



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS  
WASHINGTON, DC 20555 - 0001

ACRSR-2274

November 20, 2007

Mr. Luis A. Reyes  
Executive Director for Operations  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555-0001

SUBJECT: INTERIM LETTER: CHAPTERS 2, 5, 8, 11, 12, AND 17 OF THE NRC STAFF'S SAFETY EVALUATION REPORT WITH OPEN ITEMS RELATED TO THE CERTIFICATION OF THE ESBWR DESIGN

Dear Mr. Reyes:

During the 547<sup>th</sup> meeting of the Advisory Committee on Reactor Safeguards, November 1-3, 2007, we met with representatives of the NRC staff and General Electric – Hitachi Nuclear Energy Americas, LLC, (GEH) to discuss six Chapters from the Safety Evaluation Report (SER) related to the Economic Simplified Boiling Water Reactor (ESBWR) design certification application. Our ESBWR Subcommittee held meetings on October 2-3 and October 25, 2007, to discuss the technical aspects of the ESBWR design as well as the staff's SER, remaining open items, and the combined license (COL) action items for each of these SER Chapters. We had the benefit of the documents referenced.

## RECOMMENDATIONS

1. We plan to review the staff's resolution of open items in SER Chapters 2, 5, 8, 11, 12, and 17 during future meetings.
2. The controls on welding practice should be revised to eliminate, to the extent possible, post-weld grinding of materials susceptible to stress corrosion cracking and to mitigate its consequences in those instances when grinding is unavoidable.
3. Many of the ESBWR systems described in these Chapters may interact with systems discussed in other SER Chapters that have not been reviewed. We will consider and comment on safety implications of any system interactions in future interim letters and in our final report

## BACKGROUND

The ESBWR utilizes a direct-cycle power conversion system with natural circulation in the reactor vessel under normal operation and passive emergency core cooling system (ECCS) operation without the need of emergency alternating current power systems for core cooling within the first 72 hours following a reactor transient or accident. It also uses passive containment cooling to ensure heat transport to the ultimate heat sink for all accident scenarios. To cope with a severe reactor accident, the ESBWR design incorporates a lower drywell core retention device and allows passive drywell flooding to provide long-term debris cooling.

GEH submitted the ESBWR design certification application on August 24, 2005. Subsequently, based on staff requests, GEH submitted additional material and the staff formally accepted the complete application in December 2005. The staff issued Requests for Additional Information (RAIs) and based on the original application and GEH responses to the RAIs, the staff is preparing an SER with open items as well as COL action items. At the request of the staff, we agreed to review the staff's SER on a chapter-by-chapter basis to help timely completion of the review of the ESBWR design certification application, as well as effective resolution of our concerns prior to issuing the final SER. Accordingly, the staff has provided SER Chapters 2, 5, 8, 11, 12, and 17 with open items and COL action items for our review.

## **DISCUSSION**

Based on the information presented to us to date, we have the comments provided below.

### Chapter 2: Site Characteristics

Site characteristics include potential hazards in proximity of the plant, meteorology, hydrology, geology, seismology, and geotechnical parameters. An applicant for a COL that references the ESBWR design control document (DCD) will establish the site characteristics when it applies for a COL, or it will reference an early site permit (ESP) that reflects these characteristics. In either case, the COL applicant must show that the site parameters considered in the ESBWR DCD bound the actual site characteristics. Should the ESBWR design parameters not encompass the actual site characteristics, the COL applicant will need to demonstrate by other means, that the proposed reactor plant design is acceptable at the proposed site.

The staff identified several open items and COL action items in this Chapter. The open items seek to clarify inconsistencies in the documentation, to require additional information, and to verify that certain site meteorological assumptions are bounding. The Standard Review Plan specifies that the plant site parameters in the design certification be representative of a reasonable number of sites. The staff has found that this provision has been met.

### Chapter 5: Reactor Coolant System and Connected Systems

The reactor coolant system (RCS) includes those systems and components that contain or transport fluids coming from or going into the reactor core. These systems form the major portion of the RCS pressure boundary. The SER Chapter 5 documents the staff's evaluation of the RCS pressure boundary and associated systems (e.g., pressure vessels, piping, pumps, and valves) out to and including the outboard isolation valves.

The staff identified several open items and COL action items in this Chapter. In the SER, the staff identified the need for additional information on materials specification (e.g., materials for specific classes of valves, specific steel alloy contents, filler-weld material), materials processing and qualification, and inservice inspection procedures for a range of systems and components.

The staff should further investigate the adequacy of controls on post-weld grinding. GEH has placed controls on the use of grinding wheels and wire brushes in the fabrication of the ESBWR components and structures to prevent potentially degrading materials entering the system. However, post-weld grinding can degrade the resistance of austenitic stainless steels and nickel-based alloys to various stress corrosion cracking mechanisms when exposed to the reactor coolant. The controls on welding practice should be revised to eliminate such practices to the extent possible and to mitigate their consequences in those instances when grinding is unavoidable.

Although the materials chosen for the pressure boundary are resistant to stress corrosion cracking under normal boiling water reactor water chemistry, experience indicates that core internals will be susceptible to irradiation assisted stress corrosion cracking unless more controls are placed on water chemistry. We would like the opportunity to review ESBWR RCS chemistry controls in future meetings.

One of the key subsystems in the RCS pressure boundary is the isolation condenser, which provides a redundant path to passively remove heat under a range of transient and accident conditions. This system performs an important safety function that will be evaluated in subsequent SER Chapters. The current open items relate to materials qualification and inservice inspection issues. Resolution of these open items could allow the staff to finalize its conclusions on the RCS. Comments and questions about system interactions may arise later with regard to specific safety issues and accident sequences.

