



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION**  
WASHINGTON, D.C. 20555-0001

January 15, 2019

Mr. Robert S. Bement  
Executive Vice President  
Chief Nuclear Officer  
Mail Station 7602  
Arizona Public Service Company  
P.O. Box 52034  
Phoenix, AZ 85072-2034

**SUBJECT: PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2, AND 3 – FIRST  
REGULATORY AUDIT PLAN FOR JANUARY 22-23, 2019, IN SUPPORT  
OF FRAMATOME HIGH THERMAL PERFORMANCE FUEL LICENSE  
AMENDMENT REQUEST AND EXEMPTION (EPID L-2018-LLA-0194 AND  
EPID L-2018-LLE-0010)**

Dear Mr. Bement:

By letter dated July 6, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18187A417), as supplemented by letter dated October 18, 2018 (ADAMS Accession No. ML18296A466), Arizona Public Service Company (APS) requested changes to the Technical Specifications to support the implementation of Framatome Advanced Combustion Engineering 16x16 High Thermal Performance (HTP™) fuel design with M5® as a fuel rod cladding material and gadolinia as a burnable absorber for Palo Verde Nuclear Generating Station (PVNGS), Units 1, 2, and 3. In addition to this license amendment request (LAR), APS is requesting an exemption from certain requirements of Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.46, "Acceptance criteria for emergency core cooling systems [ECCS] for light-water nuclear power reactors," and 10 CFR Part 50, Appendix K, "ECCS Evaluation Models," to allow the use of Framatome M5® alloy as a fuel cladding material.

This amendment will adapt the approved PVNGS reload analysis methodology to address both Westinghouse and Framatome fuel, including the implementation of Framatome methodologies, parameters and correlations. The ability to use either Westinghouse or Framatome fuel will ensure security of the PVNGS fuel supply by providing for multiple fuel vendors with reliable fuel designs and geographically diverse manufacturing facilities.

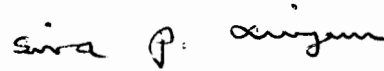
For better understanding of the LAR, the U.S. Nuclear Regulatory Commission staff will conduct an audit at the Hilton Hotel, 1750 Rockville Pike (near Twinbrook Metro Station), Rockville, Maryland, 20852, on January 22-23, 2019. The regulatory audit plan is enclosed with this letter.

R. Bement

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If you have any questions, please contact me at 301-415-1564 or via e-mail at [Siva.Lingam@nrc.gov](mailto:Siva.Lingam@nrc.gov).

Sincerely,

A handwritten signature in black ink, appearing to read "Siva P. Lingam".

Siva P. Lingam, Project Manager  
Plant Licensing Branch IV-1  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket Nos. STN 50-528, STN 50-529,  
and STN 50-530

Enclosure:  
Regulatory Audit Plan

cc: Listserv

REGULATORY AUDIT PLAN FOR JANUARY 22-23, 2019  
TO SUPPORT REVIEW OF FRAMATOME HIGH THERMAL PERFORMANCE FUEL  
LICENSE AMENDMENT REQUEST AND EXEMPTION  
ARIZONA PUBLIC SERVICE COMPANY  
PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2, AND 3  
DOCKET NOS. 50-528, 50-529, AND 50-530

1.0 BACKGROUND

The U.S. Nuclear Regulatory Commission (NRC) staff is currently engaged in a review of a license amendment request (LAR) for the Palo Verde Nuclear Generating Station (PVNGS), Units 1, 2, and 3. By letter dated July 6, 2018 (Agencywide Documents Access and Management System Accession No. ML18187A417), as supplemented by letter dated October 18, 2018 (ADAMS Accession No. ML18296A466), Arizona Public Service Company (APS, the licensee) requested changes to the Technical Specifications (TSs) to support the implementation of Framatome Advanced Combustion Engineering (CE) 16x16 High Thermal Performance (HTP™) fuel design with M5® as a fuel rod cladding material and gadolinia as a burnable absorber for PVNGS, Units 1, 2, and 3. In addition to this LAR, the licensee is requesting an exemption from certain requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.46, "Acceptance criteria for emergency core cooling systems [ECCS] for light-water nuclear power reactors," and 10 CFR Part 50, Appendix K, "ECCS Evaluation Models," to allow the use of Framatome M5® alloy as a fuel cladding material. Further, the proposed amendment would revise TS 2.1.1, "Reactor Core SLs [Safety Limits]"; TS 4.2.1, "Fuel Assemblies"; and TS 5.6.5, "Core Operating Limits Report (COLR)."

This amendment will adapt the approved PVNGS reload analysis methodology to address both Westinghouse and Framatome fuel, including the implementation of Framatome methodologies, parameters and correlations. The ability to use either Westinghouse or Framatome fuel will ensure security of the PVNGS fuel supply by providing for multiple fuel vendors with reliable fuel designs and geographically diverse manufacturing facilities.

