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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 60 – Radiation Protection – RAI Numbers 12.3-11 and 12.7-1**

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

General Electric Company

D068
NRO

Reference:

1. MFN 06-342, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 60 Related to the ESBWR Design Certification Application*, September 18, 2006

Enclosures:

1. MFN 07-222– Response to Portion of NRC Request for Additional Information Letter No. 60 – Radiation Protection – RAI Numbers 12.3-11 and 12.7-1

cc:	AE Cubbage	USNRC (with enclosures)
	GB Stramback	GE/San Jose (with enclosures)
	RE Brown	GE/Wilmington (with enclosures)
	eDRF	0067-0572 for RAI 12.3-11
		0067-4014 for RAI 12.7-1

Enclosure 1

MFN 07-222

Response to Portion of NRC Request for Additional Information Letter No. 60 Related to ESBWR Design Certification Application

Radiation Protection

RAI Numbers 12.3-11 and 12.7-1

NRC RAI No. 12.3-11:

Chapter 12 of the DCD Tier 2, notes that the conventional BWR traversing in-core probe (TIP) system has been replaced in the ESBWR with a fixed in-core detector (AFIP) system for calibrating the local power range monitors (LPRMs) in the reactor. This eliminates the TIPs as an in-plant radiologic hazard. However, DCD Tier 2, Section 1.2 states that the "AFIP sensors in an LPRM assembly are replaced together with the LPRM detectors when the whole LPRM assembly is replaced." What is the expected frequency of AFIP/LPRM assembly replacement? What is the radiation source term associated with the combined AFIP/LPRM assembly? What provisions are made in the ESBWR design to facilitate removal the reactor, storage and disposal of these activated assemblies?

GE Response:

The design lifetime of the AFIP is intended to be at least as long as the LPRM it resides within. The LPRMs are designed to reach end of life between 1.8 and 2.5E+22 nvt thermal neutron fluence, which is approximately 7 to 10 full power years. This is the fluence at which the neutron contribution to total response of the LPRM is predicted to become less than 5 times the gamma contribution. The detector, cabling, mechanical integrity, and electrical integrity shall be designed to withstand the radiation and water conditions inside the reactor core.

Tests have proven the GT to function after 2 fuel cycles (4 years) as a thermal power monitoring sensor and GTs have been proven to remain operational for a period of almost 14 years inside Arkansas Nuclear One. It should be noted that the GTs used in this case were for level monitoring and not power monitoring sensors, but were of the same general construction as power monitoring GTs.

The source term expected from the AFIP/LPRM assembly is comparable to the activation energies of BWR-6 and ABWR LPRM assemblies.

The second bullet of DCD Tier 2, Revision 3, Section 4.1.2.1 states that "all in-core instrument leads enter from the vessel bottom; this allows instrument assemblies to remain undisturbed in service through refueling." The LPRM assemblies are to be removed from the vessel while the vessel is open. The assemblies will then be placed into the Spent Fuel Pool. Once the assemblies have adequately decayed, they are to be cut up into smaller segments. Based upon the waste characteristics of the segmented piece, the segment can be disposed of as low specific activity waste (LSA), transported as other waste classifications or placed in the spent fuel pool for storage.

DCD Impact:

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

NRC RAI No. 12.7-1:
Section 5.2 of NUREG/CR-3587 lists several decommissioning facilitation techniques that are applicable during the design and construction phase of a commercial nuclear power light water reactor. Describe to what extent each of these features were incorporated in the ESBWR design, or describe why the recommendation is not practical. Provide illustrative examples.

GE Response:
Guidance from the October 10, 2006 NRC memorandum from Larry Camper, Office of Federal and State Materials and Environmental Management Programs to David Matthews, Office of New Reactors and Elmo Collins, Office of Nuclear Reactor Regulation (ADAMS #ML062620355) was used in addressing this RAI. Many of the techniques described in NUREG-CR-3587 have been consolidated into this memo. The lessons from the memo are stated below in italics, and the ESBWR design features that apply are then identified.

"Licensees should adequately characterize the subsurface hydrologic characteristics of a site prior to construction to understand how potential contamination resulting from daily operation of the facility will migrate through the soil and possibly into the groundwater."

DCD Tier 2, Chapter 2 provides the "Envelope of ESBWR Standard Plant Site Design Parameters" for licensee applicants to meet for the ESBWR design. In order the licensee to meet these criteria, a hydro-geologic study is performed, or existing study is used, such as Early Site Permit, to address the ESBWR Standard Plant Site Design Parameters.

