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Subject: **Response to Portion of NRC Request for Additional Information Letter Nos. 54 and 100 Related to ESBWR Design Certification Application – Radioactive Waste Management Systems – RAI Numbers 11.2-13S01 and 11.5-37 through 11.5-47**

Enclosure 1 contains GE-Hitachi Nuclear Energy Americas (GEH) response to the subject NRC RAIs transmitted via References 1 and 2.

If you have any questions or require additional information regarding the information provided here, please contact me.

Sincerely,

/Kathy Sedney for

James C. Kinsey
Project Manager, ESBWR Licensing

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NRO

References:

1. MFN 06-302 – Letter from US Nuclear Regulatory Commission (NRC) to David H. Hinds, *Request for Additional Information Letter No. 54 Related to ESBWR Design Certification Application,* dated August 13, 2006
2. MFN 07-327 – Letter from US Nuclear Regulatory Commission (NRC) to R. E. Brown, *Request for Additional Information Letter No. 100 Related to ESBWR Design Certification Application,* dated May 20, 2007

Enclosures:

1. Response to NRC Request for Additional Information Letter Nos. 54 and 100 Related to ESBWR Design Certification Application – Radioactive Waste Management Systems, RAI Numbers 11.2-13S01 and 11.5-37 through 11.5-47

cc: AE Cubbage USNRC (with enclosures)
GB Stramback GHNEA /San Jose (with enclosures)
RE Brown GHNEA /Wilmington (with enclosures)
eDRF 0069-2583

Enclosure 1

MFN 07-301

Response to Portion of NRC Request for Additional Information Letter Nos. 54 and 100 Related to ESBWR Design Certification Application

Process Radiation Monitoring System

RAI Numbers 11.2-13S01 and 11.5-37 through 11.5-47

NRC RAI 11.5-37:

In DCD Tier 2, Rev 3, Sections 11.5.2.1 and 11.5.2.2, one of the design criteria has been eliminated from the list. The deleted criterion, as a functional requirement of the PRMS, states that the instrumentation registers full-scale output if radiation detected exceed full scale. The staff does not agree with the deletion of this criterion in both subsections of the DCD. Accordingly, update these sections of the DCD.

GEH Response:

The criteria with the requirement that the instrumentation register full-scale output if the radiation exceeds full scale will be added to DCD Tier 2, Subsections 11.5.2.1 and 11.5.2.2. GEH could not determine why the deletion had been made in DCD Tier 2, Revision 3, as it remained part of the design criteria.

DCD Impact:

DCD Subsections 11.5.2.1 and 11.5.2.2 will be revised as shown on the attached markup.

NRC RAI 11.5-38:

In DCD Tier 2, Rev 3, Section 11.5.3.2.3, the discussion about the display ranges of the Offgas Post-Treatment RMS is inconsistent. The low end of the stated range should be reviewed and confirm whether the instrumentation can detect the stated levels of radioactivity. Accordingly, update this section of the DCD.

GEH Response:

The statement in subsection 11.5.3.2.3 will be changed **from**: "The ranges are selected to cover an Offgas release rate of 3.7E-1 Bq/s to 3.7E4 MBq/s. The lower range limit is based on the approximate value of an expected release rate for Kryptons and Xenons in the OGS." **to** "The range for noble gas detection is selected to cover an offgas release rate of approximately 3.7E-2 MBq/sec to 3.7E4 MBq/sec. The ranges for particulate and iodine detection are selected to provide coverage from approximately 1/10 of the applicable 10 CFR 20 limits using Cs-137 and I-131 respectively, plus an additional 6 decades of coverage to upper end."

DCD Impact:

DCD Tier 2, Subsection 11.5.3.2.3 will be revised as noted on the attached markup.

NRC RAI 11.5-39:

In DCD Tier 2, Rev 3, Section 11.5.8, combine the citations of ANSI In DCD Tier 2, Rev 3, Section 11.5.8. The citations of ANSI N13.10-1974 and ANS/IEEE N42-18-1990 should be combined as one and be referred to its current reaffirmation status as ANSI N42-18-2004. Accordingly, update the stated reference in the DCD.

GEH Response:

GEH agrees with updating the reference to ANSI N42-18-2004 as proposed.

DCD Impact:

DCD Tier 2, Subsection 11.5.8, References 11.5-14 and 11.5-19 will be revised as noted on the attached markup. DCD Tier 2, Table 1.9-22 has also been updated to reflect this standard as noted on the attached markup.

NRC RAI 11.5-40:

In DCD Tier 2, Rev 3, Table 11.5-2, the stated operational response range for the Offgas Pre-Treatment RMS is improperly characterized for Cs-137. Accordingly, update the entry in this DCD table.

GEH Response:

In DCD Tier 2, Rev 3, Table 11.5-2, Offgas Pre-treatment, there is no entry for Cs-137. However, in the same Table 11.5-2 Offgas Post-Treatment has an entry for CS-137. GEH has corrected a typo for Cs-137 in the Dynamic Detection Range column.

DCD Impact:

DCD Tier 2, Table 11.5-2 will be revised as noted on the attached markup.

NRC RAI 11.5-41:

In DCD Tier 2, Revision 3, Table 11.5-5, footnotes 3 and 4 commit the COL applicant to specific requirements. However, these requirements are not identified in DCD Rev. 3, Section 11.5.7, "COL Information." Accordingly, update that section of the DCD to include these items.

GEH Response:

As discussed with NRC Staff and GEH and GEH customers on June 21, 2007, the requirements stated in footnotes 3 and 4 of Table 11.5-5 will remain unchanged; however, the requirement for providing the design of wastewater effluent systems that monitor the storm, the cooling system tower blow down and sanitation wastes will now be provided by the COL Applicant instead of the COL Holder.

DCD Impact:

DCD Tier 2, Table 11.5-5 will be revised as noted on the attached markup.

NRC RAI 11.5-42:

In Revision 3 of the DCD Tier 2, Table 11.5-8, the third footnote lists a non-existent radionuclide. Accordingly, update the footnote in this DCD table.

GEH Response:

GEH agrees that there is a typo and will change DCD Tier 2, Table 11.5-8 third footnote entry for "Mn-554" to "Mn-54".

DCD Impact:

DCD Tier 2, Table 11.5-8 will be revised as noted on the attached markup.

NRC RAI 11.5-43:

In Revision 3 of the DCD Tier 2, Figure 11.5-1, a place holder for footnote (No. 3) is identified for FB Building Exhaust, but the legend for the footnote is not included in the figure. Accordingly, provide the missing legend in that DCD figure.

GEH Response:

DCD Figure 11.5-1 will be revised to add a footnote (No. 3) for Fuel Building Combined Ventilation Exhaust.

DCD Impact:

DCD Tier 2, Figure 11.5-1 will be revised as noted on the attached markup.

NRC RAIs 11.2-13S01 and 11.5-44:

NRC RAI 11.2-13 S01:

In RAI 11.2-13, the staff asked the applicant to describe how the classifications and design criteria applied to the liquid radioactive waste management system (including piping, tanks, and structures used to contain leakage) satisfy the requirements of GDC 61 with respect to designing radioactive waste systems to assure adequate safety under accident conditions. In its response, the applicant stated that the LWMS was designed to Quality Group D and modified by RG 1.143, Revision 2, Section 7 and Table 1. Referring to the response to RAI 11.2-9 and RAI 11.2-10, compliance with RG 1.143 guidance was addressed for the LWMS. The staff reviewed the response to RAI 11.2-13, and previously reviewed the responses to RAI 11.2-6 through 11.2-10 relating to the LWMS being consistent with RG 1.143 Revision 2. Based on the SRP Section 11.2, the compliance with RG 1.143 forms the bases for satisfying GDC 61. A COL applicant referencing the ESBWR certified design should describe the quality assurance (QA) program for design, fabrication, procurement, construction of structures, and installation of permanent or mobile LWMS systems and components in the plant in accordance with its overall QA program. However, DCD Rev. 3, Section 11.2.6 does not commit the COL applicant to conform with the QA guidance specified in Regulatory Guides 1.21, 1.33, and 4.15.

RAI 11.5-44:

A COL applicant referencing the ESBWR certified design should describe the quality assurance (QA) program for design, fabrication, procurement, and installation of PRMS subsystems and components in the facility in accordance with its overall QA program. However, DCD Rev. 3, Section 11.5.7 does not commit the COL applicant to conform with the QA guidance specified in Regulatory Guides 1.21, 1.33, and 4.15. Accordingly, update that section of the DCD to include this COL information item.

