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

December 18, 2013

Mr. Anthony Vitale
Vice President, Operations
Entergy Nuclear Operations, Inc.
Palisades Nuclear Plant
27780 Blue Star Memorial Highway
Covert, MI 49043-9530

SUBJECT: PALISADES NUCLEAR PLANT – UPDATED REACTOR VESSEL FLUENCE EVALUATION SUPPORTING A REVISED PRESSURIZED THERMAL SHOCK SCREENING CRITERIA LIMIT (TAC NO. MF2326)

Dear Mr. Vitale:

By letter dated June 25, 2013, Entergy Nuclear Operations, the licensee for the Palisades Nuclear Plant, requested revision to the facility licensing basis. The proposed change would incorporate an updated fluence calculation that reflects recent actual reactor operation. The updated fluence calculation would extend the date that Palisades is projected to reach the pressurized thermal shock (PTS) screening criterion as defined in Title 10 of the *Code of Federal Regulations*, Part 50, Section 61 (10 CFR 50.61).

Previously, Entergy projected that Palisades would reach the PTS screening criterion in April 2017. Based on the updated fluence calculation, Entergy projects that the PTS screening criterion would not be reached until August 2017.

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the updated fluence calculations. Because the calculations were performed using methods that are adherent to NRC Regulatory Guide 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence," the NRC staff determined that they are acceptable. Based on this consideration, the staff determined that the revision to August 2017 for Palisades to reach the PTS screening criterion is acceptable.

If you have any questions regarding this matter, please call me at (301) 415-8371.

Sincerely,

Mahesh Chawla, Project Manager
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-255

Enclosure: Safety Evaluation

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO UPDATED REACTOR VESSEL NEUTRON FLUENCE CALCULATIONS

SUPPORTING A NEW PRESSURIZED THERMAL SHOCK SCREENING CRITERION DATE

ENTERGY NUCLEAR OPERATIONS

PALISADES NUCLEAR PLANT

DOCKET NO. 50-255

1.0 INTRODUCTION

By letter dated June 25, 2013 (Agencywide Document Accession and Management System (ADAMS) Accession Number ML13176A412), Entergy Nuclear Operations (Entergy, the licensee), requested revision to the licensing basis for the Palisades Nuclear Plant (Palisades).

The proposed change would incorporate an updated fluence calculation that reflects recent actual reactor operation. The updated fluence calculation would extend the date that Palisades is projected to reach the pressurized thermal shock (PTS) screening criterion as defined in Title 10 of the *Code of Federal Regulations* (CFR), Part 50, Section 61 (10 CFR 50.61). Previously, Entergy projected that Palisades would reach the PTS screening criterion in April 2017. Based on the updated fluence calculation, Entergy projects that the PTS screening criterion would not be reached until August 2017.

2.0 REGULATORY EVALUATION

Entergy submitted updated fluence calculations to revise the date at which Palisades would exceed the PTS screening criterions. This date is significant because, among the options available when a plant is projected to exceed the PTS screening criterion, the licensee may submit a safety analysis, which must be submitted three years prior to the date that the plant is projected to exceed the PTS screening criterion. The regulatory requirements related to PTS are summarized in Section 2.1; Section 2.2 discusses the regulatory guidance applicable to fluence calculations.

2.1 PRESSURIZED THERMAL SHOCK REQUIREMENTS

The U.S. Nuclear Regulatory Commission (NRC) promulgated fracture toughness requirements for protection against pressurized thermal shock events at 10 CFR 50.61. Pursuant to 10 CFR 50.61(b)(1), pressurized water reactor (PWR) licensees must establish a value for the reference temperature for PTS, RT_{PTS}, accepted by the NRC, for each reactor vessel beltline material. Paragraph (b)(2) of 10 CFR 50.61 establishes the PTS screening criterion as 270°F for plates, forgings, and axial weld materials, and 300°F for circumferential weld materials, and also

requires that the value of RT_{PTS} must be determined for each vessel beltline material using the end of license (EOL) fluence for that material.

Paragraph (b)(3) of 10 CFR 50.61 requires each PWR licensee to implement flux reduction programs that are reasonably practicable to avoid exceeding the PTS screening criterion, if the value of RT_{PTS} for any material in the beltline is projected to exceed the PTS screening criterion using the EOL fluence. This paragraph also states that the schedule for implementation of flux reduction measures may take into account the schedule for submittal and anticipated NRC approval of detailed plant-specific analyses, submitted to demonstrate acceptable risk with RT_{PTS} above the screening limit due to plant modification, new information, or new analysis techniques.

