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

Title: Revision of AP1000 GTS Subsection 3.9.1, Boron Concentration

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-471-A, Rev. 1: Eliminate use of term CORE ALTERATIONS in ACTIONS and Notes

STS NUREGs Affected:

TSTF-471-A, Rev. 1: NUREG-1430, -1431, -1432

NRC Approval Date:

TSTF-471-A, Rev. 1: 07-DEC-06

TSTF Classification:

TSTF-471-A, Rev. 1: 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:

Not Applicable

RCOL COL Item Number and Title:

Not Applicable

RCOL PTS Change Number and Title:

The Vogtle Electric Generating Plant Units 3 and 4 License Amendment Request (VEGP LAR) proposed the following changes to the initial version of the PTS (referred to as the current TS by the VEGP LAR).

These changes include Administrative Changes (A) and Less Restrictive Changes (L) and are discussed in enumerated discussions of change (DOCs). These changes are discussed in Sections VI and VII of this GTST.

DOC A114: Revises the Note to the Applicability

DOC L03: Deletes the Required Action A.1 and renumbers subsequent Actions

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(1) applicable to operating reactor designs, but not to the AP1000 design; (2) already incorporated in the GTS; or (3) superseded by another change.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 471-A, Rev. 1 made changes to LCO 3.9.1 and Bases.

It removed the term “CORE ALTERATIONS” and made corresponding adjustments to the text in each section. DOC L03 also removed the term “CORE ALTERATIONS” from GTS 3.9.1.

TSTF 471-A, Rev. 1 also deleted the Required Action A.1 from LCO 3.9.1 and renumbered the following Actions.

DOC A114 modified the Applicability Note in LCO 3.9.1 and added a new paragraph to the Applicability in the Bases.

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 in 3.9.1, under “Required Action” A.2, the word “limits” with “limit” for consistency with Condition A and SR 3.9.1.1. This change is made for consistency with Condition A and SR 3.9.1.1 statements. (SPSB with APOG’s agreement)

Delete Ref. 1 and Ref. 2 from the list of references in B 3.9.1. Update the reference number for Ref. 3 in the third paragraph of B 3.9.1 “Background” with the proper enumeration Ref. 1.

APOG Recommended Changes to Improve Bases 3.9.1

Replace the two occurrences of “transfer tube” with “fuel transfer canal” in Background and LCO to match the TS. (APOG #484)

Add a new reference citation (Ref. 2) to the Bases References. (APOG #489)

Revise the phrase “Section 7.4” to “FSAR Section 7.4 (Ref. 2)” in the third paragraph of “Background” section of the Bases. (APOG #485)

Revise the Bases LCO by replacing the phrase “The LCO requires that a minimum boron concentration be maintained in the RCS” by “The LCO requires that boron concentration be maintained within limit in the RCS.” (APOG #486)

Replace in Bases Applicability two occurrences of “refueling canal” with “fuel transfer canal” to match the TS. (APOG #487)

Replace the first sentence of the second paragraph in Bases - Surveillance Requirements “A minimum Frequency of once every 72 hours is a ~~sufficient interval to verify~~ the boron concentration” with “A minimum Frequency of once every 72 hours is a reasonable amount of time between verifications of the boron concentration” where the deleted words are crossed out and the new text is underlined. (APOG #488)

V. Applicability

Affected Generic Technical Specifications and Bases:

Section 3.9.1, Boron Concentration

Changes to the Generic Technical Specifications and Bases:

Change the phrase “Only applicable to the fuel transfer canal and the refueling cavity when connected to the RCS” to “Applicable to the fuel transfer canal and the refueling cavity only when connected to the RCS“ in the LCO 3.9.1 Applicability Note. (DOC A114)

Delete the Required Action A.1 from LCO 3.9.1 and renumber the following Actions. (TSTF-471-A, Rev. 1 and DOC L03)

Replace in 3.9.1, under “Required Action” A.2, the word “limits” with “limit” for consistency with Condition A and SR 3.9.1.1. (SPSB with APOG’s agreement)

Replace the two occurrences of “transfer tube” with “fuel transfer canal” in Background and LCO to match the TS. (APOG #484)

Delete Ref. 1 and Ref. 2 from the list of references in B 3.9.1.

