

June 20, 2017

MEMORANDUM TO: Robert J. Pascarelli, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

FROM: Robert G. Lukes, Chief */RA/*
Nuclear Performance and Code Review Branch
Division of Safety Systems
Office of Nuclear Reactor Regulation

SUBJECT: NUCLEAR PERFORMANCE AND CODE REVIEW BRANCH
SAFETY EVALUATION INPUT FOR AMEREN MISSOURI
REQUEST TO AMEND CALLAWAY PLANT, UNIT 1,
TECHNICAL SPECIFICATION 5.6.5, "CORE OPERATING
LIMITS REPORT" (TAC NO. MF8463)

By letter dated October 11, 2016, Ameren Missouri, the licensee for Callaway Plant, Unit 1, proposed to amend the facility Technical Specification Section 5.6.5, "Core Operating Limits Report" as necessary to add references to WCAP-16045-P-A, "Qualification of the Two-Dimensional Transport Code PARAGON," WCAP-16045-P-A, Addendum 1-A, "Qualification of the NEXUS Nuclear Data Methodology," and WCAP-10965-P-A, Addendum 2-A, "Qualification of the New Pin Power Recovery Methodology."

The Nuclear Performance and Code Review Branch (SNPB) has reviewed the proposed change and determined that it is acceptable. The enclosed safety evaluation presents the basis for the staff's finding. This concludes SNPB review efforts under TAC No. MF8463.

Enclosure:
As stated

CONTACTS: Daniel Beacon, NRR/DSS/SNPB
301-415-2820

R. Pascarelli

SUBJECT: NUCLEAR PERFORMANCE AND CODE REVIEW BRANCH SAFETY
EVALUATION INPUT FOR AMEREN MISSOURI REQUEST TO AMEND CALLAWAY
PLANT, UNIT 1, TECHNICAL SPECIFICATION 5.6.5, "CORE OPERATING LIMITS REPORT"
(TAC NO. MF8463) Dated: June 20, 2017

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*via email

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NAME	DBeacon	BParks*	RLukes
DATE	06/20/17	06/19/17	06/20/17

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**NUCLEAR PERFORMANCE AND CODE REVIEW BRANCH SAFETY EVALUATION INPUT
FOR AMEREN MISSOURI REQUEST TO AMEND CALLAWAY PLANT, UNIT 1, TECHNICAL
SPECIFICATION 5.6.5, "CORE OPERATING LIMITS REPORT"**

(TAC NO. MF8463)

1.0 INTRODUCTION

By letter dated October 11, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16286A553), Ameren Missouri (Ameren), the licensee for Callaway Plant, Unit 1 (Callaway), proposed to amend the Callaway facility operating license as necessary to add three references to Technical Specification (TS) 5.6.5, "Core Operating Limits Report (COLR)." These references include WCAP-16045-P-A, "Qualification of the Two-Dimensional Transport Code PARAGON" (ADAMS Accession No. ML042250345), WCAP-16045-P-A, Addendum 1-A, "Qualification of the NEXUS Nuclear Data Methodology" (ADAMS Accession No. ML072570352), and WCAP-10965-P-A, Addendum 2-A, "Qualification of the New Pin Power Recovery Methodology" (ADAMS Accession No. ML091560106). The proposed references will replace the PHOENIX-P methodology, described in WCAP-11596-P-A, "Qualification of the PHOENIX-P/ANC Nuclear Design System for Pressurized Water Reactor Cores" (ADAMS Accession No. ML080630391).

2.0 REGULATORY EVALUATION

The guidance in U.S. Nuclear Regulatory Commission (NRC) Generic Letter (GL) 88-16, "Removal of Cycle-Specific Parameter Limits from Technical Specifications," indicates that it is acceptable for licensees to control reactor physics parameter limits by specifying an NRC-approved calculation methodology. These parameter limits may be removed from the TS and placed in a cycle-specific COLR, which is defined in the TS and required to be submitted to the NRC every operating cycle or each time it is revised. As recommended by GL 88-16, the Callaway TS includes a list of references for the NRC-approved calculation methodologies used to generate the cycle-specific operating limits. The TS changes requested by Ameren are changes to this reference list.

