Advanced Passive 1000 (AP1000)
Generic Technical Specification Traveler (GTST)

Title: Changes related to Section 3.2.4, Quadrant Power Tilt Ratio (QPTR)

I. Technical Specifications Task Force (TSTF) Travelers, Approved Since Revision 2 of STS NUREG-1431, and Used to Develop this GTST

TSTF Number and Title:

TSTF-425, Rev. 3, Relocate Surveillance Frequencies to Licensee Control – RITSTF Initiative 5b

STS NUREGs Affected:

TSTF-425, Rev. 3: NUREG-1430, -1431, -1432, -1433, -1434

NRC Approval Date:

TSTF-425, Rev. 3: 18-Mar-2009

TSTF Classification:

TSTF-425, Rev. 3: Technical Change

II. Reference Combined License (RCOL) Standard Departures (Std. Dep.), RCOL COL Items, and RCOL Plant-Specific Technical Specifications (PTS) Changes Used to Develop this GTST

RCOL Std. Dep. Number and Title:

None

RCOL COL Item Number and Title:

None

RCOL PTS Change Number and Title:

VEGP LAR DOC A011	Statements referring to “OPDMS OPERABLE” and “OPDMS INOPERABLE” are respectively revised to refer to 'OPDMS monitoring parameters” and “OPDMS not monitoring parameters.”
VEGP LAR DOC A021	TS 3.2.4 SRs are revised to include a new Note.

III. Comments on Relations Among TSTFs, RCOL Std. Dep., RCOL COL Items, and RCOL PTS Changes

This section discusses the considered changes that are: (1) applicable to operating reactor designs, but not to the AP1000 design; (2) already incorporated in the GTS; or (3) superseded by another change.

TSTF-483-T, Delete TS 3.3.1, Condition D, Power Range Neutron Flux - High Channel Inoperable, is based on Westinghouse Topical Report for operating reactors. No analysis for AP1000 is available. This TSTF is not applied for AP1000.

TSTF-425 is deferred for future consideration.

IV. Additional Changes Proposed as Part of this GTST (modifications proposed by NRC staff and/or clear editorial changes or deviations identified by preparer of GTST)

An editorial correction is made, under heading A.3, in the “Actions” section of the Bases. In the second and third sentence, “... Thermal Power reduction power Required Action A.3 ...” is replaced with “... Thermal Power reduction per Required Action A.3 ....”

APOG Recommended Changes to Improve the Bases

Correct TS 3.2.4 Bases Background reference to title of LCO 3.1.6 for consistency with TS title.

Split the last sentence of the first paragraph of the “Applicability” section in the Bases into two sentences.

Change the discussion in the “Actions” section of the Bases, under the heading “A.6,” to be consistent with the TS by supplying additional information and deleting misstatements.

Change the discussions in the “Surveillance Requirements” section, under the headings “SR 3.2.4.1” and “SR 3.2.4.2,” of the Bases to be consistent with the TS requirement.

V. Applicability

Affected Generic Technical Specifications and Bases:

Section 3.2.4, QUADRANT POWER TILT RATIO (QPTR)

Changes to the Generic Technical Specifications and Bases:

TS 3.2.4 APPLICABILITY Specification is revised replacing “OPDMS inoperable” with “OPDMS not monitoring parameters.” (DOC A011)

TS 3.2.4 SRs are revised to include a new Note stating:

“Not required to be performed until 12 hours after the last verification of OPDMS parameters.” (DOC A021)

In the “Background” section of the Bases, the title of LCO 3.1.6 is corrected. (APOG Comment)

In the “Applicability” section of the Bases, the last sentence of the first paragraph was split into two sentences. (APOG comment)

In the “Actions” section of the Bases, under heading “A.6,” misstatements are corrected and the discussion is made consistent with the requirements. (APOG comment)

In the “Surveillance Requirements” section of the Bases, under headings “SR 3.2.4.1” and “SR 3.2.4.2,” editorial corrections are made correctly identifying the neutron flux channels. (APOG comments)

VI. Traveler Information

Description of TSTF changes:

NA

Rationale for TSTF changes:

NA

Description of changes in RCOL Std. Dep., RCOL COL Item(s), and RCOL PTS Changes:

VEGP LAR DOC A011:

Various statements referring to “OPDMS OPERABLE” and “OPDMS INOPERABLE” are respectively revised to refer to 'OPDMS monitoring parameters” and “OPDMS not monitoring parameters.”

VEGP LAR DOC A021:

TS 3.2.4 SRs are revised to include a new Note stating:

“Not required to be performed until 12 hours after the last verification of OPDMS parameters.”

Rationale for changes in RCOL Std. Dep., RCOL COL Item(s), and RCOL PTS Changes:

VEGP LAR DOC A011:

The On-Line Power Distribution Monitoring System (OPDMS) is not safety related and does not have a safety function. OPDMS is an advanced core monitoring and support package. With OPDMS operating, the power distribution parameters are continuously computed and displayed, and compared against their limit. The TS definition of Operable is applied to assure a system is “capable of performing its specified safety function(s).” As such the use of the defined term is not appropriate for the OPDMS. Additionally, there is no requirement for maintaining its non-safety related capability.

The online monitoring capability of OPDMS is utilized when complying with TS 3.2.5, OPDMS-Monitored Parameters. The parameters required to meet LCO 3.2.5 are only applicable when OPDMS is providing the monitoring for compliance with the applicable limits. When OPDMS is not being utilized, the limits of TS 3.1.6, 3.2.1, 3.2.2, 3.2.3, and 3.2.4 are applicable (note that certain Actions of TS 3.1.4 also impose requirements of TS 3.2.1 and 3.2.2 when OPDMS is not being utilized). The current use of “OPERABLE” (and “inoperable”) in referencing whether OPDMS is being utilized is misleading and is more appropriately revised to “monitoring” (and “not monitoring”).