GEH Response:

The COL applicant requirements for quality assurance (QA) program for design, fabrication, procurement and installation of PRMS subsystems are included in DCD Tier 2, Chapter 17.

The requirements for quality assurance (QA) program for design, fabrication, procurement and installation of PRMS subsystems will be included in DCD Tier 2, Subsection 11.5.6.1. Regulatory Guides 1.33, and 4.15 for the COL Applicant are specified in DCD Tier 2, Chapter 17, Table 17.0-1. Regulatory Guide 1.21 will also be added to this Table 17.0-1. Similar QA statements are also added to Subsections 11.2.4, 11.3.5, and 11.4.4 for completeness.

DCD Impact:

DCD Tier 2, Chapter 11, Subsections 11.2.4, 11.3.5, 11.4.4, 11.5.6.1 and DCD Tier 2, Chapter 17, Table 17.0-1 will be revised as noted on the attached markups.

NRC RAI 11.5-45:

DCD Tier 2, Rev. 3, Sections 11.5.3.1.3 and 11.5.3.2.13 describe the design of the PRMS subsystems use to monitor the air intakes of the control building (CB) and technical support center (TSC), respectively, as being compliant with GDC 19 of Appendix A to 10 CFR Part 50. Each RMS subsystem includes provisions to initiate the isolation of the outside air intake and exhaust dampers and startup of the emergency air filtration system when doses to control room operators and occupants of the technical support center are expected to exceed 0.05 Sv (5 rem) during a postulated accident. However, DCD Tier 2, Rev. 3, Section 11.5.7 does not commit the COL applicant to establish operational set-points of the associated radiation monitoring systems for CB air intake HVAC RMS and TSC HVAC air intake RMS. Accordingly, update this section of the DCD to include this COL information item.

GEH Response:

The Control Building Air-Intake habitability systems including radiation monitoring instruments are addressed in Technical Specification (TS) 3.3.7.1, and do not need to be repeated in DCD Tier 2 Subsection 11.5.7.

The Technical Support Center (TSC) radiation monitoring instruments are nonsafety-related and are not covered in the technical specifications. The TSC instruments are verified to be operable in accordance with ITAAC 2.3.1-2. DCD Tier 2 Subsection 9.4.7 states that the TSC meets the Utility Requirement Document (URD) Section 4.6.6, that states that a TSC shall be provided that complies with NUREG-0696. NUREG-0696 requires that the TSC be provided the same level of radiological protection as that supplied to the Main Control Room (MCR) in accordance with General Design Criteria (GDC) 19. However, the level of protection afforded the TSC in accordance with NUREG-0696, Section 2.6 is not as restrictive as GDC 19; specifically: "The TSC ventilation system shall function in a manner comparable to the control room ventilation system. The TSC ventilation system need not be seismic Category I qualified, redundant, instrumented in the control room, or automatically activated to fulfill its role."

In accordance with NUREG-0696, Section 2.6, the TSC is not specifically committed to providing a safety-related environment in full compliance with GDC 19, which specifically defines the Control Building habitability acceptance criteria. Therefore, inasmuch as the ESBWR Technical Specifications currently have MCR habitability requirements in accordance with GDC 19, and Staff has previously considered that SSCs identified in Technical Specifications need not be repeated as a COL Applicant items, and the TSC compliance to NUREG-0696 and GDC 19 currently exists in DCD Tier 2 Subsection 9.4.7, GEH disagrees that it is necessary to add a COL Applicant item for the TSC HVAC air intake RMS.

DCD Impact:

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

NRC RAI 11.5-46:

DCD Tier 2, Rev. 3, Sections 11.5.1, 11.5.4, and 11.5.5 describe operational requirements of the post-accident sampling system and operational range of each process radiation monitoring system (PRMS) to ensure that they are consistent with the requirements of 10 CFR Parts 50.34(f)(2)(viii), 50.34(f)(2)(xvii), 50.34(f)(2)(xxvii), and 50.34(f)(2)(xxviii), and guidance of Regulatory Guide 1.97 and NUREG-0737 TMI-related Item II.F.1 (Attachments 1 and 2). However, DCD Rev. 3, Section 11.5.7 does not commit the COL applicant to establish operational procedures for the associated radiation monitoring systems. Accordingly, update this section of the DCD to add this COL information item.

GEH Response:

DCD Tier 2, Subsection 11.5.2 will require compliance to 10CFR Parts 50.34(f)(2)(viiii), 50.34(f)(2)(xvii), 50.34(f)(2)(xxvii), and 50.34(f)(2)(xxviiii). DCD Subsection 11.5.3.2.14 has been revised to clarify compliance with the guidance of Regulatory Guide 1.97, and NUREG-0737 TMI-related Item 11.F.1 (Attachments 1 and 2). Additionally, DCD Tier 2 Subsection 13.5.3.4 is revised to include a statement for establishing radiation monitoring systems in accordance with ANS/IEEE N42.18 – 2004 "American National Standard Specification and Performance of On-Site Instrumentation for Continuously Monitoring Radioactivity for Effluents – Description".

DCD Impact:

DCD Tier 2, Subsections 11.5.2, 11.5.3 and 13.5.3.4, and Reference 11.5-3 will be revised as noted on the attached markup.

NRC RAI 11.5-47:

In DCD Rev. 3, Chapter 11, GE identified COL holder items encompassing Operational Program including: Offsite Dose Calculation Manual (ODCM), Process Control Program (PCP), Radiological Environmental Monitoring Program (REMP), radiological effluent technical specifications (RETS), and standard radiological effluent controls (SREC). In accordance with SECY-05-0197, "Review of Operational Programs in a Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria," dated October 28, 2005, COL applicants should fully describe these operational programs in their COL application and should propose implementation milestones (license conditions) for staff review. Accordingly, revise the DCD to include COL applicant items rather than COL holder items for these operations programs.

GEH Response:

GEH is globally changing the COL holder items to COL Applicant items in DCD Tier 2, Revision 4.

DCD Tier 2, Subsections 11.5.4.5, 11.5.4.6, 11.5.4.7, 11.5.4.8, and various paragraphs of Subsection 11.5.7 will be updated to show COL Applicant.

DCD Impact:

DCD Tier 2, Subsections 11.5.4.5, 11.5.4.6, 11.5.4.7, 11.5.4.8, and 11.5.7 will be revised as noted on the attached markup.

DCD Changes
for
RAI No. 11.5-37

11.5.2.1 Radiation Monitors Required for Safety

The design criteria for the safety-related functions as defined in Subsection 11.5.1.1 include the following functional requirements:

- Withstand the effect of natural phenomena (e.g., earthquakes) without loss of capability to perform their functions.
- Perform the intended safety-related functions in the environment resulting from normal and abnormal conditions (e.g., loss of HVAC and isolation events).
- Meet the reliability, testability, independence, and failure mode requirements of engineered safety-related features.
- Provide continuous output of radiation levels to the main control room.
- Permit checking of the operational availability of each channel during reactor operation with provisions for calibration function and instrument checks.
- Ensure an extremely high probability of accomplishing safety-related functions in the event of anticipated operational occurrences.
- Initiate protective action when operational limits are exceeded.
- Annunciate the high radiation levels in the main control room to alert operating personnel of abnormal conditions.
- Insofar as practical, provide self-monitoring of the radiation monitors to the extent that power failure or equipment failure causes annunciation in the main control room and initiation of the required protective action.
- Register full-scale output if radiation detection exceeds full scale.
- Use instrumentation compatible with anticipated radiation levels and ranges expected under normal, abnormal and accident conditions, per Regulatory Guide (RG) 1.97 (Reference 11.5-11). Provide expanded ranges to take into consideration additional source term resulting from damaged core. Provide overlapping sensor/instrument ranges where the desired accuracy is not achieved with a single sensor/instrument.
- Use redundant divisional channels that satisfy the separation and single failure criteria, for the initiation of safety-related functions.

11.5.2.2 Radiation Monitors Required for Plant Operation

The design criteria for operational radiation monitoring will include the following functional requirements:

- Provide continuous indication of radiation levels in the main control room.
- Annunciate the high radiation levels in the main control room to alert operating personnel to the abnormal conditions.
- Insofar as practical, provide self-diagnosis of the radiation monitors to the extent that power failure or equipment failure causes annunciation in the main control room and isolation of the effluents paths as required.