The NRC staff has proposed to conduct a regulatory audit on January 22-23, 2019, to enhance technical understanding of the submitted documentation. This audit will help the NRC staff better understand the supporting documentation and analysis results through interaction with APS's technical experts and will help to focus on the NRC staff's requests for additional information (RAIs), where docketed information is needed to complete the review. The proposed audit will be held in accordance with the Office of Nuclear Reactor Regulation (NRR) Office Instruction LIC-111, "Regulatory Audits," dated December 16, 2008 (ADAMS Accession No. ML082900195).

## 2.0 REGULATORY AUDIT SCOPE

The NRC staff would like the licensee to make available the appropriate staff with detailed knowledge of the PVNGS licensing basis and the submitted LAR, supporting methodology, and supporting documents used in the development of the LAR.

The licensee is requested to have the presentations and documents related to the areas of focus listed. The documentation could be provided by presentations, documents, and calculation details. The following are the planned major areas of focus for detailed discussion and document review. Additional information needs to be identified during the audit and will be communicated to the designated point of contact.

The deliberations during the audit, along with the original contents of the LAR as well as the supplemental information, will be used to generate RAIs in order to complete the comprehensive review of the license amendment and exemption requests.

### 2.1 List of Items for Audit Discussion

#### 2.1.1 Thermal Hydraulics

- Discussion on Mechanical/Thermal-hydraulic compatibility of the three different fuel types (CE 16x16 STD (standard or value-added), CE 16x16 NGF (next generation fuel), and CE 16x16 HTP™) with three different cladding materials and three different critical heat flux (CHF) correlations for departure from nucleate boiling (DNB) ratio calculations. Also discuss the details of the thermal-hydraulic characterization and thermal margin analysis for the mixed core at the PVNGS, Units 1, 2, and 3 after the potential fuel transition to Framatome fuel.
- Discussion on the use of approved CHF correlations in approved codes that do not have specific approval for using such correlations, thereby changes to approved topical reports, which requires more rigorous review than normal fuel transition LARs. The licensee's modification of approved codes by inserting new CHF correlations approved for different codes (e.g., ABB-NV (Westinghouse (ABB) Non-Vane CHF Correlation) or WSSV CHF correlations (Westinghouse Side Supported Vane CHF Correlation) with VIPRE-W (Versatile Internals and Component Program for Reactors; Westinghouse) and VIPRE-01 (Versatile Internals and Component Program for Reactors; Electric Power Research Institute) codes, CE-1 correlation with VIPRE-W, CETOP-D (Combustion Engineering Thermal On-Line Program) and TORC (Thermal-hydraulics of Reactor Core) codes for use with VIPRE-01 code, and BHTP (designation for Framatome) CHF correlation in VIPRE-01 and VIPRE-W codes with CETOP-D and TORC codes).
- VIPRE-W modeling options as described in Section 5.1 of Attachment 8 of the LAR dated July 6, 2018, will require detailed review.
- Discussion on any other issues related to thermal/hydraulic design of the mixed core.

### 2.1.2 Seismic Analysis for Mixed core

- Discussion on the faulted condition analysis that evaluates structural response of the fuel assembly to externally applied forces such as earthquakes and postulated pipe breaks, based on the criteria established in the recently approved topical report ANP-10377P-A for the mixed core. Specifically, discussion on how the seismic evaluation will be done for Framatome and Westinghouse/CE fuel designs in the PVNGS core.

### 2.1.3 Setpoints Analysis

- Review of digital setpoints (COLSS (core operating limits supervisory system)/CPCS (core protection calculator system)) system at PVNGS, Units 1, 2, and 3 for mixed core with Framatome HTP™, Westinghouse NGF and Westinghouse STD fuel design
- When PVNGS switched to CE 16x16 NGF, the CE setpoint (COLSS/CPCS) methodology was implemented using the approved topical report WCAP-16500-P-A Supplement 1 Revision 1, "Application of CE Setpoint Methodology for CE 16x16 Next Generation Fuel (NGF)." However, transition to Framatome CE 16x16 HTP™ fuel should have a similar methodology, either generic or plant-specific. No plant-specific or generic methodology to support the new fuel transition was submitted for review. Discussion of detailed setpoint analysis for the mixed core is expected of the licensee during the audit.

