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

Title: Changes related to Section 3.2.2, Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$)

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 “OPDMS monitoring parameters” and “OPDMS not monitoring parameters.”
VEGP LAR DOC A019	SR 3.2.2.1 is split into two Surveillances each with specific Frequency.

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(1) applicable to operating reactor designs, but not to the AP1000 design; (2) already incorporated in the GTS; or (3) superseded by another change.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)**

An editorial correction is made in the "Actions" section, under heading "A.3," of the Bases. The sentence in the second paragraph is revised to state

> The Required Action is modified by a Note~~,~~ that states that...

APOG Recommended Changes to Improve the Bases

The Bases for Required Action A.2 is recommended to be revised to be consistent with the TS requirements.

An editorial correction is recommended in the "Applicable Safety Analyses" section of the Bases replacing "(Condition 1 events)" with "(Condition I events)."

V. Applicability

Affected Generic Technical Specifications and Bases:

Section 3.2.2, Nuclear Enthalpy Rise Hot Channel Factor ($F_{\Delta H}^{N}$)

Changes to the Generic Technical Specifications and Bases:

TS 3.2.2 APPLICABILITY and the Bases are revised replacing “OPDMS inoperable” with “OPDMS not monitoring parameters” and “OPDMS operable” with “OPDMS monitoring parameters.” (DOC A011)

SR 3.2.2.1 is replaced with SR 3.2.2.1 and SR 3.2.2.2. SR 3.2.2.1 Frequency states “Once after each refueling prior to THERMAL POWER exceeding 75% RTP” and SR 3.2.2.2 states “31 effective full power days (EFPD).” (DOC A019)

The “Applicable Safety Analyses” section of the Bases is revised replacing “(Condition 1 events)” with “(Condition I events).” (APOG Comment)

The Required Actions A.2 section of the Bases is revised to be consistent with the requirements. (APOG Comment)

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 “OPDMS monitoring parameters” and “OPDMS not monitoring parameters.”

VEGP LAR DOC A019:

TS 3.2.2, “Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$), “ SR 3.2.2.1 has two Frequencies, which require verification of $F^N_{\Delta H}$ limits:

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

AND

31 effective full power days (EFPD) thereafter”

SR 3.2.2.1 is revised to split into two Surveillances; one with the “Once after each refueling prior to THERMAL POWER exceeding 75% RTP” Frequency (i.e., new SR 3.2.2.1), and the other with the remaining Frequency of 31 EFPD (deleting “thereafter”) (i.e., new SR 3.2.2.2).

Currently, SR 3.2.2.1 is modified by a Note, which states:

“If the OPDMS becomes inoperable while in MODE 1 these Surveillances must be performed within 31 days of the last verification of OPDMS parameters.”

This Note is replaced for new SR 3.2.2.1 by including a Note stating:

“Not required to be performed if OPDMS was monitoring parameters upon exceeding 75% RTP.”

This Note is replaced for new SR 3.2.2.2 by including a Note stating:

“Not required to be performed until 31 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 A019:

TS 3.2.2, and therefore its SR, is 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 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 3.2.2 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.

The Surveillance Frequency “Once after each refueling prior to THERMAL POWER exceeding 75% RTP” for proposed SR 3.2.2.1 is associated solely with the beginning of cycle startup after a refueling. It currently has no exception related to whether OPDMS was monitoring parameters or not during the escalation above 75%. As such, if OPDMS ceased to monitor parameters (i.e., when TS 3.2.2 becomes applicable) at some point after initial power escalation above 75%, this SR 3.2.2.1 would not have been performed and it could be interpreted as not meeting SR 3.0.1.

The Note included with revised SR 3.2.2.1 will exclude this required performance when that startup was performed with OPDMS monitoring its associated parameters as power is increased above 75% RTP. It would be inappropriate to consider this SR not performed and therefore the LCO not met when appropriate core monitoring was provided for the transition above 75% RTP. This is an explicit clarification of the intent. Therefore, this change is deemed an administrative clarification with no resultant technical change to the current TS.

The second Frequency that is split out into proposed SR 3.2.2.2 relates to the periodic verification that is appropriate without the continuous monitoring capability of OPDMS. The current SR 3.2.2.1 Note provides an explicit 31-day exception to performing the Surveillance (i.e., for not meeting these Frequencies) when OPDMS is initially not monitoring parameters.

The rewording of this allowance in revised SR 3.2.2.1 Note provides the same intent, but is worded in accordance with STS Writer's Guide, TSTF-GG-05-01, subsection 4.1.7.f and 4.1.7.g.

These changes are designated as administrative changes and are acceptable because they do not result in technical changes to the TS.

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

The following editorial correction is made in the sixth paragraph of the "Applicable Safety Analyses" section of the Bases:

> ...Without the OPDMS, core monitoring and control under transient conditions (Condition **I**~~1~~ events) are accomplished....