- Monitor a representative sample of the bulk stream or volume.
- Incorporate provisions for calibration and functional checks.
- Use instrumentation compatible with anticipated radiation levels and ranges expected under normal, abnormal and accident conditions (Regulatory Guide 1.97). Provide expanded ranges to take into consideration additional source term from damaged core. Provide overlapping sensor/instrument ranges where the desired accuracy is not achieved with a single sensor/instrument.
- Register full-scale output if radiation detection exceeds full scale.
- Monitor selected non-radioactive systems for intrusion of radioactivity into the system.

11.5.3 Subsystem Description

11.5.3.1 Radiation Monitors Required for Safety

The design description of each PRMS subsystem's radiological monitoring and sampling function as identified in Subsection 11.5.1.1.1 is provided in this section under its designated name. The types of instrumentation, together with pertinent parameters for each subsystem, are presented in Tables 11.5-1, 11.5-2, and 11.5-4. Figure 11.5-1 in conjunction with Table 11.5-3 provides radiation detector location diagrams.

Figure 11.5-2 shows the block diagram of a Safety-Related PRMS channel. Signal Conditioning Units (SCUs) are located in the MCR back panel area. Displays for alarm and radiation level are provided at the SCUs, and also at the MCR console VDUs. The Safety-Related Distributed Control and Information System (Q-DCIS) receives signals from the SCUs, performs control functions, and also feeds the signals to the Nonsafety-Related Distributed Control and Information System (N-DCIS) for display, alarm, and data recording functions.

11.5.3.1.1 Reactor Building HVAC Exhaust Radiation Monitoring Subsystem (RMS)

This subsystem monitors the gross radiation level in the exhaust duct of the RB. The principal path that this subsystem monitors is exhaust from the contaminated area, which is served by Reactor Building Contaminated Area HVAC Subsystem (CONAVS). A high activity level in the ductwork could be due to fission gases from a leak or an accident.

The subsystem consists of four redundant instrument channels. Each channel consists of a gamma-sensitive detector and a Main Control Room (MCR) radiation monitor.

The detectors are located adjacent to the exhaust ducting upstream of the ventilating system isolation valves and monitor the Reactor Building HVAC exhausts. The detectors are physically located upstream of the ventilation exhaust duct isolation dampers such that closure of the dampers can be accomplished prior to exceeding radioactive effluent limits imposed by 10 CFR 50, Appendix I.

Leak Detection and Isolation System receives the individual channel signals and compares the signal level to the setpoint trips.

Any two-out-of-four channel trips result in the closure of the RB ventilating exhaust ventilation dampers and stoppage of the Reactor Building HVAC exhaust fans.

DCD Changes
for
RAI No. 11.5-38

The range of channel measurement and display is shown in Table 11.5-1 and Table 11.5-2. The range is selected to provide indication over an offgas release rate of approximately 3.7E 2Mega-Bequerels per second (MBq/s) up to approximately 3.7E 8 MBq/s (after a 30 minute decay), referenced to the noble gases listed in Table 11.1-1, Table 11.1-2 and Table 11.1-2b.

11.5.3.2.3 Offgas Post-treatment RMS

This subsystem monitors radioactivity for halogens, particulates and noble gas releases during normal and accident conditions in the Offgas piping downstream of the OGS charcoal adsorbers and upstream of the OGS discharge valve. A continuous sample is extracted from the OGS piping, passed through two Offgas post-treatment samplers for monitoring and sampling, and returned to the OGS piping. One sampler contains provisions for continuous gaseous, particulate and halogen radioactivity monitoring of the offgas post treatment process. The second sampler contains only provisions for continuous gaseous monitoring. Sampling is done in accordance with ANSI/HPS N13.1-1999 (Reference 11.5-13). Automatic compensation for variation in stack flow is provided to maintain the sample panel flow proportional to the main flow. Two local radiation monitors, connected to gamma-beta sensitive radiation detectors, analyze and visually display the measured radiation level.

The sample panel shielded chambers can be purged with room air to check detector response to background radiation. Sample line flow is measured and indicated on the sample panel. A remotely- operated check source for each detector assembly is used to check operability of the channel.

Each radiation monitor has trip circuits that actuate corresponding main control room annunciators.

The trip outputs are used to initiate closure of the OGS discharge and Charcoal Bed bypass valves. The trip setpoint is set so that valve closure is initiated prior to exceeding 10 CFR 20.1302 (Reference 11.5-1) limits. A channel trip is also used to initiate alignment of the OGS flow valves to achieve treatment through the charcoal vault.

Provisions for grab sample collection are provided and can be used for isotopic analysis and monitor calibration.

Tritium sampling is also provided by the subsystem.

Abnormal flow, measured at the sample panel, is annunciated in the MCR.

The ranges of channel display are shown in Table 11.5-1 and Table 11.5-2. The range for noble gas detection is ~~The ranges are~~ selected to cover an Offgas release rate of approximately 3.7E-~~1~~ 2 MBq/sec to 3.7E4 MBq/sec. The ranges for particulate and iodine detection are selected to provide coverage from approximately 1/10 of the applicable 10 CFR 20 limits using Cs-137 and I-131 respectively, plus an additional 6 decades of coverage to upper end. ~~The lower range limit is based on the approximate value of an expected release rate for Kryptons and Xenons in the OGS.~~ The upper range limit is set by the plant release limit, which in turn is set by plant unique factors such as site size, and meteorology.

The subsystem provides data for reports of gaseous releases of radioactive materials in accordance with Regulatory Guide 1.21.

DCD Changes
for
RAI No. 11.5-39

11.5-4 Title 10 Code of Federal Regulations Part 50.36a, "Technical Specifications on Effluents from Nuclear Power Reactors."

11.5-5 Title 10 Code of Federal Regulations Part 50, Appendix A, General Design Criterion 60, "Control of Releases of Radioactive Materials to the Environment."

11.5-6 Title 10 Code of Federal Regulations Part 50, Appendix A, General Design Criterion 63, "Monitoring Fuel and Waste Storage."

11.5-7 Title 10 Code of Federal Regulations Part 50, Appendix A, General Design Criterion 64, "Monitoring Radioactivity Releases."

11.5-8 Title 10 Code of Federal Regulations Part 50, Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low as is Reasonably Achievable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents."

11.5-9 Regulatory Guide 1.21, "Measuring and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants."

11.5-10 Regulatory Guide 1.45, "Reactor Coolant Pressure Boundary Leakage Detection Systems."

11.5-11 Regulatory Guides 1.97, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant Conditions During and Following an Accident."

11.5-12 Regulatory Guide 4.15, "Quality Assurance for Radiological Monitoring Programs (Normal Operation) - Effluent Streams and the Environment."

11.5-13 ANSI/HPS N13.1-1999, "Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities."

~~11.5-14 ANSI N13.10-1974, "Specification and Performance of On-Site Instrumentation for Continuously Monitoring Radioactivity in Effluents" (1974).~~

11.5-15 NUREG-0737, "Clarification of TMI Action Plan Requirements" (1980).

11.5-16 Title 10 Code of Federal Regulations Part 20 Appendix B, "Annual Limits on Intake (ALI's) and Derived Air Concentrations (DAC's) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage."

11.5-17 Title 10 Code of Federal Regulations Part 50 Appendix A, General Design Criterion 19, "Control Room."

11.5-18 NUREG-0800, Standard Review Plan, 11.5 Process and Effluent Radiological Monitoring Instrumentation and Sampling Systems, DRAFT Rev.4 – April 1996.

11.5-19 ANS/IEEE N42.18 – ~~1980~~2004, "American National Standard Specification and Performance of On-Site Instrumentation for Continuously Monitoring Radioactivity for Effluents – Description." (Redesignation of N13.10-1974 and Reaffirmation of N42.18-1980.)

11.5-20 Title 10 Code of Federal Regulations Part 50 Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants."

