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MFN 08-193 Supplement 1

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Subject: Response to Portion of NRC Request for Additional Information Letter No. 200 Related to ESBWR Design Certification Application - Containment Systems - RAI Number 6.2-157 S01

Enclosure 1 contains the GE Hitachi Nuclear Energy (GEH) response to the subject NRC RAI originally transmitted via the Reference 1 letter and supplemented by an NRC request for clarification in Reference 2. Enclosure 2 contains DCD markups for this response.

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

Sincerely,

Lee F. Dougherty for

Richard E. Kingston
Vice President, ESBWR Licensing

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NRO

References:

1. MFN 07-327, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 100 Related to ESBWR Design Certification Application*, May 30, 2007
2. MFN 08-475, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 200 Related to ESBWR Design Certification Application*, May 13, 2008

Enclosures:

1. MFN 08-193 Supplement 1 - Response to Portion of NRC Request for Additional Information Letter No. 200 Related to ESBWR Design Certification Application - Containment Systems - RAI Number 6.2-157 S01
2. MFN 08-193 Supplement 1 - Response to Portion of NRC Request for Additional Information Letter No. 200 Related to ESBWR Design Certification Application - Containment Systems - RAI Number 6.2-157 S01 - DCD Markups

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Enclosure 1

MFN 08-193 Supplement 1

Response to Portion of NRC Request for
Additional Information Letter No. 200
Related to ESBWR Design Certification Application

Containment Systems

RAI Number 6.2-157 S01

NRC RAI 6.2-157 S01:

(1) *In GEH's response to RAI 6.2-157 (Item A), it states that "the design of the containment isolation provisions is the responsibility of GEH not the COL applicants." However, the tables provided in the response (Tier 1 Table 2.15.1-1 and Tier 2 Tables 6.2-45 and 6.2-47) continue to have "TBD" as entries for penetration numbers and other information such as location and penetration type. Please remove "TBD" as entries and provide the pertinent information.*

(2) *DCD Tier 2, Table 6.2-42 for PRM containment isolation valves, refers to Subsection 6.2.4.2 for pipe length between containment and inboard/outboard isolation valves. However, Subsection 6.2.4.2 does not have this information. Please provide correct reference.*

(3) *GEH's response to RAI 6.2-157 (Item A), third bullet, states that the Motion Control Rod Drive System (FMCRD) lines are continuously pressurized; therefore, no containment isolation valves are needed. Please provide a more detailed justification.*

(4) *GEH's response to RAI 6.2-157 (Item A), fifth bullet, refers to the response to RAI 6.2-122 S01 which updated several DCD tables, including Table 6.2-35. However, Table 6.2-35 in the response to RAI 6.2-157 does not reflect the same information as RAI 6.2-122. Please make sure that all revisions to the DCD address commitments to all RAI responses and the latest information is included.*

(5) *GEH's response to RAI 6.2-157 (page 15 of 85) for Subsection 6.2.4.2, states that "tables 6.2-15 through 6.2-45 show the pertinent data for the containment isolation valves, except for excess flow check valves as discussed in Section 6.2.4.2.2 (Refer to COL item in 6.2.8)". Since Section 6.2.8 only addresses missing pipe lengths in Tables 6.2-15 to 6.2-45, please correct the reference.*

(6) *In GEH's response to RAI 6.2-157, new tables are added. DCD, Rev. 4, Subsections 6.2.4.3.2.1 and 6.2.4.3.2.2 refer to Tables 6.2-33 through 6.2-42. However, Table 6.2-45 should also be included in these sections. Influent and effluent lines to and from the containment for systems such as Makeup Water, Service Air, Containment Monitoring, and Equipment Floor Drain should be included in the above sections. GEH should review the existing DCD content to ensure new information is incorporated where appropriate.*

(7) *COL item 6.2-1-H in Section 6.2.8 requires COL holder to provide the missing information in Tables 6.2-16 through 6.2-42. This is the length of pipe between the containment and the isolation valve(s). Although it is understood that this information is not available until detailed design, GEH should provide acceptance criteria such that this information can be validated in ITAAC.*

GEH Response:

(1) The changes listed below were made in Revision 5 of DCD Tier 1 and Tier 2. As a result, there are no more "TBDs" in the referenced DCD tables.

