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Serial: RA-19-0245
October 25, 2021

10 CFR 50.90

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

CATAWBA NUCLEAR STATION, UNIT NOS. 1 AND 2
DOCKET NOS. 50-413, 50-414 / RENEWED LICENSE NOS. NPF-35 AND NPF-52

MCGUIRE NUCLEAR STATION, UNIT NOS. 1 AND 2
DOCKET NOS. 50-369, 50-370 / RENEWED LICENSE NOS. NPF-9 AND NPF-17

SUBJECT: Revision 1 of DPC-NE-1007-P, "Conditional Exemption of the EOC MTC Measurement Methodology"

REFERENCES:

1. NRC letter, *Catawba Nuclear Station, Units 1 and 2 (Catawba 1 and 2) and McGuire Nuclear Station, Units 1 and 2 (McGuire 1 and 2) - Issuance of Amendments Re: Technical Specification (TS) 3.1.3, "Moderator Temperature Coefficient (MTC)" and TS 5.6.5, "Core Operating Limits Report" (TAC NOS. ME8829, ME8830, ME8831, and ME8832)*, dated April 14, 2015 (ADAMS Accession No. ML15063A271)

Ladies and Gentlemen:

In accordance with the provisions of 10 CFR 50.90, Duke Energy Carolinas, LLC, referred to henceforth as "Duke Energy", is submitting a License Amendment Request (LAR) for the Renewed Facility Operating Licenses (FOLs) for Catawba Nuclear Station Units 1 and 2 (CNS) and McGuire Nuclear Station Units 1 and 2 (MNS) related to the end-of-cycle (EOC) rated thermal power (RTP) moderator temperature coefficient (MTC) measurement. Specifically, Duke Energy requests NRC review and approval of proposed changes to DPC-NE-1007-P, "Conditional Exemption of the EOC MTC Measurement Methodology."

The purpose of DPC-NE-1007-P is to allow an exemption of the EOC RTP MTC measurement required by Technical Specification (TS) Surveillance Requirement (SR) 3.1.3.2. Revision 0 of DPC-NE-1007-P was approved by the NRC in Reference 1. The proposed changes constitute Revision 1 to DPC-NE-1007-P. Notable changes in Revision 1 include:

1. Remove the incore quadrant power tilt conditional exemption acceptance criterion.

2. Add an alternate approach for calculating the most negative MTC (i.e. Safety Analysis MTC analysis value).

3. Modify the power distribution reaction rate failure criterion to prevent a false positive (criterion exceeded) due to an instrument issue.

On August 30, 2021 Duke Energy and NRC staff participated in a pre-submittal meeting regarding DPC-NE-1007-P, Revision 1.

The proposed changes have been evaluated in accordance with 10 CFR 50.91(a)(1) using criteria in 10 CFR 50.92(c), and it has been determined that the proposed changes involve no significant hazards consideration. The bases for these determinations are included in Enclosure 1. Enclosure 1 provides an evaluation of the proposed change. This LAR does not request any changes to the CNS or MNS Technical Specifications (TS). Consequently, no proposed revised TS pages are included with this submittal.

Attachment 2 provides the changes that constitute Revision 1 of DPC-NE-1007-P along with the associated technical justification. Attachment 2 includes information that is proprietary to Duke Energy. In accordance with 10 CFR 2.390, Duke Energy requests that Attachment 2 be withheld from public disclosure. An Affidavit is included (Attachment 1) attesting to the proprietary nature of the information. A non-proprietary version of Attachment 2 is included in Attachment 3.

Duke Energy requests approval of the proposed license amendments within one year of completion of the NRC's acceptance review. Once approved, the amendments shall be implemented prior to startup from each Unit’s next refueling outage after NRC approval.

This submittal contains no new regulatory commitments. In accordance with 10 CFR 50.91, Duke Energy is notifying the states of North Carolina and South Carolina of this license amendment request by transmitting a copy of this letter to the designated state officials. Should you have any questions concerning this letter, or require additional information, please contact Lee Grzeck, Manager – Nuclear Fleet Licensing, at 980-373-1530.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on October 25, 2021.