The following changes are made in the "Actions" section, under heading "A.2," of the Bases:

> Once ~~the power level has been reduced to < 50% RTP per Required Action A.1.2.1~~ **Condition A is entered**, an incore flux map (SR 3.2.2.1) must be obtained and the measured value of $F^{N}_{\Delta H}$ verified not to exceed the allowed limit~~ at the lower power level~~.

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

The deletion in the Bases discussion for Actions A.2 removes the assumption that the power was reduced to < 50% by Required Action A.1.2.1. This is not correct since it is possible that Required Action A.1.1 could be performed while Condition A Note continues to ensure that Required Action A.2 is performed. This clarifies the discussion in the Bases.

The change in the "Applicable Safety Analyses" section of the Bases is an editorial correction.

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."

Changes to the Surveillance Requirements

SR 3.2.2.1 is restructured into two SRs - SR 3.2.2.1, and SR 3.2.2.2.

The Surveillance Frequency "Once after each refueling prior to THERMAL POWER exceeding 75% RTP" for proposed SRs 3.2.2.1 is associated solely with the beginning of cycle startup after a refueling and would have a unique exception related to whether OPDMS was monitoring parameters or not. The Note included with revised SR 3.2.2.1 will exclude this required performance when that startup was performed with OPDMS monitoring its associated parameters as power is increased above 75% RTP.

The second Frequency that is split out into proposed SR 3.2.2.2 relates to the periodic verification that is appropriate without the continuous monitoring capability of OPDMS. The current SR 3.2.2.1 Note provides an explicit 31-day exception to performing the Surveillance (i.e., for not meeting these Frequencies) when OPDMS is initially not monitoring parameters. The rewording of this allowance in revised SR 3.2.2.1 Note provides the same intent, but is worded in accordance with STS Writer's Guide, TSTF-GG-05-01, subsection 4.1.7.f and 4.1.7.g.

Thus, the restructuring of the SRs into two SRs provides a better way to present the requirements. It accomplishes the following objectives:

(1) SRs are defined considering when the Surveillance is to be conducted, providing clear guidance and focus for the operators,
(2) Frequencies are specifically stated instead of being surmised from the Notes,
(3) SRs when OPDMS is monitoring parameters and when it is not are clearly stated, and
(4) The Notes are written with the intent clarified.

These changes are not technical and can be considered administrative. These changes are acceptable as they will be easier to understand and implement by the operators.

<u>Changes in the “Actions A.2” section of the Bases</u>

This change clarifies the use of Required Actions A.1.1, A.1.2.2, and A.2, and the Note in the Condition column consistent with the requirements. This is correct and is acceptable.

<u>Remaining Changes</u>

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 3.2.2 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.

1. (Internal #98) 3.2.02, Pg. 09, The sentence stating, "The use of the term "OPDMS operable" and "OPDMS inoperable" is not appropriate since only monitoring of the parameters by the system is implied." was deleted in the "Technical Analysis" section of the GTST. This sentence is not needed since sufficient information is provided in the rest of the paragraph to justify the change.

2. (Internal #99) 3.2.02, Pg. 3, An editorial correction was made in the "Applicable Safety Analyses" section of the Bases replacing "(Condition 1 events)" with "(Condition I events)."

3. (Internal #100) 3.2.02, Pg. 33, Discussion in the "Actions" section, under heading "A.2," of the Bases was revised to be consistent with the requirements.

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

3.2.2 Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$)

LCO 3.2.2 $F^N_{\Delta H}$ shall be within the limits specified in the COLR.

APPLICABILITY: MODE 1 with On-line Power Distribution Monitoring System (OPDMS) **not monitoring parameters**~~inoperable~~.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. ------------NOTE------------ Required Actions A.2 and A.3 must be completed whenever Condition A is entered. -------------------------------- $F^N_{\Delta H}$ not within limits.	A.1.1 Restore $F^N_{\Delta H}$ to within limit.	4 hours
	<u>OR</u>	
	A.1.2.1 Reduce THERMAL POWER to < 50% RTP.	4 hours
	<u>AND</u>	
	A.1.2.2 Reduce Power Range Neutron Flux - High trip setpoints to ≤ 55% RTP.	72 hours
	<u>AND</u>	
	A.2 Perform SR 3.2.2.1.	24 hours
	<u>AND</u>	
	A.3 --------------NOTE-------------- THERMAL POWER does not have to be reduced to comply with this Required Action. -------------------------------------	

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. (continued)	Perform SR 3.2.2.1.	Prior to THERMAL POWER exceeding 50% RTP <u>AND</u> Prior to THERMAL POWER exceeding 75% RTP <u>AND</u> 24 hours after THERMAL POWER reaching ≥ 95% RTP
B. Required Action and associated Completion Time not met.	B.1 Be in MODE 2.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.2.2.1	-------------------------------NOTE-------------------------------- ~~If the OPDMS becomes inoperable while in MODE 1 these Surveillances must be performed within 31 days of the last verification of OPDMS parameters.~~**Not required to be performed if OPDMS was monitoring parameters upon exceeding 75% RTP.** ---	

