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

Title: Changes related to Section 3.2.5, On-Line Power Distribution Monitoring System (OPDMS)-Monitored Parameters

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:

None

STS NUREGs Affected:

NA

NRC Approval Date:

NA

TSTF Classification:

NA

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 A022, TS 3.2.5 LCO Item 'a' is revised to "Peak Linear Power density" replacing "Peak kw/ft(Z)."

VEGP LAR DOC A023, TS 3.2.5 Required Action B.1 Note is deleted.

VEGP LAR DOC L06, TS 3.2.5 SR 3.2.5.1 is revised to require only "24 hours" as the Frequency.

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

This section discusses changes: (1) that were applicable to previous designs, but are not to the current design; (2) that are already incorporated in the GTS; and (3) that are superseded by another change.

None

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)

None

V. Applicability

Affected Generic Technical Specifications and Bases:

Section 3.2.5 On-Line Power Distribution Monitoring System (OPDMS)-Monitored Parameters

Changes to the Generic Technical Specifications and Bases:

LCO Item 'a' is revised to "Peak Linear Power Density" replacing "Peak kw/ft(Z)."

APPLICABILITY is revised replacing "OPDMS OPERABLE for parameter" with "OPDMS monitoring parameter."

Required Action B.1 Note stating "If the power distribution parameters are restored to within...where this occurs." is deleted.

SR 3.2.5.1 Frequency is revised to require only "24 hours" as the Frequency.

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:

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 A022:

TS 3.2.5 LCO Item 'a' is revised to "Peak Linear Power density" replacing "Peak kw/ft(Z)."

VEGP LAR DOC A023:

TS 3.2.5 Required Action B.1 Note is deleted. This Note currently states:

"If the power distribution parameters are restored to within the limits while power is being reduced, operation may continue at the power level where this occurs."

VEGP LAR DOC L06:

TS 3.2.5 SR 3.2.5.1 is revised to require only "24 hours" as the Frequency. Current SR 3.2.5.1 Frequency states:

"24 hours with OPDMS alarms OPERABLE

OR

12 hours with OPDMS alarms inoperable."

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 A022:

The stated “kw/ft(Z)” is a reference to the units for the monitored linear power density. The Bases discuss this parameter and the associated units. For clarity and consistency with other stated parameters, the revision replaces the units “kw/ft(Z)” with “Linear Power Density.” This change is designated as an administrative change and is acceptable because it does not result in technical changes to the TS.

VEGP LAR DOC A023:

LCO 3.2.5 lists four parameters to be maintained within limits. The Actions apply when one of the parameters is not within its limits, i.e., not meeting the LCO. Action B is associated with one of three parameters being not within LCO limits and not restored within the 1 hour allowance of Action A. Required Action B.1 requires reducing power to < 50% RTP.

TS LCO 3.0.2 states, in part, “If the LCO is met, or is no longer applicable prior to expiration of the specified Completion Time(s), completion of the Required Action(s) is not required.” As a result of restoring the parameters associated with Action B to within limits, TS 3.2.5 Action B would be exited. Furthermore, once the action to reduce power is exited, there is no restriction from TS 3.2.5 on operating power level. As such, the intent of the Required Action B.1Note allowing “If the power distribution parameters are restored to within their limits while power is being reduced, operation may continue at the power level where this occurs” is extraneous and can be deleted with no impact. This change is designated as an administrative change and is acceptable because it does not result in technical changes to the TS.

VEGP LAR DOC L06:

The On-line Power Distribution Monitoring System (OPDMS) for the AP1000 is an advanced core monitoring and support package. The OPDMS has the ability to continuously monitor core power distribution parameters. Two levels of alarms on power distribution parameters are provided to the operator. One serves as a warning before the three parameters excluding SDM exceed their values used as a base condition for the safety analysis. The other alarm indicates when the parameters have reached their limits.

Current SR 3.2.5.1 requires the operator to verify that the power distribution parameters are within their limits. This confirmation is verification in addition to the automated checking performed by the OPDMS system. A 24 hour Surveillance interval provides assurance that the system is functioning properly and that the core limits are met. In addition to the SR 3.2.5.1 normal 24 hour Frequency, the TS also contains actions (in the form of an increased surveillance frequency) to be performed in the event of inoperable alarms. These actions are

removed from the TS since the alarms themselves do not directly relate to the LCO limits or the monitoring capability of the OPDMS.