Sincerely,

Shawn Gibby
Vice President – Nuclear Engineering

Enclosure:
1. Evaluation of the Proposed Change

Attachments:
1. Affidavit of Shawn Gibby
2. Change Description and Technical Justification for Revision 1 of DPC-NE-1007-P (Proprietary)
3. Change Description and Technical Justification for Revision 1 of DPC-NE-1007 (Redacted)

cc: (all with Enclosures/Attachments unless otherwise noted)

L. Dudes, Regional Administrator USNRC Region II
J. D. Austin, USNRC Senior Resident Inspector – CNS
G. A. Hutto, USNRC Senior Resident Inspector – MNS
K. R. Cotton, NRR Project Manager – CNS
J. Klos, NRR Project Manager – MNS

W. L. Cox, III, Section Chief, NC DHSR (Without Attachment 2)
L. Garner, Manager, Radioactive and Infectious Waste Management Section (SC) (Without Attachment 2)
A. Nair, Director, Nuclear Response (SC) (without Attachment 2)

Enclosure 1

EVALUATION OF THE PROPOSED CHANGE

1.0 SUMMARY DESCRIPTION

This evaluation supports a request to amend Renewed Facility Operating Licenses (FOLs) NPF-35 and NPF-52 for Catawba Nuclear Station Units 1 and 2, and NPF-9 and NPF-17 for McGuire Nuclear Station Units 1 and 2 related to the end-of-cycle (EOC) rated thermal power (RTP) moderator temperature coefficient (MTC) measurement. Specifically, Duke Energy requests NRC review and approval of proposed changes to DPC-NE-1007-P, “Conditional Exemption of the EOC MTC Measurement Methodology.”

2.0 DETAILED DESCRIPTION

2.1 System Design and Operation

The MTC relates a change in core reactivity to a change in reactor coolant temperature (a positive MTC means that reactivity increases with increasing moderator temperature; conversely, a negative MTC means that reactivity decreases with increasing moderator temperature). The core is designed so that the MTC is less than zero when thermal power is at RTP. The actual value of the MTC is dependent on core characteristics, such as fuel loading and reactor coolant soluble boron concentration.

The purpose of DPC-NE-1007-P is to allow an exemption of the EOC RTP MTC measurement (i.e. lower MTC limit) required by Technical Specification (TS) Surveillance Requirement (SR) 3.1.3.2. Revision 0 of DPC-NE-1007-P was approved by the NRC in Reference 1. The conditional exemption methodology is independent of the method used to verify the safety analysis MTC assumption and the method used to calculate the value assumed in UFSAR accident analyses. The values of the most negative MTC Limiting Condition for Operation (LCO) and SR are controlled in the Core Operating Limits Report (COLR). COLR limits are calculated using NRC-approved methodologies as delineated in TS 5.6.5. Similarly, physics parameters used to calculate the most negative MTC and to verify the safety analysis MTC assumption are calculated using an NRC-approved core design model.

2.2 Current Technical Specifications Requirements

Technical Specification (TS) SR 3.1.3.2 requires verification that the MTC is within the lower limit. This verification is performed once each cycle. NOTE 1 of this SR reads as follows:

> Not required to be performed until 7 effective full power days (EFPD) after reaching the equivalent of an equilibrium RTP all rods out (ARO) boron concentration of 300 ppm. Measurement of the MTC may be suspended provided the benchmark criteria specified in DPC-NE-1007-PA, and the Revised MTC Prediction specified in the COLR are satisfied.

TS 5.6.5 lists the analytical methods used to determine the core operating limits which have been previously reviewed and approved by the NRC. The following methodology report is included in the list (#18 for Catawba and #17 for McGuire):

> DPC-NE-1007-PA, "Conditional Exemption of the EOC MTC Measurement Methodology" (Duke and Westinghouse Proprietary).

2.3 Reason for the Proposed Change

The proposed changes to the conditional exemption criteria are based on experience with using the method and will ensure that the EOC MTC measurement test is only performed when necessary. As explained in the following discussion, this will prevent the unnecessary performance of an infrequent plant evolution, eliminate a reactivity transient, improve plant availability, and reduce the potential for a reactivity event due to a human performance error or an unanticipated equipment issue during the test. In addition, an alternate approach for calculating the most negative MTC is being proposed to remove excessive conservatism in the current method to allow introduction of advanced fuel designs and fuel management strategies.