VEGP LAR DOC A021:

TS 3.2.4, and therefore its SRs, are currently only applicable when the Online Power Distribution Monitoring System (OPDMS) is “inoperable” (revised to “not monitoring parameters,” as discussed in VEGP LAR DOC A011).

In accordance with SR 3.0.1, SRs are required to be met when the TS is applicable, i.e., immediately on OPDMS not monitoring parameters, and failure to perform a Surveillance within the specified Frequency is a failure to meet the LCO and would constitute a violation of SR 3.0.4. As such, the TS 3.2.4 SRs must be stated such that they are “required to be performed” only after an appropriate allowance when OPDMS was not monitoring and/or is no longer monitoring parameters.

Current TS 3.2.4 SRs do not provide an explicit exception to performing the Surveillances (i.e., for not meeting these Frequencies) when OPDMS is initially not monitoring parameters. The inclusion of an allowance in the new Note for TS 3.2.4 SRs provides the same intent that existed for the SRs in TS 3.2.1 and TS 3.2.2, but was inadvertently omitted from the SRs for TS 3.2.4. Since OPDMS had been verifying core parameters at the time it ceases to monitor it is reasonable to assume that the QPTR would be within limits. As such, applying the allowed Frequency for the QPTR surveillance SR 3.2.4.2 (i.e., 12 hours) for allowing the initial performance of the TS 3.2.4 SRs is appropriate.

Since the intent to presume core parameters are within limits at the time of ceasing to monitor via OPDMS is seen in TS 3.2.1 and TS 3.2.2, it is consistent to assume QPTR is within limits at this time also. This change is designated as an administrative change and is acceptable because it does not result in technical changes to the TS.

Description of additional changes proposed by NRC staff/preparer of GTST:

In the “Background” section of the Bases, reference to title of LCO 3.1.6 is corrected as follows:

> ...and LCO 3.1.6, Control ~~Rod~~ **Bank** Insertion Limits,” provide limits...

In the “Applicability” section of the Bases, the last sentence of the first paragraph is split into two sentences:

> Therefore, QPTR must be monitored**.** ~~and t~~**T**he limits on QPTR ensure that peaking factors will be within the design limits.

In the “Actions” section of the Bases, under heading “A.6,” the following changes are made:

> Required Action A.6 is modified by a Note that states that the peaking factor surveillances may only be done after the excore detectors have been **normalized to restore QPTR to within limit** ~~calibrated to show zero tilt~~ (i.e., Required Action A.5).

In the “Surveillance Requirements” section of the Bases, under heading “3.2.4.1,” the following changes are made:

> SR 3.2.4.1 is modified by two Notes. Note allows QPTR to be calculated with three ~~p~~**Power** ~~r~~**R**ange **Neutron Flux** channels if THERMAL...

In the “Surveillance Requirements” section of the Bases, under heading 3.2.4.2,” the following changes are made:

With a PMS ~~p~~**P**ower ~~r~~**R**ange **Neutron Flux** channel inoperable, tilt monitoring for a portion of the reactor core becomes degraded.

...
For purposes of monitoring the QPTR when one ~~p~~**P**ower ~~r~~**R**ange **Neutron Flux** channel is ..

...
With the OPDMS **not monitoring parameters** and one PMS channel inoperable...

Rationale for additional changes proposed by NRC staff/preparer of GTST:

Changes to the “Actions” section of the Bases, under heading “A.6,” provide additional information, deletes misstatements, and make the discussion understandable. These changes reduce potential for misunderstanding and misapplication.

The remaining changes are editorial and they improve clarity, consistency, and operator usability.

VII. GTST Safety Evaluation

Technical Analysis:

Replacing “OPDMS inoperable” with “OPDMS not monitoring parameters”

The Applicability in the Specifications and the Bases for this Section are revised to state “OPDMS is not monitoring parameters” replacing “OPDMS is inoperable” consistent with the changes made in TS 3.2.5, OPDMS -Monitoring Parameters.”

In TS, the term “Operable” is applied to assure that a system is “capable of performing its specified safety function(s).” OPDMS is not safety related and does not have a safety function. It is a core monitoring and support package. As described, when OPDMS is operating, the power distribution parameters are continuously computed and displayed, and compared against their limit. It is, therefore, appropriate to use the terms “OPDMS is monitoring parameters” and “OPDMS is not monitoring parameters.”

Inclusion of a Note to SRs

TS 3.2.4, and therefore its SRs, are currently only applicable when the Online Power Distribution Monitoring System (OPDMS) is “not monitoring parameters”. Current SR 3.2.4.1 and SR 3.2.4.2 do not provide an explicit exception to performing the Surveillance (i.e., for not meeting these Frequencies) when OPDMS is initially not monitoring parameters. This is not appropriate, particularly since such exceptions are provided for the SRs in TS 3.2.1 and 3.2.2. Providing a clear guidance when the SR is to be performed after OPDMS ceases monitoring of the parameter is appropriate and consistent with other requirements. The inclusion of the Note provides this additional guidance.

The selection of 12 hours, i.e., applying the allowed Frequency of QPTR Surveillance, following the time when OPDMS ceases operation is also appropriate as it makes it consistent with the Frequency of the SR. When OPDMS ceases to monitor core parameters, including core peaking factor, it is reasonable to assume that the QPTR would be within limits. With that consideration, the time for first surveillance is the same as the Surveillance Frequency. This will allow adequate monitoring of QPTR and is acceptable.

Revision of Changes to the “Actions” section of the Bases

The corrections made to this section delete misstatement and includes understandable explanation. These changes improve the Bases discussion and make it consistent with the requirements. These changes are therefore acceptable.

