.8.1.16 reveals an inconsistency in design descriptions. Specifically, the design description of DCD Tier 1, Section 2.3.1(4) does not list valve actuation and/or termination of releases on high radiation signals. Accordingly, revise the design description listed in DCD Tier 1, Section 2.3.1(4) to include confirmation of system isolation or termination of release on high radioactivity level signals.

GEH Response

DCD Tier 1, Revision 4, Section 2.3.1, Process Radiation Monitoring System, Design Description, first paragraph, notes that the PRMS "initiates protective actions." Such protective actions include all protective actions provided by the PRMS, not just valve actuation and/or termination of releases on high radiation signals. This includes inputs to the LD&IS, in DCD Tier 1, Revision 4, Section 2.2.12, which in turn performs some protective actions based upon these inputs from PRMS.

GEH agrees with the addition of the automatic initiation functions to ITAAC 2.3.1-2, Item 4; through the addition of wording to Table 2.3.1-2, ITAAC 4. This ensures that all protective actions and safety functions as noted in Table 2.3.1-1 are tested. We also will add the emergency air filtration system fan starting to Table 2.3.1-1, Item 4A/4B, for the control building air intake HVAC in the safety function column as an additional initiation function.

DCD Impact

DCD Tier 1, Tables 2.3.1-1 and 2.3.1-2 will be revised as shown in the attached markups.

NRC RAI 14.3-161

NRC Summary:

Provide ITAACs for PRMS subsystems that are used to comply with Part 20 Appendix B, Table 2 liquid and gaseous effluent concentration limits.

NRC Full Text:

DCD Tier 1, Revision 4, Section 2.3.1 does not include ITAACs assigned to PRMS subsystems that are used to monitor compliance with Part 20, Appendix B, Table 2 liquid and gaseous effluent concentration limits. The lack of ITAACs for non safety-related, but yet essential subsystems used in demonstrating compliance with Part 20 is not consistent with the criteria and application process described in DCD Tier 2, Revision 4, Section 14.3.7.3 on design features used to comply with NRC regulations. Accordingly, revise DCD Tier 1, Section 2.3.1 to include the necessary ITAACs for all PRMS subsystems that are used to monitor, control, and terminate radioactive effluent releases to the environment.

GEH Response

DCD Tier 1, Revision 4, Table 2.3.1-2 will be revised to include ITAACs for nonsafety-related radiation monitors that are included in the plant to actively/automatically control offsite doses below 10CFR20 limits, as required in DCD Tier 2, Revision 4, Section 14.3.7.3(1)b(iii).

DCD Impact

DCD Tier 1, Table 2.3.1-2 will be revised by adding ITAAC #7 to address non-safety related PRMS subsystems that are used to monitor, control and terminate radioactive effluent releases to the environment.

NRC RAI 14.3-239

NRC Summary:

Suppression pool hydrodynamic loads on as built submerged structures should be verified

NRC Full Text:

NRC RAI 6.2-164 - Supplement 1 states the following:

In response to RAI 6.2-164, GEH provided reference to structures response to containment loads. The staff, however, cannot find details of the analysis for the submerged structures. In particular, the staff is concerned with the ability of the PCCS vent pipe to withstand postulated hydrodynamic loads and maintain its submergence depth, which is an essential condition for the long term containment cooling. Please indicated if such an analysis was performed and provide an appropriate reference

Please add an item to DCD Tier 1, Revision 4, Table 2.15.4-2 providing an ITAAC to verify such suppression pool hydrodynamic loads on as-built submerged structures.

GEH Response

GEH's response to RAI 6.2-164S01 in Letter, MFN 08-082 dated March 5, 2008 responded to this RAI concern. The addition of ITAAC described in response to RAI 6.2-164 S01 satisfies the request for PCCS submerged piping load analysis.

Therefore, addition of an ITAAC in DCD Tier 1 Table 2.15.4-2 is not required.

DCD Impact

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

NRC RAI 14.3-267

NRC Summary:

IEEE 603 Compliance

NRC Full Text:

Please provide justification where analysis is used in lieu of test to show compliance with IEEE Std. 603-1991, 5.4 Equipment Qualification.

GEH Response

IEEE Std 603 notes "Safety system equipment shall be qualified by type test, previous operating experience, or analysis, or any combination of these three methods, to substantiate that it will be capable of meeting, on a continuing basis, the performance requirements as specified in the design basis."

The use of analysis will be included and explained in EQ documentation for specific equipment.

See ITAAC Table 3.8-1 for Environmental Qualification of Mechanical and Electrical Equipment.

