



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

July 19, 2022

Mr. Tom Simril  
Site Vice President  
Catawba Nuclear Station  
Duke Energy Carolinas, LLC  
4800 Concord Road  
York, SC 29745

Mr. Edward Pigott  
Site Vice President  
McGuire Nuclear Station  
Duke Energy Carolinas, LLC  
12700 Hagers Ferry Road  
Huntersville, NC 28078

SUBJECT: CATAWBA NUCLEAR STATION, UNITS 1 AND 2, AND MCGUIRE NUCLEAR STATION, UNITS 1 AND 2 – ISSUANCE OF AMENDMENTS TO REVISE THE CONDITIONAL EXEMPTION OF THE END-OF-CYCLE MODERATOR TEMPERATURE COEFFICIENT MEASUREMENT METHODOLOGY (EPID L-2021-LLA-0198)

Dear Mr. Simril and Mr. Pigott:

The Nuclear Regulatory Commission (NRC, the Commission) has issued the enclosed Amendment No. 313 and 309 to Renewed Facility Operating License NPF-35 and NPF-52 for the Catawba Nuclear Station, Units 1 and 2, respectively, and Amendment Nos. 323 and 302 to Renewed Facility Operating License Nos. NPF-9 and NPF-17 for the McGuire Nuclear Station, Units 1 and 2, respectively. The amendments are in response to your application dated October 25, 2021, as supplemented by letter dated April 7, 2022.

The amendments revise the conditional exemption of the end-of-cycle moderator temperature coefficient measurement methodology which removes the incore quadrant power tilt conditional exemption acceptance criterion, adds an alternate approach for calculating the most negative moderator temperature coefficient (MTC) (i.e., the safety analysis MTC analysis value), and modifies the power distribution reaction rate failure criterion to prevent a false positive (criterion exceeded) due to an instrument issue.

<p><b>Enclosure 5 to this letter contains proprietary information. When separated from Enclosure 5, this document is DECONTROLLED.</b></p>
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T. Simril and E. Pigott

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The NRC has determined that the related safety evaluation (SE) contains proprietary information pursuant to Title 10 of the *Code of Federal Regulations* Section 2.390, "Public inspections, exemptions, requests for withholding." The proprietary information is indicated by text enclosed within double brackets. Accordingly, the NRC staff has also prepared a non-proprietary publicly available version of the SE, which is provided as Enclosure 6. The proprietary version of the SE is provided as Enclosure 5.

A Notice of Issuance will be included in the Commission's monthly *Federal Register* notice.

If you have any questions, please contact me at 301-415-0615 or by e-mail at [Zackary.Stone@nrc.gov](mailto:Zackary.Stone@nrc.gov).

Sincerely,

/RA/

Zackary Stone, Project Manager  
Plant Licensing Branch II-1  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket Nos. 50-413, 50-414, 50-369, and 50-370

Enclosures:

1. Amendment No. 313 to NPF-35
2. Amendment No. 309 to NPF-52
3. Amendment No. 323 to NPF-9
4. Amendment No. 302 to NPF-17
5. Safety Evaluation (proprietary)
6. Safety Evaluation (non-proprietary)

cc w/Enclosure 1, 2, 3, 4, and 6: Listserv

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

DUKE ENERGY CAROLINAS, LLC

NORTH CAROLINA ELECTRIC MEMBERSHIP CORPORATION

DOCKET NO. 50-413

CATAWBA NUCLEAR STATION, UNIT 1

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 313  
Renewed License No. NPF-35

1. The Nuclear Regulatory Commission (NRC, the Commission) has found that:
  - A. The application for amendment to the Catawba Nuclear Station, Unit 1 (the facility) Renewed Facility Operating License No. NPF-35 filed by the Duke Energy Carolinas, LLC, acting for itself, and North Carolina Electric Membership Corporation (the licensees), dated October 25, 2021, as supplemented by letter dated April 7, 2022, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations as set forth in 10 CFR Chapter I;
  - B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;
  - C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations set forth in 10 CFR Chapter I;
  - D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and
  - E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, by Amendment No. 313, Renewed Facility Operating License No. NPF-35, is hereby amended to accept the revision of the conditional exemption of the end-of-cycle moderator temperature coefficient measurement methodology as described in the application and supplement.
3. This license amendment is effective as of its date of issuance and shall be implemented by the completion of refueling outage C1R27 (Spring 2023).