One of the controlling parameters for power and reactivity changes is the MTC. The requirements of TS 3.1.3 ensure that the MTC remains within the bounds used in the applicable Updated Final Safety Analysis Report (UFSAR) Chapter 15 accident analysis. This, in turn, ensures inherently stable power operations during normal operation and accident conditions. Currently, TS 3.1.3 requires measurement of MTC at beginning-of-cycle (BOC) to verify the most positive MTC limit and near EOC (unless exempted by DPC-NE-1007-P) to verify the most negative MTC limit. At BOC, the measurement of the isothermal temperature coefficient is performed at Hot Zero Power (HZP) isothermal conditions and therefore eliminates uncertainty introduced by changes in the enthalpy rise or the presence of xenon. On the other hand, the EOC MTC measurement is performed near End of Life (EOL) corresponding to 300 ppm RTP equilibrium conditions. The equilibrium condition requirement is to preclude contamination of the measurement from a pre-existing xenon transient. The core reactivity during the test is kept close to zero to minimize reactor perturbations in power. Control rod positions during the test are typically fixed. The measurement is initiated by the addition of soluble boron to the Reactor Coolant System (RCS) to produce a temperature change. Because the EOC test is performed at power, the reactivity measurement calculated from the boron concentration change must be corrected to account for changes in plant parameters (i.e., power level, xenon concentration, etc.). Performing the measurement near EOC at or near hot full power (HFP) conditions requires that several plant systems be operated in a mode or condition not typical of steady state operation (e.g., reactor coolant temperature being decreased approximately 5°F from its normal programmed temperature, rod control being placed in the manual mode, and steam bypass control being placed in the pressure mode versus the T_{ave} mode). This increases the likelihood of creating an undesirable plant transient due to a human performance error or equipment issue.

2.4 Description of the Proposed Change

The proposed changes constitute Revision 1 to DPC-NE-1007-P. Notable changes in Revision 1 include:

1. Remove the incore quadrant power tilt conditional exemption acceptance criterion.

2. Add an alternate approach for calculating the most negative MTC (i.e. Safety Analysis MTC analysis value).

3. Modify the power distribution reaction rate failure criterion to prevent a false positive (criterion exceeded) due to an instrument issue.

Detailed description and markup of the changes is provided in Attachment 2 (proprietary) or Attachment 3 (redacted).

Because SR 3.1.3.2 currently allows exemption of the EOC MTC measurement in accordance with DPC-NE-1007-P and TS 5.6.5 includes DPC-NE-1007-P as an NRC approved method without a specified revision, no TS changes are required.

3.0 TECHNICAL EVALUATION

The technical justifications supporting this amendment request are included in Attachment 2 (proprietary) or Attachment 3 (redacted).

4.0 REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements/Criteria

10 CFR 50.36(c)(3), "Surveillance requirements" states the following:

> 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.

The regulatory basis for SR 3.1.3.2 for CNS and MNS is to ensure that the value of the MTC remains within the limiting condition assumed in the plant UFSAR accident and transient analyses. This requirement will continue to be met following NRC approval of this submittal.

4.2 Precedent

No direct precedent was identified.

4.3 No Significant Hazards Consideration Determination

Duke Energy Carolinas, LLC, referred to henceforth as "Duke Energy", is submitting a License Amendment Request (LAR) for the Renewed Facility Operating Licenses (FOLs) for Catawba Nuclear Station Units 1 and 2 (CNS) and McGuire Nuclear Station Units 1 and 2 (MNS) related to the end-of-cycle (EOC) rated thermal power (RTP) moderator temperature coefficient (MTC) measurement. Specifically, Duke Energy requests NRC review and approval of proposed changes to DPC-NE-1007-P, "Conditional Exemption of the EOC MTC Measurement Methodology." The proposed changes constitute Revision 1 to DPC-NE-1007-P.

Duke Energy has evaluated whether or not a significant hazards consideration is involved with the proposed amendment(s) by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No.

   The proposed changes request review and approval of DPC-NE-1007-P, Revision 1, "Conditional Exemption of the EOC MTC Measurement Methodology" to be applied to

CNS and MNS. The proposed changes do not alter the design, configuration, operation, or function of any plant structure, system, or component. In addition, there is no change to any equipment response or accident mitigation scenario, and consequently no additional challenges to fission product barrier integrity. Further, the existing limits on MTC established by the Technical Specifications (TS), based on assumptions in the safety analyses, remain unchanged and continue to be satisfied. As a result, the outcomes of previously evaluated accidents are unaffected. There is no impact on the source term or pathways assumed in accidents previously assumed. No analysis assumptions are violated and there are no adverse effects on the factors that contribute to offsite or onsite dose as the result of an accident.

Therefore, the proposed changes do not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No.