Remaining Changes

The remaining changes are editorial, clarifying, grammatical, or otherwise considered administrative. These changes do not affect the technical content, but improve the readability, implementation, and understanding of the requirements, and are therefore acceptable.

Having found that this GTST’s proposed changes to the GTS and Bases are acceptable, the NRC staff concludes that AP1000 STS Subsection 3.2.4 is an acceptable model Specification for the AP1000 standard reactor design.

References to Previous NRC Safety Evaluation Reports (SERs):

None

VIII. Review Information

Evaluator Comments:

None

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Review Information:

Availability for public review and comment on Revision 0 of this traveler approved by NRC staff on 5/20/2014.

(Internal #105) 3.2.04, Pg. 07, A clarification was added in the discussion of VEGP LAR DOC A021 in Section VI of this GTST. This clarification clearly delineated the changes in VEGP LAR DOC A011 vs the changes in VEGP LAR DOC A021.

(Internal #106) 3.2.04, Pg. 08, In the second paragraph under “Replacing “OPDMS inoperable” with “OPDMS not monitoring parameters” in Section VII of this GTST, the first sentence was deleted since sufficient information is provided in the rest of the paragraph to justify the changes.

(Internal #107) 3.2.04, Pg. 27, In the “Background” section of the Bases, the title of LCO 3.1.6 was corrected for consistency with TS title.

(Internal #108) 3.2.04, Pg. 28, In the “Applicability” section of the Bases, the last sentence of the first paragraph was split into two sentences.

(Internal #109) 3.2.04, Pg. 31, In the “Actions” section, under heading “A.6,” of the Bases, the discussion was improved removing misstatements and including additional information.

(Internal # 110) 3.2.04, Pg. 32, In the “Surveillance Requirements” section of the Bases, under heading “SR 3.2.4.1,” the discussion was made consistent with the requirements.

(Internal # 111) 3.2.04, Pg. 32, In the “Surveillance Requirements” section, under heading “SR 3.2.4.2,” of the Bases, the discussion was made consistent with the requirements.

NRC Final Approval Date: 12/4/2015

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IX. Evaluator Comments for Consideration in Finalizing Technical Specifications and Bases

None

X. References Used in GTST

1. AP1000 DCD, Revision 19, Section 16, “Technical Specifications,” June 2011 (ML11171A500).

2. Southern Nuclear Operating Company, Vogtle Electric Generating Plant, Unit 3 and 4, Technical Specifications Upgrade License Amendment Request, February 24, 2011 (ML12065A057).

3. TSTF-GG-05-01, Technical Specification Task Force (TSTF) Writer's Guide for Plant-Specific Improved Technical Specifications, Revision 1.

4. RAI Letter No. 01 Related to License Amendment Request (LAR) 12-002 for the Vogtle Electric Generating Plant Units 3 and 4 Combined Licenses, September 7, 2012 (ML12251A355).

5. Southern Nuclear Operating Company, Vogtle Electric Generating Plant, Units 3 and 4, Response to Request for Additional Information Letter No. 01 Related to License Amendment Request LAR-12-002, ND-12-2015, October 04, 2012 (ML12286A363 and ML12286A360).

6. NRC Safety Evaluation (SE) for Amendment No. 13 to Combined License (COL) No. NPF-91 for Vogtle Electric Generating Plant (VEGP) Unit 3, and Amendment No. 13 to COL No. NPF-92 for VEGP Unit 4, September 9, 2013 (ADAMS Package Accession No. ML13238A337), which contains:

ML13238A355,	Cover Letter - Issuance of License Amendment No. 13 for Vogtle Units 3 and 4 (LAR 12-002).
ML13238A359,	Enclosure 1 - Amendment No. 13 to COL No. NPF-91
ML13239A256,	Enclosure 2 - Amendment No. 13 to COL No. NPF-92
ML13239A284,	Enclosure 3 - Revised plant-specific TS pages (Attachment to Amendment No. 13)
ML13239A287,	Enclosure 4 - Safety Evaluation (SE), and Attachment 1 - Acronyms
ML13239A288,	SE Attachment 2 - Table A - Administrative Changes
ML13239A319,	SE Attachment 3 - Table M - More Restrictive Changes
ML13239A333,	SE Attachment 4 - Table R - Relocated Specifications
ML13239A331,	SE Attachment 5 - Table D - Detail Removed Changes
ML13239A316,	SE Attachment 6 - Table L - Less Restrictive Changes

   The following documents were subsequently issued to correct an administrative error in Enclosure 3:

ML13277A616,	Letter - Correction To The Attachment (Replacement Pages) - Vogtle Electric Generating Plant Units 3 and 4- Issuance of Amendment Re: Technical Specifications Upgrade (LAR 12-002) (TAC No. RP9402)
ML13277A637,	Enclosure 3 - Revised plant-specific TS pages (Attachment to Amendment No. 13) (corrected)

7. APOG-2014-008, APOG (AP1000 Utilities) Comments on AP1000 Standardized Technical Specifications (STS) Generic Technical Specification Travelers (GTSTs), Docket ID NRC-2014-0147, September 22, 2014 (ML14265A493).

XI. MARKUP of the Applicable GTS Subsection for Preparation of the STS NUREG

The entire section of the Specifications and the Bases associated with this GTST is presented next.

Changes to the Specifications and Bases are denoted as follows: Deleted portions are marked in strikethrough red font, and inserted portions in bold blue font.

QPTR
3.2.4

3.2 POWER DISTRIBUTION LIMITS

3.2.4 QUADRANT POWER TILT RATIO (QPTR)

LCO 3.2.4 The QPTR shall be ≤ 1.02.

