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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 122 Related to ESBWR Design Certification Application – Design of Structures, Components, Equipment, and Systems - RAI Numbers 3.4-12 and 3.5-18**

Enclosure 1 contains GEH's response to the subject RAI transmitted via Reference 1.

Should you have any questions about the information provided here, please contact me.

Sincerely,

James C. Kinsey
Vice President, ESBWR Licensing

D068
NRO

Reference:

1. MFN 07-659, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 122 Related to the ESBWR Design Certification Application,* December 6, 2007.

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 122 Related to ESBWR Design Certification Application – Design of Structures, Components, Equipment, and Systems - RAI Numbers 3.4-12 and 3.5-18

cc:

AE Cubbage	USNRC (with enclosure)
RE Brown	GEH/Wilmington (with enclosure)
DH Hinds	GEH/Wilmington (with enclosure)
GB Stramback	GEH/San Jose (with enclosure)
eDRF	0000-0079-4299, Revision 1

ENCLOSURE 1

MFN 08-098

Response to Portion of NRC Request for Additional Information Letter No. 122 Related to ESBWR Design Certification Application - Design of Structures, Components, Equipment, and Systems

RAI Numbers 3.4-12 & 3.5-18

NRC RAI 3.4-12

The ESBWR flood protection relies on plant personnel to take appropriate measures to assure that all facility flood protection measures are in place as a flood condition develops. The COL holder should have emergency operating procedures directing plant personnel to take the appropriate actions as flood condition develops.

GEH Response

As stated in DCD Tier 2 Revision 4 Section 3.4.1.2, flood protection from exterior sources (i.e. floods, groundwater, etc.) is provided to the ESBWR by locating design plant grade elevation at least 310 mm (1 ft.) above the design flood level and by incorporating structural provisions into the plant design which include:

- Walls below flood level designed to withstand hydrostatic loads.
- Water stops provided in all expansion and construction joints below flood and groundwater levels.
- Water seals at pipe penetrations below flood and groundwater levels.
- Roofs designed to prevent pooling of large amounts of water.

In addition, there are no exterior access openings below grade. Therefore, no emergency actions are required due to flooding to ensure the safe operation of the ESBWR plant. DCD Tier 2 Subsection 3.4.1.2 will be clarified to state the above.

DCD Impact

DCD Tier 2 Subsection 3.4.1.2 will be revised in Revision 5 as noted in the attached markup.

NRC RAI 3.5-18

GE analyzed the gravitational missiles inside containment and determined that Seismic Category I SSCs are designed with no potential to become a gravitational missile source. With regards to equipment, such as a hoist that is required during maintenance, GEH stated that such equipment will be either removed during operation to a location where it is not a potential hazard to safety-related equipment or seismically restrained to prevent it from becoming a missile. The COL holder needs to establish procedures to require equipment, such as a hoist that is required during maintenance, either be removed or seismically restrained following maintenance to prevent it from becoming a missile.

GEH Response

DCD Tier 2 Revision 5, Subsection 3.5.1.2.3, last bullet will be revised to add the following sentence: "This is ensured by plant procedures as described in Section 13.5."

Since a potential COL applicant incorporates the DCD into the COL application by reference, the applicant is committed to establishing such plant procedures when the license is granted.

DCD Impact

DCD Tier 2 Subsection 3.5.1.2.3 will be revised in Revision 5 as noted in the attached markup.

3.4.1.1 Flood Protection Summary

The safety-related systems and components of the ESBWR standard plant are located in the Seismic Category I structures that provide protection against external flood and groundwater damage. External flood design considerations for safety-related systems and components are provided for the postulated flood and groundwater levels and conditions described in Tables 2.0-1 and 3.4-1.

The Seismic Category I structures that house safety-related systems and equipment and that offer flood protection are described in Section 3.8. All exterior access openings are above flood level and exterior penetrations below design flood and groundwater levels are appropriately sealed.

The internal flood analysis evaluates whether a single pipe failure, a fire fighting event or other flooding source, as described in Subsection 3.4.1.4, could prevent safe reactor shutdown. In all cases system components are located above the flood level or are capable of operating in a flooded environment. Appropriate means are provided to prevent flooding compartments that house redundant system trains or divisions. Some of the mechanisms used to minimize flooding are structural barriers or compartments; curbs and elevated thresholds, at least 200 mm (8 in) high; and a leak detection system. See Subsection 3.4.1.3 for further discussion.

