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10 CFR 50.36(b)

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

SUBJECT:
Beaver Valley Power Station, Unit Nos. 1 and 2
Docket No. 50-334, License No. DPR-66
Docket No. 50-412, License No. NPF-73
License Amendment Request to Correct Non-conservative Technical Specifications 3.2.1, "Heat Flux Hot Channel Factor $F_Q(Z)$" and 5.6.3, "Core Operating Limits Report (COLR)"

Pursuant to 10 CFR 50.36(b), Energy Harbor Nuclear Corp. is submitting a request for amendment to the Renewed Operating Licenses DPR-66 and NPF-73 for the Beaver Valley Power Station (BVPS), Unit Nos. 1 and 2, respectively. The proposed changes correct non-conservative Technical Specification 3.2.1 to ensure plant operation will remain bounded by the facility safety analyses. The list of NRC-approved analytical methods for the core operating limits in Technical Specification 5.6.3.b would also be updated. This issue is tracked in the Energy Harbor Nuclear Corp. corrective action program, with administrative controls implemented until the licenses are amended.

The Energy Harbor Nuclear Corp. evaluation of the proposed changes is enclosed. NRC staff approval of the proposed amendment is requested by June 30, 2021. Due to the unit-specific core designs and safety analyses needed to implement the proposed amendment, implementation would coincide with the start of the BVPS Unit No. 2 fuel cycle and the mid-cycle for BVPS Unit No. 1 in Fall of 2021. The amendment would be implemented no later than December 15, 2021 for both units.

This letter contains no new regulatory commitments. If you have any questions regarding this report, please contact Mr. Thomas A. Lentz, Manager – Nuclear Licensing and Regulatory Affairs, at (440) 280-5567.

I declare under penalty of perjury that the foregoing is true and correct. Executed on June 23, 2020.

Sincerely,

Rod L. Penfield

Enclosure: Evaluation of the Proposed Changes

cc: NRC Region I Administrator
NRC Resident Inspector
NRC Project Manager
Director BRP/DEP
Site BRP/DEP Representative

Subject: License Amendment Request to Correct Non-conservative Technical Specifications 3.2.1, “Heat Flux Hot Channel Factor $F_Q(Z)$,” and 5.6.3, “Core Operating Limits Report (COLR)”

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1.0 SUMMARY DESCRIPTION

This evaluation supports a request to amend Operating Licenses DPR-66 for Beaver Valley Power Station Unit No. 1 (BVPS-1) and NPF-73 for Beaver Valley Power Station Unit No. 2 (BVPS-2).

The proposed amendments would change Technical Specification 3.2.1, "Heat Flux Hot Channel Factor $F_Q(Z)$," to ensure plant operation remains bounded by the facility safety analyses. The list of NRC-approved analytical methods in Technical Specification 5.6.3, "Core Operating Limits Report (COLR)," would also be updated.

On August 19, 2009, an administrative control to Condition B of Technical Specification 3.2.1 was implemented to address Westinghouse Electric Company LLC (Westinghouse) Nuclear Safety Advisory Letter (NSAL) 09-5, "Relaxed Axial Offset Control Analysis" (RAOC). Furthermore, on February 9, 2015, another administrative control to Surveillance Requirement (SR) 3.2.1.2 was implemented to address Westinghouse NSAL 15-1, "Heat Flux Hot Channel Factor Technical Specification Surveillance." The company participated in an industry Pressurized Water Reactor Owners Group (PWROG) project to correct the Technical Specifications. By letter dated March 18, 2019 (Accession No. ML19225C138), the PWROG submitted both proprietary and non-proprietary approval versions of a topical report to the NRC with technical specification corrections and their technical bases. By letter dated August 23, 2019 (Accession No. ML19225D179), the NRC staff approved WCAP-17661-P/NP-A, Rev. 1, "Improved RAOC and CAOC [Constant Axial Offset Control] F_Q Surveillance Technical Specifications," for use with limitations to resolve the issues.

The proposed changes to Technical Specification 3.2.1 are consistent with those changes reviewed and approved by the NRC staff in Appendix A of WCAP-17661-P/NP-A, Rev. 1. Furthermore, as both BVPS units operate with relaxed axial offset control, Energy Harbor Nuclear Corp. will comply with the two limitations identified in Section 5 of the NRC staff's Final Safety Evaluation included within WCAP-17661-P/NP-A, Rev. 1.

Attachment 1 provides the existing technical specification pages marked to show the proposed changes. Attachment 2 provides the existing technical specification bases pages annotated to show the proposed changes and is provided for information only.

2.0 DETAILED DESCRIPTION

2.1 System Design and Operation

In transient and design basis accident safety analyses, the peak fuel power and power distribution are initial conditions, and therefore, must be controlled. During power operation, the global core power distribution is limited by Technical Specifications 3.1.6, "Control Bank Insertion Limits," 3.2.3, "Axial Flux Difference (AFD)," and 3.2.4,

"Quadrant Power Tilt Ratio (QPTR)." Power distributions are quantified in terms of hot channel factors and are measures of the peak fuel pellet power within the reactor core and the total energy produced in a coolant channel, relative to the total reactor power output. Power distributions and hot channel factors are described in Updated Final Safety Analysis Report sections 3.3.2.2 and 4.3.2.2 "Power Distributions" for BVPS-1 and BVPS-2, respectively.

Specifically, the hot channel factor associated with the proposed change in this license amendment request is listed in Technical Specification 3.2.1, "Heat Flux Hot Channel Factor $F_Q(Z)$." F_Q is the heat flux hot channel factor and is defined as the maximum local heat flux on the surface of a fuel rod divided by the average fuel rod heat flux, allowing for manufacturing tolerances on fuel pellets and rods. Therefore, $F_Q(Z)$ is the maximum local heat flux on the surface of a fuel rod at core elevation Z divided by the average fuel rod heat flux.

The limiting condition for operation (LCO) for Technical Specification 3.2.1 is that $F_Q(Z)$, as approximated by $F_Q^C(Z)$ and $F_Q^W(Z)$, shall be within the limits as specified in the Core Operating Limits Report (COLR) when the units are in Mode 1. $F_Q^C(Z)$ and $F_Q^W(Z)$ are defined as follows:

$F_Q^C(Z)$:

$F_Q(Z)$ is measured with the moveable incore detector system by taking flux maps at different core elevations. This measured $F_Q(Z)$ is denoted as $F_Q^M(Z)$.