"Licensees should incorporate design features that ensure that exposures are As Low As Reasonably Achievable (ALARA) during maintenance, component replacement, surveillance, and remote sampling near areas that typically are high-radiation and/or highly contaminated areas."

DCD Tier 2, Subsection 12.1.2.1 describes general ALARA considerations for the ESBWR design, and Subsection 12.1.2.2 describes equipment ALARA considerations for the ESBWR design. Additional design feature information considered for ALARA is provided throughout the DCD for the specific systems, structures and components incorporated in the ESBWR design.

"When designing enclosures for large pieces of equipment (e.g., steam generators, large piping, tanks, etc.), the licensee should determine how these pieces will be removed for replacement or permanently removed at the time of decommissioning."

Removal capability is provided for all equipment in compartments. Larger pieces transported off-site are normally cut-up for transportation ease and are removed thru conventional access openings in the building such as those discussed below.

The Reactor Building (RB) is designed for large equipment removal. DCD Tier 2, Figure 1.2-4 shows large doors for accessing the Room 1490 of the RB from the outside. There are doors from Room 1490 to the +13570, +17500, and +34000 elevations for movement of equipment, in DCD Tier 2, Figures 1.2-6, 1.2-7, and 1.2-9, respectively. Within the RB there are large equipment hatches and doors at the -1000 (DCD Tier 2, Figure 1.2-3) elevation. Hatches are also located at other elevations of the RB.

For the Radwaste Building, DCD subsection 11.2.2.3 discusses the mobile liquid radwaste systems, which are skid-mounted. The mobile systems are located in the Liquid Waste Treatment System bay to allow truck access and mobile system skid loading and unloading, and should ease the decommissioning process. Access to the bay in the Radwaste Building from the outside is through large doors, which provide for easy installation and removal of large equipment.

Access to the Fuel Building is through the washdown bays at the +4650 elevation. There also is an equipment access hatch located in the northwest corner of the Fuel Building for equipment movement and removal.

The Turbine Building also contains a large door for large equipment removal. This door feeds into the very large main equipment hatch (Turbine Building Room 4394).

"Plant designs should minimize the use of embedded pipes, to the extent practicable, consistent with maintaining radiation doses ALARA during operations and decommissioning. Embedded pipes, especially those that are small in diameter (less than 6 inches), could complicate decommissioning activities because they can be very difficult to remove or to survey."

In general, embedded piping is avoided in the design since the structures are heavily reinforced and it is difficult to accommodate piping. Usually thru-slab sleeves are used and the piping run against the ceiling of the room, such as for floor drain lines. Text was added in DCD Revision 3 to address this issue. DCD Tier 2, subsection 12.3.1.2.4 now states that minimization of short sections with embedded piping is being done to the extent practicable which facilitates dismantlement of the systems and decommissioning of the facility.

"Minor leaks over long periods of time can contribute to significant contamination in soil and groundwater that results in significant costs for remediation. Tanks (e.g., radioactive waste storage tanks, chemical storage tanks, etc.), spent fuel pools, and process/transfer lines should be designed to resist corrosion and minimize leaks. They should be provided with leak detection and monitoring capabilities. For example, the detection system of a spent fuel pool should be capable of detecting minor leaks from the pool. This system should have the ability to be flushed with clean water to remove small quantities of borated water, and dissolve boric acid solids resulting from minor leaks from the spent fuel pool wall and floor welds, bellows to transfer channels, and access gates areas. In addition, an operational program should be implemented throughout the life of the facility to monitor and remediate any leaks."

The liquid radwaste system (tanks, piping, etc.), Radwaste Building, and the radwaste tunnels are designed to conform to Regulatory Guide 1.143. The spent fuel pool has a leak detection system to monitor any leakage during plant operation, as discussed in Revision 3 of DCD Tier 2, subsection 3.8.4.2.5. The underground tunnels to and from the Radwaste Building contain radwaste piping. The concrete in these tunnels is sealed for ease of decontamination during operation. The tunnels have floor drains to remove any fluid that potentially could leak from the piping. Plant procedures require periodic visual inspection of the radwaste piping in the tunnels.

"Licensees should develop a quality assurance inspection program that ensures that grouted areas have no cracks or fissures to allow fluids to bypass the floor drain and move into unmonitored areas beneath the floors and foundations. Concrete grouted connections for floor drains should be constructed such that leaks and spills on the floor will be collected in the floor drains."

