ATTACHMENT 1

Responses to the NRC RAIs on PWROG-22021-P/NP, Revision 0, "Justifications for the Proposed Changes to the Quadrant Power Tilt Ratio Technical Specification" (Non-Proprietary)

(19 pages, including this cover page)

U.S. NUCLEAR REGULATORY COMMISSION

OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR ADDITIONAL INFORMATION REGARDING THE

PRESSURIZED WATER REACTOR OWNERS GROUP

TOPICAL REPORT PWROG-22021-P/NP, REVISION 0,

"JUSTIFICATIONS FOR THE PROPOSED CHANGES TO THE

QUADRANT POWER TILT RATIO TECHNICAL SPECIFICATIONS,"

PROJECT NO. 99902037; EPID: L-2023-TOP-0060

1. BACKGROUND

By letter dated December 4, 2023, (Agencywide Documents Access and Management System Accession (ADAMS) No. ML23338A205), the Pressurized Water Reactor Owners Group (PWROG) submitted Topical Report (TR) PWROG -22021-P/NP, Revision (Rev.) 0, "Justifications for the Proposed Changes to the Quadrant Power Tilt Ratio [QPTR] Technical Specification [TS]" (ADAMS Nos. ML23338A206 and ML23338A207), for U.S. Nuclear Regulatory Commission (NRC) staff review and approval.

The TR proposes changes to NUREG-1431, "Standard Technical Specifications Westinghouse Plants" that would perform the following: (1) add a NOTE to the Limiting Condition for Operation (LCO) for TS 3.2.4 so that the LCO will not be applicable prior to performing the incore-excore calibration during initial core startup; (2) add an alternate action if the QPTR exceeds the LCO limit of 1.02; (3) consolidate surveillance requirements (SRs) 3.2.4.1 and 3.2.4.2; and (4) delete Required Actions D.1.2, D.2.1 and D.2.2 in TS 3.3.1.

As a result of NRC staff's technical review of the TR, the NRC staff has determined that responses to the following requests for additional information (RAI) are needed in order to complete the next phase of the review. In addition, see NRC staff's comment in the footnote regarding a minor format change in Appendix A.[1]

[1] *Appendix A of the TR – Sample TS Mark-Ups*- On page A-5 of the TR additions and deletions to STS are indicated in red font or red strikethrough font, respectively. The word "to" in NOTE 1 is in black font, but it is an addition. The word "is", after "Verify QPTR" is in red font. NRC would like to request a change font of the word "to" in NOTE 1 to red font and font of the word "is" after "Verify QPTR" to black font.

2. TECHNICAL SPECIFICATION BRANCH (STSB) REQUESTS FOR ADDITIONAL INFORMATION

2.1. Regulatory Basis for Requests Related to Technical Specification

The regulations provided in Title 10 of the Code of Federal Regulations (10 CFR), section 50.36, require that TSs include items in the following categories as stated: (1) safety limits, limiting safety system settings, and limiting control settings; (2) limiting conditions for operation; (3) surveillance requirements; (4) design features; (5) administrative controls; (6) decommissioning; (7) initial notification; and (8) written reports.

The regulation provided in 10 CFR 50.36 (c)(2) states that LCOs are the lowest functional capability or performance levels of equipment required for safe operation of the facility. When an LCO of a nuclear reactor is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the technical specifications until the condition can be met.

10 CFR 50.36 (c)(2)(ii) requires the LCOs to be established for each item meeting one or more of four criteria. Criterion 2 states: “A process variable, design feature, or operating restriction that is an initial condition of a design basis accident or transient analysis that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.”

The regulation at 10 CFR 50.36 (c)(3) states SRs 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.

Therefore, the regulatory basis for the RAIs in this section is directly related to technical specification requirements for the QPTR in accordance with the regulations listed in this section.

RAI 01 (STSB) - ***Section 5 of TR, "Revise the QPTR Value from 1.00 to 1.02 in Required Action A.1"***

NRC Comment:
Pages 5-1 and 5-2 of the TR contain statements referring to certain aspects required for design procedures, it appears these aspects become the justification to change the QPTR limit, however Section 5 of the TR does not provide a means for staff to confirm that all plants that may adopt the TR would follow the same requirements.

NRC Request:
Provide additional language and/or information for this section of the TR that describes a QPTR limit that is generically applicable to all plants that may adopt in the case of TR adoption.

Response to RAI 01 (STSB):

The revised value of 1.02 in Required Action A.1 is applicable to all plants that adopt the TR because it is consistent with the LCO limit of 1.02. Pages 5-1 and 5-2 of the TR discuss how the reload safety analyses performed in accordance with WCAP-9272-P-A, Revision 0, "Westinghouse Reload Safety Evaluation Methodology," ensure that any tilts up to and including 1.02 are covered in the safety analysis. Every plant must have appropriate uncertainties included as part of their standard uncertainty treatment to cover a QPTR value of 1.02. This is reflected in the QPTR LCO limit of 1.02 that does not include any associated penalty. If there were no uncertainties to allow for a difference of 1.02 then the plant would not be compliant with their current TS.