Table 1.9-22

Industrial Codes and Standards[2] Applicable to ESBWR

Code or Standard Number	Year	Title
M016-89	1989	Manual of Steel Construction Allowable Stress Design, 9th Edition
N690-94	1994 (R 2004)	Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities – Supplement 2: October 2004
American Iron and Steel Institute (AISI)		
CF02-1		Cold-Formed Steel Framing Design Guide (Latest edition based on the 2001 edition and 2004 supplement of the AISI Specification for the Design of Cold-Formed Steel Structural Members)
SG02-1 and SG02-2	2001	North American Specification for the Design of Cold-Formed Steel Structural Members, and Commentary
SG05-1e	2004	Supplement 2004 to the North American Specification for the Design of Cold-Formed Steel Structural Members, 2001 Edition
American National Standards Institute (ANSI)		
C37.32-1990	1990	Switchgear High-Voltage Air Switches, Bus Supports, and Switch Accessories - Schedules of Preferred Ratings, Manufacturing Specifications, and Application Guide – Revised and Re-designated as ANSI/NEMA C37.32-1996. See IEEE C37.32-2002.
C37.46-1981	1981	Specification for Power Fuses and Fuse Disconnecting Switches (See NEMA C37.46-2000)
C37.50-1989	1989	Switchgear – Low-Voltage AC Power Circuit Breakers Used in Enclosures – Test Procedures (See NEMA C37.50-1989)
C37.51-2003	2003	Switchgear – Metal Enclosed Low-Voltage AC Power Circuit Breaker Switchgear Assemblies – Conformance Test Procedures (See NEMA C37.51-2003)
C39.1-1981	1981 (R 1992)	Electrical Analog Indicating Instruments
C50.10-1990	1990	General Requirements for Synchronous Machines
C50.13	1989	Standard for Rotating Electrical Machinery – Cylindrical-Rotor Synchronous Generators
CGA G-7.1	2004	Commodity Specification for Air
ANSI/HPS N13.1-1999	1999	Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities
~~N13.10-1974~~	~~1974~~	~~Specification and Performance of On-Site Instrumentation for Continuously Monitoring Radioactivity in Effluents~~
N14.6-1993	1993	Radioactive Materials - Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More
N42.18-2004	2004	Specification and Performance of On-Site Instrumentation for Continuously Monitoring Radioactivity in Effluents (Redesignation of N13.10-1974 and Reaffirmation of N42.18-1980)
N45.4	1972	Leakage-Rate Testing of Containment Structures for Nuclear Reactors

DCD Changes
for
RAI No. 11.5-40

Table 11.5-2

Process Radiation Monitoring System (Gaseous and Airborne Monitors)

Radiation Monitor	Configuration	Dynamic Detection Range*	Principal Radionuclides Measured	Expected Activity **	Alarms*** & Trips
B. Monitors Required for Plant Operation					
MSL	Offline (adjacent to MSLs)	≈ 1.4E 2 to 1.4 E 8 MBq/m^3	N-16, O-19 & Coolant activation gases	**	DNSC INOP High High-High
Offgas Post-treatment	Offline	≈ 8 E-3 to 8 E 3 MBq/m^3 ≈ 2.6 E -3 to 2.6 E 3 MBq/m^3 ≈ 3.7 E -7 to 3.7E -1 MBq/m^3 ≈ 7.4 E -7 to 7.4E-1 MBq/m^3	Xe-133 Kr-85 Cs-137 I-131	** ** ** **	Abnormal Flow DNSC/INOP High High-High High-High-High
Offgas Pre-treatment	Offline (adjacent to sample chamber)	≈ 1.7 E 2 to1.7 E 8 MBq/m^3 ≈ 1.0 E 2 to 1.0 E 8 MBq/m^3	Xe-138 Kr-88	** **	DNSC/INOP High High-High
Main Turbine Gland Seal Steam Condenser Exhaust	Offline	≈ 8 E -3to 8E 3 MBq/m^3 ≈ 2.6 E -3 to 2.6E 3 MBq/m^3	Xe-133 Kr-85	** **	Abnormal Flow DNSC/INOP High High-High
Charcoal Vault Ventilation	Inline (adjacent and internal to HVAC duct)	≈ 5.1E 2 to 5.1E 8 MBq/m^3 ≈ 1 E 2 to 1 E 8 MBq/m^3	Xe-133 Kr-85	** **	DNSC/INOP High
TB Normal Ventilation Air HVAC	Inline (adjacent and internal to HVAC duct)	≈ 1.7 E0 to 1E 4 MBq/m^3 ≈ 3.4E1 to 3.4E5 MBq/m^3	Xe-133 Kr-85	** **	DNSC/INOP High
TB Compartment Area	Inline (adjacent and	≈ 2 E 0 to 2E 4 MBq/m^3	Xe-133	**	DNSC/INOP

DCD Changes
for
RAI No. 11.5-41

Table 11.5-5

Provisions for Sampling Liquid Streams

No.	Process Systems as listed in NUREG-0800, SRP 11.5 Table 2 (Draft Rev. 4)	ESBWR System (s) that Perform the Equivalent SRP 11.5 Function (Note 1)	In Process	In Effluent	
			Grab Notes 2 & 7	Grab Notes 2 & 7	Continuous Notes 2 & 7
14.	Non-Contaminated Waste Water System	COL Applicant Notes 3 & 4	-	(S&A, H3) Notes 3, 4 & 6	(S&A) Note 4

Notes for Table 11.5–5:

1. Table 11.5-5 addresses sampling provisions for BWRs as identified in Table 2 of SRP 11.5. For process systems identified for BWRs in Table 2, but not shown in Table 11.5-5, those systems are not applicable to ESBWR. In some cases, there are multiple subsystems that are used to perform the overall equivalent SRP function and are listed as such in the column.
2. S&A=Sampling & Analysis of radionuclides, to include gross radioactivity, identification and concentration of principal radionuclides and concentration of alpha emitters; R=Gross radioactivity (beta radiation, or total beta plus gamma); H3=Tritium
3. Liquid Radwaste is processed on a batch-wise basis. The Liquid Waste Management System sample tanks can be sampled for analysis of the batch. See Subsection 11.2.2.2 for more information on Liquid Radwaste Management.
4. The COL Applicant will provide design of wastewater effluent systems that monitor the storm, the cooling system tower blow down and sanitation wastes. See Subsection 9.2.4 for additional information.
5. The ESBWR does not include ultrasonic resin cleanup waste system at this time. Should one be installed, the Liquid Waste Management System would provide sampling and monitoring provisions.
6 The use of parenthesis indicates that these provisions are required only for the systems not monitored, sampled, or analyzed (as indicated) prior to release by downstream provisions.
7. The sensitivity of detection, also defined here as the Lower Limit of Detection (LLD), for each indicated measured variable, will be based on the applicable radionuclide (or collection of radionuclides as applicable) as given in 10 CFR 20 Appendix B and as supplemented by RG 1.21.
8. Processed through radwaste Liquid Waste Management System (LWMS) prior to discharge. Therefore, this process system is monitored, sampled, or analyzed prior to release by downstream provisions. See Note 6 above. Depending on Utility's discretion, additional sampling lines may be installed. Continuous Effluent sampling is not required per Standard Review Plan 11.5 Draft Rev. 4, April 1996, Table 2 for this system function.

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Table 11.5-8

Radiological Analysis Summary of Gaseous Effluent Samples

Sample Description	Sample Frequency*	Analysis	Sensitivity (MBq/m3)***	Purpose
1. TB Combined Ventilation Exhaust	Weekly	Gross β	**	Effluent record
		I-131	**	
		Ba/La-140	**	
	Monthly	Gamma spectrum	**	Effluent record
		I-133 and I-135	**	
		Tritium	**	
		Gross alpha	**	
	Quarterly	Sr-89 and Sr-90	**	Effluent record
2. Plant Stack	As above	As above	**	Effluent record
3. Radwaste Building Ventilation Exhaust	As above	As above	**	Effluent record
4. FB Combined Ventilation Exhaust	As above	As above	**	Effluent record

Notes for Table 11.5-8:

* All frequencies of sampling will be in accordance with RG 1.21.

** The sensitivity of detection (also defined here as the Lower Limit of Detection (LLD)) for each indicated radionuclide (or collection of radionuclides as applicable) will be as defined in 10 CFR 20 Appendix B and as supplemented by RG 1.21.

*** The principal gamma emitters for which the LLD specification applies includes the following radionuclides: Kr-85, Kr-88, Xe-133, Xe=133m, Xe-135, and Xe-138 in noble gas releases, and Mn-~~5~~54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, I-131, Cs-134, Cs-137, Ce-141, and Ce-144 in Iodine and Particulate releases. This list does not mean that only these nuclides are to be considered. Other gamma energy peaks that are identifiable, together with those of the above radionuclides, shall be analyzed and reported per RG 1.21.

