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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 93 Related to ESBWR Design Certification Application, Radiation Protection ITAAC, RAIs 14.3-134 Through 14.3-137**

Enclosure 1 contains GE's response to the subject NRC RAIs transmitted via the Reference 1 letter.

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

D068
NRO

Reference:

1. MFN 07-106, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 93 Related to ESBWR Design Certification Application,* January 31, 2007.

Enclosure:

1. MFN 07-355, Response to a Portion of NRC Request for Additional Information Letter No. 93, Related to ESBWR Design Certification Application, Radiation Protection ITAAC, RAI Numbers 14.3-134 Through 14.3-137

cc:	AE Cubbage	USNRC (with enclosures)
	DH Hinds	GEH (with enclosures)
	RE Brown	GEH (w/o enclosures)
	eDRF	0000-0068-4600

ENCLOSURE 1

MFN 07-355

Response to a Portion of NRC Request for

Additional Information Letter No. 93,

Related to ESBWR Design Certification Application,

Radiation Protection ITAAC,

RAI Numbers 14.3-134 Through 14.3-137

NRC RAI No. 14.3-134:

Provide radiation shielding ITAAC that verifies, through inspection and/or calculation, that the as-built structures, systems and components, result in dose rates in rooms and areas of the plant that are consistent with the planned access requirements described in the table on page 12.3-7 in DCD Tier 2, Revision 2, Section 12.3.1.3, Radiation Zoning.

GE Response:

Radiation shielding ITAAC are defined in the attached markup to Tier 1, Table 3.4-1.

DCD Impact:

Tier 1, Table 3.4-1 will be revised as noted on the attached markup.

NRC RAI No. 14.3-135:

Provide ITAAC that verifies that the as-built plant layout, and components are such that:

a) areas likely to be High Radiation Areas [identify], greater than 1000 mrem/hr (10 mSv/hr) are provided with barriers so personnel access can be physically controlled; and

b) an individual is not able to gain unauthorized access to dose rates in excess of 500 rem/hr (5.0 Sv/hr) [list these areas].

GE Response:

The controls on specific radiation areas is outside the scope of the DCD, and can only be addressed in detail on a plant-specific basis. On a generic basis, general radiation zoning is described in DCD Tier 2, Subsection 12.3.1.3. The level of detail requested is not within the scope of Tier 2, which is (by regulation) the source of information for Tier 1, and thus, cannot be in Tier 1.
Therefore, the RAI's requested information should be addressed on a plant-specific basis.

DCD Impact:

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

NRC RAI No. 14.3-136:

Provide ITAAC that verify the design commitments (sensitivity, range, calibration, alarm function, and power supply) of area radiation monitors in areas of the plant [list] where plant evolutions, or anticipated operational occurrences, can result in accessible dose rate increases of 100 mrem/hr (1mSv/hr) or more. The list should include, but not be limited to, monitors in fuel handling areas, steam affected areas, and radwaste transfer affected areas.

GE Response:

ITAAC for all area radiation monitors (ARMs) currently reside in Tier 1, Table 2.3.2-2.

DCD Impact:

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

NRC RAI No. 14.3-137:

Revise the Tier 1 Radiation Protection design description (Section 3.4 of DCD Tier 1) to reflect that the ESBWR main condenser will be fitted with corrosion resistant condenser tubes and tubesheets, in concert with the GE response to NRC RAI 12.5-5 (GE letter MFN 06-371, ADAMS Accession Number ML063060115).

GE Response:

Tier 1, Section 3.4 will be revised to reflect the DCD Tier 2, Revision 3, Subsection 12.4.4 text, which contains the information in the RAI 12.2-5 response (MFN letter number 06-371, dated October 18, 2006).

DCD Impact:

Tier 1, Section 3.4 will be revised as noted on the attached markup.

3.4 RADIATION PROTECTION

Design Description

The ESBWR Standard Plant is designed in accordance with Regulatory Guide 8.8, i.e., to keep radiation exposures to plant personnel as low as reasonably achievable (ALARA). This section describes the component and system designs in addition to the equipment layout employed to maintain radiation exposures ALARA. Consideration of individual systems is provided to illustrate the application of these principles.

Material selection for primary coolant piping, tubing, vessel internal surfaces, and other components in contact with the primary coolant is discussed in the following paragraphs.

Carbon steel is used in a large portion of the system piping and equipment outside of the nuclear steam supply system. Carbon steel is typically low in nickel content and contains a very small amount of cobalt impurity.

Stainless steel is used in portions of the system such as the reactor internal components and heat exchanger tubes where high corrosion resistance is required. The nickel content of the stainless steels is in the 9 to 10.5% range and is controlled in accordance with applicable ASME material specifications. Cobalt content is controlled to less than 0.05% in the XM-19 alloy used in the control rod drives.

Ni-Cr-Fe alloys such as Inconel 600 and Inconel X750, which have high nickel content, are used in some reactor vessel internal components. These materials are used in applications for which there are special requirements to be satisfied (such as possessing specific thermal expansion characteristics along with adequate corrosion resistance) and for which no suitable alternative low-nickel material is available. Cobalt content in the Inconel X750 used in the fuel assemblies is limited to 0.05%.