This response to inoperable alarms is not required to be in the TS to provide adequate protection of the public health and safety. This change is designated as a less restrictive change because a specific surveillance Frequency is being deleted.

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

None

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

None

VII. GTST Safety Evaluation

Technical Analysis:

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

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 use of the term “OPDMS operable” and “OPDMS inoperable” is not appropriate since only monitoring of the parameters by the system is implied. 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. As stated, 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.” This change of terms appropriately defines the function being carried out and is acceptable. The changes defined for the APPLICABILITY Specifications clearly define the conditions and are better understood.

Defining LCO in terms of ‘parameters,’ not ‘units’

Currently, a parameter is described in the LCO in terms of its units. The stated “kw/ft(Z)” is a reference to the units for the monitored linear power density. The Bases discuss this parameter and the associated units. Revising the description to the parameter description, i.e., changing from “kw/ft(Z)” to “Linear Power Density” is appropriate. This provides clarity and consistency with other stated parameters, and is acceptable.

Deleting the ‘Note’ in Required Action B.1

Required Action B.1 Note applies when one or more of the parameters are not within its limits, i.e., not meeting the LCO, and is not restored to within the limits within the Completion Time of 1 hour. Required Action B.1 requires reducing power to < 50% RTP. The Note is intended to allow operation at the power level, while reducing power, where the power distribution parameters have been restore to within the limits.

Based on TS LCO 3.0.2, completion of the Required Action(s) is not required when the LCO has been met. As a result of restoring the parameters associated with Action B to within limits, TS 3.2.5 Action B would be exited, and the plant can resume full power operation. The reasoning that no additional restriction, i.e., operating at the power level where the parameters have been restored to within limits, is needed is valid and the Note appears unnecessary. If the Note is applied, then it is not clear when the plant will be allowed to increase the power level.

However, it is not agreed that this change is an administrative change. It is nevertheless acceptable and will provide clarity to the Required Action in TS 3.2.5.

Revising Frequency in SR 3.2.5.1

Current SR 3.2.5.1 requires the operator to verify that the power distribution parameters are within their limits. These parameters are monitored by the OPDMS for AP1000 design. The OPDMS is associated with two levels of alarms. This confirmation is verification in addition to the automated checking performed by the OPDMS. A 24 hour Surveillance interval provides assurance that the system is functioning properly and that the core limits are met. In current surveillance requirement, for situations where the alarms are inoperable, a 12-hour surveillance frequency is required. The 12-hour surveillance frequency is based on the failure of the alarm and not the failure of the LCO requirement. NRC has previously approved changes to the TS based on Technical Specification Task Force (TSTF) submittals (TSTF-110-A, Delete SR Frequencies based on Inoperable Alarms) where requirements due to failure of alarms have been eliminated. Accordingly, this change is consistent with the TSTF changes implemented for operational reactors and is acceptable.

References to Previous NRC Safety Evaluation Reports (SERs):

None

VIII. Review Information

Evaluator Comments:

SR 3.2.5.1 requires the operator to verify that the power distribution parameters are within the limits. A 24 hour Surveillance Frequency was selected. It is stated that a 24 hour Surveillance Frequency provides assurance that the system is functioning properly and that the core limits are met. An improved justification for the 24 hour Surveillance Frequency can be included. This may include a discussion of how often OPDMS may fail to provide correct information. A longer Surveillance Frequency may be applicable and appropriate.

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Review Information:

Availability for public review and comment on Revision 0 of this traveler approved by NRC staff on Tuesday, May 20, 2014.

NRC Final Approval Date:

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

This document does not correctly align the subscript and superscript when both are used in a variable. Proper alignment of the subscripts and superscripts will need to be addressed in finalizing the STS and the Bases.

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)

6. TSTF-GG-05-01, "Writer's Guide for Plant-Specific Improved Technical Specifications," June 2005.

XI. MARKUP of the Applicable GTS Section 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

3.2.5 On-Line Power Distribution Monitoring System (OPDMS)-Monitored Parameters

LCO 3.2.5 The following parameters shall not exceed their operating limits as specified in the COLR:

a. Peak **Linear Power Density**~~kw/ft(Z)~~
b. $F_{\Delta H}^{N}$
c. DNBR
d. SDM.

