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

Title: Changes Related to LCO 3.4.8, Minimum RCS Flow

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-153-A, Rev 0, Clarify Exception Notes to be Consistent with the Requirement Being Excepted
TSTF-438-A, Rev 0, Clarify Exception Notes to be Consistent with the Requirement Being Excepted

STS NUREGs Affected:

TSTF-153-A, Rev 0: NUREGs 1430, 1431, 1432, 1433, and 1434
TSTF-438-A, Rev 0: NUREGs 1430, 1431, 1432, 1433, and 1434

NRC Approval Date:

TSTF-153-A, Rev 0: 11-Apr-97
TSTF-438-A, Rev 0: 21-Oct-02

TSTF Classification:

TSTF-153-A, Rev 0: Consistency/Standardization
TSTF-438-A, Rev 0: Editorial 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:

There are no Vogtle departures applicable to Specification 3.4.8.

RCOL COL Item Number and Title:

There are no Vogtle COL items applicable to Specification 3.4.8.

RCOL PTS Change Number and Title:

VEGP LAR DOC A038:	Numerous TS surveillances are revised by deletion of word “that” from the surveillance
VEGP LAR DOC A045:	Replace “at least” with “≥”
VEGP LAR DOC A046:	Clarify Exception Notes
VEGP LAR DOC M08:	Add Note to Condition A
VEGP LAR DOC L07:	Certain TS Required Actions requiring the RTBs to be opened are revised into two Required Actions
VEGP LAR DOC L15:	Change RCP flow reference from % rated speed to gpm in SR 3.4.8.1

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(1) applicable to operating reactor designs, but not to the AP1000 design; (2) already incorporated in the GTS; or (3) superseded by another change.

VEGP LAR DOC A046 applies essentially the same TS change allowed by the application of TSTF-438-A.

TSTF-153-A, Revision 0, was not applied to the AP1000 GTS. However, TSTF-438-A, Revision 0, supersedes TSTF-153-A and is applied by this GTST.

VEGP LAR DOC M06 was initially applied to this GTS. The VEGP TSU LAR was modified in response to NRC staff RAIs in Reference 5 and the Southern Nuclear Operating Company RAI Response in Reference 6. VEGP LAR DOC M06 was withdrawn.

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)

Replace “source range instrumentation” with “source range neutron flux instrumentation” throughout the Bases for consistency with LCO 3.4.8. (NRC Staff Comment)

APOG Recommended Changes to Improve the Bases

Insert a comma after “all rods fully inserted” in the Applicability statement to grammatically correct the sentence and prevent possible misinterpretation.

Delete the third paragraph of the “Background” section of the Bases. This paragraph contains a potentially misleading discussion of means to achieve RCS circulation beyond RCP forced circulation. Since these means are not appropriate for compliance with the LCO, this discussion should be deleted.

Revise the first paragraph of the “LCO” section of the Bases to include the 3,000 gpm limit. Currently, there is no mention of 3,000 gpm in TS 3.4.8 Bases to align with the TS 3.4.8 LCO requirement. Also, revise TS 3.4.8 Bases LCO to clarify that the intended Action entry is understood to encompass the condition of less than 3,000 gpm flow. TS 3.4.8 requires both that one RCP be in operation and that it be providing at least 3,000 gpm. Condition A states only “No RCP in operation.” Both conditions need to be included in the Bases Action entry for clarity:

> The requirement that **at least one RCP be in operation with** a minimum ~~RCS~~ **core** flow **≥ 3,000 gpm** ~~be maintained~~ provides assurance that in the event of an inadvertent BDE, the diluted water will be properly mixed with the primary system coolant, and the increase in core reactivity will be detected by the source range **neutron flux** instrumentation. **A core flow < 3,000 gpm is considered equivalent to no RCP in operation.**

V. Applicability

Affected Generic Technical Specifications and Bases:

Section 3.4.8, Minimum RCS Flow

Changes to the Generic Technical Specifications and Bases:

LCO 3.4.8 specification is revised. Corresponding bases are updated. This is consistent with Writer's Guide (Reference 4). (DOC A045)

LCO 3.4.8 Note 1 and the corresponding bases “LCO” section is revised to clarify when all RCPs may be removed from operation. This provides clarification of an ambiguous phrase. (TSTF-438-A and DOC A046)

Applicability is revised to break RTB statement into two parts. The corresponding bases are updated. This is consistent with similar applications regarding RTBs. (DOC L07)

