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

February 23, 2016

Mr. Edward D. Halpin
Senior Vice President and
Chief Nuclear Officer
Pacific Gas and Electric Company
Diablo Canyon Power Plant
P.O. Box 56, Mail Code 104/6
Avila Beach, CA 93424

SUBJECT: DIABLO CANYON POWER PLANT, UNITS 1 AND 2 - REGULATORY AUDIT REPORT FOR THE JANUARY 12, 2016 AUDIT AT THE WESTINGHOUSE FACILITY IN NORTH BETHESDA, MARYLAND, FOR THE LICENSE AMENDMENT REQUEST ASSOCIATED WITH REVISING UFSAR FOR BEACON POWER DISTRIBUTION MONITORING SYSTEM METHODOLOGY (CAC NOS. MF6120 AND MF6121)

Dear Mr. Halpin:

By letter dated April 16, 2015, Pacific Gas and Electric Company (PG&E, the licensee) submitted a license amendment request (LAR) to revise the Best Estimate Analyzer for the Core Operations-Nuclear (BEACON) power distribution monitoring system methodology described in the Updated Final Safety Analysis Report (UFSAR) Section 4.3.2.2, "Power Distribution," to the method described in the Westinghouse Electric Company LLC (Westinghouse) proprietary topical report (TR) WCAP-12472-P-A, Addendum 4, "BEACON Core Monitoring and Operation Support System," for Diablo Canyon Power Plant (DCPP), Units 1 and 2. This LAR also proposes to revise Technical Specification (TS) 5.6.5, "CORE OPERATING LIMITS REPORT (COLR)," Section b to replace the Westinghouse proprietary TR WCAP-11596-P-A, "Qualification of the PHOENIX-P/ANC Nuclear Design System for Pressurized Water Reactor Cores," with U.S. Nuclear Regulatory Commission (NRC)-approved proprietary TR WCAP-16045-P-A, "Qualification of the Two-Dimensional Transport Code PARAGON," and NRC-approved proprietary TR WCAP-16045-P-A, Addendum 1-A, "Qualification of the NEXUS Nuclear Data Methodology."

The NRC staff conducted a regulatory audit at the Westinghouse facility in North Bethesda, Maryland, on January 12, 2016, in order to gain a better understanding of the licensee's BEACON LAR for DCPP, Units 1 and 2. The enclosure to this letter describes the results of the NRC staff's audit.

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. 50-275 and 50-323

Enclosure:
Audit Report

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REGULATORY AUDIT REPORT PERFORMED AT WESTINGHOUSE FACILITY ON JANUARY 12, 2016 IN SUPPORT OF THE BEST ESTIMATE ANALYZER FOR THE CORE OPERATIONS-NUCLEAR POWER DISTRIBUTION MONITORING SYSTEM METHODOLOGY LICENSE AMENDMENT PACIFIC GAS AND ELECTRIC COMPANY DIABLO CANYON POWER PLANT, UNITS 1 AND 2 DOCKET NOS. 50-275 AND 50-323

1.0 BACKGROUND

By letter dated April 16, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15107A333), Pacific Gas and Electric Company (PG&E, the licensee) submitted a license amendment request (LAR) to revise the Best Estimate Analyzer for the Core Operations-Nuclear (BEACON) power distribution monitoring system (PMDS) methodology described in the Updated Final Safety Analysis Report (UFSAR) Section 4.3.2.2, "Power Distribution," to the method described in the Westinghouse Electric Company LLC (Westinghouse or WEC) proprietary topical report (TR) WCAP-12472-P-A, Addendum 4, "BEACON Core Monitoring and Operation Support System," for Diablo Canyon Power Plant (DCPP), Units 1 and 2. This LAR also proposes to revise Technical Specification (TS) 5.6.5, "CORE OPERATING LIMITS REPORT (COLR)," Section b to replace the Westinghouse proprietary TR WCAP-11596-P-A, "Qualification of the PHOENIX-P/ANC Nuclear Design System for Pressurized Water Reactor Cores," with U.S. Nuclear Regulatory Commission (NRC)-approved proprietary TR WCAP-16045-P-A, "Qualification of the Two-Dimensional Transport Code PARAGON," and NRC-approved proprietary TR WCAP-16045-P-A, Addendum 1-A, "Qualification of the NEXUS Nuclear Data Methodology."