APPLICABILITY: MODE 1 with THERMAL POWER > 50% RTP with OPDMS **monitoring** ~~OPERABLE for~~ parameters a, b, and c.
MODE 1 with OPDMS **monitoring**~~OPERABLE for~~ parameter d.
MODE 2 with $k_{eff} \geq 1.0$ and OPDMS **monitoring**~~OPERABLE for~~ parameter d.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more of the parameters a. through c. above not within limits.	A.2 Restore all parameters to within limits.	1 hour
B. Required Action and associated Completion Time of Condition A not met.	~~B.1 NOTE If the power distribution parameters are restored to within their limits while power is being reduced, operation may continue at the power level where this occurs.~~ **B.1** Reduce THERMAL POWER to ≤ 50% RTP.	4 hours

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. Parameter d above not within limits.	C.1 Initiate boration to restore SDM to within limits.	15 minutes

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.2.5.1	Verify the parameters a. through d. to be within their limits.	24 hours ~~with OPDMS alarms OPERABLE~~ ~~OR~~ ~~12 hours with OPDMS alarms inoperable~~

B 3.2 POWER DISTRIBUTION LIMITS

B 3.2.5 On-Line Power Distribution Monitoring System (OPDMS)-Monitored Parameters

BASES

BACKGROUND

The On-line Power Distribution Monitoring System (OPDMS) for the AP1000 is an advanced core monitoring and support package. The OPDMS has the ability to continuously monitor core power distribution parameters. In addition, the OPDMS monitors SDM.

The purpose of the limits on the OPDMS-monitored power distribution parameters is to provide assurance of fuel integrity during Conditions I (Normal Operation) and II (incidents of Moderate Frequency) events by: (1) not exceeding the minimum departure from boiling ratio (DNBR) in the core, and (2) limiting the fission gas release, fuel pellet temperature, and cladding mechanical properties to within assumed design criteria. In addition, limiting the peak linear power density during Condition I events provides assurance that the initial conditions assumed for the LOCA analyses are met and the peak cladding temperature (PCT) limit of 2200°F is not exceeded.

The definition of certain quantities used in these specifications are as follows:

Peak ~~kw/ft(Z)~~**linear power density**	Peak linear power density (axially dependent) as measured in kw/ft.
$F_{\Delta H}^{N}$	Ratio of the integral of linear power along the rod with the highest integrated power to the average rod power.
Minimum DNBR	Minimum ratio of the critical heat flux to actual heat flux at any point in the reactor that is allowed in order to assure that certain performance and safety criteria requirements are met over the range of plant conditions.

By continuously monitoring the core and following its actual operation, it is possible to significantly limit the adverse nature of power distribution initial conditions for transients which may occur at any time.

BASES

APPLICABLE SAFETY ANALYSES

The limits on the above parameters preclude core power distributions from occurring which would violate the following fuel design criteria:

a. During a large break loss of coolant accident (LOCA), the PCT must not exceed a limit of 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.

Limits on linear power density or peak kw/ft assure that the peak linear power density assumed as a base condition in the LOCA analyses is not exceeded during normal operation.

Limits on $F_{\Delta H}^{N}$ ensure that the LOCA analysis assumptions and assumptions made with respect to the Overtemperature ΔT Setpoint are maintained.

The limit on DNBR ensures that if transients analyzed in the safety analyses initiate from the conditions within the limit allowed by the OPDMS, the DNB criteria will be met.

The OPDMS-monitored power distribution parameters of this LCO satisfy Criterion 2 of 10 CFR 50.36(c)(2)(ii).

BASES

LCO

This LCO ensures operation within the bounds assumed in the safety analyses. Calculations are performed in the core design process to confirm that the core can be controlled in such a manner during operation that it can stay within these limits. If the LCO limits cannot be maintained within limits, reduction of the core power is required.

Violating the OPDMS-monitored power distribution parameter limits could result in unanalyzed conditions should a design basis event occur while the parameters are outside their specified limits.

Peak **linear power density**~~kw/ft~~ limits define limiting values for core power peaking that precludes peak cladding temperatures above 2200°F during either a large or small break LOCA. The highest calculated linear power densities in the core at specific core elevations are displayed for operator visual verification relative to the COLR values.

The determination of $F_{\Delta H}^N$ identifies the coolant flow channel with the maximum enthalpy rise. This channel has the least heat removal capability and thus the highest probability for DNB. Should $F_{\Delta H}^N$ exceed the limit given in the COLR, the possibility exists for DNBR to exceed the value used as a base condition for the safety analysis.