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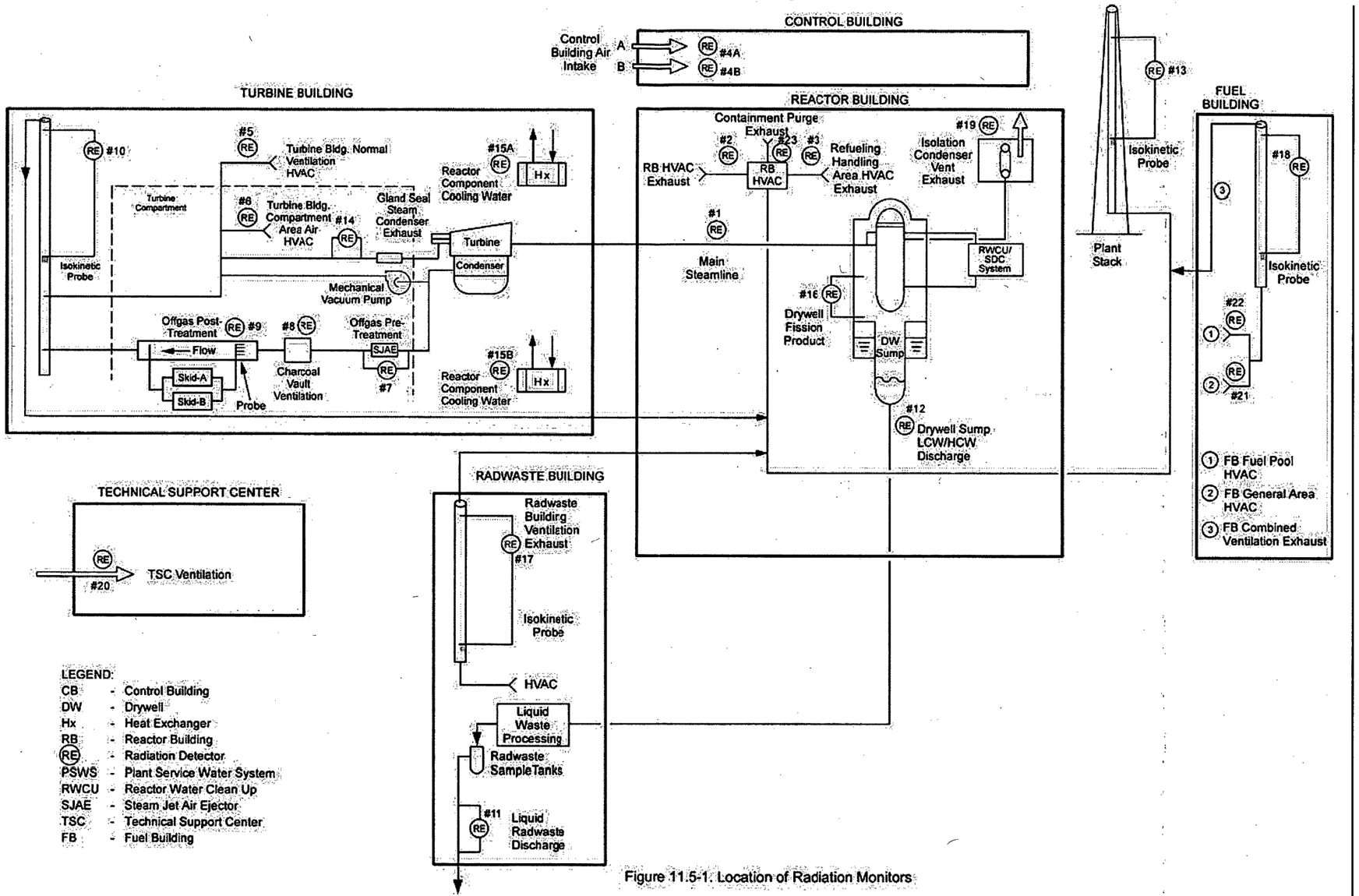

Figure 11.5-1. Location of Radiation Monitors

Figure 11.5-1. Location of Radiation Monitors

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for
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concentrated waste. The decontamination factors (DFs) that are listed in Table 11.2-3 are in accordance with NUREG-0016 (Reference 11.2-7), but are considered conservative values. The filter sludge, ion exchange resins and concentrated waste are sent to the SWMS for further processing. If the liquid meets the purity requirements it is returned to the plant for condensate makeup. If the liquid is discharged, the activity concentration is consistent with the discharge criteria of 10 CFR 20 (Reference 11.2-2) and dose commitment in 10 CFR 50, Appendix I (Reference 11.2-6).

The parameters and assumptions used to calculate releases of radioactive materials in liquid effluents and their bases are provided in Chapter 12. The LWMS design ensures that calculated individual doses from the release of radioactive liquid effluents during normal operation and anticipated operational occurrence is less than 0.03 mSv (3mrem) to the whole body and 0.1 mSv (10mrem) to any organ.

Expected releases of radioactive materials by radionuclides in liquid effluents resulting from normal operation, including anticipated operational occurrences, and from design basis fuel leakage are provided in Chapter 12.

An assessment of potential radiological liquid releases following a postulated failure of a LWMS tank and its components in accordance with SRP 15.7.3 (Reference 11.2-11) is provided in Subsection 15.3.16.

A tabulation of the releases by radionuclides can be found in Chapter 12. The tabulation is for the total system and for each subsystem and includes indication of the effluent concentrations. The calculated concentrations in the effluents are within the concentration limits of 10 CFR 20 (Reference 11.2-2); the doses resulting from the effluents are within the numerical design objectives of Appendix I to 10 CFR 50 (Reference 11.2-6) and the dose limits of 10 CFR 20 (Reference 11.2-2) as set forth in Chapter 12.

Dilution Factors

Refer to Section 12.2 for dilution factors used in evaluating the release of liquid effluents.

11.2.4 Testing and Inspection Requirements

The LWMS is given a pre-operational test as discussed in Chapter 14. Thereafter, portions of the systems are tested as needed.

During initial testing of the system, the pumps and mobile systems are performance tested to demonstrate conformance with design flows and process capabilities. An integrity test is performed on the system upon completion.

Provisions are made for periodic inspection of major components to ensure capability and integrity of the systems. Display devices are provided to indicate vital parameters required in routine testing and inspection.

The quality assurance program for design, fabrication, procurement, and installation of the liquid radioactive waste system is in accordance with the overall quality assurance program described in Chapter 17.

Design features that reduce leakage and releases of radioactive material include the following:

- Extremely stringent leak rate requirements placed upon all equipment, piping and instruments and enforced by requiring helium leak tests of the entire process system as described in section 11.3.5.
- Use of welded joints wherever practicable.
- Specification of valve types with extremely low leak rate characteristics (i.e., bellows seal, double stem seal, or equal).
- Routing of most drains through loop seals to the main condenser.
- Specification of stringent seat-leak characteristics for valves and lines discharging to the environment through other systems.

11.3.2.3 Seismic Design

OGS equipment and piping are classified Seismic Category Non-seismic (NS).

11.3.3 Ventilation System

Radioactive gases are present in the power plant buildings as a result of process leakage and steam discharges. The process leakage is the source of the radioactive gases in the air discharged through the ventilation system. The design of the ventilation system is described in Section 9.4. The radiation activity levels from the ventilation systems are treated in Section 12.2. The ventilation flow rates are shown in Section 9.4.

11.3.4 Radioactive Releases

Refer to Section 12.2 for radioactive release information from the OGS.

11.3.5 Testing and Inspection Requirements

Because the gaseous radioactive waste system has no safety-related function, no inservice inspection of the components is required.

Preoperational and startup testing, which includes hydrostatic testing of system components and piping; helium leak testing; and verification of air ejector pressure and flow, preheater operation (recombiner inlet temperature), catalyst temperature, and offgas condenser operation; is accomplished as described within Section 14.2.

During normal operation, the hydrogen analyzers, process components, and monitoring instrument channels are periodically tested and calibrated to ensure that the explosive gas mixture is below the flammability limit and projected doses from gaseous effluent releases are kept as low as reasonably achievable and below regulatory limits.

The quality assurance program for design, fabrication, procurement, and installation of the gaseous radioactive waste system is in accordance with the overall quality assurance program described in Chapter 17.

