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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 76 – Instrumentation and Control – RAI Numbers 7.1-32, 7.1–38, 7.1-41, 7.1-46, 7.2-30, 7.3-7, 7.7-3, 7.8-2, 7.8-3 and 14.3-94**

Enclosure 1 contains GE's response to the subject NRC RAI transmitted via 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

D068

Reference:

1. MFN 06-388, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 76 Related to ESBWR Design Certification Application*, October 11, 2006

Enclosures:

1. MFN 06-482–Response to Portion of NRC Request for Additional Information Letter No. 76 – Related to ESBWR Design Certification Application — RAI Numbers 7.1-32, 7.1–38, 7.1-41, 7.1-46, 7.2-30, 7.3-7, 7.7-3, 7.8-2, 7.8-3 and 14.3-94

cc: AE Cubbage USNRC (with enclosures)
David Hinds GE/Wilmington (with enclosures)
eDRF 0000-0060-2976
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Enclosure 1

MFN 06-482

Response to Portion of NRC Request for

Additional Information Letter No. 76

Related to ESBWR Design Certification Application

Instrumentation and Control Systems

RAI Numbers 7.1-32, 7.1–38, 7.1-41, 7.1-46, 7.2-30, 7.3-7, 7.7-3, 7.8-2, 7.8-3 and 14.3-94

NRC RAI 7.1-32

DCD, Tier 2, Revision 1, Figure 7.1-1 indicated the ATWS Standby Liquid Control (SLC) Logic is located in safety-related cabinets, while DCD, Tier 2, Revision 1, Section 7.8.1.1.3 stated that the Alternate Rod Insertion (ARI) function, which is part of the ATWS mitigation logic, is nonsafety-related and physically located in the Diverse Protection System (DPS). Clarify the safety classification of the ATWS mitigation systems.

GE Response

The ATWS mitigation logic is divided into safety related logic and nonsafety-related logic.

The safety related ATWS mitigation logic encompasses Standby Liquid Control (SLC) system initiation and feedwater runback (FWRB) initiation signals, as well as the Automatic Depressurization System (ADS) Inhibit signal. These ATWS mitigation logics reside in the safety related Safety System Logic and Control (SSLC) cabinets [viz. SSLC-RTIF bays] as four division logic using safety related sensors. (These features are described in DCD Tier 2, Chapter 7, with the overall ATWS mitigation system description and figures provided in Section 7.8). Additionally, the safety related ATWS mitigation logic interfaces with the safety related Nuclear Boiler System (for vessel level and pressure sensing) and Neutron Monitoring system (for power level sensing), as well as safety related manual ATWS mitigation initiation hand-switches. The SSLC/ATWS mitigation FWRB initiation signal output is optically isolated to the nonsafety-related Feedwater Control System. This isolated signal is transmitted through the nonsafety-related DPS for processing by the nonsafety-related feedwater control system. The ADS inhibit signal is optically isolated and transmitted to the nonsafety-related DPS for inhibiting diverse ECCS initiation during conditions indicative of an ATWS.

The Alternate Rod Insertion (ARI) function is implemented as nonsafety-related ATWS mitigation logic using different (nonsafety-related) sensors. This logic, which is implemented in the nonsafety-related Diverse Protection System (DPS) logic cabinets, uses a highly reliable triple modular redundant platform. To provide a back-up scram function, the same ARI signal from the nonsafety-related ATWS mitigation logic is also used to initiate a nonsafety-related Fine Motion Control Rod Drive Run-In signal [viz. a scram follow signal], to electrically insert the control rods.

The safety-related interfaces with the ARI logic occur at the isolated manual ATWS mitigation initiation hand switches which are part of the safety-related ATWS mitigation logic.

The ESBWR design requires that the nonsafety-related ATWS mitigation logic be implemented under a quality assurance program that meets or exceeds the guidance contained in US NRC Generic Letter 85-06, "Quality Assurance Guidance for ATWS Equipment That Is Not Safety-Related."