When $F_Q^M(Z)$ is multiplied by a factor to account for fuel manufacturing tolerances and flux map measurement uncertainty, it becomes the current $F_Q(Z)$, or $F_Q^C(Z)$.

$F_Q^W(Z)$:

$F_Q^W(Z)$, or the transient $F_Q(Z)$, is defined as the maximum $F_Q(Z)$ calculated to occur in normal operation over the next surveillance interval. The term includes margin for fuel manufacturing tolerances, flux map measurement uncertainty, and operational transients anticipated over the next surveillance interval. It is the product of $F_Q^C(Z)$ and W(Z). In short, W(Z) characterizes the increase in $F_Q(Z)$ for non-equilibrium operation. W(Z) factors are calculated as a function of core height and listed in the COLR on a cycle-specific basis for various burnups throughout the cycle.

2.2 Current Technical Specification Requirements

The current requirements for Technical Specification 3.2.1 is that $F_Q(Z)$, as approximated by $F_Q^C(Z)$ and $F_Q^W(Z)$, shall be within the limits as specified in the COLR when the units are in Mode 1.

Surveillance Requirements 3.2.1.1 and 3.2.1.2 verify $F_Q^C(Z)$ and $F_Q^W(Z)$, respectively, are within limits:

(1) Once after each refueling prior to thermal power exceeding 75 percent (%) rated thermal power,

(2) Once within 12 hours after achieving equilibrium conditions after exceeding, by greater than or equal to (≥) 10% rated thermal power, the thermal power at which $F_Q{}^C(Z)$ and $F_Q{}^W(Z)$ were last verified, and

(3) In accordance with the Surveillance Frequency Control Program.

The surveillances are preceded by a note stating that 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 map is obtained. SR 3.2.1.2 has another note directing additional action if the maximum over Z of $F_Q{}^C(Z)$ divided by K(Z), where K(Z) is the normalized $F_Q(Z)$ as a function of core height and provided in the COLR, has increased since the previous $F_Q{}^C(Z)$ evaluation.

For Technical Specification 3.2.1 Condition A when $F_Q{}^C(Z)$ is not within the limit, the required actions and associated completion times are:

- Reduce thermal power by a certain amount within 15 minutes after each $F_Q{}^C(Z)$ determination, and
- Reduce both the power range neutron flux high and the overpower delta-temperature trip setpoints by a certain amount within 72 hours after each $F_Q{}^C(Z)$ determination, and
- Perform Surveillance Requirements 3.2.1.1 and 3.2.1.2 prior to increasing thermal power above the limit in the first required action.

For Technical Specification 3.2.1 Condition B when $F_Q{}^W(Z)$ is not within the limits, the required actions and associated completion times are:

- Reduce axial flux difference limits by a certain amount within 4 hours, and
- Reduce both the power range neutron flux high and the overpower delta-temperature trip setpoints by a certain amount within 72 hours, and
- Perform Surveillance Requirements 3.2.1.1 and 3.2.1.2 prior to increasing thermal power above the maximum allowable power of the axial flux difference limits.

For Technical Specification 3.2.1 Condition C when the required action and associated completion times are not met, then the required action is to be in Mode 2 within 6 hours.

2.3 Reason for the Proposed Changes

It was identified that the technical specification required actions associated with $F_Q{}^W(Z)$ not being within limits when reactor power was ≥ 75% rated thermal power were not as conservative as previously understood.

Another non-conservatism was identified for plants that operate with relaxed axial offset control, such as BVPS-1 and BVPS-2. As previously described, $F_Q^W(Z)$ is the product of a surveillance measurement and analytical factors. The analytical factors, namely W(Z), are derived before each core reload for the upcoming operating cycle, and must assume a reference condition for the surveillance. The issue is that the surveillance takes place after the plant returns to power, and therefore, well after the analytical factors are derived. The initial surveillance condition is not necessarily the same as the assumed reference condition. When measured and predicted axial power shapes disagree during the surveillance, F_Q margin may be over or under-predicted, depending on the nature of the axial power shape misprediction and the limiting margin location. This is a particular problem for part-power surveillances.

Finally, it was determined that there were issues with the note and surveillance frequencies associated with Surveillance Requirement 3.2.1.2.

As described in Section 1 of this submittal, the NRC staff has approved WCAP-17661-P/NP-A, Rev. 1 for use with limitations to address these issues associated with Technical Specification 3.2.1 described in Westinghouse NSALs 09-5 and 15-1. Implementing the changes to Technical Specification 3.2.1 consistent with the NRC staff-approved WCAP will provide a series of more restrictive core operating spaces if the limiting condition for operation is not met and a more clearly defined set of surveillance requirements and required actions. The proposed changes provide a reasonable assurance that the cores operated in accordance with the technical specifications will remain within the power distribution limits assumed in the safety analyses and allow Energy Harbor Nuclear Corp. to remove the two administrative controls to Technical Specification 3.2.1 once approved.

2.4 Description of the Proposed Changes

The proposed changes correct the issues described in this submittal by updating Technical Specification 3.2.1 for the BVPS units. The changes proposed below are consistent with the Technical Specification 3.2.1 changes reviewed and approved by the NRC staff in Appendix A of WCAP-17661-P/NP-A, Rev. 1 without any technical differences.

An administrative change to the corresponding list of approved analytical methods for determining the core operating limits in Technical Specification 5.6.3.b is also made to add WCAP-17661-P-A.

The proposed changes to Technical Specifications 3.2.1 and 5.6.3.b are as follows:

<u>Technical Specification 3.2.1 Title and Header</u>

1. Administrative changes to the title and header would reflect the different methodology. The title for Technical Specification 3.2.1 would be changed from:

Heat Flux Hot Channel Factor $F_Q(Z)$

To:

Heat Flux Hot Channel Factor $F_Q(Z)$ (RAOC-T(Z) Methodology)

Similarly, the header for this specification would change from:

$F_Q(Z)$

To:

$F_Q(Z)$ (RAOC-T(Z) Methodology)

Technical Specification 3.2.1 Condition A Actions

2. Required Action A.2 would be changed from:

   Reduce Power Range Neutron Flux – High trip setpoints ≥ 1% for each 1% $F_Q^C(Z)$ exceeds limit.

