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

September 18, 2012

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

SUBJECT: CHAPTER 9 OF THE SAFETY EVALUATION REPORT WITH OPEN ITEMS FOR THE US-APWR DESIGN CERTIFICATION APPLICATION

Dear Mr. Borchardt:

During the 597th meeting of the Advisory Committee on Reactor Safeguards, September 6-8, 2012, we met with representatives of the NRC staff and Mitsubishi Heavy Industries, Ltd. (MHI) to review Chapter 9, "Auxiliary Systems," of the Safety Evaluation Report (SER) with Open Items associated with the United States Advanced Pressurized Water Reactor (US-APWR) design certification application. Our US-APWR Subcommittee also reviewed this chapter during its meeting on March 22-23, 2012. Technical aspects of the US-APWR design, as well as the open items identified in this SER chapter were discussed at that meeting. We also had the benefit of the documents referenced.

CONCLUSIONS AND RECOMMENDATIONS

1. We did not identify any issues in SER Chapter 9 with potentially significant safety implications beyond those addressed in the current open items.

2. Based on our review of this chapter, we have identified the following items that merit additional attention:

   - The staff should provide a justification for their acceptance of the analyzed single failure as the most limiting condition that requires manual isolation of the component cooling water system (CCWS) non-safety cooling headers. The justification should consider the CCWS response during a variety of design basis accident scenarios, including associated assumptions about the timing and the types of the assumed single failures.

   - The staff should reconsider their justification for omission of the essential chilled water system from the US-APWR Technical Specifications.

3. We plan to review the staff's resolution of the open items in SER Chapter 9 during future meetings.

4. Systems described in this chapter interact with other systems that are discussed in SER chapters that we have not yet reviewed. We will comment on potential safety implications of any system interactions in future interim letters and in our final report.

BACKGROUND

The US-APWR is a four-loop pressurized water reactor with a large dry containment. The design includes a combination of active and passive safety systems arranged in four divisions. Reactor protection, safeguards actuation, and other instrumentation and control functions are developed using integrated digital platforms. Other notable design features include advanced passive accumulators, elimination of low pressure injection pumps, a refueling water storage pit inside the containment, a core debris spreading area below the reactor vessel, and gas turbine generator emergency power supplies.

MHI submitted a Design Control Document (DCD) with its application for the US-APWR design certification on December 31, 2007. Revision 1 of the DCD was submitted on August 29, 2008; Revision 2 on October 27, 2009; and Revision 3 on March 31, 2011.

We have agreed to review the SER on a chapter-by-chapter basis to identify technical issues that may merit further consideration. This process aids effective resolution of early concerns and facilitates timely completion of the US-APWR design certification review. Accordingly, the staff has provided SER Chapter 9 with open items for our review. The staff's SER and our review of this chapter primarily address the information in DCD Revision 3. However, we have noted one issue that is related to a design change that is described in DCD Interim Revision 4, which has been submitted in part to support MHI responses to staff requests for additional information.

DISCUSSION

We did not identify any issues with potentially significant safety implications beyond those addressed in the current open items from this SER chapter. As part of our review, we have requested additional information about specific details of the US-APWR design. Based on our experience to date, we expect that these questions will be resolved to our satisfaction before all open items are closed and the final SER chapter is issued. For this interim report, we note the following observations and recommendations on selected elements of the design that are addressed in this chapter.

<u>Component Cooling Water System (CCWS)</u>

The CCWS is comprised of two subsystems that are not interconnected. One subsystem contains Train A and Train B, and one subsystem contains Train C and Train D. Each train is powered from a separate electrical division. Each CCWS train can provide 50% of the design basis safety-related cooling requirements. In addition to safety-related cooling loads, each CCWS subsystem also supplies cooling to non-safety equipment. For example, CCWS Header A-1 supplies cooling to spent fuel pit heat exchanger A, charging pump A, and reactor coolant pumps A and B; CCWS Header C-1 supplies cooling to spent fuel pit heat exchanger B, charging pump B, and reactor coolant pumps C and D. The non-safety headers are connected to the safety-related trains through crosstie piping equipped with isolation valves that are normally open. This arrangement allows Train A or Train B to supply flow to non-safety Header A-1; Train C or Train D can supply flow to non-safety Header C-1.