A comma is inserted after “all rods fully inserted” in the Applicability statement. (APOG Comment)

A Note is added to Condition A statement. The corresponding bases are updated. This assures that Required Action A.2 is performed as expected. (DOC M08)

The text for SR 3.4.8.1 is revised to provide clarity by deletion of the word “that” from the surveillance. (DOC A038)

The third paragraph of the “Background” section of the Bases is deleted to provide clarity and technically improve the Bases discussion. (APOG Comment)

The first paragraph of the “LCO” section of the Bases is revised to provide clarity and technically improve the Bases discussion. (APOG Comment and NRC Staff Edit)

The text for SR 3.4.8.1 is revised to provide a specific flow rate in gpm. The corresponding bases are updated. The 3000 gpm in the LCO is associated with the initial condition in the analysis of a possible Boron Dilution Event (BDE) in MODE 3, 4, or 5 for minimum mixing flow in the RCS. SR 3.4.8.1 is revised to reflect this value for consistency with the LCO. (DOC L15)

VI. Traveler Information

Description of TSTF changes:

Revise the Note to LCO 3.4.8 so that the Note, as an exception to the LCO requirement, is not subjected to different interpretations by control room operators. (TSTF-438-A)

Rationale for TSTF changes:

LCO Note 1 is revised to state that the pump that is required to be in operation “may be removed from operation.” This wording is a better description of the exception to the LCO than “may be de-energized,” which could leave the control room operators uncertain about how this allowance is intended to be done, e.g., opening the respective circuit breaker or just placing the control switch to the “Pull-to-Lock” position.

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

VEGP LAR DOC A038 revises SR 3.4.8.1 deleting “that” from the surveillance description.

VEGP LAR DOC A045 revises Specification statement by replacing “at least” with “≥.”

VEGP LAR DOC A046 revises LCO Note 1 to allow all RCPs to be “removed from operation” instead of “de-energized” when in the specified conditions of the Note.

VEGP LAR DOC M08 revises Condition A to add a Note stating “Required Action A.2 shall be completed prior to starting any RCP whenever this Condition is entered.”

VEGP LAR DOC L07 revises Certain TS Required Actions requiring the reactor trip breakers to be opened into two Required Actions.

VEGP LAR DOC L15 revises SR 3.4.8.1 from “Verify that at least one RCP is in operation at ≥ 10% rated speed or equivalent,” to “Verify at least one RCP is in operation with total flow through the core ≥ 3,000 gpm.”

A more detailed description of each DOC can be found in Reference 2, VEGP TSU LAR Enclosure 1, and the NRC staff safety evaluation can be found in Reference 3, VEGP LAR SER. The VEGP TSU LAR was modified in response to NRC staff RAIs in Reference 5 and the Southern Nuclear Operating Company RAI Response in Reference 6.

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

Deletion of “that” from SR 3.4.8.1 surveillance description per VEGP LAR DOC A038 and replacement of “at least” with “≥” in LCO specification per VEGP LAR DOC A045 are consistent with the TS Writer’s Guide (Reference 4).

VEGP LAR DOC A046 provides clarification of Note 1 similar to TSTF-438-A.

VEGP LAR DOC M08 ensures that Required Actions of Condition A are completed once the Condition is entered. Otherwise, once GTS 3.4.8 Required Action A.1 is performed (all sources

of unborated water are isolated within 1 hour) the LCO is no longer applicable because the GTS 3.4.8 Applicability is “MODES 3, 4, and 5, whenever the reactor trip breakers are open and with unborated water sources not isolated from the RCS.” Therefore, GTS 3.4.8 Required Action A.2 would not be required to be completed once all unborated water sources are isolated because the Applicability for the LCO is exited.

VEGP LAR DOC L07 provides added protection against unintended interlock actuation. When the RTBs are opened, certain other interlocks can be initiated. The initiation of the associated interlocks may have an undesirable secondary effect on operation of the plant such as the initiation of the P-4 interlock, which, in the event of low RCS temperature, can result in isolation of main feedwater to the steam generators.

VEGP LAR DOC L15 provides consistency with LCO bases. The 3000 gpm in the LCO is associated with the initial condition in the analysis of a possible Boron Dilution Event in MODE 3, 4, or 5 for minimum mixing flow in the RCS. SR 3.4.8.1 is revised to reflect this value for consistency with the LCO.