Licensees that do not use the WCAP-9272-P-A reload methodology have similar allowances and uncertainties to those discussed on Pages 5-1 and 5-2. A discussion of how those allowances and uncertainties that support a QPTR of up to 1.02 are addressed in the safety analysis for plants that do not use the WCAP-9272-P-A reload methodology will be included in the LAR that implements the TR.

The paragraph above will be added after the 5th paragraph on page 5-2 of the TR.

A markup of the TR that reflects this change is contained in Attachment 2 to this letter.

Since every plant includes uncertainties that are inherently incorporated into their safety analyses to address QPTR changes (up to at least a value of 1.02) to comply with a TS LCO limit of 1.02, the 1.00 value in Required Action A.1 can be revised to 1.02 generically for all plants that adopt this TR.

RAI 02 (STSB) - ***Section 6.2 of the TR, "Application of the Proposed Change"***

NRC Comment:
The second paragraph of Section 6.2 states:

> However, if at least 3% operating margin to the core peaking factor limits was available based on the last measurement, a second option would be available to ensure the core peaking factors remained within their LCO limits while still remaining at 100% RTP. The core peaking factor limits would be administratively reduced by 3% for each 1% that the QPTR value exceeded 1.02 if margin was available.

NRC Request: (Parts a and b)

a. Provide a detailed description of how the 3% operating margin can be verified prior to taking advantage of the second option as defined in Section 6.2.

b. Provide discussion on whether a TS NOTE above the Required Action A.1.2 is needed to ensure the second option is only available when margin exists. Is there additional information that could be added to the TR to provide these details?

Response to RAI 02, Part a. (STSB):

TS Surveillance Requirements (SRs) 3.2.1.1 (FQ) and 3.2.2.1 ($F\Delta H$) require periodic monitoring of the core peaking factors and power distribution. After these Surveillances are performed, the margin to the FQ and $F\Delta H$ limits, which are contained in the COLR, is known, and therefore it can be determined if at least 3% margin to these limits is available. That margin is available until the next performance of SRs 3.2.1.1 and 3.2.2.1, at which time the "new" margin to the limits is determined.

Response to RAI 02, Part b. (STSB):

The discussion above will be added after the 2nd paragraph in Section 6.2 on page 6-2 of the TR and will also be included in the TS Bases for proposed Required Action A.1.2, therefore, a Note does not need to be added to the Required Action.

A markup of the TR that reflects this change is contained in Attachment 2 to this letter.

RAI 03 (STSB) - ***Section 7 of the TR, "Justification for Revising the 12 Hour Frequency for SR 3.2.4.2."***

NRC Comment:
Page 7-1 contains no justification for the deletion of a sentence in the TS Bases that states: "Large tilts are likely detected with the remaining channels, but the capability for detection of small power tilts in some quadrants is decreased."

NRC Request:
Provide an explanation, including the basis, that describes the reason the deletion of the sentence in the TS Bases.

Response to RAI 03 (STSB):

Page 7-1 in the TR quotes the statement in the Bases for SR 3.2.4.2: "Large tilts are likely detected with the remaining channels, but the capability for detection of small power tilts in some quadrants is decreased." with respect to QPTR monitoring being degraded in the core quadrant with an NIS Power Range (PR) channel inoperable.

Appendix A of the TR does not contain proposed changes to the TS Bases.

Appendix A of the TR only contains markups of the QPTR Technical Specification (TS) to reflect the proposed changes and does not contain the associated Bases changes. The revised Bases that reflect the proposed changes will be contained in the TSTF Traveler.

RAI 04 (STSB) - ***Section 7 of the TR, "Justification for Revising the 12 Hour Frequency for SR 3.2.4.2."***

NRC Comment:
Section 7 states that the new second frequency of the consolidated SR 3.2.4.1 will be specified as "Once within 12 hours…" The existing frequency of SR 3.2.4.2 is "12 hours OR In accordance with the Surveillance Frequency Control Program." SR 3.0.2 provides an extension to most frequencies except those specified as "once." The SR 3.0.2 extension would appear to apply to the existing frequency of SR 3.2.4.2, but not the new second frequency of the consolidated SR 3.2.4.1.

NRC Request:
Provide clarification, with an appropriate basis, explaining that the SR 3.0.2 extension is either applicable or not applicable to the consolidated SR 3.2.4.1. Is there additional information that could be added to the TR to provide these details?

Response to RAI 04 (STSB):

The Bases for SR 3.0.2 in NUREG-1431, "Standard Technical Specifications Westinghouse Plants," Rev. 5 states:

"As stated in SR 3.0.2, the 25% extension also does not apply to the initial portion of a periodic Completion Time that requires performance on a "once per ..." basis. The 25% extension applies to each performance after the initial performance."

Therefore, the 25% SR 3.0.2 extension applies to Frequency of "[7 days OR In accordance with the Surveillance Frequency Control Program]," and does not apply to the new Frequency of "Once within 12 hours following…"

Additional information that discusses the application of SR 3.0.2 to the Frequencies in revised SR 3.2.4.1 is not proposed to be added to the TR because it is contained in the Bases for SR 3.0.2 as discussed above.