Renumber Ref. 3 to become Ref. 1 in the third paragraph of Background.

Insert a new paragraph to the Applicability in the Bases B 3.9.1 explaining the Note in the corresponding Applicability in LCO 3.9.1. (DOC A114)

Remove the phrase “CORE ALTERATIONS” in the LCO and Bases (ACTIONS). (TSTF-471-A, Rev. 1 and DOC L03)

Add a new reference citation (Ref. 2) to the Bases References. (APOG #489)

Revise the phrase “Section 7.4” to “FSAR Section 7.4 (Ref. 2)” in the third paragraph of “Background” section of the Bases. (APOG #485)

Revise the Bases LCO by replacing the phrase “The LCO requires that a minimum boron concentration be maintained in the RCS” by “The LCO requires that boron concentration be maintained within limit in the RCS.” (APOG #486)

Replace in Bases Applicability two occurrences of “refueling canal” with “fuel transfer canal” to match the TS. (APOG #487)

Revise the first sentence of the second paragraph in Bases - Surveillance Requirements. (APOG #487)

VI. Traveler Information

Description of TSTF changes:

TSTF-471-A, Rev. 1 made the following changes to WOG STS 3.9.1, Rev. 3:

In LCO Subsection 3.9.1: Boron Concentration

-Required Action A.1, “Suspend CORE ALTERATIONS” and its completion time are removed.
-The underlined word AND is removed.
-The following Item A.2 “Suspend positive reactivity additions” becomes the new item A.1, with its corresponding completion time (Immediately).
-Item A.3 (and its completion time) is renumbered to A.2.

In the Bases subsection B 3.9.1, Boron Concentration

-the ACTIONS section has a part A.1 and A.2, and also a part A.3. The term “CORE ALTERATIONS” appears four times in this subsection followed by the words “or positive reactivity additions” or “and positive reactivity additions.” The change involves removing the term” CORE ALTERATIONS” and either the ‘or’ or ‘and’ leaving only the phrase positive reactivity additions.

Rationale for TSTF changes:

TSTF-51-A, Rev. 2 eliminated all uses of the defined term “CORE ALTERATIONS” from Applicability statements in the PWR NUREGs and most uses of “CORE ALTERATIONS” in Required Actions.

TSTF-471-A, Rev. 1 eliminates the few remaining instances of the defined term “CORE ALTERATIONS” from the PWR IRS NUREGs. This GTST continues the removal of the defined term “CORE ALTERATIONS” from the AP1000 Technical Specifications. (This includes the removal of the defined term “CORE ALTERATIONS” from the list of definitions found in GTS 1.1)

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

Administrative Changes (A):

DOC A114:

The phrase in the Note to the Applicability in LCO 3.9.1 is revised from:

> “Only applicable to the fuel transfer canal and the refueling cavity when connected to the RCS.”

to

> “Applicable to the fuel transfer canal and the refueling cavity only when connected to the RCS.”

Also a new paragraph is added to the Applicability in the Bases B 3.9.1 explaining the Note in the corresponding Applicability in LCO 3.9.1. The new paragraph states the following:

> "The Applicability is modified by a Note. The Note states that the limits on boron concentration are applicable to the refueling canal and the refueling cavity only when those volumes are connected to the RCS. When the refueling canal and the refueling cavity are isolated from the RCS, no potential path for boron dilution exists from those volumes."

Less Restrictive Changes (L):

DOC L03:

Similar to TSTF-471-A, Rev. 1, DOC L03 deletes the Required Action A.1 from LCO 3.9.1 and renumbers the subsequent Required Actions.

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

The change proposed by DOC A114 to change the wording preference for the Note of the Applicability is made to provide clarification. According to VEGP TSU, the current wording of the Note could imply that "only" the fuel transfer canal and the refueling cavity boron concentration are required to meet the LCO when these two areas are connected to the Reactor Coolant System (RCS). However, the correct meaning of the Note is that the boron concentration limit is applicable to the two areas only when the two areas are actually connected to the RCS. To alleviate any misunderstanding of the Note, the term "only" is moved to reflect the correct meaning. This change is designated as an administrative change and is acceptable because it does not result in technical changes to the TS.