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

Markup of the GTS 3.4.8 Applicability statement is missing a comma separating “all rods fully inserted” from the remainder of the Applicability. (APOG Comment)

The third paragraph of the “Background” section of the Bases is deleted. (APOG Comment)

The first paragraph of the “LCO” section of the Bases is revised to include the 3,000 gpm limit (APOG Comment and NRC Staff Edit):

> The requirement that **at least one RCP be in operation with** a minimum ~~RCS~~ **core** flow **of ≥ 3,000 gpm** ~~be maintained~~ provides assurance that in the event of an inadvertent BDE, the diluted water will be properly mixed with the primary system coolant, and the increase in core reactivity will be detected by the source range **neutron flux** instrumentation. **A core flow of < 3,000 gpm is considered equivalent to no RCP in operation.**

Replace “source range instrumentation” with “source range neutron flux instrumentation” throughout the Bases. (NRC Staff Comment)

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

Failure to include the comma in the Applicability statement results in a grammatically incorrect statement that could be misinterpreted.

The third paragraph of the “Background” section of the Bases contains a potentially misleading discussion of means to achieve RCS circulation beyond RCP forced circulation. These means are not appropriate for compliance with the LCO and should not be included in the Bases discussion.

Currently, there is no mention of 3,000 gpm in GTS 3.4.8 Bases to align with the GTS 3.4.8 LCO requirement. Also, GTS 3.4.8 requires that (1) one RCP be in operation and (2) that it be providing at least 3,000 gpm. Condition A states only “No RCP in operation.” Both conditions need to be included in the Bases Action entry for clarity.

The phrase “source range neutron flux instrumentation” is consistent with LCO 3.4.8.

VII. GTST Safety Evaluation

Technical Analysis:

AP1000 GTS LCO 3.4.8 requires at least one RCP to be in operation. The LCO notes allow RCPs to be stopped for a period of time to perform a variety of tests, e.g., Control Rod drop tests. In Revision 1 of the ITS NUREGs, these Notes were worded inconsistently. Some Notes stated that the pump could be “de-energized,” others stated that the pump could be “removed from operation.” The Bases also referred to the pump being “stopped.” TSTF-153 revised the Notes to state that the pump “may not be in operation,” as a direct exception to the requirement to “be in operation.” TSTF-153 was approved by the NRC April 11, 1997.

Subsequent to the approval of TSTF-153, a consensus was reached between the NRC and the Industry that this wording was confusing. The Notes could be read as a prohibition, i.e., the pump must be stopped, instead of the intended meaning that the pump may be stopped. VEGP LAR DOC A046 and TSTF-438 revised the Notes to allow that the RCPs “may be removed from operation,” instead of “may be de-energized.”

VEGP LAR DOC L07 provides added protection against unintended interlock actuation. Each of the Required Actions to open the RTBs is intended to assure that rods cannot be withdrawn thereby eliminating the possibility for control rod related positive reactivity additions and associated heat input into the reactor coolant. Additionally, opening the RTBs would result in all rods being inserted. Therefore, replacing the Required Actions to open RTBs with two actions to “initiate action to fully insert all rods” and “place the Plant Control System in a condition incapable of rod withdrawal,” maintains the intent of the existing requirement. This change provides consistency by replacing the specific method of precluding rod withdrawal and ensuring all rods are inserted while maintaining the requirement for establishing the plant conditions equivalent to opening RTBs.

VEGP LAR DOC M08 ensures that Required Actions of Condition A are completed once the Condition is entered. The GTS 3.4.8 LCO requires that at least one RCP shall be in operation with a total flow through the core of at least 3,000 gpm. In the event no RCP is in operation, the Required Actions of GTS 3.4.8 Condition A require all sources of unborated water to be isolated and GTS SR 3.1.1.1 to be performed. The Required Action to perform SR 3.1.1.1 assures that if the boron concentration in the RCS has been reduced and not detected by the source range neutron flux instrumentation, prompt action may be taken to restore the required Shutdown Margin.

However, once GTS 3.4.8 Required Action A.1 is performed (all sources of unborated water are isolated within 1 hour) the LCO is no longer applicable because GTS 3.4.8 Applicability is “MODES 3, 4, and 5, whenever the reactor trip breakers are open and with unborated water sources not isolated from the RCS.” Therefore, GTS 3.4.8 Required Action A.2 would not be required to be completed once all unborated water sources are isolated because the Applicability for the LCO is exited. The proposed Note ensures that the Shutdown Margin is verified prior to starting any RCP once Condition A is entered, even if all unborated water sources are isolated.

