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

Title: Changes related to Section 3.2.3, Axial Flux Difference (AFD) (Relaxed Axial Offset Control (RAOC) Methodology)

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:

NA

RCOL COL Item Number and Title:

NA

RCOL PTS Change Number and Title:

VEGP LAR DOC A011	Statements referring to “OPDMS operable” and “OPDMS inoperable” are respectively revised to “OPDMS monitoring parameters” and “OPDMS not monitoring parameters.”
VEGP LAR DOC A020	SR 3.2.3.1 is 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(1) applicable to operating reactor designs, but not to the AP1000 design; (2) already incorporated in the GTS; or (3) superseded by another change.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-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)

APOG Recommended Changes to Improve the Bases

Throughout the Bases, references to Sections and Chapters of the FSAR do not include the "FSAR" clarifier. Since these Section and Chapter references are to an external document, it is appropriate to include the "FSAR" modifier. (DOC A003)

The following editorial changes are recommended:

In the "Applicable Safety Analyses" section of the Bases, the inadvertently added word "SAFETY" is to be removed from the first sentence.

In the "Applicable Safety Analyses" and "LCO" sections of the Bases, numeric formatting is to be corrected.

V. Applicability

Affected Generic Technical Specifications and Bases:

Section 3.2.3, AXIAL FLUX DIFFERENCE (AFD) (Relaxed Axial Offset Control (RAOC) Methodology)

Changes to the Generic Technical Specifications and Bases:

TS 3.2.3 APPLICABILITY in Specifications and the Bases are revised replacing “OPDMS inoperable” and “OPDMS operable” respectively with “OPDMS not monitoring parameters” and “OPDMS monitoring parameters.” (DOC A011)

SR 3.2.3.1 is revised to add a Note stating “Not required to be performed until 7 days after the last verification of OPDMS parameters.” (DOC A020)

Editorial change is made in “Applicable Safety Analyses” section of the Bases removing the word “SAFETY” from the first sentence. (APOG comment)

Numeric formatting is corrected in the “Applicable Safety Analyses” and “LCO” sections of the Bases. (APOG comment)

VI. Traveler Information

Description of TSTF changes:

None

Rationale for TSTF changes:

None

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

VEGP LAR DOC A011:

Statements referring to “OPDMS operable” and “OPDMS inoperable” are respectively revised to “OPDMS monitoring parameters” and “OPDMS not monitoring parameters.”

VEGP LAR DOC A020:

TS 3.2.3, “AXIAL FLUX DIFFERENCE (AFD) (Relaxed Axial Offset Control (RAOC) Methodology),” SR 3.2.3.1 is revised to include a new Note stating:

“Not required to be performed until 7 days 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 A020:

TS 3.2.3, and therefore its SR, are currently only applicable when the Online Power Distribution Monitoring System (OPDMS) is “inoperable” (revised to “not monitoring parameters”). (Note that references to OPDMS “OPERABLE” and “inoperable” throughout TS and Bases are revised to “monitoring parameters” and “not monitoring parameters,” respectively, as discussed in 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 3.2.3 SR must be stated such that it is “required to be performed” only after an appropriate allowance when OPDMS was not monitoring and/or is no longer monitoring parameters.

Current SR 3.2.3.1 does not provide an explicit exception to performing the Surveillance (i.e., for not meeting these Frequencies) when OPDMS is initially not monitoring parameters. The inclusion of an allowance in the new Note for SR 3.2.3.1 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 SR for TS 3.2.3. Since OPDMS had been verifying core parameters, including core peaking factor, at the time it ceases to monitor it is reasonable to assume that the AFD would be within limits. As such, applying the periodic verification Frequency for AFD (i.e., 7 days) for allowing the initial performance of SR 3.2.3.1 is appropriate. Additionally, as noted in the SR 3.2.3.1 Bases, the AFD is monitored by a computer and any deviation from requirements is alarmed.

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 AFD is also within limits at this time. 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:

The acronym “FSAR” is added to modify “Section” and “Chapter” in references to the FSAR throughout the Bases. (DOC A003)

In the “Applicable Safety Analyses” section of the Bases, the inadvertently added word “SAFETY” is removed from the first sentence:

> The AFD is a measure of the axial power distribution skewing ~~SAFETY~~ to either the top or bottom half of the core.

