1717 Wakonade Drive
Welch, MN 55089

January 29, 2020

L-PI-20-001
10 CFR 50.90

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

Prairie Island Nuclear Generating Plant, Units 1 and 2
Docket Nos. 50-282 and 50-306
Renewed Facility Operating License Nos. DPR-42 and DPR-60

License Amendment Request to Address Issues Identified in Westinghouse Nuclear Safety Advisory Letter NSAL-09-5, Revision 1, and NSAL-15-1

Pursuant to 10 CFR 50.90, Northern States Power Company, a Minnesota corporation, doing business as Xcel Energy (hereafter "NSPM"), is submitting a request for an amendment to the Technical Specifications for the Prairie Island Nuclear Generating Plant.

The proposed change revises Technical Specification 3.2.1, "Heat Flux Hot Channel Factor ($F_Q(Z)$)", and Technical Specification 5.6.5, "CORE OPERATING LIMITS REPORT (COLR)", consistent with Appendix A of Westinghouse WCAP-17661, Revision 1, "Improved RAOC and CAOC F_Q Surveillance Technical Specifications", to address the issues identified in Westinghouse Nuclear Safety Advisory Letter (NSAL) NSAL-09-5, Revision 1, "Relaxed Axial Offset Control F_Q Technical Specification Actions". The proposed amendment will also address issues identified in NSAL-15-1, "Heat Flux Hot Channel Factor Technical Specification Surveillance".

The enclosure provides a description and assessment of the proposed changes. Approval of the proposed amendment is requested within 12 months of the acceptance of this request. Once approved, the amendment shall be implemented starting up from the next refueling outage for each unit concurrent with the COLR update associated with the core reload for each unit.

In accordance with 10 CFR 50.91, a copy of this application, with enclosures, is being provided to the designated Minnesota State Official.

If there are any questions or if additional information is needed, please contact Mr. Jeff Kivi at (612) 330-5788.

Summary of Commitments

This letter makes no new commitments and no revisions to existing commitments.

I declare under penalty of perjury, that the foregoing is true and correct.
Executed on January 29, 2020.

Scott Sharp
Site Vice President, Prairie Island Nuclear Generating Plant
Northern States Power Company – Minnesota

Enclosure

cc: Administrator, Region III, USNRC
Project Manager, Prairie Island, USNRC
Resident Inspector, Prairie Island, USNRC
State of Minnesota

ENCLOSURE

PRAIRE ISLAND NUCLEAR GENERATING PLANT

Evaluation of Proposed Change

License Amendment Request

Address Issues Identified in Westinghouse Nuclear Safety Advisory Letter NSAL-09-5, Revision 1, and NSAL 15-1

ATTACHMENTS:

1. Technical Specification Pages (Mark-up)
2. Technical Specification Pages (Re-typed)
3. Technical Specification Bases Pages (Mark-up – Provided for Information Only)

1.0 SUMMARY DESCRIPTION

Pursuant to 10 CFR 50.90, Northern States Power - Minnesota (NSPM) proposes to revise Technical Specifications (TS) Section 3.2.1, "Heat Flux Hot Channel Factor ($F_Q(Z)$)", and TS Section 5.6.5, "CORE OPERATING LIMITS REPORT (COLR)", for the Prairie Island Nuclear Generating Plant (PINGP), Units 1 and 2. This amendment will adopt the TS changes described in Appendix A of WCAP-17661-P-A, Revision 1 (Reference 1). NSPM also plans, as part of implementing the proposed amendment, to apply the TS Bases changes described in Appendix B of Reference 1 and to revise the COLR consistent with Appendix C of Reference 1. These changes will address issues described in Westinghouse NSAL-09-5, Revision 1 (Reference 2) and Westinghouse NSAL-15-1 (Reference 3).

2.0 DETAILED DESCRIPTION

2.1 Background

NSAL-09-5, Revision 1 notified Westinghouse customers of an issue associated with the Required Actions for Condition B of NUREG-1431 (Reference 4) TS 3.2.1B, "Heat Flux Hot Channel Factor ($F_Q(Z)$ (RAOC-W(Z) Methodology)", for plants that have implemented the relaxed axial offset control (RAOC) methodology. In certain situations where transient F_Q, $F_Q^W(Z)$, is not within its limit, the existing Required Actions may be insufficient to restore $F_Q^W(Z)$ to within the limit. NSAL-09-5, Revision 1 provided clarification regarding the applicability of the recommended interim actions to address this issue. NSPM evaluated NSAL-09-5, Revision 1, under the corrective action program and determined PINGP TS 3.2.1 Condition B was non-conservative. As a result, NSPM implemented additional administrative controls until the TS could be amended. Implementing the TS changes of WCAP-17661-P-A, Revision 1, will provide a resolution.

NSAL-15-1, notified Westinghouse customers of an issue associated with TS Surveillance Requirement (SR) 3.2.1.2. Specifically, one aspect of the SR may not be sufficient to assure that the peaking factor assumed in the licensing basis analysis remains valid under all conditions between the instances of performance of SR 3.2.1.2. NSPM evaluated the issue of NSAL-15-1 under the corrective action program and incorporated Westinghouse's recommended changes to TS SR 3.2.1.2 into the PINGP surveillance procedures used to implement TS SR 3.2.1.2. Implementing the improved methodology will address the NSAL-15-1 issue by inclusion of the penalty factor from the SR 3.2.1.2 NOTE in the surveillance formulation and therefore make it applicable at all times.

NSPM is proposing to change TS 3.2.1, "Heat Flux Hot Channel Factor ($F_Q(Z)$)", to be consistent with the revised TS 3.2.1 provided in Appendix A of WCAP-17661-P-A, Revision 1. The Bases for TS 3.2.1 will be revised to address the proposed changes to TS 3.2.1 consistent with the Bases markups provided in Appendix B of WCAP-17661-P-A, Revision 1. Changes to the TS Bases will be incorporated in accordance with the TS Bases Control Program (TS 5.5.12) upon approval of this amendment request.

2.2 Reason for Proposed Change

As a result of the issues identified in References 2 and 3, NSPM determined that the PINGP TS were non-conservative. Implementation of the revision to PINGP TS consistent with Reference 1 will resolve the non-conservatism.

2.3 Proposed Changes

As described in detail in Reference 1, the proposed change implements an improved RAOC F_Q Surveillance formulation and TS. The new formulation essentially eliminates the sensitivity of the surveillance to the surveillance axial power shape. The new formulation also improves accuracy of part-power surveillances. Finally, the improved RAOC F_Q Surveillance TS incorporate the concept of RAOC operating spaces that are defined in the Core Operating Limits Report (COLR). If the F_Q limit is exceeded during a surveillance, a more restrictive RAOC operating space is implemented that provides the required additional F_Q margin for future operation.

Specifically, LCO 3.2.1 is changing as follows:

- Condition A
  - Revises setpoint reductions required when $F_Q^C(Z)$ limit is exceeded. Required Actions A.2 and A.3 are being revised replacing “1 percent for each 1 percent $F_Q^C(Z)$ exceeds limits” with “1% for each 1% that THERMAL POWER is limited below RATED THERMAL POWER by Required Action A.1”.
  - The Note is being revised to clarify when SR 3.2.1.2 is required.
  - These changes are evaluated in Section 4.2 of the NRC Final Safety Evaluation included in Reference 1.
- Condition B
  - A new Required Action B.1.1 was included, which requires licensees to “Implement a RAOC or [constant axial offset control] CAOC operating space specified in the COLR that restores $F_Q^W(Z)$ to within limits” whenever $F_Q^W(Z)$ is determined to be not within the limits. In the case of PINGP (a RAOC plant), the RAOC operating space is a unique combination of axial flux difference (AFD) limits and control bank insertion limits. The operating spaces are pre-analyzed using the approved methodology and included in the COLR.
  - A new Required Action B.1.2 assures that for situations involving control rod movement SRs 3.2.1.1 and 3.2.1.2 will be performed to ensure that $F_Q^C(Z)$ and $F_Q^W(Z)$ remain within limits.
  - These changes are evaluated in Section 4.3 of the NRC Final Safety Evaluation included in Reference 1.
- Removal of Notes for F_Q Surveillance
  - Two notes are deleted in the revised SRs. The first removed note applied to both SR 3.2.1.1 and SR 3.2.1.2 and required obtaining the power distribution map for measuring $F_Q^C(Z)$ and $F_Q^W(Z)$ at equilibrium conditions during power escalation at the beginning of each cycle. The effect of the change is that $F_Q^W(Z)$ will not be