DCD Figures 7.8-2, "ARI & FMCRD Run-In Logic," and 7.8-3, "ATWS Mitigation Logic (SLC system Initiation, Feedwater Runback)" provide an overview of the ATWS mitigation logic.

DCD/LTR Impact

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

NRC RAI 7.1-38

NRC Generic Letter 96-01, "Testing of Safety-Related Logic Circuits, "requested licensees to compare electrical schematic drawings and logic diagrams for the reactor protection system, and the actuation logic for the ESF systems against plant surveillance test procedures to ensure that all portions of the logic circuitry, including the parallel logic, interlocks, bypasses and inhibit circuits are adequately covered in the surveillance procedure to fulfill the technical specification requirements. DCD, Tier 2, Revision 1, Table 1C-1 for item GL 96-01 "Evaluation Result" does not sufficiently addressing this issue. If the plant surveillance test procedures are not available at the design certification stage, then the DCD should identify that this is a COL action item.

GE Response

DCD/Tier 2, 26A6642AF, Table 1C-1, item 96-01, 1/10/96, Testing of Safety-Related Circuits, has been revised in Revision 2 as shown:

> "The COL Holder will ensure that all portions of the safety-related logic circuitry are adequately covered in the surveillance procedures as described in Generic Letter 96-01."

In addition, DCD/Tier 2, 26A6642BL, Subsection 13.5.3.4, *"Procedures for Calibration, Inspection and Testing"* will revised as follows:

> ***"Procedures for Calibration, Inspection and Testing***
>
> "Calibration, inspection and testing procedures that require operator actions to be taken in the MCR or RSS shall be prepared as appropriate. The COL Holder will ensure that all portions of the safety-related logic circuitry are adequately covered in the surveillance procedures as described in Generic Letter 96-01."

DCD/LTR Impact

DCD/Tier 2 Subsection 13.5.3.4 will be revised in Rev. 3 as described above.

NRC RAI 7.1-41

Your response to the Staff's RAI question 7.1-2 stated "The ESBWR is designed with innovative means of accomplishing safety functions as described in DCD Tier 2 Section 1.5. Validations of those innovative means are summarized in Sections 7.2 through Section 7.9 for the specific system. The degree of applicability and conformance, along with any clarifications or justification for exceptions, are presented in the evaluation sections for each specific system." However, the staff finds the following contradicting reference to this issue in the DCD, Tier 2, Revision 1, Section 7.1, page 7.1-19: "The validation of innovative means of accomplishing I&C system safety-related functions does not apply to the ESBWR safety I&C design submitted for this certification application." Please clarify the applicable portions of the DCD.

GE Response

The referenced paragraph from DCD/Tier 2, Revision 1, Section 7.1, page 7.1-19, has been replaced in the DCD/Tier 2, 26A6642AW Revision 02, Section 7.1, by the following paragraph on page 7.1-21:

> "The validation of innovative means of accomplishing I&C system safety-related functions is discussed in 1.5 of the DCD."

DCD/LTR Impact

No further change to the DCD will be made in response to NRC RAI 7.1-41.

NRC RAI 7.1-46

In DCD, Tier 2, Revision 1, Section 1.2.1, page 1.2-2, the definition of Division is "refers to safety related electrical and/or instrumentation and control (I&C) equipment connected to a common electrical power source." Per IEEE-603 - 1991, the definition of division is: "The designation applied to a given system or set of components that enables the establishment and maintenance of physical, electrical, and functional independence from other redundant sets of components." Please update the DCD to use the standard's definition or propose a substantiation to differ from the IEEE standard.

GE Response

The definition of "division" as it appears in DCD/Tier 1, 26A6641AB Revision 02, Section 1.2.1, pg 1.2-2, will be revised in accordance with the definition from IEEE Std. 603 as follows;

> "Division is the designation applied to a given safety-related system or set of components that enables the establishment and maintenance of physical, electrical, and functional independence from other redundant sets of components."

DCD/LTR Impact

DCD/Tier 1, 26A6641AB, Section 1.2.1 will be revised as described above in Revision 3.

NRC RAI 7.2-30

During July 26 and 27, 2006 I&C meeting, the applicant presented the "N–2" design concept. Additional design information, basis for compliance with regulations, and the technical specification requirements should be provided.