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.2.2.1 (continued)	Verify $F^N_{\Delta H}$ within limits specified in the COLR.	Once after each refueling prior to THERMAL POWER exceeding 75% RTP ~~AND~~ ~~31 effective full power days (EFPD) thereafter~~
SR 3.2.2.2	**-------------------------------NOTE-------------------------------** **Not required to be performed until 31 days after the last verification of OPDMS parameters** **---** **Verify $F^N_{\Delta H}$ within limits specified in the COLR.**	**31 effective full power days (EFPD)**

B 3.2 POWER DISTRIBUTION LIMITS

B 3.2.2 Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$)

BASES

BACKGROUND

The purpose of this LCO is to establish limits on the power density at any point in the core so that the fuel design criteria are not exceeded and the accident analysis assumptions remain valid. The design limits on local (pellet) and integrated fuel rod peak power density are expressed in terms of hot channel factors. Control of the core power distribution with respect to these factors assures that local conditions in the fuel rods and coolant channels do not challenge core integrity at any location during either normal operation or a postulated accident analyzed in the safety analyses.

$F^N_{\Delta H}$ is defined as the ratio of the integral of the linear power along the fuel rod with the highest integrated power to the average integrated fuel rod power. Therefore, $F^N_{\Delta H}$ is a measure of the maximum total power produced in a fuel rod.

$F^N_{\Delta H}$ is sensitive to fuel loading patterns, bank insertion and fuel burnup. $F^N_{\Delta H}$ typically increases with control bank insertion and typically decreases with fuel burnup.

With the On-line Power Distribution Monitoring System (OPDMS) **monitoring parameters**~~OPERABLE~~, $F^N_{\Delta H}$ is determined continuously by the OPDMS. When the OPDMS is **not monitoring parameters**~~inoperable~~, $F^N_{\Delta H}$ is not directly measurable but is inferred from a power distribution map obtained with the incore detector system. Specifically, the results of the three dimensional power distribution map are analyzed to determine $F^N_{\Delta H}$. This factor is calculated at least every 31 effective full power days (EFPDs). Also, during power operation with the OPDMS **not monitoring parameters**~~inoperable~~, the global power distribution is monitored by LCO 3.2.3, "AXIAL FLUX DIFFERENCE (AFD)," and LCO 3.2.4, "QUADRANT POWER TILT RATIO (QPTR)," which are directly and continuously measured process variables.

The COLR provides peaking factor limits that ensure that the design basis value of the departure from nucleate boiling (DNB) is met for normal operation, operational transients, and any transient condition arising from events of moderate frequency. The DNB design basis

BACKGROUND (continued)

precludes DNB and is met by limiting the minimum local DNB heat flux ratio. Transient events that may be DNB limited are assumed to begin with a $F^N_{\Delta H}$ that satisfies the LCO requirements.

Operation outside the LCO limits may produce unacceptable consequences if a DNB limiting event occurs. The DNB design basis ensures that there is no overheating of the fuel that results in possible cladding perforation with the release of fission products to the reactor coolant.

APPLICABLE SAFETY ANALYSES

Limits on $F^N_{\Delta H}$ prevent core power distributions from occurring which would exceed the following fuel design limits:

a. There must be at least a 95% probability at a 95% confidence level (the 95/95 DNB criterion) that the hottest fuel rod in the core does not experience a DNB condition;

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

c. During an ejected rod accident, the energy deposition to the fuel must not exceed 280 cal/gm (Ref. 1); and

d. Fuel design limits required by GDC 26 (Ref. 2) for the condition when 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.

For transients that may be DNB limited, the Reactor Coolant System (RCS) flow and $F^N_{\Delta H}$ are the core parameters of most importance. The limits on $F^N_{\Delta H}$ ensure that the DNB design basis is met for normal operation, operational transients, and any transients arising from events of moderate frequency. The DNB design basis is met by limiting the minimum DNB ratio (DNBR) to the 95/95 DNB criterion. This value provides a high degree of assurance that the hottest fuel rod in the core will not experience a DNB.

APPLICABLE SAFETY ANALYSES (continued)

The allowable $F^N_{\Delta H}$ limit increases with decreasing power level. This functionality in $F^N_{\Delta H}$ is included in the analyses that provide the Reactor Core Safety Limits (SLs) of SL 2.1.1. Therefore, any DNB events in which the calculation of the core limits is modeled implicitly use this variable value of $F^N_{\Delta H}$ in the analyses. Likewise, all transients that may be DNB limited are assumed to begin with an initial $F^N_{\Delta H}$ as a function of power level defined by the COLR limit equation.