According to DOC L03 for Condition A, "If boron concentration is not within limit, the Required Actions require immediate suspension of core alterations, immediate suspension of positive reactivity additions, and immediate actions to restore the boron concentration within limits. This Specification is concerned with a boron dilution incident. The requirement to suspend positive reactivity additions and initiate actions to restore boron concentration to within limits are the appropriate actions needed to compensate for boron concentration not within limits, thus minimizing the consequences of a potential boron dilution incident. Therefore, the Action to suspend core alterations provides no safety benefit and is not needed."

Accordingly, the changes made by DOC A114 and DOC L03 are acceptable and are implemented by this GTST in AP1000 STS 3.9.1, Rev. 0.

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

Delete Ref. 1 and Ref. 2 from the list of references in B3.9.1. Update the reference number for Ref. 3 in the third paragraph of B 3.9.1 "Background" with the proper enumeration Ref. 1.

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

The first two references 1 and 2 of GTS B3.9.1 are deleted from the list of references because these two references are not mentioned in the body of Bases of STS Subsection 3.9.1, and are also not in Rev. 4 of Westinghouse STS Bases Subsection B 3.9.1.

VII. GTST Safety Evaluation

Technical Analysis:

In the WOG and BWOG NUREGs CORE ALTERATION is defined as “the movement of any fuel, sources, or reactivity control components, within the reactor vessel with the vessel head removed and fuel in the vessel. Suspension of CORE ALTERATIONS shall not preclude completion of movement of a component to a safe position.

Evaluations performed for TSTF-471-A, Rev. 1 indicate that CORE ALTERATIONS can only occur in mode 6 when the reactor vessel head is removed. The only accidents considered for mode 6 for PWR reactors is a fuel handling accident and a boron dilution accident. If all Required Actions that require suspension of CORE ALTERATIONS also require suspension of movement of [recently] irradiated fuel, suspension of CORE ALTERATIONS provides no safety benefit.

The removal of the term CORE ALTERATIONS is usually replaced by or leaves remaining, the term “positive reactivity additions.” A review of circumstances related to fuel handling accidents and boron dilution accidents concludes that the action to suspend CORE ALTERATIONS provides no benefit, and is not needed. Hence a finding of “no significant hazards consideration” is justified.

TSTF-51-A, Rev. 2 eliminated all uses of the defined term CORE ALTERATIONS from Applicability statements in the PWR NUREGs and most uses of CORE ALTERATIONS in Required Actions. Thus the term CORE ALTERATIONS can be removed from the definitions of Chapter 1 and removed from usage in all other places in the Technical Specifications of NUREG-1431 and AP1000 GTS.

The above changes are implemented by this GTST in AP1000 STS 3.9.1, Rev. 0 to comply with TSTF-471-A, Rev.1 and to be consistent with the corresponding sections of NUREG-1431, Rev. 4.

Technical discussion for the changes proposed by DOC A114 and DOC L03 are covered in the previous section VI of this GTST under “Rationale for changes in RCOL Std. Dep., RCOL COL Item(s), and RCOL PTS Changes.”

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

Having found that this GTST’s proposed changes to the GTS and Bases are acceptable, the NRC staff concludes that AP1000 STS Subsection 3.9.1 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:

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Review Information:

Availability for public review and comment on Revision 0 of this traveler approved by NRC staff on 5/15/2014.

APOG Comments (Ref. 7) and Resolutions:

1. (Internal #483) 3.9.1: Add the Applicability Note in LCO 3.9.1 Applicability. This error was inadvertent; the Note is restored.

2 (Internal #484) 3.9.1: APOG requested replacing two occurrences of “transfer tube” with “fuel transfer canal” in Background and LCO to match the TS. APOG comments that the nomenclature “transfer tube” is not utilized as the requirement by the TS, and the TS requirement for “fuel transfer canal” is not explicitly discussed in the Bases. This change is made as recommended to improve the Bases.

