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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 60 – Radiation Protection – RAI Numbers 12.4-11 and 12.4-16**

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

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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 07-099 – Response to Portion of NRC Request for Additional Information Letter No. 60 – Radiation Protection – RAI Numbers 12.4-11 and 12.4-16

cc:	AE Cubbage	USNRC (with enclosures)
	GB Stramback	GE/San Jose (with enclosures)
	BE Brown	GE/ Wilmington (with enclosures)
	eDRF	0066-5367

ENCLOSURE 1

MFN 07-099

Partial Response to RAI Letter No 60
Related to ESBWR Design Certification Application

Radiation Protection

RAI Numbers 12.4-11 and 12.4-16

RAI 12.4-11:

DCD Tier 2, Figures 1.1-1 and 12.3-4 indicate, "wash down bays" in the fuel building equipment entry facility. Identify what equipment is intended to be washed down in this facility. If contaminated or potentially contaminated equipment is to be washed down in this facility, discuss the design features employed to minimize the spread of contamination (including the provision for collecting and disposal of wash down fluids).

GE Response:

The main equipment washed down in the washdown bays is the spent fuel cask and its transporter. The spent fuel cask is decontaminated in cask pit (room 21P2). After the spent fuel cask is loaded on the transporter, any remaining potential surface contamination is monitored in the washdown bays. If any contamination is detected, the spent fuel cask and the transporter are washed down in the washdown bays. Other equipment leaving the plant will also be decontaminated inside the plant before loaded onto the transporter, monitored, and washed down if required, in the washdown bays before leaving the Fuel Building.

The washdown bays include, among others, the following design features to minimize the spread of contamination:

- Walls or curbs located around areas of potential contaminated fluid leakage.
- Floor surfaces sloped to drains, and sumps sized for cleanup water flow rate.
- Concrete surfaces, including floor surfaces, which have the potential of being flooded or sprayed with radioactive liquid, are protected with non-porous coating. Epoxy-type wall and floor coverings are selected providing smooth surfaces for ease of decontamination.
- The decontamination fluid will be processed through the liquid radwaste system as necessary, per plant operating procedures.

The washdown bays will be secured for use as per Regulatory Guide 8.8 guidance.

DCD Impact:

DCD Subsection 12.3.1.2.6 will be revised in the DCD Tier 2, Revision 4, as shown on the attached markup.

breathing air provisions are provided, for example, for CRD removal under the reactor pressure vessel and in the CRD maintenance room.

Appropriately sloped floor drains are provided in shielded cubicles and other areas where the potential for a spill exists to limit the extent of contamination. Curbs are also provided to limit contamination and simplify washdown operations. A cask decontamination vault is located in the reactor building where the spent fuel cask and other equipment may be cleaned. The CRD maintenance room is used for disassembling control rod drives to reduce the contamination potential.

Consideration is given in the design of the plant for reducing the effort required for decontamination. Epoxy-type wall and floor coverings have been selected which provide smooth surfaces to ease decontamination. Expanded metal-type floor gratings are minimized in favor of smooth surfaces in areas where radioactive spills could occur. Equipment and floor drain sumps are stainless steel lined to reduce crud buildup and to provide surfaces easily decontaminated.

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12.3.1.3 Radiation Zoning

Radiation zones are established in all areas of the plant as a function of both the access requirements of that area and the radiation sources in that area. Operating activities, inspection requirements of equipment, maintenance activities, and abnormal operating conditions are considered in determining the appropriate zoning for a given area. The relationship between radiation zone designations and accessibility requirements is presented in the following tabulation:

Zone Designation	Dose Rate µSv/hr	Access Description
A	D≤ 6 µSv/h	Uncontrolled, unlimited access
B	6 µSv/h <D≤ 10 µSv/h	Controlled and unlimited access. (No or very low radiation sources are present)
C	10 µSv/h<D ≤ 50 µSv/h	Controlled and limited access (20 hr/wk). (Low radiation sources are present)
D	50 µSv/h <D ≤ 250 µSv/h	Controlled and limited access (4 hr/wk). (Low to moderate radiation sources are present)
E	250 µSv/h <D ≤ 1 mSv/h	Controlled and limited access (1 hr/wk). (Moderate radiation sources are present)
F	1 mSv/h <D ≤ 10 mSv/h	Limited and controlled access with special authorization permit required. (High radiation sources are present)
G	10 mSv/h <D ≤ 100 mSv/h	(Same as zone F above)
H	100mSv/hr<D≤ 1 Sv/h	(Same as zone F above)
I	1 Sv/h <D≤ 5 Sv/h	(Same as zone F above)
J	D > 5 Sv/h	Inaccessible during power and shutdown operations. (Very High radiation sources are present)

The dose rate applicable for a particular zone is based on operating experience and represents design dose rates in a particular zone, and should not be interpreted as the expected dose rates which would apply in all portions of that zone, or for all types of work within that zone, or at all

12.3-7

NRC RAI 12.4-16:

DCD Tier 2, Figure 12.3-12 indicates that the radwaste piping gallery between the Turbine Building and the Radwaste Building also contains electrical equipment. Describe this electrical equipment, including the anticipated frequency of maintenance associated with it. Is shielding provided between the piping carrying radioactive fluids and this electrical equipment? If not, provide a justification why the current design is ALARA.

GE Response:

The radwaste piping gallery between the Turbine Building and the Radwaste Building contains electrical cables belonging only to nonsafety-related systems that are separated from the piping routing by a 20 cm concrete wall. Infrequent maintenance is expected to be required for replacing cables. If cable replacement is required, it will be performed either during shutdown or when no waste transfer operations are performed, and the dose rate due to the waste piping is negligible. During normal operation, the 20cm concrete shielding minimizes the potential dose to electrical equipment during waste transfer operations.