Since the specified topical reports comprise a nuclear data methodology, there are no directly applicable regulatory requirements. The NRC safety evaluations (SEs) that provide generic approval for use of WCAP-16045-P-A, its addendum, and WCAP-19065-P-A, Addendum 2-A, cite Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Section 50.34, "Contents of Applications; Technical Information" as their regulatory basis. This is appropriate, as accurate nuclear analysis forms an integral part of the safety analysis required to be provided by licensees and applicants. Similarly, these safety analyses are used to establish the limiting safety system settings (LSSS) and limiting conditions for operation (LCOs) contained in the TS. Therefore, 10 CFR 50.36, "Technical Specifications," also applies; without an accurate nuclear

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analysis, it cannot be established that the LCOs and LSSS provide for the safe operation of the facility.

3.0 TECHNICAL EVALUATION

3.1 Methodology Description

The PARAGON code, as described in WCAP-16045-P-A, is a neutron transport code intended to replace PHOENIX-P for use in providing cross section data to the Westinghouse proprietary Advanced Nodal Code (ANC), a core simulator code. NEXUS, described in WCAP-16045-P-A, Addendum 1-A, is an improvement to the PARAGON/ANC code system that changes the method of communicating the nuclear data output from PARAGON to ANC. Rather than using boron letdown curves, NEXUS accounts for variations in the neutron spectrum by parameterizing the PARAGON cross section output and reconstructing it within ANC. As discussed in the NRC staff SE approving the use of PARAGON and NEXUS at the Joseph M. Farley Nuclear Plant (ADAMS Accession No. ML13149A354), the NEXUS methodology provides a link between PARAGON and ANC without replacing either, and therefore still requires the use of both other codes.

In WCAP-16045-P-A, Addendum 1-A, the original verification was expanded to include the comparison of NEXUS results for critical boron concentration to those obtained using the previous PARAGON methodology, showing excellent agreement between NEXUS predictions and available data.

WCAP-19065-P-A, Addendum 2-A details an improved methodology for reconstructing individual pin power distributions in ANC. This methodology addresses shortcomings of the previous methodology, allowing the effects of control rod insertion on pin power to be tracked. Specific details regarding the technique used can be found in the proprietary version of the approved topical report.

Each of the methodologies to be added to Callaway TS 5.6.5 are NRC-approved, and have been extensively validated and verified using a variety of experiments and plant data that account for a wide range of differences in operating conditions.

3.2 Applicability to Callaway

The NRC staff reviewed the Updated Final Safety Analysis Report (UFSAR) for Callaway to verify that the fuel in use is covered by the verification and validation database for PARAGON, NEXUS, and ANC, as amended by Addendum 2-A. Callaway UFSAR Chapter 4, "Reactor," indicates that the unit may use any combination of 17x17 Westinghouse Standard, Optimized, VANTAGE 5, VANTAGE 5+ and Performance+ fuel designs including integral fuel burnable absorbers, intermediate flow mixer grids, Westinghouse Integral Nozzle top nozzles, standardized debris filter bottom nozzles, extended burnup capability (within licensed limits), and axial blankets. Based on this review, the NRC staff determined that all of the design features of the fuel in use at Callaway are adequately represented in the qualification of the PARAGON/NEXUS system and the NEXUS/ANC9 pin power reconstruction methodology. Therefore, the staff finds these methodologies acceptable for use at Callaway.

A single limitation imposed by the SEs for both PARAGON and NEXUS precludes their use for mixed oxide (MOX) cores. Callaway TS 4.2.1, "Fuel Assemblies," specifies the initial

composition of the fuel assemblies to be “natural or slightly enriched uranium dioxide as fuel material.” The MOX limitation is therefore inherently satisfied for Callaway.