APPLICABILITY: MODE 1 with THERMAL POWER > 50% RTP and with the On-Line Power Distribution Monitoring System (OPDMS) **not monitoring parameters**~~inoperable~~.

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. QPTR not within limit.	A.1	Reduce THERMAL POWER ≥ 3% from RTP for each 1% of QPTR > 1.00.	2 hours after each QPTR determination
	AND		
	A.2	Perform SR 3.2.4.1.	Once per 12 hours
	AND		
	A.3	Perform SR 3.2.1.1 and SR 3.2.2.1.	24 hours after achieving equilibrium conditions from a THERMAL POWER reduction per Required Action A.1 AND Once per 7 days thereafter
	AND		

QPTR
3.2.4

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. (continued)	A.4 Reevaluate safety analyses and confirm results remain valid for duration of operation under this condition. AND A.5 ----------NOTES---------- 1. Perform Required Action A.5 only after Required Action A.4 is completed. 2. Required Action A.6 shall be completed whenever Required Action A.5 is performed. ---------- Normalize excore detectors to restore QPTR to within limit. AND	Prior to increasing THERMAL POWER above the limit of Required Action A.1 Prior to increasing THERMAL POWER above the limit of Required Action A.1

QPTR
3.2.4

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. (continued)	A.6 ----------NOTE---------- Perform Required Action A.6 only after Required Action A.5 is completed. ---------- Perform SR 3.2.1.1, SR 3.2.1.2, and SR 3.2.2.1.	Within 24 hours after achieving equilibrium conditions at RTP not to exceed 48 hours after increasing THERMAL POWER above the limit of Required Action A.1
B. Required Action and associated Completion Time not met.	B.1 Reduce THERMAL POWER to ≤ 50% RTP.	4 hours

QPTR
3.2.4

SURVEILLANCE REQUIREMENTS

----------**NOTE**----------

Not required to be performed until 12 hours after the last verification of OPDMS parameters.

SURVEILLANCE		FREQUENCY
SR 3.2.4.1	----------NOTES---------- 1. With one power range channel inoperable and THERMAL POWER < 75% RTP, the remaining three power range channels can be used for calculating QPTR. 2. SR 3.2.4.2 may be performed in lieu of this Surveillance. --- Verify QPTR within limit by calculation.	7 days
SR 3.2.4.2	----------NOTE---------- Not required to be performed until 12 hours after input from one or more Power Range Neutron Flux channels are inoperable with THERMAL POWER ≥ 75% RTP. --- Verify QPTR is within limit using a minimum of 4 symmetric pairs of fixed incore detectors.	12 hours

B 3.2 POWER DISTRIBUTION LIMITS

B 3.2.4 QUADRANT POWER TILT RATIO (QPTR)

BASES

BACKGROUND

With the Online Power and Distribution Monitoring System (OPDMS) **not monitoring parameters**~~inoperable~~, the QPTR limit ensures that the gross radial power distribution remains consistent with the design values used in the safety analyses. Precise radial power distribution measurements are made during startup testing, after refueling, and periodically during power operation.

The power density at any point in the core must be limited so that the fuel design criteria are maintained. With the OPDMS **monitoring parameters**~~OPERABLE~~, the peak **linear power density** ~~kw/ft(Z)~~ is continuously and directly monitored. With the OPDMS **not monitoring parameters**~~inoperable~~, LCO 3.2.3, "AXIAL FLUX DIFFERENCE (AFD)," LCO 3.2.4, "QUADRANT POWER TILT RATIO (QPTR)," and LCO 3.1.6, "Control ~~Rod~~ **Bank** Insertion Limits," provide limits on process variables that characterize and control the three dimensional power distribution of the reactor core. Control of these variables ensures that the core operates within the fuel design criteria and that the power distribution remains within the bounds used in the safety analyses.

APPLICABLE SAFETY ANALYSES

This LCO precludes core power distributions from occurring which would violate the following fuel design criteria:

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

b. During a loss of forced reactor coolant flow accident, there must be at least a 95% probability at a 95% confidence level (the 95/95 departure from nucleate boiling (DNB) criterion) that the hot fuel rod in the core does not experience a 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).

BASES

APPLICABLE SAFETY ANALYSES (continued)

The LCO limits on the AFD, the QPTR, the Heat Flux Hot Channel Factor ($F_Q(Z)$), the Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$), and control bank insertion are established to preclude core power distributions from occurring which would exceed the safety analyses limits.

Should the OPDMS **cease monitoring parameters**~~becomeinoperable~~, the QPTR limits ensure that $F^N_{\Delta H}$ and $F_Q(Z)$ remain below their limiting values by preventing an undetected change in the gross radial power distribution.

In MODE 1, with the OPDMS **not monitoring parameters**~~inoperable~~, the $F^N_{\Delta H}$ and $F_Q(Z)$ limits must be maintained to preclude core power distributions from exceeding design limits assumed in the safety analyses.

The QPTR satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

The QPTR limit of 1.02, where corrective action is required, provides a margin of protection for both the DNB ratio (DNBR) and linear heat generation rate contributing to excessive power peaks resulting from X-Y plane power tilts. A limiting QPTR of 1.02 can be tolerated before the margin for uncertainty in $F_Q(Z)$ and $F^N_{\Delta H}$ is possibly challenged.

APPLICABILITY

The QPTR limit must be maintained in MODE 1 with THERMAL POWER > 50% RTP to preclude core power distributions from exceeding the design limits. With the OPDMS **not monitoring parameters**~~inoperable~~, a continuous on-line indication of core peaking factors is not available. Therefore, QPTR must be monitored**.** ~~and t~~**T**he limits on QPTR ensure that peaking factors will be within design limits.

