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OPPD
Omaha Public Power District
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Omaha, NE 68102-2247

LIC-11-0119
December 23, 2011

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

REFERENCES: Docket No. 50-285

SUBJECT: Fort Calhoun Station, Unit No. 1, License Amendment Request (LAR) 11-03, "Incorporate New Radial Peaking Factor Definition and Clarify Limiting Conditions for Operation (LCO) 2.10.2(6)"

Pursuant to 10 CFR 50.90, the Omaha Public Power District (OPPD) hereby proposes to revise the Fort Calhoun Station (FCS), Unit No. 1 Technical Specifications (TS). The proposed revisions remove requirements for, and references to, the "Unrodded Integrated Radial Peaking Factor" (F_R). The unrodded integrated radial peaking factor has not been used as a design limit in the safety analysis since April 2001 when OPPD converted to Siemens Power Corporation (now AREVA NP) analysis methods. Section 3.0 of the enclosed evaluation provides more detail regarding the history of this issue.

Modern day incore monitoring systems use a full-core model. As a result, parameters associated with simplified monitoring methods (e.g., quarter-core calculations with F_R and augmentation factors) are obsolete. Accordingly, the definition of "Maximum Radial Peaking Factor" (F_R^T) is incorporated into the FCS Technical Specifications and current requirements for, and references to F_R^T, are revised.

In addition, OPPD is making editorial changes to clarify LCO 2.10.2(6) regarding the shutdown control element assembly (CEA) insertion limit during power operations.

OPPD requests approval of the proposed amendment by January 1, 2013 with an implementation period of 4 months.

No commitments to the NRC are made in this letter.

If you should have any questions regarding this submittal or require additional information, please contact Mr. Bill R. Hansher at (402) 533-6894.

I declare under penalty of perjury that the foregoing is true and correct. Executed on December 23, 2011.

D. J. Bannister
Vice President and CNO

DJB/TAH/mle

Enclosure: OPPD's Evaluation of the Proposed Changes

c: E. E. Collins, Jr., NRC Regional Administrator, Region IV
L. E. Wilkins, NRC Project Manager
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OPPD's Evaluation of the Proposed Changes

Fort Calhoun Station, Unit No. 1, License Amendment Request (LAR) 11-03, "Incorporate New Radial Peaking Factor Definition and Clarify Limiting Conditions for Operation (LCO) 2.10.2(6)"

ATTACHMENTS:

1. Technical Specification Markups
2. Retyped ("Clean") Technical Specification Pages
3. Technical Specification Basis Markup Pages
4. Retyped ("Clean") Technical Specification Basis Pages

1.0 SUMMARY DESCRIPTION

The Omaha Public Power District (OPPD) is requesting an amendment to Renewed Operating License No. DPR-40 for Fort Calhoun Station (FCS), Unit No. 1. This License Amendment Request (LAR) is in response to Condition Report (CR) 2010-2429, which documented discrepancies in the actual methods used to determine the Maximum Radial Peaking Factor (F_R^T) and the information provided in the Technical Specifications (TS). This LAR also responds to CR 2011-6946, which asks that Limiting Conditions for Operation (LCO) 2.10.2(6) be clarified regarding the shutdown control element assembly (CEA) insertion limit. The following attachments are included with this LAR:

1. The existing TS pages marked with the proposed changes. Deleted text is shown in strike-out; added text is in red bold italics with a shaded background.

2. The proposed TS pages with a vertical line in the right margin to denote changes.

3. The existing TS Bases pages marked in a similar manner as the existing TS pages.

4. The proposed TS Bases pages with a thick vertical line in the right margin to denote changes.

Please note that the Bases pages are provided for information only and will be processed in accordance with TS 5.20 “Technical Specifications (TS) Bases Control Program” following NRC approval.

2.0 DETAILED DESCRIPTION

A. The proposed changes to the Table of Contents (TOC) and Definitions Section are as follows.

   i. The TOC entry for Section 2.10.2 is corrected.

      The TOC entry for Section 2.10.2 currently reads:

      2.10.2 Reactivity Control Systems and Core Physics Parameter Limits

      For consistency with the header in the LCO, the TOC entry is revised to read:

      2.10.2 Reactivity Control Systems and Core Physics Parameter<u>s</u> Limits

ii. The definition of Unrodded Integrated Radial Peaking Factor (F_R) is deleted.

iii. The definition of Maximum Radial Peaking Factor (F_R^T) is added.

The definition of F_R^T is proposed to read as follows:

Maximum Radial Peaking Factor (F_R^T)

The Maximum Radial Peaking Factor is the maximum ratio of the individual fuel pin power to the core average pin power integrated over the total core height, including tilt. The F_R^T limit is provided in the Core Operating Limits Report.

B. LCOs 2.10.2(5), 2.10.2(6), 2.10.2(7)

i. These LCOs incorrectly use the possessive form for the terms control element assemblies (i.e., CEA's) and non-trippable CEAs (i.e., NTCEA's). The correct use is CEAs and NTCEAs, respectively, and thus the extraneous apostrophe in these terms is deleted.

C. LCO 2.10.2(6)

i. LCO 2.10.2(6), Shutdown CEA Insertion Limit During Power Operation currently reads:

All shutdown CEA's shall be withdrawn to at least 114 inches as a condition for reactor criticality, or with one or more shutdown CEA's inserted to more than 114 inches withdrawn, except for surveillance testing, within one hour, either:

In order to clarify LCO 2.10.2(6), it is proposed to read:

All shutdown CEAs shall be withdrawn to at least 114 inches as a condition for reactor criticality, or with one or more shutdown CEAs withdrawn less than 114 inches, except for surveillance testing, within one hour, either:

D. LCO 2.10.4(2)

i. The title for LCO 2.10.4(2) currently reads:

Total Integrated Radial Peaking Factor

For consistency with the new definition of F_R^T, the proposed title is:

Maximum Radial Peaking Factor (F_R^T)

ii. The wording of the LCO is revised to require F_R^T to be within the limit provided in the Core Operating Limits Report (COLR). Extraneous discussion of F_R and azimuthal tilt (T_q) is deleted. The existing LCO wording is:

The calculated value of F_R^T defined by $F_R^T = F_R (1+T_q)$ shall be within the limit provided in the COLR. F_R is determined from a power distribution map with no non-trippable CEA's inserted and with all full length CEA's at or above the Long Term Steady State Insertion Limit for the existing Reactor Coolant Pump combination. The azimuthal tilt, T_q, is the measured value of T_q at the time F_R is determined.

The proposed LCO wording is:

The value of F_R^T shall be within the limit provided in the COLR. F_R^T is determined with all full length CEAs at or above the Long Term Steady State Insertion Limit.

E. LCO 2.10.4(4)(b)

i. The LCO currently contains a sentence that reads:

With the indicated azimuthal power tilt determined to be >0.03 but <0.10, correct the power tilt within two hours or determine within the next 6 hours and at least once per subsequent 8 hours, that the total integrated radial peaking factor, F_R^T, is within the limit of Specification 2.10.4(2) or reduce power to less than 70% of rated power within 8 hours of confirming T_q >0.03.

For consistency with the new definition of F_R^T, the term “total integrated” is replaced by “maximum.” LCO 2.10.4(4)(b) is made consistent with LCO 2.10.4(2) in that it will now require F_R^T to be within the COLR limit. The proposed wording and punctuation are as follows:

With the indicated azimuthal power tilt determined to be >0.03 but <0.10, correct the power tilt within two hours or determine within the next 6 hours

and at least once per subsequent 8 hours, that the maximum radial peaking factor, F_R^T, is within the COLR limit, or reduce power to less than 70% of rated power within 8 hours of confirming T_q >0.03.