   To:

   Reduce Power Range Neutron Flux – High trip setpoints ≥ 1% for each 1% that THERMAL POWER is limited below RATED THERMAL POWER by Required Action A.1.

3. Similarly, Required Action A.3 would be changed from:

   Reduce Overpower ΔT trip setpoints ≥ 1% for each 1% $F_Q^C(Z)$ exceeds limit.

   To:

   Reduce Overpower ΔT trip setpoints ≥ 1% for each 1% that THERMAL POWER is limited below RATED THERMAL POWER by Required Action A.1.

4. The NOTE in Condition A would be changed from:

   Required Action A.4 shall be completed whenever this Condition is entered.

   To:

   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.

Technical Specification 3.2.1 Condition B Actions

5. The existing B.1 Required Action would be deleted and new Required Actions B.1.1 and B.1.2 would be added as follows:

    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.

    The Completion Time for Required Action B.1.1 would be 4 hours.

    The Completion Time for Required Action B.1.2 would be 72 hours.

6. A new logical operator OR would be added to provide an alternative Required Action B.2 to satisfy the Condition.

7. A new Required Action B.2.1 would be added as follows:

    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.

    The Completion Time for Required Action B.2.1 would be 4 hours.

8. The existing Required Action B.2 would become Required Action B.2.2 and change from:

    Reduce Power Range Neutron Flux – High trip setpoints ≥ 1% for each 1% that the maximum allowable power of the AFD limits is reduced.

    To:

    Reduce Power Range Neutron Flux – High trip setpoints ≥ 1% for each 1% that THERMAL POWER is limited below RATED THERMAL POWER by Required Action B.2.1.

9. The existing Required Action B.3 would become Required Action B.2.3 and change from:

   Reduce Overpower ΔT trip setpoints ≥ 1% for each 1% that the maximum allowable power of the AFD limits is reduced.

   To:

   Reduce Overpower ΔT trip setpoints ≥ 1% for each 1% that THERMAL POWER is limited below RATED THERMAL POWER by Required Action B.2.1.

10. The existing Required Action B.4 would become Required Action B.2.4 and the Completion Time would change from:

    Prior to increasing THERMAL POWER above the maximum allowable power of the AFD limits.

    To:

    Prior to increasing THERMAL POWER above the limit of Required Action B.2.1.

11. The existing NOTE in Condition B would be deleted.

Technical Specification 3.2.1 Surveillance Requirements

12. The following NOTE to the surveillance requirements would be deleted in its entirety:

    --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 map is obtained.

13. The existing Surveillance Requirement 3.2.1.1 second requirement in the Frequency column would have the frequency extended an additional 12 hours from:

    Once within 12 hours after achieving equilibrium conditions after exceeding, by ≥ 10% RTP, the THERMAL POWER at which $F_Q^C(Z)$ was last verified

    To:

    Once within 24 hours after achieving equilibrium conditions after exceeding, by ≥ 10% RTP, the THERMAL POWER at which $F_Q^C(Z)$ was last verified

14. The following NOTE to Surveillance Requirement 3.2.1.2 would be deleted in its entirety:

--NOTE---------------------------------------
If measurements indicate that the

maximum over z of [$F_Q^C(Z)$ / K(Z)]

has increased since the previous evaluation of $F_Q^C(Z)$:

a. Increase $F_Q^W(Z)$ by the greater of a factor of 1.02 or 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 flux maps indicate that the

maximum over z of [$F_Q^C(Z)$ / K(Z)]

has not increased.

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15. The Surveillance Requirement 3.2.1.2 Frequency requirement would be changed from:

Once after each refueling prior to THERMAL POWER exceeding 75% RTP

To:

Once after each refueling within 24 hours after THERMAL POWER exceeds 75% RTP

16. The Surveillance Requirement 3.2.1.2 second Frequency requirement would be changed from:

Once within 12 hours after achieving equilibrium conditions after exceeding, by ≥ 10% RTP, the THERMAL POWER at which $F_Q^W(Z)$ was last verified

To:

Once within 24 hours after achieving equilibrium conditions after exceeding, by ≥ 10% RTP, the THERMAL POWER at which $F_Q^W(Z)$ was last verified

Technical Specification 5.6.3.b

17. An administrative change would add the NRC staff-approved core operating limits analytical method to the end of the list as follows:

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

3.0 TECHNICAL EVALUATION

The proposed changes to Technical Specification 3.2.1 address the issues described in Section 2.3 by reformulating the transient F_Q surveillance and defining new required actions that ensure adequate margin recovery. As part of this reformulation, the F_Q surveillance W(Z) factors are redefined to mitigate the sensitivity to differences between the measured and predicted steady-state power shapes. The new factors, called T(Z) factors, primarily characterize the maximum transient P(Z), that is, the maximum expected values of the normalized core average axial power shape resulting from non-equilibrium operation. With the proposed changes, the radial $F_{XY}(Z)$ peaking factors would be measured and multiplied by the T(Z) factors to obtain the measured $F_Q^W(Z)$, which is the transient $F_Q(Z)$. The measured steady-state axial power shape would not be used in the surveillance, nor would the predicted surveillance axial power shape. This proposed change will also improve the accuracy of part-power surveillances since the surveillance axial power shape is not used to determine the measured transient $F_Q(Z)$. Use of the surveillance axial power shape in the part-power transient $F_Q(Z)$ measurement is a major source of the over-measurement that can lead to anomalous reductions in transient F_Q margin for part-power surveillances.

To address the non-conservatism in Required Action B.1, the proposed changes would permit multiple RAOC operating spaces to be defined in the COLR. The COLR will include T(Z) functions for each RAOC operating space, which is defined as a unique combination of AFD limits and control bank insertion limits. If there is a measured transient F_Q violation, then a more restrictive RAOC operating space can be selected from the COLR that provides the required margin for future non-equilibrium operation. This retains the feature of using an AFD reduction to gain margin but in a manner that ensures that appropriate margin is recovered. If none of the RAOC operating spaces included in the COLR provides the required margin, then limits on thermal power and AFD must be implemented. These limits are specified in the COLR. The analysis methods used to determine the T(Z) values and the limits on thermal power and AFD are described in WCAP-17661-P/NP-A, Rev. 1.