VEGP LAR DOC L15 provides consistency with LCO bases. The 3000 gpm in the LCO is associated with the initial condition in the analysis of a possible Boron Dilution Event in MODE 3, 4, or 5 for minimum mixing flow in the RCS. SR 3.4.8.1 is revised to reflect this value for consistency with the LCO. The expected operating limit on the RCP minimum speed is expected to be higher than 10%. This results in design margin to the 3000 gpm LCO value. The

operating limit takes into account minimizing stress and wear, and increasing equipment life, and not the input assumptions for the Boron Dilution Analysis.

Surveillance acceptance criteria should match the LCO requirement to verify that the minimum flow rate is met. Operational margin details that account for minimizing stress and wear, and increasing equipment life and the expected operating limit on minimum RCP speed, are more appropriately controlled in the design and in procedures associated with operating and testing the RCPs.

The third paragraph of the “Background” section of the Bases contains a potentially misleading discussion of means to achieve RCS circulation beyond RCP forced circulation. These means are not appropriate for compliance with the LCO. Inclusion of the discussion could be misleading to the operator. Therefore, for clarity, this paragraph is removed from the Bases. The proposed change to the “Background” section of the Bases is acceptable because it clarifies the intent of the current requirement and is, therefore, administrative.

The “LCO” section of the Bases is revised to mention a minimum core flow of 3,000 gpm to align the Bases discussion with the GTS 3.4.8 LCO requirement. Also, GTS 3.4.8 requires that (1) one RCP be in operation and (2) that it be providing at least 3,000 gpm. Condition A states only “No RCP in operation.” Both conditions need to be included in the Bases discussion for clarity. The proposed change to the “LCO” section of the Bases is acceptable because it clarifies the intent of the current requirement and is, therefore, administrative.

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 3.4.8 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

Randy Belles
Oak Ridge National Laboratory
865-574-0388
bellesrj@ornl.gov

Review Information:

Availability for public review and comment on Revision 0 of this traveler approved by NRC staff on 5/16/2014.

APOG Comments (Ref. 7) and Resolutions:

1. (Internal # 6) The GTST sections often repeat VEGP LAR DOCs, which reference "existing" and "current" requirements. The inclusion in the GTST of references to "existing" and "current," are not always valid in the context of the GTS. Each occurrence of "existing" and "current" should be revised to be clear and specific to GTS, MTS, or VEGP COL TS (or other), as appropriate. Noted ambiguities are corrected in the GTST body.

2. (Internal # 7) Section VII, GTST Safety Evaluation, inconsistently completes the subsection "References to Previous NRC Safety Evaluation Reports (SERs)" by citing the associated SE for VEGP 3&4 COL Amendment 13. It is not clear whether there is a substantive intended difference when omitting the SE citation. This is resolved by removing the SE citation in Section VII of the GTST and ensuring that appropriate references to the consistent citation of this reference in Section X of the GTST are made.

3. (Internal # 248) In GTST for Subsection 3.4.8, Section III, last paragraph states that the NRC Staff RAIs are Reference 8 and the Southern Nuclear responses are Reference 9. The correct references are References 5 and 6. This is resolved by making the recommended change.

4. (Internal # 249) In GTST for Subsection 3.4.8, Section VI, Rationale for Changes, VEGP LAR DOC A046 states that it provides clarification of "Note 4." DOC A046 affects "LCO Note 1," not "Note 4." This is resolved by making the recommended change. The TSTF reference in this same section is also corrected.

5. (Internal # 250 and 251) Markup of the GTS 3.4.8 Applicability statement is missing a comma separating "all rods fully inserted" from the remainder of the Applicability. Failure to include the comma results in a grammatically incorrect statement that could be misinterpreted. This is resolved by making the recommended change.

6. (Internal # 252) Revise the "Background" section of the Bases to delete the last paragraph. This paragraph contains a potentially misleading discussion of means to achieve RCS circulation beyond RCP forced circulation. Since these means are not appropriate for compliance with the LCO, this discussion should be deleted. Specifically, delete the third

paragraph of the “Background” section of the Bases. This is resolved by making the recommended change.