3.4.1.2 Flood Protection From External Sources

Safety-related systems and components are protected from exterior sources (e.g., floods, groundwater) because they are located above design flood level or because they are enclosed in groundwater protected concrete structures.

The Seismic Category I structures that may be subjected to the design basis flood are designed to withstand the flood level and groundwater level stated in Table 2.0-1. This is done by locating the design plant grade elevation at least 310 mm (1 ft.) above the design flood level and by incorporating structural provisions into the plant design to protect the structures, systems and components from the postulated flood and groundwater conditions.

These provisions include:~~This approach provides:~~

- ~~Wall thicknesses~~Walls below flood level designed to withstand hydrostatic loads.
- Water stops provided in all expansion and construction joints below flood and groundwater levels.
- Waterproofing of below flood and groundwater levels external surfaces.
- Water seals at pipe penetrations below flood and groundwater levels.
- Roofs designed to prevent pooling of large amounts of water in accordance with Regulatory Guide 1.102.
- No exterior access openings below grade.

The flood protection measures that are described above are not only for external natural floods but also guard against flooding from on-site storage tank rupture. Such tanks are designed and constructed to minimize the risk of catastrophic failure and are located to allow drainage without damage to site facilities.

~~The typically relatively long time available as a flood condition develops allows ample time to take appropriate measures to assure all facility flood protection measures are in place.~~ Because plant grade is above design flood level, the Seismic Category I structures remain accessible during postulated flood events (See Table 3.4-1). Thus, no emergency actions are required due to flooding to ensure the safe operation of the ESBWR plant.

3.4.1.3 Internal Flooding Evaluation Criteria

All safety-related components that affect the safe shutdown of the plant are located in the Reactor Building (RB) and Control Building (CB). Redundant systems and components are physically separated from each other and from ~~Nonsafety~~nonsafety ~~Related~~ related systems. If the failure of a system results in one division being inoperable, a redundant division is available to perform the safe shutdown of the plant. Protective features used to mitigate or eliminate the consequences of internal flooding are:

- Structural enclosures or barriers
- Curbs and sills
- Leakage detection components
- Drainage systems

The internal flooding analysis, besides identifying flooding sources, equipment in each area, and effect on safety-related equipment and maximum flood levels, also considers the following criteria:

- A flooding alarm in the Main Control Room is followed by operator action within 30 minutes to identify the flooding source.
- Fire fighting events are considered assuming that fuel inventory for the fire is limited to a 1-hour event, during which two 7.9 l/s (125 gpm) fire hoses are in service.
- A single active failure of flood mitigating systems is assumed, following the initiating events, as required in ANSI/ANS 56.11 (Reference 3.4-1).
- No credit is taken for the drainage system or operation of the drain sump pumps for flooding mitigation, although they are expected to operate during some of the postulated flooding events.
- The free surface considered in each flooding zone is reduced by at least 10% due to space utilization by components located in that zone.

As established in Section 3.6, the moderate energy piping leakage failure is assumed to be a circular opening with a flow area equal to one-half of the outside pipe diameter multiplied by one-half of the pipe nominal wall thickness. Resulting leakage flow rates are calculated using normal operating pressure in the pipe.

The Fire Protection System (FPS) headers from the FPS pumps are routed outside Seismic Category I buildings. Floors are assumed to prevent water seepage to lower levels.

Spray damage is avoided by appropriate location of equipment or pipe or by providing protection from water spray. Doors and penetrations rated as 3 hour barriers are assumed to prevent water spray from crossing divisional boundaries.

persists with f* = 100 for the case of saturated water blowdown and f* = 0 for the case of saturated steam blowdown.

A typical thermowell weighs about 0.91 kg (2 lbs). Based on ejection by steam at 7.2 MPa (1044 psia), the ejection velocity could reach 61 m/s (200 ft/s), which is not sufficient to inflict significant damage to critical systems. P_4 is therefore less than 10^{-7} per year.

3.5.1.1.2.2.5 Retaining Bolts

Nuts, bolts, nut and bolt combinations, and nut and stud combinations have a small amount of stored energy and are of no concern as potential missiles.