RAI 05 (STSB) - ***Section 7 of the TR, "Justification for Revising the 12 Hour Frequency for SR 3.2.4.2."***

NRC Comment:
Section 7 refers to the retention of the 7-day frequency of SR 3.2.4.1 in justifications for the new second frequency of the consolidated SR 3.2.4.1. The existing frequency of SR 3.2.4.1 is stated as "7 days OR In accordance with the Surveillance Frequency Control Program [SFCP]."

NRC Request:
Provide information that would describe the change for plants that have extended the interval of SR 3.2.4.1 beyond 7 days using their SFCP (verification of QPTR only once within 12 hours after control rods are moved more than 12 steps with power above 75% RTP and the input to the QPTR alarm from one Power Range channel inoperable).

Response to RAI 05 (STSB):

It is not known whether any licensee has extended the 7 day Frequency for SR 3.2.4.1. However, if the 7 day Frequency was extended, the change to the 7- day Frequency would have been justified to be acceptable. The 7 day Frequency is contained in the SFCP and performing SR 3.2.4.1 with the proposed change to the SR would be the same for an extended (if it was extended) Frequency as it is for the current 7 day Frequency.

RAI 06 (STSB) - ***Section 8 of the TR, "Delete Required Actions D.1.2, D.2.1 and D.2.2 in Technical Specification 3.3.1".***

NRC Comment:
Section 8 describes the proposed removal of the alternative Required Actions for operators when a Power Range Neutron Flux High channel (NI) is inoperable. Required Actions D.1.1 with D.1.2 and D.2.1 with D.2.2 provide operators clear and complete alternative sets of remedial measures the operators can take to address an inoperable NI. It has been accepted that presenting operators with alternatives to address a given situation and continue plant operation is appropriate guidance for industry implementation of 10 CFR 50.36, identified in NUREG-1431, and not duplicative. Deleting the options to either reduce power or verify QPTR would possibly create incomplete guidance to address an inoperable NI.

NRC Request:
Provide an explanation discussing why options to either reduce power or verify QPTR, after placing the NI in trip, were not proposed to be maintained in the TS 3.3.1 ACTIONS table.

Response to RAI 06 (STSB):

TS 3.3.1, "RTS Instrumentation," and TS 3.2.4, "QPTR," address 2 different issues associated with an inoperable PR channel.

TS 3.3.1 addresses an inoperable PR channel with respect to providing a reactor trip and the only Action that is needed is to place the channel in trip, which is why only current Required Action D.1.1 is retained and Required Action D.2.1 does not need to be retained. Current Required Actions D.1.2 and D.2.2 are addressed by TS 3.2.4 as discussed below.

TS 3.2.4 addresses an inoperable PR channel with respect to monitoring the QPTR. TS 3.2.4 addresses verifying the QPTR with an inoperable PR channel when Thermal Power is $\leq$ 75% RTP and when Thermal Power is > 75% RTP via proposed SR 3.2.4.1. Since TS 3.2.4 allows QPTR to be monitored both above and below 75% RTP with an inoperable PR channel, the Required Action to reduce Thermal Power to $\leq$ 75% RTP is not required to be included in TS 3.3.1, nor is the Required Action to perform current SR 3.2.4.2.

Sections 8-1 and 8-2 on pages 8-1 and 8-2 of the TR will be revised to incorporate a correction to the text, some editorial changes, some of the additional information in the paragraph above, and to delete the text regarding being in Mode 3 in 78 hours.

A markup of the TR that reflects these changes is contained in Attachment 2 to this letter.

The second sentence on page 8-1 was revised to correct the text.

"Excore detector" will be revised to "Power Range Neutron Flux channel" in the Sample TS Markups of SR 3.2.4.1 on page A-5 in Appendix A of the TR.

The format changes discussed in the footnote in the Background Section of the RAIs regarding the Sample TS Mark-ups on page A-5 in Appendix A of the TR have been incorporated in the revised TS markup.

The changes to the Sample TS Mark-ups on page A-5 in Appendix A of the TR discussed above are contained in Attachment 2 to this letter

3. NUCLEAR METHODS AND FUELS BRANCH (SFSB) REQUEST FOR ADDITIONAL INFORMATION

RAI 07 (SFSB) - ***Section 4 of the TR, "Justification for Adding a NOTE to LCO 3.2.4 to State That it is Not Required to be Met Until the Initial Calibration of the Excore Channels is Performed per SR 3.3.1.6 Subsequent to a Refueling"***

NRC Comment:
Section 4 of the TR states:

> One proposed change to TS 3.2.4 is to add a NOTE stating that LCO 3.2.4 is not applicable until the initial calibration of the excore channels is performed per SR 3.3.1.6 subsequent to refueling.

Other TS changes may also increase the time between refueling and the first QPTR surveillance.

NUREG-0800 15.4.7 "Inadvertent Loading and Operation of a Fuel Assembly in an Improper Position," interprets General Design Criteria (GDC) 13 to mean that each licensee shall have methods/procedures for detecting a misloaded fuel assembly.

NRC Request:
Provide a brief discussion that describes and explains any potential effect that the proposed TS changes may have on the efficacy of detecting a mislocated fuel assembly following a core reload.