F. LCO 2.10.4(4)(c)

i. The LCO currently reads:

With the indicated power tilt determined to be ≥ 0.10, power operation may proceed up to 2 hours provided F_R^T does not exceed the power limits of the F_R^T and the Core Power Limitations Figure provided in the COLR, or be in at least hot standby within 6 hours. Subsequent operation for the purpose of measurement to identify the cause of the tilt is allowable provided the power level is restricted to 20% of the maximum allowable thermal power level for the existing reactor coolant pump combination.

The proposed wording is:

With the indicated power tilt determined to be ≥ 0.10, power operation may proceed up to 2 hours provided F_R^T does not exceed the limit provided in the COLR, or be in at least hot standby within 6 hours. Subsequent operation for the purpose of measurement to identify the cause of the tilt is allowable provided the power level is restricted to 20% of the maximum allowable thermal power level.

G. Surveillance Requirement (SR) 3.10(5)

i. The title for SR 3.10(5) is:

Total Integrated Radial Peaking Factors (F_R^T)

For consistency with the new definition of F_R^T, the proposed title is:

Maximum Radial Peaking Factor (F_R^T)

ii. SR 3.10(5) currently reads:

F_R^T shall be determined to be within the limits of Specification 2.10.4 at the following intervals:

a. After each refueling and prior to operation above 70 percent of rated power.

b. At least once per 31 EFPD's of accumulated power operation.

For consistency with the changes to LCOs 2.10.4(2), 2.10.4(4)(b), 2.10.4(4)(c), and to correct the punctuation of EFPDs (effective full power days), it is proposed that SR 3.10(5) read:

F_R^T shall be determined to be within the COLR limit at the following intervals:

a. After each refueling and prior to operation above 70 percent of rated power.

b. At least once per 31 EFPDs of accumulated power operation.

H. Bases Changes:

Upon approval of the TS changes, corresponding changes will be made to the Bases for Section 1.0, *Safety Limits* and LCO 2.10.4, *Power Distribution Limits*. The Bases changes are provided for information only and will be processed in accordance with TS 5.20, *Technical Specifications (TS) Bases Control Program*. The Bases pages marked to show the expected changes are attached for information and use in reviewing this request.

3.0 TECHNICAL EVALUATION

Background

The monitoring of a nuclear reactor core is performed to guarantee that predictions of core behavior used as an input for the calculated plant response to transient events is bounding of actual core operation. Fuel design limits are protected by ensuring that the starting conditions for the core distribution prior to the occurrence of a transient are bounded by the assumptions used in the analysis. This monitoring ensures that no fuel damage will occur during anticipated operational occurrences (AOO) and ensures that radiation releases for other postulated design basis accidents will be bounded by the predicted acceptable values.

Older core monitoring methods have used the concept of “tilt” as a way of augmenting measured power distributions to account for a core-wide power shift toward one of the core quadrants. Modern core monitoring methods use full-core models that do not require the concept of tilt to achieve an accurate measurement of the limiting core peaking factors. Full-core models were not previously feasible due to limitations in computer processing power and storage.

The concept of "unrodded" peaking factors is also no longer necessary due to advances in core monitoring technology. Pre-calculated power distributions derived with unrodded models are no longer required to be augmented with additional peaking caused by control rod insertion. Peaking from control rod insertion can now be directly calculated, so the concept of unrodded peaking factors is an anachronism.

More direct comparisons between the radial peaking factor limits that are used for the prediction of departure from nucleate boiling ratio (DNBR) and the actual radial peaking factors measured during core operation can now be made. However, a limitation on azimuthal power tilt is still necessary to alert operators to abnormal core behavior and ensure a thorough investigation into the cause of the phenomenon.

History

In Cycle 20, OPPD made a significant fuel design change by inserting the first reload of the Siemens Power Corporation (SPC) high thermal performance (HTP) fuel design. At the same time, OPPD also began the use of the SPC approved safety analysis methodologies. The SPC (now AREVA NP) methodologies use the XCOBRA-IIIC thermal hydraulics code with a full core model. The model applies limiting axial and radial power distributions to all DNB event analyses to determine the minimum DNBR values for limiting AOO and postulated accidents (PA). The model uses the Core Operating Limits Report (COLR) limit on F_R^T directly, and does not separate azimuthal tilt. The setpoints calculations, which use XCOBRA-IIIC and several other codes, also use F_R^T. Likewise, the methodology for evaluating the challenge to fuel centerline melt (FCM) uses F_R^T without separating azimuthal tilt. The radiological consequences analyses use the full core F_R^T limit for dose calculations.

In Cycle 25, OPPD began to use GARDEL core monitoring software. GARDEL uses a full core model to determine the operating power distribution indicated from the incore detector signals. The measured power distribution is used to verify that the TS limits for Linear Heat Rate (LHR), Maximum Radial Peaking Factor (F_R^T), and Azimuthal Power Tilt (T_q) are not exceeded.

Evaluation

A. Table of Contents and Definitions Section Changes

i. The proposed change to the TOC entry for Section 2.10.2 is an editorial change to make the TOC match the header in the LCO.

ii. The TS definition of unrodded integrated radial peaking factor (F_R) is obsolete and can be deleted since F_R and Azimuthal Tilt (T_q) are no longer treated as separate parameters in either the safety analyses or the FCS core monitoring system.

iii. Maximum Radial Peaking Factor (F_R^T) is added as a definition to reflect that F_R^T is calculated directly. Although NUREG-1432, "Standard Technical Specifications Combustion Engineering Plants" uses the terms "Total Integrated" in the title of its definition for F_R^T, these terms will be replaced by the term "Maximum" in the FCS definition. "Integrated" is a term previously used to provide a distinction between the planar radial peaking factor (F_{xy}) and the "integrated" radial peaking factor used for DNBR calculations. Since F_{xy} is no longer used as a limit due to modern full-core methods, the term "integrated" is no longer relevant. Similarly, it is more accurate to replace the term "total" with "maximum" to denote the maximum value of F_R^T in the core to which the limit is compared.

B. LCOs 2.10.2(5), 2.10.2(6), 2.10.2(7)

i. Eliminating the apostrophes in the acronyms for control element assemblies (CEAs) and non-trippable CEAs is an editorial change to correct punctuation.

C. LCO 2.10.2(6)

i. The current wording of this portion of the LCO (i.e., "with one or more shutdown CEA's inserted to more than 114 inches withdrawn") is confusing albeit correct. The proposed change makes the sentence more consistent and clarifies that with one or more shutdown CEAs withdrawn less than 114 inches (except for surveillance testing), specified actions must be taken. This revision is administrative in nature as the LCO requirements are unchanged.

D. LCO 2.10.4(2)

i. The title for LCO 2.10.4(2) is revised for consistency with the new definition of F_R^T. As such, this change is for consistency and is editorial in nature.

ii. The wording of the LCO is revised to require F_R^T to be within the limit provided in the COLR, which is consistent with LCO 3.2.3 of NUREG-

1432. Discussion of the calculation of F_R^T using F_R and azimuthal tilt (T_q) is extraneous and can be deleted since these terms are no longer treated as separate parameters in either the safety analyses or the FCS core monitoring system. LCO 2.10.2(5) effectively requires the non-trippable CEAs to be fully withdrawn. Therefore, the portion of LCO 2.10.4(2) that says F_R^T is determined "with no non-trippable CEA's inserted" is unnecessary. This wording is left over from when the non-trippable CEAs were part-length CEAs used for power shaping.