If the analysis required by 10 CFR 50.61(b)(3) indicates that no reasonably practicable flux reduction program will prevent RT_{PTS} from exceeding the PTS screening criterion using the EOL fluence, 10 CFR 50.61(b)(4) requires the licensee to submit a safety analysis to determine what, if any, modifications to equipment, systems, and operation are necessary to prevent potential failure of the reactor vessel as a result of postulated PTS events if continued operation beyond the screening criterion is allowed. This analysis must be submitted at least three years before RT_{PTS} is projected to exceed the PTS screening criterion.

2.2 REACTOR VESSEL NEUTRON FLUENCE CALCULATIONS

In the present licensing action request, Entergy proposes to revise the date that the PTS screening criterion is projected to be exceeded based on more accurate fluence calculations. The NRC has published regulatory guidance for acceptable fluence calculations in Regulatory Guide (RG) 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence." The calculations of the pressure vessel fluence consist of the following steps: (1) determination of the geometrical and material input data, (2) determination of the core neutron source, (3) propagation of the neutron fluence from the core to the vessel and into the cavity, and (4) qualification of the calculational procedure.

The source and transport calculations used to determine the Palisades reactor vessel fluence are described in the following documents:

- Plant-specific calculations, including the source approximation, are described in WCAP-15353, "Palisades Reactor Vessel Neutron Fluence Evaluation," including Supplements 1 and 3 (ML003686582, ML110060695, and Attachment 1 to ML13176A142).
- Neutron transport methods are described in NRC-approved WCAP-14040-A, Revision 4, "Methodology Used to Develop Cold Overpressure Mitigating System Setpoints and RCS Heatup and Cooldown Limit Curves" (ML050120209).
- A technique that was used to reduce variance in the calculated flux spectrum to facilitate comparison to measured data is described in NRC-approved WCAP-16083-NP-A, "Benchmark Testing of the FERRET Code for Least Squares Evaluation of Light Water Reactor Dosimetry" (ML061600256).

The NRC notes that both WCAP-14040-A and WCAP-16083-NP-A are generically approved, and safety evaluations appearing in each reflect the NRC staff determination that each is acceptable for referencing in licensing requests. Furthermore, WCAP-15353 and WCAP-15353,

Supplement 1, have been reviewed by the NRC staff, and the NRC determined that each was acceptable, having been performed according to RG 1.190-adherent methodology.

3.0 TECHNICAL EVALUATION

The fluence evaluation discussed in Supplement 3 to WCAP-15353 is summarized as follows (WCAP-15353 – Supplement 3 – NP, Page 1-2):

> In this supplement, the neutron fluence accrued by the limiting Weld W5214 during Cycles 21 through 26 is re-evaluated using revised neutron flux calculations and fuel cycle lengths and based on this re-evaluation an updated time at which the PTS screening limit will be reached is determined.

The neutron exposure is calculated as a synthesized three-dimensional neutron flux distribution. The synthesis is performed using lower-dimension transport solutions in azimuthal, axial, and radial geometry. The two-dimensional Discrete Ordinates Radial Transport code is used, as is the BUGLE-96 cross section library. Anisotropic scattering is treated with P_5 Legendre expansion; angular discretization was modeled with an S_{16} order of angular quadrature.

The NRC staff evaluated the fluence calculations to determine whether they adhere to the guidance contained in RG 1.190. The synthesis is consistent with an acceptable approach described in RG 1.190. The BUGLE-96 cross section library is based on ENDF/B-VI nuclear data, which are acceptable in accordance with RG 1.190. The polynomial expansion and angular discretization exceed the P_3 and S_8 guidance described in RG 1.190. Based on the adherence of the calculations to the guidance contained in RG 1.190, the staff determined that the calculations are acceptable.

The methods used to calculate the reactor vessel neutron fluence have been qualified as described in WCAP-14040-A, Revision 4, and also using plant-specific surveillance capsule dosimetry (WCAP-15353, Revision 0, ML003686582, accepted by NRC Safety Evaluation dated November 14, 2000, ML003768794). Since the revised fluence evaluation relies on previously approved methods, and merely updates the core neutron source to reflect more recent operating cycles, the NRC staff did not address the methodology qualification in the present review.

Since the licensee has revised the projected date that the PTS screening criterion will be reached, based on the use of acceptable fluence calculations, the NRC staff concluded that the revised date is acceptable.

4.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) there is reasonable assurance that such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the

amendments will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributor: Benjamin Parks

If you have any questions regarding this matter, please call me at (301) 415-8371.

Sincerely,

/RA/

Mahesh Chawla, Project Manager
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-255

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