   The proposed changes request review and approval of DPC-NE-1007-P, Revision 1, "Conditional Exemption of the EOC MTC Measurement Methodology" to be applied to CNS and MNS. No new accident scenarios, failure mechanisms, or limiting single failures are introduced as a result of the proposed changes. The proposed changes do not challenge the performance or integrity of any safety related system. The proposed changes neither install nor remove any plant equipment, nor alters the design, physical configuration, or mode of operation of any plant structure, system, or component. The MTC is a variable that must remain within prescribed limits, but it is not an accident initiator. No physical changes are being made to the plant, so no new accident causal mechanisms are being introduced.

   Therefore, the proposed changes do not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Does the proposed change involve a significant reduction in a margin of safety?

   Response: No.

   Margin of safety is related to the confidence in the ability of the fission product barriers to perform their design functions during and following an accident. These barriers include the fuel cladding, the reactor coolant system, and the containment system. The proposed changes request review and approval of DPC-NE-1007-P, Revision 1, "Conditional Exemption of the EOC MTC Measurement Methodology" to be applied to CNS and MNS. The proposed changes will have no effect on the availability, operability, or performance of the safety related systems and components. The proposed changes do not alter the design, configuration, operation, or function of any plant structure, system, or component. The ability of any operable structure, system, or component to perform its designated safety function is unaffected by the proposed changes.

   The TS and the Core Operating Limits Report (COLR) establish limits for the MTC based on assumptions in the accident analyses. The proposed changes modify the method for determining acceptability of exemption from the EOC MTC measurement; however,

accident analysis assumptions are satisfied through compliance with COLR limits. Determination of the most negative safety analysis MTC and the verification of this limit is performed using NRC approved methodologies and core models. Accordingly, Duke Energy methodologies will continue to ensure (a) the acceptability of analytical limits under normal, transient, and accident conditions, and (b) that all applicable design and safety limits are satisfied such that the fission product barriers will continue to perform their design functions.

Therefore, the proposed changes do not involve a significant reduction in a margin of safety.

Based on the above, Duke Energy concludes that the proposed changes present no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of “no significant hazards consideration” is justified.

4.4 Conclusions

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission’s regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

5.0 ENVIRONMENTAL CONSIDERATION

The proposed changes would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed changes do not involve (i) a significant hazards consideration, (ii) a significant change in the types or a significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed changes meet the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed change.

6.0 REFERENCES

1. NRC letter, *Catawba Nuclear Station, Units 1 and 2 (Catawba 1 and 2) and McGuire Nuclear Station, Units 1 and 2 (McGuire 1 and 2) - Issuance of Amendments Re: Technical Specification (TS) 3.1.3, "Moderator Temperature Coefficient (MTC)" and TS 5.6.5, "Core Operating Limits Report" (TAC NOS. ME8829, ME8830, ME8831, and ME8832)*, dated April 14, 2015 (ADAMS Accession No. ML15063A271)

Attachment 1

Affidavit of Shawn Gibby

AFFIDAVIT of Shawn Gibby

1. I am Vice President of Nuclear Engineering, Duke Energy Corporation, and as such have the responsibility of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear plant licensing and am authorized to apply for its withholding on behalf of Duke Energy.

2. I am making this affidavit in conformance with the provisions of 10 CFR 2.390 of the regulations of the Nuclear Regulatory Commission (NRC) and in conjunction with Duke Energy's application for withholding which accompanies this affidavit.

3. I have knowledge of the criteria used by Duke Energy in designating information as proprietary or confidential. I am familiar with the Duke Energy information contained in Attachment 2 of Duke Energy letter RA-19-0245 regarding request to approve DPC-NE-1007-P, Revision 1.

4. Pursuant to the provisions of paragraph (b)(4) of 10 CFR 2.390, the following is furnished for consideration by the NRC in determining whether the information sought to be withheld from public disclosure should be withheld.

    (i) The information sought to be withheld from public disclosure is owned by Duke Energy and has been held in confidence by Duke Energy and its consultants.

    (ii) The information is of a type that would customarily be held in confidence by Duke Energy. Information is held in confidence if it falls in one or more of the following categories.

        (a) The information requested to be withheld reveals distinguishing aspects of a process (or component, structure, tool, method, etc.) whose use by a vendor or consultant, without a license from Duke Energy, would constitute a competitive economic advantage to that vendor or consultant.

        (b) The information requested to be withheld consist of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), and the application of the data secures a competitive economic advantage for example by requiring the vendor or consultant to perform test measurements, and process and analyze the measured test data.