Response to RAI 07 (SFSB):

Any misloaded fuel assembly would not be detected by the excore detector PR channels which are used to monitor the QPTR TS limit therefore, the addition of this Note does not impact the capability to detect a misloaded fuel assembly. A misloaded fuel assembly would be identified by the power distribution measurement system that is used to determine the incore power distribution. The power distribution measurement system is utilized to perform flux symmetry confirmation after a refueling prior to reaching 100% power. Licensees perform the first incore power distribution measurement during the initial power ascension following refueling between 30% and 50% RTP.

The intent of the excore QPTR limit is to detect changes from one calibrated state to the next calibrated state. A calibrated state is the incore-excore calibration that is performed by SR 3.3.1.6, which is determining the incore power distribution using the incore power distribution measurement system and setting the excore QPTR to as close to 1.0 because the core peaking factors (F(Q) and $F\Delta H$) have been confirmed to be within their limits. Following a refueling outage, the previous incore calibrated statepoint was based on the previous cycle core and has no impact on the excore QPTR confirmation on the core following a refueling due to the addition of new fuel assemblies. Therefore, excore QPTR monitoring cannot be utilized to detect a misloaded fuel assembly.

The incore power distribution is measured using the power distribution measurement system which provides a detailed assessment of the incore power distribution. The incore power distribution information is required to provide the information necessary to identify any specific core power distribution issues, i.e., if the F(Q) and $F\Delta H$ limits are not met. The PR excore detectors do not provide details of the incore power distribution necessary to identify any anomalous incore power distribution issues. As discussed in the Actions Section for Required Action A.4 in the TS 3.2.4 Bases, QPTR, which

is indicated by the PR excore detectors can be used to identify if there is a gross radial power distribution change requiring a more detailed investigation of the incore power distribution. The PR excore detectors cannot provide information on any issue with the incore power distribution. Therefore, the proposed changes to the QPTR TS will not impact the capability to identify any incore power distribution anomalies or cause any incore power distribution anomalies.

4. NUCLEAR SYSTEMS PERFORMANCE BRANCH (SNSB) REQUESTS FOR ADDITIONAL INFORMATION

4.1 Regulatory Basis for Requests Related to Nuclear Systems Performance

The regulatory basis for RAIs by the Nuclear Systems Performance Branch (SNSB) is provided in 10 CFR Appendix A, GDC 10, “Reactor Design” which states that 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.

RAI 08 (SNSB) - ***Section 3 of the TR, “Relationship of QPTR to the Core Peaking Factors”***

NRC Comment:
Section 3.0 of the TR states:

> A QPTR value that exceeds the LCO limit of 1.02 may indicate that a change has occurred in the gross radial power distribution but does not necessarily mean that the core peaking factors have exceeded their LCO limits.

The current STS LCO 3.2.4, Required Action A.1 specifies reduction in thermal power when QPTR exceeds 1.00. The proposed LCO 3.2.4 Required Action A.1.1 allows the QPTR to exceed 1.02 before the rated thermal power is reduced. A higher QPTR will result in higher differences in the radial power distribution between the quadrants of the core and therefore would lead to increased cross-flow in the core.

NRC Request:
Provide a discussion of the impact associated with increased cross-flow on the thermal-hydraulic performance of the core.

Response to RAI 08 (SNSB):

The TS 3.2.4 LCO limit is 1.02 and is not proposed to be increased, therefore any core cross flow that exists is not impacted. Current Required Action A.1 is required to be performed when QPTR is not within the LCO limit of 1.02. Proposed Required Action A.1.1 only revises the QPTR value in the Required Action to be consistent with the LCO limit of 1.02. Therefore, Thermal Power will be reduced by $\geq$ 3% for each 1% when QPTR is greater than the LCO limit of 1.02 rather than $\geq$ 3% for each 1% when QPTR is greater than 1.00. Revising the QPTR value to 1.02 from 1.00 for implementing the Thermal Power reduction in Current Required Action A.1 has no impact on the core cross flow.

RAI 09 (SNSB) - *Section 4.1 of the TR,* "Application of the Current TS"

NRC Comment:
The current QPTR ≤ 1.02 in the STS 3.2.4 is to control power in the core quadrants so that power generation is approximately equal in the quadrants, and the core power does not exceed the licensed power. In the event QPTR exceeds 1.00, the burnup in a core quadrant would increase.

NRC Request:
Provide a discussion of the impact of higher differences in the burnup between the core quadrants on the core performance.

Response RAI 09 (SNSB):

The intent of the QPTR limit is not to control quadrant power but to detect changes in the radial power distribution from one calibrated state to the next calibrated state. The QPTR TS confirms that there are no large radial power changes determined by the PR channels between the performance of SRs 3.2.1.1 (FQ), 3.2.1.2 (FQ) and 3.2.2.1 ($F\Delta H$). The excore tilts are normalized to 1.00 via a calibration independent of what the incore quadrant power tilt may be because it is a measure of core power distribution changes as seen by the PR channels since the last QPTR calibration. A QPTR of 1.00 does not mean that there is no incore power tilt but that the quadrant powers are consistent with the previous known calibrated state.

