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MFN 07-022 Supplement 6

Docket No. 52-010

January 17, 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. 114 Related to ESBWR Design Certification Application - Technical Specifications - RAI Number 16.2-74 S02**

Enclosures 1 and 2 contain the subject supplemental RAI response resulting from NRC RAI Letter No. 114. The GE Hitachi Nuclear Energy (GEH) responses to the original and S01 RAIs were provided in the Reference 1 and 2 letters.

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

Sincerely,

Joseph Savage

for James C. Kinsey
Vice President, ESBWR Licensing

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NRO

References:

1. MFN 07-022, Letter from James C. 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****, and 16.2-76*, January 19, 2007
2. MFN 06-431, Supplement 3, Letter from James C. 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 16.2-46 S01,* ***16.2-74 S01****, and 16.2-80 S01,* May 14, 2007

Enclosures:

1. MFN 07-022, Supplement 6 - Response to Portion of NRC Request for Additional Information Letter No. 114 Related to ESBWR Design Certification Application - Technical Specifications - RAI Number 16.2-74 S02
2. MFN 07-022, Supplement 6 - DCD Tier 2, Chapter 16, Draft Revisions for RAI 16.2-74 S02

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	RE Brown	GEH (with enclosures)
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Enclosure 1

MFN 07-022, Supplement 6

Response to Portion of NRC Request for

Additional Information Letter No. 114

Related to ESBWR Design Certification Application

- Technical Specifications -

RAI Number 16.2-74 S02

NRC RAI 16.2-74

Provide basis for not including an operability requirement for a decay heat removal method in the refueling mode with the head fully detensioned or removed. DCD Tier 2, Rev. 1, Chapter 16, TS 3.5.5 states that use of the ICS as an emergency backup for decay heat removal in MODE 6 requires the reactor vessel head to be in place. Once the reactor vessel head is removed, loss of the normal decay heat removal method could result in boiling in the vessel. NUREG 1434, Rev. 3.1, specifies one or more heat removal paths operable, depending on water level, and one in operation. If the operating loop fails, an alternate residual heat removal loop must be placed in operation. If no alternate heat removal path is available at high water level, the required action specifies operation of the standby gas treatment system and establishment of secondary containment.

Provide the basis for not including an Operability requirement for a decay heat removal method in the refueling mode with the head fully detensioned or removed. Since the basis for TS 3.5.5 describes boiling within the vessel, describe how the heat would be transferred to an ultimate heat sink, and how the potential effects of boiling would be managed.

GE Response

ESBWR Technical Specifications (TSs) do establish Operability requirements for safety-related decay heat removal (DHR) capability when in the refueling mode with the head fully detensioned or removed. 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 in all Modes, including Mode 6 with head fully detensioned or removed.

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 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). LCO 3.5.3 requires operability of four branch lines of the GDCS injection subsystem capable of injecting a combined volume equal to the volume of the two smaller GDCS pools when each is filled to the normal operating level. Prior to the removal of the head, GDCS operability requires sufficient RPV venting capacity to maintain the RPV depressurized following loss of the normal DHR capability. If the Automatic Depressurization System (ADS) is selected as the available vent path, decay heat is released to the containment atmosphere. If requirements for GDCS are not met, LCO 3.5.3, Actions, require establishing an operable Reactor Building boundary, similar to the actions in NUREG-1434 for establishing secondary containment.

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 the safety-related DHR capability. Decay heat is released to the containment atmosphere. 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 a safety-related DHR capability when the RPV is flooded.

General Electric (GE) has revised DCD Tier 2, Revision 1, Chapter 16, LCO 3.5.5, Isolation Condenser System (ICS) – Shutdown," to change the Applicability to eliminate "Mode 6 when

the reactor head is in place" because adequate safety-related DHR capability when in this configuration is provided by GDCS in LCO 3.5.3. As described above, GDCS-DHR capability provides the required cooling function following the unlikely loss of both of the redundant trains of the RWCU/SDC system, which provide the normal decay heat removal capability in all Modes, including Mode 6 with the head fully detensioned or removed.

