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MFN 07-215

Docket No. 52-010

May 15, 2007

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Subject: Response to Portion of NRC Request for Additional Information Letter No. 88 Related to ESBWR Design Certification Application ESBWR Probabilistic Risk Assessment RAI Numbers 19.1-66, 19.1-67, 19.1-69).

Enclosure 1 contains GE's response to the subject NRC RAIs transmitted via the Reference 1 letter.

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

Sincerely,

Kathy Sedney for

James C. Kinsey
Project Manager, ESBWR Licensing

D068

Reference:

MFN 06-551, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 88 for the ESBWR Design Certification* Application, December 26, 2006.

Enclosures:

1. Response to Portion of NRC Request for Additional Information Letter No. 88 Related to ESBWR Design Certification Application ESBWR Probabilistic Risk Assessment RAI Numbers 19.1-66, 19.1-67, 19.1-69).

cc:	AE Cubbage	USNRC (with enclosures)
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EDRF Section 0067-5912

Enclosure 1

MFN 07-215
Response to Portion of NRC Request for Additional Information Letter No. 88 Related to ESBWR Design Certification Application ESBWR Probabilistic Risk Assessment RAI Numbers 19.1-66, 19.1-67, 19.1-69

NRC RAI 19.1-66

Clarify/explain modeling of the Containment System (Section 4.18). The staff needs additional information, related to Section 4.18 (Containment System), in the following areas:

(A) It is stated (page 4.18-3): "The Containment Isolation System provides protection against release of radioactive materials to the environment as a result of accidents occurring in systems or components within the containment." However, the next paragraph seems to contradict this statement. It is stated that "In the analysis, only the isolation of LOCAs outside containment....... .. are justified." Please clarify.

(B) It is stated (page 4.18-3): "Each vacuum breaker is equipped with a DC motor-operated valve which provides isolation capability if the vacuum breaker sticks open or leaks in the closed position." This statement does not seem to be in agreement with the fault tree modeling of the "failure to isolate vacuum breaker (VB) leaks" top event (GT10-0001_1). Instead of modeling the isolation failure of the DC motor-operated isolation valves, the failure to close of the VBs themselves is modeled. Please explain.

(C) Fault trees for two top events related to VBs are included in Appendix B.4.18-1. Top event GT10-0001-_1 models the failure to isolate VB leaks (needed to model failure of passive containment cooling, which requires leak-tight closure of all three VBs to operate efficiently). Top event GT10-0001-_2 models the failure of the steam suppression function, which requires that at least two VBs remain closed (for efficient steam suppression) and at least one VB opens when demanded to relieve pressure. However, it appears that no VB leaks during steam suppression were considered. If there is a leak in one VB and it is isolated, this VB will not be available to open to relieve pressure (which may be needed more than once during the steam suppression phase). Please explain why potential VB leakages during steam suppression were not considered.

(D) Section 4.18-7 (Basic Events) appears to have several errors. For example, the description provided for event B32-ACV-OO-F001A is "MSIV F001A Valve Fails to Close" instead of "Isolation Condenser Steam Line F001A Valve Fails to Close." Another example is the definition of event B32-MOV-OO-F002A as "Solid State Load Driver LD002 fails to Close"Reviewer Summary Full Text -2-instead of "Isolation Condenser Steam Line MOV F002A Fails to Close." Please review the basic event descriptions provided in Section 4.18-7 and revise as necessary.

(E) In Section 4.18-2 (System Dependencies Matrix), no information is provided for several components (e.g., air-operated valve G31-F3B and the eight Main Steam Isolation Valves (MSIVs)). Please review the information provided in Section 4.18-2 and revise as necessary.

(F) It is stated that there is a third normally open valve (G31-F3A or B) in the suction line of each train of the reactor water cleanup (RWCU) system which is air-operated. These valves are not shown in the simplified flow diagram but are credited in the PRA. Please provide information about the location of these valves and explain why they are not part of the system boundary,as indicated in Section 4.18.9.2 (page 4.18-6). Are these valves supplied by individual nitrogen or air accumulators?

(G) It is stated that top event GT10-0001-_9 represents the failure to isolate main steam pipe breaks outside containment. However, as modeled, this top event represents the failure to isolate all four main steam lines and not just the line where the break is located. Please explain and state any important assumptions that were made in the event tree for main steam line breaks outside containment. Also, clarify the group of MSIVs included in basic event B21-ACV-CF-MSIVCLOSE (e.g., all eight valves versus two valves in same line) and state any assumptions made in modeling common cause failure of MSIVs.

(H) For other systems modeled in the PRA, provide a simplified instrumentation and control (I&C) block diagram, with a brief description of each block element, that supports the logic of the fault trees included in Appendix B.4.18.

GE Response

A) Refer to NEDO-33201 section 4.18.3.1. For the level 1 analysis, only breaks outside containment that can lead to a significant loss of RCS inventory are modeled. Breaks inside containment are isolated by the containment.

B) The vacuum breaker isolation valves are now a completely passive, process-actuated, check-type valve that opens in response to differential pressure, much like the vacuum breaker itself. The fault trees in NEDO-33201 Figure 4.18-2 reflect these changes.

C) Addressed in NEDO Section 4.18.3.1. The consideration of vacuum breaker leakage during steam suppression (top DS-TOPVB) can be seen in the fault tree in NEDO-33201 Figure 4.18-2.

D) NEDO-33201basic event table 4.18-7 has been revised.

E) NEDO-33201 system dependency table 4.18-2A has been revised.