Applicability in MODE 1 ≤ 50% RTP and 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 the implementation of a QPTR limit on the distribution of core power. The QPTR limit in these conditions is, therefore, not important. Note that the $F^N_{\Delta H}$ and $F_Q(Z)$ LCOs still apply, but allow progressively higher peaking factors at 50% RTP or lower.

BASES

ACTIONS

A.1

With the QPTR exceeding its limit, and the OPDMS **not monitoring parameters**~~inoperable~~, a power level reduction of 3% RTP for each 1% by which the QPTR exceeds 1.00 is a conservative tradeoff of total core power with peak linear power. The Completion Time of 2 hours allows sufficient time to identify the cause and correct the tilt. Note that the power reduction itself may cause a change in the tilted condition.

The maximum allowable power level initially determined by Required Action A.1 may be affected by subsequent determinations of QPTR. Increases in QPTR would require power reduction within 2 hours of QPTR determination, if necessary to comply with the decreased maximum allowable power level and increasing power up to this revised limit.

A.2

After completion of Required Action A.1, the QPTR alarm may be in its alarmed state. As such, any additional changes in the QPTR are detected by requiring a check of the QPTR once per 12 hours thereafter. A 12 hour Completion Time is sufficient because any additional change in QPTR would be relatively slow.

A.3

The peaking factors $F_Q(Z)$, as approximated by $F_Q^C(Z)$ and $F_Q^W(Z)$, and $F_{\Delta H}^N$ are of primary importance in assuring that the power distribution remains consistent with the initial conditions used in the safety analyses. Performing SRs on $F_{\Delta H}^N$ and $F_Q(Z)$ within the Completion Time of 24 hours after achieving equilibrium conditions from a Thermal Power reduction ~~power~~**per** Required Action A.1 ensures that these primary indicators of power distribution are within their respective limits. A Completion Time of 24 hours after achieving equilibrium conditions from a Thermal Power reduction ~~power~~**per** Required Action A.1 takes into consideration the rate at which peaking factors are likely to change, and the time required to stabilize the plant and perform a flux map. If these peaking factors are not within their limits, the Required Actions of these Surveillances provide an appropriate response for the abnormal condition. If the QPTR remains above its specified limits, the peaking factor surveillances are required each 7 days thereafter to evaluate $F_{\Delta H}^N$ and $F_Q(Z)$ with changes in power distribution. Relatively small changes are expected due to

ACTIONS (continued)

either burnup and xenon redistribution or correction of the cause for exceeding the QPTR limit.

A.4

Although $F^{N}_{\Delta H}$ and $F_Q(Z)$ are of primary importance as initial conditions in the safety analyses, other changes in the power distribution may occur as the QPTR limit is exceeded and may have an impact on the validity of the safety analysis. A change in the power distribution can affect such reactor parameters as bank worths and peaking factors for rod malfunction accidents. When the QPTR exceeds its limit, it does not necessarily mean a safety concern exists. It does mean that there is an indication of a change in the gross radial power distribution that requires an investigation and evaluation that is accomplished by examining the incore power distribution. Specifically, the core peaking factors and the quadrant tilt must be evaluated because they are the factors which best characterize the core power distribution. This re-evaluation is required to assure that, before increasing THERMAL POWER to above the limit of Required Action A.1, the reactor core conditions are consistent with the assumptions in the safety analyses.

A.5

If the QPTR has exceeded the 1.02 limit and a re-evaluation of the safety analysis is completed and shows that safety requirements are met, the excore detectors are normalized to restore QPTR to within limits prior to increasing THERMAL POWER to above the limit of Required Action A.1. Normalization is accomplished in such a manner that the indicated QPTR following normalization is near 1.00. This is done to detect any subsequent significant changes in QPTR.

Required Action A.5 is modified by two Notes. Note 1 states that the QPTR is not restored to within limits until after the re-evaluation of the safety analysis has determined that core conditions at RTP are within the safety analysis assumptions (i.e., Required Action A.4). Note 2 states that if Required Action A.5 is performed, then Required Action A.6 shall be performed. Required Action A.5 normalizes the excore detectors to restore QPTR to within limits, which restores compliance with LCO 3.2.4. Thus, Note 2 prevents exiting the Actions prior to completing flux mapping to verify peaking factors, per Required Action A.6. These Notes are intended to prevent any ambiguity about the required sequence of actions.

BASES

ACTIONS (continued)

A.6

Once the flux tilt is restored to within limits (i.e., Required Action A.5 is performed), it is acceptable to return to full power operation. However, as an added check that the core power distribution is consistent with the safety analysis assumptions, Required Action A.6 requires verification that $F_Q(Z)$ as approximated by $F_Q^C(Z)$ and $F_Q^W(Z)$, and $F_{\Delta H}^N$ are within their specified limits within 24 hours of achieving equilibrium conditions at RTP. As an added precaution, if the core power does not reach equilibrium conditions at RTP within 24 hours, but is increased slowly, then the peaking factor surveillances must be performed within 48 hours after increasing THERMAL POWER above the limit of Required Action A.1. These Completion Times are intended to allow adequate time to increase THERMAL POWER to above the limit of Required Action A.1, while not permitting the core to remain with unconfirmed power distributions for extended periods of time.

Required Action A.6 is modified by a Note that states that the peaking factor surveillances may only be done after the excore detectors have been **normalized to restore QPTR to within limit** ~~calibrated to show zero tilt~~ (i.e., Required Action A.5). The intent of this Note is to have the peaking factor surveillances performed at operating power levels, which can only be accomplished after the excore detectors are calibrated to show zero tilt and the core returned to power.