GE Response

The N-2 concept extends design conservatism such that all required safety functions are performed in the event of dual control system failures. All safeguards actuation functions will occur with the failure of 2 divisions. A description of this design is included in DCD Tier 2 Revision 2 Sections 7.3.1.1.2, 7.3.1.2.2, 7.4.1.2.1, 7.4.4.3 and Figures 7.3-1A, 7.3-1B, 7.3-2. The basis for compliance with regulations is shown in Sections 7.3.1.1.3, 7.3.1.2.3, 7.4.1.3.1, and 7.4.4.3.1

A similar approach will be used for containment isolation valves via the Leak Detection & Isolation System. N-2 design information regarding containment isolation functions will be added to revision 3 of DCD Tier 2 subsection 7.3.3.

Instrumentation Technical Specifications for the N-2 design will be provided in DCD Tier 2 Revision 2 Chapter 16 Section 3.3.

DCD Impact

DCD Tier 2 Section 7.3.3 will be revised in revision 3 to include an N-2 description of containment isolation valves.

DCD Tier 2 Section 16.3.3 will be revised in revision 2 to include Instrumentation Technical Specifications for the N-2 design.

NRC RAI 7.3-7

IE Bulletin 80-06, Engineered Safety Feature (ESF) Reset Controls, requested to review the ESF design to determine whether or not, following the reset of an ESF actuation signal, all associated safety-related equipment remains in its emergency mode. In DCD,Tier 2, Revision 1, Table 1C-1, Operating Experience Review Results Summary, the evaluation result for item 80-06 addresses an unrelated subject. Please provide correct response to this subject.

GE Response

The entry for 80-06 in Table 1C-1, DCD Chapter 1, Appendices 1A-1D, Revision 1 on page 1C-2 is an error. The table is broken into two parts. The top part concerns Generic Letters and the bottom part concerns Generic Bulletins. Generic Letter 80-06 is not applicable to the ESBWR so this entry has been removed from Table 1C-1 in Revision 2. IE Bulletin 80-06 is listed in the lower part of the table on page 1C-12. This entry has been changed in Revision 2 of the DCD to more specifically indicate the subsections that address this issue.

DCD Impact

No additional changes to DCD Tier 2 will be made in response to this RAI.

NRC RAI 7.7-3

In DCD, Tier 2, Revision 1, Section 7.7.1.2, it is stated that the wide range level instrumentation is both safety and nonsafety-related (for Diverse Protection System (DPS)). Please confirm that the boundary difference begins with the level transmitters. Also, will the level transmitters for the DPS be seismically qualified?

GE Response

The Diverse Protection System will use dedicated wide range level transmitters separate from the safety-related transmitters. This begins the boundary difference between E-DCIS and DPS. These transmitters will be qualified seismic category 1. This is described in DCD Tier 2 Rev 2, Subsection 7.8.2.3.

DCD/LTR Impact

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

NRC RAI 7.8-2

The staff finds that many design features described in the NEDO-33251, "ESBWR I&C Defense-In-Depth and Diversity Report," were not clearly documented in DCD, Tier 2, Revision 1, Section 7.8. DCD Section 7.8 needs to be updated to include all new information provided in the NEDO-33251. DCD, Tier 2, Revision 1, Section 7.8 should provide a summary table identifying all the input signals to the Diverse Protection System (DPS) and identifying all the outputs from the DPS. For manual DPS action, a summary table should identify all the related parameters that will guide the operator in performing manual DPS actions.

GE Response

Section 7.8 of DCD Tier 2, Revision 2, was updated to discuss the Diverse Protection System (DPS) design features described in Licensing Topical Report NEDO-33251, "ESBWR I&C Defense-In-Depth And Diversity Report," as indicated in the response to RAI 7.8-1. However, the information is not provided in a summary table format. The information provided includes initiating signals and DPS actions (which are considered the DPS inputs and the outputs).

