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Subject: Response to Portion of NRC Request for Additional Information Letter No. 40 Related to ESBWR Design Certification Application ESBWR Probabilistic Risk Assessment RAI Numbers 19.2-8, 19.2-9, 19.2-14, 19.2-29 and 19.2-30.

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

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Reference:

1. MFN 06-222, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 40 Related to ESBWR Design Certification Application*, July 5, 2006

Enclosures:

1. Response to Portion of NRC Request for Additional Information Letter No. 40 Related to ESBWR Design Certification Application ESBWR Probabilistic Risk Assessment RAI Numbers 19.2-8, 19.2-9, 19.2-11, 19.2-14, 19.2-23 S01, 19.2-29 and 19.2-30

cc:	AE Cubbage	USNRC (with enclosures)
	George Stramback	GE/San Jose (with enclosures)
	RE Brown	GE/Wilmington (with enclosures)

EDRF Section 67-5912

Enclosure 1
MFN 07-212
Response to Portion of NRC Request for Additional Information Letter No. 40 Related to ESBWR Design Certification Application ESBWR Probabilistic Risk Assessment RAI Numbers 19.2-8, 19.2-9, 19.2-14, 19.2-29 and 19.2-30

NRC RAI 19.2-8

Vacuum breaker failure is modeled in the PRA as the probability of vacuum breaker leakage (1E-4) AND the probability of failure of vacuum breaker closure (events GT10-0103-1 through GT10-0105-1 in Figure B.4.18 of the PRA). Provide a description of each of the failures and basic events considered in the fault tree. Provide the values for events GT10-0103-1 through GT10-0105-1 for each accident class. Justify that the impacts of vacuum breaker leakage on the pressure suppression and PCCS functions are adequately addressed in the fault tree.

GE Response

Descriptions are addressed in NEDO-33201 Section 4.18, Table 4.18-7 "Basic Events". Values for the basic events can be found in NEDO-33201 Section 5, Table 5.2-3 "Modeled Basic Events". The impact of vacuum breaker leakage on pressure suppression is considered in top gate DS-TOPVB, as described in NEDO-33201 Section 4.18.9.1 and shown in the fault tree, NEDO-33201 Figure 4.18-2. For pressure suppression only one vacuum breaker is allowed to leak, so that portion of the tree is a COM2 gate with the three vacuum breaker leakage gates below it. Regarding PCCS, all vacuum breakers are required to be leak-tight, so top DL-TOPVB is an OR gate with the three vacuum breaker leakage gates as inputs. Gate DL-TOPVB always immediately precedes the PCCS top gate (WP-TOPDHR) in the event trees.

Affected Documents

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

No changes will be made to NEDO-33201 in response to this RAI.

NRC RAI 19.2-9

Provide the basis for the assumed value of 1E-4 for both the probability of a vacuum breaker leak, and the probability of the failure to close the vacuum breaker (presumably using the DC motor-operated isolation valves.) Discuss the degree to which these values are based on vacuum breaker test data and/or operator actions, and the process by which these low values will be achieved and maintained.

GE Response

The vacuum breaker leakage / fail to close combined failure rate is addressed in NEDO-33201 Section 5.2, Table 5.2-2, footnote 5. Isolation valve design is no longer a DC-powered, motor operated valve. The current design in progress is a passive, diverse, backup vacuum breaker of a duo-plate check valve design. Currently, the model uses traditional check valve data for fail to open, fail to close, and reverse leakage failure modes, which are judged to be conservative in this application. No operator actions are credited or possible with respect to operation of the vacuum breakers and backup valves, as they are completely passive in the new design. Values will be achieved through design, and maintained through periodic testing and maintenance during refueling outages.

Affected Documents

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

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

NRC RAI 19.2-14

Provide design information for the containment spray system, in particular, the elevation of the containment spray header inside the drywell, spray water temperature, and spray mean droplet diameter.

GE Response

Providing detailed design information is not necessary for the drywell spray (containment spray). The system is not credited at all in the PRA

Affected Documents

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

No changes to NEDO-33201 will be made in response to this RAI.