The wording in LCO 2.10.4(2) regarding "the existing Reactor Coolant Pump combination" is deleted because LCO 2.1.1(1) requires all four reactor coolant pumps to be in operation when the reactor is critical. As such, in regard to LCO 2.10.4(2), there are no separate Long Term Insertion Limits for different reactor coolant pump combinations and therefore, the wording is unnecessary.

E. LCO 2.10.4(4)(b)

i. For consistency with the new definition of F_R^T, the term "total integrated" is replaced by "maximum." LCO 2.10.4(4)(b) is made consistent with LCO 2.10.4(2) in that it will now require F_R^T to be within the COLR limit. The changes to LCO 2.10.4(4)(b) are editorial in nature.

F. LCO 2.10.4(4)(c)

i. LCO 2.10.4(4)(c) is simplified to remove an unnecessarily specific reference to a figure in the COLR and will instead simply require that F_R^T be within the limit provided in the COLR. Because LCO 2.10.4(4)(c) is applicable when operating above 70% of rated power when all four reactor coolant pumps must be in operation, the verbiage "for the existing reactor coolant pump combination" is unnecessary and is deleted.

G. Surveillance Requirement (SR) 3.10(5)

i. The title of the SR is changed to be consistent with the new definition of F_R^T.

For consistency with the changes to LCOs 2.10.4(2), 2.10.4(4)(b), 2.10.4(4)(c), F_R^T is required to be within the COLR limit. In addition, the punctuation of EFPDs (effective full power days) is corrected by removing the apostrophe. The proposed changes are administrative in nature.

H. Bases Changes:

The change to the Basis of the Safety Limits is for consistency with the new definition of F_R^T. The changes to the Basis of LCO 2.10.4 are intended primarily to better organize the sequencing of the Basis information to the LCOs and reflect the changes to F_R^T and azimuthal power tilt as described above. In addition, out-of-date information related to the validity of azimuthal tilt assumed by ABB-CE is deleted as OPPD now uses AREVA NP methodology.

Conclusion

The proposed TS changes more closely align the description of the monitoring methods to the fuel design limits. Core monitoring functions will not change as a result of this license amendment request and Safety Limits for LHR, F_R^T and T_q will continue to be met.

4.0 REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements/Criteria

The Maximum Radial Peaking Factor is an assumption that is used as an initial condition for transient analyses that present a challenge to the integrity of the cladding. As such, the Maximum Radial Peaking Factor satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii). The applicable criteria for these reactivity and power distribution design requirements are 10 CFR 50, Appendix A and 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Plants."

However, as FCS was licensed for construction prior to May 21, 1971, in lieu of 10 CFR 50, Appendix A, OPPD is for the most part, committed to the draft General Design Criteria (GDC) published for comment in the Federal Register on July 11, 1967 (32 FR 10213). The draft GDC and OPPD's response thereto are located in Appendix G of the Updated Safety Analysis Report (USAR). In a memorandum (Reference 6.1) dated September 18, 1992, the Commission approved the staff proposal in SECY-92-223, "Resolution of Deviations Identified During the Systematic Evaluation Program," not to apply 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants," to plants with construction permits issued prior to May 21, 1971.

USAR, Appendix G, Criterion 6, "Reactor Core Design" is the Criterion that is most applicable to the proposed amendment. The proposed changes ensure

that Fort Calhoun Station will continue to comply with Criterion 6 and limit damage to the fuel cladding during an accident by ensuring that the plant is operating within allowable conditions at the onset of a transient.

USAR, Appendix G, Criterion 11, “Control Room” is also applicable to the proposed amendment. However, as a result of licensing basis changes, compliance with it has been superseded by compliance with 10 CFR 50, Appendix A, Criterion 19, “Control room.” The accident source term used in the design basis radiological analyses for control room habitability was replaced with an alternative source term (AST) pursuant to 10 CFR 50.67, "Accident Source Term." The changes proposed by this LAR ensure that Fort Calhoun Station continues to comply with 10 CFR 50, Appendix A, Criterion 19.

4.2 Precedent

Fort Calhoun Station, Unit No. 1 has custom Technical Specifications. The proposed changes to the radial peaking factor definition, associated LCO, and SR are similar to those approved in Amendment No. 205 (Reference 6.2) to Facility Operating License No. DPR-20 for the Palisades Plant, which uses Standard Technical Specifications.

4.3 Significant Hazards Consideration

The proposed License Amendment Request (LAR) would delete Technical Specification (TS) references to the Unrodded Integrated Radial Peaking Factor (F_R), (a peaking factor no longer used in core design or safety analyses). In recognition of modern day incore monitoring systems that use a full-core model, the definition of “Maximum Radial Peaking Factor” (F_R^T) is incorporated into the Fort Calhoun Station (FCS) Technical Specifications and current requirements for, and references to F_R^T, are revised accordingly. The LAR also clarifies but does not otherwise alter the actions required by Limiting Conditions for Operation (LCO) 2.10.2(6) regarding the shutdown control element assembly (CEA) insertion limit.

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

   There are no changes in plant systems, plant control operating procedures or instrument alarm or trip settings associated with this LAR. Because neither physical equipment nor operating methods for that equipment change, the probability of accident initiation does not change. Therefore, the proposed TS

change does not involve a significant increase in the probability of an accident previously evaluated.

The Unrodded Integrated Radial Peaking factor (F_R) has been used in past safety analyses and radiological consequence analyses. These analyses utilized the assumption that F_R would remain within the TS limit during plant operations. These analyses verify, for anticipated operational occurrences (AOO) and postulated accidents (PA), that:

1. The departure from nucleate boiling ratio (DNBR) remains above the appropriate TS Safety Limit, and

2. The calculated offsite doses and control room dose for the affected events remain within the guidelines of 10 CFR 50.67, 10 CFR 100, and 10 CFR 50, Appendix A, General Design Criteria (GDC) 19, "Control room."

All current safety analysis calculations are performed using the Maximum Radial Peaking Factor (F_R^T) limit (which remains unchanged), without exceeding the specified Safety Limits. The radiological consequence events have used the F_R^T limit to determine the source strength.

Because the results of the transient analyses meet the Safety Limits, and because the dose consequences of all analyzed events are within the guidelines of 10 CFR 50.67, 10 CFR 100, and GDC 19, the proposed LAR does not involve a significant increase in the consequences of an accident previously evaluated.

The remaining changes are administrative or editorial in nature. Therefore, operation of the plant in accordance with the proposed TS does not involve a significant increase in the probability or consequences of an accident previously evaluated.

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

Operation of the plant in accordance with the proposed TS does not add any new equipment, settings, or alter any plant operating practices. The Unrodded Integrated Radial Peaking Factor (F_R) is a peaking factor no longer used in core design or safety analyses. The definition of “Maximum Radial Peaking Factor” (F_R^T) is incorporated into the TS and current requirements for, and references to F_R^T, are revised accordingly to reflect modern day incore monitoring systems. The remaining changes are administrative or

editorial in nature. Since there are no changes in operating plant equipment, settings, or normal operating practices, operation in accordance with the proposed TS does not create the possibility of a new or different kind of accident from any accident previously evaluated.