The NRC staff conducted a regulatory audit at the Westinghouse facility in North Bethesda, Maryland, on January 12, 2016, in order to gain a better understanding of the licensee's BEACON LAR. Information gathered during this audit will aid NRC's evaluation of the proposed BEACON LAR.

The following NRC staff members participated in the audit:

- Margaret Watford – Project Manager
- Fred Forsaty – Lead technical reviewer

Enclosure

PG&E was represented by the following personnel:

- Jay Lesko – PG&E
- Ken Schrader – PG&E
- Jim Andrachek - WEC
- Bill Boyd – WEC

2.0 AUDIT REPORT

To facilitate an expedited review of the BEACON LAR and to develop a clear understanding of the information provided by the licensee, a regulatory audit, consistent with the audit plan dated December 24, 2015 (ADAMS Accession No. ML15355A157), was conducted on January 12, 2016.

2.1 Technical Issues Discussed During Audit

The audit team focused on the following items:

- History of changes related to the present LAR topic.

By letter dated March 31, 2004, NRC approved license Amendments Nos. 164 and 166 for DCPP, Units 1 and 2, respectively, which included approval of BEACON WCAP-12472-P-A, Addendum 0 as a methodology referenced in the TS bases (ADAMS Accession No. ML040920245). Addendum 0 used an early nodal code called SPNOVA.

By letter dated January 9, 2013, NRC approved license Amendment Nos. 214 and 216 for DCPP, Units 1 and 2, respectively, which revised DCPP UFSAR Section 4.3.2.2, "Power Distribution," to allow use of the Westinghouse BEACON PMDS methodology as described in WCAP-12472-P-A, Addendum 1-A (ADAMS Accession No. ML12345A379). Addendum 1-A replaced SPNOVA with a 3-dimensional (3D) advanced nodal code (ANC) called Phoenix-P/ANC.

By letter dated April 16, 2015, PG&E submitted an LAR to use WCAP-12472-P-A, Addendum 4, which would provide further refinement to BEACON PMDS methodology currently in use. Specifically, Addendum 4 provides information needed to review and approve updated thermocouple uncertainty analysis process that will be applied in the BEACON on-line core monitoring system.

WCAP-12472-P-A, Addendum 4, also affirms the continued use of NRC-approved Westinghouse designed model methodologies, which are PHOENIX-P/ANC, PARAGON/ANC, and NEXUS/ANC in the BEACON system. DCPP currently uses PHOENIX-P/ANC methodology (approved in Addendum 1-A). By letters dated March 18, 2004, and February 23, 2007, the NRC found PARAGON/ANC and NEXUS/ANC methodologies acceptable for use in the BEACON system (ADAMS Accession Nos. ML040780402 and ML070320398, respectively). The current BEACON LAR requests NRC approval for use of PARAGON/ANC and NEXUS/ANC methodologies at DCPP.

- DCPP's plant-specific information that impacts the PDMS.

The licensee explained that the PDMS requires information on current plant and core conditions at DCPP in order to determine the core power distribution using the core peaking factor measurements and measurement uncertainty methodology. Core and plant condition information is used as input to the continuous core power distribution measurement software that automatically determines the current core peaking factors. The core power distribution calculation software provides the measured peaking factor values at nominal 1-minus intervals to allow operators to confirm that the core peaking factors are within design limits. The licensee stated that in order for PDMS to accurately determine the peaking factor values, the core power distribution measurement software requires accurate information about the current reactor power level, average reactor vessel inlet temperature, control bank positions, power range detector currents, and the core exit thermocouples.

- Present Core Monitoring System at DCPP.

The licensee explained the two methods for performing core power distribution calculations at DCPP: BEACON and moveable in-core detector system (MIDS). Both can be used to satisfy core peaking TS surveillance requirements.

The BEACON system provides on-line monitoring of the core using current plant instrumentation. Excore neutron detectors and core exit thermocouples are used with three-dimensional (3D) calculated power distribution on a nearly continuous basis. Generation of 3D power distribution involves periodic calibration of BEACON (using MIDS) and frequent processing of excore neutron detector and core exit thermocouple readings. The BEACON system also allows processing of MIDS flux map data and can provide core depletion and fuel isotopic distribution information by calculating 3D power distributions and associated neutron flux distributions. BEACON can be used to provide core reactivity calculations, such as critical conditions and shutdown margin, in order to meet TS requirements and can provide load follow simulations.