3. (Internal # 485 and # 3) 3.9.1: Revise the phrase “Section 7.4” to “FSAR Section 7.4 (Ref. 2)” in the third paragraph of “Background” section of the Bases. Throughout the Bases, references to Sections and Chapters of the FSAR do not include the “FSAR” clarifier. Since these Section and Chapter references are to an external document, it is appropriate (DOC A003) to include the “FSAR” modifier. This is resolved by adding the FSAR modifier as appropriate.

4. (Internal #486) 3.9.1: APOG requested revising Bases LCO by replacing the phrase “The LCO requires that a minimum boron concentration be maintained in the RCS” by “The LCO requires that boron concentration be maintained within limit in the RCS.” APOG comments that for better consistency with TS LCO, the LCO does not require a minimum boron concentration to be maintained, but requires boron concentration to be within limits. This change is made as recommended to improve the Bases.

5. (Internal #487) 3.9.1, Bases Applicability: APOG requested replacing two occurrences of “refueling canal” with “fuel transfer canal” to match the TS. APOG comments that the nomenclature “refueling canal” is not utilized as the requirement by the TS, and the TS requirement for “fuel transfer canal” is not explicitly discussed in the Bases. This change is made as recommended to improve the Bases.

6. (Internal #488) 3.9.1, Surveillance Requirements: APOG requested replacing the sentence "A minimum Frequency of once every 72 hours is a ~~sufficient interval to verify~~ the boron concentration" with "A minimum Frequency of once every 72 hours is a reasonable amount of time between verifications of the boron concentration" where the deleted words are crossed out and the new text is underlined. APOG comments that the changes are editorial as these non-technical changes provide improved clarity, consistency, and operator usability. This change is made as recommended.

7. (Internal #489) 3.9.1, Bases References: APOG recommends including a new reference citation to provide improved clarity, consistency, and operator usability. This change is made as recommended.

8. (Internal # 5) TSTF-51-A made two changes: (1) it changed Applicabilities and Actions from "movement of irradiated fuel" to "movement of [recently] irradiated fuel" and (2) removed most uses of the defined term Core Alterations. This change has the effect of removing the Applicability of the affected TS after a specified decay time (i.e., beyond "recently") has occurred. Only the second change to delete Core Alterations was incorporated into the AP1000 STS. Further clarification of the full scope of TSTF-51 should be addressed; that is to acknowledge that it is deferred for future consideration. This is resolved by making the requested notation for TSTF-51-A.

NRC Final Approval Date: 12/14/2015

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

References 1 and 2 of GTS Bases Subsection B 3.9.1 are omitted from the list of references in the AP1000 STS Bases Subsection B 3.9.1, “References” section, because they are not otherwise cited in the AP1000 GTS or STS Bases Subsection B 3.9.1. These references are also not included in Rev. 4 of NUREG-1431, STS for Westinghouse Plants, Bases Subsection B 3.9.1. Accordingly, in the Bases for STS 3.9.1, “(Ref. 3)” in the third paragraph of the “Background” section of GTS Bases Subsection B 3.9.1 is changed to “(Ref. 1)”; and in the “References” section, Reference 3 is renumbered as Reference 1.

X. References Used in GTST

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

2. Vogtle Electric Generating Plant (VEGP), Units 3 &4 COL Application, Part 4, Technical Specifications, Revision 3 (ML11180A102, 07/01/2011).

3. Vogtle Electric Generating Plant (VEGP) Units 3 and 4 - Final Safety Evaluation Report (ML110450302, 08/10/2011)

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

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 07, 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. 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)

8. 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 (ML 14265A493).

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.

3.9 REFUELING OPERATIONS

3.9.1 Boron Concentration

LCO 3.9.1 Boron concentration of the Reactor Coolant System (RCS), the fuel transfer canal, and the refueling cavity shall be maintained within the limit specified in COLR.