B.1

If Required Actions A.1 through A.6 are not completed within their associated Completion Times, the unit must be brought to a MODE or condition in which the requirements do not apply. To achieve the status, THERMAL POWER must be reduced to < 50% RTP within 4 hours. The allowed Completion Time of 4 hours is reasonable based on operating experience regarding the amount of time required to reach the reduced power level without challenging plant systems.

SURVEILLANCE REQUIREMENTS

The Surveillances are modified by a Note allowing 12 hours without the continuous monitoring capability of the OPDMS before QPTR must be initially verified. The first verification must be made within 12 hours of the most recent date where the OPDMS data has verified parameters. This is consistent with the 12 hour Surveillance Frequency for QPTR in SR 3.2.4.2.

SURVEILLANCE REQUIREMENTS (continued)

SR 3.2.4.1

SR 3.2.4.1 is modified by two Notes. Note 1 allows QPTR to be calculated with three ~~p~~**P**ower ~~r~~**R**ange **Neutron Flux** channels if THERMAL POWER is < 75% RTP and the input from one Power Range Neutron Flux channel is inoperable. Note 2 allows performance of SR 3.2.4.2 in lieu of SR 3.2.4.1.

This Surveillance verifies that the QPTR as indicated by the Protection and Safety Monitoring System (PMS) excore channels is within its limits. The Frequency of 7 days takes into account other information and alarms available to the operator in the control room.

For those causes of QPT that occur quickly (a dropped rod), there are other indications of abnormality that prompt a verification of core power tilt.

SR 3.2.4.2

This Surveillance is modified by a Note, which states that it is not required until 12 hours after the input from one or more Power Range Neutron Flux channels are inoperable and the THERMAL POWER is ≥ 75% RTP.

With a PMS ~~p~~**P**ower ~~r~~**R**ange **Neutron Flux** channel inoperable, tilt monitoring for a portion of the reactor core becomes degraded. Large tilts would likely be detected with the remaining channels, but the capability for detection of small power tilts in some quadrants is decreased. Performing SR 3.2.4.2 at a Frequency of 12 hours provides an accurate alternative means for assuring that any tilt remains within its limits.

For purposes of monitoring the QPTR when one ~~p~~**P**ower ~~r~~**R**ange **Neutron Flux** channel is inoperable, the incore detectors are used to confirm that the normalized symmetric power distribution is acceptable.

With the OPDMS **not monitoring parameters** and one PMS channel inoperable, the surveillance of the incore power distribution on a 12 hour basis is sufficient to maintain peaking factors within their normal limits, especially, considering the other LCOs and ACTIONS required when the OPDMS is out of service.

BASES

REFERENCES

1. Title 10, Code of Federal Regulations, Part 50.46, “Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors.”

2. Regulatory Guide 1.77, Rev. 0, “Assumptions Used for Evaluating a Control Rod Ejection Accident for Pressurized Water Reactors,” May 1974.

3. Title 10, Code of Federal Regulations, Part 50, Appendix A, “General Design Criteria for Nuclear Power Plants,” GDC 26, “Reactivity Control System Redundancy and Capability.”

XII. Applicable STS Subsection After Incorporation of this GTST's Modifications

The entire subsection of the Specifications and the Bases associated with this GTST, following incorporation of the modifications, is presented next.

QPTR
3.2.4

3.2 POWER DISTRIBUTION LIMITS

3.2.4 QUADRANT POWER TILT RATIO (QPTR)

LCO 3.2.4 The QPTR shall be ≤ 1.02.

APPLICABILITY: MODE 1 with THERMAL POWER > 50% RTP and with the On-Line Power Distribution Monitoring System (OPDMS) not monitoring parameters.

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. QPTR not within limit.	A.1	Reduce THERMAL POWER ≥ 3% from RTP for each 1% of QPTR > 1.00.	2 hours after each QPTR determination
	AND		
	A.2	Perform SR 3.2.4.1.	Once per 12 hours
	AND		
	A.3	Perform SR 3.2.1.1 and SR 3.2.2.1.	24 hours after achieving equilibrium conditions from a THERMAL POWER reduction per Required Action A.1 AND Once per 7 days thereafter
	AND		

QPTR
3.2.4

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. (continued)	A.4 Reevaluate safety analyses and confirm results remain valid for duration of operation under this condition. AND	Prior to increasing THERMAL POWER above the limit of Required Action A.1
	A.5 ----------NOTES---------- 1. Perform Required Action A.5 only after Required Action A.4 is completed. 2. Required Action A.6 shall be completed whenever Required Action A.5 is performed. ---------- Normalize excore detectors to restore QPTR to within limit. AND	Prior to increasing THERMAL POWER above the limit of Required Action A.1

QPTR
3.2.4

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. (continued)	A.6	----------NOTE---------- Perform Required Action A.6 only after Required Action A.5 is completed. ---------- Perform SR 3.2.1.1, SR 3.2.1.2, and SR 3.2.2.1.	Within 24 hours after achieving equilibrium conditions at RTP not to exceed 48 hours after increasing THERMAL POWER above the limit of Required Action A.1
B. Required Action and associated Completion Time not met.	B.1	Reduce THERMAL POWER to ≤ 50% RTP.	4 hours

QPTR
3.2.4

SURVEILLANCE REQUIREMENTS

----------NOTE----------
Not required to be performed until 12 hours after the last verification of OPDMS parameters.