DCD Impact

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

NRC RAI 16.2-74, Supplement 1

The response to RAI 16.2-74 states that, prior to the removal of the head, GDCS operability requires sufficient Reactor Pressure Vessel (RPV) venting capacity to maintain the RPV depressurized following loss of the normal Decay Heat Removal (DHR) capability. This vent path is part of the primary success path for decay heat removal using the GDCS as a source of inventory makeup, and, therefore, satisfies Criterion 3 of 10 CFR 50.36 (c)(2)(ii). If the Automatic Depressurization System (ADS) is selected as the available vent path, decay heat is released to the containment atmosphere. However, no specific availability controls on the vent path are specified.

Provide supporting analyses and a suitable Limiting Condition for Operation for the Reactor Coolant System (RCS) vent path necessary to allow inventory makeup from GDCS to function as a decay heat removal method in Operational Mode 6 with the reactor vessel head in place.

GE Response

General Electric will revise Design Control Document (DCD), Tier 2, Revision 3, Chapters 16 and 16B, LCO 3.5.3, "Gravity-Driven Cooling System (GDCS) - Shutdown," to include a Surveillance Requirement (SR) for reactor pressure vessel (RPV) venting capability. This SR will require verification that the RPV has venting capacity capable of maintaining the RPV sufficiently depressurized to allow GDCS injection following loss of decay heat removal capability.

DCD Impact

DCD Tier 2, Chapters 16 and 16B, Revision 4, will include the following SR and supporting Bases:

Specification 3.5.3 INSERT:

SURVEILLANCE		FREQUENCY
SR 3.5.3.1	Verify availability of RPV venting capacity sufficient to allow GDCS injection following loss of decay heat removal capability.	24 hours

Specification 3.5.3 Bases INSERT:

SR 3.5.3.1

This SR requires verification every 24 hours that the RPV has venting capacity capable of maintaining the RPV sufficiently depressurized to allow GDCS injection following loss of decay heat removal capability. This SR may be met by the OPERABILITY of the ADS function. The ADS capacity needed to meet this SR is established based on the existing decay heat and include an allowance for a single failure.

RPV vent paths other than the ADS may also be used to meet this SR provided those vent path(s) are sufficient for the existing decay heat load and are maintained open.

The 24 hour Frequency for performing this SR is based on engineering judgment. This Frequency is acceptable because this SR ensures that the required RPV venting capacity is available when required to support the decay heat removal function of the GDCS.

NRC RAI 16.2-74, Supplement 2

In a supplement to RAI 16.2-74, the staff recommended providing a specification addressing the need to maintain a vent path for GDCS operability, when shutdown. In addition, TS availability controls should be provided for the RWCU/SDC system.

In its response, the applicant proposed a new SR for TS 3.5.3, GDC - Shutdown, to once per 24 hours "Verify availability of RPV venting capacity sufficient to allow GDCS injection following loss of decay heat removal capability."

In a teleconference between the NRC staff and the applicant on September 6, 2007, this SR was discussed. The staff suggested that the SR was actually an indirect expansion of the Applicability of the ADS from Modes 1 and 2, to add Mode 5, in order to support GDCS operability in the event of a loss of decay heat removal, because meeting the SR in Mode 5 would require making the ADS operable to provide the necessary vent path. The staff prefers revising the applicability of the ADS specification to the applicant's proposal to add a SR to the shutdown GDCS specification, recognizing that there may be other associated changes, such as to ECCS instrumentation function applicability. Pending revision of the applicability for TS 3.5.1 to include Mode 5, and other appropriate TS changes, this is designated Open Item 16.2-74.

GEH Response

GEH will revise Surveillance Requirement (SR) 3.5.3.1 in Design Control Document (DCD), Tier 2, Revision 4, Chapters 16 and 16B, LCO 3.5.3, "Gravity-Driven Cooling System (GDCS) - Shutdown," to require periodic verification of the operability of sufficient Automatic Depressurization System (ADS) capacity to support the assumed GDCS injection following loss of decay heat removal capability. In conjunction with this change, GEH will add LCO 3.5.3, Condition B, to establish Actions that address GDCS inoperability due to inoperability of the required ADS function. Additionally, GEH will revise Function 1 in Table 3.3.5.2-1, Emergency Core Cooling System Actuation Instrumentation, in DCD, Tier 2, Revision 4, Chapter 16, to require operability of ADS actuation instrumentation in Mode 5 and in Mode 6 prior to the removal of the reactor pressure vessel head.