Incore quadrant power differences over the long term can cause differences in fuel assembly burnup between symmetric core quadrant locations. However, incore quadrant power differences tend to equilibrate over time. Any increased burnup in an individual core quadrant will eventually result in lower power in that core quadrant due to the decreased uranium content caused by the higher power operation which will shift the power slightly to the core quadrants with less burned fuel inventory thereby rebalancing the core power distribution. This occurs throughout the cycle when any in-core tilt early in the cycle is evened out to a flat core power distribution by the middle of the cycle. Any differences in core burnup due to in-core tilt are consistent with the current QPTR TS because the proposed changes to the QPTR TS retain the requirement to perform a Required Action at the same 1.02 QPTR value as the LCO limit.

RAI 10 (SNSB) - *Section 2.5 of the TR, "QPTR and Quadrant Power Tilt"*

NRC Comment:
In the event QPTR exceeds its limit due to QPT in two or more quadrants.

NRC Request:
Provide an explanation describing how the power would be controlled in the quadrants to maintain 100% licensed power.

Response to RAI 10 (SNSB):

The reactor power level is not calculated or monitored by the QPTR. With a core average QPTR of 1.0, a change in QPTR does not result in a change in Thermal Power. Compliance with the licensed core power level is determined by performing a calorimetric heat balance calculation.

The intent of the QPTR limit is not to control quadrant power but to detect changes in the radial power distribution from one calibrated state to the next calibrated state. The last known calibrated state includes any measured incore quadrant power tilt that existed at the time of the previous calibration. Both the incore quadrant power tilt and QPTR are measured as a relative quantity as compared to the other core quadrants, and the average is normalized to 1.0. If the tilt in any core quadrant is greater than 1.02 the other core quadrants on a relative basis, will be less than 1.02 to maintain the average relative power of the core quadrants to 1.0. Therefore, if two core quadrants were 1.02 in relative power, the other two core quadrants on average would be 0.98.

SR 3.3.1.2, which is performed on a 24 hour Frequency, requires the percent indication of power for each PR channel to be compared to the secondary calorimetric of Thermal Power. If the Thermal Power is more than 2% higher than the PR indication, the PR percent power indication is adjusted to match Thermal Power. Each PR channel has a percent power indication based on the sum of the upper and lower PR detectors. The signal from the upper PR detector and the signal from the lower PR detector are fed into a summing and level amplifier that determines the percent power indication. This amplifier has a coarse gain potentiometer and a fine gain potentiometer, and its output is only used for the percent power indication. When an adjustment is required to match PR indicated power to the secondary calorimetric Thermal Power as required by SR 3.3.1.2, these potentiometers are adjusted. The PR percent power indication provides the input to the PR reactor trip functions.

The signal processing that provides the input to the QPTR circuitry is as follows. In each PR channel, via circuits that are independent of the percent power indication, the signal from the upper PR detector and the signal from the lower PR detector are individually sent to isolation amplifiers. The output from these amplifiers in all four PR channels goes directly to the detector current comparator circuitry. The four upper PR detector signals are averaged in the upper section flux deviation alarm circuit, and the four lower PR detector signals are averaged in the lower section flux deviation alarm circuit. In each circuit, the flux deviation is calculated as the difference between the average of all four PR upper or PR lower detectors and each individual PR upper or PR lower detector. This deviation is the QPTR.

RAI 11 (SNSB) – Section 6 of the TR, "Add a New Required Action A.1.2, That Applies a Penalty to F_Q and $F_{\Delta H}$ as an Alternative to Current Required Action A.1, with a QPTR Value of 1.02"

NRC Comment:
The proposed Required Action A.1.2 in STS 3.2.4, states:

> Reduce the limits for F_Q (Z) and $F^N_{\Delta H}$ ≥ 3% for each 1% QPTR > 1.02.

NRC Request:
Provide an explanation and technical basis describing why the reduction in the limits for F_Q (Z) and $F^N_{\Delta H}$ by at least 3% is conservative.

Response to RAI 11 (SNSB):

The safety analyses assume that the core is operated within the initial conditions required by the TS. The initial conditions in the safety analyses assume operation at the TS limits (FQ and F∆H) and the safety analysis will determine the impacts of a core transient from those initial conditions.

The safety analysis is only concerned with the initial power density either locally or as a rod average (FQ and F∆H). Since the core peaking factors are a relative quantity, they must be multiplied by core power to determine the initial power densities. Current Required Action A.1 requires Thermal Power to be reduced by 3% from the initial core power. This reduces the initial core power by 3%, and when multiplied by a peaking factor results in an initial condition that is less than what was assumed in the safety analysis. A reduction in either core power or the initial peaking factors will result in the same ultimate power density reduction.

A reduction of 3% in the core peaking factor is slightly more conservative than a power reduction of the same magnitude because both the margin to the FQ and F∆H limits will increase when power is reduced from 100% as required by current Required Action A.1. A reduction of 3% in the core peaking factors would result in a reduction in the power densities assumed as initial conditions in the safety analyses thereby providing the same or better protection of the analysis of record as reducing the power.

RAI 12 (SNSB) – Section 2.4 of the TR, "When the QPTR Exceeds the LCO Limit"

NRC Comment:
Section 2.4 of the TR states that:

The bases for Required Action A.4 for TS 3.2.4 states:

> When the QPTR exceeds its limit, it does not necessarily mean a safety concern exists.