NRC RAI 19.2-29

Some LDW flooding valves are actuated by thermocouples in the drywell floor. Others are passively activated through fusion of eutectic alloys exposed to the LDW thermal environment. Provide the following information: (a) a more detailed discussion of the thermocouple arrangement, including the number, location, and depth at which they are located in the floor, (b) an assessment of the reliability of the thermocouples and associated support systems in severe accidents, including station blackout events, (c) a more detailed discussion of the eutectic valve arrangement, including their location and expected reliability, (d) an estimate of the time delay associated with actuation of the thermocouple-based valves and the eutectic-based valves, and (e) an assessment of the potential for pre-mature system actuation due to either a time-phased release of core debris from the vessel (a small initial discharge of core debris, followed by the release of the remainder of the core debris), or accident-induced LDW temperatures prior to RPV breach.

GE Response

There are no LDW flooding valves actuated by fusion of eutectic alloys in the ESBWR design. The design details of the actuation system for the LDW flooding valves are not complete at this time. However, actuation of the LDW flowing is discussed in DCD Tier 2 Revision 3 Section 6.3.2.7.2. This DCD section provides the information requested.

(a) *A more detailed discussion of the thermocouple arrangement, including the number, location, and depth at which they are located in the floor* – complete design details are not specified at this time. However, the DCD Tier 2 section listed above explains that the lower drywell basemat is divided into 30 cells, with two thermocouples (channel A and B) installed in each cell.

(b) *Assessment of the reliability of the thermocouples and associated support systems in severe accidents, including station blackout events* – the deluge valve is designed to survive the severe accident environment of a core melt and still perform its intended function. The pyrotechnic material of the squib charge used in the deluge valve is different from the material used in the other GDCS squib valves to prevent common mode failure. The deluge valve initiation circuitry is powered by non-safety related, 250 V DC.

(c) *More detailed discussion of the eutectic valve arrangement, including their location and expected reliability* – not applicable to ESBWR design

(d) *An estimate of the time delay associated with the actuation of the thermocouple-based valves and the eutectic-based valves.* The details on depth of thermocouple location have not been determined at this time.

(e) *An assessment of the potential for pre-mature system actuation due to either a time-phased release of core debris from the vessel (a small initial discharge of core debris, followed by release of the remainder of the core debris), or accident-induced LDW temperatures prior to RPV breach.* Prevention of pre-mature system actuation is accomplished by the use of the grid of thermocouples which are connected to two channels. Actuation requires

thermocouples in both channels from two adjacent cells sensing high temperature with two thermocouples in the lower drywell sensing high temperatures.

Affected Documents

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

NRC RAI 19.2-30

In PRA Section 21, the failure of BiMAC to function, including deluge activation, is judged to be physically unreasonable on the basis of the high reliability of the active system and the diverse passive system. Clarify whether a quantitative linked fault tree analysis of the reliability of the thermocouple-based squib valves and the eutectic-based valves been performed to confirm the asserted reliability level of <0.001 failure. If it has not been performed, provide alternate numerical-based justification of the reliability level.

GE Response

There are no LDW flooding valves actuated by fusion of eutectic alloys in the ESBWR design. The design details of the actuation system for the LDW flooding valves are not complete at this time. Therefore, a quantitative linked fault tree analysis of the reliability of the thermocouple-based squib valves has not been completed. The reliability level of <0.001 probability per demand will be verified at the completion of system design.

See DCD Tier 2 Revision 3 Subsection 6.3.2.7.2 for a system description.

There are 12 deluge squib valves, 3 in each of the 4 lines from the GDCS pools. The system design is such that a single active failure in one of the deluge valves does not prevent any of the pool from draining into the lower drywell. If it is conservatively assumed that 2 deluge squib valve failures would fail the deluge function, this would be a failure rate of 3.0E-4/demand. This failure rate is based on the failure rate 3.0E-3/demand (from Advanced Light Water Reactor Utilities Requirements Document) * 0.1 (common cause beta factor). In reality, 2 squib valve failures in one line would only fail 1 of the 4 lines from the GDCS pools.

The overall system reliability level will be evaluated at the completion of system design.

Affected Documents

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

No changes will be made to NEDO-33201 Rev 2 in response to this RAI.