determined until 24 hours after exceeding 75 percent of RATED THERMAL POWER (RTP), instead of within 12 hours of achieving equilibrium conditions after exceeding 75 percent RTP following refueling outages as currently specified.
    - The second removed note applies to SR 3.2.1.2 and required multiplication of $F_Q^W(Z)$ by a factor and increased surveillance under certain conditions. In the improved methodology, the penalty factor is embedded in the methodology and a separate penalty factor is not applicable.
    - The deletion of these notes is evaluated in Section 4.4 of the NRC Final Safety Evaluation included in Reference 1.
- Revision of Second Surveillance Frequency for SRs 3.2.1.1 and 3.2.1.2
    - The time interval for completing the SRs is increased from 12 to 24 hours.
    - These changes are evaluated in Section 4.5 of the NRC Final Safety Evaluation included in Reference 1.
- Deletion of Note in SR 3.2.1.2
    - The deleted note required increasing the Frequency to once per 7 effective full power days (EFPD) for certain conditions until the conditions are satisfied. In the new methodology, the required penalty factor is part of the $F_Q^W(Z)$ formulation.
    - This change is evaluated in Section 4.6 of the NRC Final Safety Evaluation included in Reference 1.
- Change in Frequency of SR 3.2.1.2 during power escalations
    - The Frequency is being changed to require $F_Q^W(Z)$ to be verified within the limits follow each refueling within 24 hours after THERMAL POWER exceeds 75 percent RTP.
    - This change is evaluated in Section 4.7 of the NRC Final Safety Evaluation included in Reference 1.

The detailed proposed changes to PINGP TS are provided in mark-up form in Attachment 1 to this enclosure. The detailed proposed changes to the PINGP TS Bases are provided in mark-up form in Attachment 3 to this enclosure.

3.0 ASSESSMENT

3.1 Applicability of Safety Evaluation

The NRC Final Safety Evaluation (SE) included in Reference 1 concluded that, subject to the limitations provided in Chapter 5 of the SE, the RAOC surveillance formulations and required actions proposed in Reference 1 were acceptable and that Reference 1 may be considered approved for use by the NRC staff, for the purpose of justifying the TS changes contained therein. NSPM has reviewed the SE in Reference 1 and determined the WCAP and NRC safety evaluation with limitations, as described below, apply to the PINGP.

3.2 Final Safety Evaluation Limitations

Chapter 5.0 of the SE in Reference 1 includes two limitations, adherence to which are necessary to ensure acceptable implementation of WCAP-17661-P-A, Revision 1.

LIMITATION 1: USE OF A_{XY} AND A_Q

As discussed in Section 4.1.1 of the SE in Reference 1, the use of Methods 1 and 2 are acceptable for calculating A_{XY} and A_Q when performing RAOC and CAOC W(Z) surveillances, respectively, subject to the limitations below. PINGP is a RAOC plant; therefore, only the limitations associated with calculating A_{XY} will apply to PINGP TS.

1. The NRC-approved methods provided in the response to RAI 15.b must be used to perform the surveillance-specific A_{XY} and A_Q calculations. Newer methods with similar capabilities may be considered acceptable provided the NRC staff specifically approves them for calculating A_{XY} and A_Q factors.

NSPM will use the NRC-approved methods described in References 5 through 11. Newer methods with similar capabilities may be used if the NRC specifically approves them for A_{XY} calculation.

2. The depletion calculation used to determine the numerator and denominator of the A_{XY} and A_Q factor must be performed similarly to the original design calculation, as described in the response to RAI 15.c.

NSPM will perform depletion calculations to determine the numerator and denominator of the A_{XY} factor similarly to the original design calculations, that is, either with the BEACON™ core monitoring system without using nodal calibration factors, or with Advanced Nodal Code using the same nuclear model and depletion basis used to generate the original T(Z) function.[1]

3. The use of Method 1 for calculating A_Q is only acceptable subject to the constraints discussed in the response to RAI 15.a. The surveillance Axial Offset must be within 1.5-percent of the target AO, and there must be assurance that the limiting $F_Q^W(Z)$ location does not lie within a rodded elevation at the time of surveillance. Note that the use of Method 1 remains acceptable when surveillance-specific W(Z) functions are used.

This limitation applies to CAOC TS only and, thus does not apply to the PINGP TS.

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[1] BEACON is a trademark or registered trademark of Westinghouse Electric Company LLC, its Affiliates and/or its Subsidiaries in the United States of America and may be registered in other countries throughout the world. All rights reserved. Unauthorized use is strictly prohibited. Other names may be trademarks of their respective owners.

LIMITATION 2: POWER LEVEL REDUCTION TO 50 PERCENT RTP

As noted in Section 4.3.2 of the safety evaluation of Reference 1, the use of 50 percent as the final power level reduction in the event of failed F_Q surveillance is not included in the TS, but rather in the BASES and in the COLR. As such, this final power level, 50 percent, must be implemented on a plant-specific basis and included in COLR input generated using this methodology, in order to use this TR.

NSPM will implement a final power level of 50 percent in the event of a failed F_Q surveillance. This will be on a plant-specific basis and included in COLR input generated using this methodology upon implementing the License Amendment that allows adoption of the TR.

3.3 Variations

NSPM proposes the following variations from the TS changes described in Appendix A of Reference 1:

- Different titles – the NUREG-1431 title for TS section 3.2.1 changes from $F_Q(Z)$ (RAOC W(Z) Methodology) to $F_Q(Z)$ (RAOC T(Z) Methodology). The PINGP title for TS section 3.2.1 is simply $F_Q(Z)$, so no title change proposed.
- Frequency of SR 3.2.1.2 – NUREG-1431 includes a first Frequency that is different than the current PINGP TS SR 3.2.1.2. This Frequency will be changed to match that in the Reference 1, Appendix A.

4.0 REGULATORY ANALYSIS

4.1 Applicable Regulatory Requirements

PINGP was not licensed to the 10 CFR 50, Appendix A, General Design Criteria (GDC). The PINGP was designed and constructed to comply with NSP's understanding of the intent of the AEC General Design Criteria for Nuclear Power Plant Construction Permits, as proposed on July 10, 1967. Since the construction of the plant was significantly completed prior to the issuance of the February 20, 1971, 10CFR50, Appendix A GDC, the plant was not reanalyzed and the Final Safety Analysis Report (FSAR) was not revised to reflect these later criteria. However, the AEC Safety Evaluation Report acknowledged that the AEC staff assessed the plant, as described in the FSAR, against the Appendix A design criteria and "... are satisfied that the plant design generally conforms to the intent of these criteria."

GDC 10, states the reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences.

GDC 20, states, the protection system shall be designed (1) to initiate automatically the operation of appropriate systems including the reactivity control systems, to assure that specified acceptable fuel design limits are not exceeded as a result of anticipated operational occurrences and (2) to sense accident conditions and to initiate the operation of systems and components important to safety.

GDC 26, states, two independent reactivity control systems of different design principles shall be provided. One of the systems shall use control rods, preferably including a positive means for inserting the rods, and shall be capable of reliably controlling reactivity changes to assure that under conditions of normal operation, including anticipated operational occurrences, and with appropriate margin for malfunctions such as stuck rods, specified acceptable fuel design limits are not exceeded. The second reactivity control system shall be capable of reliably controlling the rate of reactivity changes resulting from planned, normal power changes (including xenon burnout) to assure acceptable fuel design limits are not exceeded. One of the systems shall be capable of holding the reactor core subcritical under cold conditions.

10 CFR 50.36, Technical Specifications, paragraph (c)(2) states that technical specifications will include limiting conditions for operation. Paragraph (c)(3) states that technical specifications will include surveillance requirements.

Paragraph (c)(2) of 10 CFR 50.36 discusses LCOs, stating that such TSs are the lowest functional capability or performance levels of equipment required for safe operation of the facility. The requirements indicate that LCOs must be established for each item that meets one or more of four criteria. One of the criteria is a process variable, design feature, or operating restriction that is an initial condition of a design-basis accident (OBA) or transient analysis that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.

Paragraph (c)(3) of 10 CFR 50.36 states:

> *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 LCOs will be met.*

The guidance contained in GL 88-16 provides a means by which the values of certain parameters could be determined and modified on a cycle-specific basis without prior NRC review and approval. In order to implement this guidance, licensees are required to do the following: (1) use NRC-approved methodology to determine the operating limits; (2) include a list, in the TS Administrative Controls section, of the references used to determine the operating limits; and (3) maintain the limits in a COLR, which must be submitted to the NRC for information.