Subsection 7.8.1.3 describes the DPS monitoring and indication features. Although the DPS design has provisions for manual initiation capability for its functions, one manual action specifically discussed in Section 5.4 of NEDO-33251, is the suppression pool equalization function of the Gravity Driven Cooling System. Condition monitoring alarms, reactor vessel pressure and reactor vessel level are monitoring and indication features that are provided to support manual suppression pool equalization via the DPS.

Specific monitoring and indication to support the DPS functions will be part of the HFE design implementation process and documented in the HFE task analysis reports.

DCD/LTR Impact

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

NRC RAI 7.8-3

Topical report NEDO-33251, "ESBWR I&C Defense-In-Depth and Diversity Report," Section 4.4 stated that the DPS provides a diverse means to actuate some ESF functions. Please identify those DPS-ESF functions. DCD, Tier 2, Revision 1, Section 5.8, Event Scenarios, stated that Appendix A provides a discussion of the DCD Chapter 15 accidents and transients evaluated to determine the effectiveness and scope of the DPS. Appendix A also listed five items for DPS scope expansion. Define the scope of the DPS in DCD Section 7.8.

GE Response

As indicated in response to RAI 7.8-1 (under Enclosure 1 to letter MFN 06-214, "Response to Portion of NRC Request for Additional Information Letter No. 6 Related to ESBWR Design Certification Application Instrumentation and Control Systems RAI Number 7.8-1"), DCD Tier 2, Revision 2, has been updated to include the changes to the DPS scope that resulted from the evaluation discussed in NEDO-33251.

The diverse ESF functions described in Section 4.4 of NEDO-33251, are identified in Section 2.4 of NEDO-33251: The DPS will initiate the ECCS systems on low reactor water level (i.e., the ADS, GDCS, ICS and SLCS).

The DPS provides the following isolations:

- Closure of the MSIVs on detection of high steam flow, low reactor pressure or low reactor level
- Closure of the IC isolation valves on high steam flow. (Additionally, ICS isolation on excessive condensate flow is performed by the DPS.)
- Closure of the RWCU/SDC isolation valves on high differential flow

The reference to DCD, Tier 2, Revision 1, Section 5.8, Event Scenarios, is concluded to be an incorrect reference. The following response is based on NEDO-33251, Section 5.8, Event Scenarios, as the correct reference. Appendix A of NEDO-33251, listed five (5) items for DPS scope expansion.

1. Diverse MSIV closure reactor trip
2. Diverse RWCU/SDC isolation on differential flow or [high] temperature or [high] radiation
3. Diverse ICS isolation on differential flow, or [high] radiation
4. Diverse MSIV isolation on high steam flow or low reactor pressure
5. "Possible" diverse containment isolation on low reactor level

Based on the qualitative evaluation discussed in the body of NEDO-33251 (reference Sections 2 and 5), only large leakage paths to the environment were selected for inclusion into the DPS scope (i.e., items 1-4 above). Automatic isolation of all containment isolation valves (item 5) is not performed by the DPS based on the qualitative assessment performed. The scope of the DPS discussed in the body of NEDO-33251, has been incorporated into Section 7.8, Diverse Instrumentation and Control Systems of DCD Tier 2, Revision 2.

DCD/LTR Impact

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

NRC RAI 14.3-94

Topical report NEDO-33251, "ESBWR I&C Defense-In-Depth and Diversity Report," Section 4.3.1 stated that Type 1 failures will be analyzed during detailed system design of DPS. This item should be documented in DCD Tier 1, and provide a proposed ITAAC.

GE Response

To support completion of the ESBWR defense-in-depth and diversity based on the guidance in NUREG/CR-6303, "Method for Performing Diversity and Defense-in-Depth Analysis of Reactor Protection Systems," GE concurs that the requirements to perform a FMEA for Type 1 failures, described in Section 4.3.1 of NEDO-33251, as part of the detailed system design needs to be documented in DCD Tier 1 and an ITAAC provided. Therefore, DCD Tier 1, Revision 3, will be updated with an ITAAC for the evaluation of Type 1 failures as part of the detailed design of the DPS.

DCD/LTR Impact

DCD Tier 1 will be revised as described above in Revision 3.