



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

December 22, 2008

Mr. R.W. Borchardt
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

**SUBJECT: INTERIM LETTER 6: CHAPTERS 7 AND 14 OF THE NRC STAFF'S
SAFETY EVALUATION REPORT WITH OPEN ITEMS RELATED TO
THE CERTIFICATION OF THE ESBWR DESIGN**

Dear Mr. Borchardt:

During the 558th meeting of the Advisory Committee on Reactor Safeguards, December 4-6, 2008, we discussed Chapters 7 and 14 of the NRC staff's Safety Evaluation Report (SER) with open items related to the Economic Simplified Boiling Water Reactor (ESBWR) design certification application. Our ESBWR Subcommittee held meetings on October 21-22 and December 3, 2008, to discuss technical aspects of the ESBWR design as well as the open items and the combined license (COL) action items identified in these Chapters. During these meetings, we had the benefit of discussions with representatives of the NRC staff and General Electric-Hitachi Nuclear Energy (GEH). We also had the benefit of the documents referenced. We previously commented on Chapters 2, 5, 8, 11, 12, and 17 in our November 20, 2007, letter, on Chapters 9, 10, 13, and 16 in our March 20, 2008, letter, on Chapters 4, 6, 15, 18, and 21 in our May 23, 2008, letter, on Chapter 3 in our July 21, 2008, letter, and on Chapter 19 and 22 in our October 29, 2008, letter. Our reviews have not addressed security matters and their impact on ESBWR design.

CONCLUSIONS AND RECOMMENDATIONS

1. The applicant has an acceptable process for developing the Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) for the Initial Plant Test Program as described in Section 14.2 of Chapter 14.
2. The Design Acceptance Criteria (DAC) for the Distributed Control and Instrumentation System are incomplete. The staff has issued requests for additional information (RAIs) that address the DAC needed to ensure adequacy of the design process.
3. The Tier 2 Design Certification Document (DCD) should include additional information on the architecture of the instrumentation and control (I&C) system, and appropriate ITAAC and DAC should be added to the Tier 1 DCD.
4. We will review the resolution of open items in SER Chapters 7 and 14 during future meetings.

BACKGROUND

The ESBWR is a direct-cycle power conversion system with natural circulation cooling in the reactor vessel under normal operation. It has a passive emergency core cooling system that operates without the need for emergency alternating current power systems or operator actions within the first 72 hours following a reactor transient or accident.

At the request of the staff, we have agreed to review the staff's SER on a chapter-by-chapter basis to identify technical issues that merit further consideration. Accordingly, the staff has provided at this time SER Chapters 7 and 14 with open items for our review.

DISCUSSION

The ESBWR design certification application was accepted formally by the staff in December 2005. Since that time, revisions to the DCD have been issued, with the most recent being DCD Revision 5. These revisions have included updates to the overall design and modifications that address the staff's RAIs originating from the review of DCD Revision 4.

When 10 CFR Part 52 was approved, the Commission determined that the level of detail in a design certification (DC) application must be sufficient to enable a judgment regarding the applicant's proposed means of ensuring that construction conforms to the design and to reach a final conclusion for all safety issues associated with a design.

The DC application should contain ITAAC that are sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a facility that incorporates the certified design will have been constructed and will be operated in conformance with the certified design specifications and NRC regulations. The ITAAC are designed to ensure that a specific plant will conform to the certified design in all areas that are safety-significant.

There are two "tiers" in the DCD. Tier 1 is that portion of the design-related information contained in the generic DCD that is approved and certified by Appendix to Part 52. Tier 2 is that portion of the design-related information contained in the generic DCD that is approved but not certified by Appendix to Part 52. Based on its review of the applicant's selection criteria and process for identifying Tier 1 information contained in Tier 2 DCD, Section 14.3, the staff determined that the applicant's process was acceptable. However, it did not provide cross-references in Tier 2 DCD, Section 14.3, showing where key ESBWR design features, systems, and parameters from the accident analyses are addressed in the Tier 1 information. These include the safety analyses of design-basis accidents, severe accidents, flooding, overpressure protection, containment, core cooling, fire protection, anticipated operational occurrences, shutdown risk, and anticipated transient without scram. The staff requested that GEH provide this cross-reference table. We agree that the clarity and completeness of the ESBWR ITAAC process will be improved by providing such a cross-reference table.

