JULY 27-30, 2026, REGULATORY AUDIT PLAN FOR FRAMATOME TOPICAL REPORT, ANP-10359P, REVISION 0, "PROTECT: INCORPORATION OF CHROMIUM-COATED M5 CLADDING MATERIAL PROPERTIES IN FRAMATOME PWR METHODS"

DOCKET NO. 99902041

EPID: 2026-TOP-0015

1.0 BACKGROUND

By letter dated April 17, 2026 (Agencywide Documents Access and Management System (ADAMS) Package Accession No. ML26107A264), Framatome Inc. (Framatome) submitted Topical Report (TR) ANP-10359, Revision 0, "PROtect: Incorporation of Chromium-Coated M5 Cladding Material Properties in Framatome PWR Methods," for U.S. Nuclear Regulatory Commission (NRC) staff's review and approval.

Based on the initial review of the TR, the NRC staff have determined that a regulatory audit would facilitate its review. The audit will be conducted in-person from July 27-30, 2026, at Framatome's facility located in Lynchburg, Virginia.

2.0 REGULATORY AUDIT BASES

Regulatory guidance for the review of fuel system designs and adherence to Title 10 of the *Code of Federal Regulations,* Appendix A to Part 50, General Design Criteria-10, "Reactor Design," is provided in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (SRP), Section 4.2, "Fuel System Design." In accordance with SRP, Section 4.2, the objectives of the fuel design's safety review is to provide reasonable assurance that: (1) the fuel system is not damaged as a result of normal operation and anticipated operational occurrence, (2) fuel system damage is never so severe as to prevent control rod insertion when it is required, (3) the number of fuel rod failures is not underestimated for postulated accidents, and (4) coolability is always maintained. The design bases include (1) fuel system damage, (2) fuel rod failure, and (3) fuel coolability. Dimensional changes of the fuel channel must be included in the design analysis to establish operational tolerances, which are part of the requirements in the design bases.

3.0 REGULATORY AUDIT SCOPE

The audit will focus primarily on the TR, the enclosed audit information needs, all relevant supporting documentation (e.g., methodology, calculations), and questions identified in Section 8.0, "Audit Questions and Requests," below. The purpose of this audit is to gain a more detailed understanding of the information supporting Framatome's proposed TR methodology and to address questions via in-person discussions.

The audit will be performed consistent with NRC Office of Nuclear Reactor Regulation Office Instruction LIC-111, Revision 2, "Regulatory Audits," (ML24309A281). Non-docketed information reviewed during the audit that the NRC staff deems necessary to support the development of its safety evaluation will be requested to be submitted on the docket.

Enclosure 1

4.0 INFORMATION REQUESTS

To facilitate efficient face-to-face audit interactions, the NRC staff is requesting that Framatome provide access to requested audit documentation through an online reference portal before the face-to-face portion of the audit.

5.0 AUDIT TEAM

Key Framatome personnel involved in the development of the TR should be made available for interactions on a mutually agreeable schedule to respond to any questions from the NRC staff.

Team Member	Organization	Role
Ngola Otto	NRC	Project Manager
Richard Fu	NRC	Technical Reviewer
River Rohrman	NRC	Technical Reviewer
Joshua Kaizer	NRC	Technical Reviewer

6.0 LOGISTICS

The audit should be conducted from July 27-30, 2026, from approximately 8:30am – 5:00pm Eastern Standard Time at Framatome's facilities in Lynchburg, VA. The audit will involve both the review of documents and data on an electronic portal as well as an in-person face-to-face discussion.

7.0 DELIVERABLES

The NRC team will develop an audit summary report to convey the results. The report will be placed in ADAMS within 90 days of the completion of the final audit session.

8.0 AUDIT QUESTIONS AND REQUESTS

Requested Documents

1. Data and analysis associated with mechanical tests performed on PROtect Chromium coated cladding which determine the uniform and total elongation.

2. Data and analysis associated with the TR, Figure 8-5, "Best-Estimate Uniaxial Yield Strength of Irradiated Cr-coated M5$_{\text{Framatome}}$ Cladding as a Function of Fast Fluence," and Figure 8-6, "Best-Estimate Uniaxial Tensile Strength of Irradiated Cr-coated M5$_{\text{Framatome}}$ Cladding as a Function of Fast Fluence," at higher Fluences.

3. Data and analysis associated with TR, Figure 8-7, "Room Temperature and Elevated Temperature **[[ ]]** Yield Strength for Cr-coated M5$_{\text{Framatome}}$ Cladding," and Figure 8-8, "Room Temperature and Elevated Temperature **[[ ]]** Yield Strength and Tensile Strength for Cr-coated M5$_{\text{Framatome}}$ Cladding," at higher burnups.

4. Data and analysis associated with the TR, Figure 9-2, “Cr-coated $M5_{Framatome}$ Cladding Hydrogen Content vs. Exposure Time,” at higher Effective Full Power Days for Cr-Coated M5 Data (360 degrees Celsius (^{o}C)).