The LOCA safety analysis indirectly models $F^N_{\Delta H}$ as an input parameter. The Nuclear Heat Flux Hot Channel Factor ($F_Q(Z)$) and the axial peaking factors are inserted directly into the LOCA safety analyses that verify the acceptability of the resulting peak cladding temperature (Ref. 3).

The fuel is protected in part by Technical Specifications, which provide assurance that the initial conditions assumed in the safety and accident analyses remain valid. With the OPDMS **monitoring parameters**~~OPERABLE~~, peak **linear power density** ~~kw/ft(Z)~~ and $F^N_{\Delta H}$ are directly monitored. Should the OPDMS **cease monitoring parameters**~~become inoperable~~, the following LCOs assure that the conditions assumed for the safety analysis remain valid: LCO 3.2.3, “AXIAL FLUX DIFFERENCE (AFD),” LCO 3.2.4, “QUADRANT POWER TILT RATIO (QPTR),” LCO 3.1.6, “Control Bank Insertion Limits,” LCO 3.2.2, “Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$),” and LCO 3.2.1, “Heat Flux Hot Channel Factor ($F_Q(Z)$).”

When the OPDMS is not available to measure power distribution parameters continuously, $F^N_{\Delta H}$ and $F_Q(Z)$ are measured periodically using the incore detector system. Measurements are generally taken with the core at, or near, steady-state conditions. Without the OPDMS, core monitoring and control under transient conditions (Condition ~~1~~**I** events) are accomplished by operating the core within the limits of the LCOs on AFD, QPTR, and Bank Insertion Limits.

$F^N_{\Delta H}$ satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

$F^N_{\Delta H}$ shall be maintained within the limits of the relationship provided in the COLR.

BASES

LCO (continued)

The $F^N_{\Delta H}$ limit identifies the coolant flow channel with the maximum enthalpy rise. This channel has the least heat removal capability and thus the highest probability for a DNB.

The limiting value of $F^N_{\Delta H}$, described by the equation contained in the COLR, is the design radial peaking factor used in the unit safety analyses.

A power multiplication factor in this equation includes an additional margin for higher radial peaking from reduced thermal feedback and greater control rod insertion at low power levels. The limiting value of $F^N_{\Delta H}$ is allowed to increase 0.3% for every 1% RTP reduction in THERMAL POWER.

APPLICABILITY

When the OPDMS is **not monitoring parameters**~~inoperable~~ and core power distribution parameters cannot be continuously monitored, it is necessary to monitor $F^N_{\Delta H}$ on a periodic basis. Furthermore, $F^N_{\Delta H}$ limits must be maintained in MODE 1 to preclude core power distributions from exceeding the fuel design limits for DNBR and peak cladding temperature (PCT). Applicability in other modes is not required because there is either insufficient stored energy in the fuel or insufficient energy being transferred to the coolant to require a limit on the distribution of core power. Specifically, the design bases events that are sensitive to $F^N_{\Delta H}$ in other modes (MODES 2 through 5) have significant margin to DNB, and therefore, there is no need to restrict $F^N_{\Delta H}$ in these modes.

ACTIONS

A.1.1

With $F^N_{\Delta H}$ exceeding its limit, the unit is allowed 4 hours to restore $F^N_{\Delta H}$ to within its limits. This restoration may, for example, involve realigning any misaligned rods or reducing power enough to bring $F^N_{\Delta H}$ within its power-dependent limit.

When the $F^N_{\Delta H}$ limit is exceeded, it is not likely that the DNBR limit would be violated in steady state operation, since events that could significantly perturb the $F^N_{\Delta H}$ value (e.g., static control rod misalignment) are

ACTIONS (continued)

considered in the safety analyses. However, the DNBR limit may be violated if a DNB limiting event occurs. Thus, the allowed Completion Time of 4 hours provides an acceptable time to restore $F^N_{\Delta H}$ to within its limits without allowing the plant to remain outside $F^N_{\Delta H}$ limits for an extended period of time.

Condition A is modified by a Note that requires that Required Actions A.2 and A.3 must be completed whenever Condition A is entered. Thus, if power is not reduced because this Required Action is completed within the 4 hour time period, Required Action A.2 would nevertheless require another measurement and calculation of $F^N_{\Delta H}$ within 24 hours in accordance with SR 3.2.2.1.

However, if power were reduced below 50% RTP, Required Action A.3 requires that another determination of $F^N_{\Delta H}$ must be done prior to exceeding 50% RTP, prior to exceeding 75% RTP, and within 24 hours after reaching or exceeding 95% RTP. In addition, Required Action A.2 would be performed if power ascension were delayed past 24 hours.