The existing Surveillance Requirements 3.2.1.1 and 3.2.1.2 are modified by a note that could cause confusion:

> 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 map is obtained.

This proposed amendment would delete the note in its entirety. The proposed surveillance frequencies for $F_Q^C(Z)$ and $F_Q^W(Z)$ are unambiguous. It is sufficient to confirm $F_Q^C(Z)$ once prior to exceeding 75% RTP following a refueling. It is sufficient to confirm $F_Q^W(Z)$ once within 24 hours after exceeding 75% RTP following a refueling (discussed in further detail below). When the criterion for a higher power level is achieved, another verification of $F_Q^C(Z)$ and $F_Q^W(Z)$ is required. Thus, the surveillances will continue to be confirmed at high power levels where margin will be at its minimum.

A proposed change to the second frequency in SR 3.2.1.1 would require verification of $F_Q^C(Z)$ within 24 hours instead of 12 hours after achieving equilibrium conditions upon exceeding, by ≥ 10% RTP, the THERMAL POWER at which $F_Q^C(Z)$ was last verified. This frequency of 24 hours is contained in some plant technical specifications and is a reasonable period of time to perform the verification given the small likelihood of limiting power shapes or limiting design basis events occurring prior to completion of the surveillance.

The intent of SR 3.2.1.2 is to confirm that the F_Q limit will be met during future non-equilibrium operation within the allowed operating space between the time of the current surveillance and the next required surveillance. There are two areas for improvement in SR 3.2.1.2. The first area for improvement concerns the surveillance frequencies.

The first frequency for SR 3.2.1.2 would be changed to state that $F_Q^W(Z)$ must be verified to be within its limit following each refueling within 24 hours after thermal power exceeds 75% RTP. This change is justified since core power distribution measurements taken at low powers (less than 50% RTP to confirm that the core is loaded properly) will provide ample indication that the core is operating consistent with expectations. The proposed frequency will ensure that verification of $F_Q^W(Z)$ is performed within a reasonable time period and prior to extended operation at power levels where the maximum permitted peak linear heat rate could potentially be challenged. Power levels of less than or equal to (≤) 75% RTP are non-limiting for minimum transient $F_Q^W(Z)$ margin. Furthermore, surveillances at low power levels can be challenging with respect to obtaining an accurate transient F_Q margin assessment. Performing this initial verification within 24 hours after exceeding 75% power ensures that the surveillance will be performed with appropriate steady state peaking factors measured at or near the power level where future non-equilibrium operation could be limiting. If the surveillance indicates that future nonequilibrium operation could challenge the limit, the proposed required actions will provide appropriate compensatory measures to ensure that the LCO will be met during such operation.

The second frequency for SR 3.2.1.2 would be changed to require verification of $F_Q^W(Z)$ within 24 hours (instead of 12 hours) after achieving equilibrium conditions upon exceeding, by ≥ 10% RTP, the THERMAL POWER at which $F_Q^W(Z)$ was last verified. The frequency of 24 hours is a reasonable time period in which to confirm that $F_Q^W(Z)$ is within its limits given the extremely small likelihood of limiting power shapes or limiting design basis events occurring prior to completion of the surveillance.

The second area for improvement of SR 3.2.1.2 concerns the existing note modifying it. The intent of this note is to account for potential increases in $F_Q^W(Z)$ between surveillances. It requires application of the greater of a 1.02 factor or a factor specified in the COLR whenever measurements indicate that the maximum value of $F_Q^C(Z)$ / K(Z) has increased. Alternatively, SR 3.2.1.2 must be repeated once per 7 EFPD until $F_Q^W(Z)$ is within limits with the penalty factor applied or two successive flux maps indicate that $F_Q^C(Z)$ / K(Z) has not increased.

This proposed change will eliminate this note, but application of a penalty factor will continue to be required whenever the minimum margin to the $F_Q^W(Z)$ limit is predicted to decrease. The required penalty factors, referred to as R_j factors, will be included in the COLR and will become part of the $F_Q^W(Z)$ formulation. The penalty factors will be tied to a predicted decrease in the actual transient F_Q margin in the upcoming time period rather than a measured increase in the value of $F_Q^C(Z)$ / K(Z) over the previous time period. When margin is predicted to increase, the COLR will indicate an R_j factor of 1.0 (no penalty). When margin is predicted to decrease, the COLR will indicate an appropriate R_j factor based on predicted margin trends.

This is more appropriate and rigorous than the current method since decreases in margin in the upcoming time period are the relevant concern. The basis for the current surveillance requirement is that past measurement trends of $F_Q^C(Z)$ / K(Z) can be used to determine whether or not the transient F_Q margin will decrease in the future and, therefore, whether or not a penalty factor is needed. Past measurement trends of $F_Q^C(Z)$ / K(Z), however, may or may not be indicative of future margin trends. Though unlikely, it is possible for the maximum value of $F_Q^C(Z)$ / K(Z) to be decreasing while margin is also decreasing since margin depends not only on the maximum value of $F_Q^C(Z)$ / K(Z), which characterizes steady state peaking factors, but also on the range of possible non-equilibrium axial power shapes, characterized analytically by W(Z) and T(Z). Furthermore, the R_j penalty factors tend to be largest at beginning of life when the burnable absorbers are depleting relatively quickly with consequent changes in the power distribution. Current core models predict burnable absorber depletion and the resulting power distribution changes well. Thus, consistency between the measured and predicted trends in steady-state peaking factors is expected. Consequently, basing the application and magnitude of the penalty factor on predicted margin trends is a reasonable approach.

Another difficulty with the current surveillance requirement is that a minimum penalty of 2% is applied regardless of how small the increase in $F_Q^C(Z)$ / K(Z) was measured to be. Even a small increase in $F_Q^C(Z)$ / K(Z) of 0.1% would require a 2% penalty to be applied. The proposed surveillance requirement eliminates this problem since the magnitude of the penalty factor is based on the predicted margin trends. No minimum penalty is specified.