4.2 No Significant Hazards Consideration Determination

NSPM requests approval to apply topical report WCAP-17661-P-A, Revision 1, (Reference 1) which includes proposed changes to the Standard Technical

Specifications. The proposed change revises TS 3.2.1 Conditions and Surveillance Requirements to eliminate non-conservatisms described in References 2 and 3. The proposed change also revises TS 5.6.5 to include WCAP-17661-P-A, Revision 1, as a reference. NSPM has evaluated whether or not a significant hazards consideration is involved with the proposed amendment 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 described in WCAP-17661, Revision 1, (Reference 1) resolve non-conservative PINGP TS Required Actions identified via Westinghouse NSAL-09-5, Revision 1, (Reference 2). The proposed changes also resolve non-conservative PINGP TS Surveillance Requirements identified via Westinghouse NSAL-15-1. Operation in accordance with the revised TS ensures that the assumptions for initial conditions of key parameter values in the safety analyses remain valid and does not result in actions that would increase the probability or consequences of any accident previously evaluated.

   Therefore, the proposed change does 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 change does not involve a physical alteration of the plant (i.e., no new or different type of equipment will be installed). Operation in accordance with the revised TS and its limits precludes new challenges to systems, structures, or components that might introduce a new type of accident. Applicable design and performance criteria will continue to be met and no new single failure mechanisms will be created. The proposed change for resolution of Westinghouse NSAL-09-5, Revision 1 and NSAL-15-1 does not involve the alteration of plant equipment or introduce unique operational modes or accident precursors.

   Therefore, the proposed change does 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

   Operation in accordance with the revised TS and its limits does not impact assumptions made in the safety analyses. This ensures that applicable design and performance criteria associated with the safety analysis will continue to be met and that the margin of safety is not affected.

Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above, NSPM concludes that the proposed amendment does not involve a 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.

4.3 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. Therefore, it is concluded that the requested amendment does not involve a 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.

5.0 ENVIRONMENTAL EVALUATION

NSPM's review of the proposed amendment has determined it would change a requirement with respect to the 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.

Therefore, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9) and pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

6.0 REFERENCES

1. Westinghouse WCAP-17661-P-A, Revision 1, "Improved RAOC and CAOC F_Q Surveillance Technical Specifications", February 2019.
2. Westinghouse Nuclear Safety Advisory Letter, NSAL-09-5, Revision 1, "Relaxed Axial

Offset Control F_Q Technical Specification Actions”, September 23, 2009.

3. Westinghouse Nuclear Safety Advisory Letter, NSAL-15-1, “Heat Flux Hot Channel Factor Technical Specification Surveillance”, February 3, 2015.
4. NUREG-1431, Volumes 1 and 2, Rev. 4.0, “Standard Technical Specifications Westinghouse Plants,” USNRC, June 2004.
5. Westinghouse WCAP-12472-P-A, Addendum 4, “BEACON™ Core Monitoring and Operations Support System, Addendum 4”, September 2012.
6. Westinghouse WCAP-10965-P-A, “ANC – A Westinghouse Advanced Nodal Computer Code”.
7. Westinghouse WCAP-10965-P-A, Addendum 1, “Enhancements to Rod Power Recover”.
8. Westinghouse WCAP-10965-P-A, Addendum 2, “Qualification of New Pin Power Recovery Methodology”.
9. Westinghouse WCAP-16045-P-A, “Qualification of the Two-Dimensional Transport Code PARAGON”.
10. Westinghouse WCAP-16045, P-A, Addendum 1, “Qualification of the NEXUS Nuclear Data Methodology”.
11. Westinghouse WCAP-11596-P-A, “Qualification of the PHOENIX-P/ANC Nuclear Design System for Pressurized Water Reactor Cores”, June 1988.

ENCLOSURE, ATTACHMENT 1

PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2

License Amendment Request:

Address Issues Identified in Westinghouse Nuclear Safety Advisory Letter NSAL-09-5, Revision 1, and NSAL-15-1

PROPOSED TECHNICAL SPECIFICATION CHANGES (Mark-up)

(7 pages follow)

3.2 POWER DISTRIBUTION LIMITS

3.2.1 Heat Flux Hot Channel Factor ($F_Q(Z)$)

LCO 3.2.1 $F_Q(Z)$, as approximated by $F_Q^C(Z)$ and $F_Q^W(Z)$, shall be within the limits specified in the COLR.

APPLICABILITY: MODE 1.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. -----------NOTE----------- Required Action A.4 shall be completed whenever this Condition is entered prior to increasing THERMAL POWER above the limit of Required Action A.1. SR 3.2.1.2 is not required to be performed if this Condition is entered prior to THERMAL POWER exceeding 75% RTP after a refueling. ------------------------------ $F_Q^C(Z)$ not within limit.	A.1 Reduce THERMAL POWER ≥ 1% RTP for each 1% $F_Q^C(Z)$ exceeds limit.	15 minutes after each $F_Q^C(Z)$ determination
	AND	
	A.2 Reduce Power Range Neutron Flux -High trip setpoints ≥ 1% for each 1% ~~$F_Q^C(Z)$ exceeds limit~~ that THERMAL POWER is limited below RATED THERMAL POWER by Required Action A.1.	72 hours after each $F_Q^C(Z)$ determination
	AND	
	A.3 Reduce Overpower ΔT trip setpoints ≥ 1% for each 1% ~~$F_Q^C(Z)$ exceeds limit~~ that THERMAL POWER is limited below RATED THERMAL POWER by Required Action A.1.	72 hours after each $F_Q^C(Z)$ determination
	AND	

Implement a RAOC operating space specified in the COLR that restores $F_Q^W(Z)$ to within its limits.

AND

B.1.2 Perform SR 3.2.1.1 and SR 3.2.1.2 if control rod motion is required to comply with the new operating space.

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. (continued)	A.4 Perform SR 3.2.1.1 and SR 3.2.1.2.	Prior to increasing THERMAL POWER above the limit of Required Action A.1
B. ~~------------NOTE------------ Required Action B.4 shall be completed whenever this Condition is entered. --------------------------------~~ $F_Q^W(Z)$ not within limits.	B.1 ~~Reduce AFD limits ≥ 1% for each 1% $F_Q^W(Z)$ exceeds limit.~~	4 hours ~~after each $F_Q^W(Z)$ determination~~
	AND	72 hours 4 hours
	B.2 Reduce Power Range Neutron Flux-High trip setpoints ≥ 1% for each 1% ~~that the maximum allowable power of the AFD limit is reduced.~~	72 hours ~~after each $F_Q^W(Z)$ determination~~
	AND	
	B.3 Reduce Overpower ΔI trip setpoints ≥ 1% for each 1% ~~that the maximum allowable power of the AFD limit is reduced.~~	72 hours ~~after each $F_Q^W(Z)$ determination~~
	AND	

.1

.2

.2.3

that THERMAL POWER is limited below RATED THERMAL POWER by Required Action B.2.1.

OR

B.2.1-----------NOTE-----------

Required Action B.2.4 shall be completed whenever Required Action B.2.1 is performed prior to increasing THERMAL POWER above the limit of Required Action B.2.1

Limit THERMAL POWER to less than RATED THERMAL POWER and reduce AFD limits as specified in the COLR.

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. (continued)	B.~~4~~ 2.4 Perform SR 3.2.1.1 and SR 3.2.1.2.	Prior to increasing THERMAL POWER above the ~~maximum allowable power of the AFD limits~~ limit of Required Action B.2.1
C. Required Action and associated Completion Time not met.	C.1 Be in MODE 2.	6 hours

SURVEILLANCE REQUIREMENTS

~~---NOTE---~~

~~During power escalation at the beginning of each cycle, THERMAL POWER may be increased until an equilibrium power level has been achieved, at which a power distribution measurement is obtained.~~

~~---~~

SURVEILLANCE		FREQUENCY
SR 3.2.1.1	Verify $F^C_Q(Z)$ is within limit.	Once after each refueling prior to THERMAL POWER exceeding 75% RTP <u>AND</u> Once within ~~12~~ 24 hours after achieving equilibrium conditions after exceeding, by $\geq$ 10% RTP, the THERMAL POWER at which $F^C_Q(Z)$ was last verified <u>AND</u> In accordance with the Surveillance Frequency Control Program