A.1.2.1 and A.1.2.2

If the value of $F^N_{\Delta H}$ is not restored to within its specified limit either by adjusting a misaligned rod or by reducing THERMAL POWER, the alternative option is to reduce THERMAL POWER to < 50% RTP in accordance with Required Action A.1.2.1 and reduce the Power Range Neutron Flux - High to ≤ 55% RTP in accordance with Required Action A.1.2.2. The reduction in trip setpoints ensures that continuing operation remains at an acceptable low power level with adequate DNBR margin. The allowed Completion Time of 4 hours for Required Action A.1.2.1 is consistent with those specified in Required Action A.1.1 and provides an acceptable time to reach the required power level from full power operation without allowing the plant to remain in an unacceptable condition for an extended period of time. The Completion Time of 4 hours for Required Actions A.1.1 and A.1.2.1 are not additive.

The allowed Completion Time of 72 hours to reset the trip setpoints per Required Action A.1.2.2 recognizes that, once power is reduced, the safety analysis assumptions are satisfied and there is no urgent need to reduce the trip setpoints. This is a sensitive operation that may cause an inadvertent reactor trip.

BASES

ACTIONS (continued)

A.2

Once the power level has been reduced to < 50% RTP per Required Action A.1.2.1**Condition A is entered**, an incore flux map (SR 3.2.2.1) must be obtained and the measured value of $F^N_{\Delta H}$ verified not to exceed the allowed limit at the lower power level. The unit is provided 20 additional hours to perform this task over and above the 4 hours allowed by either Action A.1.1 or Action A.1.2.1. The Completion Time of 24 hours is acceptable because of the increase in the DNB margin, which is obtained at lower power levels, and the low probability of having a DNB limiting event within this 24 hour period. Additionally, operating experience has indicated that this Completion Time is sufficient to obtain the incore flux map, perform the required calculations, and evaluate $F^N_{\Delta H}$.

A.3

Verification that $F^N_{\Delta H}$ is within its specified limits after an out of limit occurrence assures that the cause that led to the $F^N_{\Delta H}$ exceeding its limit is corrected, and that subsequent operation will proceed within the LCO limit. This Action demonstrates that the $F^N_{\Delta H}$ limit is within the LCO limits prior to exceeding 50% of RTP, again prior to exceeding 75% RTP, and within 24 hours after THERMAL POWER is ≥ 95% RTP.

This Required Action is modified by a Note, that states that THERMAL POWER does not have to be reduced prior to performing this action.

B.1

When Required Actions A.1.1 through A.3 cannot be completed within their required Completion Times, the plant must be placed in a mode in which the LCO requirements are not applicable. This is done by placing the plant in at least MODE 2 within 6 hours. The allowed Completion Time of 6 hours is reasonable, based on operating experience regarding the time required to reach MODE 2 from full power conditions in an orderly manner without challenging plant systems.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.2.2.1 **and SR 3.2.2.2**

When the OPDMS is **monitoring parameters**~~OPERABLE~~, the value of $F^N_{\Delta H}$ is directly and continuously monitored. With the OPDMS **not monitoring parameters**~~inoperable~~, the value of $F^N_{\Delta H}$ is determined by using the incore detector system to obtain a flux distribution map. A data reduction computer program then calculates the maximum value of $F^N_{\Delta H}$ from the measured flux distributions. The measured value of $F^N_{\Delta H}$ must be multiplied by a measurement uncertainty factor before making comparisons to the $F^N_{\Delta H}$ limit.

After each refueling, with the OPDMS **not monitoring parameters**~~inoperable~~, $F^N_{\Delta H}$ must be determined prior to exceeding 75% RTP. This requirement ensures that $F^N_{\Delta H}$ limits are met at the beginning of each fuel cycle.

SR 3.2.2.1 is modified by a Note, which applies to the situation where the OPDMS is not monitoring parameters at the beginning of cycle startup, i.e., applies during the first power ascension after a refueling. It states that performance is not required if OPDMS was monitoring parameters upon exceeding 75% RTP.

With the OPDMS **not monitoring parameters**~~inoperable~~, the 31 EFPDs Frequency is acceptable because the power distribution will change relatively slowly over this amount of fuel burnup. This Frequency is short enough so that the $F^N_{\Delta H}$ limit will not be exceeded for any significant period of operation.

SR 3.2.2.2 is modified by a Note, which applies to the situation where the OPDMS is no longer monitoring parameters. Without the continuous monitoring capability of the OPDMS, $F^N_{\Delta H}$ limits must be monitored on a periodic basis. The first measurement must be made within 31 days of the most recent date where the OPDMS data has verified parameters to be within limits. This is consistent with the 31 day Surveillance Frequency.

BASES

REFERENCES

1. Regulatory Guide 1.77, Rev. 0, May 1979.

2. 10 CFR 50, Appendix A, GDC 26.

3. 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors."

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

3.2.2 Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$)

LCO 3.2.2 — $F^N_{\Delta H}$ shall be within the limits specified in the COLR.