In the “Applicable Safety Analyses” section of the Bases, numeric formatting is corrected:

> ... initial condition in the analyses of Condition **II**~~2~~, **III**~~3~~, or **IV**~~4~~ events. This ensures that the fuel cladding integrity is maintained for these postulated accidents. The most important Condition **IV**~~4~~ event is the LOCA. The most important Condition III~~3~~ event is the loss of flow accident. The most important Condition **II**~~2~~ events are uncontrolled bank withdrawal and boration dilution accidents. Condition **II**~~2~~ accidents...

In the “LCO” section of the Bases, numeric formatting is corrected:

> ... with the OPDMS inoperable, could produce unacceptable consequences if a Condition **II, III, or IV**~~2, 3 or 4~~ event occurs while the AFD is outside its...

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

Since Bases references to FSAR Sections and Chapters are to an external document, it is appropriate to include the “FSAR” modifier.

The remaining changes are editorial and they provide improved consistency, clarity 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 SR 3.2.3.1

TS 3.2.3, and therefore its SR, is currently only applicable when the Online Power Distribution Monitoring System (OPDMS) is “not monitoring parameters”. Current SR 3.2.3.1 does 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 7 days following the time when OPDMS ceases operation is also appropriate as it is consistent with the Frequency of the SR. The AFD is monitored by a computer and any deviation from requirements is alarmed. When OPDMS ceases to monitor core parameters, including core peaking factor, it is reasonable to assume that the AFD 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 AFD and is 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 3.2.3 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 4/3/2014.

APOG Comments (Ref. 7) and Resolutions

(Internal #3) Throughout the Bases, references to Sections and Chapters of the FSAR do not include the “FSAR” modifier. Since these Section and Chapter references are to an external document, it is appropriate to include the “FSAR” modifier. This is resolved by adding the “FSAR” modifier as appropriate.

(Internal #101) 3.2.03, Pg. 08, The first sentence in the second paragraph of the “Technical Analysis” of this GTST was deleted since sufficient justification is provided in the rest of the paragraph to justify the change.

(Internal #102) 3.2.03, Pg. 21, In the “Applicable Safety Analyses” section of the Bases, the inadvertently added word “SAFETY” was removed from the first sentence.

(Internal #103) 3.2.03, Pg. 21, In the “Applicable Safety Analyses” section of the Bases, numeric formatting was corrected.

(Internal #104) 3.2.03, Pg. 22, In the “LCO” section of the Bases, numeric formatting was corrected.

NRC Final Approval Date: 06/25/15

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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.

3.2 POWER DISTRIBUTION LIMITS

3.2.3 AXIAL FLUX DIFFERENCE (AFD) (Relaxed Axial Offset Control (RAOC) Methodology)

LCO 3.2.3 The AFD in %-flux-difference units shall be maintained within the limits specified in the COLR.

----------NOTE----------
The AFD shall be considered outside limits when two or more OPERABLE excore channels indicate AFD to be outside limits.

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. AFD not within limits.	A.1 Reduce THERMAL POWER to < 50% RTP.	30 minutes

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.2.3.1	**----------NOTE----------** **Not required to be performed until 7 days after the last verification of OPDMS parameters.** **---** Verify AFD within limits for each OPERABLE excore channel.	7 days

B 3.2 POWER DISTRIBUTION LIMITS

B 3.2.3 AXIAL FLUX DIFFERENCE (AFD) (Relaxed Axial Offset Control (RAOC) Methodology)

BASES

BACKGROUND

The purpose of this LCO is to establish limits on the values of the AFD in order to limit the amount of axial power distribution skewing to either the top or bottom of the core when the On-Line Power Distribution Monitoring System (OPDMS) is **not monitoring parameters**~~inoperable~~. By limiting the amount of power distribution skewing, core peaking factors are consistent with the assumptions used in the safety analyses. Limiting power distribution skewing over time also minimizes the xenon distribution skewing which is a significant factor in axial power distribution control.

RAOC is a calculational procedure which defines the allowed operational space of the AFD versus THERMAL POWER. The AFD limits are selected by considering a range of axial xenon distributions that may occur as a result of large variations of the AFD. Subsequently, power peaking factors and power distributions are examined to assure that the loss of coolant accident (LOCA), loss of flow accident, and anticipated transient limits are met. Violation of the AFD limits invalidate**s** the conclusions of the accident and transient analyses with regard to fuel cladding integrity.