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.2.1.2	~~-------------------------------NOTE-------------------------------~~ ~~If measurements indicate that the~~ ~~maximum over z~~ ~~$\left[\frac{F_Q^C(Z)}{K(Z)}\right]$~~ ~~has increased since the previous evaluation of $F_Q^C(Z)$:~~ ~~a. Increase $F_Q^W(Z)$ by an appropriate factor specified in the COLR and reverify $F_Q^W(Z)$ is within limits; or~~ ~~b. Repeat SR 3.2.1.2 once per 7 EFPD until either a. above is met or two successive power distribution measurements indicate that the~~ ~~maximum over z~~ ~~$\left[\frac{F_Q^C(Z)}{K(Z)}\right]$~~ ~~has not increased.~~ ~~--~~	
--	Verify $F_Q^W(Z)$ is within limit.	Once after each refueling within 24 hours after thermal power exceeds 75% RTP. ~~Once within 12 hours after achieving equilibrium conditions after each refueling after THERMAL POWER exceeds 75% RTP~~ <u>AND</u>

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.2.1.2 (continued)	Once within ~~12~~ 24 hours after achieving equilibrium conditions after exceeding, by ≥ 10% RTP, the THERMAL POWER at which $F_Q^W(Z)$ was last verified AND In accordance with the Surveillance Frequency Control Program

5.6 Reporting Requirements

5.6.5 CORE OPERATING LIMITS REPORT (COLR) (continued)

29. Caldon Engineering Report ER-157P, "Supplement to Topical Report ER-80P: Basis for a Power Uprate with the LEFM or LEFM CheckPlus System";

30. WCAP-12610-P-A, "VANTAGE+ Fuel Assembly Reference Core Report";

31. WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A, "Optimized ZIRLO™";

32. Commencing Unit 1 Cycle 30 and Unit 2 Cycle 30, this reference shall be used in lieu of reference 23: WCAP-16045-P-A, "Qualification of the Two-Dimensional Transport Code PARAGON', August 2004; ~~and~~

33. Commencing Unit 1 Cycle 30 and Unit 2 Cycle 30, this reference shall be used in lieu of reference 23: WCAP-16045-P-A, Addendum 1-A, "Qualification of the NEXUS Nuclear Data Methodology", August 2007~~.~~ ;

34. WCAP-17661-P-A, "Improved RAOC and CAOC F_Q Surveillance Technical Specifications", February 2019.

c. The core operating limits shall be determined such that all applicable limits (e.g., fuel thermal-mechanical limits, core thermal-hydraulic limits, Emergency Core Cooling Systems (ECCS) limits, nuclear limits such as SDM, transient analysis limits, and accident analysis limits) of the safety analysis are met.

d. The COLR, including any midcycle revisions or supplements, shall be provided upon issuance for each reload cycle to the NRC.

ENCLOSURE, ATTACHMENT 2

PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2

License Amendment Request:

Address Issues Identified in Westinghouse Nuclear Safety Advisory Letter NSAL-09-5, Revision 1, and NSAL-15-1

PROPOSED TECHNICAL SPECIFICATION CHANGES (Re-typed)

(7 pages follow)

3.2 POWER DISTRIBUTION LIMITS

3.2.1 Heat Flux Hot Channel Factor ($F_Q(Z)$)

LCO 3.2.1 $F_Q(Z)$, as approximated by $F_Q^C(Z)$ and $F_Q^W(Z)$, shall be within the limits specified in the COLR.

APPLICABILITY: MODE 1.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. -----------NOTE----------- Required Action A.4 shall be completed whenever this Condition is entered prior to increasing THERMAL POWER above the limit of Required Action A.1. SR 3.2.1.2 is not required to be performed if this Condition is entered prior to THERMAL POWER exceeding 75% RTP after a refueling. ------------------------------ $F_Q^C(Z)$ not within limit.	A.1 Reduce THERMAL POWER $\geq$ 1% RTP for each 1% $F_Q^C(Z)$ exceeds limit.	15 minutes after each $F_Q^C(Z)$ determination
	AND	
	A.2 Reduce Power Range Neutron Flux -High trip setpoints $\geq$ 1% for each 1% that THERMAL POWER is limited below RATED THERMAL POWER by Required Action A.1.	72 hours after each $F_Q^C(Z)$ determination
	AND	

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. (continued)	A.3 Reduce Overpower ΔT trip setpoints $\geq$ 1% for each 1% that THERMAL POWER is limited below RATED THERMAL POWER by Required Action A.1.	72 hours after each $F_Q^C(Z)$ determination
	AND	
	A.4 Perform SR 3.2.1.1 and SR 3.2.1.2.	Prior to increasing THERMAL POWER above the limit of Required Action A.1

ACTIONS

B. $F_Q^W(Z)$ not within limits.	B.1.1 Implement a RAOC operating space specified in the COLR that restores $F_Q^W(Z)$ to within its limits. AND B.1.2 Perform SR 3.2.1.1 and SR 3.2.1.2 if control rod motion is required to comply with the new operating space. OR B.2.1-----------NOTE----------- Required Action B.2.4 shall be completed whenever Required Action B.2.1 is performed prior to increasing THERMAL POWER above the limit of Required Action B.2.1 ------------------------------ Limit THERMAL POWER to less than RATED THERMAL POWER and reduce AFD limits as specified in the COLR. AND	4 hours 72 hours 4 hours

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. (continued)	B.2.2 Reduce Power Range Neutron Flux-High trip setpoints $\geq$ 1% for each 1% that THERMAL POWER is limited below RATED THERMAL POWER by Required Action B.2.1. AND	72 hours
	B.2.3 Reduce Overpower ΔT trip setpoints $\geq$ 1% for each 1% that THERMAL POWER is limited below RATED THERMAL POWER by Required Action B.2.1. AND	72 Hours
	B.2.4 Perform SR 3.2.1.1 and SR 3.2.1.2.	Prior to increasing THERMAL POWER above the limit of Required Action B.2.1
C. Required Action and associated Completion Time not met.	C.1 Be in MODE 2.	6 hours

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.2.1.1	Verify $F_Q^C(Z)$ is within limit.	Once after each refueling prior to THERMAL POWER exceeding 75% RTP <u>AND</u> Once within 24 hours after achieving equilibrium conditions after exceeding, by $\geq$ 10% RTP, the THERMAL POWER at which $F_Q^C(Z)$ was last verified <u>AND</u> In accordance with the Surveillance Frequency Control Program

SURVEILLANCE	FREQUENCY
SR 3.2.1.2 Verify $F_Q^W(Z)$ is within limit.	Once after each refueling within 24 hours after thermal power exceeds 75% RTP <u>AND</u> Once within 24 hours after achieving equilibrium conditions after exceeding, by $\geq$ 10% RTP, the THERMAL POWER at which $F_Q^W(Z)$ was last verified <u>AND</u> In accordance with the Surveillance Frequency Control Program

5.6 Reporting Requirements

5.6.5 CORE OPERATING LIMITS REPORT (COLR) (continued)

29. Caldon Engineering Report ER-157P, "Supplement to Topical Report ER-80P: Basis for a Power Uprate with the LEFM or LEFM CheckPlus System";

30. WCAP-12610-P-A, "VANTAGE+ Fuel Assembly Reference Core Report";

31. WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A, "Optimized ZIRLO™";

32. Commencing Unit 1 Cycle 30 and Unit 2 Cycle 30, this reference shall be used in lieu of reference 23: WCAP-16045-P-A, "Qualification of the Two-Dimensional Transport Code PARAGON', August 2004;

33. Commencing Unit 1 Cycle 30 and Unit 2 Cycle 30, this reference shall be used in lieu of reference 23: WCAP-16045-P-A, Addendum 1-A, "Qualification of the NEXUS Nuclear Data Methodology", August 2007;

34. WCAP-17661-P-A, "Improved RAOC and CAOC F_Q Surveillance Technical Specifications", February 2019.

c. The core operating limits shall be determined such that all applicable limits (e.g., fuel thermal-mechanical limits, core thermal-hydraulic limits, Emergency Core Cooling Systems (ECCS) limits, nuclear limits such as SDM, transient analysis limits, and accident analysis limits) of the safety analysis are met.

d. The COLR, including any midcycle revisions or supplements, shall be provided upon issuance for each reload cycle to the NRC.

ENCLOSURE, ATTACHMENT 3

PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2

License Amendment Request:
Address Issues Identified in Westinghouse Nuclear Safety Advisory Letter
NSAL-09-5, Revision 1, and NSAL-15-1

PROPOSED CHANGES TO TECHNICAL SPECIFICATION BASES PAGES
(Provided for Information Only)

(25 pages follow)

B 3.2 POWER DISTRIBUTION LIMITS

B 3.2.1 Heat Flux Hot Channel Factor ($F_Q(Z)$)

BASES

BACKGROUND

The purpose of the limits on the values of $F_Q(Z)$ is to limit the local (i.e., pellet) peak power density. The value of $F_Q(Z)$ varies along the axial height (Z) of the core.