F) Valves G31-F3A/B are no longer modeled. There are two normally-open valves on each train of RWCU in addition to the containment isolation valves that can be seen in the updated simplified drawings in NEDO-33201 Figure 4.18-1.

G) Addressed in NEDO-33201 Section 4.18.2. Top BC-TOPMSL does model the isolation of all four main steam lines for a break outside of containment in a main steam line. This is a conservative way to approach isolation of a break in any MSL. NEDO section 5.3 addresses the CCF groups for the main steam lines.

H) Addressed in NEDO-33201 Section 4.18.2. Simplified drawings for the I&C system are part of the I&C system sections – NEDO-33201 Section 4.5.

Affected Documents

No DCD changes will be made in response to this RAI.

NEDO-33201 Rev 2 Section 4.18 has been revised as noted above.

NRC RAI 19.1-67

Clarify/explain modeling of the Passive Containment Cooling System (Section 4.19). The staff needs additional information related to Section 4.19, Passive Containment Cooling System (PCCS), in the following areas:

(A) it is stated (Section 4.19.8) that "The pool water in each . . . subcompartment is removable without emptying the entire ICS/PCCS pool. The individual partitioned PCC (passive containment cooling) pool is isolated by closing the locked open valve . . . to replenish the pool, the normally open valve is re-opened and the water refills the pool." If this task is allowed to be performed during plant operation at power, PCC pool unavailability due to Reviewer Summary Full Text -3-maintenance should be included in the PRA models as well as operator failure to open the valves. Similarly, if online corrective maintenance of PCC condensers is allowed by the technical specifications, the unavailability of the impacted IC (isolation condenser) loop(s) should be modeled. Please explain.

(B) It appears that a potential failure, which could also impact multiple PCC loops (common cause failure), is the plugging of the spargers in the suppression pool. Was such a potential failure investigated? Please discuss.

(C) The fault tree provided in PRA Appendix B.4.19 (page 1) for "loss of pool water during 72 hours" includes two identical descriptions for events GB32-0201-_1 and GB32-0301-_1. Please clarify by providing descriptions consistent with Figure 4.19-2 (Schematic of IC/PCC Pools and Interconnections). Also, it appears that not all common cause failure combinations of motor operated valved (MOVs) F72H A,B,C,D (consistent with PCCS system success criteria) were considered. Please explain.

(D) The PCCS drain lines discharge into the Gravity Driven Cooling System (GDCS) pools. Located on the drain line and submerged in the pool, just upstream of the discharge point, is a loop seal which prevents back-flow of steam and gas mixture from the drywell (DW) to the vent line (such back flow could short circuit the flow through the condenser to the vent line). The potential that the function of this feature (loop seal) is defeated should be investigated. Does this feature prevent back-flow under all accident conditions and in the presence of multiple failures? For example, do all seal loops prevent back-flow during a large LOCA with failure of multiple GDCS lines to inject? Please discuss.

GE Response

A) Refer to NEDO-33201, Section 4.19.2. A maintenance unavailability fraction was created using the Tech Spec allowed outage time per loop, although any maintenance would normally be during shutdown. Isolating one sub-pool has no effect on adjacent sub-pools, so no dependency is modeled. No restoration errors are modeled for the maintenance valves because they will have tech spec mandated confirmation of the open position as well as indication and alarm in the main control room.

B) Addressed in NEDO-33201, Section 4.19.2. Spargers were not modeled for plugging because of the direction of flow from the sparger, the inlet filters on each loop, and the high water quality in the suppression pool.

C) Addressed in NEDO section 4.19.5. These events are now differentiated based on which of the two inner expansion pools they represent. The two valves to each pool are now diverse; CCF failures are modeled, but will not affect flow to either pool alone because of the diverse valve design.

D) Refer to NEDO-33201 Section 4.19.3.2. DCD Subsection 6.2.2.2.2 states that the loop seals prevent backflow from the DW to the vent line. The proposed scenario, in which GDCS pools fail to inject, does not seem challeging to the loop seals because they would remain covered by the water in the GDCS pools.

Affected Documents

No DCD changes will be made in response to this RAI.

NEDO-33201, Section 4.19 Rev 2 has been revised as noted above.

NRC RAI 19.1-69

Expand PRA results in Section 7 to include post 24-hour system or operator actions needed to prevent core damage. In general, an accident sequence is categorized as successful if the reactor achieves a stable shutdown condition without core damage and this condition can be maintained for at least 24 hours following event initiation without further operator action or system operation. This means that it is not sufficient to avoid core damage during the first 24 hours if conditions are not stabilized in 24 hours, or if core damage is anticipated following 24 hours without any action. The results provided in Section 7, which are used to perform sensitivity and importance analyses (documented in Section 11), do not include post 24-hour system or operator actions needed to prevent core damage. For example, the successful post 24-hour operation of ICS and PCCS require the opening of a pair of motor-operated valves MOVs to replenish the IC/PCC pools. The staff could not find any cutsets including common cause failure of these MOVs. The modeling of post 24-hour actions in the PRA can be very important in sensitivity studies, such as the "focused PRA"sensitivity study which is used to identify non-safety-related systems that are candidates for regulatory oversight. Please discuss. Reviewer Summary Full Text -5-

GE Response

Event trees have been updated and the stated issue no longer exists. All current sequences end in either a stable reactor state or core damage. NEDO-33201 Rev 2 Section 3 contains event tree details.

Affected Documents

No DCD changes will be made in response to this RAI.

NEDO-33201 Rev 2 Section 3 has been revised as noted above.