A limitation is also specified in the SE for the NEXUS/ANC9 pin power reconstruction methodology. The limitation specifies that the methodology must be used in conjunction with the PARAGON/NEXUS code system on which it relies. Since this license amendment requests the use of all three methodologies, this limitation is also inherently satisfied. The NRC staff has therefore determined that the NRC-approved methodologies described in WCAP-16045-P-A, WCAP-16045-P-A, Addendum 1-A, and WCAP-19065-P-A, Addendum 2-A are applicable to Callaway.

The originally proposed amendment would preserve both the current PHOENIX-P/ANC nuclear design methodology and the new PARAGON-NEXUS/ANC nuclear design methodology in the licensee’s TS. By leaving both the current and proposed methodologies in the TS, the proposed amendment leaves open the possibility that either methodology could be used to calculate the core operating limits addressed in the COLR, effectively creating a new, ambiguous methodology. The NRC staff issued an RAI requesting the licensee to propose a revision to the license amendment request (LAR) that provides for a single, unambiguous method to determine how the core operating limits discussed in the submittal will be calculated. Ameren responded to the RAI in a letter (ADAMS Accession no. ML17138A213) dated May 18, 2017. Additionally, as indicated in the RAI response, Ameren provided a supplement to the LAR (ADAMS Accession no. ML17153A277) on June 2, 2017. The supplement included new marked-up and retyped TS pages that removed the WCAP-11596-P-A methodology from the proposed wording, specifying a single unambiguous methodology.

This satisfies the GL 88-16 requirement for licensees to use NRC-approved methods to determine core operating limits. Furthermore, the applicability of the generic qualification helps to establish that nuclear design analyses performed for Callaway using the methods described will be reasonably accurate, consistent with the 10 CFR 50.34 requirements for safety analyses. Accuracy of the nuclear analysis also helps ensure the adequacy of the TS LCOs and LSSS to provide for the safe operation of the facility, consistent with the requirements of 10 CFR 50.36.

3.3 Additional Review Topics

The addendum to WCAP-16045-P-A brings about a change to the way boron letdown curves are calculated and input into the overall nuclear design method. Because of this, the NRC staff determined that it was necessary to verify that no changes were made to the analysis methods for post-loss of coolant accident (LOCA) subcriticality and boric acid precipitation behavior. A RAI was issued requesting Ameren to verify this statement. In response, Ameren verified that the use of WCAP-16045-P-A, Addendum 1-A, does not affect the inputs of methods for ensuring post-LOCA core subcriticality. Additionally, the response confirmed that the boric acid precipitation behavior remains unaffected since neither the boron source concentration nor the heat generation are impacted.

The NRC staff determined that the response was acceptable, as it confirmed that the implementation of PARAGON-NEXUS/ANC at Callaway would not affect the calculation of post-LOCA boron requirements or emergency procedures to mitigate post-LOCA boric acid precipitation. Therefore, the NRC staff concluded that the existing post-LOCA analyses for subcriticality and long-term cooling remain applicable.

4.0 CONCLUSION

The NRC staff has determined that the proposed TS changes required to replace the PHOENIX-P code system with the PARAGON/NEXUS code system, as supplemented, are acceptable for Callaway. This determination is based on the following considerations: (1) that PARAGON and NEXUS are NRC-approved methods which have been determined to be applicable to Callaway and (2) that the Callaway post-LOCA subcriticality and boric acid precipitation analyses will be unaffected by the proposed changes. Additionally, the staff has determined that the adoption of the NEXUS/ANC9 pin power reconstruction methodology is acceptable for Callaway when used in conjunction with the PARAGON/NEXUS code system. Therefore, the NRC staff concluded that the proposed TS revision is consistent with the guidance provided in GL 88-16, and that the generic qualification and robust validation of the PARAGON-NEXUS/ANC system satisfy the requirements of 10 CFR 50.34 and 10 CFR 50.36.