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Subject: **Transmittal of ESBWR DCD Tier 2, Chapter 12 Markups Related to GEH Corrective Action**

The purpose of this letter is to submit markups to the ESBWR DCD Tier 2, Chapter 12, resulting from GEH corrective action.

The term "lead-loaded silicone foam" was used in four places in Chapter 12. This specific material is no longer commercially available and the ESBWR DCD must be corrected to indicate a currently available and acceptable replacement material.

Enclosure 1 provides the DCD Tier 2, Chapter 12 markups to be incorporated into the DCD, Rev. 8.

If you have any questions or require additional information, please contact me.

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

Enclosure:

1. Transmittal of ESBWR DCD Tier 2, Chapter 12 Markup Related to GEH Corrective Action – DCD Markups

cc:	AE Cubbage	USNRC (with enclosure)
	JG Head	GEH/Wilmington (with enclosure)
	DH Hinds	GEH/Wilmington (with enclosure)
	TL Enfinger	GEH/Wilmington (with enclosure)
	eDRF Section	0000-0124-4696

Enclosure 1

MFN 10-309

Transmittal of ESBWR DCD Tier 2, Chapter 12 Markups Related to GEH Corrective Action

DCD Markups

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. Examples of ~~T~~the shielding materials used in these applications include ~~lead-loaded silicone foam~~a modified high density silicone elastomer, 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 (e.g., blowers, coolers) is located in dedicated low radiation areas to minimize exposures to personnel maintaining this equipment. 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. “Clean” services, such as compressed air and demineralized water, are not routed through shielded pipe chases, where possible. 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.

Some piping may be embedded in concrete (e.g., feed-throughs with short sections). Minimization of embedded piping to the extent practicable facilitates the dismantlement of the systems and the decommissioning of the facility, as required by 10 CFR 20.1406.

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, 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 operations to be controlled remotely, without need for entering the cubicle.

are the highest radiation level components in the system. Each unit is located in a concrete-shielded cubicle that is accessible through a shielded hatch. The demineralizer rooms in the FB are identified in Figure 12.3-72. The radiation source term associated with the FAPCS demineralizers is provided in Table 12.2-8a. Adjacent rooms to the demineralizers are identified in Figures 12.3-71 through 12.3-73. Provisions are made for remotely backflushing the units when filter and resin material are spent. This removal of radioactivity from contaminated material reduces the component radiation level considerably and serves to minimize exposures during maintenance. All valves (inlet, outlet, recycle, vent, and drain) to the filter demineralizer units are located outside the shielded cubicles in a separate shielded cubicle together with associated piping, headers, and instrumentation. The radiation level in this cubicle is sufficiently low to permit required maintenance to be performed. Piping potentially containing resin is continuously sloped downward to the backwash tank. The system also includes two low radiation level heat exchangers and two circulation pumps.

All of the shielded system components are consolidated in the same section of the RB. Personnel access to shielded system components is controlled to minimize personnel exposure. Shielding for the components is designed to reduce the radiation level to less than 10 μSv/hr (1 mrem/hr) in adjacent areas where normal access is permitted.

Operation of the system is accomplished from the main control room (MCR) and local control panels which are located where design radiation levels are less than 25 μSv/hr (2.5 mrem/hr) and normal personnel access is permitted.

12.3.1.4.3 Main Steam System

All radioactive materials in the main steam system, located in the main steam-feedwater pipe tunnel of the RB, result from radioactive sources carried over from the reactor during plant operation, including high energy short-lived N-16. During plant shutdown, residual radioactivity from prior plant operation is the radiation source.

Access to the main steam pipe tunnel in the RB is controlled. Entry into the Reactor Building steam tunnel is through a controlled personnel access door shielded by a concrete labyrinth to attenuate radiation streaming from the steam lines to adjoining areas. During reactor operation, the steam tunnel is not accessible except in the hot standby conditions under controlled access.

Providing valve drains that are piped to equipment drain sumps minimizes leakage from selected valves into surrounding areas. Floor drains are provided to minimize the spread of contamination should a leakage occur.

Penetrations through the steam tunnel walls are minimized to reduce the streaming paths made available by these penetrations. Penetrations through the steam tunnel walls are located so as to exit in controlled access areas or in areas that are not aligned with the steam lines. A ~~lead-loaded silicone foam~~ modified high density silicone elastomer is employed whenever possible for these penetrations to reduce the available streaming area presented.

12.3.1.4.4 Inclined Fuel Transfer System

The inclined fuel transfer tube transits, through a shielded tube, 21P1, and rooms 18P2 and 1702, with no connection to any other room or area that could be potentially accessible during fuel transfer operations (Figure 9.1-2). Accessible areas and rooms adjacent to the inclined fuel operational occurrence, and hence represents conservatism in design. For components where N-16 is the major radiation source, a concentration based upon operating plant data is used.