APPLICABILITY: MODE 1 with On-line Power Distribution Monitoring System (OPDMS) not monitoring parameters.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. ------------NOTE------------ Required Actions A.2 and A.3 must be completed whenever Condition A is entered. -------------------------------- $F^N_{\Delta H}$ not within limits.	A.1.1 Restore $F^N_{\Delta H}$ to within limit.	4 hours
	OR	
	A.1.2.1 Reduce THERMAL POWER to < 50% RTP.	4 hours
	AND	
	A.1.2.2 Reduce Power Range Neutron Flux - High trip setpoints to ≤ 55% RTP.	72 hours
	AND	
	A.2 Perform SR 3.2.2.1.	24 hours
	AND	

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. (continued)	A.3	--------------NOTE-------------- THERMAL POWER does not have to be reduced to comply with this Required Action. ------------------------------------ Perform SR 3.2.2.1.	Prior to THERMAL POWER exceeding 50% RTP <u>AND</u> Prior to THERMAL POWER exceeding 75% RTP <u>AND</u> 24 hours after THERMAL POWER reaching ≥ 95% RTP
B. Required Action and associated Completion Time not met.	B.1	Be in MODE 2.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.2.2.1	------------------------------NOTE------------------------------ Not required to be performed if OPDMS was monitoring parameters upon exceeding 75% RTP. --- Verify $F^N_{\Delta H}$ within limits specified in the COLR.	Once after each refueling prior to THERMAL POWER exceeding 75% RTP
SR 3.2.2.2	------------------------------NOTE------------------------------ Not required to be performed until 31 days after the last verification of OPDMS parameters --- Verify $F^N_{\Delta H}$ within limits specified in the COLR.	31 effective full power days (EFPD)

B 3.2 POWER DISTRIBUTION LIMITS

B 3.2.2 Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$)

BASES

BACKGROUND

The purpose of this LCO is to establish limits on the power density at any point in the core so that the fuel design criteria are not exceeded and the accident analysis assumptions remain valid. The design limits on local (pellet) and integrated fuel rod peak power density are expressed in terms of hot channel factors. Control of the core power distribution with respect to these factors assures that local conditions in the fuel rods and coolant channels do not challenge core integrity at any location during either normal operation or a postulated accident analyzed in the safety analyses.

$F^N_{\Delta H}$ is defined as the ratio of the integral of the linear power along the fuel rod with the highest integrated power to the average integrated fuel rod power. Therefore, $F^N_{\Delta H}$ is a measure of the maximum total power produced in a fuel rod.

$F^N_{\Delta H}$ is sensitive to fuel loading patterns, bank insertion and fuel burnup. $F^N_{\Delta H}$ typically increases with control bank insertion and typically decreases with fuel burnup.

With the On-line Power Distribution Monitoring System (OPDMS) monitoring parameters, $F^N_{\Delta H}$ is determined continuously by the OPDMS. When the OPDMS is not monitoring parameters, $F^N_{\Delta H}$ is not directly measurable but is inferred from a power distribution map obtained with the incore detector system. Specifically, the results of the three dimensional power distribution map are analyzed to determine $F^N_{\Delta H}$. This factor is calculated at least every 31 effective full power days (EFPDs). Also, during power operation with the OPDMS not monitoring parameters, the global power distribution is monitored by LCO 3.2.3, “AXIAL FLUX DIFFERENCE (AFD),” and LCO 3.2.4, “QUADRANT POWER TILT RATIO (QPTR),” which are directly and continuously measured process variables.

The COLR provides peaking factor limits that ensure that the design basis value of the departure from nucleate boiling (DNB) is met for normal operation, operational transients, and any transient condition arising from events of moderate frequency. The DNB design basis

BASES

BACKGROUND (continued)

precludes DNB and is met by limiting the minimum local DNB heat flux ratio. Transient events that may be DNB limited are assumed to begin with a $F^N_{\Delta H}$ that satisfies the LCO requirements.

Operation outside the LCO limits may produce unacceptable consequences if a DNB limiting event occurs. The DNB design basis ensures that there is no overheating of the fuel that results in possible cladding perforation with the release of fission products to the reactor coolant.

APPLICABLE SAFETY ANALYSES

Limits on $F^N_{\Delta H}$ prevent core power distributions from occurring which would exceed the following fuel design limits:

a. There must be at least a 95% probability at a 95% confidence level (the 95/95 DNB criterion) that the hottest fuel rod in the core does not experience a DNB condition;

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

c. During an ejected rod accident, the energy deposition to the fuel must not exceed 280 cal/gm (Ref. 1); and

d. Fuel design limits required by GDC 26 (Ref. 2) for the condition when 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.

For transients that may be DNB limited, the Reactor Coolant System (RCS) flow and $F^N_{\Delta H}$ are the core parameters of most importance. The limits on $F^N_{\Delta H}$ ensure that the DNB design basis is met for normal operation, operational transients, and any transients arising from events of moderate frequency. The DNB design basis is met by limiting the minimum DNB ratio (DNBR) to the 95/95 DNB criterion. This value provides a high degree of assurance that the hottest fuel rod in the core will not experience a DNB.