Finally, the proposed surveillance requirement avoids any lag in the application of the penalty factor caused by the current requirement for two successive measurements, which could be a month apart, to indicate a potential decrease in margin. These measurements characterize the margin trend in the time period that just ended. Therefore, the proposed

surveillance requirement will better capture the expected trend of the margin based on predictions. By eliminating the note, however, the option to perform more frequent surveillances in lieu of applying the penalty factor is also eliminated. It will be necessary to demonstrate that the LCO is met with the COLR R_j factor applied. If the LCO is not met, then the required actions must be implemented to restore margin.

WCAP-17661-P-A was approved by the NRC with two limitations listed in the Safety Evaluation Report. The first limitation is on the use of a correction factor for RAOC surveillance conditions, A_{xy}, and has two stipulations (one of a total of three stipulations pertains to constant axial offset control, or CAOC, correction factor A_Q plants only and will not be included):

1. The NRC-approved methods provided in the response to RAI 15.b must be used to perform the surveillance-specific A_{xy} calculation. Newer methods with similar capabilities may be considered acceptable provided the NRC staff specifically approves them for calculating A_{xy} factors.
2. The depletion calculation used to determine the numerator and denominator of the A_{xy} factor must be performed similarly to the original design calculation, as described in the response to RAI 15.c.

The second limitation pertains to the final power level reduction to 50% RTP in the event of a failed surveillance. As noted in Section 4.3.2 of the NRC staff's Safety Evaluation Report of WCAP-17661-P/NP-A, Rev. 1, the use of 50% as the final power level reduction is not included in the technical specifications but rather in the technical specification bases and in the COLR. Therefore, this value must be implemented on a plant-specific basis and included in COLR input generated using this methodology in order to use WCAP-17661-P/NP-A, Rev. 1.

These limitations will be met for BVPS-1 and BVPS-2. The methodology for calculating A_{xy} will come from WCAP-17661-P/NP-A, Rev. 1. The statement in the COLR describing A_{xy} will state: "$A_{xy}(Z)$ may be assumed to equal 1.0 or may be determined for the specific surveillance conditions using the approved methods listed in Technical Specification 5.6.3." The proposed change to Technical Specification 5.6.3 would list WCAP-17661-P-A as an approved methodology. The final power level of less than 50% RTP in case of a failed surveillance will also be in the COLR.

4.0 REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements/Criteria

The following NRC regulatory requirements are applicable to this license amendment request.

<u>10 CFR 50.46, Acceptance Criteria for Emergency Core Cooling Systems for Light-water Nuclear Power Reactors</u>

10 CFR 50.46, requires, in part, that emergency core cooling system performance must be calculated in accordance with an acceptable evaluation model for a number of postulated loss-of-coolant accident break sizes, locations, and other properties sufficient to provide assurance that the most severe postulated loss-of-coolant accidents are calculated. Furthermore, the emergency core cooling system shall be designed and analyzed with an acceptable evaluation model and demonstrate that the acceptance criteria are met in 10 CFR 50.46(b). Inputs to the evaluation model include peak fuel power and power distribution. The proposed changes to Technical Specification 3.2.1, “Heat Flux Hot Channel Factor $F_Q(Z)$,” in this license amendment request provide reasonable assurance that the cores operated in accordance with the technical specifications will remain within the power distribution limits assumed in the safety analyses, and therefore, compliance with 10 CFR 50.46 continues to be met.

<u>10 CFR 50, Appendix A, General Design Criteria for Nuclear Power Plants</u>

General Design Criterion 10, “Reactor Design,” of 10 CFR Part 50, Appendix A, requires 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. The proposed changes to Technical Specification 3.2.1 provide reasonable assurance that the cores operated in accordance with the technical specifications will remain within the power distribution limits assumed in the safety analyses, and therefore, Criterion 10 continues to be met.

General Design Criterion 20, “Protection System Functions,” of 10 CFR Part 50, Appendix A, requires that 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.

General Design Criterion 26, “Reactivity Control System Redundancy and Capability,” of 10 CFR Part 50, Appendix A, in part, defines requirements for a reactivity control system using control rods, including a 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, specified fuel design limits are not exceeded.

The proposed changes continue to require reactor protection system trip setpoint adjustment in the event the heat flux hot channel factor is not within limits. Therefore, General Design Criteria 20 and 26 continue to be met.

10 CFR 50.36, Technical Specifications

10 CFR 50.36 requires in part, that operating licenses include technical specifications derived from the analyses and evaluation included in the safety analysis report. Technical specifications include, in part, limiting conditions for operation [10 CFR 50.36 paragraph (c)(2)], and surveillance requirements [paragraph (c)(3)].

NRC Generic Letter (GL) 88-16, "Removal of Cycle-Specific Parameter Limits From Technical Specifications," (Accession No. ML031200485), established the NRC position that licensees could remove cycle-specific values of certain operating limits from the technical specifications and maintain them in a COLR, provided that certain requirements were met. Licensees are required to do the following:

1. Use NRC-approved methodology to determine the operating limits,
2. Include a list, in the technical specification 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.

Compliance with 10 CFR 50.36 and GL 88-16 would be met with NRC approval of the proposed changes and submittal of the COLR to the NRC in accordance with BVPS Technical Specification 5.6.3.d.

4.2 No Significant Hazards Consideration Analysis

Pursuant to 10 CFR 50.36(b), Energy Harbor Nuclear Corp. is submitting a request for amendment to the Renewed Operating Licenses DPR-66 and NPF-73 for the Beaver Valley Power Station (BVPS), Unit Nos. 1 and 2, respectively. The proposed changes correct non-conservative Technical Specification 3.2.1, "Heat Flux Hot Channel Factor $F_Q(Z)$," to ensure plant operation remains bounded by the facility safety analyses. The changes are consistent with those described in the NRC staff-approved (with specified limitations) WCAP-17661-P/NP-A, Rev. 1, "Improved RAOC and CAOC F_Q Surveillance Technical Specifications." The list of NRC-approved analytical methods for the core operating limits in Technical Specification 5.6.3, "Core Operating Limits Report (COLR)," would also be updated.

