

May 27, 2011

**DESIGN CERTIFICATION SECTION 6.2 & 6.3  
CONTAINMENT SUMP STRAINER HEAD LOSS TEST AUDIT PLAN**

**June 6 - 10, 2011**

**US-APWR DESIGN CERTIFICATION  
Mitsubishi Heavy Industries, Ltd.  
Docket No. 52-021**

Location: Alden Research Laboratory, Inc.  
30 Shrewsbury Street  
Holden, MA 01520-1843

Purpose:

The purpose of the audit is to review, verify and identify information and documentation that is related to containment sump strainer head loss testing associated with containment spray/residual heat removal and safety injection pumps. The audit will review and evaluate testing methods and implementation for the Mitsubishi Heavy Industries Ltd. (MHI) Design Control Document Section 6.2.2, "Containment Heat Removal Systems" and Section 6.3, "Emergency Core Cooling Systems (ECCS)", as well as related Technical Report MUAP-08001-P, Revision 3, "US-APWR Sump Strainer Performance."

Background:

MHI submitted to the U.S. Nuclear Regulatory Commission (NRC) a Final Safety Analysis Report for its application of the United States - Advanced Pressurized Water Reactor (US-APWR) dated December 31, 2007. MHI submitted Technical Report MUAP-08001-P, Revision 3, "US-APWR Sump Strainer Performance" dated November 19, 2010. This technical report summarizes the design and evaluation of the standard US-APWR sump strainer, and supports the US-APWR Design Control Document (DCD), Chapter 6, Subsections 6.2.2 "Containment Heat Removal Systems" and 6.3 "Emergency Core Cooling Systems (ECCS)." Requests for Additional Information (RAIs) have been submitted by the NRC staff concerning sump strainer performance, to include testing.

MHI plans to conduct US-APWR plant specific strainer head loss testing to qualify their strainer design. The audit is necessary to assess the adequacy of the MHI's basis for determining strainer head loss.

A prior audit of MHI's strainer testing took place between June 8 - 9, 2010, and is documented in the Agencywide Documents Access and Management System (ADAMS) under accession number ML102380426. RAIs generated during the June 8 - 9, 2010, audit influenced MHI's decision to conduct additional testing.

Regulatory Audit Bases:

To satisfy the requirements of Generic Design Criteria 38 and Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50.46(b)(5) regarding the long-term spray system and ECCS, the containment emergency sump in pressurized water reactors (PWRs) should be designed to provide a reliable, long-term water source for ECCS and containment spray system pumps. The design of the sumps and the protective strainer assemblies is a critical element in ensuring long-term recirculation cooling capability. Therefore, adequate design consideration of potential debris generation and associated effects including debris screen blockage under postulated post loss-of-coolant accident conditions and impacts of debris penetrating strainers on long-term coolability of the core is necessary. Regulatory Guide 1.82, Revision 3 (Reference 3), as modified and supplemented for PWRs by the Nuclear Energy Institute (NEI) Guidance Report (GR) Reference 4 and the NRC safety evaluation (SE) (Reference 5), provide guidance for PWR debris evaluations. Other documents on which the regulatory audit is based are included in the reference section.

Regulatory Audit Scope:

The scope for the regulatory audit will be observing strainer head loss testing and focusing on attributes listed below:

1. Test plan (protocol) and test matrix
2. Test procedure
3. Test data collection
4. Scaling analysis
5. Surrogate material selection
6. Debris generation (source term)
7. Debris transport
8. Debris preparation, sequencing, and addition
9. Debris accumulation
10. Chemicals
11. Debris settlement or floating debris
12. Test apparatus and measurement equipment

Information and Other Material Necessary for the Regulatory Audit:

Plant-specific analyses that provide design basis information used to support containment sump strainer testing should be available. For example, information related to design inputs into strainer head lost test protocol such as debris generation, debris transport, strainer design, surrogate debris, strainer submergence, etc., should be available.

Team Assignments:

Clint Ashley - Lead Auditor  
Christopher VanWert - Team Member  
Eduardo Sastre - Team Member  
Syed Haider - Team Member  
Ruth Reyes - Project Manager

Logistics:

The audit is planned for the week of June 6, 2011, at the office of Alden Research Laboratory, Inc. located in Holden, Massachusetts.

