HITACHI

GE Hitachi Nuclear Energy

James C. Kinsey
Vice President, ESBWR Licensing

PO Box 780 M/C A-55
Wilmington, NC 28402-0780
USA

T 910 675 5057
F 910 362 5057

MFN 08-080

Docket No. 52-010

March 26, 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. 79 Related to ESBWR Design Certification Application - Containment Systems - RAI Number 6.2-115 S01

Enclosure 1 contains the GE Hitachi Nuclear Energy (GEH) response to the subject NRC RAI originally transmitted via the Reference 1 letter and supplemented by an NRC request for clarification in Reference 2. DCD Markups related to this response are provided in Enclosure 2.

If you have any questions or require additional information, please contact me.

Sincerely,

James C. Kinsey

James C. Kinsey
Vice President, ESBWR Licensing

D068
NRO

References:

1. MFN 06-393, Letter from U.S. Nuclear Regulatory Commission to David H. Hinds, *Request for Additional Information Letter No. 79 Related to ESBWR Design Certification Application*, October 11, 2006
2. E-Mail from Shawn Williams, U.S. Nuclear Regulatory Commission, to George Wadkins, GE Hitachi Nuclear Energy, dated May 30, 2007 (ADAMS Accession Number ML071500023)

Enclosures:

1. MFN 08-080 - Response to Portion of NRC Request for Additional Information Letter No. 79 Related to ESBWR Design Certification Application - Containment Systems - RAI Number 6.2-115 S01
2. MFN 08-080 - Response to Portion of NRC Request for Additional Information Letter No. 79 Related to ESBWR Design Certification Application - Containment Systems - RAI Number 6.2-115 S01 – DCD Markups

cc:	AE Cubbage	USNRC (with enclosures)
	DH Hinds	GEH/Wilmington (with enclosures)
	GB Stramback	GEH/San Jose (with enclosures)
	RE Brown	GEH/Wilmington (with enclosures)
	eDRF	0000-0077-1616R1

Enclosure 1

MFN 08-080

Response to Portion of NRC Request for Additional Information Letter No. 79 Related to ESBWR Design Certification Application

Containment Systems

RAI Number 6.2-115 S01

NRC RAI 6.2-115 S01:

RAI 6.2-115(B) stated:

DCD, Tier 2, Revision 1, Section 6.2.4.3.3, "Evaluation of Single Failure," discusses, in general, the principles used to evaluate single failure. It implies that evaluations were performed for the containment isolation system, but does not provide the actual evaluations or even specific conclusions, other than an unsupported statement that "Electrical and mechanical systems are designed to meet the single failure criterion..." It refers to DCD, Section 3.1 for more information, but 3.1 is only a general discussion of the ESBWR 's compliance with the GDC. Provide the actual single failure evaluations performed for the containment isolation system, or at least a better discussion of the evaluation. Address particularly the example given in part 1 of this RAI. [The example was of 2 redundant CIVs on the same emergency power bus, where a single failure of that bus would fail both CIVs.]

The applicant's response was:

Subsection 6.2.4.3.3, as noted on the attached markup, will be revised to include statement that each of the power operated containment isolation valve for any given penetration is powered from a different division in order to meet the single failure criteria.

Supplemental Request:

GE's response only addresses the one item particularly called out by the staff. The response does not address the request as a whole. It is necessary for the applicant to demonstrate the soundness of their method to evaluate single failure events. Therefore, for each type or class of penetrations, provide a detailed single failure analyses, with charts and tables naming each failure considered for each penetration or class of penetrations, and explanations for why each single failure would not cause loss of safety function.

GEH Response:

The supplemental request indicates that the DCD should explain a method for evaluating containment penetration isolation design against the single-failure criterion. The single-failure evaluation method for containment penetration isolation designs is based on the commitment to standards ANSI/ANS 58.9 and IEEE 379-2000 (refer to DCD Tier 2, Table 1.9-21), and the position stated for Regulatory Guide 1.53 compliance (refer to DCD Tier 2, Subsections 7.1.6.4, 7.2.1.3.4, 7.3.3.3.4 and 7.5.2.3.4, and Table 7.1-1).