Energy Harbor Nuclear Corp. 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 amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No.

The proposed amendment to correct the heat flux hot channel factor non-conservative Technical Specification 3.2.1 uses NRC staff-approved methodology with specified limitations, and the administrative change to Technical Specification 5.6.3 would add the NRC staff-approved topical report to the list of approved analytical methods. There are no plant modifications or plant operating procedure changes associated with this proposed amendment that could significantly increase the probability of a previously-evaluated accident.

The correction to Technical Specification 3.2.1 would provide a series of more restrictive core operating spaces if the limiting condition for operation is not met, and a more clearly defined set of surveillance requirements and required actions. The proposed amendment provides a reasonable assurance that the cores operated in accordance with the technical specifications will remain within the power distribution limits assumed in previously-evaluated accidents, and therefore, does not involve a significant increase in the consequences of a previously-evaluated accident.

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

   Response: No

   There are no plant modifications or plant operating procedure changes with the proposed amendment. Plant operation in accordance with the corrected TS 3.2.1 would preclude new challenges to systems, structures, and components that might introduce a new type of accident. The proposed change to TS 5.6.3 is administrative only.

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

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

   Response: No

   The proposed amendment does not modify the plant or change operating procedures. The proposed amendment provides a reasonable assurance that the cores operated in accordance with the technical specifications will remain within the power distribution limits assumed in previously-evaluated accidents, and therefore, does not involve a significant reduction in a margin of safety.

Based on the above, Energy Harbor Nuclear Corp. 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.

5.0 ENVIRONMENTAL CONSIDERATION

A review has determined 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 effluents that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

Attachment 1

Technical Specification Page Markups
(5 pages follow)

(RAOC-T(Z) Methodology)

3.2 POWER DISTRIBUTION LIMITS

3.2.1 Heat Flux Hot Channel Factor $F_Q(Z)$ (RAOC-T(Z) Methodology)

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
---------- **- 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. ----------		
A. $F_Q^C(Z)$ 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	
	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

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.

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.

$F_Q(Z)$
3.2.1

(RAOC-T(Z) Methodology)

CONDITION	REQUIRED ACTION		COMPLETION TIME
------------NOTE------------ Required Action B.4 shall be completed whenever this Condition is entered. ---------------------------- B. $F_Q^W(Z)$ not within limits.	B.1 (.1)	~~Reduce AFD limits ≥ 1% for each 1% $F_Q^W(Z)$ exceeds limit.~~	4 hours 72 hours 4 hours
	AND		
	B.2 (.2)	Reduce Power Range Neutron Flux - High trip setpoints ≥ 1% for each 1% that ~~the maximum allowable power of the AFD limits is reduced.~~ THERMAL POWER is limited below RATED THERMAL POWER by Required Action B.2.1.	72 hours
	AND		
	B.3 (2.3)	Reduce Overpower ΔT trip setpoints ≥ 1% for each 1% that ~~the maximum allowable power of the AFD limits is reduced.~~ THERMAL POWER is limited below RATED THERMAL POWER by Required Action B.2.1.	72 hours
	AND		
	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 map is obtained.~~

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

(RAOC-T(Z) Methodology)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.2.1.2	-- ~~- NOTE -~~ ~~If measurements indicate that the~~ ~~maximum over z of [$F_Q^C(Z)$ / K(Z)]~~ ~~has increased since the previous evaluation of $F_Q^C(Z)$:~~ ~~a. Increase $F_Q^W(Z)$ by the greater of a factor of 1.02 or 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 flux maps indicate that the~~ ~~maximum over z of [$F_Q^C(Z)$ / K(Z)]~~ ~~has not increased.~~ -- Verify $F_Q^W(Z)$ is within limit.	Once after each refueling ~~prior to THERMAL POWER exceeding 75% RTP~~ within 24 hours after THERMAL POWER exceeds 75% RTP <u>AND</u> 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 <u>AND</u> In accordance with the Surveillance Frequency Control Program

5.6 Reporting Requirements

5.6.3 CORE OPERATING LIMITS REPORT (COLR) (continued)

WCAP-16045-P-A, “Qualification of the Two-Dimensional Transport Code PARAGON,”

WCAP-16045-P-A, Addendum 1-A, “Qualification of the NEXUS Nuclear Data Methodology,”

WCAP-12610-P-A & CENPD-404-P-A, Addendum 1-A, “Optimized ZIRLO™~~.”~~ ,"

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

As described in reference documents listed above, when an initial assumed power level of 102% of RATED THERMAL POWER is specified in a previously approved method, 100.6% of RATED THERMAL POWER may [illegible] when input for reactor thermal power measurement of feedwater [illegible]y the leading edge flow meter (LEFM).

Caldon, Inc. Engineering Report-80P, "Improving Thermal Power Accuracy and Plant Safety While Increasing Operating Power Level Using the LEFM √ ™ System"

Caldon, Inc. Engineering Report-160P, "Supplement to Topical Report ER-80P: Basis for a Power Uprate with the LEFM √ ™ System"

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.

5.6.4 Reactor Coolant System (RCS) PRESSURE AND TEMPERATURE LIMITS REPORT (PTLR)

a. RCS pressure and temperature limits for heat up, cooldown, low temperature operation, criticality, and hydrostatic testing, Overpressure Protection System (OPPS) enable temperature, and PORV lift settings as well as heatup and cooldown rates shall be established and documented in the PTLR for the following:

LCO 3.4.3, "RCS Pressure and Temperature (P/T) Limits," and

LCO 3.4.12, "Overpressure Protection System (OPPS)"

b. The analytical methods used to determine the RCS pressure and temperature limits shall be those previously reviewed and approved by the NRC, specifically those described in the following documents:

Attachment 2

Technical Specification Bases Page Markups (for information only)
(18 pages follow)

B 3.2 POWER DISTRIBUTION LIMITS

B 3.2.1 Heat Flux Hot Channel Factor ($F_Q(Z)$) (RAOC-T(Z) Methodology)

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 the incore detector 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 value of $F_Q(Z)$ which are present during nonequilibrium situations such as load following or power ascension.

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~~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.

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.

