

## AUDIT PLAN

### BAW-10227, REVISION 1, SUPPLEMENT 1P

#### “EVALUATION OF ADVANCED CLADDING AND STRUCTURAL MATERIAL (M5) IN PWR REACTOR FUEL”

APPLICANT: Framatome

APPLICANT CONTACT: Jerald Holm  
Framatome Licensing Engineer  
509-554-6938  
jerald.holm.ext@framatome.com

TIME: Start on 1/30/2019: 8:30 am to 5:00 pm  
End on 1/31/2019: 8:30 am to 12:00 pm

LOCATION: Framatome Inc.  
3315 Old Forest Road  
Lynchburg, VA 24501

NRC AUDIT TEAM: Paul Clifford  
Amrit Patel  
Jonathan Rowley

#### **BACKGROUND**

In a letter dated May 4, 2017, Framatome Inc. (Framatome) submitted proprietary Topical Report (TR) BAW-10227, Revision 1, Supplement 1P, “Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel” (BAW-10227 R1, S1), for U.S. Nuclear Regulatory Commission (NRC) review and approval (Agencywide Documents Access and Management System (ADAMS) Accession Number ML17130A708). Framatome explained its intent for the supplement is to re-establish the iron impurity concentration limit without a need to change any application methods or licensee Technical Specifications methodology references based on its evaluation. The NRC staff completed its acceptance review on October 18, 2017 and found that the material presented was sufficient to begin its review (ADAMS Accession Number ML17283A261). After an initial review, the NRC staff has identified some areas requiring further discussion and determined it necessary to review documents supporting BAW-10227 R1, S1, analyses to resolve the NRC staff concerns.

#### **PURPOSE AND APPROACH**

The purpose of this audit is to review several issues identified by the NRC staff regarding BAW-10227 R1, S1. The audit team will review documents, drawings,

analysis, specifications, and other relevant design information associated with the BAW-10227 R1, S1, review. The audit findings will be documented in an audit report.

The NRC staff has identified the following open items to facilitate discussions and so that necessary documentation can be made available for the audit team's review during the audit:

1. Sections 3 and 4 of BAW-10227 R1, S1, reference a technical paper (Impact of Iron in M5™) presented at the American Society for Testing and Materials B10 Zirconium in the Nuclear Industry Symposium for a vast amount of data and analysis to support this TR supplement. The technical paper is cited 31 times. The technical paper was authored by representatives from several different Framatome organizations in France, Germany, and the US. This technical paper lacks the pedigree necessary to support an NRC safety finding. The NRC staff requests an audit of the underlying Framatome testing and research reports and requests that Framatome affirm that the information cited from the technical paper is accurate and was processed under the Framatome quality assurance program.
2. Section 4 of BAW-10227 R1, S1, describes various material properties. The NRC staff requests that Framatome discuss why material properties aren't updated based on the current state-of-knowledge. For example, M5 density reported in the base TR from 2003 is an extrapolation between pure zirconium (Zr) and a CANDU Zr-2.5 Niobium alloy.
3. The various subsections in Section 4 of BAW-10227 R1, S1, refer to "reported uncertainties." Provide a reference for the reported uncertainties for the structure-insensitive properties as they are not located with M5 material properties in Appendix A of the base TR.
4. Section 4.10.2 of BAW-10227 R1, S1, describes the evaluation for guide tube creep. Framatome is requested to discuss the basis for not providing data [ ].
5. Section 4.14.2 of BAW-10227 R1, S1, describes the evaluation of fuel rod and guide tube growth. Based on observations and growth measurement, Framatome states "[T]he slight reduction in fuel rod growth will result in a slightly larger shoulder gap, which is not detrimental to fuel performance. Therefore, models of fuel rod growth for M5 remain applicable." A decrease in fuel rod growth would have a negative impact on predicted void volume and rod internal pressure, therefore the impact of the re-defined M5 depends on whether the application methods credit fuel rod growth in those predictions. Framatome is requested to discuss the impacts of the re-defined M5 on previously approved application methods.
6. Framatome is requested to discuss how differences between COPERNIC models and methods and those of GALILEO were considered in the development of BAW-10227 R1, S1.
7. Section 4.14.2 of BAW-10227 R1, S1, describes the evaluation on fuel rod and guide tube growth. Guide tube measurements suggest a slight increase in

growth at higher iron concentrations. Framatome concludes that existing models remain applicable. Framatome has an NRC-approved process for measuring guide tube growth and updating design-specific models without prior NRC review. Framatome is requested to explain why BAW-10227 R1, S1, doesn't acknowledge this process and commit to follow it in the future should significant growth differences be observed.

8. Section 4.17 of BAW-10227 R1, S1, describes the evaluation of phase transition temperature. Iron has been identified as a beta-stabilizer in Zr alloys. As such, the NRC staff expects the alpha-Zr to alpha-Zr plus beta-Zr phase transition temperature should be slightly reduced at the higher iron concentrations. Framatome is requested to discuss the basis for assuming the phase transition temperature remains the same for the re-defined M5 considering other factors besides iron may impact the phase transition temperature.

The NRC staff expects all open items to be covered. If an open item cannot be closed during the audit, a plan should be provided to the audit team for how the open item will be resolved.

#### **AUDIT ACTIVITIES AND SCHEDULE**

The NRC staff plans to conduct the review over a period of two business days. Following the audit, an audit report will be prepared discussing specific findings and will identify any remaining open items.