DCD Impact

See Enclosure 2 for changes to DCD Tier 2, Chapters 16 and 16B, LCO 3.3.5.2, "Emergency Core Cooling System (ECCS) Actuation," and LCO 3.5.3, "Gravity-Driven Cooling System (GDCS) - Shutdown," and their associated Bases.

Enclosure 2

MFN 07-022, Supplement 6

DCD Tier 2, Chapter 16, Draft Revisions for RAI 16.2-74 S02

Table 3.3.5.2-1 (page 1 of 1)
Emergency Core Cooling System Actuation Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS
1. Automatic Depressurization System (ADS)	1,2,3,4,5,6[(a)]
2. Gravity–Driven Cooling System (GDCS) Injection Lines	1,2,3,4,5,6[(ba)]
3. Gravity—Driven Cooling System (GDCS) Equalizing Lines	1,2,3,4
4. Standby Liquid Control (SLC)	1,2

(a) When the reactor pressure vessel head is in place.

(b) Except with the new fuel pool gate removed and water level ≥ 7.01 meters (23.0 feet) over the top of the reactor pressure vessel flange.

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APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

OPERABILITY of the ECCS actuation circuitry from the outputs of the DTMs through the LDs that consists of the VLUs the timers, and the LDs associated with the ADS safety relief valves (SRVs), the ADS depressurization valves (DPVs), the GDCS injection valves, the GDCS equalizing line valves, and the SLC squib-actuated valves.

Although there are four divisions of ECCS actuation for each function, only three ECCS actuation divisions for each function are required to be OPERABLE. The three required divisions are those divisions associated with the DC and Uninterruptible AC Electrical Power Distribution Divisions required by LCO 3.8.6, "Distribution Systems - Operating," and LCO 3.8.7, "Distribution Systems - Shutdown." This is acceptable because the single-failure criterion is met with three OPERABLE ECCS actuation divisions, and because each ECCS actuation division is associated with and receives power from only one of the four electrical divisions.

1. Automatic Depressurization System (ADS)

The ADS actuation divisions receive input from the Reactor Vessel Level - Low, Level 1.0. ADS actuation is required to be OPERABLE in Modes 1, 2, 3, and 4, consistent with the requirements of LCO 3.5.1, "Automatic Depressurization System (ADS) - Operating." ADS actuation is also required to be OPERABLE in MODE 5 and in MODE 6 when the reactor pressure vessel head is in place, consistent with the requirements of LCO 3.5.3, "Gravity-Driven Cooling System (GDCS) - Shutdown." Three actuation divisions are required to be OPERABLE to ensure that no single actuation failure can preclude the actuation function.

2. Gravity-Driven Cooling System (GDCS) Injection Lines

The GDCS injection line actuation divisions receive input from the Reactor Vessel Level - Low, Level 1.0. GDCS injection line actuation is required to be OPERABLE in MODES 1, 2, 3, and 4, consistent with the requirements of LCO 3.5.2, "Gravity Driven-Driven Cooling System (GDCS) - Operating." GDCS injection line actuation is required to be OPERABLE in Modes 5 and 6, except with the new fuel pool gate removed and water level ≥ 7.01 meters (23 feet) over the top of the reactor pressure vessel flange, consistent with the requirements of LCO 3.5.3, "ECCS - Shutdown." Three actuation divisions are required to be OPERABLE to ensure that no single actuation failure can preclude the actuation function.

3.5 Emergency Core Cooling Systems (ECCS)

3.5.3 Gravity-Driven Cooling System (GDCS) - Shutdown

LCO 3.5.3 Four branch lines of the GDCS injection subsystem capable of injecting a combined volume ≥ 986.8 m^3 (34,848 ft^3) from the associated GDCS pools shall be OPERABLE.

APPLICABILITY: MODE 5,
MODE 6 except with the new fuel pool gate removed and water level ≥ 7.01 meters (23.0 feet) over the top of the reactor pressure vessel flange.