FOR THE NUCLEAR REGULATORY COMMISSION

***/RA - S. Williams for/***

Michael T. Markley, Chief  
Plant Licensing Branch II-1  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Date of Issuance: July 19, 2022



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

DUKE ENERGY CAROLINAS, LLC

NORTH CAROLINA MUNICIPAL POWER AGENCY NO. 1

PIEDMONT MUNICIPAL POWER AGENCY

DOCKET NO. 50-414

CATAWBA NUCLEAR STATION, UNIT 2

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 309  
Renewed License No. NPF-52

1. The Nuclear Regulatory Commission (NRC, the Commission) has found that:
  - A. The application for amendment to the Catawba Nuclear Station, Unit 2 (the facility) Renewed Facility Operating License No. NPF-52 filed by the Duke Energy Carolinas, LLC, acting for itself, North Carolina Municipal Power Agency No. 1 and Piedmont Municipal Power Agency (the licensees), dated October 25, 2021, as supplemented by letter dated April 7, 2022, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations as set forth in 10 CFR Chapter I;
  - B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;
  - C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations set forth in 10 CFR Chapter I;
  - D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and
  - E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, by Amendment No. 309, Renewed Facility Operating License No. NPF-52, is hereby amended to accept the revision of the conditional exemption of the end-of-cycle moderator temperature coefficient measurement methodology as described in the application and supplement.
3. This license amendment is effective as of its date of issuance and shall be implemented by the completion of refueling outage C2R26 (Spring 2024).

FOR THE NUCLEAR REGULATORY COMMISSION

***/RA - S. Williams for/***

Michael T. Markley, Chief  
Plant Licensing Branch II-1  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Date of Issuance: July 19, 2022



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

DUKE ENERGY CAROLINAS, LLC

DOCKET NO. 50-369

MCGUIRE NUCLEAR STATION, UNIT 1

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 323  
Renewed License No. NPF-9

1. The Nuclear Regulatory Commission (NRC, the Commission) has found that:
  - A. The application for amendment to the McGuire Nuclear Station, Unit 1 (the facility), Renewed Facility Operating License No. NPF-9, filed by the Duke Energy Carolinas, LLC (the licensee), dated October 25, 2021, as supplemented by letter dated April 7, 2022, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations as set forth in 10 CFR Chapter I;
  - B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;
  - C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations set forth in 10 CFR Chapter I;
  - D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and
  - E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, by Amendment No. 323, Renewed Facility Operating License No. NPF-9, is hereby amended to accept the revision of the conditional exemption of the end-of-cycle moderator temperature coefficient measurement methodology as described in the application and supplement.
3. This license amendment is effective as of its date of issuance and shall be implemented by the completion of refueling outage M1R29 (Fall 2023).

FOR THE NUCLEAR REGULATORY COMMISSION

***/RA - S. Williams for/***

Michael T. Markley, Chief  
Plant Licensing Branch II-1  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Date of Issuance: July 19, 2022





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

DUKE ENERGY CAROLINAS, LLC

DOCKET NO. 50-370

MCGUIRE NUCLEAR STATION, UNIT 2

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 302  
Renewed License No. NPF-17

1. The Nuclear Regulatory Commission (NRC, the Commission) has found that:
  - A. The application for amendment to the McGuire Nuclear Station, Unit 2 (the facility), Renewed Facility Operating License No. NPF-17, filed by the Duke Energy Carolinas, LLC (the licensee), dated October 25, 2021, as supplemented by letter dated April 7, 2022, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations as set forth in 10 CFR Chapter I;
  - B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;
  - C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations set forth in 10 CFR Chapter I;
  - D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and
  - E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, by Amendment No. 302, Renewed Facility Operating License No. NPF-17, is hereby amended to accept the revision of the conditional exemption of the end-of-cycle moderator temperature coefficient measurement methodology as described in the application and supplement.
3. This license amendment is effective as of its date of issuance and shall be implemented by the completion of refueling outage M2R28 (Spring 2023).