NRC Request:
Provide an explanation describing why a safety concern does not exist when QPTR exceeds its current LCO limit of 1.02 in MODE 1 for all applicable plant types.

Response to RAI 12 (SNSB):

The intent of the QPTR limit is to detect changes in the radial power distribution from one calibrated state to the next calibrated state. A QPTR that is greater than 1.02 means that the relative quadrant powers detected by the excore PR channels have changed at least 2% compared to the last calibrated state. Slow changes that exceed the QPTR limit over the course of time since the last calibration was performed are unlikely to result in exceeding the core peaking factor (FQ and $F\Delta H$) limits since it may not be indicative of a true unexpected change in core power distribution. A slow increase in QPTR could be due to gradual equilibrium of the incore tilt with burnup rather than an abnormal change in the core power distribution. If the core peaking factors (FQ and $F\Delta H$) are within their limits, then the core is operating within the initial conditions assumed in safety analysis, and therefore a safety concern does not exist, as discussed in the TS Bases.

Sudden large changes in QPTR are an indication that a gross power distribution change has occurred, and it is prudent to evaluate the core power distribution when the QPTR exceeds 1.02, by performing SRs 3.2.1.1, 3.2.1.2 and 3.2.2.1 as required by current Required Action A.3. If the peaking factors are not within limits, the applicable Required Actions in TS 3.2.1 and/or 3.2.2 will be performed when the QPTR limit is exceeded. The Required Actions in TS 3.2.4 are implemented regardless of how much the QPTR exceeds the LCO limit of 1.02.

SRs 3.2.1.1, 3.2.1.2 and 3.2.2.1 verify that the core peaking factor TS limits are met. The QPTR TS monitors changes in core power since the last calibration to ensure that the previous performance of SRs 3.2.1.1, 3.2.1.2 and 3.2.2.1 remains an accurate representation of the incore power distribution. If QPTR exceeds the limit it may not result in an incore power distribution that exceeds the core peaking factor limits but is an indication that the peaking factors should be revalidated.

RAI 13 (SNSB) - Section 2.4 of the TR, "When the QPTR Exceeds the LCO Limit"

NRC Comment:
Section 2.4 of the TR states that:

> It is, however, conservative to assume that when the QPTR exceeds its limit of 1.02, the core peaking factors, $F_Q(Z)$ and $F_{\Delta H}$ may have exceeded the limits of LCOs 3.2.1 and 3.2.2 and action is required to restore the core peaking factors to within their limits. Required Action A.1 requires a power reduction within 2 hours which is intended to reduce the peak linear power.

As stated above, the core peaking factors may have exceeded their limits since their monitoring is according to the surveillance frequency control program. Given the time between surveillances, the limits could have been exceeded for several hours without a power reduction.

Section 2.4 of the TR also states:

> Since it is possible that the core peaking factors, $F_Q(Z)$ and $F_{\Delta H}$ may have exceeded their LCO limits, Required Action A.4 requires a re-evaluation of the safety analysis to confirm that the results remain valid for the duration of operation when the QPTR LCO limit is not met. Required Action A.4 must be completed prior to increasing THERMAL POWER above the limit of Required Action A.1.

NRC Request:
For STS 3.2.4, Required Action A.4, specify which safety analysis, including methodology, needs to be re-evaluated and when should it be done.

Response to RAI 13 (SNSB):

The reevaluation of the safety analysis is dependent on what caused the QPTR to exceed the limit of 1.02. Required Action A.3 requires verification of the core peaking factors (SRs 3.2.2.1, 3.2.2.2, and 3.2.2.1) 24 hours after achieving equilibrium conditions from the Thermal Power reduction required by current Required Action A.1. Performing these SRs will determine the incore power distribution of the core. If the incore power distribution shows a distinct core power imbalance that is caused by a transient such as a misaligned rod, the reevaluation of the safety analysis would be completed consistent with TS 3.1.4 for Rod Group Misalignment. If the core power imbalance is caused by some other transient such that peaking factor limits are exceeded, Required Actions in TS 3.2.1 and 3.2.2 address this condition.

If the core power distribution measurements (SRs 3.2.2.1, 3.2.2.2, and 3.2.2.1) determine that resumption of HFP operation may result in the core peaking factors exceeding their limits or the core power distribution differences exceeds the uncertainties applied to the peaking factors, the reevaluation of the safety analyses are performed to determine the appropriate maximum power level for continued operation. The safety analysis reevaluation will confirm the core peaking factor applied uncertainties remain valid such that all of the safety analyses remain valid. The core power distribution and core peaking factors can directly impact Large Break Loss of Coolant Accident (LOCA) Peak Cladding Temperature (PCT), the Loss of RCS Flow with respect to Departure from Nucleate Boiling (DNB), Rod Ejection Accident energy deposition to the fuel, and the shutdown margin assumption as discussed in the Applicable Safety Analyses Section of the Bases for TS 3.2.4.

The reevaluations would be performed with the NRC approved codes and methodologies associated with performing those analyses in the safety analysis for that cycle of operation. The Completion Time for Required Action A.4 states: “Prior to increasing THERMAL POWER above the limit of Required Action A.1.”

