

**U.S. NUCLEAR REGULATORY COMMISSION REGULATORY AUDIT OF ECCS STRAINER
DESIGN AS PART OF THE ABWR DESIGN CONTROL DOCUMENT**

REGULATORY AUDIT

ABWR RENEWAL APPLICATION

Docket No. 52-045

AUDIT PLAN

APPLICANT: General Electric Hitachi (GEH)

APPLICANT CONTACT: Patricia Campbell,
GE Hitachi Nuclear Energy
Washington Regulatory Affairs
202-637-4239
patricial.campbell@ge.com

DURATION: Phase 1 - February 21, 2017 – April 20, 2017

LOCATION: **US NRC Headquarter Office**
11545 Rockville Pike
Rockville, MD 20852-2738

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|-----------------------------|--------------------------|-----------------|
| <u>AUDIT TEAM:</u> | | |
| Henry Wagage (Lead Auditor) | Sr. Reactor Engineer | NRO/ DSRA /SCVB |
| Tuan Le | Mechanical Engineer | NRO/DEIA/MEB |
| Gregory Makar | Materials Engineer | NRO/DEIA/MCB |
| James Gilmer | Reactor Systems Engineer | NRO/DSRA/SRSB |
| Getachew Tesfaye | Sr. Project Manager | NRO/DNRL/LB3 |

I. BACKGROUND

On December 7, 2010, GEH applied to the U.S. Nuclear Regulatory Commission (NRC) for the renewal of the ABWR standard plant design certification (DC), which the NRC had issued on June 11, 1997. Because of lessons learned from BWR operating experience and from the review of Generic Safety Issue-191, "Assessment of [Effect of] Debris Accumulation on PWR Sump Performance," the staff determined that additional information was required to evaluate compliance of the Emergency Core Cooling System (ECCS) design with 10 CFR 50.46(b)(5). Lessons learned included recognition of the inadequacy of the criterion to allow 50 percent blockage of the strainer surface area and recognition of chemical precipitates as a potential debris source. The staff incorporated these and other lessons learned into revisions of Regulatory Guide (RG) 1.82, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident." (Reference 2).

As part of its review, the staff issued requests for additional information (RAIs) 06.03-1 and 06.03-2, dated March 10, 2015, and December 15, 2015, respectively. These RAIs focused on the design of the strainer, the analysis for potential chemical precipitates in the debris source term, and long-term cooling of the reactor core. The applicant's latest response, dated

December 19, 2016, is a revised response (Revision 1) to RAI 06.03-2 (Reference 6). The staff determined that an audit is needed for performing its review.

II. PURPOSE

The purpose of the audit is to confirm that the design of ECCS strainers and ECCS is consistent with the commitments made in the ABWR DCD Tier 2, as part of the NRC staff reviews in accordance with SRP Sections 6.2.2 and 6.3.

III. REGULATORY AUDIT BASIS

The audit is based on the following regulatory requirements:

- Title 10 of the Code of Federal Regulations (10 CFR), Part 52, Appendix A, "Design Certification Rule for the U.S. Advanced Boiling Water Reactor."
- Title 10 of the Code of Federal Regulations (10 CFR), Part 52, Section 47, "Contents of applications; technical information,"
- 10 CFR 52.57, "Application for renewal"
- 10 CFR 52.59, "Criteria for renewal"
- 10 CFR 50.46(b)(5), "Long-term cooling"
- General Design Criterion (GDC) 35, "Emergency core cooling," of Appendix A to 10 CFR Part 50.
- GDC 38, "Containment heat removal"

IV. REGULATORY AUDIT SCOPE

The primary scope of this audit is to review design specifications and design reports of ECCS strainers provided by the applicant to verify that the component design is in accordance with the methodology and criteria described in the ABWR DCD Tier 2. The review scope of this audit will be focused to confirm the design of ECCS strainers conform to RG 1.82 and that the design requirements have been properly translated to design specifications and design reports to ensure construction will conform to the design requirements.

In addition, the staff will also focus on documents that show how the GEH ABWR design meets the regulatory requirements of the ECCS with respect to:

- ECCS strainer functional design
- ECCS strainer structural design
- Type and amount of debris assumed in the design
- In-vessel downstream effects of post-LOCA debris

The staff will conduct this audit in accordance with the guidance provided in NRO-REG-108, "Regulatory Audits" (Reference 5).