- Effort is made to locate processing equipment in a manner that minimizes the shielding requirements. Shielded labyrinths are used to eliminate radiation streaming through access ways from sources located in cubicles.
- Penetrations through shield walls are located so as to minimize the effect on surrounding areas due to radiation streaming through the penetrations. The approaches used to locate and shield penetrations, when required, are discussed in Subsection 12.3.1.2.1.
- Wherever possible, radioactive piping is run in a manner that minimizes radiation exposure to plant personnel. This involves:
  - Minimizing radioactive pipe routing in corridors;
  - Avoiding the routing of high-activity pipes through low-radiation zones;
  - Use of shielded pipe trenches and pipe chases, where routing of high-activity pipes in low-level areas cannot be avoided; and
  - Separating radioactive and non-radioactive pipes for maintenance purposes.
- To maintain acceptable levels at the valve stations, motor-operated or diaphragm valves are used, where practical. For valve maintenance, provision is made for draining and flushing associated equipment so that radiation exposure is minimized. If manual valves are used, provision is made for shielding the operator from the valve by use of shield walls and valve stem extensions, where practicable.
- Shielding is provided to permit access and occupancy of the control room to ensure that plant personnel exposure following an accident does not exceed the values set forth in 10 CFR 50, Appendix A, GDC 19. The analyses of the doses to MCR personnel for the design basis accidents are included in Chapter 15.
- The dose at the site boundary as a result of direct and scattered radiation from the turbine and associated equipment is considered.
- In selected situations, provisions are made for shielding major radiation sources during inservice inspection to reduce exposure to inspection personnel. For example, steel platforms are provided for inservice inspection (ISI) of the RPV nozzle welds and associated piping.
- The primary material used for shielding is concrete at a density of 2.35 gm/cm^3. Concrete used for shielding purposes is designed in accordance with Regulatory Guide 1.69 (Reference 12.3-12). Where special circumstances dictate, steel, lead, water, ~~lead-loaded silicone foam~~a modified high density silicone elastomer, or a boron-laced refractory material is used.

12.3.2.2.2 Method of Shielding Design

The radiation shield wall thicknesses are determined using basic shielding data and proven shielding codes. A list of the computer programs used is contained in Table 12.3-1. The

The ESBWR plant includes all necessary shielding provisions in the upper drywell in order to reduce the dose ALARA during transfer of irradiated spent fuel assemblies. The ESBWR plant includes all applicable shielding design provisions to minimize dose rates in case of a fuel handling mishap resulting in dropping a fuel assembly across the reactor flange.

Reactor Building - In general, the shielding for the RB is designed to maintain open areas at dose rates less than 6 μSv/hr (0.6 mrem/hr).

Penetrations of the containment wall are shielded to reduce radiation streaming. Localized dose rates outside these penetrations are limited to less than 50 μSv/hr (5 mrem/hr). The penetrations through interior shield walls of the Reactor Building are shielded using a ~~lead-loaded silicone sleeve~~ modified high density silicone elastomer to reduce the radiation streaming. Penetrations are also located so as to minimize the consequences of radiation streaming into surrounding areas.

The components of the RWCU/SDC System are located in the RB. Both the RWCU/SDC regenerative and nonregenerative heat exchangers are located in shielded cubicles separated from the other components of the system. Neither cubicle needs to be entered for system operation.

Process piping between the heat exchangers and the demineralizers is routed through shielded areas or embedded in concrete to reduce the dose rate in surrounding areas. The RWCU/SDC demineralizers are located in separate shielded cubicles. This arrangement allows maintenance of one unit while operating the other. The dose rate in the adjoining demineralizer cubicle from the operating unit is less than 250 μSv/hr (25 mrem/hr). Entry into the demineralizer cubicle, which is required infrequently, is via shielded hatches. The bulk of the piping and valves for the filter demineralizers is located in an adjacent shielded valve gallery. Backfilling and resin application of the filter demineralizers are controlled from an area where dose rates are less than 10 μSv/hr (1 mrem/hr).

The ESBWR employs a passive cooling system in addition to the RWCU/SDC System for cooling the core and vessel. Access into the cubicles is not required to operate the systems. All such components that could become contaminated in the event of an accident are located in the containment except those components that would be used as part of the RWCU/SDC System.

Fuel Storage - The fuel storage pool is designed to ensure the dose rate around the pool area is less than 25 μSv/hr (2.5 mrem/hr). In the event of an anticipated operational occurrence where the fuel sustains significant damage, such as a fuel drop accident, airborne dose rates in the pool area could significantly exceed this dose rate.

Fuel Handling – In combination with integral shielding installed on the refueling machine (equivalent to one foot of water), a safe water shielding depth of at least 2.74 m (9.0 ft.) is maintained over the active fuel during transit of a single grappled fuel bundle from/to the reactor vessel. For the fuel handling machine, a safe shielding depth of 3.05 m (10 ft) is maintained over the active fuel during transit of a single grappled fuel bundle from/to the spent fuel racks. Under these conditions, the dose rate is calculated to be less than 25 μSv/hr (2.5 mrem/hr) at the water surface, satisfying the dose rate standard of ANSI/ANS 57.1. The effective dose rate for plant personnel on the refueling floor or fuel handling floor, and for the operators on the refueling machine or the fuel handling machine, is consistent with Figures 12.3-4, 12.3-9, 12.3-10 and 12.3-11.