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

The disposition of the USAR Chapter 14 events, the setpoint verification, the fuel centerline melt (FCM) and the minimum DNBR analyses will continue to use the Maximum Radial Peaking Factor in accordance with approved methods. A detailed XCOBRA-IIIC model, which incorporates the limiting radial and axial power distributions, is applied to pre-trip departure from nucleate boiling (DNB) event analyses to determine the minimum DNBR values for limiting AOOs and PAs with the high thermal performance (HTP) DNB correlation. A post-trip event (Main Steam Line Break) has all CEAs inserted except for the most reactive CEA, and therefore has different radial and axial power distributions to which the Core Operating Limits Report (COLR) F_R^T limit does not apply. The calculated results for the limiting events meet the Safety Limits specified in the TS. A simplified XCOBRA-IIIC model is used in the verification of the plant protection system setpoints.

Therefore, operation of the plant in accordance with the proposed TS does not involve a significant reduction in the margin of safety.

4.4 Conclusion

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

A review has determined that the proposed amendment 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 amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or 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 amendment meets to 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 or environmental assessment need be prepared in connection with the proposed amendment.

6.0 REFERENCES

6.1 Memorandum from Samuel J. Chilk, Secretary, NRC, for James M. Taylor, Executive Director for Operations, Subject: "Resolution of Deviations Identified during the Systematic Evaluation Program," dated September 18, 1992 (ADAMS Legacy Library Accession No. AN9210060362)

6.2 Letter from NRC (Darl S. Hood) to Palisades Plant (Douglas E. Cooper), “Palisades Plant - Issuance of Amendment Re: Assembly Radial Peaking Factor (TAC No. MB1683),” dated August 1, 2001 (ML011990100)

Technical Specification Markups[1]

[1] Deleted text shown in ~~strikeout~~; added text in ***shaded bold italics***.

TECHNICAL SPECIFICATIONS

TABLE OF CONTENTS

DEFINITIONS

Azimuthal Power Tilt - T_q

Azimuthal Power Tilt shall be the power asymmetry between azimuthally symmetric fuel assemblies.

~~Unrodded Integrated Radial Peaking Factor - F_R~~

~~The Unrodded Integrated Radial Peaking Factor is the ratio of the peak pin power to the average pin power in an unrodded core, excluding azimuthal tilt, T_q. The maximum F_R limit is provided in the Core Operating Limits Report.~~

Maximum Radial Peaking Factor (F_R^T)

The Maximum Radial Peaking Factor is the maximum ratio of the individual fuel pin power to the core average pin power integrated over the total core height, including tilt. The F_R^T limit is provided in the Core Operating Limits Report.

Process Control Program (PCP)

The document(s) that contain the current formulas, sampling, analyses, tests, and determinations to be made to ensure that processing and packaging of solid radioactive wastes based on demonstrated processing of actual or simulated wet solid wastes will be accomplished in such a way as to assure compliance with 10 CFR 20, 61, 71, State Regulations, burial ground requirements, and other requirements governing the disposal of solid waste.

Dose Equivalent I-131

That concentration of I-131 (μCi/gm) which alone would produce the same thyroid dose as the quantity and isotopic mixture of I-131, I-132, I-133, I-134 and I-135 actually present. In other words,

Dose Equivalent I-131 (μCi/gm)	=	μCi/gm of I-131
	+	0.0361 x μCi/gm of I-132
	+	0.270 x μCi/gm of I-133
	+	0.0169 x μCi/gm of I-134
	+	0.0838 x μCi/gm of I-135

2.0 **LIMITING CONDITIONS FOR OPERATION**
2.10 Reactor Core (Continued)
2.10.2 Reactivity Control Systems and Core Physics Parameters Limits (Continued)

(5) Non-trippable CEA Position During Power Operation

All non-trippable CEA~~'~~s (NTCEA) shall be withdrawn to at least 114 inches (actual position). If one or more NTCEA~~'~~s becomes misaligned from other NTCEA~~'~~s by more than 12 inches (actual position) either:

a. Restore the NTCEA to within the specified alignment requirements within one hour, or
b. Be in at least hot shutdown within an additional 6 hours.

(6) Shutdown CEA Insertion Limit During Power Operation

All shutdown CEA~~'~~s shall be withdrawn to at least 114 inches as a condition for reactor criticality, or with one or more shutdown CEA~~'~~s ~~inserted~~ withdrawn ~~to more~~ less than 114 inches ~~withdrawn~~, except for surveillance testing, within one hour, either:

a. Withdraw the CEA~~'~~s to at least 114 inches, or
b. Declare the CEA~~'~~s inoperable and apply Specification 2.10.2(4).

(7) Regulating CEA Insertion Limits During Hot Standby and Power Operation

The regulating CEA groups shall be positioned within the acceptable operating range for regulating rod position of the Power Dependent Insertion Limits Figure provided in the COLR except during CEA exercises above 114 inches. With all CEA~~'~~s operable, CEA insertion beyond the Long Term Insertion Limits is restricted to:

1. 4 hours per 24 hour interval,
2. 4 EFPD per 30 EFPD interval, and
3. 14 EFPD per fuel cycle.

a. When the regulating CEA groups are inserted beyond the Transient Insertion Limits within two hours, either:

(i) Restore the regulating CEA groups to above the Transient Insertion Limits, or

(ii) Reduce reactor power to the allowed power of the Power Dependent Insertion Limit Figure of the COLR which permits continued operation above the Transient Insertion Limit using the existing CEA group position.

2.0 **LIMITING CONDITIONS FOR OPERATION**
2.10 Reactor Core (Continued)
2.10.4 Power Distribution Limits (Continued)

(c) When the linear heat rate is continuously monitored by the excore detectors, withdraw the full length CEA~~'~~s beyond the long term insertion limits of Specification 2.10.2(7) and maintain the Axial Shape Index, Y_I within the limits of Limiting Condition for Operations for the Excore Monitoring of LHR Figure provided in the COLR. If the linear heat rate is exceeding its limits as determined by the Axial Shape Index, Y_I, being outside the limits of the Limiting Condition for Operation for Excore Monitoring of LHR Figure provided in the COLR:

(i) Restore the reactor power and Axial Shape Index, Y_I, to within the limits of the Limiting Condition for Operations for Excore Monitoring of LHR Figure provided in the COLR within 2 hours, or

(ii) Be in at least hot standby within the next 6 hours.

(d) When calibration of the ex-core detectors has not been accomplished within the previous 30 equivalent full power days, then:

(i) reduce the axial power distribution monitoring trip setpoints as shown in the Axial Power Distribution LSSS for 4 Pump Operation Figure provided in the COLR by 0.03 ASI units; and

(ii) reduce the axial power distribution monitoring Limiting Condition for Operations (LCO for Excore Monitoring of LHR and LCO for DNB Monitoring Figures provided in the COLR) by 0.03 ASI units.

When calibration of the ex-core detectors has not been accomplished within the previous 200 equivalent full power days, the power shall be limited to less than that corresponding to 75% of the peak linear heat rate permitted by Specification 2.10.4(1).

(2) ~~Total Integrated~~ ***Maximum*** Radial Peaking Factor ***(F_R^T)***

The ~~calculated~~ value of F_R^T ~~defined by $F_R^T = F_R (1+T_q)$~~ shall be within the limit provided in the COLR. F_R^T is determined ~~from a power distribution map with no non-trippable CEA's inserted and~~ with all full length CEA~~'~~s at or above the Long Term Steady State Insertion Limit ~~for the existing Reactor Coolant Pump combination. The azimuthal tilt, T_q, is the measured value of T_q at the time F_R is determined~~.

Amendment No. ~~5,20,32,43, 47,117,126,141, 167,249, 259~~

2.0 **LIMITING CONDITIONS FOR OPERATION**
2.10 Reactor Core (Continued)
2.10.4 Power Distribution Limits (Continued)

(4) Azimuthal Power Tilt (T_q)

When operating above 70% of rated power,

(a) The azimuthal power tilt (T_q) shall not exceed 0.10 whenever the CEA~~'~~s are at or above the Long Term Insertion Limit and F_R^T is being monitored with the incore detectors.