        (c) Use by a competitor of the information requested to be withheld would reduce the competitor's expenditure of resources, or improve its competitive position, in the design, manufacture, shipment, installation assurance of quality or licensing of a similar product.

        (d) The information requested to be withheld reveals cost or price information, production capacities, budget levels or commercial strategies of Duke Energy or its customers or suppliers.

        (e) The information requested to be withheld reveals aspects of the Duke Energy funded (either wholly or as part of a consortium) development plans or programs of commercial value to Duke Energy.

(f) The information requested to be withheld consists of patentable ideas.

The information in Attachment 2 of Duke Energy letter RA-19-0245 is held in confidence for the reasons set forth in paragraphs 4(ii)(a) or 4(ii)(c) above. The category for all proprietary information is identified next to the right proprietary bracket. Rationale for holding this information in confidence is that public disclosure of this information would provide a competitive advantage if the information was used by vendors or consultants without a license from Duke Energy. Public disclosure of this information would diminish the information's marketability, and its use by a vendor or consultant would reduce their expenses to duplicate similar information. The information consists of analysis methodology details, analysis results, supporting data, and aspects of development programs, relative to a method of analysis that provides a competitive advantage to Duke Energy.

(iii) The information was transmitted to the NRC in confidence and under the provisions of 10 CFR 2.390, it is to be received in confidence by the NRC.

(iv) The information sought to be protected is not available in public to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld is that which is marked in Attachment 2 of Duke Energy letter RA-19-0245 regarding request to approve DPC-NE-1007-P, Revision 1. This information enables Duke Energy to:

(a) Support license amendment requests and reload calculations for its Catawba and McGuire reactors.

(b) Conditionally Exempt the EOC MTC Measurement required by Technical Specification Surveillance Requirement 3.1.3.2.

(vi) The proprietary information sought to be withheld from public disclosure has substantial commercial value to Duke Energy.

(a) Duke Energy uses this information to reduce vendor and consultant expenses associated with supporting the operation and licensing of nuclear power plants.

(b) Duke Energy can sell the information to nuclear utilities, vendors, and consultants for the purpose of supporting the operation and licensing of nuclear power plants.

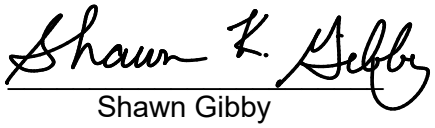
(c) The subject information could only be duplicated by competitors at similar expense to that incurred by Duke Energy.

5. Public disclosure of this information is likely to cause harm to Duke Energy because it would allow competitors in the nuclear industry to benefit from the results of a significant development program without requiring a commensurate expense or allowing Duke Energy to recoup a portion of its expenditures or benefit from the sale of the information.

Shawn Gibby affirms that he is the person who subscribed his name to the foregoing statement, and that all the matters and facts set forth herein are true and correct to the best of his knowledge.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on October 25, 2021.



Shawn Gibby

Attachment 2

Change Description and Technical Justification for Revision 1 of DPC-NE-1007-P (Proprietary)

Note: Text that is within brackets with a superscript is proprietary to Duke Energy.

Attachment 3

Change Description and Technical Justification for Revision 1 of DPC-NE-1007 (Redacted)

Note: Text that is within brackets with a superscript is proprietary to Duke Energy and has been removed.

RA-19-0245, Attachment 3
DPC-NE-1007-P, Revision 1 Changes and Technical Justifications
(Non-Proprietary Version)

Administrative Changes (Report Cover, Table of Contents, etc)

Change Intro-1: Report Cover and New Admin Page

Description of Change: The report date, revision number and engineering division name is updated. The proprietary notice on the cover page is also revised, and a new page with additional proprietary information is added as page "i".

Technical Justification: Editorial.

McGuire Nuclear Station
Catawba Nuclear Station

Conditional Exemption of the
EOC MTC Measurement Methodology

DPC-NE-1007-A
Revision ~~0~~1

~~April 2015~~
October 2021

Non-Proprietary

Nuclear ~~Engineering Division~~ **Fuels Engineering**
Nuclear Generation Department
Duke Energy Carolinas, LLC

Change Intro-2: New Proprietary Notice (new page)

Description of Change: A proprietary notice is inserted before the Statement of Disclaimer page and subsequent pages are renumber accordingly.

Technical Justification: Editorial.

Proprietary Notice

Certain data in this report is proprietary to Duke Energy and its subsidiaries. Proprietary data is denoted by brackets in text, tables and figures with a superscript identifying the type of proprietary data. Proprietary data is deleted in this version of the report.