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. One required branch line of the GDCS injection subsystem inoperable.	A.1	Restore required GDCS branch line to OPERABLE status.	14 days
B. GDCS inoperable due to required ADS function inoperable.	B.1.1	Establish vent flow path(s) with area equivalent to required ADS valves.	4 hours
	OR		
	B.1.2	Ensure capability of two methods of injecting a combined water volume of ≥ 986.8 m^3 (34,848 ft^3).	4 hours
	AND		
	B.2	Restore compliance with the LCO.	72 hours

CONDITION	REQUIRED ACTION	COMPLETION TIME
C~~B~~. GDCS inoperable~~LCO not met~~ for reasons other than Condition A or B.	C~~B~~.1 Ensure capability of two methods of injecting a combined water volume of ≥ 986.8 m^3 (34,848 ft^3). AND C~~B~~.2 Restore compliance with the LCO.	4 hours from discovery of each Condition C~~B~~ entry 72 hours
D~~C~~. Required Action and associated Completion Time not met.	D~~C~~.1 Initiate action to suspend operations with a potential for draining the reactor vessel (OPDRVs). AND D~~C~~.2 Initiate action to restore Reactor Building to OPERABLE status.	Immediately Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.5.3.1	---------- **- NOTE -** Only required to be met in MODE 5 and in MODE 6 prior to removal of the reactor pressure vessel head. ---------- Verify required ADS ~~availability of RPV venting~~ capacity sufficient to allow GDCS injection following loss of decay heat removal capability.	24 hours
SR 3.5.3.2	Verify available combined water volume in GDCS pools associated with OPERABLE GDCS injection branch lines is ≥ 986.8 m^3 (34,848 ft^3).	24 hours

B 3.5 EMERGENCY CORE COOLING SYSTEMS (ECCS)

B 3.5.3 GDCS - Shutdown

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BACKGROUND

A description of the ADS is provided in the Bases for LCO 3.5.1, "Automatic Depressurization System (ADS) - Operating." A description of the GDCS is provided in the Bases for LCO 3.5.2, "Gravity-Driven Cooling System (GDCS) - Operating."

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. Loss of decay heat removal capability could result from the unavailability of both Reactor Water Cleanup/Shutdown Cooling loops, loss of reactor component cooling water or plant service water systems, or loss of preferred power. Loss of reactor coolant inventory could result from pipe breaks in the RCS associated with maintenance or refueling, misalignment of systems connected to the RCS, or leakage during replacement of control rod drive assemblies.

GDCS pools with a minimum combined volume within the limit specified in this LCO provide additional water inventory to support decay heat removal for an extended period and makeup to respond to a loss of reactor coolant inventory.

ADS supports the GDCS function by providing a vent path that is adequate to maintain the RPV close to containment pressure following loss of decay heat removal capability. The number of ADS valves required to support GDCS is a function of core decay heat load.

APPLICABLE SAFETY ANALYSES

Two GDCS trains are required to be OPERABLE in MODES 5 and 6 to provide additional water inventory inside the containment to respond to a loss of non-safety-related decay heat removal capability or a loss of reactor coolant inventory (Ref. 1).

The GDCS satisfies Criterion 4 of 10 CFR 50.36(c)(2)(ii).

LCO

This LCO requires that four branch lines of the GDCS injection subsystem are OPERABLE and capable of injecting the specified combined volume from the associated GDCS pools. OPERABLE ADS capacity~~The RPV must have or have the ability to establish~~ sufficient ~~RPV venting capacity~~

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to maintain the RPV depressurized to close to containment pressure following loss of decay heat removal capability ~~for~~ is required to ensure the~~a~~ GDCS injection branch lines ~~to be~~ are capable of injecting into the RPV.

APPLICABILITY

Two GDCS divisions are required to be OPERABLE in MODES 5 and 6 to assure adequate coolant inventory and sufficient heat removal capability for the irradiated fuel in the core in response to a loss of decay heat removal capability, a LOCA, or an inadvertent draindown of the RPV. These requirements are not applicable 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.

ACTIONS

A.1

If one GDCS injection branch line is inoperable, the remaining OPERABLE branch lines provide sufficient RPV flooding capability to recover from a loss of decay heat removal capability, LOCA, or inadvertent vessel draindown. However, overall reliability is reduced. Therefore, the inoperable branch line must be restored to OPERABLE within 14 days. The 14 day Completion Time for restoring the required secondary line to OPERABLE status has been shown to be acceptable by Reference 2.