APPLICABILITY: MODE 6

---------- NOTE ----------
~~Only applicable~~**Applicable** to the fuel transfer canal and the refueling cavity **only** when connected to the RCS.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Boron concentration not within limit.	~~A.1 Suspend CORE ALTERATIONS.~~ ~~AND~~ A.~~2~~**1** Suspend positive reactivity additions. AND A.~~3~~**2** Initiate actions to restore boron concentration to within limit~~s~~.	~~Immediately~~ Immediately Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.9.1.1	Verify boron concentration is within the limit specified in the COLR.	72 hours

B 3.9 REFUELING OPERATIONS

B 3.9.1 Boron Concentration

BASES

BACKGROUND

The limit on the boron concentration of the Reactor Coolant System (RCS), the refueling cavity, the **fuel** transfer **canal**~~tube~~ during refueling ensures that the reactor remains subcritical during MODE 6. Refueling boron concentration is the soluble boron concentration in the coolant in each of these volumes having direct access to the reactor core during refueling.

The soluble boron concentration offsets the core reactivity and is measured by chemical analysis of a representative sample of the coolant in each of the volumes. The refueling boron concentration limit is specified in the COLR. Plant procedures ensure the specified boron concentration in order to maintain an overall core reactivity of $k_{eff} \leq 0.95$ during fuel handling with control rods and fuel assemblies assumed to be in the most adverse configuration (least negative reactivity) allowed by procedures.

GDC 26 of 10 CFR 50, Appendix A requires that two independent reactivity control systems of different design principles be provided (Ref. ~~3~~**1**). One of these systems, the Passive Core Cooling System (PXS), is capable of holding the core subcritical under safe shutdown conditions as described in **FSAR** Section 7.4 **(Ref. 2)**.

The reactor is brought to shutdown conditions before beginning operations to open the reactor vessel for refueling. After the RCS is cooled down and depressurized, the vessel head is unbolted and slowly removed. The refueling cavity and the fuel transfer canal are then flooded with borated water from the In-containment Refueling Water Storage Tank (IRWST) by the use of the Spent Fuel Pool Cooling System (SFS).

During refueling, the water volumes in the RCS, the fuel transfer canal and the refueling cavity are contiguous. However, the soluble boron concentration is not necessarily the same in each volume. If additions of boron are required during refueling, the Chemical and Volume Control System (CVS) provides the borated makeup.

BASES

BACKGROUND (continued)

The pumping action of the Normal Residual Heat Removal System (RNS) in the RCS, the SFS pumps in the spent fuel pool and refueling cavity, and the natural circulation due to thermal driving heads in the reactor vessel and refueling cavity mix the added concentrated boric acid with the water in the fuel transfer canal. The RNS is in operation during refueling to provide forced circulation in the RCS, while the SFS is in operation to cool and purify the spent fuel pool and refueling cavity. Their operation assists in maintaining the boron concentration in the RCS, the refueling cavity, and fuel transfer canal above the COLR limit.

APPLICABLE SAFETY ANALYSES

The boron concentration limit, specified in the COLR, is based on the core reactivity at the beginning of each fuel cycle (the end of refueling) and includes an uncertainty allowance.

The required boron concentration and the plant refueling procedures that verify the correct fuel loading plan (including full core mapping) ensure that the k_{eff} of the core will remain ≤ 0.95 during the refueling operation. Hence, at least a 5% Δk/k margin of safety is established during refueling.

The RCS boron concentration satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

The LCO requires that ~~a minimum~~boron concentration be maintained **within limit** in the RCS, the refueling cavity and the **fuel** transfer **canal**~~tube~~ while in MODE 6. The boron concentration limit specified in the COLR ensures that a core k_{eff} ≤ 0.95 is maintained during fuel handling operations. Violation of the LCO could lead to an inadvertent criticality during MODE 6.

APPLICABILITY

This LCO is applicable in MODE 6 to ensure that the fuel in the reactor vessel will remain subcritical. The required boron concentration ensures a k_{eff} of ≤ 0.95. Above MODE 6, LCO 3.1.1, “SHUTDOWN MARGIN (SDM)” ensures that an adequate amount of negative reactivity is available to shut down the reactor and maintain it subcritical.

BASES

APPLICABILITY (continued)

The Applicability is modified by a Note. The Note states that the limits on boron concentration are applicable to the ~~refueling~~ fuel transfer canal and the refueling cavity only when those volumes are connected to the RCS. When the ~~refueling~~ fuel transfer canal and the refueling cavity are isolated from the RCS, no potential path for boron dilution exists from those volumes.