BASES

APPLICABLE SAFETY ANALYSES

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

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

b. During a loss of forced reactor coolant flow accident, 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,

c. During an ejected rod accident, the energy deposition to the fuel must not exceed 280 cal/gm (Ref. 2), 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. 3).

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.

$F_Q(Z)$ 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:

$F_Q(Z) \le [CFQ / P]\ K(Z)$ for $P > 0.5$

$F_Q(Z) \le [CFQ / 0.5]\ K(Z)$ for $P \le 0.5$

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 = THERMAL POWER / RTP

The actual values of CFQ and K(Z) are given in the COLR; however, CFQ is normally a number on the order of 2.40, and K(Z) is a function that looks like the one provided in Figure B 3.2.1-1. Figure B 3.2.1-1 is for illustration purposes only. The actual unit specific K(Z) as a function of core height figures are contained in the COLR.

BASES

LCO (continued)

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 an incore flux map in MODE 1. From the incore flux map results we obtain the measured value ($F_Q^M(Z)$) of $F_Q(Z)$. Then,

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- NOTE -

An additional measurement uncertainty is to be applied if the number of measured thimbles for the moveable incore detector system is less than or equal to 37 but greater than or equal to 25. The additional uncertainty of (0.01)*[3-(T/12.5)] is added to the measurement uncertainty, 1.05, where T is the total number of measured thimbles. The total uncertainty applied is then 1.03 times the adjusted measurement uncertainty. At least three measured thimbles per core quadrant are also required.

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

where 1.0815 is a factor that accounts for fuel manufacturing tolerances and flux map measurement uncertainty (Ref. 4).

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

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

$F_Q^W(Z) =$ ~~$F_Q^C(Z)\ W(Z)$~~ $F_{XY}(Z)[T(Z)]^{COLR}\ A_{XY}(Z)\ Rj\ [1.0815] / P$

~~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 $F_Q^C(Z)$ is calculated at equilibrium conditions.~~

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:

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(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 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.

$A_{XY}(Z)$ 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 6.

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

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.

This LCO requires operation within the bounds assumed in the safety analyses. 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. 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, a more restrictive RAOC operating space must be implemented or core power limits and AFD limits must be reduced.~~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.~~

LCO (continued)

~~Violating the LCO limits for $F_Q(Z)$ produces 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 a factor accounting for manufacturing tolerances and measurement uncertainties. $F_Q^M(Z)$ is 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 $F_Q^C(Z)$ and would require power reductions within 15 minutes of the $F_Q^C(Z)$ determination, if necessary to comply with the decreased maximum allowable power level. Decreases in $F_Q^C(Z)$ would allow increasing the maximum allowable power level and increasing power up to this revised limit.

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, 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.

A.2

A reduction of the Power Range Neutron Flux - High trip setpoints by ≥ 1% for each 1% that THERMAL POWER is limited below RATED THERMAL POWER by Required Action A.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 Power Range Neutron Flux - High trip setpoints initially determined by Required Action A.2 may be affected by subsequent determinations of $F_Q^C(Z)$ and would require Power Range Neutron Flux - High trip setpoint reductions within 72 hours of the $F_Q^C(Z)$ determination, if necessary to comply with the decreased maximum allowable Power Range Neutron Flux - High trip setpoints. Decreases in $F_Q^C(Z)$ would allow increasing the maximum allowable Power Range Neutron Flux - High trip setpoints.

BASES

ACTIONS (continued)

A.3

Reduction in the Overpower ΔT trip setpoints (value of K_4) by ≥ 1% for each 1% that THERMAL POWER is limited below RATED THERMAL POWER by Required Action A.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 trip 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 operation are consistent with safety analyses assumptions.

Condition A is modified by a Note that requires Required Action A.4 to be performed whenever the Condition is entered 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. This ensures that SR 3.2.1.1 and SR 3.2.1.2 (if required) 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.

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. 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. ~~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, restricts the axial flux distribution such that even if a transient occurred, core peaking factors are not exceeded.

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 Required Actions B.2, B.3 and B.4.

BASES

ACTIONS (continued)

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 property 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. 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, 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.

B.2.2

A reduction of the Power Range Neutron Flux-High 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 limit and ~~as a result of reducing~~ AFD limits in accordance with Required Action B.2.1.

B.2.3

Reduction in the Overpower ΔT trip setpoints value of K_4 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 limit and ~~as a result of reducing~~ AFD limits in accordance with Required Action B.2.1.

B.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 maximum allowable power limit imposed by Required Action B.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 A 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.~~

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C.1

If Required Actions A.1 through A.4 or B.1 through B.2.4 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.

BASES

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 map 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 $F_Q^C(Z)$ and $F_Q^W(Z)$ 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 these parameters before exceeding 75% RTP. This ensures that some determination of $F_Q^C(Z)$ and $F_Q^W(Z)$ are 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. In the absence of these Frequency conditions, it is possible to increase power to RTP and operate for 31 days 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

- NOTE -

An additional measurement uncertainty is to be applied if the number of measured thimbles for the moveable incore detector system is less than or equal to 37 but greater than or equal to 25. The additional uncertainty of (0.01)*[3-(T/12.5)] is added to the measurement uncertainty, 1.05, where T is the total number of measured thimbles. The total uncertainty applied is then 1.03 times the adjusted measurement uncertainty. At least three measured thimbles per core quadrant are also required.

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 $F_Q^C(Z)$. Specifically, $F_Q^M(Z)$ is the measured value of $F_Q(Z)$ obtained from incore flux map results and $F_Q^C(Z) = F_Q^M(Z)$ 1.0815 (Ref. 4). $F_Q^C(Z)$ 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.

BASES

SURVEILLANCE REQUIREMENTS (continued)

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

If THERMAL POWER has been increased by ≥ 10% RTP since the initial or most recent ~~last~~ determination of $F_Q^C(Z)$, another evaluation of this factor is required ~~12~~ 24 hours after achieving equilibrium conditions at this higher power level (to ensure that $F_Q^C(Z)$ values are being reduced sufficiently with power increase to stay within the LCO limits). 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.