7. (Internal # 253) Revise the first paragraph of the “LCO” section of the Bases to include the 3,000 gpm limit. Currently, there is no mention of 3,000 gpm in TS 3.4.8 Bases to align with the TS 3.4.8 LCO requirement. This discussion was inappropriately provided in the Bases for LCO 3.4.4 (Internal Comment # 239). Also, revise TS 3.4.8 Bases for the LCO to clarify that the intended Action entry is understood to encompass the condition of less than 3,000 gpm flow. LCO 3.4.8 requires both that one RCP be in operation and that it be providing at least 3,000 gpm flow through the core. Condition A states only “No RCP in operation.” Both conditions need to be included in the Bases Action entry for clarity:

   > The requirement that **at least one RCP be in operation with** a minimum ~~RCS~~ **core** flow **≥ 3,000 gpm** ~~be maintained~~ provides assurance that in the event of an inadvertent BDE, the diluted water will be properly mixed with the primary system coolant, and the increase in core reactivity will be detected by the source range instrumentation. **A core flow < 3,000 gpm is considered equivalent to no RCP in operation.**

   This is resolved by making the recommended change with additional edits:

   > The requirement that **at least one RCP be in operation with** a minimum ~~RCS~~ **core** flow **of ≥ 3,000 gpm** ~~be maintained~~ provides assurance that in the event of an inadvertent BDE, the diluted water will be properly mixed with the primary system coolant, and the increase in core reactivity will be detected by the source range **neutron flux** instrumentation. **A core flow of < 3,000 gpm is considered equivalent to no RCP in operation.**

   Replace “source range instrumentation” with “source range neutron flux instrumentation” throughout the Bases for consistency with LCO 3.4.8.

NRC Final Approval Date: 5/27/2015

NRC Contact:

Hien Le
United States Nuclear Regulatory Commission
301-415-1511
Hien.Le@nrc.gov

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, Units 3 and 4, Technical Specifications Upgrade License Amendment Request, February 24, 2011 (ML12065A057).

3. 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)

4. TSTF-GG-05-01, “Writer's Guide for Plant-Specific Improved Technical Specifications,” June 2005.

5. 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).

6. 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)

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.

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.8 Minimum RCS Flow

LCO 3.4.8 At least one Reactor Coolant Pump (RCP) shall be in operation with a total flow through the core of ~~at least~~ **≥** 3,000 gpm.

----------NOTES----------

1. All RCPs may be ~~de-energized~~ **removed from operation** for ≤ 1 hour per 8 hour period provided:

   a. No operations are permitted that would cause introduction into the RCS, coolant with boron concentration less than required to meet the SDM of LCO 3.1.1; and

   b. Core outlet temperature is maintained at least 10°F below saturation temperature.

2. No RCP shall be started when the RCS temperature is ≥ 350°F unless pressurizer level is < 92%.

3. No RCP shall be started with any RCS cold leg temperature ≤ 350°F unless the secondary side water temperature of each steam generator (SG) is ≤ 50°F above each of the RCS cold leg temperatures and the RCP is started at ≤ 25% of RCP speed.

APPLICABILITY: MODES 3, 4, and 5~~, whenever the reactor trip breakers are open~~ **with Plant Control System incapable of rod withdrawal, all rods fully inserted,** and ~~with~~ unborated water sources not isolated from the RCS.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. **----------NOTE----------** **Required Action A.2 shall be completed prior to starting any RCP whenever this Condition is entered.** **----------** No RCP in operation.	A.1 Isolate all sources of unborated water. AND A.2 Perform SR 3.1.1.1.	1 hour 1 hour

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.4.8.1	Verify ~~that~~ at least one RCP is in operation **with total flow through the core ≥ 3,000 gpm** ~~at ≥ 10% rated speed or equivalent~~.	12 hours

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.8 Minimum RCS Flow

BASES

BACKGROUND

The ~~AP1000~~ RCS consists of the reactor vessel and two heat transfer loops, each containing a steam generator (SG), two reactor coolant pumps (RCPs), a single hot leg and two cold legs for circulating reactor coolant. Loop 1 also contains connections to the pressurizer and passive residual heat removal (PRHR).

The primary function of the reactor coolant is removal of decay heat and the transfer of this heat, via the SGs to the secondary plant fluid. The secondary function of the reactor coolant is to act as a carrier for soluble neutron poison, boric acid.