- Numbers were assigned for all penetrations, and DCD tables (DCD Tier 1, Table 2.15.1-1 and DCD Tier 2, Tables 6.2-45 and 6.2-47) were updated accordingly.
- The "Location/Room #" and "RCCV Sector" columns were deleted from DCD Tier 2, Table 6.2-47 because this information is beyond the level of detail necessary to be reviewed and evaluated by NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants."
- DCD Tier 2, Table 6.2-47 was updated to list the penetration type for all penetrations.

(2) The references to DCD Tier 2, Subsection 6.2.4.2 were deleted in DCD Revision 5 and replaced with "COL Holder to provide."

(3) Control Rod Drive (CRD) systems in BWRs are not provided with containment isolation valves. Operation of this system post-accident is required for reactor scram, and the number of active components whose failure could prevent a scram is minimized. Since these lines are normally pressurized post-accident, leakage in the reverse flow direction would not be expected. However, there are check valves in each CRD mechanism and in the hydraulic control units that would prevent reverse flow if pressure were lost.

(4) The DCD changes documented in the responses to RAI 6.2-122 S01 and RAI 6.2-157 were incorporated in Revision 5 of the DCD.

(5) A new sentence was added in Revision 5 of DCD Tier 2, Subsection 6.2.4.2 to discuss the information to be provided by the COL Holder.

(6) References to the DCD Tier 2, Section 6.2 containment isolation valve tables will be corrected to "Tables 6.2-16 through 6.2-45."

(7) Section 3.11.9.6 of NEDE-33271P, "NP-2010 COL Demonstration Project: Project Design Manual (PDM)," states the following:

> "The containment isolation valves shall be located as close to the containment as practical. Sufficient space shall be provided between the valves and containment boundary to permit the following:
>
> - In-service inspection of non-isolable welds.
> - Appendix J of 10CFR50 leak testing.
> - Cutout and replacement of isolation valves using standard pipe fitting tools and equipment.
> - Local control.
> - Valve seat resurfacing in place."

The PDM provides the overall design methodology for the ESBWR and is the vehicle through which GEH project management provides instructions and design requirements/guidance to engineers. Inclusion of the above requirements and design criteria in the PDM assures they become part of the detailed design of the plant. The PDM is available for review by the NRC upon request. Provision of the piping lengths between containment and the containment isolation valves is assigned in DCD Revision 5 as a COL Holder item; therefore, an ITAAC is not required.

DCD Impact:

DCD Tier 2, Subsections 6.2.4.1, 6.2.4.3.2.1, 6.2.4.3.2.2, 6.2.6.3, and Table 6.2-15 will be revised as shown in the enclosed DCD markup pages.

Enclosure 2

MFN 08-193 Supplement 1

Response to Portion of NRC Request for Additional Information Letter No. 200 Related to ESBWR Design Certification Application

Containment Systems

RAI Number 6.2-157 S01

DCD Markups

- Isolation Condenser System steam supply.
- Isolation Condenser System condensate return.
- Fuel and Auxiliary Pools Cooling System suppression pool suction.
- Fuel and Auxiliary Pools Cooling System suppression pool return.

The containment isolation function is designed to Seismic Category I. Safety and quality group classifications of equipment and systems are found in Table 3.2-1. Containment isolation valve functions are identified in Tables 6.2-16 through ~~6.2-42~~. 6.2-45

Penetration piping is evaluated for entrapped liquid subject to thermally-induced pressurization following isolation. The preferred pressure relief method is through a self-relieving penetration by selection and orientation of an inboard isolation valve that permits excess fluid to be released inward to the containment. Use of a separate relief valve to provide penetration piping overpressure protection is permissible on a case-by-case basis when no other isolation valve selection option is available.

The criteria for the design of the LD&IS, which provides containment and reactor vessel isolation control, are listed in Subsection 7.1.2. The bases for assigning certain signals for containment isolation are listed and explained in Subsection 7.3.3.