DCD Tier 2, Subsection 1.2.1.2, states, "Safety-related functions are performed by equipment of sufficient redundancy and independence so that no single failure of active components, or of passive components in certain cases in the long term, prevents performance of the safety-related functions. For systems or components to which IEEE 603 applies, single failures of either active or passive electrical components are considered in recognition of the higher anticipated failure rates of passive electrical components relative to passive mechanical components." Discussion of the application of the single-failure criterion to event analyses is provided in DCD Tier 2, Chapter 15. Standard IEEE 379-2000, Section 6.1, provides the outline of a procedure for performing single-failure analysis of a system. The same basic approach can also be applied to containment penetration isolation design.

The DCD summarizes the top-level guidance and commitments to be met by the detailed ESBWR plant design. The method by which single-failure is evaluated for containment isolation will be clarified in DCD Tier 2, Subsection 6.2.4.3.3. The requirements stated in the DCD, such as the performance of containment penetration isolation design single-failure analysis, is implemented by project design controls. Those requirements and commitments that are to be demonstrated or confirmed for plant construction completion are addressed under the DCD Tier 1 Inspections, Tests, Analyses and Acceptance Criteria (ITAAC).

DCD Impact:

DCD Tier 1, Subsection 2.15.1 and Table 2.15.1-2, and DCD Tier 2, Subsection 6.2.4.3.3, will be revised as shown in the attached markups.

Enclosure 2

MFN 08-080

Response to Portion of NRC Request for Additional Information Letter No. 79 Related to ESBWR Design Certification Application

Containment Systems

RAI Number 6.2-115 S01

DCD Markups

2.15 CONTAINMENT, COOLING AND ENVIRONMENTAL CONTROL SYSTEMS

2.15.1 Containment System

Design Description

The Containment System confines the potential release of radioactive material in the event of a design basis accident. The Containment System is comprised of a reinforced concrete containment vessel (RCCV), penetrations and drywell head.

The Containment System is as shown in Figure 2.15.1-1. The RCCV is located in the Reactor Building.

(1) The functional arrangement of the Containment System is described in the Design Description of this Section 2.15.1 and as shown in Figure 2.15.1-1.

(2) Components and piping identified in Table 2.15.1-1 as ASME Code Section III are designed and constructed in accordance with ASME Code Section III requirements.

   i. The RCCV and its liners are designed to meet the requirements in Article CC-3000 of ASME Code, Section III, Division 2.

   ii. The steel components of the RCCV are designed to meet the requirements in Article NE-3000 of ASME Code, Section III, Division 1.

(3) Pressure boundary welds in components and piping identified in Table 2.15.1-1 as ASME Code Section III meet ASME Code Section III requirements.

(4) The components and piping identified in Table 2.15.1-1 as ASME Code Section III retain their pressure boundary integrity at their design pressure.

(5) The seismic Category I equipment identified in Table 2.15.1-1 can withstand seismic design basis load without loss of structural integrity and safety function.

(6) a. The equipment qualification of Containment Systems components is addressed in DCD Tier 1 Section 3.8.

   b. The safety-related components identified in Table 2.15.1-1 are powered from their respective safety-related division.

   c. Separate electrical penetrations are provided for circuits of each safety-related division and for nonsafety-related circuits.

   d. The circuits of each electrical penetration are of the same voltage class.

(7) The containment system provides a barrier against the release of fission products to the atmosphere.

(8) The containment system pressure boundary retains its integrity when subject to a design pressure of 310 kPa gauge (45 psig).

(9) The containment system provides the safety-related function of containment isolation for containment boundary integrity.

(10) Containment electrical penetration assemblies, whose maximum available fault current (including failure of upstream devices) is greater than the continuous rating of the penetration, are protected against currents that are greater than the continuous ratings.

(11) The minimum set of displays, alarms and controls, based on the emergency procedure guidelines and important operator actions, is available in the main control room

(12) The containment penetration isolation design for each fluid piping system requiring isolation meets the single-failure criterion.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.15.1-2 provides a definition of the inspections, tests, and/or analyses, together with associated acceptance criteria for the Containment System.

Table 2.15.1-2
ITAAC For The Containment System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
12. The containment penetration isolation design for each fluid piping system requiring isolation meets the single-failure criterion.	An analysis is performed on the isolation design of each penetration class or penetration, as applicable, to verify single-failure criterion is met.	A report of the analysis exists and concludes that the applicable primary containment fluid system penetrations and penetration classes meet the single-failure criterion.

- are protected against a high energy line break outside of containment when needed for containment isolation.

Process Radiation Monitoring System

The penetrations for the fission products monitor sampling lines consist of one sampling line and one return line. Each line uses three tandem stop or shutoff valves. One valve is a manual-operated valve used for maintenance and is located close to the containment. The other two valves are pneumatic, solenoid or equivalent power operated valves and are used for isolation. All three valves are located outside the containment for easy access. The piping to these valves is considered an extension of the containment boundary.