DCD Impact:

DCD Subsection 12.3.1.2.4 will be revised in the DCD Tier 2, Revision 4, as shown on the attached markup.

through a shield wall are frequently employed for electrical penetrations to reduce the streaming of radiation through these penetrations.

Where permitted, the annular region between pipe and penetration sleeves, as well as electrical penetrations, are filled with shielding material to reduce the streaming area presented by these penetrations. The shielding materials used in these applications include lead-loaded silicone foam, with a density comparable to concrete, and boron-loaded refractory-type material for applications requiring neutron as well as gamma shielding. There are certain penetrations where these two approaches are not feasible or are not sufficiently effective. In those cases, a shielded enclosure about the penetration as it exits in the shield wall, with a 90-degree bend of the process pipe as it exits the penetration, is employed.

12.3.1.2.2 Sample Stations

Sample stations in the plant provide for the routine surveillance of reactor water quality. These sample stations are located in low radiation areas to reduce the exposure to operating personnel. Flushing provisions are included using demineralized water, and pipe drains to plant sumps are provided to minimize the possibility of spills. Fume hoods are employed for airborne contamination control. Both working areas and fume hoods are constructed of polished stainless steel to ease decontamination if a spill does occur. Grab spouts are located above the sink to reduce the possibility of contaminating surrounding areas during the sampling process.

12.3.1.2.3 HVAC Systems

Major HVAC equipment (blowers, coolers, and the like) is located in dedicated low radiation areas to minimize exposures to personnel maintaining this equipment ALARA. HVAC ducting is routed outside pipe chases and does not penetrate pipe chase walls, which could compromise the shielding. HVAC ducting penetrations through walls of shielded cubicles are located to minimize the effect of the streaming radiation levels in adjoining areas. Additional HVAC design considerations are addressed in Subsection 12.3.3.

12.3.1.2.4 Piping

Piping containing radioactive fluids is routed through shielded pipe chases, shielded equipment cubicles, or embedded in concrete walls and floors, whenever possible. Where possible, "clean" services, such as compressed air and demineralized water, are not routed through shielded pipe chases. For situations in which radioactive piping must be routed through corridors or other low radiation areas, an analysis is conducted to ensure this routing does not compromise the existing radiation zoning.

Radioactive services are routed separately from piping containing nonradioactive fluids, whenever possible, to minimize the exposure to personnel during maintenance. When such routing combinations are required, however, drain provisions are provided to remove the radioactive fluid contained in equipment and piping. In such situations, provisions are made for the valves required for process operation to be controlled remotely, without need for entering the cubicle.

Radwaste piping gallery between the Turbine Building and the Radwaste Building contains only nonsafety-related electrical cables that are segregated from the radwaste piping by a 20 cm shield wall. Cable replacement, though infrequent, will be performed during shutdown or when no waste transfer operations are occurring in accordance with plant maintenance procedures that take into account ALARA. The dose rate from the waste piping is negligible.

"Clean" services and radioactive piping are required at times to be routed together in shielded cubicles. In such situations, provisions are made for the valves required for process operation to be controlled remotely, without need for entering the cubicle.

Penetrations for piping through shield walls are designed to minimize the effect on surrounding areas. Approaches used to accomplish this objective are described in Subsection 12.3.1.2.

Piping configurations are designed to minimize the number of "dead legs" and low points in piping runs to avoid accumulation of radioactive crud and fluids in the line. Drains and flushing provisions are employed whenever feasible to reduce the effect of required "dead legs" and low points. Systems containing radioactive fluids are welded to the most practical extent to reduce leakage through flanged or screwed connections. For highly radioactive systems, butt welds are employed to minimize crud traps. Provisions are also made in radioactive systems for flushing with condensate or chemically cleaning the piping to reduce crud buildup.

12.3.1.2.5 Equipment Layout

Equipment layout is designed to reduce the exposure of personnel required to inspect or maintain equipment. "Clean" pieces of equipment are located separately from those which are sources of radiation whenever possible. For systems that have components that are major sources of radiation, piping and pumps are located in separate cubicles to reduce exposure from these components during maintenance. These major radiation sources are also separately shielded from each other.

12.3.1.2.6 Contamination Control

Contaminated piping systems are welded to the most practical extent to minimize leaks through screwed or flanged fittings. For systems containing highly radioactive fluids, drains are hard piped directly to equipment drain sumps, rather than to allow contaminated fluid to flow across the floor to a floor drain. Certain valves in the main steam line are also provided with leakage drains piped to equipment drain sumps to reduce contamination of the steam tunnel. Pump casing drains are employed on radioactive systems whenever possible to remove fluids from the pump prior to disassembly. In addition, provisions for flushing with condensate, and in especially contaminated systems, for chemically cleaning the equipment prior to maintenance, are provided.

The HVAC System is designed to limit the extent of airborne contamination by providing air-flow patterns from areas of low contamination to more contaminated areas. This, in general, is accomplished by pressurizing the main corridor on each floor with the flow directed outward in each cubicle and then to the pipe chases where the flow is directed to the plant stack. Penetrations through outer walls of the building containing radiation sources are sealed to prevent miscellaneous leaks into the environment. The equipment drain sump vents that contain airborne contaminants from discharges to the sump are piped directly to their respective building HVAC System. Wet transfer of both the steam dryer and separator also reduces the likelihood of contaminants on this equipment being released into the plant atmosphere. In areas where the reduction of airborne contaminants cannot be eliminated efficiently by HVAC Systems, breathing air provisions are provided, for example, for CRD removal under the reactor pressure vessel and in the CRD maintenance room.