Change Intro-3: Abstract

Description of Change: The abstract is revised to describe the purpose of Revision 1.

Technical Justification: Editorial.

Abstract

This report describes the Duke Energy Carolinas methodology to allow for the conditional exemption of the end-of-cycle (EOC) rated thermal power (RTP) moderator temperature coefficient (MTC) Technical Specification Surveillance Requirement. The exemption of the EOC RTP MTC measurement is predicated on demonstrating that the reactor core is operating as designed. This is accomplished on a cycle-specific basis by confirming predicted and measured physics and power distribution information are within specified limits, and also by demonstrating that the predicted MTC is bounded by the EOC MTC surveillance limit after appropriate adjustments are made for uncertainty and actual core performance. Approval of the conditional exemption of the EOC measurement is being pursued to remove the performance of an infrequent plant evolution, eliminate a reactivity transient, and to improve plant availability. The methodology presented is applicable to the McGuire and Catawba Nuclear Stations using the CASMO-4 SIMULATE-3 methodology.

Revision 1

Revision 1 includes an alternate approach for calculating the most negative MTC used in safety related analyses. Core performance criteria used to confirm the core is operating as designed are also modified to remove an unnecessarily restrictive performance criterion. Other revisions are editorial.

Change 2-1: Relationship Between The Technical Specification LCO limit and The Most Negative MTC (Section 2.2)

Description of Change: Change "affect" to "effects" in the last sentence of Section 2.2, paragraph 2. Add an alternative approach for calculating the most negative MTC used in UFSAR Chapter 15 transient and accident analyses

2.2 Relationship Between The Technical Specification LCO Limit and The Most Negative MTC

The Technical Specification LCO limit is established to ensure that the MTC value assumed in the evaluation of UFSAR Chapter 15 accident and transient analyses is not exceeded. The difference between the most negative analysis limit assumed in the safety analysis and the TS LCO MTC limit is the result of differences in the initial condition assumptions made in the evaluation of UFSAR Chapter 15 accidents relative to the conditions associated with the Technical Specification LCO limit. The Technical Specification LCO limit corresponds to EOC rated thermal power (RTP) ARO equilibrium conditions.

[

] [a,c]

[

] [a,c]

Technical Justification:

The first change removes excessive conservatism in the method **[**

] [a,c] The second change is editorial.

[a,c]

Change 3-1: Confirmation of Reactor Core Performance (Section 3.3)

Description of Change: Modify Section 3.3 and Table 3-2 to remove the incore tilt performance criteria.

Startup physics testing is performed following each refueling outage to confirm that the core operating characteristics are consistent with the design. The successful completion of the physics test program coupled with meeting Technical Specification surveillances performed at RTP during the cycle ensure that the core is operating as designed, and key accident analysis assumptions assumed in the evaluation of UFSAR Chapter 15 accidents are preserved for the operating core. The core performance parameters used to justify the conditional exemption of the EOC MTC measurement are the same reactivity and power distribution measurements performed as part of the startup physics testing program and required by Technical Specifications Surveillances during full power operation. The parameters evaluated to confirm core operating characteristics are:

- Assembly Power (Normalized Measured Reaction Rates)
- ~~Measured Incore Quadrant Power Tilt~~
- Core Reactivity
- BOC HZP Isothermal Temperature Coefficient
- Control Bank Worth

Comparisons between predicted and measured results for each parameter is performed to determine if the core is operating as designed. The core is operating as designed if the predicted to measured deviations for all core performance parameters satisfy the acceptance criteria for each parameter. If all core performance criteria are satisfied, then there is high confidence in the accuracy of the predicted EOC MTC, and the measurement required by Technical Specification Surveillance Requirement 3.1.3.2 can be exempted. Conversely, if core performance criteria are not satisfied, then the accuracy of the core model comes into question, and the SR 3.1.3.2 EOC 300 ppm MTC measurement is performed to demonstrate the MTC safety analysis input assumption is satisfied.

Table 3-2 shows the core performance criteria that must be satisfied. The core performance criteria for each parameter~~, with the exception of the incore tilt parameters~~ are based on the NRC-approved Duke reload startup physics test program (Reference 3), modified to include the dynamic rod worth measurement (DRWM) technique as described in WCAP-13360-P-A (Reference 4), and Technical Specifications (Reference 5). Responses to NRC RAI questions 2 and 3 resulted in a decrease in the ITC and reactivity performance criteria from that specified in Duke's startup physics test program and Technical Specifications. ~~The performance criteria for incore tilt are industry accepted values based on the level of incore tilt where an additional evaluation of the core power distribution and affected safety analyses may be warranted~~.

