GE Energy

James C. Kinsey
Project Manager, ESBWR Licensing

PO Box 780 M/C J-70
Wilmington, NC 28402-0780
USA

T 910 675 5057
F 910 362 5057
jim.kinsey@ge.com

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Supplement 1

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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 63 Related to ESBWR Design Certification Application - Technical Specifications - RAI Number 16.2-73 S01**

Enclosure 1 contains the subject supplemental RAI response resulting from a March 27, 2007 e-mail from the NRC. GE's original response was provided in the Reference 1 letter.

If you have any questions or require additional information regarding the information provided here, please contact me.

Sincerely,

Kathy Sedney for

James C. Kinsey
Project Manager, ESBWR Licensing

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NRO

References:

1. MFN 07-022, Letter from Jim Kinsey to U.S. Nuclear Regulatory Commission, *Response to Portion of NRC Request for Additional Information Letter No. 63 Related to ESBWR Design Certification Application – Technical Specifications – RAI Numbers 16.2-23, 16.2-30, 16.2-45, 16.2-50, 16.2-54, 16.2-73, 16.2-74, 16.2-76, and 16.2-77*, January 19, 2007

Enclosures:

1. MFN 07-022, Supplement 1 - Response to Portion of NRC Request for Additional Information Letter No. 63 Related to ESBWR Design Certification Application - Technical Specifications - RAI Number 16.2-73 S01

cc:

AE Cubbage	USNRC (with enclosures)
DH Hinds	GE (with enclosures)
RE Brown	GE (w/o enclosures)
eDRF	0000-0060-4196/4

Enclosure 1

MFN 07-022, Supplement 1

Response to Portion of NRC Request for

Additional Information Letter No. 63

Related to ESBWR Design Certification Application

- Technical Specifications -

RAI Number 16.2-73 S01

NRC RAI 16.2-73

DCD 16B, TS 3.5.3 states that, in MODES 5 and 6, GDCS is used to provide additional water inventory inside the containment to respond to a loss of decay heat removal capability or a loss of reactor coolant inventory. The Applicability basis states that operability in mode 6 is not required when the new fuel pool gate is removed and water level is above the specified level over the top of the reactor pressure vessel flange because of the additional inventory available when in this configuration. However, this inventory is not protected in that it may be lost through various paths including failure of the non-seismic and nonsafety refueling seal or fuel transfer system.

The Bases for the Residual Heat Removal-High Water Level TS in NUREG-1434, under Actions, describe that the residual heat removal system provides reliable heat removal for loss of cooling water inventory conditions initiating from the high water level conditions. However, the proposed ESBWR Bases for TS 3.5.5 states that RWCU/SDC is a nonsafety-related system [that cannot be assumed to remain available following an equipment failure or a loss of offsite power] and that, once the reactor vessel head is removed, loss of the normal decay heat removal method could result in boiling in the vessel. The ESBWR Bases go on to state that water in the GDCS pools is a source of reactor coolant inventory for this mode of decay heat removal. Provide justification for limiting the applicability of GDCS injection operability to operational Mode 6, "refueling," with water level less than 23 feet above the reactor vessel flange.

GE Response

ESBWR Technical Specifications (TSs) establish operability requirements for safety-related decay heat removal (DHR) capability only. The safety-related DHR capability provides adequate cooling following the unlikely loss of both of the redundant trains of the reactor water cleanup/shutdown cooling (RWCU/SDC) system, which provide the nonsafety-related decay heat removal capability.

Design Control Document (DCD) Tier 2, Revision 1, Chapter 16, LCO 3.5.3, "Gravity-Driven Cooling System (GDCS) - Shutdown," provides safety-related DHR capability when in Mode 6 but prior to water level being increased greater than 7.01 meters (23.0 feet) over the top of the reactor pressure vessel flange with the new fuel pool gate removed (i.e., reactor pressure vessel (RPV) not flooded). When in Mode 6 with the water level greater than 7.01 meters (23.0 feet) over the top of the reactor pressure vessel flange and the new fuel pool gate removed (i.e., RPV flooded), the large amount of water stored above the core provides sufficient DHR capability. This approach is consistent with BWR/6 Standard Technical Specifications (STS), NUREG-1434, Revision 3.1, which also use the volume of water stored above the core as the safety-related DHR capability when the RPV is flooded. As explained in sections 13 and 16 of NEDO-33201, Revision 1, "Licensing Topical Report: ESBWR Certification Probabilistic Risk Assessment," dated September 2006, the risk associated with loss of decay heat removal in Mode 6 is negligible. When in Mode 6 with the RPV flooded, the Fuel and Auxiliary Pool Cooling System (FAPCS) can be aligned to cool water in the reactor well, which provides an additional alternative to the RWCU/SDC. Additionally, the cooling provided by the water stored above the core provides a substantial amount of time to establish makeup from alternate sources including control rod drive pumps, FAPCS pumps, condensate pumps, or firewater pumps.

Loss of coolant accidents (LOCAs) in Mode 6 (RPV flooded and not flooded) are addressed in section 16 of NEDO-33201, Revision 1, 'ESBWR Certification Probabilistic Risk Assessment,' dated September 2006, which addresses LOCAs at four break locations: the GDCS injection line, feedwater line, break above top of active fuel (TAF) other than GDCS or feedwater lines, and breaks below the TAF. Only break elevations below the level that automatically isolates RWCU/SDC are analyzed because RWCU/SDC continues removing the decay heat and no safety function is directly challenged for breaks above this level. A loss of inventory via a break in the refueling seal or fuel transfer system, as postulated in this RAI, is not considered a significant risk because a very substantial amount of coolant inventory would remain below the break location but above the TAF. In the unlikely event of a coincident loss of RWCU/SDC, the cooling provided by the water stored above the core provides a substantial amount of time to establish makeup from alternate sources including control rod drive pumps, FAPCS pumps, condensate pumps, or firewater pumps.