3.5.1.1.2.2.6 Blowout Panels

Blowout panels are hinged to prevent them from becoming missiles. Guard rails for personnel protection are provided where required by the swing pattern. Thus by design, P_2 is less than 10^{-7} per year.

3.5.1.1.3 Missile Barriers and Loadings

Credit is taken in some cases of rotating and pressurized components generating missiles for missile-consequence mitigation by structural walls and slabs. These walls and slabs are designed to withstand internal missile effects; the applicable seismic category and quality group classification are listed in Section 3.2. Penetration of structural walls by internally generated missiles is not considered credible.

3.5.1.2 Internally Generated Missiles (Inside Containment)

Internal missiles are those resulting from plant equipment failures within the containment. Potential missile sources from both rotating equipment and pressurized components are considered, when applicable.

3.5.1.2.1 Rotating Equipment

By an analysis similar to that in Subsection 3.5.1.1.1, it is concluded that no items of rotating equipment inside the containment have the capability of generating potential missiles.

3.5.1.2.2 Pressurized Components

Identification of potential missiles and their consequences outside containment are specified in Subsection 3.5.1.1.2. The same conclusions are drawn for pressurized components inside of containment. For example, the ADS accumulators are moderate energy vessels and are therefore not considered a credible missile source. Another group of items is Fine Motor Control Rod Drives (FMCRDs) under the reactor vessel. The FMCRD mechanisms are not credible missiles. The FMCRD housings are designed (Section 4.6) to prevent any significant nuclear transient in the event of a drive housing break.

3.5.1.2.3 Evaluation of Potential Gravitational Missiles Inside Containment

Gravitational missiles inside the containment are considered as follows:

Seismic Category I systems, components, and structures are not potential gravitational missile sources.

Non-Seismic items and systems inside containment are considered as follows:

- Cable Trays - All cable trays for both safety-related and nonsafety-related circuits are seismically supported whether or not a hazard potential is evident.
- Conduit and Nonsafety-Related Pipe - Nonsafety-related conduit is seismically supported if it is identified as a potential hazard to safety-related equipment. All nonsafety-related piping that is identified as a potential hazard is seismically analyzed per Subsection 3.7.3.8.
- Equipment for Maintenance - All other equipment, such as a hoist, that is required during maintenance is either removed during operation, moved to a location where it is not a potential hazard to safety-related equipment, or seismically restrained to prevent it from becoming a missile. This is ensured by plant procedures as described in Section 13.5.

3.5.1.3 Turbine Missiles

See Subsection 3.5.1.1.1.2.

3.5.1.4 Missiles Generated by Natural Phenomena

This subsection considers possible hazards due to missiles generated by the design basis tornado, flood, and any other natural phenomena identified in Section 3.5.

Tornado generated missiles are determined to be the limiting natural phenomena hazard in the design of all structures required for safe shutdown of the nuclear power plant. Because tornado missiles are used in the design basis, they envelop missiles generated by less intense phenomena such as extreme winds. See Reference 3.5-8.

The design basis tornado and missile spectrum as defined in Table 2.0-1 is included in the design of Seismic Category I buildings, and is in compliance with positions C1 and C2 of Regulatory Guide 1.76, "Design Basis Tornado for Nuclear Power Plants," positions C1, C2, and C3 of Regulatory Guide 1.117, "Tornado Design Classification," Position C2 of Regulatory Guide 1.13, "Spent Fuel Storage Facility Design Basis," and positions C2 and C3 of Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants."

Since Seismic Category I buildings are designed to resist tornado missiles for their full height (See Table 2.0-1), their resistance to missiles is independent of site topography.

Non-tornado resistant building superstructures are constructed from materials such as reinforced concrete block, and/or structural steel with metal siding and roof deck. Potential missiles or debris from these materials, resulting from failure of superstructure or from items blown off, when subjected to winds of tornado intensity, are not considered to generate missiles more severe than the Spectrum I missiles of SRP 3.5.1.4 in accordance with Reference 3.5-8.

3.5.1.5 Site Proximity Missiles (Except Aircraft)

The site is selected such that the probability of occurrence of the site proximity missile (except aircraft) is less than 10^{-7} occurrences per year. The site proximity missile has been dismissed from further consideration because at that likelihood it is considered not to be a statistically significant risk.