(b) The azimuthal power tilt (T_q) shall not exceed 0.03 whenever the provisions of 2.10.4(4)(a) do NOT allow F_R^T to be monitored with the incore detectors. With the indicated azimuthal power tilt determined to be >0.03 but <0.10, correct the power tilt within two hours or determine within the next 6 hours and at least once per subsequent 8 hours, that the ~~total integrated~~ *maximum* radial peaking factor, F_R^T, is within the *COLR* limit~~, of Specification 2.10.4(2)~~ or reduce power to less than 70% of rated power within 8 hours of confirming T_q >0.03.

(c) With the indicated power tilt determined to be ≥ 0.10, power operation may proceed up to 2 hours provided F_R^T does not exceed the ~~power~~ limit~~s of the F_R^T and the Core Power Limitations Figure~~ provided in the COLR, or be in at least hot standby within 6 hours. Subsequent operation for the purpose of measurement to identify the cause of the tilt is allowable provided the power level is restricted to 20% of the maximum allowable thermal power level ~~for the existing reactor coolant pump combination~~.

3.0 **SURVEILLANCE REQUIREMENTS**
3.10 Reactor Core Parameters (Continued)

(2) Moderator Temperature Coefficient

The MTC shall be determined at the following frequencies and power conditions during each fuel cycle:

1. Prior to initial operation above 5% of rated power, after each fuel loading.
2. At any power level within 500 MWD/T of initial operation after each refueling.
3. At any power level within ± 14 EFPD of reaching a rated power equilibrium boron concentration of 300 ppm.

(3) Regulating CEA Insertion Limits

a. The position of each regulating CEA group shall be determined to be above the Transient Insertion Limits at least once per shift.

b. The accumulated times during which the regulating CEA groups are inserted beyond the Steady State Insertion Limits but above the Transient Insertion Limits shall be determined once per day.

(4) Linear Heat Rate Monitoring Systems

a. The incore detector monitoring system may be used for monitoring the core power distribution provided that at least once per 31 days of accumulated power operation the incore detector alarms generated by the plant computer are verified to be valid and satisfy the requirements of the core distribution map.

b. The excore detector monitoring system may be used for monitoring the core power distribution by:

1. Verifying at least once per 31 days of accumulated power operation that the axial shape index, Y_I, monitoring limit setpoints are maintained within the allowable limits of the Limiting Condition for Operations for Excore LHR Monitoring Figure provided in the COLR, as adjusted by Specification 2.10.4(1).

(5) ~~Total Integrated~~ ***Maximum*** Radial Peaking Factor~~s~~ (F_R^T)

F_R^T shall be determined to be within the ***COLR*** limit~~s of Specification 2.10.4~~ at the following intervals:

a. After each refueling and prior to operation above 70 percent of rated power.

b. At least once per 31 EFPD~~'~~s of accumulated power operation.

Retyped ("Clean") Technical Specification Pages

TECHNICAL SPECIFICATIONS

TABLE OF CONTENTS

DEFINITIONS

Azimuthal Power Tilt - T_q

Azimuthal Power Tilt shall be the power asymmetry between azimuthally symmetric fuel assemblies.

Maximum Radial Peaking Factor (F_R^T)

The Maximum Radial Peaking Factor is the maximum ratio of the individual fuel pin power to the core average pin power integrated over the total core height, including tilt. The F_R^T limit is provided in the Core Operating Limits Report.

Process Control Program (PCP)

The document(s) that contain the current formulas, sampling, analyses, tests, and determinations to be made to ensure that processing and packaging of solid radioactive wastes based on demonstrated processing of actual or simulated wet solid wastes will be accomplished in such a way as to assure compliance with 10 CFR 20, 61, 71, State Regulations, burial ground requirements, and other requirements governing the disposal of solid waste.

Dose Equivalent I-131

That concentration of I-131 (μCi/gm) which alone would produce the same thyroid dose as the quantity and isotopic mixture of I-131, I-132, I-133, I-134 and I-135 actually present. In other words,

Dose Equivalent I-131 (μCi/gm)	=	μCi/gm of I-131
	+	0.0361 x μCi/gm of I-132
	+	0.270 x μCi/gm of I-133
	+	0.0169 x μCi/gm of I-134
	+	0.0838 x μCi/gm of I-135

2.0 **LIMITING CONDITIONS FOR OPERATION**
2.10 Reactor Core (Continued)
2.10.2 Reactivity Control Systems and Core Physics Parameters Limits (Continued)

(5) Non-trippable CEA Position During Power Operation

All non-trippable CEAs (NTCEA) shall be withdrawn to at least 114 inches (actual position). If one or more NTCEAs becomes misaligned from other NTCEAs by more than 12 inches (actual position) either:

a. Restore the NTCEA to within the specified alignment requirements within one hour, or
b. Be in at least hot shutdown within an additional 6 hours.

(6) Shutdown CEA Insertion Limit During Power Operation

All shutdown CEAs shall be withdrawn to at least 114 inches as a condition for reactor criticality, or with one or more shutdown CEAs withdrawn less than 114 inches, except for surveillance testing, within one hour, either:

a. Withdraw the CEAs to at least 114 inches, or
b. Declare the CEAs inoperable and apply Specification 2.10.2(4).

(7) Regulating CEA Insertion Limits During Hot Standby and Power Operation

The regulating CEA groups shall be positioned within the acceptable operating range for regulating rod position of the Power Dependent Insertion Limits Figure provided in the COLR except during CEA exercises above 114 inches. With all CEAs operable, CEA insertion beyond the Long Term Insertion Limits is restricted to:

1. 4 hours per 24 hour interval,
2. 4 EFPD per 30 EFPD interval, and
3. 14 EFPD per fuel cycle.

a. When the regulating CEA groups are inserted beyond the Transient Insertion Limits within two hours, either:

(i) Restore the regulating CEA groups to above the Transient Insertion Limits, or

(ii) Reduce reactor power to the allowed power of the Power Dependent Insertion Limit Figure of the COLR which permits continued operation above the Transient Insertion Limit using the existing CEA group position.

2.0 **LIMITING CONDITIONS FOR OPERATION**
2.10 Reactor Core (Continued)
2.10.4 Power Distribution Limits (Continued)

(c) When the linear heat rate is continuously monitored by the excore detectors, withdraw the full length CEAs beyond the long term insertion limits of Specification 2.10.2(7) and maintain the Axial Shape Index, Y_I within the limits of Limiting Condition for Operations for the Excore Monitoring of LHR Figure provided in the COLR. If the linear heat rate is exceeding its limits as determined by the Axial Shape Index, Y_I, being outside the limits of the Limiting Condition for Operation for Excore Monitoring of LHR Figure provided in the COLR:

(i) Restore the reactor power and Axial Shape Index, Y_I, to within the limits of the Limiting Condition for Operations for Excore Monitoring of LHR Figure provided in the COLR within 2 hours, or

(ii) Be in at least hot standby within the next 6 hours.

(d) When calibration of the ex-core detectors has not been accomplished within the previous 30 equivalent full power days, then:

(i) reduce the axial power distribution monitoring trip setpoints as shown in the Axial Power Distribution LSSS for 4 Pump Operation Figure provided in the COLR by 0.03 ASI units; and

(ii) reduce the axial power distribution monitoring Limiting Condition for Operations (LCO for Excore Monitoring of LHR and LCO for DNB Monitoring Figures provided in the COLR) by 0.03 ASI units.