V. DOCUMENTS/INFORMATION NECESSARY FOR THE AUDIT

Specific documents in the scope of the audit include the following:

- ECCS strainer design specifications and design reports including referenced stress calculation packages (Reference (6) RAI response part A. "Design and Analysis of ECCS Strainer")

- Evaluation DBR-0017510 – ABWR Suction Strainer Performance Evaluation
- Calculation 31113-0E11-2113, Rev. 1, NPSH (RHR)
- Calculation 31113-0E22-2106, Rev. 0, NPSH (HPCF)
- Calculation 31113-0E51-2121, Rev. 0, NPSH (RCIC)
- Drawing 105E2586, Rev. 4, Suction Strainer
- Calculation 0000-0080-3039, Rev. 1, RHR Suction Strainer
- Report GE-NE-T23-00700-15-21, Rev. 1, March 1996, Effects of Debris on ECCS Performance

Other documents not specifically identified by document number, including:

- Test data and calculations supporting revised head loss correlation (from that of NEDC-32721-P-A)
- Calculation for Nukon fiber quantity
- Evaluation of zinc chemical debris from inorganic zinc coatings (Reference (6) RAI response B.3)
- Test data for Defender Lower Tie Plate
- Calculations or other documents showing flow loss and/or area assumptions for core support plate and fuel bundle lower tie plate inlet orifices and bypass flow paths, grid spacer pressure losses, spray nozzle and sparger losses, and any other form losses contributing to the downstream effects evaluation

The requested documents should be uploaded into the electronic reading room and made available for the NRC staff's audit by February 21, 2017.

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

VI. SPECIAL REQUESTS

The NRC staff requests that GEH provide the technical staff with access to the audit documents. GEH can upload the requested documents into the GEH electronic reading room (GE ERR) for staff's review. During the audit, the staff will have questions and concerns to be discussed with GEH/GNF subject matter experts. The NRC project manager will arrange such discussions with coordination through the GEH project manager.

VII. AUDIT ACTIVITIES AND DELIVERABLES

The NRC staff review will cover the technical areas identified in Section IV of this audit plan. Depending upon the effort needed in a given area, NRC team members may be reassigned to ensure adequate coverage of important technical elements.

The regulatory audit will be conducted in two phases at the Rockville NRC Headquarters using an electronic reading room. Phase 1 supports the staff's review of ABWR ECCS suction strainer design, which will be extended to an optional Phase 2 if needed based on the outcome of Phase 1 and for resolving follow up RAIs to RAI 06-03-2.

Phase 1: February 21, 2017 to April 20, 2017

Phase 2: April 21, 2017 to July 20, 2017

An audit kick-off teleconference between NRC and GEH will be held on February 21, 2017. The NRC Project Manager will coordinate with GEH to arrange teleconferences or meetings with GEH as needed during the duration of the audit. The audit exit meeting will be scheduled within that timeframe as convenient for GEH and NRC staff.

The audit team will perform the audit activities and complete audit reports accordingly.

The NRC Project Manager will coordinate with GEH in advance of audit activities to verify specific documents and identify any changes to the audit schedule and requested documents. The NRC staff acknowledges the proprietary nature of the information requested. It will be handled appropriately throughout the audit. While the NRC staff will take notes, the NRC staff will not remove hard copies or electronic files from the audit site.

At the completion of the audit, the NRC staff will issue an audit summary within 90 days that will be declared and entered as an official agency record in the NRC's Agencywide Documents Access and Management System (ADAMS) records management system. The audit outcome may be used to identify any additional information to be submitted for making regulatory decisions, and it will assist the NRC staff in the issuance of RAls (if necessary) for the licensing review of ABWR DCD Chapter 6, in preparation of the NRC staff's Safety Evaluation Report.

The NRC contact for this audit is Getachew Tesfaye (NRC), (Telephone: 301-415-8013, email: Getachew.Tesfaye@nrc.gov).

VIII. REFERENCES

1. "GE-Hitachi ABWR Design Control Document Tier 1 & 2, Rev.6" ADAMS Accession Number ML16081A122, February 19, 2016.
2. RG 1.82 "Water Sources for Long-Term Recirculation Cooling Following A Loss-Of-Coolant Accident", Revision 4, 2012.
3. SRP Section 6.2.2, "Containment Heat Removal Systems", Revision 5.
4. SRP Section 6.3, "Emergency Core Cooling System", Revision 3.
5. NRO-REG-108, "Regulatory Audits," ADAMS Accession Number ML081910260, April 2, 2009.
6. Letter MFN-16-034, Revision 1, from Jerald G. Head, GEH, to the USNRC, Revised response to Request for Additional Information 06.03-2, ADAMS Accession Number ML1635A445, December 19, 2016.