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 flux maps are taken in steady state conditions, the variations in power distribution resulting from normal operational maneuvers are not present in the flux map data. These variations are, however, conservatively calculated 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, $F_Q^W(Z)$.~~

~~The SR Note specifies in part "If measurements indicate that the maximum over z of [$F_Q^C(Z)$/ K(Z)] has increased ...". This statement in the Note refers to the fact that both F_Q^C and K are functions of the axial height. At each applicable core elevation the ratio of $F_Q^C(Z)$ / K(Z) is calculated to determine the maximum ratio (maximum over z). If this maximum ratio~~

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~~has increased since the last set of evaluations, then the Note modifying this SR specifies additional verifications that must be performed.~~

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 lessor 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.

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 $[T(Z)]^{COLR}$ functions are specified~~W(Z) Table is provided~~ in the COLR for discrete core elevations. Flux map data are typically taken for 30 to 75 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 10% inclusive, ~~and~~

b. Upper core region, from 90 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.

BASES

SURVEILLANCE REQUIREMENTS (continued)

These regions The top and bottom 10% of the core are excluded from the evaluation because of the low probability that they these regions would be more limiting in the safety analyses and because of the difficulty of making a precise measurement in these regions. 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.

This Surveillance has been modified by a Note that may require 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 of [$F_Q^C(Z)$ / K(Z)], it is required to meet the $F_Q(Z)$ limit with the last $F_Q^W(Z)$ increased by the greater of a factor of 1.02 or by an appropriate factor specified in the COLR (Ref. 5) 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.

Performing the Surveillance in MODE 1 prior to exceeding 75% RTP ensures that the $F_Q(Z)$ limit is met when RTP is achieved, because peaking factors are generally decreased as power level is increased.

$F_Q(Z)$ is verified at power levels ≥ 10% RTP above the THERMAL POWER of its last verification, 12 hours after achieving equilibrium conditions to ensure that $F_Q(Z)$ is within its limit at higher power levels.

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 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.

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

REFERENCES

1. 10 CFR 50.46, 1974.

2. Regulatory Guide 1.77, Rev. 0, May 1974.

3. 10 CFR 50, Appendix A, GDC 26.

4. WCAP-7308-L-P-A, "Evaluation of Nuclear Hot Channel Factor Uncertainties," June 1988.

5. WCAP-10216-P-A, Rev. 1A, "Relaxation of Constant Axial Offset Control (and) F_Q Surveillance Technical Specification," February 1994.

6. WCAP-17661-P-A, “Improved RAOC and CAOC F_Q Surveillance Technical Specifications,” February 2019.

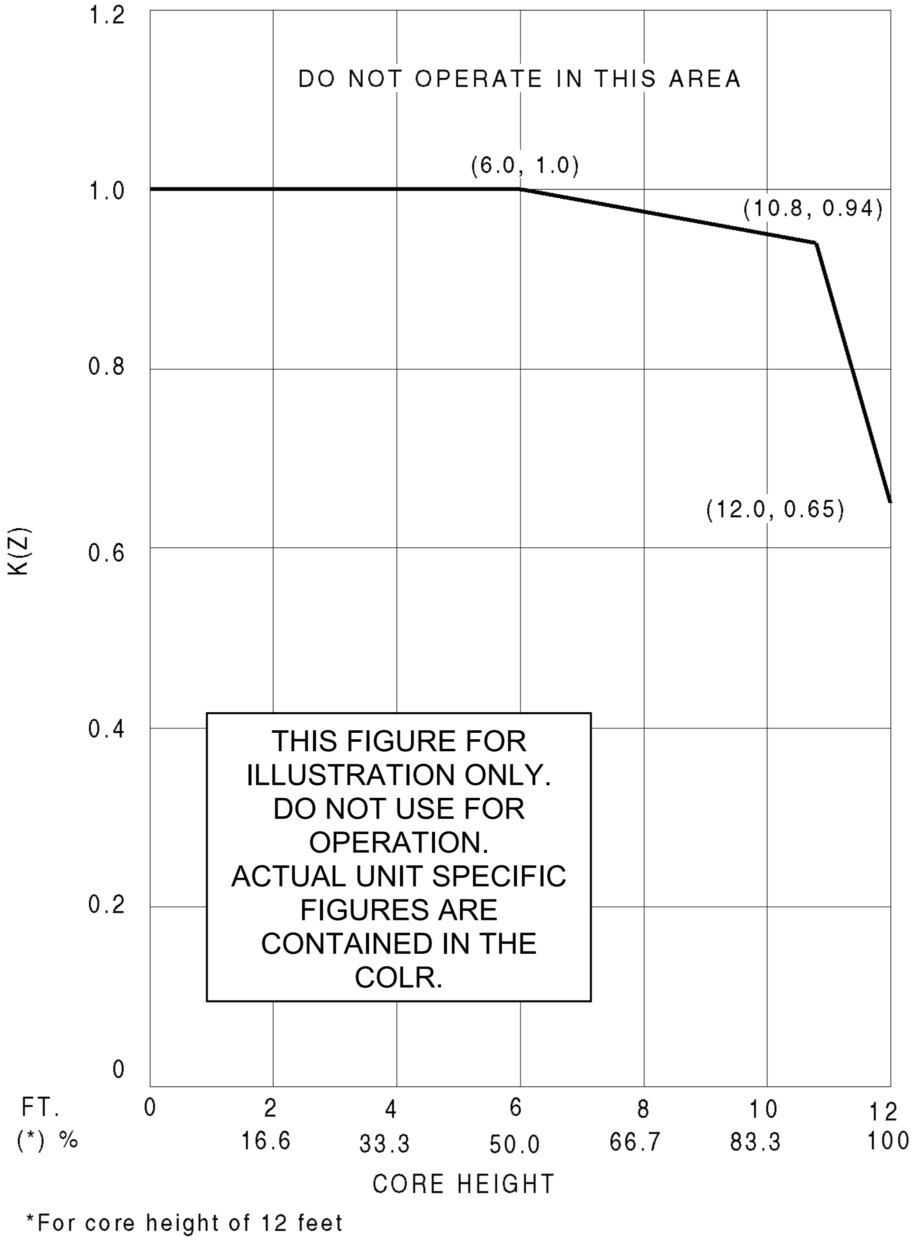

Figure B 3.2.1-1 (page 1 of 1)
K(Z) - Normalized $F_Q(Z)$ as a Function of Core Height