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

June 4, 2019

Mr. Robert S. Bement
Executive Vice President Nuclear/
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 – SECOND REGULATORY AUDIT PLAN FOR JUNE 17–20, 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 letters dated October 18, 2018, March 1, 2019, and May 17, 2019 (ADAMS Accession Nos. ML18296A466, ML19060A298, and ML19137A118, respectively), Arizona Public Service Company (the licensee) 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 (Palo Verde), Units 1, 2, and 3. In addition to this license amendment request (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.

This amendment will adapt the approved Palo Verde 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 Palo Verde 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 conducted the first audit at the Hilton Hotel, 1750 Rockville Pike, Rockville, Maryland, 20852, on January 22-23, 2019. During this audit, the staff informed the licensee that a week-long audit of all the calculation notebooks and relevant documents related to the LAR will be conducted during June 17–20, 2019, at the plant site in Arizona. The corresponding regulatory audit plan is enclosed with this letter.

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

Sincerely,

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 JUNE 17–20, 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. STN 50-528, STN 50-529, AND STN 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 (Palo Verde), Units 1, 2, and 3. By letter dated July 6, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18187A417), as supplemented by letters dated October 18, 2018, March 1, 2019, and May 17, 2019 (ADAMS Accession Nos. ML18296A466, ML19060A298, and ML19137A118, respectively), 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 Palo Verde, 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 Palo Verde 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 Palo Verde fuel supply by providing for multiple fuel vendors with reliable fuel designs and geographically diverse manufacturing facilities.

The NRC staff conducted a regulatory audit on January 22-23, 2019 (ADAMS Accession No. ML19011A108), to enhance technical understanding of the submitted documentation. During this audit, the licensee made presentations in support of the LAR (ADAMS Accession No. ML19060A298). This audit helped the NRC staff to better understand the supporting documentation and analysis results through interaction with APS's technical experts and also helped to prepare the draft NRC staff's requests for additional information (RAIs). During this audit, the staff informed the licensee that a week-long audit of all the calculation notebooks and relevant documents related to the LAR will be conducted during June 17–20, 2019, at the plant site in Arizona. The proposed site 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).

Enclosure

2.0 REGULATORY AUDIT SCOPE

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

The scope of this regulatory audit includes a detailed discussion of the LAR, with focus items discussed in Section 3.0, "Information Needs," of this audit plan with the appropriate licensee or its contractor staff. During this audit the NRC staff intends to review the supporting methodology, supporting documents, and calculation notebooks used in the development of the LAR.

3.0 INFORMATION NEEDS

The licensee is requested to have the presentations and documents related to the areas of focus listed below. 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, are used to generate RAIs to complete the comprehensive review of the license amendment and exemption requests. The documents/calculations are listed in Section 3.1 of this audit plan. The relevant sections in the LAR for the documents/calculations are listed in parenthesis for each of the document.

3.1 List of Items for Audit Discussion and Review

3.1.1 Fuel Mechanical, Nuclear Design Analyses

1. Discussion/Presentation from licensee on the draft RAIs transmitted to the licensee on April 10 and May 20, 2019 (proprietary).

2. Fuel-mechanical design analysis for Framatome fuel (Section 2, Attachment 8 of the LAR dated July 6, 2018).

3. Fuel assembly mechanical compatibility of Framatome fuel with the resident fuel and core internals at Palo Verde (Section 2.2 of Attachment 8 of the LAR dated July 6, 2018).

4. Fuel rod analyses as described in Section 2.3.1 of Attachment 8 of the LAR dated July 6, 2018.

5. Documents or calculations of updated core reload analytical methods that have been fully implemented, validated in accordance with 10 CFR Part 50, Appendix B Software QA procedures, and exercised (on at least a sample core reload pattern).

3.1.2. Thermal Hydraulics

1. Detailed discussion on RAIs from the NRC staff on thermal-hydraulics analysis of the mixed core at Palo Verde following the Framatome HTP™ fuel transition.

2. Mechanical/Thermal-hydraulic compatibility of the three different fuel types (CE 16x16 STD (standard or value added), Framatome 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 Palo Verde, Units 1,2, and 3, after the potential fuel transition to Framatome fuel.

3. 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).

4. VIPRE-W modeling options, such as 1-pass and 2-pass models, as described in Section 5.1 of Attachment 8 of the LAR dated July 6, 2018, will require detailed review.