When calibration of the ex-core detectors has not been accomplished within the previous 200 equivalent full power days, the power shall be limited to less than that corresponding to 75% of the peak linear heat rate permitted by Specification 2.10.4(1).

(2) Maximum Radial Peaking Factor (F_R^T)

The value of F_R^T shall be within the limit provided in the COLR. F_R^T is determined with all full length CEAs at or above the Long Term Steady State Insertion Limit.

2.0 **LIMITING CONDITIONS FOR OPERATION**
2.10 Reactor Core (Continued)
2.10.4 Power Distribution Limits (Continued)

(4) Azimuthal Power Tilt (T_q)

When operating above 70% of rated power,

(a) The azimuthal power tilt (T_q) shall not exceed 0.10 whenever the CEAs are at or above the Long Term Insertion Limit and F_R^T is being monitored with the incore detectors.

(b) The azimuthal power tilt (T_q) shall not exceed 0.03 whenever the provisions of 2.10.4(4)(a) do NOT allow F_R^T to be monitored with the incore detectors. With the indicated azimuthal power tilt determined to be >0.03 but <0.10, correct the power tilt within two hours or determine within the next 6 hours and at least once per subsequent 8 hours, that the maximum radial peaking factor, F_R^T, is within the COLR limit, or reduce power to less than 70% of rated power within 8 hours of confirming T_q >0.03.

(c) With the indicated power tilt determined to be ≥ 0.10, power operation may proceed up to 2 hours provided F_R^T does not exceed the limit provided in the COLR, or be in at least hot standby within 6 hours. Subsequent operation for the purpose of measurement to identify the cause of the tilt is allowable provided the power level is restricted to 20% of the maximum allowable thermal power level.

3.0 **SURVEILLANCE REQUIREMENTS**

3.10 Reactor Core Parameters (Continued)

(2) Moderator Temperature Coefficient

The MTC shall be determined at the following frequencies and power conditions during each fuel cycle:

1. Prior to initial operation above 5% of rated power, after each fuel loading.
2. At any power level within 500 MWD/T of initial operation after each refueling.
3. At any power level within ± 14 EFPD of reaching a rated power equilibrium boron concentration of 300 ppm.

(3) Regulating CEA Insertion Limits

a. The position of each regulating CEA group shall be determined to be above the Transient Insertion Limits at least once per shift.

b. The accumulated times during which the regulating CEA groups are inserted beyond the Steady State Insertion Limits but above the Transient Insertion Limits shall be determined once per day.

(4) Linear Heat Rate Monitoring Systems

a. The incore detector monitoring system may be used for monitoring the core power distribution provided that at least once per 31 days of accumulated power operation the incore detector alarms generated by the plant computer are verified to be valid and satisfy the requirements of the core distribution map.

b. The excore detector monitoring system may be used for monitoring the core power distribution by:

1. Verifying at least once per 31 days of accumulated power operation that the axial shape index, $Y_{I,}$ monitoring limit setpoints are maintained within the allowable limits of the Limiting Condition for Operations for Excore LHR Monitoring Figure provided in the COLR, as adjusted by Specification 2.10.4(1).

(5) Maximum Radial Peaking Factor (F_R^T)

F_R^T shall be determined to be within the COLR limit at the following intervals:

a. After each refueling and prior to operation above 70 percent of rated power.

b. At least once per 31 EFPDs of accumulated power operation.

Technical Specification Basis Markup Pages

1.0 SAFETY LIMITS

1.1 Safety Limits (SLs) (continued)

Basis

To maintain the integrity of the fuel cladding and prevent the release of significant amounts of fission products to the reactor coolant, it is necessary to prevent overheating of the cladding under normal operating conditions. This is accomplished by operating within the nucleate boiling regime of heat transfer, wherein the heat transfer coefficient is large enough so that the clad surface temperature is only slightly greater than the coolant saturation temperature. The upper boundary of the nucleate boiling regime is termed "departure from nucleate boiling" (DNB).

At DNB there is a sharp reduction of the heat transfer coefficient, which would result in high clad temperature and the possibility of clad failure. Although DNB is not an observable parameter during reactor operation, the observable parameters of reactor thermal power and reactor coolant flow, temperature and pressure can be related to DNB through a correlation. The local DNB ratio (DNBR), defined as the ratio of the heat flux that would cause DNB at a particular core location to the actual heat flux at that location, is indicative of the margin to DNB.

The minimum value of the DNBR during steady state operation, normal operational transients, and anticipated transients corresponds to a 95% probability at a 95% confidence level that DNB will not occur, which is considered an appropriate margin to DNB for all operating conditions.(1)

The curves of Figure 1-1 represent the loci of points for reactor thermal power (either neutron flux instruments or ΔT instruments), reactor coolant system pressure, and cold leg temperature for which the minimum DNBR is not less than the minimum DNBR limit. The area of safe operation is below these lines.

SL 1.1.1(b) ensures that fuel centerline temperature remains below the fuel melt temperature 5081°F during normal operating conditions or design anticipated operational occurrences (AOOs) with adjustments for burnup and burnable poison. An adjustment of 58°F per 10,000 MWD/MTU has been established in XN-NF-82-06(P)(A), Revision 1, Supplements 2, 4 and 5 (Ref. 8) and adjustments for burnable poisons are established based on XN-NF-79-56(P)(A), Revision 1, Supplement 1 (Ref. 9).

The reactor core safety limits are based on radial peaks limited by the CEA insertion limits in Section 2.10 and axial shapes within the axial power distribution trip limits in the COLR. The Thermal Margin/Low Pressure trip requirements shall be within the limits provided in the COLR. The Thermal Margin/Low Pressure trip is based on ~~an unrodded integrated total radial peak (F_R^I)~~ ***the maximum radial peaking factor (F_R^T)*** that is provided in the COLR.

2.0 **LIMITING CONDITIONS FOR OPERATION**
2.10 Reactor Core (Continued)
2.10.4 Power Distribution Limits (Continued)

(5) DNBR Margin During Power Operation Above 15% of Rated Power

(a) The following limits on DNB-related parameters shall be maintained:

(i)	Cold Leg Temperature (Core Inlet Temperature)	as specified in the COLR
(ii)	Pressurizer Pressure	≥ 2075 psia(1)
(iii)	Reactor Coolant Flow rate	≥ 202,500 gpm indicated
(iv)	Axial Shape Index	as specified in the COLR

(b) With any of the above parameters exceeding the limit, restore the parameter to within its limit within 2 hours or reduce power to less than 15% of rated power within the next 8 hours.

Basis

Linear Heat Rate

The limitation on linear heat rate ensures that in the event of a LOCA, the peak temperature of the fuel cladding will not exceed 2200°F.

Either of the two core power distribution monitoring systems, the Excore Detector Monitoring System or the Incore Detector Monitoring System, provides adequate monitoring of the core power distribution and is capable of verifying that the linear heat rate does not exceed its limit. The Excore Detector Monitoring System performs this function by continuously monitoring the axial shape index (ASI) with the operable quadrant symmetric excore neutron flux detectors. The axial shape index is maintained within the allowable limits of the Limiting Condition for Operation for Excore Monitoring of LHR Figure provided in the COLR. This ASI is adjusted by Specification 2.10.4(1)(c) for the allowed linear heat rate of the Allowable Peak Linear Heat Rate vs. Burnup Figure provided in the COLR and the F_R^T and Core Power Limitations Figure provided in the COLR. In conjunction with the use of the excore monitoring system and in establishing the axial shape index limits, the following assumptions are made: (1) the CEA insertion limits of Specification 2.10.1(6) and long term insertion limits of Specification 2.10.1(7) are satisfied, and (2) the flux peaking augmentation factors are as shown in Figure 2-8.