FOR THE NUCLEAR REGULATORY COMMISSION

***/RA - S. Williams for/***

Michael T. Markley, Chief  
Plant Licensing Branch II-1  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Date of Issuance: July 19, 2022

**ENCLOSURE 6**

NON-PROPRIETARY SAFETY EVALUATION FOR

AMENDMENT NOS. 313 AND 309

TO RENEWED FACILITY OPERATING LICENSE NPF-35 AND NPF-52

DUKE ENERGY CAROLINAS, LLC

CATAWBA NUCLEAR STATION, UNITS 1 AND 2

DOCKET NOS. 50-413 AND 50-414

AND

LICENSE AMENDMENT NOS. 323 AND 302

TO RENEWED FACILITY OPERATING LICENSE NPF-9 AND NPF-17

MCGUIRE NUCLEAR STATION, UNITS 1 AND 2

DOCKET NOS. 50-369 AND 50-370



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION FOR

AMENDMENT NOS. 313 AND 309

TO RENEWED FACILITY OPERATING LICENSE NPF-35 AND NPF-52

DUKE ENERGY CAROLINAS, LLC

CATAWBA NUCLEAR STATION, UNITS 1 AND 2

DOCKET NOS. 50-413 AND 50-414

AND

LICENSE AMENDMENT NOS. 323 AND 302

TO RENEWED FACILITY OPERATING LICENSE NPF-9 AND NPF-17

MCGUIRE NUCLEAR STATION, UNITS 1 AND 2

DOCKET NOS. 50-369 AND 50-370

1.0 INTRODUCTION

By application dated October 25, 2021 (Reference 1), as supplemented by letter dated April 7, 2022 (Reference 2), Duke Energy Carolinas, LLC (Duke, the licensee), requested changes to DPC-NE-1007-PA, Revision 0, "Conditional Exemption of the EOC [End of Cycle] MTC [Moderator Temperature Coefficient] Measurement Methodology," (Reference 3), (Reference 4), (Reference 5), and (Reference 6), a methodology used to meet Surveillance Requirement (SR) 3.1.3.2 in lieu of an EOC MTC measurement for the Catawba Nuclear Station, Units 1 and 2 (CNS or Catawba), and the McGuire Nuclear Station, Units 1 and 2 (MNS or McGuire).

The proposed changes would remove the incore quadrant power tilt conditional exemption acceptance criterion, add an alternate approach for calculating the most negative MTC (i.e., the safety analysis MTC analysis value), and modify the power distribution reaction rate failure criterion to prevent a false positive (criterion exceeded) due to an instrument issue.

From March 1 to March 2, 2022, the U.S. Nuclear Regulatory Commission's (NRC) staff conducted an audit to support its review of the amendment request, as discussed in the NRC staff's audit plan dated February 18, 2022 (Reference 7), and audit summary dated

March 15, 2022 (Reference 8). The supplement dated April 7, 2022, provided additional information that clarified the application, did not expand the scope of the application as originally noticed, and did not change the staff's original proposed no significant hazards consideration determination as published in the *Federal Register* on February 8, 2022 (87 FR 7211).

The NRC staff's safety evaluation (SE) contains proprietary information as originally submitted by letter dated October 25, 2021, as supplemented by letter dated April 7, 2022. Proprietary information withheld under Title 10 of the *Code of Federal Regulations* (10 CFR) Section 2.390 is identified by text enclosed within double brackets as shown here **[[ ]]**.

## 2.0 REGULATORY EVALUATION

### 2.1 Description of System

SR 3.1.3.2 requires the licensee to measure MTC within seven effective full power days of reaching the equivalent of an equilibrium core boron concentration of 300 parts per million (ppm). The measured value of MTC is then compared to the surveillance limit as specified in the core operating limits report (COLR). This demonstrates that limiting condition of operation (LCO) 3.1.3, "Moderator Temperature Coefficient," is met which ensures that the MTC is within the limits assumed in the licensee's accident or transient analysis, as documented in the Catawba and McGuire Updated Final Safety Analysis Reports (UFSARs) (Reference 9) and (Reference 10). If the MTC is more negative than assumed in certain accident and transient analyses, then the magnitude of power excursions caused by overcooling will be underestimated.