Table 3-2
Criteria for the Conditional Exemption of the EOC MTC Measurement

Parameter	Criteria
Assembly Power (Measured Normalized Reaction Rate) Note 1	+/- 10%
~~Measured Incore Quadrant Tilt (Intermediate Power) Note 1~~	~~+/- 4%~~
~~Measured Incore Quadrant Tilt (Full Power)~~	~~+/- 2.0%~~
Core Reactivity Difference	+/- 500 pcm
BOC HZP ITC	+/- 1.25 pcm/ºF
Individual Control Bank Worth	+/- 15% or +/- 100 pcm
Total Control Bank Worth	+/- 8 or 10% Note 2

% Difference = (Measured – Predicted)/Predicted *100

Note 1: Applicable for power distribution measurements greater than or equal to 50% RTP and for reaction rates greater than or equal to 1.0. Low power measurements are not considered because of the potential for high noise to signal ratios leading to erroneous results. ~~Intermediate power is a power level between 50 and 80% RTP.~~

Note 2: The safety evaluations from References 4 and 8 require the total bank worth review criterion be reduced from 10% to 8% to account for the potential propagation of errors in predicted parameters unfavorably influencing measured rod worths.

Technical Justification:

Power distribution measurements are performed during the initial startup following a refueling outage and then approximately once per month during power operation to comply with the frequency requirements of 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 ($F_{\Delta H}(X,Y)$. These measurements are used to confirm the heat flux hot channel factor (subsequently referred to as F_Q) and the nuclear enthalpy rise hot channel factor (subsequently referred to as $F_{\Delta H}$) are within their respective limits, in addition to confirming the core axial power shape (in terms of axial flux difference) is within its required TS 3.2.3, Axial Flux Difference (AFD), limits. Collectively, these specifications provide the primary means to confirm core radial, axial and local peaking factors are within their prescribed limits. A measure of the core radial asymmetry is also performed for each power distribution measurement. While the influence of a core asymmetry is included in the measurement of core peaking factors and in the confirmation of the F_Q and $F_{\Delta H}$ limits, **[**

] [a,c]

For the conditional exemption of the EOC MTC measurement, an incore tilt acceptance criteria of +/- 2% is applied to any of the eight incore quadrant power tilts calculated from a power distribution measurement. If any single quadrant exceeds the +/- 2% criteria, an EOC MTC measurement is performed in accordance with the requirements of SR 3.1.3.2. A total of **[ ]** [a,c] reactor cores have used the conditional MTC exemption methodology since NRC approval. Of these cores, **[ ]** [a,c] have exceeded the incore tilt acceptance criteria, and several more have challenged it. The **[**

] [a,c]

[

] [a,c]

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] [a,c]

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] [a,c]

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] [a,c]

The definition of intermediate power levels in Table 3-1, Note 1, is no longer needed following the removal of the incore tilt performance criteria, and is therefore deleted.

Figure 1
Quadrant Definitions

a,c

a,c

a,c

Change 3-2: Confirmation of Reactor Core Performance (Section 3.3)

Description of Change: Modify Note 1 in Table 3-2 to require at least two reaction rate measurements to exceed the +/-10% reaction rate performance criteria.

Table 3-2
Criteria for the Conditional Exemption of the EOC MTC Measurement

Parameter	Criteria
Assembly Power (Measured Normalized Reaction Rate) Note 1	+/- 10%
~~Measured Incore Quadrant Tilt (Intermediate Power)~~ ~~Note 1~~	~~+/- 4%~~
~~Measured Incore Quadrant Tilt (Full Power)~~	~~+/- 2.0%~~
Core Reactivity Difference	+/- 500 pcm
BOC HZP ITC	+/- 1.25 pcm/ºF
Individual Control Bank Worth	+/- 15% or +/- 100 pcm
Total Control Bank Worth	+/- 8 or 10% Note 2

% Difference = (Measured – Predicted)/Predicted *100

Note 1: Applicable for power distribution measurements greater than or equal to 50% RTP and for reaction rates greater than or equal to 1.0. Low power measurements are not considered because of the potential for high noise to signal ratios leading to erroneous results. ~~Intermediate power is a power level between 50 and 80% RTP.~~ [

] a,c

Note 2: The safety evaluations from References 4 and 8 require the total bank worth review criterion be reduced from 10% to 8% to account for the potential propagation of errors in predicted parameters unfavorably influencing measured rod worths.