(1) Limit not applicable during either a thermal power ramp in excess of 5% of rated thermal power per minute or a thermal power step of greater than 10% of rated thermal power.

2.0 **LIMITING CONDITIONS FOR OPERATION**
2.10 Reactor Core (Continued)
2.10.4 Power Distribution Limits (Continued)

The Incore Detector Monitoring system provides a direct measure of the peaking factors and the alarms which have been established for the individual incore detector segments ensure that the peak linear heat rates will be continuously maintained within the allowable limits of the Allowable Peak Linear Heat Rate vs. Burnup Figure provided in the COLR. The setpoints for these alarms include allowances, set in the conservative directions. If the plant computer fails, the incore detector alarms become inoperable. The provisions of Section 2.10.4(1)(b) are intended to address this situation and assure safe operation of the reactor for up to 7 days.

Calibration of the ex-core detector input to the APD calculator is required to eliminate ASI uncertainties due to instrument drift and axially nonuniform detector exposure. If the recalibration is not performed in the period specified, the prescribed steps will assure safe operation of the reactor.

~~Total Integrated Radial Peaking Factor (F_R^I) and Azimuthal Power Tilt (T_q)~~

~~The limitation of T_q is provided to ensure that the assumptions used in the analysis for establishing the Linear Heat Rate and Local Power Density - High LCO's and LSSS setpoints remain valid during operation at the various allowable CEA group insertion limits. The limitations of F_R^I and T_q are provided to ensure that the assumptions used in the analysis establishing the DNB Margin LCO and Thermal Margin/Low Pressure LSSS setpoints remain valid during operation at the various allowable CEA group insertion limits. If F_R^I or T_q exceed their basic limitations, operation may continue under the additional restrictions imposed by the action statements since these additional restrictions provide adequate assurance that the assumptions used in establishing the Linear Heat Rate, Thermal Margin/Low Pressure and Local Power Density - High LCO's and LSSS setpoints remain valid. An azimuthal power tilt >0.10 is not expected and if it should occur, subsequent operation would be restricted to only those operations required to identify the cause of this unexpected tilt.~~

~~The value of T_q that must be used in the equation $F_R^I = F_R(1 + T_q)$ is the measured tilt.~~

~~The surveillance requirements for verifying that F_R^I and T_q are within their limits provide assurance that the actual values of F_R^I and T_q do not exceed the assumed values. Verifying F_R^I after each fuel loading prior to exceeding 70% of rated power provides additional assurance that the core was properly loaded.~~

Maximum Radial Peaking Factor (F_R^T)

The limitation on F_R^T is provided to ensure that the assumptions used in the analysis establishing the DNB Margin LCO and Thermal Margin/Low Pressure LSSS setpoints remain valid during operation at the various allowable CEA group insertion limits. If the maximum F_R^T exceeds the COLR limit, operation may continue under the additional restrictions imposed by the action statements since these additional restrictions provide adequate assurance that the assumptions used in establishing the Thermal Margin/Low Pressure and Local Power Density - High LCOs and LSSS setpoints remain valid. The surveillance requirements for verifying that the maximum F_R^T is within the COLR limit provides assurance that the actual value of F_R^T does not exceed

the assumed values. Verifying F_R^T after each fuel loading prior to exceeding 70% of rated power provides additional assurance that the core was properly loaded.

~~DNBR Margin During Power Operation Above 15% of Rated Power~~

~~The selection of limiting safety system settings and reactor operating limits is such that:~~

~~1. No specified acceptable fuel design limits will be exceeded as a result of the design basis anticipated operational occurrences, and~~

~~2. The consequences of the design basis postulated accidents will be no more severe than the predicted acceptable consequences of the accident analysis in Section 14.~~

2.0 **LIMITING CONDITIONS FOR OPERATION**
2.10 Reactor Core (Continued)
2.10.4 Power Distribution Limits (Continued)

~~In order for these objectives to be met, the reactor must be operated consistent with the operating limits specified for margin to DNB.~~

~~The parameter limits given in (5) and the F_R^T, and Core Power Limitations Figure provided in the COLR along with the parameter limits on quadrant tilt and control element assembly position (Power Dependent Insertion Limit Figure provided in the COLR) provide a high degree of assurance that the DNB overpower margin will be maintained during steady state operation.~~

~~The actions specified assure that the reactor is brought to a safe condition.~~

~~The Reactor Coolant System flow rate of 202,500 gallons per minute is the indicated value. It does not include instrumentation uncertainties.~~

~~The calorimetric methodology shall be used to measure the Reactor Coolant System flow rate.~~

~~AZIMUTHAL POWER TILT~~*Azimuthal Power Tilt*

Azimuthal Power Tilt is measured using symmetric in-core or ex-core detectors by assuming that the ratio of the power at any core location in the presence of a tilt to the ~~untitled~~ *untilted* power at that location is of the form:

$$P_{tilt}(r,\theta)/P_{avg}(r,\theta) - 1 = T_q \bullet g(r) \bullet \cos(\theta - \theta_o)$$

where

$P_{tilt}(r,\theta)$	is the tilted power at radius r and azimuthal angle θ
$P_{avg}(r,\theta)$	is the average or untilted power at that location
T_q	is the azimuthal tilt magnitude
g(r)	is the radial normalizing factor, normalized to a maximum value of unity
θ	is the azimuthal core location
θ_o	is the azimuthal core location of maximum tilt

T_q represents the maximum fractional increase in power that can occur anywhere in the core because of tilt. ~~It is the appropriate measured value of tilt to be used when ensuring the validity of the azimuthal tilt assumed by ABB-CE in establishing safety limits.~~

An azimuthal power tilt > 0.10 is not expected and if it should occur, subsequent operation would be restricted to only those operations required to identify the cause of this unexpected tilt.

DNBR Margin During Power Operation Above 15% of Rated Power

The selection of limiting safety system settings and reactor operating limits is such that:

1. *No specified acceptable fuel design limits will be exceeded as a result of the design basis anticipated operational occurrences, and*

2. *The consequences of the design basis postulated accidents will be no more severe than the predicted acceptable consequences of the accident analysis in Section 14.*

In order for these objectives to be met, the reactor must be operated consistent with the operating limits specified for margin to DNB.

The parameter limits given in (5) and the COLR along with the parameter limits on azimuthal tilt and control element assembly position (Power Dependent Insertion Limit Figure provided in the COLR) provide a high degree of assurance that margin to DNB will be maintained during steady state operation.

The actions specified assure that the reactor is brought to a safe condition.

The reactor coolant system flow rate of 202,500 gallons per minute is the indicated value. It does not include instrumentation uncertainties.

The calorimetric methodology shall be used to measure the reactor coolant system flow rate.

Retyped ("Clean") Technical Specification Basis Pages

1.0 **SAFETY LIMITS**

1.1 Safety Limits (SLs) (continued)

Basis

To maintain the integrity of the fuel cladding and prevent the release of significant amounts of fission products to the reactor coolant, it is necessary to prevent overheating of the cladding under normal operating conditions. This is accomplished by operating within the nucleate boiling regime of heat transfer, wherein the heat transfer coefficient is large enough so that the clad surface temperature is only slightly greater than the coolant saturation temperature. The upper boundary of the nucleate boiling regime is termed "departure from nucleate boiling" (DNB).