The floor drains are designed to be of monolithic construction and to minimize possibility of liquid penetrating at embedment boundaries. No grout is used in the installation of the floor drains. Periodic visual inspections of the installation around the floor drains will be performed to ensure that no bypass exists in these floor drain areas.

"Licensees should develop a floor/wall expansion joint inspection procedure so that floor and wall joints are installed properly to ensure that spills and leaks on the floors do not enter unmonitored areas beneath the floors and foundations."

Periodic visual inspections of the floor/wall expansion joints will be performed to ensure that no spills and leaks on the floors enter unmonitored areas beneath the floors and foundations.

"Licensees should ensure that concrete block walls, constructed to allow removal for future maintenance, or replacement of large components, are completely sealed to prevent intrusion of radioactive materials into the block interiors. Block walls that are not connected to the ceiling are not always sealed on top, allowing contamination to enter the walls. In addition, hollow and solid block walls that are sealed by concrete, paint, or other coatings, have been found with contamination inside the walls. Contamination has been found with walls that are connected to ceilings and free-standing walls that are not physically connected to the ceilings or roofs. On properly sealed walls, the ceilings are sealed or closed so that no contamination can enter."

There is no concrete block wall construction in ESBWR. Holes provided for removal of components is filled with interlocking metallic blocks filled with concrete for shielding purposes, as discussed in the last two paragraphs of DCD Tier 2, subsection 3.8.4. Therefore, there is no exposed porous concrete that could be contaminated, which provides for easier decommissioning.

DCD Impact:

DCD Tier 2, Revision 4, Section 12.6 will be revised as shown on the attached markup.

12.6 MINIMIZATION OF CONTAMINATION AND RADWASTE GENERATION

This section discusses how the ESBWR design procedures for operation will minimize contamination of the facility and environment, facilitate decommissioning, and minimize the generation of radioactive waste, in compliance with 10 CFR 20.1406.

12.6.1 Minimization of Contamination to Facilitate Decommissioning

Examples of ESBWR design procedures for operation that minimize contamination and facilitate decommissioning include the following:

- Design of equipment to minimize the buildup of radioactive material and to facilitate flushing of crud traps;
- Provision to design features such as the Reactor Water Cleanup/Shutdown Cooling System and the condensate demineralizer to minimize crud buildup;
- Provisions for draining, flushing, and decontaminating equipment and piping;
- Penetrations through outer walls of a building containing radiation sources are sealed to prevent miscellaneous leaks to the environment;
- Equipment drain sump vents are piped directly to the radwaste HVAC system to remove airborne contaminants evolved from discharges to the sump;
- Appropriately sloped floor drains are provided in areas where the potential for a spill exists to limit the extent of contamination. The floor drains are designed to be of monolithic construction and to minimize possibility of liquid penetrating at embedment boundaries. No grout is used in the installation of the floor drains. Periodic visual inspections of the installation around the floor drains will be performed to ensure that no bypass exists in these floor drain areas;
- Provisions for decontaminable wall and floor coverings which provide smooth surfaces to ease decontamination;
- Equipment and floor drain sumps are stainless steel lined to reduce crud buildup and to provide surfaces easily decontaminated;
- For all areas potentially having airborne radioactivity, the ventilation systems are designed such that during normal and maintenance operations, airflow between areas is always from an area of low potential contamination to an area of higher potential contamination;
- The reactor building HVAC system is divided into two major components: the contaminated and clean areas. The clean area system conditions and circulates air through all the clean areas of the reactor building; the contaminated area system conditions and circulates air through the contaminated areas of the building;
- The Fuel and Auxiliary Pools Cooling System (FAPCS), equipped with two independent filter demineralizer units, is designed to reduce pool water radioactive contamination in the major pools in the ESBWR;