The COL holder is responsible for ensuring initial and future mobile system, structure, component operations comply with the requirements of NUREG-0800, Section 11.4 (Reference 11.4-1) Solid Waste Management Systems, Draft Rev. 3 – April 1996, including BTP - ETSB 11-3, Regulatory Guide 1.143 (Reference 11.4-3), Regulatory Guide 8.8 (Reference 11.4-4) and Regulatory Guide 8.10 (Reference 11.4-5). The COL holder is responsible for evaluating the initial, and then subsequently updated future, mobile systems per the guidance and information in IE Bulletin 80-10 (Reference 11.4-19), May 6, 1980 for the express purpose of identifying and rectifying connections that are considered as non-radioactive, but could become radioactive through interfaces with radioactive systems, i.e., a non-radioactive system that could become contaminated due to leakage, valving errors or other operating conditions in radioactive systems. The COL holder will have a Process Control Program (PCP), and it will include classifying waste as A, B, C per 10 CFR 61.55 (Reference 11.4-16).

11.4.3 Safety Evaluation

The SWMS has no safety-related function. There is no liquid plant discharge from the SWMS. Failure of the subsystem does not compromise any safety-related system or component nor does it prevent shutdown of the plant. No interface with the Safety-related electrical system exists.

As mobile waste processes are selected for use, during the design stage before installation of final hook-up and connection with the permanent plant SWMS systems, the issues of IE Bulletin No. 80-10 (Reference 11.4-19), dated May 6, 1980, will be evaluated by the COL holder for the express purpose of ensuring that systems considered as non-radioactive, but could become radioactive through interfaces with radioactive systems, remain non-radioactive.

11.4.4 Testing and Inspection Requirements

The SWMS is given a pre-operational test as discussed in Chapter 14. Thereafter, portions of the subsystems are tested as needed.

The COL holder is responsible for testing new and subsequent mobile systems. These tests should include provisions of Regulatory Guide 8.8 (Reference 11.4-4), as applicable.

During initial testing of the system, the pumps and the other equipment will be performance tested to demonstrate conformance with design flows and process capabilities. An integrity test is performed on the system upon completion.

Provisions are made for periodic inspection of major components to ensure capability and integrity of the subsystems.

The quality assurance program for design, fabrication, procurement, and installation of the solid radioactive waste system is in accordance with the overall quality assurance program described in Chapter 17.

11.4.5 Instrumentation Requirements

The SWMS is operated and monitored from the radwaste control room or local operating stations within the facility. Major system parameters, i.e., tank levels, process flow rates, etc., are indicated (recorded and alarmed as required) to provide operational information and performance assessment. Key system alarms are repeated in the main control room. Instruments, including back flushing provisions, are located in low radiation areas when possible, as described in

11.5.6 Calibration and Maintenance

11.5.6.1 Inspection and Tests

During reactor operation, daily checks of system operability are made by observing channel behavior. At periodic intervals during reactor operation, the detector response of each monitor provided with a remotely positioned check source is verified, together with the instrument background count rate, to ensure proper functioning of the monitors. Any detector whose response cannot be verified by observation during normal operation or by using the remotely positioned check source is response checked with a portable radiation source. A record is maintained showing the background radiation level and the detector response.

The system incorporates self-diagnostics and online calibration for its process radiation monitors that operate continuously to assure maximum availability and minimum down time. In addition, a provision for using test signals for checking system operability is included in the design. Also, each radiation channel is tested and calibrated periodically using a standard radiation source to validate channel operability.

The following monitors have alarm trip circuits that can be tested by using test signals or portable gamma sources:

- MSL,
- Reactor Building HVAC Exhaust,
- Refuel Handling Area HVAC Exhaust,
- Control Building Air Intake HVAC,
- FB General Area HVAC,
- Isolation Condenser Vent Exhaust,
- TB Normal Ventilation Air HVAC,
- TB Compartment Area Air HVAC,
- Charcoal Vault Ventilation,
- Drywell Sump LCW/HCW Discharge,
- TSC HVAC Air Intake,
- Offgas Pre-treatment,
- FB Fuel Pool HVAC, and
- Containment Purge Exhaust HVAC.

The following monitors include built-in check sources:

- Offgas Post-treatment,
- Liquid Radwaste Discharge,
- Radwaste Building Ventilation Exhaust,
- Main Turbine Gland Seal Steam Condenser Exhaust,

- TB Combined Ventilation Exhaust,
- Drywell Fission Product,
- Reactor Component Cooling Water Intersystem Leakage,
- FB Combined Ventilation Exhaust, and
- Plant Stack.

The quality assurance program for design, fabrication, procurement, and installation of the PRMS is in accordance with the overall quality assurance program described in Chapter 17.

11.5.6.2 Calibration

Calibration of radiation monitors is performed using certified commercial radionuclide sources traceable to the National Institute of Standards and Technology. Each continuous monitor is calibrated during plant operation or during the refueling outage if the detector is not readily accessible. Calibration can also be performed on the applicable instrument by using liquid or gaseous radionuclide standards or by analyzing particulate iodine or gaseous grab samples with laboratory instruments.

11.5.6.3 Maintenance

Control and routine maintenance and cleaning operations of the sampling systems is conducted from either the front or the top of the skid or panel. Lifting eyes or other devices are provided for hoisting the units, to facilitate replacement if it is ever required.

Instrument modules are design to facilitate calibration checks and troubleshooting. Accessibility for power supply adjustments is provided.

Sampling racks and electronic modules are serviced and maintained on an annual basis or in accordance with the operational instructions to ensure reliable operation. Such maintenance includes servicing and replacement of defective components and adjustments, as required, after performing a test or calibration check. If any work is performed that would affect the calibration of the instrument, a re-calibration is performed following the maintenance operation.

11.5.7 COL Information

11.5.7.1 The analysis sensitivities derivation of each Subsystem's Lower Limit of Detection is to be determined by the COL Applicant based on site specific conditions and operating characteristics of each installed effluent radiation monitoring subsystem.

11.5.7.2 Offsite Dose Calculation Manual

The COL Applicant will also develop an ODCM that contains the methodology and parameters used for calculation of offsite doses resulting from gaseous and liquid effluents. The COL Applicant will address operational setpoints for the radiation monitors and address programs for monitoring and controlling the release of radioactive material to the environment, which eliminates the potential for unmonitored and uncontrolled release. The ODCM will include planned discharge flow rates.

Table 17.0-1

Compliance With Quality Assurance Related Regulatory Guides

Regulatory Guide No.	Revision	Comments
RG 1.8	3	COL holder scope
RG 1.21	1	COL applicant scope
RG 1.26	3	No exception
RG 1.28	3	Except for NRC-accepted alternate positions in Table 2-1 of Reference 17.0-1
RG 1.29	3	No exception
RG 1.30	0	No exception
RG 1.33	2	COL holder scope
RG 1.37	0	Except for NRC-accepted alternate positions in Table 2-1 of Reference 17.0-1
RG 1.38	2	Except for NRC-accepted alternate positions in Table 2-1 of Reference 17.0-1
RG 1.39	2	No exception
RG 1.54	1	No exception
RG 1.58	Withdrawn	Superseded by Regulatory Guide 1.28, Rev. 3
RG 1.64	Withdrawn	Superseded by Regulatory Guide 1.28, Rev. 3, except for NRC-accepted alternate positions in Table 2-1 of Reference 17.0-1
RG 1.74	Withdrawn	Superseded by Regulatory Guide 1.28, Rev. 3
RG 1.88	Withdrawn	Superseded by Regulatory Guide 1.28, Rev. 3
RG 1.94	1	COL holder scope
RG1.97	4	No exception
RG 1.116	0-R	No exception
RG 1.123	Withdrawn	Superseded by Regulatory Guide 1.28, Rev. 3
RG 1.143	2	No exception
RG 1.144	Withdrawn	Superseded by Regulatory Guide 1.28, Rev. 3
RG 1.146	Withdrawn	Superseded by Regulatory Guide 1.28, Rev. 3
RG 1.152	2	No exception

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The following PRMS subsystems are provided to meet the above design objectives:

- Monitoring Gaseous Effluent Streams;
  - Plant Stack RMS,
  - TB Normal Ventilation Air HVAC RMS,
  - TB Compartment Area Air HVAC RMS,
  - Radwaste Building Ventilation Exhaust RMS,
  - Main Turbine Gland Seal Steam Condenser Exhaust RMS,
  - FB Combined Ventilation Exhaust RMS, and
  - TB Combined Ventilation Exhaust RMS.
- Monitoring Liquid Effluent Streams;
  - Liquid Radwaste Discharge RMS.
- Monitoring Gaseous Process Streams;
  - MSL RMS,
  - Offgas Pre-treatment RMS,
  - Offgas Post-treatment RMS,
  - Charcoal vault ventilation RMS, and
  - Drywell Fission Product RMS.
- Monitoring Liquid Process Streams; and
  - Reactor Component Cooling Water Intersystem Leakage RMS.
- Monitoring Gaseous Intake Streams.
  - TSC HVAC Air Intake RMS.