APPLICABLE SAFETY ANALYSES (continued)

The allowable $F^N_{\Delta H}$ limit increases with decreasing power level. This functionality in $F^N_{\Delta H}$ is included in the analyses that provide the Reactor Core Safety Limits (SLs) of SL 2.1.1. Therefore, any DNB events in which the calculation of the core limits is modeled implicitly use this variable value of $F^N_{\Delta H}$ in the analyses. Likewise, all transients that may be DNB limited are assumed to begin with an initial $F^N_{\Delta H}$ as a function of power level defined by the COLR limit equation.

The LOCA safety analysis indirectly models $F^N_{\Delta H}$ as an input parameter. The Nuclear Heat Flux Hot Channel Factor ($F_Q(Z)$) and the axial peaking factors are inserted directly into the LOCA safety analyses that verify the acceptability of the resulting peak cladding temperature (Ref. 3).

The fuel is protected in part by Technical Specifications, which provide assurance that the initial conditions assumed in the safety and accident analyses remain valid. With the OPDMS monitoring parameters, peak linear power density and $F^N_{\Delta H}$ are directly monitored. Should the OPDMS cease monitoring parameters, the following LCOs assure that the conditions assumed for the safety analysis remain valid: LCO 3.2.3, "AXIAL FLUX DIFFERENCE (AFD)," LCO 3.2.4, "QUADRANT POWER TILT RATIO (QPTR)," LCO 3.1.6, "Control Bank Insertion Limits," LCO 3.2.2, "Nuclear Enthalpy Rise Hot Channel Factor ($F^N_{\Delta H}$)," and LCO 3.2.1, "Heat Flux Hot Channel Factor ($F_Q(Z)$)."

When the OPDMS is not available to measure power distribution parameters continuously, $F^N_{\Delta H}$ and $F_Q(Z)$ are measured periodically using the incore detector system. Measurements are generally taken with the core at, or near, steady-state conditions. Without the OPDMS, core monitoring and control under transient conditions (Condition I events) are accomplished by operating the core within the limits of the LCOs on AFD, QPTR, and Bank Insertion Limits.

$F^N_{\Delta H}$ satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

$F^N_{\Delta H}$ shall be maintained within the limits of the relationship provided in the COLR.

BASES

LCO (continued)

The $F^N_{\Delta H}$ limit identifies the coolant flow channel with the maximum enthalpy rise. This channel has the least heat removal capability and thus the highest probability for a DNB.

The limiting value of $F^N_{\Delta H}$, described by the equation contained in the COLR, is the design radial peaking factor used in the unit safety analyses.

A power multiplication factor in this equation includes an additional margin for higher radial peaking from reduced thermal feedback and greater control rod insertion at low power levels. The limiting value of $F^N_{\Delta H}$ is allowed to increase 0.3% for every 1% RTP reduction in THERMAL POWER.

APPLICABILITY

When the OPDMS is not monitoring parameters and core power distribution parameters cannot be continuously monitored, it is necessary to monitor $F^N_{\Delta H}$ on a periodic basis. Furthermore, $F^N_{\Delta H}$ limits must be maintained in MODE 1 to preclude core power distributions from exceeding the fuel design limits for DNBR and peak cladding temperature (PCT). Applicability in other modes is not required because there is either insufficient stored energy in the fuel or insufficient energy being transferred to the coolant to require a limit on the distribution of core power. Specifically, the design bases events that are sensitive to $F^N_{\Delta H}$ in other modes (MODES 2 through 5) have significant margin to DNB, and therefore, there is no need to restrict $F^N_{\Delta H}$ in these modes.

ACTIONS

A.1.1

With $F^N_{\Delta H}$ exceeding its limit, the unit is allowed 4 hours to restore $F^N_{\Delta H}$ to within its limits. This restoration may, for example, involve realigning any misaligned rods or reducing power enough to bring $F^N_{\Delta H}$ within its power-dependent limit.

When the $F^N_{\Delta H}$ limit is exceeded, it is not likely that the DNBR limit would be violated in steady state operation, since events that could significantly perturb the $F^N_{\Delta H}$ value (e.g., static control rod misalignment) are

BASES

ACTIONS (continued)

considered in the safety analyses. However, the DNBR limit may be violated if a DNB limiting event occurs. Thus, the allowed Completion Time of 4 hours provides an acceptable time to restore $F^N_{\Delta H}$ to within its limits without allowing the plant to remain outside $F^N_{\Delta H}$ limits for an extended period of time.

Condition A is modified by a Note that requires that Required Actions A.2 and A.3 must be completed whenever Condition A is entered. Thus, if power is not reduced because this Required Action is completed within the 4 hour time period, Required Action A.2 would nevertheless require another measurement and calculation of $F^N_{\Delta H}$ within 24 hours in accordance with SR 3.2.2.1.