The AFD is monitored on an automatic basis using the computer which has an AFD monitor alarm. The computer determines the 1 minute average of each of the OPERABLE excore detector outputs and provides an alarm message immediately if the AFD for two or more OPERABLE excore channels is outside its specified limits.

Although the RAOC defines limits that must be met to satisfy safety analyses, typically, without the OPDMS, an operating scheme, Constant Axial Offset Control (CAOC), is used to control axial power distribution in day-to-day operation (Ref. 1). CAOC requires that the AFD be controlled within a narrow tolerance band around a burnup-dependent target to minimize the variation of axial peaking factors and axial xenon distribution during unit maneuvers.

The CAOC operating space is typically smaller and lies within the RAOC operating space. Control within the CAOC operating space constrains the variation of axial xenon distributions and axial power distributions. RAOC calculations assume a wide range of xenon distributions and then

BASES

BACKGROUND (continued)

confirm that the resulting power distributions satisfy the requirements of the accident analyses.

APPLICABLE SAFETY ANALYSES

The AFD is a measure of the axial power distribution skewing ~~SAFETY~~ to either the top or bottom half of the core. The AFD is sensitive to many core related parameters such as control bank positions, core power level, axial burnup, axial xenon distribution, and, to a lesser extent, reactor coolant temperature and boron concentration.

The allowed range of the AFD is used in the nuclear design process to confirm that operation within these limits produces core peaking factors and axial power distributions that meet safety analysis requirements.

Three dimensional power distribution calculations are performed to demonstrate that normal operation power shapes are acceptable for the LOCA, the loss of flow accident, and for initial conditions of anticipated transients (Ref. 2). The tentative limits are adjusted as necessary to meet the safety analysis requirements.

With the OPDMS **not monitoring parameters**~~inoperable~~, the limits on the AFD ensure that the Heat Flux Hot Channel Factor ($F_Q(Z)$) is not exceeded during either normal operation or in the event of xenon redistribution following power changes. The limits on the AFD also restrict the range of power distributions that are used as initial conditions in the analyses of Condition **II**~~2~~, **III**~~3~~, or **IV**~~4~~ events. This ensures that the fuel cladding integrity is maintained for these postulated accidents. The most important Condition **IV**~~4~~ event is the LOCA. The most important Condition **III**~~3~~ event is the loss of flow accident. The most important Condition **II**~~2~~ events are uncontrolled bank withdrawal and boration or dilution accidents. Condition **II**~~2~~ accidents simulated to begin from within the AFD limits are used to confirm the adequacy of the Overpower ΔT and Overtemperature ΔT trip setpoints.

The limits on the AFD satisfy Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

The shape of the power profile in the axial (i.e., the vertical) direction is largely under the control of the operator through the manual operation of the control banks or automatic motion of control banks. The automatic motion of the control banks is in response to temperature deviations resulting from manual operation of the Chemical and Volume Control

BASES

LCO (continued)

System (CVS) to change boron concentration or from power level changes.

Signals are available to the operator from the Protection and Safety Monitoring System (PMS) excore neutron detectors (Ref. 3). Separate signals are taken from the top and bottom detectors. The AFD is defined as the difference in normalized flux signals between the top and bottom excore detectors in each detector well. For convenience, this flux difference is converted to provide flux difference units expressed as a percentage and labeled as %Δ flux or %ΔI.

The AFD limits are provided in the COLR. Figure B 3.2.3-1 shows typical RAOC AFD limits. The AFD limits for RAOC do not depend on the target flux difference. However, the target flux difference may be used to minimize changes in the axial power distribution.

Violating this LCO on the AFD, with the OPDMS **not monitoring parameters**~~inoperable~~, could produce unacceptable consequences if a Condition **II, III, or IV** ~~2, 3 or 4~~ event occurs while the AFD is outside its specified limits.

APPLICABILITY

The AFD requirements are applicable in MODE 1 greater than or equal to 50% RTP where the combination of THERMAL POWER and core peaking factors are of primary importance in safety analysis.

For AFD limits developed using RAOC methodology, the value of the AFD does not affect the limiting accident consequences with THERMAL POWER < 50% RTP and for lower operating power MODES. With the OPDMS **not monitoring parameters**~~inoperable~~, it is necessary to monitor AFD via the excore detectors to ensure that it remains within the RAOC limits.