Two levels of alarms on power distribution parameters are provided to the operator. One serves as a warning before the three parameters (**linear power density**~~kw/ft(Z)~~, $F_{\Delta H}^N$, DNBR) exceed their values used as a base condition for the safety analysis. The other alarm indicates when the parameters have reached their limits.

APPLICABILITY

The OPDMS-monitored power distribution parameter limits must be maintained in MODE 1 above 50% RTP to preclude core power distributions from exceeding the limits assumed in the safety analyses. Applicability in other MODES, and MODE 1 below 50% RTP, is not required because there is either insufficient stored energy in the fuel or insufficient energy transferred to the reactor coolant to require a limit on the distribution of core power. The OPDMS monitoring of SDM is applicable in MODES 1 and 2 with $k_{eff} \geq 1.0$.

Specifically for $F_{\Delta H}^N$, the design bases accidents (DBAs) that are sensitive to $F_{\Delta H}^N$ in other MODES (MODES 2 through 5) have significant margin to DNB, and therefore, there is no need to restrict $F_{\Delta H}^N$ in these modes.

BASES

APPLICABILITY (continued)

In addition to the alarms discussed in the LCO section above (alarms on OPDMS-monitored power distribution parameters), there is an alarm indicating the potential ~~inoperability of~~ the OPDMS itself **to be not monitoring parameters**.

Should the OPDMS be determined to be ~~inoperable~~**not monitoring parameters** for other than reasons of alarms inoperable, this LCO is no longer applicable and LCOs 3.2.1 through 3.2.4 become applicable.

ACTIONS

A.1

With any of the OPDMS-monitored power distribution parameters outside of their limits, the assumptions used as most limiting base conditions for the DBA analyses may no longer be valid. The 1 hour operator ACTION requirement to restore the parameter to within limits is consistent with the basis for the anticipated operational occurrences and provides time to assess if there are instrumentation problems. It also allows the possibility to restore the parameter to within limits by rod cluster control assembly (RCCA) motion if this is possible. The OPDMS will continuously monitor these parameters and provide an indication when they are approaching their limits.

B.1

If the OPDMS-monitored power distribution parameters cannot be restored to within their limits within the Completion Time of ACTION A.1, it is likely that the problem is not due to a failure of instrumentation. Most of these parameters can be brought within their respective limits by reducing THERMAL POWER because this will reduce the absolute power density at any location in the core thus providing margin to the limit.

If the parameters cannot be returned to within limits as power is being reduced, THERMAL POWER must be reduced to < 50% RTP where the LCOs are no longer applicable.

~~A Note has been added to indicate that if the power distribution parameters in violation are returned to within their limits during the power reduction, then power operation may continue at the power level where~~

BASES

ACTIONS (continued)

~~this occurs. This is a conservative action for protection against the consequences of severe transients with unanalyzed power distributions.~~The Completion Time of 4 hours provides an acceptable time to reduce power in an orderly manner and without allowing the plant to remain outside the $F_{\Delta H}^{N}$ limits for an extended period of time.

C.1

If the SDM requirements are not met, boration must be initiated promptly. A Completion Time of 15 minutes is adequate for an operator to correctly align and start the required systems and components. It is assumed that boration will be continued until the SDM requirements are met. In the determination of the required combination of boration flow rate and boron concentration, there is no unique requirement that must be satisfied. Since it is imperative to raise the boron concentration of the RCS as soon as possible, the boron concentration should be a concentrated solution. The operator should begin boration with the best source available for the plant conditions.

SURVEILLANCE REQUIREMENTS

With OPDMS **monitoring parameters**~~operating~~, the power distribution parameters are continuously computed and displayed, and compared against their limit. Two levels of alarms are provided to the operator. The first alarm provides a warning before these parameters (**linear power density**~~kw/ft(Z)~~, $F_{\Delta H}^{N}$, and DNBR) exceed their limits. The second alarm indicates when they actually reach their limits. A third alarm indicates trouble with the OPDMS system.

SR 3.2.5.1

This Surveillance requires the operator to verify that the power distribution parameters are within their limits. This confirmation is a verification in addition to the automated checking performed by the OPDMS system. A 24 hour Surveillance interval provides assurance that the system is functioning properly and that the core limits are met.

