

U. S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
REGULATORY AUDIT REPORT FOR THE CLOSED REGULATORY AUDIT CONDUCTED
ON DECEMBER 12-13, 2024,
TOPICAL REPORT WCAP-18869-P/NP, REVISION 0,
“HIGH PERFORMANCE CLADDING FOR USE IN BOILING WATER REACTOR FUEL”
WESTINGHOUSE ELECTRIC COMPANY
DOCKET NO. 99902038; EPID L-2024-TOP-0007

1.0 BACKGROUND

By letter dated March 8, 2024 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML24072A267), Westinghouse Electric Company (Westinghouse) submitted Topical Report (TR) WCAP-18869-P/NP, Revision 0, “High Performance Cladding for Use in Boiling Water Reactor Fuel,” for U.S. Nuclear Regulatory Commission (NRC) review and approval. This TR describes a cladding material with increased Ferrum content compared to Zircaloy-2 (Zr-2) used in boiling water reactor (BWR) nuclear fuel to maximize the safety margins amid increasing demands for higher fuel duties and burnup, by reducing the hydrogen uptake. The proposed TR would allow Westinghouse to use the cladding with all its licensed BWR fuel designs.

The NRC staff determined that a regulatory audit was needed to increase the efficiency, facilitate discussion, and clarify issues identified during the NRC staff’s initial review and conducted a virtual closed regulatory audit on December 12 through December 13, 2024, based on the audit plan issued on November 25, 2024 (ADAMS Package Accession No. ML24324A166). The audit was held in accordance with the NRC Office of Nuclear Reactor Regulation procedure as described in LIC-111, “Regulatory Audits,” and under the guidance provided in LIC-500, Revision 9, “Topical Report Process.” The information discussed during the audit was determined to be proprietary by the NRC staff. Based on the results of the audit and the close out of the open items, the NRC issued its request for additional information (RAI) February 19, 2025 (ADAMS Package Accession No. ML25049A230).

2.0. REGULATORY AUDIT OBJECTIVES

The objective of this audit was to increase review process efficiency through direct interaction with Westinghouse’s technical experts toward a timely resolution of questions associated with this TR review. More specifically, in preparation for the audit, Westinghouse made available, through its online document portal, the documents listed in Section 5.0 of this audit report.

The audit allowed the NRC staff to examine the documents, obtain clarification on its contents, have extended discussions about differences in technical opinion, and identify those areas of the review that need additional focus.

The list of audit participants is contained in the table below:

Name	Affiliation
Jeremy Dean	NRC
Richard Fu	NRC
Ekaterina Lenning	NRC
Jerrold Ewing	Westinghouse
Nathaniel Mackereth	Westinghouse
Joshua Yagozinski	Westinghouse
David Favrot	Westinghouse
Britta Helmersson	Westinghouse
Carolin Holmkvist	Westinghouse
Kenneth Göransson	Westinghouse
Thomas Lindqvist	Westinghouse
Karin Oldberg	Westinghouse

3.0 REGULATORY AUDIT BASES

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, “Domestic Licensing of Production and Utilization Facilities,” contains the general design criteria (GDC) described in Appendix A to Part 50 including GDC 10, “Reactor design,” GDC 25, “Protection system requirements for reactivity control malfunctions,” GDC 26, “Reactivity control system redundancy and capability,” GDC 27, “Combined reactivity control systems capability,” GDC 28, “Reactivity limits,” and GDC 35, “Emergency core cooling.” Regulatory guidance for the review of fuel system designs and adherence to these GDCs is provided in NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants – LWR Edition” (SRP). Specifically, Section 4.2, “Fuel System Design.” Additionally, SRP Section 4.3, “Nuclear Design,” and Section 4.4, “Thermal and Hydraulic Design,” are pertinent to the review of fuel systems.

4.0 AUDIT RESULTS

The NRC staff conducted a virtual closed audit of WCAP-18869-P/NP, Revision 0, on December 12-13, 2024, in accordance with the audit plan (ADAMS Package Accession No. ML24324A166).

Discussion of Audit Questions and Topical Report

The audit consisted of a detailed discussion of the audit questions in the audit plan and TR WCAP-18869-P, Revision 0. The NRC staff discussed each of the approximately 12 comprehension questions based on the content of this TR. These questions covered multiple subject matter areas including additional data that was collected since publication of the

submitted TR for all lead test rod/post irradiation examination programs for HiFi cladding, justifications why the U.S. BWR reactor chemistry control programs are not expected to have a negative effect on the performance of HiFi cladding, models' uncertainty of HiFi cladding predicted oxide thickness that justifies using [] the impact of high-performance cladding response to LOCA and associated analyses, fabrication specifications applied to texture and second phase particles for HiFi cladding in production compared to Zr-2, the detailed data for the fuel rod design (FRD) criteria along with the evaluations of the use of HiFi cladding on the specific criteria, and the justification for the acceptance criterion and material performance up to []

Westinghouse representatives provided explanations for each of the comprehension questions in these subject matter areas, enabling the NRC staff to focus on verifying the NRC staff's understanding of material in the TR outside the scope of the comprehension questions. To address this material, the NRC staff and Westinghouse representatives engaged in a methodical, page-by-page walk-through of the TR contents, identifying material that needed to be clarified and discussing it as needed. Westinghouse identified the areas within the TR where justification and applicable data were provided.

During the audit, Westinghouse representatives answered most of the NRC staff's comprehension, clarification, and discussion questions. Some of the information that the NRC staff needed to clarify was not readily available during the audit. The NRC staff and Westinghouse discussed and agreed upon that, based on the regulatory audit findings, the following open items needed to be addressed post-audit by Westinghouse prior to the NRC issuance of the RAIs: []

[] During the exit briefing, the NRC staff discussed with Westinghouse representatives the material that was covered in the audit and indicated that the potential RAIs would be drafted after five open items are closed out. Westinghouse stated that resolution to the NRC open items will be uploaded to the portal. Westinghouse notified NRC via email dated January 19, 2025, that the clarifying information was uploaded to the portal. Open items were closed out after the NRC staff reviewed clarifying information on the Westinghouse electronic library portal. Based on the results of the audit, the NRC issued its RAI on February 19, 2025 (ADAMS Package Accession No. ML25049A230).

5.0 EXAMINED AUDIT DOCUMENTS

1. []
2. []
3. []
4. []
5. []

6.0 CONCLUSION

The NRC regulatory audit accomplished the objectives listed in Section 2.0 by allowing direct interaction with Westinghouse's technical experts. The NRC staff obtained clarification on the contents of the update, the TR as submitted, and discussed 12 audit questions and related documents. The clarifications and additional information helped the NRC staff's review. The discussions on the topics of concern allowed the NRC staff and Westinghouse to facilitate full resolution of these concerns during the audit review process.