11.5.2 System Design Bases and Criteria

The instrumentation used in the subsystems of the PRMS is designed to be in conformance with the relevant requirements and guidelines of:

- 10 CFR 20.1302 (Reference 11.5-1), 10 CFR 20 Appendix B (Reference 11.5-16), 10 CFR 50.34a (Reference 11.5-2), 10 CFR 50.36a (Reference 11.5-4).
- 10 CFR 50, Appendix A, GDC 19 (Reference 11.5-17), 60 (Reference 11.5-5), 63 (Reference 11.5-6), and 64 (Reference 11.5-7).
- 10 CFR 50 Appendix I (Reference 11.5-8).
- 10 CFR 50.34 (f) (2) (viii),10 CFR 50.34 (f) (2) (xvii), 10 CFR 50.34 (f) (2) (xxvii), and 10 CFR 50.34 (f) (2) (xxviii) (Reference 11.5-3).
- Regulatory Guides (RG) 1.21 (Reference 11.5-9), 1.45 (Reference 11.5-10), 1.97 (Reference 11.5-11), 4.15 (Reference 11.5-12).

11.5.3.2.13 Technical Support Center HVAC Air Intake RMS

This subsystem continuously monitors the intake air ventilation duct of the TSC with a single gamma sensitive radiation monitor. Upon detection of radioactivity, the Air Handling Unit (AHU) outdoor air damper for the TSC is closed and the filter train fan is started.

This monitor provides upscale and inoperative alarms that are alarmed in the MCR.

The range of channel measurement and display is given in Table 11.5-1 and Table 11.5-2. The range is selected to cover the normal radiation background up to, and several decades beyond, the dose rate given in 10 CFR 50 Appendix A GDC 19 (Reference 11.5-17). Under normal conditions, only background radioactivity is anticipated at the TSC HVAC intake.

11.5.3.2.14 Plant Stack RMS

The Plant Stack RMS will be used to monitor particulate, iodine and gaseous concentrations in the main stack effluent for both normal and accident plant conditions. It will be composed of three sampling channels that are designed to meet the requirements of both 10 CFR 20.1302 (Reference 11.5-1) for effluent releases and Regulatory Guide 1.97 (Reference 11.5-11) for accident effluent releases.

The dynamic range is selected to demonstrate compliance with RG 1.21 (Reference 11.5-9) and 1.97 (Reference 11.5-11) normal and post accident releases. In addition, the capability of the subsystem is such that if multiple indications are needed, sufficient decade overlap, via different instruments, is provided for measurement and display.

Provisions for grab sample collection are provided and can be used for isotopic analysis and monitor calibration.

Provisions for monitoring tritium will also be provided.

A sample, continuously extracted from the stack, passes through the panel and returns to the stack exhaust. Sampling is done in accordance with ANSI/HPS N13.1-1999 (Reference 11.5-13). Automatic compensation for variation in stack flow is provided to maintain the sample panel flow proportional to the main flow. The subsystem will have provisions for purging the sample panel with room air to check detector response to the background radiation level reading.

The subsystem has a remotely controlled radioactive check source.

Also, abnormal flow, measured at the sample panel, is annunciated in the MCR.

The Plant Stack RMS is nonsafety-related. The stack is sampled continuously for the full range of concentrations between normal conditions and those postulated in Regulatory Guide 1.97 (Reference 11.5-11). The Plant Stack radiation monitor is a post-accident monitor and meets the guidelines of Regulatory Guide 1.97 (Reference 11.5.11), ~~and~~ which endorses (with certain exceptions specified in Section C of the Regulatory Guide) IEEE Std. 497. The IEEE Std. 497 establishes flexible, performance based criteria for selection, performance, design, qualification display, and quality assurance of accident monitoring variables. See Subsection 7.5.1.3.1.4 for a completed discussion of Regulatory Guide 1.97 compliance. NUREG-0737 (Reference 11.5-15) conformance is described in Subsections 7.1.5.1.2 and 7.1.5.5.1. The plant vent radiation monitor also provides data for plant effluent release reports identified in Regulatory Guide 1.21 (Reference 11.5-9).

Procedures for Maintenance and Modification

Maintenance and modification procedures that require operator actions to be taken in the MCR or RSS shall be prepared as appropriate.

Procedures for Radiation Control

Procedures for the control of radioactive releases as discussed in Section A7 (d) of ANSI/ANS-3.2 1994: R1999, as endorsed by Regulatory Guide 1.33 Rev. 2, shall be prepared as appropriate.

Procedures for Calibration, Inspection and Testing

Calibration, inspection and testing procedures that require operator actions to be taken in the MCR or RSS shall be prepared as appropriate. The COL holder will ensure that all portions of the safety-related logic circuitry are adequately covered in the surveillance procedures as described in Generic Letter 96-01.

Procedures for Radiation Monitoring

Procedures for the monitoring of radioactive releases as discussed in Subsection 5.3.4.4 of ANSI/IEEE 3.2 1994: R1999, as endorsed by Regulatory Guide 1.33 Revision 2, shall be prepared as appropriate.

13.5.4 References

13.5-1 NEDO-33276, ESBWR HFE Verification and Validation Implementation Plan, Revision 0, May 2006.

13.5-2 ANSI/ANS-3.2-1994: R1999, Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants.

13.5-3 NUREG-0737, Clarification of TMI Action Plan Requirements, November 1980.

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11.5.4.2 Expected Radiation Levels

Expected radiation levels are provided in Tables 11.5-1 and 11.5-2.

11.5.4.3 Instrumentation

Grab samples are analyzed to identify and quantify the specific radionuclides in effluents. The results from the sample analysis are used to establish relationships between the gross gamma monitor readings and concentrations or release rates of radionuclides in continuous effluent releases. Tables 11.5-4 through 11.5-8 provide summary information concerning the frequency, analysis, sensitivity and purpose for both liquid and gaseous process and effluent extracted samples that are analyzed in the health physics laboratory. Table 11.5-9 provides information concerning the selection of dynamic ranges for monitoring.

11.5.4.4 Setpoints

The trip setpoints for effluent and discharge safety-related radiation monitors are specified in the Offsite Dose Calculation Manual (ODCM) required by plant TS. Trip setpoints for nonsafety-related radiation monitors are specified in the plant Operating Procedures.

11.5.4.5 Offsite Dose Calculation Manual

The COL ~~Holder~~ Applicant will also develop an ODCM that contains the methodology and parameters used for calculation of offsite doses resulting from gaseous and liquid effluents. The COL ~~Holder~~ Applicant will address operational setpoints for the radiation monitors and address programs for monitoring and controlling the release of radioactive material to the environment, which eliminates the potential for unmonitored and uncontrolled release. The ODCM will include planned discharge flow rates.

11.5.4.6 Process and Effluent Monitoring Program

In addition, the COL ~~Holder~~ Applicant is responsible for the site-specific programs, (Radiological Effluent Monitoring Program, and associated Radiological Effluent Technical Specifications, and the National Pollutant Discharge Elimination System permit) aspects of the process and effluent monitoring and sampling per ANSI N13.1 (Reference 11.5-13) and Regulatory Guides 1.21 (Reference 11.5-9) and 4.15 (Reference 11.5-12).

11.5.4.7 Site Specific Offsite Dose Calculation

The COL ~~Holder~~ Applicant is responsible for addressing 10 CFR 50, Appendix I (Reference 11.5-8) guidelines for maximally exposed offsite individual doses and population doses via liquid and gaseous effluents.

11.5.4.8 Instrument Sensitivities

The COL ~~Holder~~ Applicant is responsible for the sensitivities, frequencies and basis for each gaseous and liquid samples.

11.5.7 COL Information

11.5.7.1 The derivation of each Subsystem's Lower Limit of Detection is to be determined by the COL ~~Holder~~ Applicant based on site specific conditions and operating characteristics of each installed effluent radiation monitoring subsystem.

