HITACHI

GE Hitachi Nuclear Energy

Richard E. Kingston
Vice President, ESBWR Licensing

PO Box 780 M/C A-55
Wilmington, NC 28402 USA
USA

T 910 819 6192
F 910 362 6192
jrick.kingston@ge.com

MFN 07-422, Supplement 4

Docket No. 52-010

November 18, 2008

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. 222 Related to ESBWR Design Certification Application - RAI Number 19.1-100 S02**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by NRC letter 222 dated August 15, 2008 (Reference 1).

Previous RAIs and responses are References 2 through 5. The GEH response to RAI Number 19.1-100 S02 is in Enclosure 1.

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

D068
NRO

References:

1. MFN 08-649, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 222 Related to ESBWR Design Certification Application*, August 15, 2008.

2. MFN 07-555, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 109 Related to ESBWR Design Certification Application*, October 12, 2007.

3. MFN 07-422, *Response to Portion of NRC Request for Additional Information Letter No. 88 Related to ESBWR Design Certification Application ESBWR Probabilistic Risk Assessment RAI Numbers 19.1-81 through 19.1-95 and 19.1-97 through 19.1-101.* August 8, 2007.

4. 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.

5. MFN 07-422, Supplement 1, Response to Portion of NRC Request for Additional Information Letter No. 222 Related to ESBWR Design Certification Application, RAI Number 19.1-100 S01, dated December 6, 2007

Enclosures:

1. Response to Portion of NRC Request for Additional Information Letter No. 222 Related to ESBWR Design Certification Application Regulatory ESBWR Probabilistic Risk Assessment, Regulatory Treatment of Non-Safety Systems (RTNSS) RAI Number 19.1-100 S02

2. Attachment 1, DCD Tier 2, Revision 6 Markup

cc: AE Cubbage USNRC (with enclosure)
RE Brown GEH/Wilmington (with enclosure)
eDRF Section 0000-0091-8691

Enclosure 1

MFN 07-422, Supplement 4

Response to Portion of NRC Request for

Additional Information Letter No. 222

Related to ESBWR Design Certification Application

ESBWR Probabilistic Risk Assessment

Regulatory Treatment of Non-Safety Systems (RTNSS)

RAI Number 19.1-100 S02

***Original Responses previously submitted are included without DCD updates to provide historical continuity during review.**

NRC RAI 19.1-100 (original)

Address common cause failure of non-safety related components for loss of shutdown cooling. As described in PRA Section 20.4.4.6, Loss of Shutdown Cooling was excluded from the initiating events assessment since both trains of RWCU/SDCS need to fail to cause a loss of the decay heat removal function. Common cause failure of the non-safety related RWCU/SDC pumps or the common cause failure of the non-safety related Reactor Component Cooling Water System (RCCWS) pumps was not considered. Please revise the RTNSS evaluation to consider common cause failure of non-safety related components associated with RWCU/SDCS and its support systems for the shutdown initiating events evaluation.

GEH Response

The initiating event frequency for 'Loss of both RWCU/SDC trains' has been revised to now include several common cause failures that could lead to loss of both trains. The value does not, however, include loss of RCCWS pumps. The initiating event 'Loss of all Service Water PSWS/RCCWS' accounts for loss of the RCCWS pumps. The value for that initiator is from Chapter 2 of NEDO-33201 (Table 2.3-3).

The Loss of both RWCU/SDC initiating event in revision 1 of NEDO-33201 was obtained from the common cause failure of the RWCU pumps to run. The new initiating event is the sum of several RWCU common cause failures.
The new number includes CCF failures for:

- Pumps to run,
- AOV/NOV valves to spuriously transfer to de-energized position,
- MOVs to close, and
- Suction Transmitters failing low.

The frequency does not include RWCU pumps CCF failure to start, and breakers failing to close. Since at least one train is running during shutdown, these events were not credited in determining the shutdown initiating event for loss of both trains (NEDO-33201 Chapter 16, Table 16.3-3b). The evaluation section in Section *DCD chapter 19 states:*

i. PRA Initiating Events Assessment

The At-Power and Shutdown PRA models are reviewed to determine whether non-safety SSCs could have a significant effect on the estimated frequency of initiating events. The following screening criteria are imposed on the at-power and shutdown initiating events:

- *Are nonsafety related SSCs considered in the calculation of the initiating event frequency?*

- *Does the unavailability of the nonsafety-related SSCs significantly affect the calculation*

of the initiating event frequency?