In the case that the proposed peaking factor reduction is utilized when the QPTR limit is exceeded, the power distribution measurement system confirmation of SRs 3.2.2.1, 3.2.2.2, and 3.2.2.1 will ensure that full power operation remains within the TS limits. The safety evaluation is either confirmed to be unimpacted if the reduced peaking factor limits applied as part of QPTR Required Actions are met or Required Actions in TS 3.2.1 and/or 3.2.2 are performed to return the core to within the TS limits.

RAI 14 (SNSB) – Section 3 of the TR, "Relationship of QPTR to the Core Peaking Factors"

NRC Comment:
The moderator temperature coefficient (MTC) of reactivity is an important operational parameter connected with safety considerations. The MTC is defined as the change of reactivity per degree change of the core-averaged moderator temperature.

NRC Request:
Provide a detailed explanation describing how the MTC affects the QPTR during an operating cycle and from cycle to cycle.

Response to RAI 14 (SNSB):

The MTC itself does not impact the QPTR during an operating cycle. The MTC is generally considered a global reactivity effect largely dependent on the average moderator temperature, boron concentration, and to a lesser extent core neutron leakage. A global reactivity effect would have a consistent impact on all core quadrants and therefore would have no impact on QPTR.

Even if one core quadrant is slightly hotter due to an incore quadrant power tilt than an opposite core quadrant, the overall global MTC value impact will be evened out by the core quadrant that is lower in power to compensate for the higher power core quadrant resulting in a net zero impact on the MTC. Since the MTC is negative at full power, any small increase in temperature in a single core quadrant would result in a slightly more negative local reactivity feedback and a colder quadrant would have a less negative reactivity feedback thereby producing a dampening effect on the incore tilt.

ATTACHMENT 2

Topical Report and Technical Specification Revisions Associated with the Responses to the NRC RAIs on PWROG-22021-P/NP, Revision 0, "Justifications for the Proposed Changes to the Quadrant Power Tilt Ratio Technical Specification" (Non-Proprietary)

(6 pages, including this cover page)

Page 5-2, Section 5.0 REVISE THE QPTR VALUE FROM 1.00 to 1.02 IN REQUIRED ACTION A.1

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Licensees that do not use the WCAP-9272-P-A reload methodology have similar allowances and uncertainties to those discussed on Pages 5-1 and 5-2. A discussion of how those allowances and uncertainties that support a QPTR of up to 1.02 are addressed in the safety analysis for plants that do not use the WCAP-9272-P-A reload methodology will be included the LAR that implements the TR.

5.1 APPLICATION OF THE CURRENT TS

For the first 1% increase above the limit to 1.03, the current TS requires a power reduction of 3% RTP for each 1% that the QPTR exceeds 1.00, or 9% RTP.

$$Power\ Reduction = 3\%\ RTP \times \frac{1.03 - 1.00}{100\%} = 9\%\ RTP$$

Page 6-2, Section 6.2 Application of the Proposed Change

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Current Required Action A.1 is retained and will also restore core peaking factor margin if sufficient margin does not exist to implement the new proposed Required Action. The new proposed Required Action will, therefore, be added as an "OR" to provide an alternative to current Required Action A.1. Including two acceptable Required Actions provides operational flexibility, and ensures that operation is within the assumptions in the safety analysis. The same 3% penalty will be used consistent with the current power reduction to ensure the same level of remedial action is implemented when the QPTR value is greater than the LCO limit.

6.1 APPLICATION OF THE CURRENT TS

The current TS are written assuming that the core peaking factors are at or near the TS limits. If the core peaking factors are at the TS limits, the only option to reduce core power. Current Required Action A.1 requires power to be reduced by 9% for a QPTR value of 1.03 and an additional 3% RTP for each 1% that the QPTR value exceeded 1.03. This power reduction is required even if the core peaking factors were initially well below the limits.

Following the power reduction, Required Actions A.2 through A.6 must be performed, which include verification that the core peaking factors are within their limits and an incore-excore calibration (SR 3.3.1.6) to normalize the QPTR.

6.2 APPLICATION OF THE PROPOSED CHANGE

The option to reduce power is retained in the proposed change. The proposed change requires a power reduction of 3% per 1% that the QPTR value exceeds 1.02. Power would be reduced to 97% RTP for a QPTR value of 1.03.

However, if at least 3% operating margin to the core peaking factor limits was available based on the last measurement, a second option would be available to ensure the core peaking factors remained within their LCO limits while still remaining at 100% RTP. The core peaking factor limits would be administratively reduced by 3% for each 1% that the QPTR value exceeded 1.02 if margin was available.

TS Surveillance Requirements (SRs) 3.2.1.1 (FQ) and 3.2.2.1 (FΔH) require periodic monitoring of the core peaking factors and power distribution. After these Surveillances are performed, the margin to the FQ and FΔH limits, which are contained in the COLR, is known to determine if at least 3% margin to these limits is available. That margin is available until the next performance of SRs 3.2.1.1 and 3.2.2.1, at which time the "new" margin to the limits is determined.