5. Discussion of any other issues related to thermal/hydraulic design of the mixed core.

3.1.3 Seismic Analysis for Mixed core

1. Discussion of 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 Palo Verde core.

3.1.4 Setpoints Analysis

1. Review of digital setpoints (COLSS (core operating limits supervisory system)/CPCS (core protection calculator)) system at Palo Verde, Units 1, 2, and 3, for mixed core with Framatome HTP™, Westinghouse NGF and Westinghouse STD fuel design.

2. When Palo Verde 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.

3.1.5 Non-Loss-of-Coolant Accident (LOCA) Transients

1. Calculational details of Palo Verde Loss of Flow Analysis.

2. 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.

3. Understanding of which transients utilize input from COPERNIC computer code.

4. Basis for use of convolution method for Framatome fuel.

5. Understanding of DNB probability distribution function for Framatome fuel and how it impacts applicable transient analysis.

6. Basis for continued use of DNB propagation analysis including evidence of strain behavior for Framatome fuel.

7. 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.

8. Understanding of how Framatome fuel parameters (Hgap (fuel-to-clad gap coefficient of conductance), Gadolinia effects) are accounted for in CENTS and HERMITE codes.

9. Understanding of how updated guidance on reactivity-initiated accidents will be addressed in the updated final safety analysis report (UFSAR) following the fuel transition.

3.1.6 Large Break and Small Break LOCA Analysis

1. Calculation reports supporting results and conclusions presented in large- and small-break LOCA licensing reports (ANP-3639P and ANP-3640P).

   a. Including loss of offsite power and offsite power available cases, reactor coolant pump trip cases, break locations, other sensitivity studies, etc.

2. For realistic large-break LOCA analysis, view documentation of statistical fidelity during implementation, selection of number of cases, initial seed, etc.

3. Representative S-RELAP5 input decks for limiting large- and small-break LOCA cases.

4. Capability to plot S-RELAP5 parameters from limiting large- and small-break LOCA cases upon request during audit (may be done remotely if necessary).

5. Review of system parameters and initial conditions for large- and small-break LOCA analysis.

6. Comparison of sampled parameter ranges with actual plant limits and data (e.g., axial shape index sample range versus current COLR values, linear heat generation rate sampling range basis (CE only), safety injection tank liquid volume maximum range for sampling versus UFSAR, Table 6.3.2-2, Revision 19, (ADAMS Accession No. ML17234A028), upper range of reactor coolant system flow.

7. Calculation results showing impact of predicted strain/rupture/relocation behavior.

3.1.7 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

3.2 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 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 on the NRC docket that would enable an accelerated and effective review of the LAR.

4.0 TEAM AND REVIEW ASSIGNMENTS

Area of Review	**Assigned Auditor**
Branch Chief	Shaun Anderson (NRC/NRR)
Technical Adviser	Paul Clifford (NRC/NRR)
Technical Reviewer	Joshua Kaizer (NRC/NRR)
Technical Reviewer	John Lehning (NRC/NRR)
Technical Reviewer	Diana Woodyatt (NRC/NRR)

5.0 LOGISTICS

The audit will be conducted at the Palo Verde site from June 17–20, 2019, starting at 8:30 a.m. Arizona 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 8:30 a.m. on Monday, June 17, 2019, and conclude on Thursday, June 20, 2019, at 4:30 p.m. approximately (subject to change).

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

June 17-20, 2019

8:30 a.m.	Entrance Meeting - Introductions, Audit Activities, Goals, and Logistics
8:45 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 Exit

6.0 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. Further, as a result of this audit, the staff will identify any open items. The staff will also document its understanding of the proposed resolution of any identified open items. The audit report will be provided to the licensee in draft form for proprietary markup. Additionally, the results of the audit will be utilized to focus the scope of any RAIs issued in the course of this review. The NRC final Regulatory Audit Report will be issued within 90 days of the completion of the audit.

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ADAMS Accession No.: ML19154A469 *by memorandum

OFFICE	NRR/DORL/LPL4/PM	NRR/DORL/LPL4/LA	NRR/DSS/SNPB/BC*
NAME	SLingam	PBlechman	RLukes
DATE	06/04/19	06/04/19	05/31/19
OFFICE	NRR/DSS/SRXB/BC(A)*	NRR/DORL/LPL4/BC	NRR/DORL/LPL4/PM
NAME	JBorromeo	RPascarelli (BSingal for)	SLingam
DATE	05/31/19	06/04/19	06/04/19

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