The Duke Energy methodology report, DPC-NE-1007-PA, Revision 0, describes a methodology by which EOC MTC measurement may be exempted, provided that the revised predicted MTC is less negative than the SR 3.1.3.2 limit specified in the COLR and measurements of other core operating characteristics (assembly power, incore quadrant tilt, core reactivity difference, beginning of cycle (BOC) hot zero power MTC, individual control bank worth, and total control bank worth) are consistent with design predictions.

The revised predicted MTC is the design prediction of EOC MTC adjusted to account for uncertainty in the prediction and corrections for **[[**

**]]** The requirements that other core operating characteristics be consistent with design predictions provide assurance that the prediction of MTC can be relied on. These requirements are referred to as benchmark criteria throughout this document.

### 2.2 Description of Proposed Change

The licensee proposed three changes to the methodology in DPC-NE-1007-PA, Revision 0. One change adds an alternate approach for calculating the difference between the safety analysis MTC and the LCO 3.1.3 MTC limit. The current method assesses the change in MTC **[[**

**]]**

The other two changes modify the benchmark criteria of the method. One of these changes removes the intermediate power and full power incore quadrant power tilt benchmark criteria. The other change would modify the assembly power benchmark criterion so that a faulty measurement does not result in violation of the criterion.

Additionally, the licensee proposed administrative changes to DPC-NE-1007-PA, Revision 0, to update the revision number and report date, fix grammatical errors, and adjust numbering of tables.

### 2.3 Regulatory Requirements and Guidance Documents

The regulations in 10 CFR 50.36(b) states, in part:

The technical specifications will be derived from the analyses and evaluation included in the safety analysis report, and amendments thereto, submitted pursuant to [10 CFR] 50.34.

The regulations in 10 CFR 50.36(c)(2), "Limiting conditions for operation," states, in part:

Limiting conditions for operation are the lowest functional capability or performance levels of equipment required for safe operation of the facility. When a limiting condition for operation of a nuclear reactor is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the technical specifications until the condition can be met.

The regulations in 10 CFR 50.36(c)(3), "Surveillance requirements," states, in part:

Surveillance requirements are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation will be met.

Regulatory Guide 1.105, Revision 4, "Setpoints for Safety-Related Instrumentation," (Reference 11) describes an approach that is acceptable for ensuring that setpoints for safety-related instrumentation are initially within and remain within technical specification limits.

The Westinghouse report, WCAP-14851-A, "Safety Evaluation Supporting the Conditional Exemption of the Most Negative EOL [end of life] Moderator Temperature Coefficient" (Reference 12) is an example of a generic NRC-approved topical report that, like DPC-NE-1007-P, allows for conditional exemption of EOC MTC measurement.

American National Standards Institute (ANSI)/International Society of Automation (ISA) 67.04.01-2018, "Setpoints for Nuclear Safety-Related Instrumentation," (Reference 13) is endorsed to be used in complying with the regulations to ensure that: (a) setpoints for safety-related instrumentation are established to protect nuclear powerplant safety and analytical limits, and (b) the maintenance of instrument channels implementing these setpoints ensures they are functioning as required, consistent with the plant technical specifications.

ANSI/American Nuclear Society (ANS)-19.11-2017, "Calculation and Measurement of the Moderator Temperature Coefficient of Reactivity for Pressurized Water Reactors" (Reference 14) is a third-party standard intended to provide guidance and specify criteria for the calculation and measurement of the MTC of reactivity in pressurized water reactors.

### 3.0 TECHNICAL EVALUATION

The NRC staff evaluated the proposed changes to the method to ensure that SR 3.1.3.2 continues to verify that LCO 3.1.3 is met, and that meeting LCO 3.1.3 ensures that actual MTC is bounded by the value assumed in the Catawba and McGuire UFSAR accident and transient analysis.