5. Data and analysis associated with the TR, Figure 10-1, “Cr-coated $M5_{Framatome}$ Fuel Rod Growth.”

6. Data and analysis associated with the TR, Figure 12-6, “**[[ ]]** for Irradiated Cr-coated $M5_{Framatome}$ Cladding.”

<u>Audit Questions</u>

1. Does the **[[ ]]** to prepare for Physical Vapor Deposition alter the substrate’s properties?

2. In Section 4, it is stated that Cr-coated M5 cladding may be used with any fuel type. Please outline the tests that were performed with non-uranium dioxide (UO2) fuel pellets.

3. In Section 5, “Material Definition,” Figure 5-4, “Coating Process Outline,” of the TR the Cr coating process is described. How does Framatome conduct quality control of defect-free Cr coating in **[[ ]]**

4. In Section 5, please provide justification that the surface finish for Chromium coated M5 **[[ ]]** and that Chromium coated M5 **[[ ]].** Please provide the manufacturing drawings and specifications which define the finish as the limiting criterion for design purposes.

5. In Section 5.3, “Manufacturing,” the thickness of the Cr coating layer is stated. What is the tolerance range for this specification and how does the Framatome quality assurance process ensure that the coating is sufficiently thick?

6. In Section 6, “Operating Experience,” based on Table 6-1, “Summary of Cr-coated Cladding Irradiation Through 2025,” walk through all Irradiation experience in different sections of the TR, especially focused on properties at higher burnup justifying use to **[[ ]]** Gigawatt days Metric ton of Uranium (GWd/mtU) fuel rod average burnup.

7. In Section 9, “Oxidation and Hydrogen Pickup During Normal Operations,” oxidation data from autoclaves is presented. Please provide any oxidation data from the rods which were operated as mentioned in Section 6 of the TR.

8. Please provide a walk-through of Section 10, “Fuel rod and Assembly Performance,” of the TR and discuss how the conclusions were determined and provide supporting data.

9. Please provide a walk-through of Section 11, “New Degradation Mechanisms/Other Consideration,” of the TR and discuss the testing performed to evaluate the performance of Cr coated M5 cladding with regards to the new degradation mechanisms.

10. For Section 12.2, “GALILEO Creep Model for Cr-coated M5Framatome Cladding,” of the TR, please describe how the updated irradiation creep models were determined. Also describe the validation process and uncertainty determination.

11. For Section 12.3.6, “Fuel Rod Transient Cladding Strain Analysis,” and Section 15.2.2, “Reactivity Initiated Accidents (RIA),” of the TR, please provide the **[[ ]]** values and the comparison to M5 which informed the conclusion that **[[ ]]**.

12. In Figure 12-4, “Rod Diameter Change Predicted-Measured vs. Burnup,” are the **[[ ]]** in the key referring to different versions of the coating during the development process? After pellet cladding contact, the pellet swelling is the primary mechanism for rod diameter change, is this behavior impacted by the Chromium coated cladding? Additionally, it is stated that **[[ ]]**. Please provide a comparison of coated and uncoated creep rates from testing performed, as well as a description of the testing.

13. Please provide a walk-through of Section 14, “Thermal Hydraulics,” of the TR, and discuss how the conclusions were determined. Additionally, in Section 14.1, please provide the supporting literature and data used to determine that Cr-coated M5 cladding **[[ ]].**

14. For Section 15, “Non-LOCA [Loss-of-Coolant Accident] Methodology,” of the TR, please discuss how the determination was made that the ARITA and AREA methodologies are applicable for use with Cr-coated cladding.

15. Please provide the tests and data that support the information provided in Section 15.2.2 of the TR pertaining to the eutectic performance of the coating under RIA conditions. Specifically, **[[ ]]**.

16. Is there data from any tests performed on rods in which the cladding is intentionally cracked? The impact of cracking on delamination is unclear.

17. For Section 16.2.5, “Future Data Accommodation,” of the TR, what is the established process for communicating changes to the NRC? In what ways will reassessment change the model? What is the nature of potential changes and how large can they be?

18. For Section 16.3, “Metal-Water Reaction,” of the TR, provide analysis or data which supports the claim **[[ ]]**.

19. In Section 16.4.1, "Post Quench Ductility," of the TR, how is the Equivalent Cladding Reacted calculated and compared to **[[ ]]**

20. Was a critical strain for coating cracking observed in the LOCA tests?

21. In Section 17, "Surveillance," of the TR, the same surveillance process as described within Section 14.0 of Reference 6 will be utilized for Cr-coated $M5_{Framatome}$ cladding. How does Framatome implement the surveillance in this TR?

22. Is the applicability of the "Increased Burnup for PWRs" TR's suite of advanced codes and methods demonstrated for Cr-coated $M5_{Framatome}$ cladding?