However, if power were reduced below 50% RTP, Required Action A.3 requires that another determination of $F^N_{\Delta H}$ must be done prior to exceeding 50% RTP, prior to exceeding 75% RTP, and within 24 hours after reaching or exceeding 95% RTP. In addition, Required Action A.2 would be performed if power ascension were delayed past 24 hours.

A.1.2.1 and A.1.2.2

If the value of $F^N_{\Delta H}$ is not restored to within its specified limit either by adjusting a misaligned rod or by reducing THERMAL POWER, the alternative option is to reduce THERMAL POWER to < 50% RTP in accordance with Required Action A.1.2.1 and reduce the Power Range Neutron Flux - High to ≤ 55% RTP in accordance with Required Action A.1.2.2. The reduction in trip setpoints ensures that continuing operation remains at an acceptable low power level with adequate DNBR margin. The allowed Completion Time of 4 hours for Required Action A.1.2.1 is consistent with those specified in Required Action A.1.1 and provides an acceptable time to reach the required power level from full power operation without allowing the plant to remain in an unacceptable condition for an extended period of time. The Completion Time of 4 hours for Required Actions A.1.1 and A.1.2.1 are not additive.

The allowed Completion Time of 72 hours to reset the trip setpoints per Required Action A.1.2.2 recognizes that, once power is reduced, the safety analysis assumptions are satisfied and there is no urgent need to reduce the trip setpoints. This is a sensitive operation that may cause an inadvertent reactor trip.

BASES

ACTIONS (continued)

A.2

Once Condition A is entered, an incore flux map (SR 3.2.2.1) must be obtained and the measured value of $F^N_{\Delta H}$ verified not to exceed the allowed limit. The unit is provided 20 additional hours to perform this task over and above the 4 hours allowed by either Action A.1.1 or Action A.1.2.1. The Completion Time of 24 hours is acceptable because of the increase in the DNB margin, which is obtained at lower power levels, and the low probability of having a DNB limiting event within this 24 hour period. Additionally, operating experience has indicated that this Completion Time is sufficient to obtain the incore flux map, perform the required calculations, and evaluate $F^N_{\Delta H}$.

A.3

Verification that $F^N_{\Delta H}$ is within its specified limits after an out of limit occurrence assures that the cause that led to the $F^N_{\Delta H}$ exceeding its limit is corrected, and that subsequent operation will proceed within the LCO limit. This Action demonstrates that the $F^N_{\Delta H}$ limit is within the LCO limits prior to exceeding 50% of RTP, again prior to exceeding 75% RTP, and within 24 hours after THERMAL POWER is ≥ 95% RTP.

This Required Action is modified by a Note that states that THERMAL POWER does not have to be reduced prior to performing this action.

B.1

When Required Actions A.1.1 through A.3 cannot be completed within their required Completion Times, the plant must be placed in a mode in which the LCO requirements are not applicable. This is done by placing the plant in at least MODE 2 within 6 hours. The allowed Completion Time of 6 hours is reasonable, based on operating experience regarding the time required to reach MODE 2 from full power conditions in an orderly manner without challenging plant systems.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.2.2.1 and SR 3.2.2.2

When the OPDMS is monitoring parameters, the value of $F^N_{\Delta H}$ is directly and continuously monitored. With the OPDMS not monitoring parameters, the value of $F^N_{\Delta H}$ is determined by using the incore detector system to obtain a flux distribution map. A data reduction computer program then calculates the maximum value of $F^N_{\Delta H}$ from the measured flux distributions. The measured value of $F^N_{\Delta H}$ must be multiplied by a measurement uncertainty factor before making comparisons to the $F^N_{\Delta H}$ limit.

After each refueling, with the OPDMS not monitoring parameters, $F^N_{\Delta H}$ must be determined prior to exceeding 75% RTP. This requirement ensures that $F^N_{\Delta H}$ limits are met at the beginning of each fuel cycle.

SR 3.2.2.1 is modified by a Note, which applies to the situation where the OPDMS is not monitoring parameters at the beginning of cycle startup, i.e., applies during the first power ascension after a refueling. It states that performance is not required if OPDMS was monitoring parameters upon exceeding 75% RTP.

With the OPDMS not monitoring parameters, the 31 EFPDs Frequency is acceptable because the power distribution will change relatively slowly over this amount of fuel burnup. This Frequency is short enough so that the $F^N_{\Delta H}$ limit will not be exceeded for any significant period of operation.

SR 3.2.2.2 is modified by a Note, which applies to the situation where the OPDMS is no longer monitoring parameters. Without the continuous monitoring capability of the OPDMS, $F^N_{\Delta H}$ limits must be monitored on a periodic basis. The first measurement must be made within 31 days of the most recent date where the OPDMS data has verified parameters to be within limits. This is consistent with the 31 day Surveillance Frequency.

BASES

REFERENCES

1. Regulatory Guide 1.77, Rev. 0, May 1979.
2. 10 CFR 50, Appendix A, GDC 26.
3. 10 CFR 50.46, “Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors.”