### 2.1.4 Non-LOCA Transients

- Demonstration that fuel centerline melt temperature will not be exceeded considering inadequacy of 21 kilowatts/foot limit at certain times in cycle life and simultaneous separate burnup dependent limits for Westinghouse and Framatome fuel.
- Understanding of which transients utilize input from the COPENIC computer code.
- Basis for use of convolution method for Framatome fuel.
- Understanding of DNB probability distribution function for Framatome fuel and how it impacts applicable transient analysis.
- Basis for continued use of DNB propagation analysis including evidence of strain behavior for Framatome fuel.
- Evidence of comparisons for M5® cladding to Zircaloy-4 alloy discussed in Section 6.4 of Attachment 8 of the LAR dated July 6, 2018.
- Understanding of how Framatome fuel parameters (Hgap (fuel-to-clad gap coefficient of conductance), Gadolinia effects) are accounted for in CENTS and HERMITE codes.
- Understanding of how updated guidance on reactivity initiated accidents will be addressed in the updated final safety analysis report following the fuel transition.

#### 2.1.5 Applicability of Approved Methodology to Both Westinghouse and Framatome Fuel Designs

- Technical Specifications (TS 4.2.1)
- Loss-of-Coolant Accident (LOCA)
- Anticipated Operational Occurrences (AOOs)
- Containment Analysis

#### 2.2 Supporting Information from Licensee

The licensee is requested to make the appropriate personnel or contractors who are familiar with the proposed LAR available for the audits (either in person or on the phone). The NRC staff also requests the licensee to have the supporting documents related to the above topics available and be prepared to discuss them with the NRC staff during the audit. The documents could be provided by paper copies or electronically. The NRC staff may require the licensee to provide appropriate documents to the NRC docket that would enable an accelerated and effective review of the LAR.

#### 3.0 TEAM AND REVIEW ASSIGNMENTS

<b>Area of Review</b>	<b>Assigned Auditor</b>
Technical Adviser	Paul Clifford (NRC/NRR)
Technical Reviewer	Michelle Bales (NRC/NRR)
Technical Reviewer	Joshua Kaizer (NRC/NRR)
Technical Reviewer	John Lehning (NRC/NRR)
Technical Reviewer	Mathew Panicker (NRC/NRR)
Technical Reviewer	Diana Woodyatt (NRC/NRR)
Project Manager	Siva P. Lingam (NRC/NRR)

#### 4.0 LOGISTICS

The audit will be conducted at the Hilton Hotel near the Twinbrook Metro Station in Rockville, Maryland, on January 22-23, 2019, starting at 8:00 a.m. eastern standard time. Entrance and exit briefings will be held at the beginning and end of this audit, respectively.

The licensee is requested to provide a conference room with a white board for discussions.

The licensee should also provide any other documentation that may aid discussion on the specific topics of interest.

The audit will start at 8:00 a.m. on Tuesday, January 22, 2019, and conclude on Wednesday, January 23, 2019, at 1:00 p.m. approximately.

Please note that the following proposed schedule is subject to change:

January 22, 2019

8:00 a.m.	Entrance Meeting - Introductions, Audit Activities, Goals, and Logistics
8:15 a.m.	Licensee and NRC Staff to Discuss Methods Applicability to Westinghouse and Framatome Fuels, Thermal Hydraulics, Setpoint Analysis, Seismic Analysis
12:00 p.m.	Lunch
1:00 p.m.	Discussion on Methods Applicability to Westinghouse and Framatome Fuel, LOCA, and AOO and Calculation Note Books Review
3:30 p.m.	NRC Audit Team Caucus
4:00 p.m.	NRC/Licensee Interim Meeting
4:30 p.m.	Audit Team Daily Closeout

January 23, 2019

8:00 a.m.	Licensee Discussion on Containment Analyses and Technical Specifications (and any items leftover from previous day)
9:30 a.m.	NRC Team Discussion on Containment Analyses and Technical Specifications (and any items leftover from previous day)
12:00 p.m.	NRC Follow-up on Open Items
1:00 p.m.	Audit Exit

5.0 DELIVERABLES

At the conclusion of the audit, the NRC staff will provide a summary of audit results for each of the topics defined in the audit scope. The NRC Regulatory Audit Report will be issued within 90 days of the completion of the audit.

SUBJECT: PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2, AND 3 – FIRST REGULATORY AUDIT PLAN FOR JANUARY 22-23, 2019, IN SUPPORT OF FRAMATOME HIGH THERMAL PERFORMANCE FUEL LICENSE AMENDMENT REQUEST AND EXEMPTION (EPID L-2018-LLA-0194 AND EPID L-2018-LLE-0010) DATED JANUARY 15, 2019

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MBales, NRR

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MPanicker, NRR

DWoodyatt, NRR

**ADAMS Accession No.: ML19011A108**

\*by memorandum

OFFICE	NRR/DORL/LPL4/PM	NRR/DORL/LPL4/LA	NRR/DSS/SNPB/BC*
NAME	SLingam	PBlechman	RLukes
DATE	1/11/19	1/11/19	1/10/19
OFFICE	NRR/DORL/LPL4/BC	NRR/DORL/LPL4/PM	
NAME	RPascarelli	SLingam	
DATE	1/15/19	1/15/19	

**OFFICIAL RECORD COPY**