ACTIONS

A.1 ~~and A.2~~

Continuation of ~~CORE ALTERATIONS or~~positive reactivity additions (including actions to reduce boron concentration) is contingent upon maintaining the plant in compliance with the LCO. If the boron concentration of any coolant volume in the RCS, the refueling cavity, or the fuel transfer canal is less than its limit, all operations involving ~~CORE ALTERATIONS or~~positive reactivity additions must be suspended immediately.

Suspension of ~~CORE ALTERATIONS and~~positive reactivity additions shall not preclude completion of actions to establish a safe condition, including moving a component to a safe position.

A.~~3~~**2**

In addition to immediately suspending ~~CORE ALTERATIONS or~~positive reactivity additions, boration to restore the concentration must be initiated immediately.

In determining the required combination of boration flow rate and concentration, no unique design basis accident (DBA) must be satisfied. The only requirement is to restore the boron concentration to its required value as soon as possible. In order to raise the boron concentration as soon as possible, the operator shall begin boration with the best source available for plant operations.

Once boration is initiated, it must be continued until the boron concentration is restored. The restoration time depends on the amount of boron that must be injected to reach the required concentration.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.9.1.1

This SR verifies that the coolant boron concentration in the RCS, the refueling cavity and the fuel transfer canal is within the COLR limit. The boron concentration of the coolant in each volume is determined periodically by chemical analysis.

A minimum Frequency of once every 72 hours is a ~~sufficient interval~~ **reasonable amount of time between verifications of** ~~to verify~~ the boron concentration. The surveillance interval is based on operating experience, isolation of unborated water sources in accordance with LCO 3.9.2, and the availability of the source range neutron flux monitors required by LCO 3.9.3.

REFERENCES

~~1. Chapter 15, "Accident Analysis."~~
~~2. NS-57.2, ANSI/ANS-57.2-1983, Section 6.4.2.2.3, American Nuclear Society, American National Standard, "Design Requirements for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Plants," 1983.~~
~~3~~**1**. 10 CFR 50, Appendix A, GDC 26.

2. FSAR Section 7.4, "Systems Required for Safe Shutdown."

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.

3.9 REFUELING OPERATIONS

3.9.1 Boron Concentration

LCO 3.9.1 Boron concentration of the Reactor Coolant System (RCS), the fuel transfer canal, and the refueling cavity shall be maintained within the limit specified in COLR.

APPLICABILITY: MODE 6

---------- NOTE ----------
Applicable to the fuel transfer canal and the refueling cavity only when connected to the RCS.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Boron concentration not within limit.	A.1 Suspend positive reactivity additions. AND	Immediately
	A.2 Initiate actions to restore boron concentration to within limit.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.9.1.1	Verify boron concentration is within the limit specified in the COLR.	72 hours

B 3.9 REFUELING OPERATIONS

B 3.9.1 Boron Concentration

BASES

BACKGROUND

The limit on the boron concentration of the Reactor Coolant System (RCS), the refueling cavity, the fuel transfer canal during refueling ensures that the reactor remains subcritical during MODE 6. Refueling boron concentration is the soluble boron concentration in the coolant in each of these volumes having direct access to the reactor core during refueling.

The soluble boron concentration offsets the core reactivity and is measured by chemical analysis of a representative sample of the coolant in each of the volumes. The refueling boron concentration limit is specified in the COLR. Plant procedures ensure the specified boron concentration in order to maintain an overall core reactivity of $k_{eff} \leq 0.95$ during fuel handling with control rods and fuel assemblies assumed to be in the most adverse configuration (least negative reactivity) allowed by procedures.

GDC 26 of 10 CFR 50, Appendix A requires that two independent reactivity control systems of different design principles be provided (Ref. 1). One of these systems, the Passive Core Cooling System (PXS), is capable of holding the core subcritical under safe shutdown conditions as described in FSAR Section 7.4 (Ref. 2).