DCD Impact

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

NRC RAI 16.2-73, Supplement 1

The response to NRC RAI 16.2-73 incorrectly cites the BWR/6 Standard Technical Specifications (STS), NUREG-1434, Revision 3.1, as crediting the volume of water stored above the core as a "safetyrelated" decay heat removal capability when the reactor cavity is fully flooded. The STS credit this volume as an adequate volume to allow operator action to isolate any potential drain path before forced recirculation cooling would be lost due to loss of inventory. The STS also credit this volume as an adequate temporary heat sink in the event the operating residual heat removal system fails. The volume does not provide a safety-related decay heat removal capability because the pressure boundary for the entire volume is not suitably reliable and safety-related.

As noted in the response to NRC RAI 16.2-73, the RWCU/SDC system performs an important function for coolant inventory loss events by continuing to remove the decay heat so that no safety function is directly challenged. Consistent with Criterion 4 of 10 CFR 50.36 (c)(2)(ii) and the bases for the Residual Heat Removal (RHR) TS of NUREG-1434, provide one of the following for operational Mode 6, "Refueling": (1) a Limiting Condition for Operation for the decay heat removal function performed by the RWCU/SDC system, (2) a Limiting Condition for Operation for a suitable alternative decay heat removal path such as GDCS inventory makeup and an analysis demonstrating adequate heat transfer to an ultimate heat sink assuming boiling in the vessel, or (3) an analysis demonstrating that the remaining coolant inventory above the top of active fuel for all shutdown LOCA events is adequate to provide 72 hours of decay heat removal to an ultimate heat sink without credit for inventory makeup or forced decay heat removal.

GE Response

ESBWR Technical Specifications (TS) include requirements that ensure the plant is capable of responding to the loss of decay heat removal capability when in the Refueling Mode with water level $\geq$ 7.01 meters (23.0 feet) over the top of the reactor pressure vessel flange (i.e., flooded) and the new fuel pool gate removed. Additionally, Regulatory Treatment of Non-Safety Systems

(RTNSS) short-term availability controls will be included in an Availability Control Manual (ACM) as an Appendix to DCD, Tier 2, Chapter 19. These Availability Controls will include requirements for makeup water transfer to the reactor vessel cavity when in the Refueling Mode with the reactor vessel flooded.

The ESBWR's capability to respond to loss of decay heat removal capability when flooded in the Refueling Mode is demonstrated below by comparison to the equivalent capability provided by BWR/6 Standard Technical Specifications (STS), NUREG-1434, Revision 3.1. Both the ESBWR TS and the BWR/6 STS rely on the volume of water stored above the core to provide sufficient time for operators to respond to the loss of decay heat removal capability when the reactor vessel is flooded for refueling. (Note that concerns about the effect of a failure of the refueling bellows seal or the inclined fuel transfer tube on the availability of this volume of water are addressed in the response to RAI 16.2-77 (GE letter MFN 07-247, dated May 16, 2007).)

For decay heat removal, BWR/6 STS require operability of only one of the two RHR subsystems during refueling when the reactor cavity is flooded. The Bases for BWR/6 STS, LCO 3.9.8, "RHR - High Water Level," explain: "Only one subsystem is required because the volume of water above the RPV flange provides backup decay heat removal capability." The BWR/6 design uses the RHR system for routine decay heat removal. If the one required safety-related RHR subsystem is not operable to perform the routine decay heat removal function, BWR/6 STS, LCO 3.9.8 the required compensatory action is to verify that an alternate method of decay heat removal method is available (e.g., the non-safety related reactor water cleanup system). No completion time for restoration of the RHR subsystem is imposed and no other restrictions are placed on reactor evolutions because, as stated in the BWR/6 STS, LCO 3.9.8 Bases, "the volume of water above the RPV flange provides adequate decay heat removal capability."

For decay heat removal, ESBWR TSs do not specify requirements for active decay heat removal systems during refueling when the reactor cavity is flooded. As explained in sections 13 and 16 of NEDO-33201, Revision 1, "ESBWR Certification Probabilistic Risk Assessment," dated September 2006, the risk associated with complete loss of decay heat removal in this condition "is negligible." ESBWR decay heat removal is normally performed by either of two non-safety related trains of reactor water cleanup/shutdown cooling (RWCU/SDC). Additionally, with the reactor cavity flooded, the Fuel and Auxiliary Pools Cooling System (FAPCS) can be aligned to cool water in the reactor well, which provides another alternative to the redundant RWCU/SDC trains. The volume of water available in the flooded condition provides a substantial amount of time to establish makeup from an alternate source. The addition of the RTNSS Availability Controls for the makeup water transfer to the reactor vessel cavity will ensure the availability of another alternate source of makeup to assure continued availability of adequate heat transfer assuming boiling in the vessel.

The combination of the volume of water above the core and the number and variety of alternate methods of decay heat removal and sources of makeup water provide the ESBWR with a substantial level of protection against loss of decay heat removal capability when in refueling with the reactor vessel flooded. With the inclusion of a requirement for availability of makeup water transfer to the reactor vessel cavity in the ACM, the ESBWR design, TS, and ACM provide an equivalent or greater level of protection than presented in the BWR/6 STS.

DCD Impact

An Availability Control for makeup water transfer to the reactor vessel cavity when in the Refueling Mode with the reactor vessel flooded will be included in an Appendix to DCD, Tier 2, Chapter 19.