Special Requests:

Appropriate handling and protection of proprietary information shall be acknowledged and observed throughout the audit.

Deliverables:

The NRC staff will conduct the review during the week of June 6 - 10, 2011. The NRC staff may request an ad-hoc extension of the audit if findings during the ongoing audit reveal the need for additional time. Such an extension will be requested before the audit is adjourned on June 10, 2011, by the NRC staff responsible for the audit.

An audit report will be generated after the completion of the audit. The audit outcome will be used to identify any additional information to be submitted for making regulatory decisions. The audit will assist the NRC staff in the preparation and issuance of further RAIs for the licensing review of the US-APWR Design Certification Application, Section 6.2 and 6.3.

References:

1. US-APWR DCD Revision 3.
2. Technical Report MUAP-08001-P, Revision 3, "US-APWR Sump Strainer Performance," dated November 19, 2010.
3. Regulatory Guide 1.82, Revision 3, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident," dated November 30, 2003.
4. NEI 04-07, "PWR Sump Performance Evaluation Methodology," documented in ADAMS under accession number ML041550332, dated May 28, 2004.
5. SE for NEI GR 04-07, "PWR Sump Performance Evaluation Methodology," U.S. Nuclear Regulatory Commission, Washington, DC, documented in ADAMS under accession number ML050550156, dated December 6, 2004.
6. NRC Staff Review Guidance regarding Generic Letter 2004-02 Closure in the Area of Strainer Head Loss and Vortexing," U.S. Nuclear Regulatory Commission, Washington, DC, documented in ADAMS under accession number ML080230038, dated March 28, 2008.
7. GL 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors," U.S. Nuclear Regulatory Commission, Washington, DC, dated September 13, 2004.
8. "NRC Staff Review Guidance regarding Generic Letter 2004-02 Closure in the Area of Plant-Specific Chemical Effect Evaluations," U.S. Nuclear Regulatory Commission, documented in ADAMS under accession number ML080380214, dated March 28, 2008.
9. NRC NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," documented in ADAMS under accession number ML090580432, dated January 29, 2003.
10. "NRC Staff Review Guidance regarding Generic Letter 2004-02 Closure in the Area of Coatings Evaluation," U.S. Nuclear Regulatory Commission, Washington, DC, documented in ADAMS under accession number ML080230462, dated March 28, 2008.

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References:

11. US-APWR DCD Revision 3.
12. Technical Report MUAP-08001-P, Revision 3, "US-APWR Sump Strainer Performance," dated November 19, 2010.
13. Regulatory Guide 1.82, Revision 3, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident," dated November 30, 2003.
14. NEI 04-07, "PWR Sump Performance Evaluation Methodology," documented in ADAMS under accession number ML041550332, dated May 28, 2004.
15. SE for NEI GR 04-07, "PWR Sump Performance Evaluation Methodology," U.S. Nuclear Regulatory Commission, Washington, DC, documented in ADAMS under accession number ML050550156, dated December 6, 2004.
16. NRC Staff Review Guidance regarding Generic Letter 2004-02 Closure in the Area of Strainer Head Loss and Vortexing," U.S. Nuclear Regulatory Commission, Washington, DC, documented in ADAMS under accession number ML080230038, dated March 28, 2008.
17. GL 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors," U.S. Nuclear Regulatory Commission, Washington, DC, dated September 13, 2004.
18. "NRC Staff Review Guidance regarding Generic Letter 2004-02 Closure in the Area of Plant-Specific Chemical Effect Evaluations," U.S. Nuclear Regulatory Commission, documented in ADAMS under accession number ML080380214, dated March 28, 2008.
19. NRC NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," documented in ADAMS under accession number ML090580432, dated January 29, 2003.
20. "NRC Staff Review Guidance regarding Generic Letter 2004-02 Closure in the Area of Coatings Evaluation," U.S. Nuclear Regulatory Commission, Washington, DC, documented in ADAMS under accession number ML080230462, dated March 28, 2008.

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