~~Within the RCS, coolant loop flow can be provided by the reactor coolant pumps, the Normal Residual Heat Removal System (RNS), and to a lesser degree when in the passive mode of operation, natural circulation.~~

APPLICABLE SAFETY ANALYSES

An initial condition in the Design Basis Accident (DBA) analysis of a possible Boron Dilution Event (BDE) in MODE 3, 4, or 5 is the assumption of a minimum mixing flow in the RCS. In this scenario, dilute water is inadvertently introduced into the RCS, is uniformly mixed with the primary coolant, and flows to the core. The increase in reactivity is detected by the source range **neutron flux** instrumentation which provides a signal to terminate the inadvertent dilution before the available SDM is lost. If there is inadequate mixing in the RCS, the dilute water may stratify in the primary system, and there will be no indication by the source range **neutron flux** instrumentation that a dilution event is in progress. When primary flow is finally increased, the dilution event may have progressed to the point that mitigation by the source range **neutron flux** instrumentation is too late to prevent the loss of SDM.

Thus, a minimum mixing flow in the RCS is a process variable which is an initial condition in a DBA analysis.

Minimum RCS Flow satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

BASES

LCO

The requirement that **at least one RCP be in operation with** a minimum **core** ~~RCS~~ flow **of ≥ 3,000 gpm** ~~be maintained~~ provides assurance that in the event of an inadvertent BDE, the diluted water will be properly mixed with the primary system coolant, and the increase in core reactivity will be detected by the source range **neutron flux** instrumentation. **A core flow of < 3,000 gpm is considered equivalent to no RCP in operation.**

Note 1 permits all RCPs to be **removed from operation** ~~de-energized~~ for ≤ 1 hour per 8 hour period. The purpose of the Note is to permit tests that are designed to validate various accident analysis values. One of these tests is for the validation of the pump coastdown curve, used as input to a number of accident analyses including a loss of flow accident. This test is generally performed in MODE 3 during the initial startup testing program, and as such should only be performed once. If, however, changes are made to the RCS that would cause a change to the flow characteristics of the RCS, the input values of the coastdown curve may need to be revalidated by conducting the test again.

Another test performed during the startup testing program is the validation of the rod drop times during cold conditions, both with and without flow.

The no-flow tests may be performed in MODE 3, 4, or 5, and require that the pumps be stopped for a short period of time. The Note permits ~~the de-energizing of the pumps~~ **removing all RCPs from operation** in order to perform this test and validate the assumed analysis values. As with the validation of the pump coastdown curve, this test should only be performed once, unless the flow characteristics of the RCS are changed. The 1~~-~~hour time period specified is adequate to perform the desired tests and experience has shown that boron stratification is not a problem during this short period with no forced flow.

Utilization of the Note is permitted provided the following conditions are met along with any other conditions imposed by initial startup test procedures:

a. No operations are permitted that would dilute the RCS boron concentration with coolant at boron concentrations less than required to assure the SDM of LCO 3.1.1, thereby maintaining the margin to criticality. Boron reduction with coolant at boron concentrations less than required to assure SDM is maintained is prohibited because a uniform concentration distribution throughout the RCS cannot be ensured when in natural circulation and

BASES

LCO (continued)

b. Core outlet temperature is maintained at least 10°F below saturation temperature, so that no vapor bubble may form and possibly cause natural circulation flow obstruction.

Note 2 prohibits startup of an RCP when the RCS temperature is ≥ 350°F unless pressurizer level is < 92%. This restraint is to prevent a low temperature overpressure event due to a thermal transient when an RCP is started.

Note 3 requires that the secondary side water temperature of each SG be ≤ 50°F above each of the RCS cold leg temperatures before the start of an RCP with any RCS cold leg temperature ≤ 350°F, and the RCP must be started at ≤ 25% of RCP speed. This restraint is to prevent a low temperature overpressure event due to a thermal transient when an RCP is started. This limitation also helps to ensure that the RNS system pressure remains below both the piping design pressure and the acceptable RNS relief valve inlet pressure.

APPLICABILITY

Minimum RCS flow is required in MODES 3, 4, and 5 with the ~~reactor trip breakers (RTBs) open~~ **Plant Control System incapable of rod withdrawal, all rods fully inserted,** and ~~with~~ unborated water sources not isolated from the RCS because an inadvertent BDE is considered possible in these MODES.

In MODES 1 and 2, and in MODES 3, 4, and 5 with the ~~RTBs closed~~ **Plant Control System capable of rod withdrawal or one or more rods not fully inserted**, LCO 3.4.4 requires all four RCPs to be in operation. Thus, in the event of an inadvertent boron dilution, adequate mixing will occur.

A minimum mixing flow is not required in MODE 6 because LCO 3.9.2 requires that all valves used to isolate unborated water sources shall be secured in the closed position. In this situation, an inadvertent BDE is not considered credible.