11.5.7.2 Offsite Dose Calculation Manual

The COL ~~Holder~~Applicant will also develop an ODCM that contains the methodology and parameters used for calculation of offsite doses resulting from gaseous and liquid effluents. The ~~COL Holder~~COL Applicant will address operational setpoints for the radiation monitors and address programs for monitoring and controlling the release of radioactive material to the environment, which eliminates the potential for unmonitored and uncontrolled release. The ODCM will include planned discharge flow rates.

The COL ~~Holder~~ Applicant will evaluate site-specific conditions and requirements in assessing radiation exposure, including N_{16} source and skyshine doses to members of the public in the ODCM in accordance with 10 CFR 20.1301 (e) and 10 CFR 20.1302.

11.5.7.3 Process and Effluent Monitoring Program

In addition, the COL ~~Holder~~ Applicant is responsible for the site-specific program aspects of the process and effluent monitoring and sampling per ANSI N13.1 (Reference 11.5-13) and Regulatory Guides 1.21 (Reference 11.5-9) and 4.15 (Reference 11.5-10).

11.5.7.4 Site Specific Offsite Dose Calculation

The COL ~~Holder~~ Applicant is responsible for addressing 10 CFR 50, Appendix I (Reference 11.5-8) guidelines for maximally exposed offsite individual doses and population doses via liquid and gaseous effluents.

11.5.7.5 Instrument Sensitivities

The COL ~~Holder~~Applicant is responsible for the sensitivities, frequencies and basis for each gaseous and liquid samples.

11.5.8 References

11.5-1 Title 10 Code of Federal Regulations Part 20.1302, "Compliance with Dose Limits for Individual Members of the Public."

11.5-2 Title 10 Code of Federal Regulations Part 50.34a, "Design Objectives for Equipment to Control Releases of Radioactive Material in Effluents-Nuclear Power Plants."

11.5-3 Title 10 Code of Federal Regulations Parts 50.34 (f)(2)(xiii), 50.34(f)(2)(xvii), 50.34 (f)(2)(xxvii), and ~~10 CFR~~ 50.34(f)(2)(xxvii).

11.5-4 Title 10 Code of Federal Regulations Part 50.36a, "Technical Specifications on Effluents from Nuclear Power Reactors."

11.5-5 Title 10 Code of Federal Regulations Part 50, Appendix A, General Design Criterion 60, "Control of Releases of Radioactive Materials to the Environment."

Table 11.5-2

Process Radiation Monitoring System (Gaseous and Airborne Monitors)

Radiation Monitor	Configuration	Dynamic Detection Range*	Principal Radionuclides Measured	Expected Activity **	Alarms*** & Trips
Radwaste Building Ventilation Exhaust	Offline	≈ 8 E -3 to 8 E 3 MBq/m^3 ≈ 2.6E -3 to 2.6 E 3 MBq/m^3 ≈ 7.4 E -7 to 7.4 E -1 MBq/m^3 ≈ 7.4 E-7 to 7.4E-1 MBq/m^3	Xe-133 Kr-85 Cs-137 I-131	** ** ** **	Abnormal Flow DNSC/INOP High High-High
FB Combined Ventilation Exhaust	Offline	≈ 8 E -3 to 8 E 3 MBq/m^3 ≈ 2.6 E -3 to 2.6 E 3 MBq/m^3 ≈ 7.4 E -7 to 7.4 E-1 MBq/m^3 ≈ 7.4 E -7 to 7.4 E -1 MBq/m^3	Xe-133 Kr-85 Cs-137 I-131	** ** ** **	Abnormal Flow DNSC/INOP High High-High
TSC HVAC Air Intake	Inline and internal to HVAC intake duct	≈ 8 E0 to 8E4 MBq/m^3 ≈ 1.7E2 to 1.7E 6 MBq/m^3	Xe-133 Kr-85	** **	DNSC/INOP High High-High

* Dynamic detection ranges are estimated and will be adjusted according to plant unique configurations and radiation background.

** Activity levels are expected to be at the subsystem's lower limit of detection (LLD). The derivation of each LLD is to be determined by the COL ~~Holder~~ Applicant based on site-specific conditions and operating characteristics of each installed effluent radiation monitoring subsystem. See Section 12.2 for expected activity of various processes and effluents.

*** Bq/ m^3 = Becquerels per cubic meter, MB/m^3 = Mega Becquerels per cubic meter; DNSC/INOP = downscale/inoperative; Abnormal Flow = High or Low flow in the sampling system outside system limits

Table 11.5-5

Provisions for Sampling Liquid Streams

No.	Process Systems as listed in NUREG-0800, SRP 11.5 Table 2 (Draft Rev. 4)	ESBWR System (s) that Perform the Equivalent SRP 11.5 Function (Note 1)	In Process	In Effluent	
			Grab Notes 2 & 7	Grab Notes 2 & 7	Continuous Notes 2 & 7
7.	Chemical & Regeneration Solution Waste Systems	Chemical Waste Drain Subsystem	-	S&A, H3	(S&A) Notes 6 & 8
8.	Laboratory & Sample System Waste Systems	Chemical Waste Drain Subsystem	-	S&A, H3	(S&A) Notes 6 & 8
9.	Laundry & Decontamination Waste Systems	Detergent Drain Subsystem	-	S&A, H3	(S&A) Notes 6 & 8
10.	Resin Slurry, Solidification & Baling Drain Systems	Equipment (Low Conductivity) Drain Subsystem, Floor (High) Drain Subsystem	-	S&A, H3	(S&A) Notes 6 & 8
11.	Storm & Underdrain Water System	COL ~~Holder~~ Applicant Note 4	-	(S&A, H3) Notes 3 & 6	(S&A) Notes 3 & 6
12.	Tanks and Sumps Inside Reactor Building	Equipment (Low Conductivity) Drain Subsystem, Floor (High) Drain Subsystem, Chemical Waste Drain Subsystem, Detergent Drain Subsystem	-	S&A, H3	(S&A) Notes 6 & 8
13.	Ultrasonic Resin Cleanup Waste Systems	Note 5	-	Note 5	Note 5

Table 11.5-5

Provisions for Sampling Liquid Streams

No.	Process Systems as listed in NUREG-0800, SRP 11.5 Table 2 (Draft Rev. 4)	ESBWR System (s) that Perform the Equivalent SRP 11.5 Function (Note 1)	In Process	In Effluent	
			Grab Notes 2 & 7	Grab Notes 2 & 7	Continuous Notes 2 & 7
14.	Non-Contaminated Waste Water System	COL ~~Holder~~ Applicant Notes 3 & 4	-	(S&A, H3) Notes 3, 4 & 6	(S&A) Note 4

Notes for Table 11.5–5:

1. Table 11.5-5 addresses sampling provisions for BWRs as identified in Table 2 of SRP 11.5. For process systems identified for BWRs in Table 2, but not shown in Table 11.5-5, those systems are not applicable to ESBWR. In some cases, there are multiple subsystems that are used to perform the overall equivalent SRP function and are listed as such in the column.
2. S&A=Sampling & Analysis of radionuclides, to include gross radioactivity, identification and concentration of principal radionuclides and concentration of alpha emitters; R=Gross radioactivity (beta radiation, or total beta plus gamma); H3=Tritium
3. Liquid Radwaste is processed on a batch-wise basis. The Liquid Waste Management System sample tanks can be sampled for analysis of the batch. See Subsection 11.2.2.2 for more information on Liquid Radwaste Management.
4. The COL ~~Holder~~ Applicant will provide design of wastewater effluent systems that monitor the storm, the cooling system tower blow down and sanitation wastes. See Subsection 9.2.4 for additional information.
5. The ESBWR does not include ultrasonic resin cleanup waste system at this time. Should one be installed, the Liquid Waste Management System would provide sampling and monitoring provisions.
6 The use of parenthesis indicates that these provisions are required only for the systems not monitored, sampled, or analyzed (as indicated) prior to release by downstream provisions.
7. The sensitivity of detection, also defined here as the Lower Limit of Detection (LLD), for each indicated measured variable, will be based on the applicable radionuclide (or collection of radionuclides as applicable) as given in 10 CFR 20 Appendix B and as supplemented by RG 1.21.
8. Processed through radwaste Liquid Waste Management System (LWMS) prior to discharge. Therefore, this process system is monitored, sampled, or analyzed prior to release by downstream provisions. See Note 6 above. Depending on Utility's discretion, additional sampling lines may be installed. Continuous Effluent sampling is not required per Standard Review Plan 11.5 Draft Rev. 4, April 1996, Table 2 for this system function.