ACTIONS

A.1

Required Action A.1 requires a THERMAL POWER reduction to < 50% RTP. This places the core in a condition where the value of the AFD is not important in the applicable safety analyses. A Completion Time of 30 minutes is reasonable, based on operating experience, to reach 50% RTP without challenging plant systems.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.2.3.1

This surveillance verifies that the AFD, as indicated by the PMS excore channel, is within its specified limits. The Surveillance Frequency of 7 days is adequate considering that the AFD is monitored by a computer and any deviation from requirements is alarmed.

This SR is modified by a Note allowing 7 days without the continuous monitoring capability of the OPDMS before AFD must be initially verified. The first measurement must be made within 7 days of the most recent date where the OPDMS data has verified parameters. This is consistent with the 7 day Surveillance Frequency of the AFD.

REFERENCES

1. WCAP-8385, “Power Distribution Control and Load Following Procedures,” Westinghouse Electric Corporation, September 1974 (Westinghouse Proprietary) and WCAP-8403 (Non-Proprietary).

2. R. W. Miller et al., “Relaxation of Constant Axial Offset Control: F_Q Surveillance Technical Specification,” WCAP-10216-P-A, June 1983 (Westinghouse Proprietary) and WCAP-10217-A (Non-Proprietary).

3. **FSAR** Chapter 15, “Accident Analysis.”

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.

3.2 POWER DISTRIBUTION LIMITS

3.2.3 AXIAL FLUX DIFFERENCE (AFD) (Relaxed Axial Offset Control (RAOC) Methodology)

LCO 3.2.3 The AFD in %-flux-difference units shall be maintained within the limits specified in the COLR.

----------NOTE----------
The AFD shall be considered outside limits when two or more OPERABLE excore channels indicate AFD to be outside limits.

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. AFD not within limits.	A.1 Reduce THERMAL POWER to < 50% RTP.	30 minutes

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.2.3.1	----------NOTE---------- Not required to be performed until 7 days after the last verification of OPDMS parameters. --- Verify AFD within limits for each OPERABLE excore channel.	7 days

B 3.2 POWER DISTRIBUTION LIMITS

B 3.2.3 AXIAL FLUX DIFFERENCE (AFD) (Relaxed Axial Offset Control (RAOC) Methodology)

BASES

BACKGROUND

The purpose of this LCO is to establish limits on the values of the AFD in order to limit the amount of axial power distribution skewing to either the top or bottom of the core when the On-Line Power Distribution Monitoring System (OPDMS) is not monitoring parameters. By limiting the amount of power distribution skewing, core peaking factors are consistent with the assumptions used in the safety analyses. Limiting power distribution skewing over time also minimizes the xenon distribution skewing which is a significant factor in axial power distribution control.

RAOC is a calculational procedure which defines the allowed operational space of the AFD versus THERMAL POWER. The AFD limits are selected by considering a range of axial xenon distributions that may occur as a result of large variations of the AFD. Subsequently, power peaking factors and power distributions are examined to assure that the loss of coolant accident (LOCA), loss of flow accident, and anticipated transient limits are met. Violation of the AFD limits invalidates the conclusions of the accident and transient analyses with regard to fuel cladding integrity.

The AFD is monitored on an automatic basis using the computer which has an AFD monitor alarm. The computer determines the 1 minute average of each of the OPERABLE excore detector outputs and provides an alarm message immediately if the AFD for two or more OPERABLE excore channels is outside its specified limits.

Although the RAOC defines limits that must be met to satisfy safety analyses, typically, without the OPDMS, an operating scheme, Constant Axial Offset Control (CAOC), is used to control axial power distribution in day-to-day operation (Ref. 1). CAOC requires that the AFD be controlled within a narrow tolerance band around a burnup-dependent target to minimize the variation of axial peaking factors and axial xenon distribution during unit maneuvers.

The CAOC operating space is typically smaller and lies within the RAOC operating space. Control within the CAOC operating space constrains the variation of axial xenon distributions and axial power distributions. RAOC calculations assume a wide range of xenon distributions and then

BASES

BACKGROUND (continued)

confirm that the resulting power distributions satisfy the requirements of the accident analyses.

