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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 79 - Containment Systems - RAI Number 6.2-131**

Enclosure 1 contains GHNEA's response to the subject NRC RAI transmitted via the Reference 1 letter.

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

Sincerely,

Kathy Sedney for

James C. Kinsey
Project Manager, ESBWR Licensing

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NRO

Reference:

1. MFN 06-393, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 79 Related to ESBWR Design Certification Application*, October 11, 2006

Enclosure:

1. MFN 07-283 - Response to Portion of NRC Request for Additional Information Letter No. 79 - Related to ESBWR Design Certification Application - Containment Systems - RAI Number 6.2-131

| | | |
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**Enclosure 1**

**MFN 07-283**

**Response to Portion of NRC Request for**

**Additional Information Letter No. 79**

**Related to ESBWR Design Certification Application**

**Containment Systems**

**RAI Number 6.2-131**

**NRC RAI 6.2-131:**

*Provide discussions in the DCD.*

*(A) The automatic isolation signals for CIVs and their diversity of parameters sensed, per item II.l. of SRP 6.2.4, Rev. 2.*

*(B) Classification of systems as essential or non-essential and the automatic isolation of non-essential systems during an accident, per NUREG-0737, item II.E.4.2, and item II.h. of SRP 6.2.4, Rev. 2.*

*(C) Reducing the containment setpoint pressure that initiates containment isolation for nonessential penetrations to the minimum compatible with normal operating conditions, per NUREG-0737, item II.E.4.2(5), and item II.k. of SRP 6.2.4, Rev. 2.*

**GHNEA Response:**

(A) NUREG-0800, Standard Review Plan (SRP) 6.2.4, Revision 2, item II.l of the SRP acceptance criteria states: "There should be diversity in the parameters sensed for the initiation of containment isolation to satisfy the GDC 54 requirement for reliable isolation capability." SRP 6.2.4, Revision 3 provides the same guidance in item II.12. DCD Tier 2, Revision 3, Tables 6.2-16 through 6.2-42, describe all fluid penetrations and list the primary actuation methods for each containment isolation valve along with a reference to the automatic containment isolation signals provided, if applicable. Table 6.2-15 provides a description of the automatic containment isolation signals. As shown in these Tables, multiple, diverse actuation signals are provided for those containment isolation valves in systems not required for emergency operation. DCD Tier 2, Revision 3, Subsections 5.2.5 and 7.3.3.2 provide a discussion of those automatic containment isolation signals processed by the Leak Detection and Isolation System with a listing of the parameters sensed. Therefore, the multiple, diverse actuation signals are described in the DCD Tier 2 as required. DCD Tier 2, Subsection 6.2.4, will be revised to include a reference to the discussions in DCD Tier 2, Subsections 5.2.5 and 7.3.3.2.

(B) SRP 6.2.4, Revision 2, item II.h, states: "Item II.E.4.2 of NUREG-0737 and NUREG-0718 requires that systems penetrating the containment be classified as either essential or nonessential. Regulatory Guide 1.141 will contain guidance on the classification of essential and nonessential systems. Essential systems, such as those described in items b and c, may include remote manual containment isolation valves, but provisions should be made to detect possible leakage from the lines outside containment. Item II.E.4.2 of NUREG-0737 and NUREG-0718 also requires that nonessential systems be automatically isolated by the containment isolation signal." SRP 6.2.4, Revision 3 provides similar guidance in item II.8. In addition, NUREG-0737, Item II.E.4.2, Table 1A-1, states, "The containment isolation system, in general, closes fluid penetrations for support systems that are not safety-related."

GHNEA does not use the terms 'essential' or 'non-essential' in the DCD Tier 2 for the classification of systems. Instead, GHNEA prefers to consistently use the terms 'safety-related' and 'nonsafety-related' for clarity when describing the importance of the functions of a system with regard to safety, similar to the terminology in NUREG-0737, Item II.E.4.2, Table 1A-1. DCD Tier 2, Subsection 6.2.4.1, provides the criteria used by GHNEA for categorizing the fluid penetrations that require automatic containment isolation versus remote manual containment isolation based on the same basic criteria further described in SRP 6.2.4 Revision 3, item II.8. Specifically, DCD Tier 2, Subsection 6.2.4.1, states: "The containment isolation function automatically closes fluid penetrations of fluid systems not required for emergency operation. Fluid penetrations supporting ESF systems have remote manual isolation valves that can be closed from the control room, if required." Based on these criteria, if a fluid penetration includes a portion of a system that does not have a safety-related function (i.e., only has a nonsafety-related function not in support of an ESF function), then the design of the containment isolation valves includes automatic containment isolation actuation as the primary actuation method, consistent with SRP 6.2.4, item II.8.