B.1.1, B.1.2 and B.2

If GDCS is inoperable due to the required ADS support function being inoperable, RPV venting capacity may not be sufficient to allow GDCS injection. Required Action B.1.1 requires that GDCS injection capability be restored within 4 hours by establishing vent flow path(s) with area equivalent to the required ADS valves. RPV vent paths other than the ADS may be used provided the vent path(s) are sufficient for the existing decay heat load and are maintained open. A combination of OPERABLE ADS valves and other open vent paths can satisfy this Required Action.

Alternately, Required Action B.1.2 requires establishing at least two methods of injecting the minimum specified volume of water into the RPV that do not rely on GDCS or the ADS support function. Alternate sources and methods for water injection are identified in the plant's Abnormal and

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Emergency Operating Procedures. The method used to provide water for core flooding is based on plant conditions.

ACTIONS (continued)

The Completion Times are based on engineering judgment considering the need for prompt action to establish an alternate method to supply RPV inventory makeup or the need for timely restoration of vent capacity sufficient to allow GDCS injection.

Required Action B.2 requires that LCO requirements be met within 72 hours. This Completion Time is based on engineering judgment considering the low probability of an event requiring GDCS injection when in this Condition.

C~~B~~.1 and C~~B~~.2

If the LCO is not met for reasons other than Condition A or B, action must be initiated to provide at least two methods of injecting the minimum specified volume of water into the RPV. In addition, LCO requirements must be met within 72 hours. The Completion Times have been shown to be acceptable by Reference 2.

Alternate sources and methods for water injection are identified in the plant's Abnormal and Emergency Operating Procedures. The method used to provide water for core flooding ~~should be the most prudent and the safest choice,~~is based ~~up~~on plant conditions.

D~~C~~.1 and D~~C~~.2

If Required Actions and associated Completion Times for Conditions A, B or C~~B~~ are not met, the water inventory available for injection may not be sufficient for a LOCA. Therefore, actions ~~must~~ to suspend operations with a potential for draining the reactor vessel (OPDRVs) must be initiated immediately to minimize the probability of a vessel draindown. Actions must continue until OPDRVs are suspended. In addition, action must be initiated immediately to restore Reactor Building to OPERABLE status as described in the Bases for LCO 3.6.3.1, "Reactor Building." This action is needed to establish appropriate compensatory measures for a potential loss of decay heat removal as a result of an inadvertent draindown event. The Completion Times have been shown to be acceptable by Reference 2.

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SURVEILLANCE REQUIREMENTS

SR 3.5.3.1

This SR requires verification every 24 hours that ~~the RPV has~~sufficient ADS capacity is OPERABLE ~~venting capacity capable of~~ to maintain~~ing~~ the RPV sufficiently depressurized to allow GDCS injection following loss of decay heat removal capability. ~~This SR may be met by the OPERABILITY of the ADS function.~~ The ADS capacity needed to meet this SR is established based on the existing decay heat and includes an allowance for a single failure. ~~RPV vent paths other than the ADS may also be used to meet this SR provided those vent path(s) are sufficient for the existing decay heat load and are maintained open.~~

The 24 hour Frequency for performing this SR is based on engineering judgment. This Frequency is acceptable because this SR ensures that the required RPV venting capacity is available when required to support the decay heat removal function of the GDCS.

SR 3.5.3.2

This SR requires verification every 24 hours that the combined water volume associated with Operable GDCS injection branch lines is greater than or equal to the specified limit. This SR ensures adequate inventory is maintained in the containment to respond to a loss of decay heat removal capability or a loss of reactor coolant due to a LOCA or inadvertent draining of the RPV.

The 24 hour Frequency is acceptable because highly reliable GDCS pool low level alarms will provide prompt notification of an abnormal level in any of the GDCS pools.

SR 3.5.3.3

This SR requires verification every 31 days of the continuity of each of the required circuits that initiate the explosive charge for squib-actuated valves in the GDCS. The 31 day Frequency is acceptable because an alarm will provide prompt notification of loss of circuit continuity.

This SR is modified by a Note that continuity is not required to be met for one required squib firing circuit intermittently bypassed under administrative controls. This is acceptable because the keylock switch that disables the firing circuit allows the continuity monitor to be tested and allows surveillance and maintenance with the assurance that the valve will not be opened inadvertently. The operation of the keylock