#### 3.1 Relationship Between the Technical Specification 3.1.3 Limit and the Most Negative MTC

Section 2.2 of DPC-NE-1007-P, Revision 1, describes the relationship between the MTC assumed in the safety analyses and the LCO 3.1.3 MTC. The most negative MTC permitted by LCO 3.1.3 is defined at the "all rods out" condition. However, LCO 3.1.6, "Control Bank Insertion Limits," and LCO 3.2.3, "Axial Flux Difference," permit a range of control rod positions and axial flux difference, some of which result in a more negative MTC. The LCO 3.1.3 MTC is less negative than the safety analysis MTC because the LCOs, which are derived from the safety analyses, include some margin to assure that operation will be within the bounds of the initial conditions assumed in the safety analysis. The difference accounts for, among other things, variations in [[ ]] and instrumentation uncertainty.

The approved DPC-NE-1007-PA, Revision 0, describes a [[ ]] procedure for calculating the difference between the safety analysis and LCO 3.1.3 MTC. In this approach, [[ ]]

]]

The NRC staff reviewed the licensee's proposed approach for [[ ]]

]] As part of the licensee's approach, they confirmed that the set of effects considered is complete, assessed the magnitude of each effect, and clarified that [[ ]]

]] This SE discusses the completeness of the set of terms and the value of each term, however, only the [[ ]] is modified by the licensee's proposed changes.

##### 3.1.1 Completeness of set of terms

The licensee considered perturbations to MTC from [[ ]]

]] In the "Selection of Key Parameters" Section of Reference 2, the licensee justified why the terms in equation 1 of DPC-NE-1007-P, Revision 1, represent the complete set contributing to the difference between the LCO 3.1.3 MTC and the MTC assumed in the safety analysis. [[ ]]

]]

As a point of comparison, the NRC staff considered discussion in Section 2.4, "Conservatism of the Most Negative Feasible MTC Conversion," of WCAP-14851-A and the recommendations in Section 6.2, "Extrapolation," of ANSI/ANS-19.11-2017 (Ref. 13). These documents list the following variables as important to the calculation of MTC:

- Moderator temperature
- Pressure
- Axial flux difference
- Control rod position
- Reactor power
- Boron concentration
- Xenon concentration

[[

]]

Based on the above, and because the set of terms is not modified by the proposed revision, the NRC staff finds that the licensee included the important terms affecting MTC for the purpose of determining the difference between the LCO 3.1.3 limit and the MTC assumed in the accident and transient analyses.

### 3.1.2 Values of terms

The licensee's method assesses MTC [[



]]

The licensee stated that [[

]] The licensee explained that these uncertainties reflect larger variation than is typically encountered during operation and provided a frequency distribution of actual [[  
]] in their supplement dated  
April 7, 2022, to support their claim. [[

]] The NRC staff finds that these  
frequency distributions support the conservatism of [[  
]] modeled by the licensee's method.

Due to the consistency of methods of determining [[  
]] with  
existing guidance, the conservatism of the [[  
]], and because the method of determining values of these allowances is not  
changed by the proposed revision, the NRC staff finds that the licensee has appropriately  
justified the approach in determining values of these allowances.

### 3.1.3 Independence of terms

The licensee provided justification for [[  
]], since this is implicitly assumed by the licensee's [[

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licensee's [ ] [ ] Therefore, the NRC staff finds the [ ] to be acceptable.

Since the licensee adequately justified the independence of its terms, the NRC staff finds that the proposed method of calculating margin between the safety analysis MTC and LCO 3.1.3 MTC conservatively accounts for the difference attributable to instrumentation uncertainty and the range of conditions permitted by technical specifications.

### 3.2 Removal of Measured Incore Quadrant Power Tilt Criterion

The Duke Energy methodology report, DPC-NE-1007-PA, Revision 0, included seven benchmark criteria that must be met for the licensee to be exempted from the SR 3.1.3.2 requirement to measure MTC. The proposed revision would remove the full power and intermediate power incore quadrant tilt benchmark criteria. This change is described in "Change 3-1: Confirmation of Reactor Core Performance (Section 3.3)" and associated "Technical Justification" sections of Attachment 2 to the licensee's submittal dated October 25, 2021.