DCD Impact

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

NRC RAI 14.3-365

NRC Summary:

Main control room alarms

NRC Full Text:

For ITAAC Table 2.6.1-2 Item 4, the staff requests that the applicant consider rewording DC from "Control room features" to "main control room alarms" for consistency with Table 2.6.1-1. The staff suggests reword of AC for consistency also.

GEH Response

GEH agrees with the suggestion. "Control room features" will be reworded to include "Main Control Room (MCR) alarms and remote operation features of mechanical equipment".

DCD Tier 1, Subsection 2.6.1(4) and DCD Tier 1, Table 2.6.1-2, ITAAC 4 will be revised accordingly as indicated in the attachments.

DCD Impact

DCD Tier 1, Section 2.6.1(4) and Table 2.6.1-2 will be revised as attached.

NRC RAI 14.3-366

NRC Summary:

FAPCS compliance with ASME Code requirements

NRC Full Text:

For ITAAC Table 2.6.2-2, Item 2, the DC specifies design and construction in accordance with ASME Code Section III requirements, however, the AC only specifies a design report. The staff requests that the applicant expand the AC to include appropriate verification for the as-built system also. In addition, the ITA should be clarified as the as-built system is not expected to be documented in the design report. The applicant needs to ensure consistency between the associated DC, ITA, and AC.

GEH Response

RAI 14.3-390 (See MFN 08-086, Supplement 3, dated February 15, 2008) has addressed the difference in content between the DC and AC ITAAC Table 2.6.2-2.

DCD Impact

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

NRC RAI 14.3-367

NRC Summary:

Hydrostatic testing for FAPCS

NRC Full Text:

For ITAAC Table 2.6.2-2, Item 4, the DC refers to piping and components, however the ITA and AC refer only to components. The staff requests that the applicant ensure consistency among the associated DC, ITA, and AC (i.e., modify ITA and AC to include piping). In addition, the staff requests clarification of "a hydrostatic or pressure test" phrase used in the ITA. The staff discerns no need for a distinction when ASME Code Section III requirements are applied. Likewise, use of the term "pressure test" in the AC should be clarified or modified to be consistent with the ITA.

GEH Response

GEH Agrees. DCD Tier 1 Table 2.6.2-2, Item 4 will be revised as follows:

a) Change the ITA from "A hydrostatic or pressure test..." to "A pressure test..."

RAI 14.3-390 (See MFN 08-086, Supplement 3, dated February 15, 2008) has modified the ITA and AC to include piping.

DCD Impact

DCD Tier 1, Table 2.6.2-2 will be revised as noted in the attached markup.

NRC RAI 14.3-369

NRC Summary:

FAPCS suppression pool cooling mode

NRC Full Text:

For ITAAC Table 2.6.2-2, Item 7a), the ITA specifies the performance of a test for the flow path, however, the AC is implies that capacity is confirmed. The staff requests that the applicant modify the ITA to include a confirmation of capacity and revise the AC to include the flow rate criteria for acceptance.

GEH Response

GEH agrees. The AC of DCD Tier #1 Table 2.6.2-2, Item 7a) will be changed by the addition of "The flowrate is $\geq$ 545.1 m^3/hr."

DCD Impact

DCD Tier 1, Table 2.6.2-2, Item 7a will be revised as noted in the attached markup.

Table 2.3.1-2

ITAAC For The Process Radiation Monitoring System

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

2.3 RADIATION MONITORING SYSTEMS

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

2.3.1 Process Radiation Monitoring System

Design Description

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

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

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

b. The safety-related PRMS subsystems identified in Table 2.3.1-1 have electrical divisional separation.

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

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

a. Indications in MCR for radiation levels

b. Indications on SCUs for radiation levels

c. Alarms in MCR on radiation level exceeding setpoint

d. Indications on SCUs on radiation level exceeding setpoint.

e. Alarms in MCR on upscale/downscale or inoperative conditions.

f. Initiation of protective actions as noted in Table 2.3.1-1

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

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

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

Inspections, Tests, Analyses and Acceptance Criteria

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

2.10 RADIOACTIVE WASTE MANAGEMENT SYSTEM

2.10.1 Liquid Waste Management System

Design Description

The ESBWR Liquid Waste Management System (LWMS) is designed to control, collect, process, handle, store, and dispose of liquid radioactive waste generated as the result of normal operation, including anticipated operational occurrences. The LWMS is designed to process liquid prior to release and ensure compliance with Part 20 effluent concentration and dose limits, and Part 50, Appendix I dose objectives for liquid effluents when the plant is operational.