DCD Tier 2, Revision 3, Tables 6.2-16 through 6.2-42, further describe all fluid penetrations and lists the applicable primary actuation methods for each containment isolation valve along with a reference to the automatic containment isolation signals provided, if applicable. Table 6.2-15 provides a description of the automatic containment isolation signals. In addition, Tables 6.2-16 through 6.2-42 provide the post-accident position for each containment isolation valve, and those containment isolation valves in fluid penetrations not required for emergency operation are typically designated as "Closed."

For the ESBWR, a majority of the containment penetrations are automatically isolated and remain closed after a containment isolation signal, since there are only a few penetrations required for emergency operation either supporting ESF systems or directly as a process flow path for an ESF system. The Fuel and Auxiliary Pool Cooling System (FAPCS) is classified as a nonsafety-related system, but does contain certain specific functions classified as safety-related or as Regulatory Treatment of Non-Safety Systems (RTNSS) as described in Subsection 9.1.3 (See response to RAI 9.1-42). Those FAPCS containment penetrations required for emergency operation include remote manual isolation valves or check valves. In addition, the Standby Liquid Control System (SLC) and Isolation Condenser System (ICS) are ESF systems that have fluid paths through containment penetrations. The SLC penetrations are not automatically isolated and do not contain remote manual isolation valves. Instead, the SLC penetrations are isolated if necessary by process-actuated check valves, but only after the SLC flow into the reactor pressure vessel/containment has ceased following an accident. The ICS penetrations listed in Tables 6.2-23 through 6.2-30 consist of various system process lines, all of which may be open or required to be opened following an accident in order to perform the required ESF function. The ICS penetration flow paths contain remote manual isolation valves, process-actuated flow control valves, or automatic isolation valves that only close for the applicable ICS train if leakage outside of containment is detected through IC/Passive Containment Cooling (PCC) pool high radiation or IC lines high flow.

(C) DCD Tier 2, Table 1A-1, item II.E.4.2, states that ESBWR is compliant with NUREG-0737 and that alarm setpoints are determined analytically or based on actual measurements from preoperational tests. To address this RAI, DCD Tier 2, Table 1A-1, item II.E.4.2, will be revised to also state that ESBWR containment isolation initiation setpoint pressure is reduced to the minimum compatible with normal operating conditions for containment penetrations containing process lines that are not required for emergency operation.

**DCD Impact:**

(A) DCD Tier 2, Subsection 6.2.4, will be revised to include a reference to Subsection 5.2.5 and 7.3.3.2 for the parameters used to initiate containment isolation as shown in the attached markup.

(B) DCD Tier 2, Subsections 6.2.4.2 and 9.1.3.2, will be revised to include a description of the isolation of systems that support emergency ESF functions as described above and shown in the attached markup.

(C) DCD Tier 2, Appendix 1A, will be revised as described above and shown in the attached markup.

### 6.2.4 Containment Isolation Function

The primary objective of the containment isolation function is to provide protection against releases of radioactive materials to the environment as a result of an accident. The objective is accomplished by isolation of lines or ducts that penetrate the containment vessel. Actuation of the containment isolation function is automatically initiated at specific limits defined for reactor plant operation. After the isolation function is initiated, it goes through to completion. Containment isolation signals result from diverse sources of sensory inputs. Subsections 5.2.5 and 7.3.3.2 describe the parameters used to initiate these signals.

#### 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 reactor coolant pressure boundary (RCPB) influent lines are identified in Table 6.2-13, and the RCPB effluent lines are identified in Table 6.2-14. Table 6.2-15 through 6.2-42 show the pertinent data for the containment isolation valves. 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. 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 Regulatory Guide 1.26 may be found in Subsection 3.2.2. General compliance or alternate approach assessment for Regulatory Guide 1.29 may be found in Subsection 3.2.1.

Containment isolation valves are generally automatically actuated by the various signals in primary actuation mode or are remote manually operated in secondary actuation mode. Other appropriate actuation modes, such as process-actuated check valves, are identified in the containment isolation valve information Tables 6.2-13 through 6.2-42.

Systems containing penetrations that support or provide a flow path for emergency operation of ESF systems are not automatically isolated. The penetrations supporting ESF systems include some of the Fuel and Auxiliary Pool Cooling System (FAPCS) penetrations. Those FAPCS penetrations required for emergency operation include remote manual isolation valves or check valves. In addition, the Standby Liquid Control System (SLC) and Isolation Condenser System (ICS) are ESF systems that have fluid paths through containment penetrations. The SLC penetrations are not automatically isolated and do not contain remote manual isolation valves.

Instead, the SLC penetrations are isolated if necessary by process-actuated check valves, but only after the SLC flow into the reactor pressure vessel/containment has ceased following an accident. The ICS penetrations listed in Tables 6.2-23 through 6.2-30 consist of various system process lines, all of which may be open or required to be opened following an accident in order to perform the required ESF function. The ICS penetration flow paths contain remote manual isolation valves, process-actuated flow control valves, or automatic isolation valves that only close for the applicable ICS train if leakage outside of containment is detected through IC/Passive Containment Cooling (PCC) pool high radiation or IC lines high flow.