6.2.4.2 System Design

The containment isolation function is accomplished by valves and control signals, required for the isolation of lines penetrating the containment. The RCPB influent lines are identified in Table 6.2-13, and the RCPB effluent lines are identified in Table 6.2-14. Tables 6.2-15 through 6.2-45 show the pertinent data for the containment isolation valves, except for excess flow check valves as discussed in Subsection 6.2.4.2.2. The COL Holder will provide the pipe lengths from containment to the isolation valves (COL 6.2-1-H). A detailed discussion of the LD&IS controls associated with the containment isolation function is included in Subsection 7.3.3.

Power-operated containment isolation valves have position indicating switches in the control room to show whether the valve is open or closed. Power for valves used in series originates from physically independent sources without cross ties to assure that no single event can interrupt motive power to both closure devices.

All POVs with geared or bi-directional actuators (motorized or fluid-powered) remain in their last position upon failure of valve power. All POVs with fluid-operated/spring-return actuators (not applicable to air-testable check valves) close on loss of fluid pressure or power supply. To support the inerted containment design, pneumatic actuators for valves located inside containment are supplied with pressurized nitrogen gas, whereas pneumatic actuators for valves located outside of containment are generally supplied compressed air.

The design of the containment isolation function includes consideration for possible adverse effects of sudden isolation valve closure when the plant systems are functioning under normal operation.

General compliance or alternate approach assessment for RG 1.26 may be found in Subsection 3.2.2. General compliance or alternate approach assessment for RG 1.29 may be found in Subsection 3.2.1.

could be contained by either of the redundant isolation valves. Furthermore, a break between the isolation valves and the containment would still be contained by the closed system outside containment and would require an additional break before a radioactive release could occur.

Reactor Water Cleanup System /Shutdown Cooling System

The Reactor Water Cleanup/Shutdown Cooling (RWCU/SDC) System consists of two independent trains. Each train takes its suction from the RPV mid-vessel region as well as from the RPV bottom region. The suction lines of each train are isolated by one automatic pneumatic-operated valve inside and one automatic pneumatic-operated valve outside the containment. The reactor bottom suction line has a sampling line isolated by one automatic solenoid-operated valve inside and one automatic solenoid-operated valve outside the containment. The details regarding these valves are shown in Table 6.2-31. RWCU/SDC pumps, heat exchangers and demineralizers are located outside the containment.

6.2.4.3.1.3 Conclusion on Criterion 55

In order to ensure protection against the consequences of accidents involving the release of radioactive material, pipes which form the reactor coolant pressure boundary are shown to provide adequate isolation capabilities on a case-by-case basis. A special isolation arrangement is required for the Isolation Condenser System and it has been shown to be an adequate alternative to the explicit requirements of GDC 55. In all other cases, two isolation barriers were shown to protect against the release of radioactive materials in accordance with GDC 55.

In addition to meeting the isolation requirements stated in Criterion 55, the pressure-retaining components which comprise the reactor coolant pressure boundary are designed to meet other appropriate requirements which minimize the probability or consequences of an accidental pipe rupture. The quality requirements for these components ensure that they are designed, fabricated, and tested to the highest quality standards of all reactor plant components. The classification of components which comprise the reactor coolant pressure boundary are designed in accordance with the ASME Boiler and Pressure Vessel Code, Section III, Class 1.

It is therefore concluded that the design of piping systems which comprise the reactor coolant pressure boundary and which penetrate the containment satisfies Criterion 55.

6.2.4.3.2 Evaluation Against Criterion 56

Criterion 56 requires that lines, which penetrate the containment and communicate with the containment atmosphere, must have two isolation valves; one inside the containment, and one outside, unless it can be demonstrated that the containment isolation functions for a specific class of lines are acceptable on some other basis.

The following paragraphs summarize the basis for ESBWR compliance with the requirements imposed by Criterion 56.