BASES

ACTIONS

A.1

If no RCP is in operation, all sources of unborated water must be isolated within 1 hour. This action assures that no unborated water will be introduced into the RCS when proper mixing cannot be assured. The allowed Completion Time requires that prompt action be taken, and is based on the low probability of a DBA occurring during this time.

A.2

The Requirement to perform SR 3.1.1.1 (SDM verification) within 1 hour assures that if the boron concentration in the RCS has been reduced and not detected by the source range **neutron flux** instrumentation, prompt action may be taken to restore the required SDM. The allowed Completion Time is consistent with that required **by** ~~of~~ Action A.1 because the conditions and consequences are the same.

Condition A is modified by a Note that requires Required Action A.2 to be performed prior to starting any RCP whenever the Condition is entered. This ensures that SR 3.1.1.1 will be performed prior to starting an RCP, even when Condition A is exited prior to performing Required Action A.2. Performance of SR 3.1.1.1 is necessary to assure SDM is properly evaluated prior to starting an RCP.

SURVEILLANCE REQUIREMENTS

SR 3.4.8.1

This Surveillance requires verification every 12 hours that a minimum mixing flow is present in the RCS. A Frequency of 12 hours is adequate considering the low probability of an inadvertent BDE during this time, and the ease of verifying the required RCS flow.

REFERENCES

None.

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.

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.8 Minimum RCS Flow

LCO 3.4.8 At least one Reactor Coolant Pump (RCP) shall be in operation with a total flow through the core of ≥ 3,000 gpm.

----------NOTES----------

1. All RCPs may be removed from operation for ≤ 1 hour per 8 hour period provided:

   a. No operations are permitted that would cause introduction into the RCS, coolant with boron concentration less than required to meet the SDM of LCO 3.1.1; and

   b. Core outlet temperature is maintained at least 10°F below saturation temperature.

2. No RCP shall be started when the RCS temperature is ≥ 350°F unless pressurizer level is < 92%.

3. No RCP shall be started with any RCS cold leg temperature ≤ 350°F unless the secondary side water temperature of each steam generator (SG) is ≤ 50°F above each of the RCS cold leg temperatures and the RCP is started at ≤ 25% of RCP speed.

APPLICABILITY: MODES 3, 4, and 5 with Plant Control System incapable of rod withdrawal, all rods fully inserted, and unborated water sources not isolated from the RCS.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. ----------NOTE---------- Required Action A.2 shall be completed prior to starting any RCP whenever this Condition is entered. ---------- No RCP in operation.	A.1 Isolate all sources of unborated water. AND A.2 Perform SR 3.1.1.1.	1 hour 1 hour

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.4.8.1	Verify at least one RCP is in operation with total flow through the core ≥ 3,000 gpm.	12 hours

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.8 Minimum RCS Flow

BASES

BACKGROUND

The RCS consists of the reactor vessel and two heat transfer loops, each containing a steam generator (SG), two reactor coolant pumps (RCPs), a single hot leg and two cold legs for circulating reactor coolant. Loop 1 also contains connections to the pressurizer and passive residual heat removal (PRHR).

The primary function of the reactor coolant is removal of decay heat and the transfer of this heat, via the SGs to the secondary plant fluid. The secondary function of the reactor coolant is to act as a carrier for soluble neutron poison, boric acid.

APPLICABLE SAFETY ANALYSES

An initial condition in the Design Basis Accident (DBA) analysis of a possible Boron Dilution Event (BDE) in MODE 3, 4, or 5 is the assumption of a minimum mixing flow in the RCS. In this scenario, dilute water is inadvertently introduced into the RCS, is uniformly mixed with the primary coolant, and flows to the core. The increase in reactivity is detected by the source range neutron flux instrumentation which provides a signal to terminate the inadvertent dilution before the available SDM is lost. If there is inadequate mixing in the RCS, the dilute water may stratify in the primary system, and there will be no indication by the source range neutron flux instrumentation that a dilution event is in progress. When primary flow is finally increased, the dilution event may have progressed to the point that mitigation by the source range neutron flux instrumentation is too late to prevent the loss of SDM.

Thus, a minimum mixing flow in the RCS is a process variable which is an initial condition in a DBA analysis.

Minimum RCS Flow satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

The requirement that at least one RCP be in operation with a minimum core flow of ≥ 3,000 gpm provides assurance that in the event of an inadvertent BDE, the diluted water will be properly mixed with the primary system coolant, and the increase in core reactivity will be detected by the source range neutron flux instrumentation. A core flow of < 3,000 gpm is considered equivalent to no RCP in operation.