Stellite is used for hard facing of components that must be extremely wear resistant. Use of high cobalt alloys such as Stellite is restricted to those applications where no satisfactory alternative material is available. An alternative material (Colmonoy) has been used for some hard facings in the core area.

The condenser tube material (with compatible tubesheet material) is corrosion resistant (e.g., titanium or stainless steel) which reduces leakage of corrosion products into the Condensate and Feedwater System.

The radiation shielding protects operating personnel and the general public from radiation emanating from the reactor, the power conversion systems, the radwaste process systems, and the auxiliary systems, while maintaining appropriate access for operation and maintenance. The radiation shielding keeps radiation doses to equipment below levels at which disabling radiation damage occurs.

Specifically, the shielding requirements in the plant are designed to perform the following functions:

- Limit the exposure of the general public, plant personnel, contractors, and visitors to levels that are ALARA and within 10 CFR 20 requirements;

- Limit the radiation exposure of personnel, in the unlikely event of an accident, to levels that are ALARA and which conform to the limits specified in 10 CFR 50, Appendix A, Criterion 19 to ensure that the plant is maintained in a safe condition during an accident; and
- Limit the radiation exposure of critical components within specified radiation tolerances, to assure that component performance and design life are not impaired.

The radiation control aspects of the HVAC systems apply the following design objectives:

- The systems shall be designed to make airborne radiation exposures to plant personnel and releases to the environment ALARA. To achieve this objective, the guidance provided in Regulatory Guide 8.8 shall be followed.
- The concentration of radionuclides in the air in areas accessible to personnel for normal plant surveillance and maintenance will be below the concentrations that define an airborne radioactive area in 10 CFR 20 during normal power operation. This is accomplished by establishing in each area a reasonable compromise between specifications on potential airborne leakages in the area and HVAC flow through the area.

The following systems are provided to monitor area radiation and airborne radioactivity within the plant:

- The Area Radiation Monitoring System (ARMS) continuously measures, indicates and records the gamma radiation levels at strategic locations throughout the plant except within the primary containment, and activates alarms in the MCR as well as in local areas to warn operating personnel to avoid unnecessary or inadvertent exposure to radiation. This system is classified as nonsafety-related.
- The Containment Monitoring System (CMS) continuously measures, indicates, and records the gamma radiation levels within the primary containment (drywell and suppression chamber), and activates alarms in the MCR on high radiation level.
- Airborne radioactivity in effluent releases and ventilation air exhausts is continuously sampled and monitored by the Process Radiation Monitoring System (PRMS) for noble gases, air particulates and halogens. Airborne contamination is sampled and monitored at the stack common discharge, in the off-gas releases, and in the ventilation exhaust from the reactor, radwaste and turbine buildings. Samples are periodically collected and analyzed for radioactivity. In addition to this instrumentation, portable air samplers are used for compliance with 10 CFR 20 restrictions to check for airborne radioactivity in work areas prior to entry where potential radiation levels may exit that exceed the allowable limits. The radiation instrumentation that monitors airborne radioactivity is classified as nonsafety-related.

The locations requiring access to mitigate the consequences of an accident during the 100-day post-accident period are the control room, the technical support center, the remote shutdown panels, the primary containment sampling locations, the health physics facility (counting room), the isolation condenser (IC) pool refill nozzles, and the nitrogen gas supply bottles. Each area has low post LOCA radiation levels. The dose evaluations are within regulatory guidelines.

The post-accident radiation zone maps for the areas in the Reactor Building have been developed. These zone maps represent the maximum gamma dose rates that exist in these areas during the post-accident period.

Inspections, Tests, Analyses and Acceptance Criteria

Table 3.4-1 provides definitions of the inspections, test and/or analyses, together with associated acceptance criteria for ventilation and airborne monitoring and shielding.

Table 3.4-1

ITAAC For Ventilation and Airborne Monitoring and Shielding

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
3. The plant design shall provide radiation shielding for rooms, corridors and operating areas commensurate with their occupancy requirements.	3. Analyses (with inspections) of the expected radiation levels in each plant area will verify the adequacy of the shielding designs.	3. Analysis/inspection report(s) demonstrate that the maximum expected radiation dose rates in each plant area (deep dose equivalent measured at 30 cm from the source of the radiation, not contact dose rates) are no greater than the dose rates specified for the following zones, based on the access requirements of that area for plant operation and maintenance. Zone — Dose Rate (mSv/hr) — Access Requirements A — ≤ 0.006 — Uncontrolled, unlimited access B — 0.006 ≤ 0.01 — Controlled and unlimited access C — 0.01 ≤ 0.05 — Controlled and limited access (20 hr/week) D — 0.05 ≤ 0.25 — Controlled and limited access (4 hr/week) E — 0.25 ≤ 1 — Controlled and limited access (1 hr/week) F — 1 ≤ 10 — Limited and controlled access with special

Table 3.4-1

ITAAC For Ventilation and Airborne Monitoring and Shielding

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria		
				authorization permit required
		G	10 ≤ 100	Same as Zone F
		H	100 ≤ 1000	Same as Zone F
		I	1000 ≤ 5000	Same as Zone F
		J	> 5000	Inaccessible during power and shutdown operations