The LWMS neither performs nor ensures any safety-related function, and is not required to achieve or maintain safe shutdown.

The functional arrangement of the LWMS is that it has components in four subsystems which receive and store radioactive or potentially radioactive liquid waste. The four LWMS subsystems are as follows:

- Equipment (low conductivity) drain subsystem;
- Floor (high conductivity) drain subsystem;
- Chemical drain subsystem; and
- Detergent drain subsystem.

Table 2.10.1-1 describes the major components in each of these four subsystems. Other equipment includes piping, pumps, and valves for transferring the process flow. The LWMS processing equipment is located in the Radwaste Building. ~~The permanent LWMS will connect to non-permanent mobile systems that process radioactive waste (actual mobile system unit operations and chemical reactors may differ based on improvements in radwaste technology).~~ The LWMS is operated and monitored from the Radwaste Building Control Room. Main control room alarms are provided for key parameters of the LWMS. The LWMS either returns processed water to the condensate system or discharges to the circulating water system.

(1) The functional arrangement of the LWMS is as described in Subsection 2.10.1.

(2) The LWMS piping systems retain their pressure boundary integrity under internal pressures that will be experienced during service.

(3) LWMS discharge flow ~~to circulating water~~ is monitored for high radiation. Discharge flow is terminated on receipt of a high radiation signal from this monitor. 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.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.10.1-2 provides a definition of the inspections, tests, and/or analyses, together with associated acceptance criteria for the Liquid Waste Management System. ITAAC, for the liquid radwaste discharge radiation monitor, part of the process radiation monitoring system, also are located in Table 2.3.1-2.

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.	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~~ A~~a~~ 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 2.3.1-1

Process Radiation Monitors (Shown on Figure 2.3.1-1)

ID on Figure 2.3.1-1	Safety-Related	Description	Safety Function
4A, 4B	Yes	Control Building Air Intake HVAC	The Radiation Detection Assemblies continuously monitor the gamma radiation levels from each air intake plenum for the building or area containing the MCR and auxiliary rooms. The Control Room outside air intake is secured and the emergency air filtration units are started in the event of a high radiation levels.
5	No	TB Normal Ventilation Air HVAC	NA
6	No	TB Compartment Area Air HVAC	NA
7	No	Offgas Pre-treatment	NA
8	No	Charcoal Vault Ventilation	NA
9	No	Offgas Post-treatment	NA
10	No	TB Combined Ventilation Exhaust	NA
11	No	Liquid Radwaste Discharge	NA

Table 2.3.1-2

ITAAC For The Process Radiation Monitoring System

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

Table 2.3.1-2

ITAAC For The Process Radiation Monitoring System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7. The nonsafety-related PRNM subsystem monitors which perform active/automatic control functions in order to control offsite doses below 10 CFR 20 limits provide the following: a. Indications in MCR for radiation levels b. Alarms in MCR on radiation level exceeding setpoint c. Alarms in MCR on upscale/downscale or inoperative conditions	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.	Test/inspection reports exist and document that the as-built indication, alarm, and automatic initiation functions are met.

2.6 REACTOR AND CONTAINMENT AUXILIARY SYSTEMS

The following subsections describe the auxiliary systems for the ESBWR.

2.6.1 Reactor Water Cleanup/Shutdown Cooling System

Design Description

The Reactor Water Cleanup/Shutdown Cooling (RWCU/SDC) system, purifies reactor coolant during normal operation and shutdown, provides shutdown cooling to bring the reactor to cold shutdown, and removes core decay heat to maintain cold shutdown. The RWCU/SDC system is as shown in Figure 2.6.1-1.

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

(2) The containment isolation portions of the RWCU/SDC System are addressed in Tier 1, Subsection 2.15.1.

(3) Pressure Boundary Integrity

a. The components identified in Table 2.6.1-1 as ASME Code Section III retain their pressure boundary integrity ~~under internal pressures that will be experienced during service~~at their design pressure.

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

(4) Main Control R~~r~~oom (MCR) alarms and remote operation features of mechanical equipment ~~features~~ provided for the RWCU/SDC System are defined in Table 2.6.1-1.

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

(6) Each of the RWCU/SDC System safety-related components with safety-related power identified in Table 2.6.1-1 is powered from its respective safety-related division.

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

(8) ASME Code Section III

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

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

(9) Pressure Boundary Welds

a. Pressure boundary welds in components identified in Table 2.6.1-1 as ASME Code Section III meet ASME Code Section III requirements.

a. Pressure boundary welds in piping identified in Table 2.6.1-1 as ASME Code Section III meet ASME Code Section III requirements.