$F_Q(Z)$ is defined as the maximum local fuel rod linear power density divided by the average fuel rod linear power density, assuming nominal fuel pellet and fuel rod dimensions. Therefore, $F_Q(Z)$ is a measure of the peak fuel pellet power within the reactor core.

During power operation, the global power distribution is limited by LCO 3.2.3, "AXIAL FLUX DIFFERENCE (AFD)," and LCO 3.2.4, "QUADRANT POWER TILT RATIO (QPTR)," which are directly and continuously measured process variables. These LCOs, along with LCO 3.1.6, "Control Bank Insertion Limits," maintain the core limits on power distributions on a continuous basis.

$F_Q(Z)$ varies with fuel loading patterns, control bank insertion, fuel burnup, and changes in axial power distribution.

$F_Q(Z)$ is measured periodically using either the incore detector system or the Power Distribution Monitoring System. These measurements are generally taken with the core at or near equilibrium conditions.

Using the measured three dimensional power distributions, it is possible to derive a measured value for $F_Q(Z)$. However, because this value represents an equilibrium condition, it does not include the variations in the values of $F_Q(Z)$ which are present during non-equilibrium situations such as load following or power ascension.

Insert A

BASES

BACKGROUND (continued)

To account for these possible variations, ~~the equilibrium value of $F_Q(Z)$ is adjusted as $F_Q^W(Z)$ by an elevation dependent factor that accounts for the calculated worst case transient conditions.~~ Core monitoring and control under non-equilibrium conditions are accomplished by operating the core within the limits of the appropriate LCOs, including the limits on AFD, QPTR, and control rod insertion.

APPLICABLE SAFETY ANALYSES

This LCO precludes core power distributions that violate the following fuel design criteria:

a. During a large break loss of coolant accident (LOCA), the peak cladding temperature must not exceed 2200°F (Ref. 1);

b. During transient conditions arising from events of moderate frequency (Condition II events), there must be at least 95% probability at the 95% confidence level (the 95/95 DNB criterion) that the hot fuel rod in the core does not experience a departure from nucleate boiling (DNB) condition (Ref. 1);

c. During an ejected rod accident, the energy deposition to the fuel must not exceed 200 cal/gm (Ref. 1); and

d. The control rods must be capable of shutting down the reactor with a minimum required SDM with the highest worth control rod stuck fully withdrawn (Ref. 2).

Limits on $F_Q(Z)$ ensure that the value of the initial total peaking factor assumed in the accident analyses remains valid. Other criteria must also be met (e.g., maximum cladding oxidation, maximum hydrogen generation, coolable geometry, and long term cooling). However, the peak cladding temperature is typically most limiting.

Insert A

the elevation dependent measured planar radial peaking factors, $F_{XY}(Z)$, are increased by an elevation dependent factor, $[T(Z)]^{COLR}$, that accounts for the expected maximum values of the transient axial power shapes postulated to occur during RAOC operation. Thus, $[T(Z)]^{COLR}$ accounts for the worst case non-equilibrium power shapes that are expected for the assumed RAOC operating space.

The RAOC operating space is defined as the combination of AFD and Control Bank Insertion Limits assumed in the calculation of a particular $[T(Z)]^{COLR}$ function. The $[T(Z)]^{COLR}$ factors are directly dependent on the AFD and Control Bank Insertion Limit assumptions. The COLR may contain different $[T(Z)]^{COLR}$ functions that reflect different operating space assumptions. If the limit on $F_Q(Z)$ is exceeded, a more restrictive operating space may be implemented to gain margin for future non-equilibrium operation.

BASES

APPLICABLE SAFETY ANALYSES (continued)

The Large Break LOCA (LBLOCA) analysis is the analysis that determines the LCO limit for $F_Q(Z)$. The $F_Q(Z)$ assumed in the Safety Analysis for other postulated accidents is either equal to or greater than that assumed in the LBLOCA analysis. Therefore, this LCO provides conservative limits for other postulated accidents.

$F_Q(Z)$ satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

The Heat Flux Hot Channel Factor, $F_Q(Z)$, shall be limited by the following relationships:

$$F_Q(Z) \leq \frac{CFQ}{P} K(Z) \quad \text{for } P > 0.5$$

$$F_Q(Z) \leq \frac{CFQ}{0.5} K(Z) \quad \text{for } P \leq 0.5$$

where: CFQ is the $F_Q(Z)$ limit at RTP provided in the COLR,

K(Z) is the normalized $F_Q(Z)$ limit as a function of core height provided in the COLR, and

$$P = \frac{\text{THERMAL POWER}}{\text{RTP}}$$

For Relaxed Axial Offset Control operation, $F_Q(Z)$ is approximated by $F_Q^C(Z)$ and $F_Q^W(Z)$. Thus both $F_Q^C(Z)$ and $F_Q^W(Z)$ must meet the preceding limits on $F_Q(Z)$.

An $F_Q^C(Z)$ evaluation requires obtaining a power distribution measurement in MODE 1 from which a measured value ($F_Q^M(Z)$) of $F_Q(Z)$ is obtained. If the power distribution measurement is obtained with the movable incore detector system,

BASES

LCO (continued)

$$F_Q^C(Z) = F_Q^M(Z)*(1.0815)$$

where 1.0815 is a factor that accounts for fuel manufacturing tolerances (1.03) multiplied by a factor associated with the flux map measurement uncertainty (1.05) (Ref. 3).

If the power distribution measurement is obtained with the Power Distribution Monitoring System,

$$F_Q^C(Z) = F_Q^M(Z)*(1.03)\,(1.0 + \frac{U_Q}{100})$$

where 1.03 is a factor that accounts for fuel manufacturing tolerances and U_Q is a factor that accounts for Power Distribution Monitoring System measurement uncertainty (%), determined as described in References 5 and 6, and commencing with Unit 1 Cycle 30 and Unit 2 Cycle 30, Reference 7 will replace Reference 6.

$F_Q^C(Z)$ is an excellent approximation for $F_Q(Z)$ when the reactor is at the steady state power at which the power distribution measurement was taken.

The expression for $F_Q^W(Z)$ is:

$$F_Q^W(Z) = \sout{F_Q^C(Z)\ W(Z)}$$

$$F_{XY}^M(Z)\ \frac{[T(Z)]^{COLR}}{P}\ A_{XY}(Z)\ Rj\ [1.0815]$$

~~where W(Z) is a cycle dependent function that accounts for power distribution transients encountered during normal operation. W(Z) is included in the COLR. The $F_Q^W(Z)$ is calculated at equilibrium conditions.~~

Insert B

If the power distribution measurement is obtained with the Power Distribution Monitoring System,

$$F_Q^W(Z) = F_{XY}^M(Z)\ \frac{[T(Z)]^{COLR}}{P}\ A_{XY}(Z)\ Rj\ (1.03)(1+\frac{U_Q}{100})$$

Insert B

The various factors in this expression are defined below:

$F_{XY}^{M}(Z)$ is the measured radial peaking factor at axial location Z and is equal to the value of $F_Q^M(Z)/P^M(Z)$, where $P^M(Z)$ is the measured core average axial power shape.

$[T(Z)]^{COLR}$ is the cycle and burnup dependent function, specified in the COLR, which accounts for power distribution transients encountered during non-equilibrium normal operation. $[T(Z)]^{COLR}$ functions are specified for each analyzed RAOC operating space (i.e., each unique combination of AFD limits and Control Bank Insertion Limits). The $[T(Z)]^{COLR}$ functions account for the limiting non-equilibrium axial power shapes postulated to occur during normal operation for each RAOC operating space. Limiting power shapes at both full and reduced power operation are considered in determining the maximum values of $[T(Z)]^{COLR}$. The $[T(Z)]^{COLR}$ functions also account for the following effects: (1) the presence of spacer grids in the fuel assembly, (2) the increase in radial peaking in rodded core planes due to the presence of control rods during non-equilibrium normal operation, (3) the increase in radial peaking that occurs during part-power operation due to reduced fuel and moderator temperatures, and (4) the increase in radial peaking due to non-equilibrium xenon effects. The $[T(Z)]^{COLR}$ functions are normally calculated assuming that the Surveillance is performed at nominal RTP conditions with all shutdown and control rods fully withdrawn, i.e., all rods out (ARO). Surveillance specific $[T(Z)]^{COLR}$ values may be generated for a given surveillance core condition.

P is the THERMAL POWER / RTP.