6.2.4.3.2.1 Influent Lines to Containment

Tables 6.2-33 through ~~6.2-42 identifies~~ 6.2-45 identify the isolation valve functions in the influent lines to the containment.

High Pressure Nitrogen Supply System

The High Pressure Nitrogen Supply System penetrates the containment at two places. Each line has one air-operated shutoff valve outside and one check valve inside the containment.

6.2.4.3.2.2 Effluent Lines from Containment

Tables 6.2-33 through ~~6.2-42~~ 6.2-45 identify the isolation functions in the effluent lines from the containment.

Fuel and Auxiliary Pools Cooling System Suction Lines

The FAPCS suction line from the GDCS pool is provided with two power-assisted shutoff valves, one pneumatic-operated or equivalent inside and one pneumatic-operated or equivalent outside the containment.

Before it exits containment, the FAPCS suction line from the suppression pool branches into two parallel lines, each of which penetrate the containment boundary. Once outside, each parallel flow path contains two pneumatic isolation valves in series after which the lines converge back into a single flow path. The CIVs are normally closed and fail as-is for improved reliability. "Fail as-is" valves are acceptable because the valves are normally closed, are only opened when it is necessary to provide cooling to the suppression pool and do not communicate with the DW atmosphere. This arrangement is an exception to GDC 56, which requires that such lines contain one isolation valve outside and one isolation valve inside the containment. Such an alternative arrangement is necessary because an inboard valve could potentially be under water under certain accident conditions. Leak detection is provided for CIVs on the suppression pool suction line and the valves are located as close as possible to the containment.

Chilled Water System

The CWS effluent lines penetrating the containment each has a pneumatic-operated or equivalent shutoff valve outside containment and a pneumatic-operated or equivalent shutoff valve inside the containment.

Containment Inerting System

The penetration of the Containment Inerting System consists of two tandem quarter-turn shutoff valves (normally closed) in parallel with tandem stop or shutoff valves. All isolation valves on these lines are outside of the containment so that they are not exposed to the harsh environment of the wet well and dry well and are accessible for maintenance, inspection and testing during reactor operation. Both containment isolation valves are located as close as practical to the containment. The valve nearest to the containment is provided with a capability of detection and termination of a leak. The piping between the containment and the first isolation valve and the piping between the two isolation valves are designed as per requirements of SRP 3.6.2. These piping are also designed to:

- Meet Safety Class 2 design requirements.
- Withstand the containment design temperature.
- Withstand internal pressure from containment structural integrity test.
- Withstand loss-of-coolant accident transient and environment.

test, because normal locking mechanisms are not designed for the full differential pressure across the door in the reverse direction.

6.2.6.3 Containment Isolation Valve Leakage Rate Test (Type C)

Type C tests are performed on all containment isolation valves required to be tested per 10 CFR 50 Appendix J Option A or Option B. Containment isolation valves subject to Type C tests are listed within Tables 6.2-16 through ~~6.2-42~~. 6.2-45

Type C tests (like Type B tests) are performed by local pressurization using either the pressure-decay or flowmeter method. The test pressure is applied in the same direction as when the valve is required to perform its safety function, unless it can be shown that results from tests with pressure applied in a different direction are equivalent or conservative. For the pressure-decay method, test volume is pressurized with air or nitrogen to at least P_a. As an exemption from 10 CFR 50 Appendix J, Option A, Section III.D.2.(b)(ii), can be satisfied by testing at the end of periods when containment integrity is not required by the plant's Technical Specifications at a lower test pressure specified in the Technical Specification applied between the door seals with an acceptable maximum measured leakage rate of 0.01 L_a. The rate of decay of pressure of the known test volume is monitored to calculate the leakage rate. For the flowmeter method, the required test pressure is maintained in the test volume by making up air or nitrogen through a calibrated flowmeter. The flowmeter fluid flow rate is the isolation valve leakage rate.

All isolation valve seats that are exposed to containment atmosphere subsequent to a LOCA are tested with air or nitrogen at containment peak accident pressure P_a.