SURVEILLANCE		FREQUENCY
SR 3.2.4.1	----------NOTES---------- 1. With one power range channel inoperable and THERMAL POWER < 75% RTP, the remaining three power range channels can be used for calculating QPTR. 2. SR 3.2.4.2 may be performed in lieu of this Surveillance. --- Verify QPTR within limit by calculation.	7 days
SR 3.2.4.2	----------NOTE---------- Not required to be performed until 12 hours after input from one or more Power Range Neutron Flux channels are inoperable with THERMAL POWER ≥ 75% RTP. --- Verify QPTR is within limit using a minimum of 4 symmetric pairs of fixed incore detectors.	12 hours

B 3.2 POWER DISTRIBUTION LIMITS

B 3.2.4 QUADRANT POWER TILT RATIO (QPTR)

BASES

BACKGROUND

With the Online Power and Distribution Monitoring System (OPDMS) not monitoring parameters, the QPTR limit ensures that the gross radial power distribution remains consistent with the design values used in the safety analyses. Precise radial power distribution measurements are made during startup testing, after refueling, and periodically during power operation.

The power density at any point in the core must be limited so that the fuel design criteria are maintained. With the OPDMS monitoring parameters, the peak linear power density is continuously and directly monitored. With the OPDMS not monitoring parameters, LCO 3.2.3, “AXIAL FLUX DIFFERENCE (AFD),” LCO 3.2.4, “QUADRANT POWER TILT RATIO (QPTR),” and LCO 3.1.6, “Control Bank Insertion Limits,” provide limits on process variables that characterize and control the three dimensional power distribution of the reactor core. Control of these variables ensures that the core operates within the fuel design criteria and that the power distribution remains within the bounds used in the safety analyses.

APPLICABLE SAFETY ANALYSES

This LCO precludes core power distributions from occurring which would violate the following fuel design criteria:

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

b. During a loss of forced reactor coolant flow accident, there must be at least a 95% probability at a 95% confidence level (the 95/95 departure from nucleate boiling (DNB) criterion) that the hot fuel rod in the core does not experience a 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).

BASES

APPLICABLE SAFETY ANALYSES (continued)

The LCO limits on the AFD, the QPTR, the Heat Flux Hot Channel Factor ($F_Q(Z)$), the Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$), and control bank insertion are established to preclude core power distributions from occurring which would exceed the safety analyses limits.

Should the OPDMS cease monitoring parameters, the QPTR limits ensure that $F^N_{\Delta H}$ and $F_Q(Z)$ remain below their limiting values by preventing an undetected change in the gross radial power distribution.

In MODE 1, with the OPDMS not monitoring parameters, the $F^N_{\Delta H}$ and $F_Q(Z)$ limits must be maintained to preclude core power distributions from exceeding design limits assumed in the safety analyses.

The QPTR satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

The QPTR limit of 1.02, where corrective action is required, provides a margin of protection for both the DNB ratio (DNBR) and linear heat generation rate contributing to excessive power peaks resulting from X-Y plane power tilts. A limiting QPTR of 1.02 can be tolerated before the margin for uncertainty in $F_Q(Z)$ and $F^N_{\Delta H}$ is possibly challenged.

APPLICABILITY

The QPTR limit must be maintained in MODE 1 with THERMAL POWER > 50% RTP to preclude core power distributions from exceeding the design limits. With the OPDMS not monitoring parameters, a continuous on-line indication of core peaking factors is not available. Therefore, QPTR must be monitored. The limits on QPTR ensure that peaking factors will be within design limits.

Applicability in MODE 1 ≤ 50% RTP and 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 the implementation of a QPTR limit on the distribution of core power. The QPTR limit in these conditions is, therefore, not important. Note that the $F^N_{\Delta H}$ and $F_Q(Z)$ LCOs still apply, but allow progressively higher peaking factors at 50% RTP or lower.

BASES

ACTIONS

A.1

With the QPTR exceeding its limit, and the OPDMS not monitoring parameters, a power level reduction of 3% RTP for each 1% by which the QPTR exceeds 1.00 is a conservative tradeoff of total core power with peak linear power. The Completion Time of 2 hours allows sufficient time to identify the cause and correct the tilt. Note that the power reduction itself may cause a change in the tilted condition.

The maximum allowable power level initially determined by Required Action A.1 may be affected by subsequent determinations of QPTR. Increases in QPTR would require power reduction within 2 hours of QPTR determination, if necessary to comply with the decreased maximum allowable power level and increasing power up to this revised limit.

A.2

After completion of Required Action A.1, the QPTR alarm may be in its alarmed state. As such, any additional changes in the QPTR are detected by requiring a check of the QPTR once per 12 hours thereafter. A 12 hour Completion Time is sufficient because any additional change in QPTR would be relatively slow.

A.3

The peaking factors $F_Q(Z)$, as approximated by $F_Q^C(Z)$ and $F_Q^W(Z)$, and $F_{\Delta H}^N$ are of primary importance in assuring that the power distribution remains consistent with the initial conditions used in the safety analyses. Performing SRs on $F_{\Delta H}^N$ and $F_Q(Z)$ within the Completion Time of 24 hours after achieving equilibrium conditions from a Thermal Power reduction per Required Action A.1 ensures that these primary indicators of power distribution are within their respective limits. A Completion Time of 24 hours after achieving equilibrium conditions from a Thermal Power reduction per Required Action A.1 takes into consideration the rate at which peaking factors are likely to change, and the time required to stabilize the plant and perform a flux map. If these peaking factors are not within their limits, the Required Actions of these Surveillances provide an appropriate response for the abnormal condition. If the QPTR remains above its specified limits, the peaking factor surveillances are required each 7 days thereafter to evaluate $F_{\Delta H}^N$ and $F_Q(Z)$ with changes in power distribution. Relatively small changes are expected due to

ACTIONS (continued)

either burnup and xenon redistribution or correction of the cause for exceeding the QPTR limit.