APPLICABLE SAFETY ANALYSES

The AFD is a measure of the axial power distribution skewing to either the top or bottom half of the core. The AFD is sensitive to many core related parameters such as control bank positions, core power level, axial burnup, axial xenon distribution, and, to a lesser extent, reactor coolant temperature and boron concentration.

The allowed range of the AFD is used in the nuclear design process to confirm that operation within these limits produces core peaking factors and axial power distributions that meet safety analysis requirements.

Three dimensional power distribution calculations are performed to demonstrate that normal operation power shapes are acceptable for the LOCA, the loss of flow accident, and for initial conditions of anticipated transients (Ref. 2). The tentative limits are adjusted as necessary to meet the safety analysis requirements.

With the OPDMS not monitoring parameters, the limits on the AFD ensure that the Heat Flux Hot Channel Factor ($F_Q(Z)$) is not exceeded during either normal operation or in the event of xenon redistribution following power changes. The limits on the AFD also restrict the range of power distributions that are used as initial conditions in the analyses of Condition II, III, or IV events. This ensures that the fuel cladding integrity is maintained for these postulated accidents. The most important Condition IV event is the LOCA. The most important Condition III event is the loss of flow accident. The most important Condition II events are uncontrolled bank withdrawal and boration or dilution accidents. Condition II accidents simulated to begin from within the AFD limits are used to confirm the adequacy of the Overpower ΔT and Overtemperature ΔT trip setpoints.

The limits on the AFD satisfy Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

The shape of the power profile in the axial (i.e., the vertical) direction is largely under the control of the operator through the manual operation of the control banks or automatic motion of control banks. The automatic motion of the control banks is in response to temperature deviations resulting from manual operation of the Chemical and Volume Control

BASES

LCO (continued)

System (CVS) to change boron concentration or from power level changes.

Signals are available to the operator from the Protection and Safety Monitoring System (PMS) excore neutron detectors (Ref. 3). Separate signals are taken from the top and bottom detectors. The AFD is defined as the difference in normalized flux signals between the top and bottom excore detectors in each detector well. For convenience, this flux difference is converted to provide flux difference units expressed as a percentage and labeled as %Δ flux or %ΔI.

The AFD limits are provided in the COLR. Figure B 3.2.3-1 shows typical RAOC AFD limits. The AFD limits for RAOC do not depend on the target flux difference. However, the target flux difference may be used to minimize changes in the axial power distribution.

Violating this LCO on the AFD, with the OPDMS not monitoring parameters, could produce unacceptable consequences if a Condition II, III, or IV event occurs while the AFD is outside its specified limits.

APPLICABILITY

The AFD requirements are applicable in MODE 1 greater than or equal to 50% RTP where the combination of THERMAL POWER and core peaking factors are of primary importance in safety analysis.

For AFD limits developed using RAOC methodology, the value of the AFD does not affect the limiting accident consequences with THERMAL POWER < 50% RTP and for lower operating power MODES. With the OPDMS not monitoring parameters, it is necessary to monitor AFD via the excore detectors to ensure that it remains within the RAOC limits.

ACTIONS

A.1

Required Action A.1 requires a THERMAL POWER reduction to < 50% RTP. This places the core in a condition where the value of the AFD is not important in the applicable safety analyses. A Completion Time of 30 minutes is reasonable, based on operating experience, to reach 50% RTP without challenging plant systems.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.2.3.1

This surveillance verifies that the AFD, as indicated by the PMS excore channel, is within its specified limits. The Surveillance Frequency of 7 days is adequate considering that the AFD is monitored by a computer and any deviation from requirements is alarmed.

This SR is modified by a Note allowing 7 days without the continuous monitoring capability of the OPDMS before AFD must be initially verified. The first measurement must be made within 7 days of the most recent date where the OPDMS data has verified parameters. This is consistent with the 7 day Surveillance Frequency of the AFD.

REFERENCES

1. WCAP-8385, “Power Distribution Control and Load Following Procedures,” Westinghouse Electric Corporation, September 1974 (Westinghouse Proprietary) and WCAP-8403 (Non-Proprietary).

2. R. W. Miller et al., “Relaxation of Constant Axial Offset Control: F_Q Surveillance Technical Specification,” WCAP-10216-P-A, June 1983 (Westinghouse Proprietary) and WCAP-10217-A (Non-Proprietary).

3. FSAR Chapter 15, “Accident Analysis.”