The Initial Test Program is described in DCD Tier 2, Section 14.2, "Initial Plant Test Program for Final Safety Analysis Reports." This program includes the preoperational testing phase as well as the initial startup-testing phase. Provided that open items are properly addressed, the staff concluded that the applicant provided sufficient information in the Initial Test Program to test all

the systems and components important to safety and adequately addressed the methods and guidance contained in the Standard Review Plan. We concur with the staff's conclusion.

The DCD and associated ITAAC are designed to ensure that a specific plant will be constructed and operated to conform to the certified design in all areas that are safety-significant. This means that the DC application must be complete. There are two exceptions for which the applicant may choose not to provide a complete design:

- Items for which the technology is rapidly changing and may be significantly different at the COL stage.
- Items for which the level of detail cannot be provided at the time of certification review (or for which the as-procured and as-built characteristics are needed).

If the applicant chooses to take an exception, DAC are required as part of the ITAAC. DAC are a set of prescribed limits, parameters, procedures, and attributes for particular systems and components that must be verified for the completed design and construction. The precedent for the use of DAC was established with the certifications of the Combustion Engineering System 80+ Pressurized Water Reactor, the General Electric Advanced Boiling Water Reactor, and the Westinghouse AP600 and AP1000 designs. For these designs, the staff accepted DAC for the I&C system, for the control room design with regard to human factors, and for the detailed piping design.

The GEH treatment of DAC for the I&C system is incomplete. The staff has issued numerous RAIs to ensure the design meets all the regulatory requirements, including applicable Institute of Electrical and Electronics Engineers standards. However, these RAIs primarily address process issues.

The use of DAC is justified for detailed elements of I&C systems that may use specific hardware or software that are prone to obsolescence between the time of design certification and plant construction. However, the functional architecture and logical design of the integrated I&C systems are determined by the fundamental plant protection and control requirements. Those requirements and the designers' decisions about how to functionally achieve them are not altered by evolving technology for the hardware and software. The functional description of I&C system design provides a technical basis from which to develop comprehensive DAC and ITAAC for final I&C qualification.

The Tier 2 DCD should include additional information on the architecture of the I&C system and appropriate ITAAC and DAC should be added to the Tier 1 documentation. For example, in several sections, the Reactor Protection System divisions are simply stated to be deterministic in operation and independent - physically, electrically, and for inter-division communications, but these characteristics are not captured in the DAC. As another example, the current Tier 2 documentation does not contain integrated functional logic diagrams at a level of detail showing input signals, protection and actuation logic, output signals, and basic dependencies such as power supplies. This information should be included in Tier 2 descriptions and verified by Tier 1 DAC or ITAAC.

We will review the resolution of open items in SER Chapters 7 and 14 during future meetings.

Sincerely,

/RA/

William J. Shack
Chairman

References:

1. Memorandum from D. B. Matthews, Director, Division of New Reactor Licensing/Office of New Reactors (DNRL/NRO), to E. M. Hackett, Executive Director, Advisory Committee on Reactor Safeguards, dated November 7, 2008, "Safety Evaluation Report (SER) with Open Items (OIs) for Chapter 7, 'Instrumentation and Controls' Regarding the Economic Simplified Boiling Water Reactor (ESBWR) Design Certification Review" (ML082600487)
2. Memorandum from D. B. Matthews, Director, DNRL/NRO, to E. M. Hackett, Executive Director, Advisory Committee on Reactor Safeguards, dated October 2, 2008, "Safety Evaluation Report (SER) with Open Items (OIs) for Chapter 14.2, 'Initial Test Program for Final Safety Analysis Reports' Regarding the Economic Simplified Boiling Water Reactor (ESBWR) Design Certification Review" (ML082420017)
3. Memorandum from D. B. Matthews, Director, DNRL/NRO, to E. M. Hackett, Executive Director, Advisory Committee on Reactor Safeguards, dated October 2, 2008, "Safety Evaluation Report (SER) with Open Items (OIs) for Chapter 14.3, 'Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC)' Regarding the Economic Simplified Boiling Water Reactor (ESBWR) Design Certification Review" (ML082420005)
4. Letter from James C. Kinsey, Project Manager, ESBWR Licensing, GEH, to NRC, dated February 22, 2007, transmitting ESBWR Design Control Document, Revision 3 (ML070660561)
5. Letter from William J. Shack, Chairman, Advisory Committee on Reactor Safeguards, to Luis A. Reyes, Executive Director for Operations, dated November 20, 2007, "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" (ML073070006)
6. Letter from William J. Shack, Chairman, Advisory Committee on Reactor Safeguards, to Luis A. Reyes, Executive Director for Operations, dated March 20, 2008, "Interim Letter Chapters 9, 10, 13, and 16 of the NRC Staff's Safety Evaluation Report with Open Items Related to the Certification of the ESBWR Design" (ML080670596)

7. Letter from William J. Shack, Chairman, Advisory Committee on Reactor Safeguards, to R. W. Borchardt, Executive Director for Operations, dated May 23, 2008, "Interim Letter 3: Chapters 4, 6, 15, 18, and 21 of the NRC Staff's Safety Evaluation Report with Open Items Related to the Certification of the ESBWR Design" (ML081330447)
8. Letter from William J. Shack, Chairman, Advisory Committee on Reactor Safeguards, to R. W. Borchardt, Executive Director for Operations, dated July 21, 2008, "Interim Letter 4: Chapter 3 of the NRC Staff's Safety Evaluation Report with Open Items Related to the Certification of the ESBWR Design" (ML081930777)
9. Letter from William J. Shack, Chairman, Advisory Committee on Reactor Safeguards, to Dale E. Klein, Chairman, U. S. Nuclear Regulatory Commission, dated April 29, 2008, "Digital Instrumentation and Control Systems Interim Staff Guidance" (ML081050636)
10. Letter from William J. Shack, Chairman, Advisory Committee on Reactor Safeguards, to R. W. Borchardt, Executive Director for Operations, dated October 29, 2008, "Interim Letter 5: Chapters 19 and 22 of the NRC Staff's Safety Evaluation Report with Open Items Related to the Certification of the ESBWR Design" (ML082810703)

We will review the resolution of open items in SER Chapters 7 and 14 during future meetings.
Sincerely,

/RA/

William J. Shack
Chairman

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1. Memorandum from D. B. Matthews, Director, Division of New Reactor Licensing/Office of New Reactors (DNRL/NRO), to E. M. Hackett, Executive Director, Advisory Committee on Reactor Safeguards, dated November 7, 2008, "Safety Evaluation Report (SER) with Open Items (OIs) for Chapter 7, 'Instrumentation and Controls' Regarding the Economic Simplified Boiling Water Reactor (ESBWR) Design Certification Review" (ML082600487)
2. Memorandum from D. B. Matthews, Director, DNRL/NRO, to E. M. Hackett, Executive Director, Advisory Committee on Reactor Safeguards, dated October 2, 2008, "Safety Evaluation Report (SER) with Open Items (OIs) for Chapter 14.2, 'Initial Test Program for Final Safety Analysis Reports' Regarding the Economic Simplified Boiling Water Reactor (ESBWR) Design Certification Review" (ML082420017)
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6. Letter from William J. Shack, Chairman, Advisory Committee on Reactor Safeguards, to Luis A. Reyes, Executive Director for Operations, dated March 20, 2008, "Interim Letter Chapters 9, 10, 13, and 16 of the NRC Staff's Safety Evaluation Report with Open Items Related to the Certification of the ESBWR Design" (ML080670596)

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Letter to R. W. Borchardt, EDO, NRC, from William J. Shack, Chairman, ACRS, dated December 22, 2008

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