- The ESBWR is designed to limit the use of cobalt bearing materials on moving components that have historically been identified as major sources of in-water contamination;
- To facilitate decommissioning, the Reactor, Fuel, Turbine, and Radwaste Buildings are all designed for large equipment removal, consisting of entry doors from the outside and numerous equipment hatches within the buildings;
- The mobile liquid radwaste systems are skid-mounted and are located in the Liquid Waste Treatment System bay to allow truck access and mobile system skid loading and unloading, to ease the decommissioning process;
- For some piping, feed-throughs with short sections, the piping may be embedded in concrete as discussed in subsection 12.3.1.2.4. Minimization of short sections with embedded piping to the extent practicable facilitates the dismantlement of the systems and the decommissioning of the facility;
- In consideration of minor leaks over long periods of time, the liquid radwaste system (tanks, piping, etc.), Radwaste Building, and the radwaste tunnels are designed to conform to Regulatory Guide 1.143. The spent fuel pool has a leak detection system to monitor any leakage during plant operation, as discussed in Revision 3 of DCD Tier 2, subsection 3.8.4.2.5. The underground tunnels to and from the Radwaste Building contain radwaste piping. The concrete in these tunnels is sealed for ease of decontamination during operation. The tunnels have floor drains to remove any fluid that potentially could leak from the piping. Plant procedures require periodic visual inspection of the radwaste piping in the tunnels; and
- There is no concrete block wall construction in ESBWR. Holes provided for removal of components are filled with interlocking metallic blocks filled with concrete for shielding purposes, as discussed in the last two paragraphs of DCD Tier 2, subsection 3.8.4. Therefore, there is no exposed porous concrete that could be contaminated, which provides for easier decommissioning.

12.6.2 Minimization of Radioactive Waste Generation

Examples of ESBWR design procedures for operation that minimize the generation of radioactive waste include the following:

- The Liquid Waste Management System (LWMS) is divided into several subsystems, so that the liquid wastes from various sources can be segregated and processed separately, based on the most efficient process for each specific type of impurity and chemical content. This segregation allows for efficient processing and minimization of overall liquid waste.
- During liquid processing by the LWMS, radioactive contaminants are removed and the bulk of the liquid is purified and either returned to the condensate storage tank or discharged to the environment, minimizing overall liquid waste. The radioactivity removed from the liquid waste is concentrated in filter media ion exchange resins and concentrated waste. The filter sludge, ion exchange resins and concentrated waste are sent to the Solid Waste Management System (SWMS) for further processing.

- The SWMS is designed to segregate and package the wet and dry types of radioactive solid waste for off-site shipment and burial. This segregation allows for efficient processing and minimization of overall solid waste.
- For management of gaseous radioactive waste, the Offgas System (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.

The LWMS, OGS, and SWMS are discussed and described in more detail in Sections 11.2, 11.3, and 11.4, respectively.

Examples of ESBWR design features that minimize the generation of radioactive waste during decommissioning operations include the following:

- Reduction of cobalt content in structural and bearing materials;
- Minimization of crud buildup in drains by use of stainless steel linings, improving drainage, and facilitating flushing; and
- Easing surface decontamination by providing epoxy-type wall and floor coverings.

12.6.3 COL Information

None.

12.6.4 References

None.

South Texas Project Units 3 and 4 COLA Part 7 DCD Departure Report

Departure Number: STD-DEP T1 2.4-1

Departure Topic: Residual Heat Removal System and Spent Fuel Pool Cooling

CDC Number: 2006026

Description

The DCD Departure was reviewed, and is summarized below.

The original DCD only included two cooling loops from RHR (divisions B and C) to the spent fuel pool.

Including a third loop from the 'A' division RHR loop has been added to provide another option for cooling to the spent fuel pool. This addition of piping and valves will be of the same quality standard as the B and C RHR components, along with another capability to provide makeup or cooling to the Spent Fuel Pool. This design change was chosen based on improved reliability and performance. This design has operating experience at the Lungmen, K6 and K7 plants.

Safety Evaluation Summary

This Departure was evaluated per 10CFR52.63(a)(1). This evaluation covered Tier 1 and related Tier 2 changes. Conclusions were based on 10 CFR 50.12 and engineering judgment.

This change provides the ability supply cooling from all three RHR loops in the Spent Fuel Pool cooling assist mode.. This will enhance capabilities and reliability to perform division outages for maintenance and other activities. Division outages will be better able to be coordinated during all plant operational Modes. With this enhanced redundancy, spent fuel pool cooling single failure, during a division outage is no longer a . This will allow division outage in any order and not be impeded by capabilities required by spent fuel pool cooling.

The events and accidents in Chapter 15 were reviewed. The analyses and conclusions presented in Chapter 15 are not affected. No negative impacts on severe accident probability or severity have been identified nor has a new type of severe accident been created. The bases in the generic Technical Specifications in Chapter 16 will be met or exceeded.

This departure to be adopted by STP Units 3 and 4 is justified using the criterion in 10CFR50.12(a)(2)(iv) as a net benefit to the public health and safety.

External References

None

Prepared By: R. W. Cutright / ______ Date: ______
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Reviewed By: B. Rudd / ______ Date: ______
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