The "Technical Justification" Section states that the licensee has used the conditional exemption methodology for [ ] [ ] cores, [ ] [ ] of which violated the incore tilt benchmark criterion. The licensee measured MTC each time the incore tilt benchmark criterion was violated in accordance with SR 3.1.3.2. [ ]

[ ] This data was compared with that used to establish the predictive bias and uncertainty in MTC during review of DPC-NE-1007-P, Revision 0.

Few measurements are available to assess the effect of violating the incore tilt criterion on MTC prediction because most of the Catawba and McGuire cores have met the incore tilt benchmark criterion since DPC-NE-1007-PA, Revision 0, was adopted. Further, it is unclear whether incore

tilt criteria were met for the data in the comparison (DPC-NE-1007-PA, Revision 0) set. Although limited in statistical power, the new data does not indicate that the predictive bias and uncertainty in MTC established during review of DPC-NE-1007-P, Revision 0, is inapplicable when the incore tilt criterion is violated.

[[

]] The incore quadrant tilt criterion accounts for flux asymmetry between core quadrants. The licensee performed two analytical studies to examine the effect of flux asymmetry between core quadrants on MTC. In the first, [[

]] This would violate the incore tilt benchmark criterion. [[

]] As points of comparison, the difference between the TS 3.1.3 MTC limit defined in the COLRs for Catawba Units 1 and 2 (Reference 16) and (Reference 17), and McGuire, Units 1 and 2 (Reference 18) and (Reference 19), and the MTC assumed in the accident and transient analysis (as documented in Table 15-4 the Catawba and McGuire UFSAR) is 8 pcm/°F.

The licensee's second study considered an [[

]] The licensee stated that this scenario is highly improbable because it assumes that the defective fuel is located in the same core quadrant with manufacturing defects that are consistently biased in one direction relative to the design specification, and that fuel with these defects are loaded in the same quadrant of the core through random chance. [[

]]

The licensee stated that both studies demonstrate the [[  
]]

The NRC staff reviewed the licensee's calculations and finds that they demonstrated the [[  
]]

associated with quadrant power tilts. Because the [[  
]], the NRC staff finds that removing this criterion will not result in reduced assurance of the accuracy of the MTC prediction. Additionally, other benchmark criteria, such as the assembly power benchmark criterion, will continue to require measurement of EOC MTC in the event that the power distribution is not as designed. Since the revised set of benchmark criteria will still provide assurance that the MTC prediction reflects the as-loaded core, performing the revised surveillance methodology will continue to provide assurance that LCO 3.1.3 is met. The NRC staff finds that this change is consistent with 10 CFR 50.36(c)(3) and is therefore, acceptable.

### 3.3 Modification of Assembly Power Criterion

The licensee proposed to modify the assembly power benchmark criterion that must be met for the SR 3.1.3.2 requirement to measure MTC to be suspended. This change is described in "Change 3-2: Confirmation of Reactor Core Performance (Section 3.3)" and associated "Technical Justification" sections of Attachment 2 to the licensee's submittal dated

October 25, 2021. Assembly power is measured at multiple instances throughout the cycle, as specified by TS 3.2.1, "Heat Flux Hot Channel Factor  $F_Q(X,Y,Z)$ " and TS 3.2.2, "Nuclear Enthalpy Rise Hot Channel Factor ( $F_{\Delta H}(X,Y)$ )." In each instance, data is obtained in multiple locations throughout the core. Currently, all these measurements must be within  $\pm 10$  percent of the predicted value to exempt the EOC MTC measurement requirement.