- *Does the initiating event significantly affect CDF or LRF for the baseline PRA?*

If the answer to all three of these questions is "Yes", then the non-safety SSC is a RTNSS candidate. The results are discussed below.

With the above criteria, RWCU/SDC is not a candidate for regulatory oversight. The answer to the third questions above is 'No' for RWCU. There is no RWCU initiating event in the Level 1 PRA model. Loss of RWCU/SDC is only an initiating event during shutdown. Additionally, with a higher initiating event frequency than the previous revision, Loss of both RWCU/SDC trains accounts for less than 1% of the total shutdown CDF (NEDO 33201, Chapter 16, Table 16.9-2).

DCD/NEDO-033201 Impact

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

NEDO-33201 Rev 2 will be revised as noted above.

NRC RAI 19.1-100 S01

The staff has reviewed GEH's response to RAI 19.1-100 regarding the RTNSS evaluation of RWCU/SDC. The staff learned that the failure data for loss of both RWCU/SDC trains, the loss of Preferred Power, and the loss of the RCCWS is based on the data for operating plants. However, in current plants, the RHR system and its support systems have Technical Specifications. The staff does not believe that this data is applicable for a new design in which the RHR function is provided by non-safety-related equipment with no increased regulatory treatment (RTNSS). The staff also noted that if these non-safetyrelated systems become unreliable, failure of these systems become a dominant risk contributor. Please revise the RTNSS evaluation to either include the RWCU/SDC and its support systems in the RTNSS program, or describe what controls will be in place to maintain the availability of these systems consistent with what was assumed in the PRA.

GEH Response

Although the RWCU/SDC system does not satisfy the RTNSS criteria, residual heat removal (RHR) is also provided by ICS, which is safety-related, and by three FAPCS functions that are within the scope of RTNSS. The FAPCS functions of coolant injection, suppression pool cooling, and backup shutdown cooling are in the RTNSS category. FAPCS has regulatory oversight in the form of availability controls.

The reliability and availability of RWCU/SDC and its support systems are managed by the licensee per the requirements in 10 CFR 50.65(a)(4), as described in DCD Tier 2 Section 17.4. RWCU/SDC components also have an impact on power generation. Also, because shutdown risk is dominated by loss of coolant events, RWCU/SDC components have a relatively low importance. Therefore, it is unlikely that their performance would degrade to the point where there is a measurable effect on Core Damage Frequency.

DCD/NEDO-33201 Impact

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

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

NRC RAI 19.1-100 S02

The staff reviewed GEH's response to RAI 19.1.100 S01 regarding the omission of the RWCU/SDC from RTNSS. GEH stated, "although the RWCU/SDC does not satisfy the RTNSS criteria, residual heat removal (RHR) is also provided by ICS, which is safety-related, and by three FAPCS functions that are within the scope of RTNSS. The FAPCS functions of coolant injection, suppression pool cooling, and backup shutdown cooling are in the RTNSS category. FAPCS has regulatory oversight in the form of availability controls."

The staff requests GEH to document this response to RAI 19.1.100 S01 in Chapter 19 of the DCD as to why the RWCU/SDC is not a RTNSS candidate.

GEH Response

DCD Section 19A.4.3.7 will be revised to document why RWCU/SDC is not a RTNSS candidate.

DCD Impact

DCD Section 19A.4.3.7 will be revised as shown in the attached mark-up.

Attachment 1

DCD Tier 2, Revision 6 Markup

and a loss of feedwater, with longer-term effects on other mitigating systems requiring AC power.

The associated systems and components that comprise the plant-centered failures, such as the onsite AC power distribution system are nonsafety-related, and thus, Questions 1, and 2 are answered "Yes." However, those plant-centered components, such as substations, breakers, motor control centers, and protective relays, are much less risk-significant and below the threshold for RTNSS consideration, so Question 3 is answered "No."

Although the cumulative effects of LOPP are significant contributor to CDF and LRF with respect to the other initiating events for at-power and shutdown risk, but are not significant relative to the NRC safety goal guidelines. The dominant risk contributions are from the loss of incoming AC power from the utility grid and weather related faults. These types of faults are caused by components that are not controlled by the site organization. Questions 1 and 2 are answered "No" for these components because they are not controllable by the plant. Therefore, the SSCs within the ESBWR design scope for preventing a LOPP initiating event are not risk significant and do not warrant additional regulatory oversight. The standby diesel generators and PIP buses have RTNSS controls due to other criteria.