~~With the OPDMS parameter alarms inoperable, an increased Surveillance Frequency is provided to assure that parameters are not approaching the limits. A 12 hour Frequency is adequate to identify changes in these parameters that could lead to their exceeding their limits.~~

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,” 1974.

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

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

3.2.5 On-Line Power Distribution Monitoring System (OPDMS)-Monitored Parameters

LCO 3.2.5 The following parameters shall not exceed their operating limits as specified in the COLR:

a. Peak Linear Power Density
b. $F_{\Delta H}^{N}$
c. DNBR
d. SDM.

APPLICABILITY: MODE 1 with THERMAL POWER > 50% RTP with OPDMS monitoring parameters a, b, and c.
MODE 1 with OPDMS monitoring parameter d.
MODE 2 with $k_{eff} \geq 1.0$ and OPDMS monitoring parameter d.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more of the parameters a. through c. above not within limits.	A.2 Restore all parameters to within limits.	1 hour
B. Required Action and associated Completion Time of Condition A not met.	B.1 Reduce THERMAL POWER to ≤ 50% RTP.	4 hours
C. Parameter d above not within limits.	C.1 Initiate boration to restore SDM to within limits.	15 minutes

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.2.5.1	Verify the parameters a. through d. to be within their limits.	24 hours

B 3.2 POWER DISTRIBUTION LIMITS

B 3.2.5 On-Line Power Distribution Monitoring System (OPDMS)-Monitored Parameters

BASES

BACKGROUND

The On-line Power Distribution Monitoring System (OPDMS) for the AP1000 is an advanced core monitoring and support package. The OPDMS has the ability to continuously monitor core power distribution parameters. In addition, the OPDMS monitors SDM.

The purpose of the limits on the OPDMS-monitored power distribution parameters is to provide assurance of fuel integrity during Conditions I (Normal Operation) and II (incidents of Moderate Frequency) events by: (1) not exceeding the minimum departure from boiling ratio (DNBR) in the core, and (2) limiting the fission gas release, fuel pellet temperature, and cladding mechanical properties to within assumed design criteria. In addition, limiting the peak linear power density during Condition I events provides assurance that the initial conditions assumed for the LOCA analyses are met and the peak cladding temperature (PCT) limit of 2200°F is not exceeded.

The definition of certain quantities used in these specifications are as follows:

Peak linear power density	Peak linear power density (axially dependent) as measured in kw/ft.
$F_{\Delta H}^{N}$	Ratio of the integral of linear power along the rod with the highest integrated power to the average rod power.
Minimum DNBR	Minimum ratio of the critical heat flux to actual heat flux at any point in the reactor that is allowed in order to assure that certain performance and safety criteria requirements are met over the range of plant conditions.

By continuously monitoring the core and following its actual operation, it is possible to significantly limit the adverse nature of power distribution initial conditions for transients which may occur at any time.

BASES

APPLICABLE SAFETY ANALYSES

The limits on the above parameters preclude core power distributions from occurring which would violate the following fuel design criteria:

a. During a large break loss of coolant accident (LOCA), the PCT must not exceed a limit of 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.

Limits on linear power density or peak kw/ft assure that the peak linear power density assumed as a base condition in the LOCA analyses is not exceeded during normal operation.

Limits on $F_{\Delta H}^{N}$ ensure that the LOCA analysis assumptions and assumptions made with respect to the Overtemperature ΔT Setpoint are maintained.

The limit on DNBR ensures that if transients analyzed in the safety analyses initiate from the conditions within the limit allowed by the OPDMS, the DNB criteria will be met.

The OPDMS-monitored power distribution parameters of this LCO satisfy Criterion 2 of 10 CFR 50.36(c)(2)(ii).

BASES

LCO

This LCO ensures operation within the bounds assumed in the safety analyses. Calculations are performed in the core design process to confirm that the core can be controlled in such a manner during operation that it can stay within these limits. If the LCO limits cannot be maintained within limits, reduction of the core power is required.

Violating the OPDMS-monitored power distribution parameter limits could result in unanalyzed conditions should a design basis event occur while the parameters are outside their specified limits.

Peak linear power density limits define limiting values for core power peaking that precludes peak cladding temperatures above 2200°F during either a large or small break LOCA. The highest calculated linear power densities in the core at specific core elevations are displayed for operator visual verification relative to the COLR values.