Table 2.6.1-2

ITAAC For The Reactor Water Cleanup/Shutdown Cooling System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4. Main Control Rroom- (MCR) alarms and remote operation features of mechanical equipment ~~features~~ provided for the RWCU/SDC System are defined in Table 2.6.1-1	Inspections will be performed on the ~~Control Room~~ MCR alarms and remote operation features of mechanical equipment ~~features~~ for the RWCU/SDC system.	Report(s) document that MCR alarms and remote operation features of mechanical equipment ~~features~~ exist or can be retrieved in the Control Room as defined in Table 2.6.1-1.
5. Manual closure of the RPV bottom head isolation valve can be accomplished remotely.	Remote manual closure testing of the RPV bottom head isolation valve will be performed by closing the inboard containment isolation valve in the RWCU/SDC system suction line from the RPV bottom head.	Report(s) document that the RPV bottom head isolation valve can be manually closed remotely.
6. Each of the RWCU/SDC System safety-related components with safety-related power identified in Table 2.6.1-1 is powered from its respective safety-related division.	Testing will be performed on the RWCU/SDC System by providing a test signal in only one safety-related division at a time.	Report(s) document that a test signal exists in the safety-related division (or at the equipment identified in Table 2.6.1-1 powered from the safety-related division) under test in the RWCU/SDC System.

Table 2.6.2-2

ITAAC For The Fuel and Auxiliary Pools Cooling Cleanup System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4. The components and piping identified in Table 2.6.2-1 as ASME Code Section III retain their pressure boundary integrity at their design pressure.	i) A ~~hydrostatic or~~ pressure test will be performed on the components and piping required by the ASME Code Section III to be tested.	i) An ASME Code report exists and ~~documents~~ concludes that the results of the pressure test of the components and piping identified in Table 2.6.2-1 as ASME Code Section III ~~conform~~ comply with the requirements of the ASME Code Section III.
	ii) Impact testing will be performed on the containment and pressure-retaining materials in accordance with the ASME Code Section III to confirm the fracture toughness of the materials.	ii) An ASME Code report exists and ~~documents~~ concludes that the containment and pressure-retaining penetration materials ~~conform~~ comply with fracture toughness requirements of the ASME Code section III.
5a. The seismic Category I equipment ~~and piping~~ identified in Table 2.6.2-1 can withstand seismic design basis loads without loss of ~~structural integrity and~~ safety function.	i) Inspection will be performed to verify that the seismic Category I equipment and valves identified in Table 2.6.2-1 are located in a seismic Category I structure. ~~i) Type tests and/or analyses of seismic Category I equipment and piping will be performed.~~	Report(s) document that: i) The seismic Category I equipment identified in Table 2.6.2-1 is located in in a seismic Category I structure. ~~A report exists and documents that the seismic Category I equipment and piping can withstand seismic design basis dynamic loads without loss of structural integrity and safety function.~~

Table 2.6.2-2

ITAAC For The Fuel and Auxiliary Pools Cooling Cleanup System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
a. Suppression pool cooling mode	pools.	by operation of the function. The flow rate is ≥ 545.1 m^3/hr.
b. Low-pressure coolant injection mode.	Perform a test to confirm the flow path from the FAPCS to the RWCU/SDC system.	Test report(s) document that the injection flow path is demonstrated and confirmed by operation of the function. The flowrate is ≥340 m^3/hr (1500 gpm) at a differential pressure of 1.03 MPa (150 psi).
c. External connection for emergency water to IC/PCC pool and Spent Fuel Pool from the Fire Protection System and offsite water supplies	Perform a test to confirm flow path and flow capacity from the Fire Protection System and offsite water sources to the pools.	Test report(s) document that the makeup water flow path and flow capacity are ~~is~~ demonstrated and confirmed by operation of the function.
8. FAPCS minimum inventory of alarms, displays, and status indications in the main control room (MCR) are addressed in Section 3.3.	See Tier 1 Section 3.3.	See Tier 1 Section 3.3.
9. Level instruments with adequate operating ranges are provided for the Spent Fuel Pool and IC/PCC pools.	Inspections of the FAPCS will be conducted to verify that level instruments with adequate operating ranges are provided for the Spent Fuel Pool and IC/PCC pools.	Inspection report(s) document that the as-built FAPCS provides Spent Fuel Pool and IC/PCC pool level instrumentation with adequate operating ranges.
10. Equipment qualification for the FAPCS is addressed in Tier 1 Section 3.8.	See Tier 1 Section 3.8.	See Tier 1 Section 3.8.