At DNB there is a sharp reduction of the heat transfer coefficient, which would result in high clad temperature and the possibility of clad failure. Although DNB is not an observable parameter during reactor operation, the observable parameters of reactor thermal power and reactor coolant flow, temperature and pressure can be related to DNB through a correlation. The local DNB ratio (DNBR), defined as the ratio of the heat flux that would cause DNB at a particular core location to the actual heat flux at that location, is indicative of the margin to DNB.

The minimum value of the DNBR during steady state operation, normal operational transients, and anticipated transients corresponds to a 95% probability at a 95% confidence level that DNB will not occur, which is considered an appropriate margin to DNB for all operating conditions.(1)

The curves of Figure 1-1 represent the loci of points for reactor thermal power (either neutron flux instruments or ΔT instruments), reactor coolant system pressure, and cold leg temperature for which the minimum DNBR is not less than the minimum DNBR limit. The area of safe operation is below these lines.

SL 1.1.1(b) ensures that fuel centerline temperature remains below the fuel melt temperature 5081°F during normal operating conditions or design anticipated operational occurrences (AOOs) with adjustments for burnup and burnable poison. An adjustment of 58°F per 10,000 MWD/MTU has been established in XN-NF-82-06(P)(A), Revision 1, Supplements 2, 4 and 5 (Ref. 8) and adjustments for burnable poisons are established based on XN-NF-79-56(P)(A), Revision 1, Supplement 1 (Ref. 9).

The reactor core safety limits are based on radial peaks limited by the CEA insertion limits in Section 2.10 and axial shapes within the axial power distribution trip limits in the COLR. The Thermal Margin/Low Pressure trip requirements shall be within the limits provided in the COLR. The Thermal Margin/Low Pressure trip is based on the maximum radial peaking factor (F_R^T) that is provided in the COLR.

2.0 **LIMITING CONDITIONS FOR OPERATION**
2.10 Reactor Core (Continued)
2.10.4 Power Distribution Limits (Continued)

(5) DNBR Margin During Power Operation Above 15% of Rated Power

(a) The following limits on DNB-related parameters shall be maintained:

(i)	Cold Leg Temperature (Core Inlet Temperature)	as specified in the COLR
(ii)	Pressurizer Pressure	≥ 2075 psia[(1)]
(iii)	Reactor Coolant Flow rate	≥ 202,500 gpm indicated
(iv)	Axial Shape Index	as specified in the COLR

(b) With any of the above parameters exceeding the limit, restore the parameter to within its limit within 2 hours or reduce power to less than 15% of rated power within the next 8 hours.

Basis

Linear Heat Rate

The limitation on linear heat rate ensures that in the event of a LOCA, the peak temperature of the fuel cladding will not exceed 2200°F.

Either of the two core power distribution monitoring systems, the Excore Detector Monitoring System or the Incore Detector Monitoring System, provides adequate monitoring of the core power distribution and is capable of verifying that the linear heat rate does not exceed its limit. The Excore Detector Monitoring System performs this function by continuously monitoring the axial shape index (ASI) with the operable quadrant symmetric excore neutron flux detectors. The axial shape index is maintained within the allowable limits of the Limiting Condition for Operation for Excore Monitoring of LHR Figure provided in the COLR. This ASI is adjusted by Specification 2.10.4(1)(c) for the allowed linear heat rate of the Allowable Peak Linear Heat Rate vs. Burnup Figure provided in the COLR and the F_R^T and Core Power Limitations Figure provided in the COLR. In conjunction with the use of the excore monitoring system and in establishing the axial shape index limits, the following assumptions are made: (1) the CEA insertion limits of Specification 2.10.1(6) and long term insertion limits of Specification 2.10.1(7) are satisfied, and (2) the flux peaking augmentation factors are as shown in Figure 2-8.

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(1) Limit not applicable during either a thermal power ramp in excess of 5% of rated thermal power per minute or a thermal power step of greater than 10% of rated thermal power.

2.0 **LIMITING CONDITIONS FOR OPERATION**
2.10 Reactor Core (Continued)
2.10.4 Power Distribution Limits (Continued)

The Incore Detector Monitoring system provides a direct measure of the peaking factors and the alarms which have been established for the individual incore detector segments ensure that the peak linear heat rates will be continuously maintained within the allowable limits of the Allowable Peak Linear Heat Rate vs. Burnup Figure provided in the COLR. The setpoints for these alarms include allowances, set in the conservative directions. If the plant computer fails, the incore detector alarms become inoperable. The provisions of Section 2.10.4(1)(b) are intended to address this situation and assure safe operation of the reactor for up to 7 days.

Calibration of the ex-core detector input to the APD calculator is required to eliminate ASI uncertainties due to instrument drift and axially nonuniform detector exposure. If the recalibration is not performed in the period specified, the prescribed steps will assure safe operation of the reactor.

Maximum Radial Peaking Factor (F_R^T)

The limitation on F_R^T is provided to ensure that the assumptions used in the analysis establishing the DNB Margin LCO and Thermal Margin/Low Pressure LSSS setpoints remain valid during operation at the various allowable CEA group insertion limits. If the maximum F_R^T exceeds the COLR limit, operation may continue under the additional restrictions imposed by the action statements since these additional restrictions provide adequate assurance that the assumptions used in establishing the Thermal Margin/Low Pressure and Local Power Density - High LCOs and LSSS setpoints remain valid. The surveillance requirements for verifying that the maximum F_R^T is within the COLR limit provides assurance that the actual value of F_R^T does not exceed the assumed values. Verifying F_R^T after each fuel loading prior to exceeding 70% of rated power provides additional assurance that the core was properly loaded.

Azimuthal Power Tilt

Azimuthal Power Tilt is measured using symmetric in-core or ex-core detectors by assuming that the ratio of the power at any core location in the presence of a tilt to the untilted power at that location is of the form:

$$P_{tilt}(r,\theta)/P_{avg}(r,\theta) - 1 = T_q \bullet g(r) \bullet \cos(\theta - \theta_o)$$

where

$P_{tilt}(r,\theta)$	is the tilted power at radius r and azimuthal angle θ
$P_{avg}(r,\theta)$	is the average or untilted power at that location
T_q	is the azimuthal tilt magnitude
g(r)	is the radial normalizing factor, normalized to a maximum value of unity
θ	is the azimuthal core location
θ_o	is the azimuthal core location of maximum tilt

2.0 **LIMITING CONDITIONS FOR OPERATION**
2.10 Reactor Core (Continued)
2.10.4 Power Distribution Limits (Continued)

T_q represents the maximum fractional increase in power that can occur anywhere in the core because of tilt.

An azimuthal power tilt > 0.10 is not expected and if it should occur, subsequent operation would be restricted to only those operations required to identify the cause of this unexpected tilt.

DNBR Margin During Power Operation Above 15% of Rated Power

The selection of limiting safety system settings and reactor operating limits is such that:

1. No specified acceptable fuel design limits will be exceeded as a result of the design basis anticipated operational occurrences, and

2. The consequences of the design basis postulated accidents will be no more severe than the predicted acceptable consequences of the accident analysis in Section 14.

In order for these objectives to be met, the reactor must be operated consistent with the operating limits specified for margin to DNB.

The parameter limits given in (5) and the COLR along with the parameter limits on azimuthal tilt and control element assembly position (Power Dependent Insertion Limit Figure provided in the COLR) provide a high degree of assurance that margin to DNB will be maintained during steady state operation.

The actions specified assure that the reactor is brought to a safe condition.

The reactor coolant system flow rate of 202,500 gallons per minute is the indicated value. It does not include instrumentation uncertainties.

The calorimetric methodology shall be used to measure the reactor coolant system flow rate.