19A.4.3.5 *At-Power LOCA*

Loss of coolant accidents are initiated by piping leaks, valve leaks, or breaks. LOCAs are postulated to initiate in systems, such as RWCU/SDC and Main Steam. However, general design considerations require that all piping and components within the reactor coolant pressure boundary be safety-related. The RWCU/SDC and Main Steam piping have redundant safety-related isolation valves that automatically close on a LOCA signal. Questions 1, 2, and 3 are answered "No."

In addition, Safety Relief Valves are safety-related. Therefore, there are no RTNSS candidates from this category.

19A.4.3.6 *Shutdown Loss of Preferred Power*

The causes and effects of loss of preferred power initiating event during shutdown are similar to at-power conditions, which were discussed previously. Loss of preferred power, during shutdown, initiates a loss of shutdown cooling and affects the availability of active mitigation systems. Plant-centered components, such as substations, breakers, motor control centers, and protective relays, are not risk-significant and below the threshold for RTNSS consideration.

19A.4.3.7 *Loss of Shutdown Cooling*

The decay heat removal function during shutdown modes of operation is provided by the Reactor Water Cleanup/Shutdown Cooling System (RWCU/SDCS) System operating in shutdown cooling mode. Shutdown risk is dominated by loss of coolant events. Therefore, RWCU/SDC components have a relatively low importance and it is unlikely that their performance would degrade to the point where there is a measurable effect on Core Damage Frequency.

During Mode 5, in addition to RWCU/SDC, decay heat removal can be provided by safety-related ICS. During Mode 6~~With the reactor well flooded~~, FAPCS may be used as an alternative. FAPCS suppression pool cooling and low pressure injection functions can remove

decay heat, and they are in the RTNSS category with regulatory oversight in the form of availability controls.

If the reactor well is flooded, the risk associated with loss of decay heat removal is negligible because the large amount of water stored above the core assures long-term core cooling.

With the reactor well unflooded, it is assumed that both RWCU/SDC trains are in service and that one train is sufficient to remove decay heat while maintaining stable reactor coolant temperature. Therefore, if one RWCU/SDC pump were to trip in this configuration, it would not initiate a loss of shutdown cooling event, and Questions 1, 2, and 3 are answered "No."

There are no RTNSS candidates for regulatory oversight.

19A.4.3.8 *Shutdown LOCA*

The frequency of Shutdown LOCA events is lower than at full power, due to the reduced vessel pressure and temperature. Also, the fact that control rods are fully inserted, the reduced pressure and temperature of the reactor coolant, and the lower decay heat level allow for longer times available for recovery actions.

Breaks outside containment can be originated only in ICS, RWCU/SDC or FAPCS piping, or instrument lines, because these are the only systems that remove reactor coolant from the containment during shutdown. The rest of the RPV vessel piping is isolated. The RWCU/SDC and FAPCS containment penetrations have redundant and automatic power-operated safety-related containment isolation valves that close on signals from the leak detection and isolation system and the reactor protection system. The ICS lines have redundant power operated safety-related isolation valves inside containment to terminate a loss of inventory in the event of an ICS line break outside of containment. Questions 1, 2, and 3 are answered "No."

An equipment hatch for removal of equipment during maintenance and an air lock for entry of personnel are provided in the lower drywell. These access openings are sealed under normal plant operation but may be opened when the plant is shut down. Closure of both hatches is required for the shutdown Loss-of-Coolant Accident (LOCA) below top of active fuel (TAF) initiators during MODES 5 and 6. Therefore, the lower drywell hatches are in the scope of RTNSS.

19A.4.4 Summary of RTNSS Candidates from Criterion C

The focused PRA sensitivity study requires certain portions of DPS being designated as RTNSS. The portions that provide capability for a manual backup of safety-related automatic actuation of safety functions provides the level of protection necessary to meet both the CDF and LRF goals. These RTNSS DPS functions are: GDCS actuation, ADS actuation, isolation of RWCU/SDC isolation valves, and opening of the IC/PCCS pool cross-connect valves. They are risk significant and receive high regulatory oversight, as described in subsection 19A.8.1.

The assessment of uncertainties concludes that the defense-in-depth role of FAPCS in providing a backup source of low pressure injection and suppression pool cooling is within the scope for RTNSS. Supporting systems for FAPCS include: RCCWS, standby diesel generators, PIP buses, Electrical Building HVAC, Fuel Building HVAC, Nuclear Island Chilled Water, and PSWS. In addition, the assessment of shutdown initiating events identifies that the lower drywell hatches should have regulatory oversight.