$A_{XY}(Z)$ is a function that adjusts the $F_Q^W(Z)$ Surveillance for differences between the reference core condition assumed in generating the $[T(Z)]^{COLR}$ function and the actual core condition that exists when the Surveillance is performed. Normally, this reference core condition is 100% RTP, all rods out, and equilibrium xenon. For simplicity, $A_{XY}(Z)$ may be assumed to be 1.0, as this will typically result in an accurate $F_Q^W(Z)$ Surveillance result for a Surveillance that is performed at or near the reference core condition, and an underestimation of the available margin to the F_Q limit for Surveillances that are performed at core conditions different from the reference condition. Alternatively, the $A_{XY}(Z)$ function may be calculated using the NRC approved methodology in Reference 8.

Rj is a cycle and burnup dependent analytical factor specified in the COLR that accounts for potential increases in $F_Q^W(Z)$ between surveillances. Rj values are provided for each RAOC operating space.

BASES

LCO (continued)

The $F_Q(Z)$ limits define limiting values for core power peaking that precludes peak cladding temperatures above 2200°F during either a large or small break LOCA.

Insert C

This LCO precludes core power distributions that could violate the assumptions in the safety analyses. Calculations are performed in the core design process to confirm that the core can be controlled in such a manner during operation that it can stay within the LOCA $F_Q(Z)$ limits. If $F_Q^C(Z)$ cannot be maintained within the LCO limits, reduction of the core power is required, and if $F_Q^W(Z)$ cannot be maintained within the LCO limits, ~~reduction of the AFD limits is required. Note that sufficient reduction of the AFD limits will also result in a reduction of the core power.~~

Insert D

~~Violating the LCO limits for $F_Q(Z)$ may result in unacceptable consequences if a design basis event occurs while $F_Q(Z)$ is outside its specified limits.~~

APPLICABILITY

The $F_Q(Z)$ limits must be maintained in MODE 1 to prevent core power distributions from exceeding the limits assumed in the safety analyses. Applicability in other MODES is not required because there is either insufficient stored energy in the fuel or insufficient energy being transferred to the reactor coolant to require a limit on the distribution of core power.

ACTIONS

A.1

Reducing THERMAL POWER by ≥ 1% RTP for each 1% by which $F_Q^C(Z)$ exceeds its limit, maintains an acceptable absolute power density. $F_Q^C(Z)$ is $F_Q^M(Z)$ multiplied by factors accounting for manufacturing tolerances and measurement uncertainties. $F_Q^M(Z)$ is

Insert C

Violating the LCO limits for $F_Q(Z)$ could result in unacceptable consequences if a design basis event were to occur while $F_Q(Z)$ exceeds its specified limits.

Insert D

a more restrictive RAOC operating space must be implemented or core power limits and AFD limits must be reduced.

BASES

ACTIONS

A.1 (continued)

the measured value of $F_Q(Z)$. The Completion Time of 15 minutes provides an acceptable time to reduce power in an orderly manner and without allowing the plant to remain in an unacceptable condition for an extended period of time. The maximum allowable power level initially determined by Required Action A.1 may be affected by subsequent determinations of $F^C_Q(Z)$ and would require power reductions within 15 minutes of the $F^C_Q(Z)$ determination, if necessary to comply with the decreased maximum allowable power level. Decreases in $F^C_Q(Z)$ would allow increasing the maximum allowable power level and increasing power up to this revised limit.

Insert E

A.2

that THERMAL POWER is limited below RATED THERMAL POWER by Required Action A.1

A reduction of the Power Range Neutron Flux-High trip setpoints by ≥ 1% for each 1% ~~by which $F^C_Q(Z)$ exceeds its limit~~, is a conservative action for protection against the consequences of severe transients with unanalyzed power distributions. The Completion Time of 72 hours is sufficient considering the small likelihood of a severe transient in this time period and the preceding prompt reduction in THERMAL POWER in accordance with Required Action A.1. The maximum allowable Power Range Neutron Flux-High trip setpoints initially determined by Required Action A.2 may be affected by subsequent determinations of $F^C_Q(Z)$ and would require Power Range Neutron Flux-High trip setpoint reductions within 72 hours of the $F^C_Q(Z)$ determination, if necessary to comply with the decreased maximum allowable Power Range Neutron Flux-High trip setpoints. Decreases in $F^C_Q(Z)$ would allow increasing the maximum allowable Power Range Neutron Flux-High trip setpoints.

Insert E

If an F_Q surveillance is performed at 100% RTP conditions, and both $F_Q^C(Z)$ and $F_Q^W(Z)$ exceed their limits, the option to reduce the THERMAL POWER limit in accordance with Required Action B.2.1 instead of implementing a new operating space in accordance with Required Action B.1.1, will result in a further power reduction after Required Action A.1 has been completed. However, this further power reduction would be permitted to occur over the next 4 hours. In the event the evaluated THERMAL POWER reduction in the COLR for Required Action B.2.1 did not result in a further power reduction (for example, if both Condition A and Condition B were entered at less than 100% RTP conditions), then the THERMAL POWER level established as a result of completing Required Action A.1 will take precedence, and will establish the effective operating power level limit for the unit until both Conditions A and B are exited.

that THERMAL POWER is limited below RATED THERMAL POWER by Required Action A.1

BASES

ACTIONS (continued)

A.3

Reduction in the Overpower ΔT trip setpoints by ≥ 1% for each 1% ~~by which $F_Q^C(Z)$ exceeds its limit~~, is a conservative action for protection against the consequences of severe transients with unanalyzed power distributions. The Completion Time of 72 hours is sufficient considering the small likelihood of a severe transient in this time period, and the preceding prompt reduction in THERMAL POWER in accordance with Required Action A.1. The maximum allowable Overpower ΔT trip setpoints initially determined by Required Action A.3 may be affected by subsequent determinations of $F_Q^C(Z)$ and would require Overpower ΔT setpoint reductions within 72 hours of the $F_Q^C(Z)$ determination, if necessary to comply with the decreased maximum allowable Overpower ΔT trip setpoints. Decreases in $F_Q^C(Z)$ would allow increasing the maximum allowable Overpower ΔT trip setpoints.

A.4

Verification that $F_Q^C(Z)$ has been restored to within its limit, by performing SR 3.2.1.1 and SR 3.2.1.2 prior to increasing THERMAL POWER above the limit imposed by Required Action A.1, ensures that core conditions during operation at higher power levels, and future operations, are consistent with safety analyses assumptions.

prior to increasing THERMAL POWER above the limit of Required Action A.1. The Note also states that SR 3.2.1.2 is not required to be performed if this Condition is entered prior to THERMAL POWER exceeding 75% RTP after a refueling.

BASES

ACTIONS

A.4 (continued)

Condition A is modified by a Note that requires Required Action A.4 to be performed whenever the Condition is entered. This ensures that SR 3.2.1.1 and SR 3.2.1.2 will be performed prior to increasing THERMAL POWER above the limit of Required Action A.1, even when Condition A is exited prior to performing Required Action A.4. Performance of SR 3.2.1.1 and SR 3.2.1.2 are necessary to assure $F_Q(Z)$ is properly evaluated prior to increasing THERMAL POWER.

(if required)

B.1 .1

If it is found that the maximum calculated value of $F_Q(Z)$ that can occur during normal maneuvers, $F_Q^W(Z)$, exceeds its specified limits, there exists a potential for $F_Q^C(Z)$ to become excessively high if a normal operational transient occurs. ~~Reducing the AFD limits by ≥ 1% for each 1% by which $F_Q^W(Z)$ exceeds its limit within the allowed Completion Time of 4 hours, maintains an acceptable absolute power density such that even if a transient occurred, core peaking factors are not exceeded (Ref. 4).~~

Implementing a more restrictive RAOC operating space, as specified in the COLR, within the allowed Completion Time of 4 hours will restrict the AFD such that peaking factor limits will not be exceeded during non-equilibrium normal operation. Several RAOC operating spaces, representing successively smaller AFD envelopes and, optionally, shallower Control Bank Insertion LImits, may be specified in the COLR. The corresponding T(Z) functions for these operating spaces can be used to determine which RAOC operating space will result in acceptable non-equilibrium operation within the $F_Q^W(Z)$ limit.