Page 8-1, Section 8 Delete Required Actions D.1.2, D.2.1 and D.2.2 in Technical Specification 3.3.1 and Section 8.1 Application of the Current TS

8 DELETE REQUIRED ACTIONS D.1.2, D.2.1 AND D.2.2 IN TECHNICAL SPECIFICATION 3.3.1

Required Actions D.1.2 and D.2.2 are duplicative of the intent of SR 3.2.4.2.

SR 3.2.4.1 can be performed if the input from one PR NIS channel is inoperable and thermal power is less~~greater~~ than or equal to 75% RTP.

SR 3.2.4.2 must be performed if the input from one or more PR channels are inoperable and thermal power is greater than 75% RTP

The Bases for Required Action D.1.2 discusses the intent of the power reduction:

"Reducing the power level prevents operation of the core with radial power distributions beyond the design limits. With one of the NIS power range detectors inoperable, ¼ of the radial power distribution monitoring is lost."

Ensuring that the QPTR is within its limit ensures that the radial power distribution is acceptable without the need for a power reduction. As stated in current SRs 3.2.4.1 and 3.2.4.2 and in the proposed change to SR 3.2.4.1, with one PR channel input to the QPTR alarm inoperable, there are two options to ensure that the QPTR is within its limit:

1. Reduce power to ≤ 75% RTP to use the input from three operable PR channels to verify that the QPTR is within limit; or
2. If thermal power > 75% RTP, SR 3.2.4.2 can be performed in lieu of SR 3.2.4.1.

To eliminate this duplication, Required Actions D.1.2 and D.2.2 will be deleted from TS 3.3.1. Current Required Actions D.1,1 and D.2.1 both required placing the inoperable PR channel in trip. With the deletion of Required Actions D.1.2 and D.2.2, the only action that is required is to place the inoperable PR channel in trip which is accomplished by Required Action D.1.1; therefore, Required Action D.2.1 will be deleted.

8.1 APPLICATION OF THE CURRENT TS

If a Power Range channel is inoperable, Condition D of TS 3.3.1 must be entered.

The Required Actions for Condition D are:

1. Place the channel in trip within 72 hours and reduce THERMAL POWER to less than or equal to 75% RTP within 78 hours per Required Actions D.1.1 and D.1.2; OR
2. Place the channel in trip within 72 hours and perform SR 3.2.4.2 within 12 hours per Required Actions D.2.1 and D.2.2.~~; OR~~

~~3. Be in MODE 3 within 78 hours per Action D.3~~

Page 8-2, Section 8.2 Application of THE PROPOSED Changes

Item 1 eliminates the need to perform SR 3.2.4.1 because power would be less than or equal to 75% RTP, but the power reduction is not required as a direct result of the channel being inoperable. Item 2 maintains plant conditions where SR 3.2.4.2 applies and must be performed; however, the SR is not associated with the capability of the Reactor Trip System Instrumentation to perform its function. SR 3.2.4.2 applies and must be performed; however, the SR is not associated with the capability of the Reactor Trip System Instrumentation to perform its function. Item 3 would eliminate the need to perform SR 3.2.4.2 by entering a MODE where LCO 3.2.4 does not apply; however, it is driven by the Power Range channel being inoperable, not by performing SR 3.2.4.

8.2 APPLICATION OF THE PROPOSED CHANGES

With the proposed changes, only the Required Action~~s~~ associated with the Reactor Trip System Instrumentation is~~are~~ retained for Condition D of TS 3.3.1. The inoperable Power Range channel is required to be placed in trip within 72 hours~~ or the plant must be in Mode 3 in 78 hours~~, which is~~are~~ the same Required Action (D.1.1)~~s~~ that is contained in current TS 3.3.1. The only difference is that Required Action D.2.1~~2~~, which duplicates current Required Action D.1.1, is deleted.

The need to perform a verification of the QPTR when one Power Range channel is inoperable is addressed by ~~TS, 3.2.4~~proposed SR 3.2.4.1 when Thermal Power is ≤ 75% RTP and when Thermal Power is > 75% RTP, and therefore does not need to be duplicated in TS 3.3.1. With the proposed changes, a QPTR verification would only be required by proposed SR 3.2.4.1 if control rods were moved at least 12 steps and the rod position indication system was inoperable.

Page A-5, APPENDIX A - SAMPLE TS MARK-UPS

QPTR
3.2.4

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.2.4.1	----------NOTES---------- 1. With the calibrated output ~~input from~~ of one Power Range Neutron Flux channel ~~inoperable~~ unavailable and THERMAL POWER ≤ 75% RTP, the remaining three P~~p~~ower R~~r~~ange Neutron Flux channels can be used ~~for calculating~~to determine QPTR. 2. ~~SR 3.2.4.2 may be performed in lieu of this Surveillance~~The moveable incore detector system can be used to determine QPTR. ---------- Verify QPTR is within limit ~~by calculation~~.	[7 days OR In accordance with the Surveillance Frequency Control Program] AND ----NOTE---- Only required to be performed if the calibrated output of one Power Range Neutron Flux channel is unavailable, and THERMAL POWER >75% RTP. --- Once within 12 hours following any rod motion ≥ 12 steps, if an associated [digital] rod position indicator is inoperable.