Passive Containment Cooling System

The PCCS does not have isolation valves as the heat exchanger modules and piping are designed as extensions of the safety-related containment. The design pressure of the PCCS is greater than twice the containment design pressure and the design temperature is same as the drywell design temperature.

6.2.4.3.2.3 Conclusion on Criterion 56

In order to ensure protection against the consequences of an accident involving release of significant amounts of radioactive materials, pipes that penetrate the containment have been demonstrated to provide isolation capabilities on a case-by-case basis in accordance with Criterion 56.

In addition to meeting isolation requirements, the pressure-retaining components of these systems are designed to the quality standards commensurate with their importance to safety.

6.2.4.3.2.4 Evaluation Against General Design Criterion 57

The ESBWR has no closed system lines penetrating the containment that are within the scope of GDC 57.

6.2.4.3.2.5 Evaluation Against Regulatory Guide 1.11

Instrument lines that connect to the RCPB and penetrate the containment have 1/4-inch orifices and manual isolation valves, in compliance with Regulatory Guide 1.11 requirements.

6.2.4.3.3 Mass and Energy Release Analyses for Postulated Loss-of-Coolant Accidents

A single failure can be defined as a failure of a component (for example, a pump, valve, or a utility such as offsite power) to perform its intended safety-related functions as a part of a safety-related system. The purpose of ~~the~~single failure evaluation of fluid system penetration isolation design is to demonstrate that the safety-related function of the system ~~would~~can be completed even ~~with that~~assuming a single failure. Appendix A to 10 CFR 50 requires that electrical systems be designed specifically against a single passive or active failure. Section 3.1 describes the implementation of these standards, as well as General Design Criteria 17, 21, 35, 38, 41, 44, 54, 55 and 56.

Electrical and mechanical systems are designed to meet the single-failure criterion, regardless of whether the component is required to perform a safety-related action or function. If a component, such as an electrically-operated valve, is designed to not ~~receive a signal to~~ change state (open or close) ~~in a~~by its safety-related logic scheme, ~~it is accounted as~~ a single failure ~~if the system~~is assumed in the analysis if the component does change state. Electrically-operated valves include those valves that are electrically piloted ~~but~~with air/nitrogen-operated actuators, as well as valves that are directly operated by an ~~electrical~~electromagnetic device (solenoid motor, motorized-gearbox, or electrohydraulic actuators). In addition, all electrically-operated valves that ~~are automatically actuated~~receive automatic actuation signals can also be remote-manually actuated from the main control room. Therefore, a single failure in any electrical or mechnical system is analyzed, regardless of whether the loss of a safety-related function results from a component failing to perform a requisite mechanical motion or from a component performing an unnecessary mechanical motion due to a spurious/incorrect signal or manual operating error. Each of the power operated containment isolation valves for any given penetration is powered from different divisions in order to meet the single failure criteria.

The isolation design for each penetration or penetration class also applies the guidance of standards ANS 58.9 and IEEE 379-2000 (see Table 1.9-22), and complies as appropriate with Regulatory Guide 1.53 (refer to Tables 1.9-21 and 7.1-1, and to Subsections 7.3.3 and 7.5.2). Standard IEEE 379-2000 provides a suggested single-failure review method which includes:

- For each design event:
  - Determine the safety function to be performed;
  - Determine the proctective action(s) available to accomplish the safety function;
  - Determine safety-related component that performs the protective action and satisfies the safety function; and,
  - Verify independence between redundant safety-related components; or
  - Iterate design as required when independence is not verified, considering the electrical, mechanical and system logic failures potentially affecting the isolation design.
- Evaluate for interconnections between redundant circuits.
- Evaluate isolation system logic for common failures affecting isolation capability.
- Evaluate actuation devices for preferred mode on loss of power and for single-point failure mechanisms that might cause common failure of the isolation design.
- Evaluate support systems and auxiliary features, in particular the actuator power supplies (including backup electrical power, mechanical or process power and fluid accumulator stored energy supplies).
- Evaluate for nonsafety-related attachments or interfaces with the isolation design that could interfere with completion of the protective action.

6.2.4.4 Test and Inspections

The automatic functions of the Containment Isolation Valves (CIVs) are periodically tested by ensuring actuation to the isolation position on an actual or simulated isolation signal. The