~~The percent that $F_Q(Z)$ exceeds its transient limit is calculated based on the following expression:~~

$$\left\{\left(\underset{\text{over } z}{\text{maximum}}\left[\frac{F_Q^C(Z)*W(z)}{\frac{CFQ}{P}*K(z)}\right]\right)-1\right\}*100 \text{ for } P>0.5$$

BASES

ACTIONS

B.1 (continued) .1

$$\left\{\left(\begin{matrix}\text{maximum}\\ \text{over z}\end{matrix}\left[\frac{F_Q^C(Z) * W(z)}{\frac{CFQ}{0.5} * K(z)}\right]\right) - 1\right\} * 100 \text{ for } P \leq 0.5$$

The implicit assumption is that if W(Z) values were recalculated (consistent with the reduced AFD limits), then $F_Q^C(Z)$ times the recalculated W(Z) values would meet the $F_Q(Z)$ limit. Note that complying with this action (of reducing AFD limits) may also result in a power reduction. Hence the need for B.2, B.3 and B.4.

Insert F

B.2 .2

A reduction of the Power Range Neutron Flux-High trip setpoints by $\geq$ 1% for each 1% by which the maximum allowable power is reduced, is a conservative action for protection against the consequences of severe transients with unanalyzed power distributions. The Completion Time of 72 hours is sufficient considering the small likelihood of a severe transient in this time period and the preceding prompt reduction in the THERMAL POWER as a result of reducing limit and AFD limits in accordance with Required Action B.1 2.1.

Insert F

B.1.2

If it is found that the maximum calculated value of $F_Q(Z)$ that can occur during normal maneuvers, $F_Q^W(Z)$, exceeds its specified limits, there exists a potential for $F_Q^C(Z)$ to become excessively high if a normal operational transient occurs. As discussed above, Required Action B.1.1 requires that a new RAOC operating space be implemented to restore $F_Q^W(Z)$ to within its limits. Required Action B.1.2 requires that SR 3.2.1.1 and SR 3.2.1.2 be performed if control rod motion occurs as a result of implementing the new RAOC operating space in accordance with Required Action B.1.1. The performance of SR 3.2.1.1 and SR 3.2.1.2 is necessary to assure $F_Q(Z)$ is properly evaluated after any rod motion resulting from the implementation of a new RAOC operating space in accordance with Required Action B.1.1.

B.2.1

When $F_Q^W(Z)$ exceeds its limit, Required Action B.2.1 may be implemented instead of Required Action B.1.1. Required Action B.2.1 limits THERMAL POWER to less than RATED THERMAL POWER by the amount specified in the COLR. It also requires reductions in the AFD limits by the amount specified in the COLR. This maintains an acceptable absolute power density relative to the maximum power density value assumed in the safety analyses.

If the required $F_Q^W(Z)$ margin improvement exceeds the margin improvement available from the pre-analyzed THERMAL POWER and AFD reductions provided in the COLR, then THERMAL POWER must be further reduced to less than or equal to 50% RTP. In this case, reducing THERMAL POWER to less than or equal to 50% RTP will provide additional margin in the transient F_Q by the required change in THERMAL POWER and the increase in the F_Q limit. This will ensure that the F_Q limit is met during transient operation that may occur at or below 50% RTP.

The Completion time of 4 hours provides an acceptable time to reduce the THERMAL POWER and AFD limits in an orderly manner to preclude entering an unacceptable condition during future non-equilibrium operation. The limit on THERMAL POWER initially determined by Required Action B.2.1 may be affected by subsequent determinations of $F_Q^W(Z)$ and would require power reductions within 4 hours of the $F_Q^W(Z)$ determination, if necessary to comply with the decreased THERMAL POWER limit. Decreases in $F_Q^W(Z)$ would allow increasing the THERMAL POWER limit and increasing THERMAL POWER up to this revised limit.

Required Action B.2.1 is modified by a Note that states Required Action B.2.4 shall be completed whenever Required Action B.2.1 is performed prior to increasing THERMAL POWER above the limit of Required Action B.2.1. Required Action B.2.4 requires the performance of SR 3.2.1.1 and SR 3.2.1.2 prior to increasing THERMAL POWER above the limit established by Required Action B.2.1. The Note ensures that the SRs will be performed even if Condition B may be exited prior to performing Required Action B.2.4. The performance of SR 3.2.1.1 and SR 3.2.1.2 is necessary to assure $F_Q(Z)$ is properly evaluated prior to increasing THERMAL POWER.

If an F_Q surveillance is performed at 100% RTP conditions, and both $F_Q^C(Z)$ and $F_Q^W(Z)$ exceed their limits, the option to reduce the THERMAL POWER limit in accordance with Required Action B.2.1 instead of implementing a new operating space in accordance with Required Action B.1.1, will result in a further power reduction after Required Action A.1 has been completed. However, this further power reduction would be permitted to occur over the next 4 hours. In the event the evaluated THERMAL POWER reduction in the COLR for Required Action B.2.1 did not result in a further power reduction (for example, if both Condition A and Condition B were entered at less than 100% RTP conditions),. then the THERMAL POWER level established as a result of completing Required Action A.1 will take precedence, and will establish the effective operating power level limit for the unit until both Conditions A and B are exited.

BASES

ACTIONS (continued)

B.3 [2.3]

Reduction in the Overpower ΔT trip setpoints by ≥ 1% for each 1% by which the maximum allowable power is reduced, is a conservative action for protection against the consequences of severe transients with unanalyzed power distributions. The Completion Time of 72 hours is sufficient considering the small likelihood of a severe transient in this time period, and the preceding prompt reduction in [the] THERMAL POWER ~~as a result of reducing~~ [limit and] AFD limits in accordance with Required Action B.~~1~~[2.1].

B.4 [2.4]

Verification that $F_Q^W(Z)$ has been restored to within its limit, by performing SR 3.2.1.1 and SR 3.2.1.2 prior to increasing THERMAL POWER above the limit imposed by Required Action B.~~1~~[2.1], ensures that core conditions during operation at higher power levels, and future operation, are consistent with safety analyses assumptions.

~~Condition B is modified by a Note that requires Required Action B.4 to be performed whenever the Condition is entered. This ensures that SR 3.2.1.1 and SR 3.2.1.2 will be performed prior to increasing THERMAL POWER above the limit of Required Action B.1, even when Condition B is exited prior to performing Required Action B.4. Performance of SR 3.2.1.1 and SR 3.2.1.2 are necessary to assure $F_Q(Z)$ is properly evaluated prior to increasing THERMAL POWER.~~

BASES

ACTIONS (continued)

C.1

.1 2.4

If Required Actions A.1 through A.4 or B.1 through B.4 are not met within their associated Completion Times, the plant must be placed in a mode or condition in which the LCO requirements are not applicable. This is done by placing the plant in at least MODE 2 within 6 hours.

This allowed Completion Time is reasonable based on operating experience regarding the amount of time it takes to reach MODE 2 from full power operation in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

~~SR 3.2.1.1 and SR 3.2.1.2 are modified by a Note. The Note applies during the first power ascension after a refueling. It states that THERMAL POWER may be increased until an equilibrium power level has been achieved at which a power distribution measurement can be obtained. This allowance is modified, however, by one of the Frequency conditions that requires verification that $F_Q^C(Z)$ and $F_Q^W(Z)$ are within their specified limits after a power rise of more than 10% RTP over the THERMAL POWER at which they were last verified to be within specified limits. Because $F_Q^C(Z)$ could not have previously been measured in this reload core, there is a second Frequency condition, applicable only for reload cores, that requires determination of $F_Q^C(Z)$ before exceeding 75% RTP. This ensures that some determination of $F_Q(Z)$ is made at a lower power level at which adequate margin is available before going to 100% RTP. Also, this Frequency condition, together with the Frequency condition requiring verification of $F_Q^C(Z)$ and $F_Q^W(Z)$ following a power increase of more than 10%, ensures that they are verified as soon as RTP (or any other level for extended operation) is achieved.~~

BASES

SURVEILLANCE REQUIREMENTS (continued)

In the absence of these Frequency conditions, it is possible to increase power to RTP and operate without verification of $F_Q^C(Z)$ and $F_Q^W(Z)$. The Frequency condition is not intended to require verification of these parameters after every 10% increase in power level above the last verification. It only requires verification after a power level is achieved for extended operation that is 10% higher than that power at which $F_Q(Z)$ was last measured.

SR 3.2.1.1

Verification that $F_Q^C(Z)$ is within its specified limits involves increasing $F_Q^M(Z)$ to allow for manufacturing tolerance and measurement uncertainties in order to obtain $F_Q^C(Z)$ as described in the preceding LCO section. $F_Q^C(Z)$ is then compared to its specified limits. The limit with which $F_Q^C(Z)$ is compared varies inversely with power above 50% RTP and directly with a function called K(Z) provided in the COLR.