**9.1.3.2 System Description**

**System Description Summary**

*[DCD Tier 2, Section 9.1.3.2, paragraph 12]*

~~T~~With the exception of valves needed to perform accident recovery functions described above, the containment isolation valves are automatically closed upon receipt of a containment isolation signal from the Leakage Detection and Isolation System (LD&IS).~~ The containment isolation valves needed to perform an accident recovery function described above, will require a manual operator action to override the isolation signal.~~

**Table 1A-1 TMI Action Plan Items**

| Regulation | TMI Item | Description | ESBWR Resolution | Associated Tier 2 Location(s) |
|---|---|---|---|---|
| 10 CFR 50.<br>34(f)(2)(xiv) | II.E.4.2 | Provide containment isolation systems that:<br>(A) Ensure all non-essential systems are isolated automatically by the containment isolation system,<br>(B) For each non-essential penetration (except instrument lines) have two isolation barriers in series,<br>(C) Do not result in reopening of the containment isolation valves on resetting of the isolation signal,<br>(D) Utilize a containment set point pressure for initiating containment isolation as low as is compatible with normal operations, and<br>(E) Include automatic closing on a high radiation signal for all systems that provide a path to the environs. | The ESBWR Containment Isolation System meets the NRC requirements, including the post-TMI requirements. In general, this means that two barriers are provided.<br>Redundancy and physical separation are required in the electrical and mechanical design of the containment isolation system to ensure that no single failure in the system prevents it from performing its intended functions. Electrical redundancy is provided for each set of isolation valves, eliminating dependency on one power source to attain isolation. Electrical cables for isolation valves in the same line are routed separately. Cables are selected and based on the specific environment to which they may be subjected (e.g., magnetic fields, high radiation, high temperature and high humidity).<br>Classification of structures, systems and components for the ESBWR design is addressed in Section 3.2 and identified in Table 3.2-1. The basis for classification is also presented in Section 3.2.<br>The containment isolation system, in general, closes fluid penetrations for support systems that are not safety-related. | 10 CFR 50.<br>34(f)(2)(xiv) |

| Regulation | TMI Item | Description | ESBWR Resolution | Associated Tier 2 Location(s) |
|---|---|---|---|---|
| | | | The design of the control systems for automatic containment isolation valves ensures that resetting the isolation signal does not result in the automatic reopening of containment isolation valves.<br><br>Actuation of the containment isolation system is automatically initiated by the Leak Detection and Isolation System (LD&IS) at specific limits defined for reactor plant operation. The LD&IS (described in Subsections 5.2.5 and 7.3.3) is designed to detect, monitor and alarm leakage inside and outside the containment, and automatically initiates the appropriate protective action to isolate the source of the leak. Various plant variables are monitored, including pressure, and these are used in the logic to isolate the containment. The drywell pressure is monitored by four divisional channels, using pressure transmitters to sense the drywell atmospheric pressure from four separate locations. A pressure rise above the nominal level indicates a possible leak or loss of reactor coolant within the drywell. A high pressure indication is alarmed in the main control room, and initiates reactor scram and with the exception of the MSIVs, closure of the containment isolation valves. The alarm and initiation setpoints of the LD&IS are set | |

| Regulation | TMI Item | Description | ESBWR Resolution | Associated Tier 2 Location(s) |
|---|---|---|---|---|
| | | | to the minimum compatible with normal operating conditions to initiate containment isolation for containment penetrations containing process lines that are not required for emergency operation. The values for these setpoints are determined analytically or are based on actual measurements made during startup and preoperational tests. All ESBWR containment purge valves meet the criteria provided in BTP CSB 6-4. The main purge valves are fail-closed and are verified to be closed at a frequency interval of 31 days as defined in the plant technical specifications. All purge and vent valves are pneumatically operated, fail closed and receive containment isolation signals. Bleed valves and makeup valves can be remote manually opened in the presence of an isolation signal, by utilizing override control if continued inerting is necessary.<br><br>In the ESBWR design, redundant primary containment isolation valves (purge and vent) close automatically upon receipt of an isolation signal from the Leak Detection and Isolation System (LD&IS). The LD&IS is a four-divisional system designed to detect and monitor leakage from the reactor coolant pressure boundary, and, in certain cases, isolates the source of the leak by | |

| Regulation | TMI Item | Description | ESBWR Resolution | Associated Tier 2 Location(s) |
|---|---|---|---|---|
| | | | initiating closure of the appropriate containment isolation valves. Various plant variables are monitored, including radiation level, and these are used in the logic to initiate alarms and the required control signals for containment isolation. High radiation levels detected in the reactor building HVAC air exhaust or in the refueling area air exhaust automatically isolates the containment purge and vent isolation valves. | |