The determination of $F_{\Delta H}^N$ identifies the coolant flow channel with the maximum enthalpy rise. This channel has the least heat removal capability and thus the highest probability for DNB. Should $F_{\Delta H}^N$ exceed the limit given in the COLR, the possibility exists for DNBR to exceed the value used as a base condition for the safety analysis.

Two levels of alarms on power distribution parameters are provided to the operator. One serves as a warning before the three parameters (linear power density, $F_{\Delta H}^N$, DNBR) exceed their values used as a base condition for the safety analysis. The other alarm indicates when the parameters have reached their limits.

APPLICABILITY

The OPDMS-monitored power distribution parameter limits must be maintained in MODE 1 above 50% RTP to preclude core power distributions from exceeding the limits assumed in the safety analyses. Applicability in other MODES, and MODE 1 below 50% RTP, is not required because there is either insufficient stored energy in the fuel or insufficient energy transferred to the reactor coolant to require a limit on the distribution of core power. The OPDMS monitoring of SDM is applicable in MODES 1 and 2 with $k_{eff} \geq 1.0$.

Specifically for $F_{\Delta H}^N$, the design bases accidents (DBAs) that are sensitive to $F_{\Delta H}^N$ in other MODES (MODES 2 through 5) have significant margin to DNB, and therefore, there is no need to restrict $F_{\Delta H}^N$ in these modes.

BASES

APPLICABILITY (continued)

In addition to the alarms discussed in the LCO section above (alarms on OPDMS-monitored power distribution parameters), there is an alarm indicating the potential the OPDMS itself to be not monitoring parameters.

Should the OPDMS be determined to be not monitoring parameters for other than reasons of alarms inoperable, this LCO is no longer applicable and LCOs 3.2.1 through 3.2.4 become applicable.

ACTIONS

A.1

With any of the OPDMS-monitored power distribution parameters outside of their limits, the assumptions used as most limiting base conditions for the DBA analyses may no longer be valid. The 1 hour operator ACTION requirement to restore the parameter to within limits is consistent with the basis for the anticipated operational occurrences and provides time to assess if there are instrumentation problems. It also allows the possibility to restore the parameter to within limits by rod cluster control assembly (RCCA) motion if this is possible. The OPDMS will continuously monitor these parameters and provide an indication when they are approaching their limits.

B.1

If the OPDMS-monitored power distribution parameters cannot be restored to within their limits within the Completion Time of ACTION A.1, it is likely that the problem is not due to a failure of instrumentation. Most of these parameters can be brought within their respective limits by reducing THERMAL POWER because this will reduce the absolute power density at any location in the core thus providing margin to the limit.

If the parameters cannot be returned to within limits as power is being reduced, THERMAL POWER must be reduced to < 50% RTP where the LCOs are no longer applicable.

The Completion Time of 4 hours provides an acceptable time to reduce power in an orderly manner and without allowing the plant to remain outside the $F_{\Delta H}^{N}$ limits for an extended period of time.

BASES

ACTIONS (continued)

C.1

If the SDM requirements are not met, boration must be initiated promptly. A Completion Time of 15 minutes is adequate for an operator to correctly align and start the required systems and components. It is assumed that boration will be continued until the SDM requirements are met. In the determination of the required combination of boration flow rate and boron concentration, there is no unique requirement that must be satisfied. Since it is imperative to raise the boron concentration of the RCS as soon as possible, the boron concentration should be a concentrated solution. The operator should begin boration with the best source available for the plant conditions.

SURVEILLANCE REQUIREMENTS

With OPDMS monitoring parameters, the power distribution parameters are continuously computed and displayed, and compared against their limit. Two levels of alarms are provided to the operator. The first alarm provides a warning before these parameters (linear power density, $F_{\Delta H}^{N}$, and DNBR) exceed their limits. The second alarm indicates when they actually reach their limits. A third alarm indicates trouble with the OPDMS system.

SR 3.2.5.1

This Surveillance requires the operator to verify that the power distribution parameters are within their limits. This confirmation is a verification in addition to the automated checking performed by the OPDMS system. A 24 hour Surveillance interval provides assurance that the system is functioning properly and that the core limits are met.

REFERENCES

1. Title 10, Code of Federal Regulations, Part 50.46, “Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors,” 1974.

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