A.4

Although $F^N_{\Delta H}$ and $F_Q(Z)$ are of primary importance as initial conditions in the safety analyses, other changes in the power distribution may occur as the QPTR limit is exceeded and may have an impact on the validity of the safety analysis. A change in the power distribution can affect such reactor parameters as bank worths and peaking factors for rod malfunction accidents. When the QPTR exceeds its limit, it does not necessarily mean a safety concern exists. It does mean that there is an indication of a change in the gross radial power distribution that requires an investigation and evaluation that is accomplished by examining the incore power distribution. Specifically, the core peaking factors and the quadrant tilt must be evaluated because they are the factors which best characterize the core power distribution. This re-evaluation is required to assure that, before increasing THERMAL POWER to above the limit of Required Action A.1, the reactor core conditions are consistent with the assumptions in the safety analyses.

A.5

If the QPTR has exceeded the 1.02 limit and a re-evaluation of the safety analysis is completed and shows that safety requirements are met, the excore detectors are normalized to restore QPTR to within limits prior to increasing THERMAL POWER to above the limit of Required Action A.1. Normalization is accomplished in such a manner that the indicated QPTR following normalization is near 1.00. This is done to detect any subsequent significant changes in QPTR.

Required Action A.5 is modified by two Notes. Note 1 states that the QPTR is not restored to within limits until after the re-evaluation of the safety analysis has determined that core conditions at RTP are within the safety analysis assumptions (i.e., Required Action A.4). Note 2 states that if Required Action A.5 is performed, then Required Action A.6 shall be performed. Required Action A.5 normalizes the excore detectors to restore QPTR to within limits, which restores compliance with LCO 3.2.4. Thus, Note 2 prevents exiting the Actions prior to completing flux mapping to verify peaking factors, per Required Action A.6. These Notes are intended to prevent any ambiguity about the required sequence of actions.

BASES

ACTIONS (continued)

A.6

Once the flux tilt is restored to within limits (i.e., Required Action A.5 is performed), it is acceptable to return to full power operation. However, as an added check that the core power distribution is consistent with the safety analysis assumptions, Required Action A.6 requires verification that $F_Q(Z)$ as approximated by $F_Q^C(Z)$ and $F_Q^W(Z)$, and $F_{\Delta H}^N$ are within their specified limits within 24 hours of achieving equilibrium conditions at RTP. As an added precaution, if the core power does not reach equilibrium conditions at RTP within 24 hours, but is increased slowly, then the peaking factor surveillances must be performed within 48 hours after increasing THERMAL POWER above the limit of Required Action A.1. These Completion Times are intended to allow adequate time to increase THERMAL POWER to above the limit of Required Action A.1, while not permitting the core to remain with unconfirmed power distributions for extended periods of time.

Required Action A.6 is modified by a Note that states that the peaking factor surveillances may only be done after the excore detectors have been normalized to restore QPTR to within limit (i.e., Required Action A.5). The intent of this Note is to have the peaking factor surveillances performed at operating power levels, which can only be accomplished after the excore detectors are calibrated to show zero tilt and the core returned to power.

B.1

If Required Actions A.1 through A.6 are not completed within their associated Completion Times, the unit must be brought to a MODE or condition in which the requirements do not apply. To achieve the status, THERMAL POWER must be reduced to < 50% RTP within 4 hours. The allowed Completion Time of 4 hours is reasonable based on operating experience regarding the amount of time required to reach the reduced power level without challenging plant systems.

SURVEILLANCE REQUIREMENTS

The Surveillances are modified by a Note allowing 12 hours without the continuous monitoring capability of the OPDMS before QPTR must be initially verified. The first verification must be made within 12 hours of the most recent date where the OPDMS data has verified parameters. This is consistent with the 12 hour Surveillance Frequency for QPTR in SR 3.2.4.2.

SURVEILLANCE REQUIREMENTS (continued)

SR 3.2.4.1

SR 3.2.4.1 is modified by two Notes. Note 1 allows QPTR to be calculated with three Power Range Neutron Flux channels if THERMAL POWER is < 75% RTP and the input from one Power Range Neutron Flux channel is inoperable. Note 2 allows performance of SR 3.2.4.2 in lieu of SR 3.2.4.1.

This Surveillance verifies that the QPTR as indicated by the Protection and Safety Monitoring System (PMS) excore channels is within its limits. The Frequency of 7 days takes into account other information and alarms available to the operator in the control room.

For those causes of QPT that occur quickly (a dropped rod), there are other indications of abnormality that prompt a verification of core power tilt.

SR 3.2.4.2

This Surveillance is modified by a Note, which states that it is not required until 12 hours after the input from one or more Power Range Neutron Flux channels are inoperable and the THERMAL POWER is ≥ 75% RTP.

With a PMS Power Range Neutron Flux channel inoperable, tilt monitoring for a portion of the reactor core becomes degraded. Large tilts would likely be detected with the remaining channels, but the capability for detection of small power tilts in some quadrants is decreased. Performing SR 3.2.4.2 at a Frequency of 12 hours provides an accurate alternative means for assuring that any tilt remains within its limits.

For purposes of monitoring the QPTR when one Power Range Neutron Flux channel is inoperable, the incore detectors are used to confirm that the normalized symmetric power distribution is acceptable.

With the OPDMS not monitoring parameters and one PMS channel inoperable, the surveillance of the incore power distribution on a 12 hour basis is sufficient to maintain peaking factors within their normal limits, especially, considering the other LCOs and ACTIONS required when the OPDMS is out of service.

BASES

REFERENCES

1. Title 10, Code of Federal Regulations, Part 50.46, “Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors.”

2. Regulatory Guide 1.77, Rev. 0, “Assumptions Used for Evaluating a Control Rod Ejection Accident for Pressurized Water Reactors,” May 1974.

3. Title 10, Code of Federal Regulations, Part 50, Appendix A, “General Design Criteria for Nuclear Power Plants,” GDC 26, “Reactivity Control System Redundancy and Capability.”