Per ANSI/ANS-56.8-1994 (for Option A) and NEI 94-01, Revision 0 (for Option B), a Type C local leakage rate test may not be performed for the following cases:

- Primary containment boundaries that do not constitute potential primary containment atmospheric pathways during and following a DBA;
- Boundaries sealed with a qualified seal system; or
- Test connection vents and drains between primary containment isolation valves that are one inch or less in size, administratively secured closed and consist of a double barrier.

Per ANSI/ANS-56.8-1994, a qualified seal system is "a system that is capable of sealing the leakage with a liquid at a pressure no less than 1.1 P_{ac} [equivalent to P_a in 10 CFR 50, Appendix J] for at least 30 days following the DBA." Type C valves with a qualified seal system are periodically tested to prove functionality by pressurizing the line with the sealing fluid to a pressure of not less than 1.10 P_a. The measured leakage is excluded when determining the combined leakage rate, provided that:

- Such valves have been demonstrated to have fluid leakage rates that do not exceed those specified in the technical specifications or associated bases; and
- The installed isolation valve seal-water system fluid inventory is sufficient to assure the sealing function for at least 30 days at a pressure of 1.10 P_a.

Unless there is essentially an unlimited supply of sealing fluid, valve-specific leakage rate limits are assigned, based on analyses to assure fluid inventory for 30 days at a pressure of 1.10 P_a

Q Process actuated
R Local manual (By Hand)
T High HVAC radiation exhaust from refueling area or from Reactor Building.
U Feedwater lines differential flow
W Containment water level high
X Reactor vessel low-low water level – Level 0.5

(e) Valve Types[2]:

OS&Y Outside stem and yoke, typical of gate and globe valve designs that have an externally exposed rising or non-rising stem that connects a yoke-mounted actuator (any type) to the internal disk assembly, and includes a stem sealing gland (with or without a hermetic disk-to-stem internal seal such as a metal bellows or diaphragm).

Gate (GT) Any of several styles of valve where the disk is formed as a plate which transits the fluid flow stream with an orthogonal motion. The seating surface of the valve body is also manufactured to be at a slight angle to or set orthogonal to the flow stream. The disk can be wedge-shaped in either solid or split/flexible form, or as two plates mounted back-to-back or similar form (e.g., parallel-slide or double-disk gate), matching the seat configuration. Additional variants include shutter type and rotating-slide type gate valves.

Globe (GB) Any of several styles and configurations of valves where the disk is formed either as a truncated cone or curved section (spherical, elliptical, parabolic, etc.) with or without a following structure to support and guide the disk-and-stem motion. The body seat is centered around the flow stream and the disk-and-stem motion axis is perpendicular to the seat (i.e., axially concentric with the flow stream at the seat orifice plane). Body variations are based on the angle of the inlet-to-outlet nozzles or the angle of the stem to the inlet or outlet nozzle. Stem and disk assembly may be unconnected to permit a combined check and stop valve function (floating-disk stop, non-return check, etc.).

Quarter-turn (QT) Any of various types of butterfly (QBF) and ball (QBL) valves where the stem/shaft is mounted across the flow stream and the pallet, ball or plug (disk) is rotated through a 90 degree arc from full-closed to full-open. The actuator mechanism is typically mounted directly to the valve bonnet and there may be no exposed stem. The butterfly valve pallet remains in the flow stream when the valve is open whereas the plug and ball valves provide either a reduced or full pipe diameter flow orifice and shield the valve and disk seating surfaces when opened.

Axial-flow (AF) A variant of globe valves with the valve bonnet and disk-stem assembly rotated to be completely internalized and concentric with the fluid flow axis through the valve. There may be no external exposed stem or sealing gland, depending on design function(s) and selected actuation option. Based on specific product design, the flow path is typically formed as either an annular nozzle in a wafer-style body or as annular venturi in a teardrop-style body.

6.2-45

2 Valve type(s) listed for each containment isolation valve number in Tables 6.2-16 through ~~6.2-42~~ indicates either the specific design characteristics of a type or the range of types with suitable equivalent design characteristics capable of performing the intended function(s) for each application. The first type listed is generally based on historical selection from previous BWR designs.