The licensee proposed to modify this requirement so that one measurement is permitted to differ from the predicted value by more than  $\pm 10$  percent. Specifically, the criterion is not failed unless two [[

]]

The licensee stated that the purpose of this change is to eliminate the condition where a bad measurement due to an instrument issue causes the benchmark criterion to be violated. They also stated that [[

]]

The NRC staff reviewed the licensee's arguments and agrees that a failed instrument does not indicate that the core is behaving differently than designed, and therefore preventing exemption of the MTC measurement due to a failed instrument is not consistent with the purpose of the conditional exemption methodology benchmark criteria. The NRC staff also finds the licensee's assertion reasonable that [[

]] The NRC staff finds that the proposed revision does not degrade the ability of this benchmark criterion to detect deficiencies in the as-loaded core or the design prediction. The DPC-NE-1007-P, Revision 1, methodology will continue to provide assurance that LCO 3.1.3 is met because the revised assembly power benchmark criterion will still detect deficiencies in the as-loaded core or design predictions. Because performing the revised surveillance methodology will continue to assure that LCO 3.1.3 is met, this change is consistent with 10 CFR 50.36(c)(3) and the NRC staff find it acceptable.

### 3.4 Editorial Changes

In addition to the changes discussed in Sections 0, 3.2, and 3.3 of this SE, the licensee also proposed multiple editorial changes to DPC-NE-1007-PA, Revision 0. These changes reflect the change in the date of the report and the revision number, fix grammatical errors, and adjust numbering of tables to be consistent with other changes in the document. Since these changes do not alter the implementation of SR 3.1.3.2, the NRC staff finds them acceptable.

### 3.5 NRC Staff Conclusion

The NRC staff reviewed the proposed changes to DPC-NE-1007-P, Revision 1, with respect to the requirements of limiting conditions for operation and surveillance requirements described in 10 CFR 50.36(c)(2)(i) and 10 CFR 50.36(c)(3). The NRC staff finds that since the MTC is    and since the revised assembly power criterion will still detect deficiencies in the as-loaded core or design predictions, the revised set of benchmark criteria, if met, will continue to provide assurance that the MTC prediction reflects the as-loaded core. Therefore, meeting the revised surveillance requirement will assure that LCO 3.1.3 is met consistent with 10 CFR 50.36(c). The NRC staff also finds that the licensee's proposed    method of calculating the difference between the LCO and safety analysis MTC will continue to result in an LCO that, if met, will ensure that actual core conditions are more favorable than the initial conditions of the accident and transient analyses. Additionally, the NRC staff finds that the conclusions reached during review of DPC-NE-1007-PA, Revision 0, are not changed by the proposed revision. Therefore, the NRC staff finds these changes acceptable.

### 4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the South Carolina and North Carolina State official was notified of the proposed issuance of the amendments on June 7, 2022. On June 15, 2022, the State official confirmed that the State of South Carolina had no comments. On June 10, 2022, the State official confirmed that the State of North Carolina had no comments.

### 5.0 ENVIRONMENTAL CONSIDERATION

The amendments change the requirements with respect to the installation or use of facility components located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendments involve no significant increase in the amounts and no significant change in the types of any effluents that may be released offsite and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendments involve no significant hazards consideration published in the *Federal Register* on February 8, 2022 (87 FR 7211), and there has been no public comment on such finding. Accordingly, the amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendments.

### 6.0 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.

## 7.0 REFERENCES

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- 11 U.S. Nuclear Regulatory Commission, "Regulatory Guide 1.105, Revision 4 - Setpoints for Safety-Related Instrumentation," February 2021 (ML20330A329).
- 12 Westinghouse Electric Corporation, WCAP-14851-A (Public) and WCAP-13749-P-A (Non-Public), "Safety Evaluation Supporting the Conditional Exemption of the Most Negative EOL Moderator Temperature Coefficient Measurement," 1997 (ML20140D215, ML14358A301 (non-public)).
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Date: July 19, 2022



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T. Simril and E. Pigott

- 3 -

SUBJECT: CATAWBA NUCLEAR STATION, UNITS 1 AND 2, AND MCGUIRE NUCLEAR STATION, UNITS 1 AND 2- ISSUANCE OF AMENDMENTS TO REVISE THE CONDITIONAL EXEMPTION OF THE END-OF-CYCLE MODERATOR TEMPERATURE COEFFICIENT MEASUREMENT METHODOLOGY (EPID L-2021-LLA-0198) DATED JULY 19, 2022

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