Insert G

following a refueling

Performing this Surveillance in MODE 1 prior to exceeding 75% RTP ensures that the $F_Q^C(Z)$ limit is met during the power ascension following a refueling, including when RTP is achieved, because peaking factors generally decrease as power level is increased.

initial or most recent

24

If THERMAL POWER has been increased by ≥ 10% RTP since the last determination of $F_Q^C(Z)$, another evaluation of this factor is required 12 hours after achieving equilibrium conditions at this higher power level (to ensure that $F_Q^C(Z)$ values are being reduced sufficiently with the power increase to stay within the LCO limits).

Insert H

Insert G

some determination of $F_Q^C(Z)$ is made prior to achieving a significant power level where the peak linear heat rate could approach the limits assumed in the safety analyses.

Insert H

Equilibrium conditions are achieved when the core is sufficiently stable at the intended operating conditions required to perform the Surveillance.

The allowance of up to 24 hours after achieving equilibrium conditions at the increased THERMAL POWER level to complete the next $F_Q^C(Z)$ surveillance applies to situations where the $F_Q^C(Z)$ has already been measured at least once at a reduced THERMAL POWER level. The observed margin in the previous surveillance will provide assurance that increasing power up to the next plateau will not exceed the F_Q limit, and that the core is behaving as designed.

This Frequency condition is not intended to require verification of these parameters after every 10% increase in RTP above the THERMAL POWER at which the last verification was performed. It only requires verification after a THERMAL POWER is achieved for extended operation that is 10% higher than the THERMAL POWER at which $F_Q^C(Z)$ was last measured.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.2.1.1 (continued)

The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

SR 3.2.1.2

The nuclear design process includes calculations performed to determine that the core can be operated within the $F_Q(Z)$ limits. Because power distribution measurements are taken at or near steady state conditions, the variations in power distribution resulting from normal operational maneuvers are not present in the measurements. These variations are, however, conservatively calculated during the nuclear design process by considering a wide range of unit maneuvers in normal operation. ~~The maximum peaking factor increase over steady state values, calculated as a function of core elevation, Z, is called W(Z). Multiplying the measured total peaking factor, $F_Q^C(Z)$, by W(Z) gives the maximum $F_Q(Z)$ calculated to occur in normal operation, $F_Q^W(Z)$.~~

Insert I

The limit with which $F_Q^W(Z)$ is compared varies inversely with power above 50% RTP and directly with the function K(Z) provided in the COLR.

The ~~W(Z) curve is provided~~ $[T(Z)]^{COLR}$ functions are specified in the COLR for discrete core elevations. Flux map data are taken for 61 core elevations. $F_Q^W(Z)$ evaluations are not applicable for ~~the following~~ axial core regions, measured in percent of core height:

a. Lower core region, from 0 to 15% inclusive~~; and~~ ,

b. Upper core region, from 85 to 100% inclusive~~.~~ ,

c. Grid plane regions, ± 2% inclusive, and

d. Core plane regions, within ± 2% of the bank demand position of the control banks.

Insert I

The measured $F_Q(Z)$ can be determined through a synthesis of the measured planar radial peaking factors, $F_{XY}{}^M(Z)$, and the measured core average axial power shape, $P^M(Z)$. Thus, $F_Q{}^C(Z)$ is given by the following expression:

$$F_Q{}^C(Z) = F_{XY}{}^M(Z)\ P^M(Z)[1.0815] = F_Q{}^M(Z)\ [1.0815]$$

For RAOC operation, the analytical $[T(Z)]^{COLR}$ functions, specified in the COLR for each RAOC operating space, are used together with the measured $F_{XY}(Z)$ values to estimate $F_Q(Z)$ for non-equilibrium operation within the RAOC operating space. When the $F_{XY}(Z)$ values are measured at HFP ARO conditions ($A_{XY}(Z)$ equals 1.0), $F_Q{}^W(Z)$ is given by the following expression:

$$F_Q{}^W(Z) = F_{XY}{}^M(Z)[T(Z)]^{COLR}\ Rj\ [1.0815]$$

Non-equilibrium operation can result in significant changes to the axial power shape. To a lesser extent, non-equilibrium operation can increase the radial peaking factors, $F_{XY}(Z)$, through control rod insertion and through reduced Doppler and moderator feedback at part-power conditions.

The $[T(Z)]^{COLR}$ functions quantify these effects for the range of power shapes, control rod insertion, and power levels characteristic of the operating space. Multiplying $[T(Z)]^{COLR}$ by the measured full power, unrodded $F_{XY}{}^M(Z)$ value, and the factor that accounts for manufacturing and measurement uncertainties gives $F_Q{}^W(Z)$, the maximum total peaking factor postulated for non-equilibrium RAOC operation.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.2.1.2 (continued)

These regions

The top and bottom 15% of the core are excluded from the evaluation because of the low probability that these regions would be more limiting in the safety analyses and because of the difficulty of making a precise measurement in these regions.

they

This Surveillance has been modified by a Note that may require that more frequent surveillances be performed. If $F_Q^W(Z)$ is evaluated, an evaluation of the expression below is required to account for any increase to $F_Q^M(Z)$ that may occur and cause the $F_Q(Z)$ limit to be exceeded before the next required $F_Q(Z)$ evaluation.

If the two most recent $F_Q(Z)$ evaluations show an increase in the expression

maximum over z $\left[\dfrac{F_Q^C(Z)}{K(Z)}\right]$

it is required to meet the $F_Q(Z)$ limit with the last $F_Q^W(Z)$ increased by an appropriate factor specified in the COLR, or to evaluate $F_Q(Z)$ more frequently, each 7 EFPD. These alternative requirements prevent $F_Q(Z)$ from exceeding its limit for any significant period of time without detection.

The excluded regions at the top and bottom of the core are specified in the COLR and are defined to ensure that the minimum margin location is adequately surveilled. A slightly smaller exclusion zone may be specified, if necessary, to include the limiting margin location in the surveilled region of the core.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.2.1.2 (continued)

During the power ascension following a refueling outage, startup physics testing program controls ensure that the $F_Q(Z)$ will not exceed the values assumed in the safety analysis. These controls include power distribution measurement, ramp rate restrictions, and restrictions on RCCA motion. They provide the necessary controls to precondition the fuel and ensure that the reactor power may be safely increased to equilibrium conditions at or near RTP, at which time $F_Q^W(Z)$ and AFD target band are determined. Performing the Surveillance within 12 hours after achieving equilibrium conditions after each refueling after THERMAL POWER exceeds 75% RTP, ensures that the $F_Q(Z)$ limit is met when the unit is released for normal operations.

If THERMAL POWER has been increased by ≥ 10% RTP since the last determination of $F_Q^W(Z)$, another evaluation of this factor is required 12 hours after achieving equilibrium condition at this higher power level (to ensure that $F_Q^W(Z)$ values are being reduced sufficiently with the power increase to stay within the LCO limits).

Insert J

The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

Insert J

SR 3.2.1.2 requires a Surveillance of $F_Q^W(Z)$ during the initial startup following each refueling within 24 hours after exceeding 75% RTP. THERMAL POWER levels below 75% are typically non-limiting with respect to the limit for $F_Q^W(Z)$. Furthermore, startup physics testing and flux symmetry measurements, also performed at low power, provide confirmation that the core is operating as expected. This Frequency ensures that verification of $F_Q^W(Z)$ is performed prior to extended operation at power levels where the maximum permitted peak LHR could be challenged and that the first required performance of SR 3.2.1.2 after a refueling is performed at a power level high enough to provide a high level of confidence in the accuracy of the Surveillance result.

Equilibrium conditions are achieved when the core is sufficiently stable at the intended operating conditions required to perform the Surveillance.

If a previous Surveillance of $F_Q^W(Z)$ was performed at part power conditions, SR 3.2.1.2 also requires that $F_Q^W(Z)$ be verified at power levels ≥ 10% RTP above the THERMAL POWER of its last verification within 24 hours after achieving equilibrium conditions. This ensures that $F_Q^W(Z)$ is within its limit using radial peaking factors measured at the higher power level.

The allowance of up to 24 hours after achieving equilibrium conditions will provide a more accurate measurement of $F_Q^W(Z)$ by allowing sufficient time to achieve equilibrium conditions and obtain the power distribution measurement.

BASES (continued)

REFERENCES

1. USAR, Section 14.

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Atomic Energy Commission Proposed Rule Making, Part 50 - Licensing of Production and Utilization Facilities; General Design Criteria for Nuclear Power Plant Construction Permits, Federal Register 32, No. 132 (July 11, 1967): 10213. [NRC Accession Number: ML043310029]

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4. WCAP-10216-P-A, Revision 1A, "Relaxation of Constant Axial Offset Control/ F_Q Surveillance Technical Specification," February 1994.

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