- Core exit thermocouple design at DCPP and justification that the updated thermocouple evaluation process (in Addendum 4) is applicable to DCPP.

The licensee confirmed that the core exit thermocouple design configuration at DCPP is typical of Westinghouse plants. Westinghouse stated in the LAR, that this thermocouple uncertainty methodology is only applied to plants with MIDS.

- Failures of thermocouples at DCPP.

The licensee stated that calibration and generation of thermocouple mixing factors are done during the initial startup of the cycle when the maximum number of thermocouples are available. When thermocouples are taken out of service or fail, they are removed from the thermocouple geometry and the BEACON system performs its power distribution adjustments with the reduced thermocouple set. Average thermocouple standard deviation and peaking factor uncertainties are then based on the remaining available thermocouples. As the number of

available thermocouples is reduced, the measurement uncertainties increase. Individual thermocouple mixing factors are not influenced by other thermocouples being removed from service.

The licensee explained two ways thermocouples can be identified as failed and removed from the BEACON system input. The BEACON system is continuously verifying that each thermocouple temperature is within a broad operating range of the coolant exit temperature. If the thermocouple temperature is outside this range, the BEACON system will automatically remove the violating thermocouple data for the input set. Failed thermocouples result in an output temperature reading of 0 degrees. Also, the individual thermocouple data can be easily removed from the BEACON input set by the user. If it is determined that a core monitoring anomaly or deviation in the flux map analysis results is being caused by thermocouple temperature deviation that is not consistent with current core conditions, the user can remove the thermocouples from service through BEACON system user interface.

- Changes to the BEACON core monitoring system software and the software quality control process.

The licensee stated that the BEACON core monitoring system is controlled by vendor software quality control process. DCPP follows configuration management and recommendations supplied by the vendor.

- Information and requirements currently in WCAP-12472-P-A, Addendum 1-A versus Addendum 4.

The licensee stated that all of the information and requirements in Addendum 1-A are also in Addendum 4.

- Comparison of updated power-dependent thermocouple standard deviation and uncertainly methodology between methods using DCPP-specific cycle/power dependent data and plant-specific implementation of the methodology.

The licensee stated that the measured peaking factor uncertainty is lower at reduced powers when using the power dependent thermocouple methodology. Results are consistent with those documented for the sample plants used in Addendum 4 of WCAP-12472-P-A.

- Description and justification of fuel types to be utilized at DCPP.

The licensee stated that DCPP has utilized both 17x17 standard fuel and 17x17 optimized fuel in the core reload design and that both of these fuel types are part of the analyzed fuel types for the new methods and codes. Currently, DCPP is using optimized fuel design.

Other Items:

The licensee confirmed that it meets all the provisions listed in Section 4.0, "Limitations and Conditions," in NRC's safety evaluation for NEXUS nuclear data methodology. The NEXUS/ANC code system is limited to uranium-fueled, pressurized-water reactor applications

and has not been approved for mixed-oxide fuel applications. The licensee stated that DCPP has enriched uranium dioxide fuel material and not mixed-oxide fuel.

2.2 Exit Meeting

During the exit meeting on January 12, 2016, the NRC staff stated that the audit helped to better understand areas of the licensee's submittal, and provided information pertinent to resolution for several NRC requests for additional previously transmitted to the licensee. There was open communication throughout the audit and it was conducted in accordance with the audit plan with no known deviations. At this time, NRC staff does not anticipate requesting any additional information from the licensee in order to complete its technical review of the BEACON LAR.

Date of Issuance: February 23, 2016

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

Sincerely,

/RA/

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

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Enclosure:
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ADAMS Accession No.: ML16053A323 *Audit Summary by memo

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DATE	2/23/2016	2/23/2016	2/18/2016
OFFICE	NRR/DORL/LPL4-1/BC	NRR/DORL/LPL4-1/PM	
NAME	RPascarelli	SLingam	
DATE	2/23/2016	2/23/2016	

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