BASES

LCO (continued)

Note 1 permits all RCPS to be removed from operation for ≤ 1 hour per 8 hour period. The purpose of the Note is to permit tests that are designed to validate various accident analysis values. One of these tests is for the validation of the pump coastdown curve, used as input to a number of accident analyses including a loss of flow accident. This test is generally performed in MODE 3 during the initial startup testing program, and as such should only be performed once. If, however, changes are made to the RCS that would cause a change to the flow characteristics of the RCS, the input values of the coastdown curve may need to be revalidated by conducting the test again.

Another test performed during the startup testing program is the validation of the rod drop times during cold conditions, both with and without flow.

The no-flow tests may be performed in MODE 3, 4, or 5, and require that the pumps be stopped for a short period of time. The Note permits removing all RCPs from operation in order to perform this test and validate the assumed analysis values. As with the validation of the pump coastdown curve, this test should only be performed once, unless the flow characteristics of the RCS are changed. The 1-hour time period specified is adequate to perform the desired tests and experience has shown that boron stratification is not a problem during this short period with no forced flow.

Utilization of the Note is permitted provided the following conditions are met along with any other conditions imposed by initial startup test procedures:

a. No operations are permitted that would dilute the RCS boron concentration with coolant at boron concentrations less than required to assure the SDM of LCO 3.1.1, thereby maintaining the margin to criticality. Boron reduction with coolant at boron concentrations less than required to assure SDM is maintained is prohibited because a uniform concentration distribution throughout the RCS cannot be ensured when in natural circulation and

b. Core outlet temperature is maintained at least 10°F below saturation temperature, so that no vapor bubble may form and possibly cause natural circulation flow obstruction.

BASES

LCO (continued)

Note 2 prohibits startup of an RCP when the RCS temperature is ≥ 350°F unless pressurizer level is < 92%. This restraint is to prevent a low temperature overpressure event due to a thermal transient when an RCP is started.

Note 3 requires that the secondary side water temperature of each SG be ≤ 50°F above each of the RCS cold leg temperatures before the start of an RCP with any RCS cold leg temperature ≤ 350°F, and the RCP must be started at ≤ 25% of RCP speed. This restraint is to prevent a low temperature overpressure event due to a thermal transient when an RCP is started. This limitation also helps to ensure that the RNS system pressure remains below both the piping design pressure and the acceptable RNS relief valve inlet pressure.

APPLICABILITY

Minimum RCS flow is required in MODES 3, 4, and 5 with the Plant Control System incapable of rod withdrawal, all rods fully inserted, and unborated water sources not isolated from the RCS because an inadvertent BDE is considered possible in these MODES.

In MODES 1 and 2, and in MODES 3, 4, and 5 with the Plant Control System capable of rod withdrawal or one or more rods not fully inserted, LCO 3.4.4 requires all four RCPs to be in operation. Thus, in the event of an inadvertent boron dilution, adequate mixing will occur.

A minimum mixing flow is not required in MODE 6 because LCO 3.9.2 requires that all valves used to isolate unborated water sources shall be secured in the closed position. In this situation, an inadvertent BDE is not considered credible.

ACTIONS

A.1

If no RCP is in operation, all sources of unborated water must be isolated within 1 hour. This action assures that no unborated water will be introduced into the RCS when proper mixing cannot be assured. The allowed Completion Time requires that prompt action be taken, and is based on the low probability of a DBA occurring during this time.

BASES

ACTIONS (continued)

A.2

The Requirement to perform SR 3.1.1.1 (SDM verification) within 1 hour assures that if the boron concentration in the RCS has been reduced and not detected by the source range neutron flux instrumentation, prompt action may be taken to restore the required SDM. The allowed Completion Time is consistent with that required by Action A.1 because the conditions and consequences are the same.

Condition A is modified by a Note that requires Required Action A.2 to be performed prior to starting any RCP whenever the Condition is entered. This ensures that SR 3.1.1.1 will be performed prior to starting an RCP, even when Condition A is exited prior to performing Required Action A.2. Performance of SR 3.1.1.1 is necessary to assure SDM is properly evaluated prior to starting an RCP.

SURVEILLANCE REQUIREMENTS

SR 3.4.8.1

This Surveillance requires verification every 12 hours that a minimum mixing flow is present in the RCS. A Frequency of 12 hours is adequate considering the low probability of an inadvertent BDE during this time, and the ease of verifying the required RCS flow.

REFERENCES None.