Technical Justification:

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] [a,c]

Change C-1: Appendix C, Demonstration Analysis for the Conditional Exemption of the 300 ppm EOC Moderator Temperature Coefficient Measurement (Appendix C, Sections 2.0, Table 2-1 and Section 3.0)

Description of Change: The demonstration analysis performed in Appendix C is modified to remove reference to the incore tilt performance criteria in Appendix C Section 2.0, Table 2-1 and Section 3.0. Appendix C Table 3-2 is deleted, and subsequent Tables renumber accordingly. The qualifier associated with the Reaction Rate performance criteria, Table 2-1, Note 1, is also updated.

Technical Justification:

Changes performed in Appendix C of the report are considered editorial since they reflect the methodology updates previously described in Section 3 Changes 3-1 and 3-2.

Section 2 Changes:

2.0 Procedure

The conditional exemption of the EOC RTP 300 ppm MTC measurement is based on the **[**

] [a,c] Reactivity measurements are performed in accordance with the requirements of Technical Specification 3.1.2. Deviations in predicted minus measured RTP all rods out boron concentrations are converted to reactivity by a predicted differential boron worth. Power distribution data is obtained from incore flux maps performed in accordance with the requirements of Technical Specifications 3.2.1 and 3.2.2. ~~Incore tilts and~~ ~~measured~~ **Measured** minus predicted reaction rate errors are calculated from this power distribution data.

Table 2-1 Changes:

Table 2-1
Criteria for the Conditional Exemption of the EOC MTC Measurement

Parameter	Criteria
Assembly Power (Measured Normalized Reaction Rate) Note 1	+/- 10%
~~Measure Incore Quadrant Tilt (Intermediate Power)~~ ~~Note 1~~	~~+/- 4%~~
~~Measure Incore Quadrant Tilt (Full Power)~~	~~+/- 2%~~
Core Reactivity Difference	+/- 500 pcm
BOC HZP ITC	+/- 1.25 pcm/ºF
Individual Control Bank Worth	+/- 15% or +/- 100 pcm
Total Control Bank Worth	+/- 8 or 10% Note 2

% Difference = (Measured – Predicted)/Predicted *100

Note 1: Applicable for power distribution measurements ≥ 50% rated thermal power and for reaction rates ≥ 1.0. (All acceptance criteria is from Reference 1.) ~~Intermediate power is a power level between 50 and 80% RTP.~~ [

] a,c

Note 2: The safety evaluations from References 2 and 4 require the total bank worth review criterion be reduced from 10% to 8% to account for the potential propagation of errors in predicted parameters unfavorably influencing measured rod worths.

Section 3.0 Changes:

3.0 Confirmation of Core Performance Requirements

The following predicted and measured cycle-specific data from the C1C18 core design is evaluated against the core performance criteria in Table 2-1:

- Maximum and minimum reaction rates deviations
- ~~Maximum and minimum measured incore quadrant power tilts~~
- Full power core reactivity data as a function of burnup
- BOC ZPPT data (Includes the ARO critical boron concentration, ITC, and bank worths)

Core performance data for the above parameters are contained in Tables 3-1 through ~~3-4~~ **3-3**. All predicted data was generated using an NRC-approved CASMO-4/SIMULATE-3 core model (Reference 3). **[** **]** [a,c]
Therefore, the Revised Predicted MTC can be calculated using the methodology outlined in Table 3-5 contained in the main body of DPC-NE-1007-P (Ref. 1).

Change C-2: Appendix C, Tables 3-2, 3-3 and 3-4 (Appendix C, Section 3.0)

Description of Change: Table 3-2 is deleted based on the removal of the incore tilt performance criteria, and Tables 3-3 and 3-4 are renumbered accordingly.

Technical Justification: Editorial.

Table ~~3-3~~ 3-2
C1C18 HFP Reactivity Core Performance Data

Table ~~3-4~~ 3-3
C1C18 Zero Power Physics Test Core Performance Data

Change C-3: Appendix C, References (Section 5.0)

Description of Change: Reference 1 is updated to Revision 1 of DPC-NE-1007-P-A.

Technical Justification: Editorial to reflect methodology updates.

1. DPC-NE-1007-PA, **Rev. 1**, "Conditional Exemption of the EOC MTC Measurement Methodology"