#### Chapter 8: Electric Power

The on-site and off-site electric power systems include those systems that supply power to safety and non-safety related equipment. The ESBWR design does not require Class IE alternating current electrical power to accomplish the plant's safety related functions. The isolation condenser, a passive safety system for the RCS, and the passive containment cooling system require only Class IE direct current power to perform their functions during the initial 72 hours following all accident sequences.

The staff identified an open item in this Chapter, e. g., GEH should provide a loading profile for the safety related batteries to verify that they are properly sized to meet the design requirement for the initial 72 hour time period. The staff's review of the safety related electric power systems identified a need to consider system interactions. For example, confirmation is needed that the Class IE uninterruptible power supplies are not compromised by the lack of active room cooling during an extended accident sequence. This type of system interaction will need to be considered.

#### Chapter 11: Radioactive Waste Management

The radioactive waste management system for the ESBWR controls the handling and treatment of gaseous, liquid, and solid radioactive wastes. The release of radioactivity to the reactor coolant is part of the design basis for the radioactive waste system. This system is designed and operated to limit the dose to plant workers and members of the public to within regulatory limits and to ensure that doses are as low as reasonably achievable. The staff's review of the radioactive waste management system identified three open items that require better design definition of the skid-mounted 'mobile' radioactive waste systems as well as a number of COL action items and confirmatory items. We concur with these open items and action items.

GEH has used an assumed "source term" for radioactive materials released from the fuel into the RCS. The source term was estimated based on operational experience from the current fleet of boiling water reactors. The staff has accepted this source term as conservative for the ESBWR. Although this approach seems reasonable, we would like to review the data and the analysis procedure used to develop the source term.

#### Chapter 12: Radiation Protection

This Chapter describes the types and quantities of radioactive materials expected to be produced during the operation of the ESBWR, as well as the means for controlling or limiting radiation exposures within the requirements of 10 CFR Part 20. The measures are intended to ensure that radiation exposures to plant personnel, contractors, and the general public, resulting

from plant operation and anticipated operational occurrences are within regulatory limits and are as low as reasonably achievable. The SER identified several open items in this Chapter that need to be addressed.

#### Chapter 17: Quality Assurance

The quality assurance program (QAP) for the ESBWR is based on the standard GEH QAP documented in GE topical report NEDO-11209-04A . The staff inspected the implementation of the GEH QAP for the ESBWR activities as part of the review of this Chapter. Based on the review, the staff identified an open item whereby the applicant will provide the list of risk-significant systems, structures, and components that are within the scope of the design reliability assurance program.

We plan to review the resolution of the open items identified on the above Chapters during future meetings.

Sincerely,

*/RA/*

William J. Shack  
Chairman

#### References:

1. Memorandum from David B. Matthews, Director, Division of New Reactor Licensing (DNRL), Office of New Reactors (NRO), to Frank P. Gillespie, Executive Director, Advisory Committee on Reactor Safeguards and Advisory Committee on Nuclear Waste and Materials (ACRS/ACNW&M), dated August 31, 2007, transmitting SER with open items for Chapter 2, "Site Characteristics" (ML072270679 and ML072270468).
2. Memorandum from David B. Matthews, Director, DNRL, NRO, to Frank P. Gillespie, Executive Director, ACRS/ACNW&M, dated August 31, 2007, transmitting SER with open items for Chapter 5, "Reactor Coolant System and Connected Systems" (ML070780172 and ML072290103).
3. Memorandum from David B. Matthews, Director, DNRL, NRO, to Frank P. Gillespie, Executive Director, ACRS/ACNW&M, dated August 31, 2007, transmitting SER with open items for Chapter 8, "Electric Power" (ML072120282 and ML072120144).
4. Memorandum from David B. Matthews, Director, DNRL, NRO, to Frank P. Gillespie, Executive Director, ACRS/ACNW&M, dated September 24, 2007, transmitting SER with open items for Chapter 11, "Radioactive Waste Management" (ML072340212 and ML072340198).
5. Memorandum from David B. Matthews, Director, DNRL, NRO, to Frank P. Gillespie, Executive Director, ACRS/ACNW&M, dated September 24, 2007, transmitting SER with open items for Chapter 12, "Radiation Protection" (ML071730022 and ML072340020).
6. Memorandum from David B. Matthews, Director, DNRL, NRO, to Frank P. Gillespie, Executive Director, ACRS/ACNW&M, dated August 27, 2007, transmitting SER with open items for Chapter 17, "Quality Assurance" (ML072140668 and ML072140652).

7. Letter from James C. Kinsey, Project Manager, ESBWR Licensing, GEH, to NRC, dated February 22, 2007, transmitting ESBWR Design Control Document, Revision 3 (ML070660561).
8. General Electric Company, NEDO-11209-04A, Revision 8, "GE Nuclear Energy Quality Assurance Program Description," March 1989.
9. 10 CFR Part 20, "Standards for Protection Against Radiation."

7. Letter from James C. Kinsey, Project Manager, ESBWR Licensing, GEH, to NRC, dated February 22, 2007, transmitting ESBWR Design Control Document, Revision 3 (ML070660561).
8. General Electric Company, NEDO-11209-04A, Revision 8, "GE Nuclear Energy Quality Assurance Program Description," March 1989.
9. 10 CFR Part 20, "Standards for Protection Against Radiation."

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