In the CCWS design described in DCD Revision 3, the valves that supply the non-safety headers were closed automatically by three isolation signals. The operators could reset the isolation signals to permit manual restoration of cooling to the non-safety loads, if necessary. However, we were informed that the design has been changed in DCD Interim Revision 4 to remove the automatic isolation signals. The revised design requires that the operators must close the isolation valves manually from the main control room if they determine that CCWS train separation is needed to satisfy safety-related cooling requirements. This design change was made to maintain continuous CCWS flow to the reactor coolant pumps and their thermal barrier coolers during all analyzed transients and accidents.

The staff indicated that MHI has performed an analysis which concludes that manual isolation of the non-safety headers is not required for at least 24 hours during any design basis accident. We did not review details of that analysis. However, the assumed single failure conditions in that analysis (i.e., failure of one division of electric power at the same time as the initiating event) may not provide the most limiting requirements for these operator actions. For example, depending on the timing and the specific type of single failure that is assumed, the revised design could result in a system configuration with one CCWS pump (e.g., Pump A) supplying all of its subsystem safety-related loads and non-safety loads (i.e., all Train A safety loads, all Train B safety loads, and all Header A-1 non-safety loads). It has not been shown that flow from one pump or cooling through one CCWS heat exchanger is adequate to supply all of these heat loads during a loss of coolant accident or other design basis accidents. Therefore, this flow configuration may require operator actions to close the crosstie valves or to isolate specific loads within much less time than the cited 24 hours.

The staff should provide a justification for their acceptance of the analyzed single failure as the most limiting condition that requires manual isolation of the non-safety cooling headers. The justification should consider the CCWS response during a variety of design basis accident scenarios, including associated assumptions about the timing and the types of the assumed single failures.

Essential Chilled Water System (ECWS)

The ECWS is a safety-related support system that is required to maintain acceptable environmental conditions for the operation of safety-related mechanical, electrical, instrumentation, control, and main control room habitability systems. However, the US-APWR Technical Specifications do not include explicit requirements for operability or surveillance of the ECWS equipment.

The staff noted that this omission is acceptable because support system operability requirements are included implicitly within the Technical Specifications for each respective frontline system (i.e., all systems that are cooled by ECWS). However, that rationale does not provide consistent understanding and clarity in the Technical Specifications, which include explicit operability requirements for many other support systems, such as the ultimate heat sink, essential service water system, CCWS, ventilation systems, AC and DC electric power supplies, etc. The staff should reexamine the justification for omission of the ECWS from the US-APWR Technical Specifications.

We plan to review the resolution of the open items identified in SER Chapter 9 during future meetings. Systems described in this chapter interact with other systems that are discussed in SER chapters that we have not yet reviewed. We will comment on potential safety implications of any system interactions in future interim letters and in our final report.

Sincerely,

/RA/

J. Sam Armijo
Chairman

REFERENCES

1. NRC Memorandum, Subject: United States - Advanced Pressurized Water Reactor Design Certification Application - Safety Evaluation with Open Items for Chapter 9, “Auxiliary Systems,” (ML120390206), dated February 22, 2012.

2. Mitsubishi Heavy Industries, MUAP-DC009, Revision 3, Design Control Document for the US-APWR, Chapter 9, "Auxiliary Systems," (ML110980217), dated March 31, 2011.

3. Mitsubishi Heavy Industries, MUAP-07020, Revision 0, "Validation of the MHI Criticality Safety Methodology," (ML080250087), dated December 31, 2007.

4. Mitsubishi Heavy Industries, MUAP-07024, Revision 2, "Qualification and Test Plan of Class 1E Gas Turbine Generator System," (ML103120130), dated October 26, 2010.

5. Mitsubishi Heavy Industries, MUAP-07032, Revision 1, "Criticality Analysis for US-APWR New and Spent Fuel Racks," (ML093510508), dated December 10, 2009.

6. Mitsubishi Heavy Industries, MUAP-09014, Revision 0, "Thermal-Hydraulic Analysis for US-APWR Spent Fuel Racks," (ML091620275), dated June 5, 2009.

7. Mitsubishi Heavy Industries, MUAP-10020, Revision 1, "Safety-Related Air Conditioning, Heating, Cooling, and Ventilation Systems Calculations," (ML111010226), dated April 1, 2011.

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Letter to R.W. Borchardt, EDO, from J. Sam Armijo, ACRS Chairman dated September 18, 2012

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