The reactor is brought to shutdown conditions before beginning operations to open the reactor vessel for refueling. After the RCS is cooled down and depressurized, the vessel head is unbolted and slowly removed. The refueling cavity and the fuel transfer canal are then flooded with borated water from the In-containment Refueling Water Storage Tank (IRWST) by the use of the Spent Fuel Pool Cooling System (SFS).

During refueling, the water volumes in the RCS, the fuel transfer canal and the refueling cavity are contiguous. However, the soluble boron concentration is not necessarily the same in each volume. If additions of boron are required during refueling, the Chemical and Volume Control System (CVS) provides the borated makeup.

BASES

BACKGROUND (continued)

The pumping action of the Normal Residual Heat Removal System (RNS) in the RCS, the SFS pumps in the spent fuel pool and refueling cavity, and the natural circulation due to thermal driving heads in the reactor vessel and refueling cavity mix the added concentrated boric acid with the water in the fuel transfer canal. The RNS is in operation during refueling to provide forced circulation in the RCS, while the SFS is in operation to cool and purify the spent fuel pool and refueling cavity. Their operation assists in maintaining the boron concentration in the RCS, the refueling cavity, and fuel transfer canal above the COLR limit.

APPLICABLE SAFETY ANALYSES

The boron concentration limit, specified in the COLR, is based on the core reactivity at the beginning of each fuel cycle (the end of refueling) and includes an uncertainty allowance.

The required boron concentration and the plant refueling procedures that verify the correct fuel loading plan (including full core mapping) ensure that the k_{eff} of the core will remain ≤ 0.95 during the refueling operation. Hence, at least a 5% Δk/k margin of safety is established during refueling.

The RCS boron concentration satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

The LCO requires that boron concentration be maintained within limit in the RCS, the refueling cavity and the fuel transfer canal while in MODE 6. The boron concentration limit specified in the COLR ensures that a core k_{eff} ≤ 0.95 is maintained during fuel handling operations. Violation of the LCO could lead to an inadvertent criticality during MODE 6.

APPLICABILITY

This LCO is applicable in MODE 6 to ensure that the fuel in the reactor vessel will remain subcritical. The required boron concentration ensures a k_{eff} of ≤ 0.95. Above MODE 6, LCO 3.1.1, “SHUTDOWN MARGIN (SDM)” ensures that an adequate amount of negative reactivity is available to shut down the reactor and maintain it subcritical.

BASES

APPLICABILITY (continued)

The Applicability is modified by a Note. The Note states that the limits on boron concentration are applicable to the fuel transfer canal and the refueling cavity only when those volumes are connected to the RCS. When the fuel transfer canal and the refueling cavity are isolated from the RCS, no potential path for boron dilution exists from those volumes.

ACTIONS

A.1

Continuation of positive reactivity additions (including actions to reduce boron concentration) is contingent upon maintaining the plant in compliance with the LCO. If the boron concentration of any coolant volume in the RCS, the refueling cavity, or the fuel transfer canal is less than its limit, all operations involving positive reactivity additions must be suspended immediately.

Suspension of positive reactivity additions shall not preclude completion of actions to establish a safe condition, including moving a component to a safe position.

A.2

In addition to immediately suspending positive reactivity additions, boration to restore the concentration must be initiated immediately.

In determining the required combination of boration flow rate and concentration, no unique design basis accident (DBA) must be satisfied. The only requirement is to restore the boron concentration to its required value as soon as possible. In order to raise the boron concentration as soon as possible, the operator shall begin boration with the best source available for plant operations.

Once boration is initiated, it must be continued until the boron concentration is restored. The restoration time depends on the amount of boron that must be injected to reach the required concentration.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.9.1.1

This SR verifies that the coolant boron concentration in the RCS, the refueling cavity and the fuel transfer canal is within the COLR limit. The boron concentration of the coolant in each volume is determined periodically by chemical analysis.

A minimum Frequency of once every 72 hours is a reasonable amount of time between verifications of the boron concentration. The surveillance interval is based on operating experience, isolation of unborated water sources in accordance with LCO 3.9.2, and the availability of the source range neutron flux monitors required by LCO 3.9.3.

REFERENCES

1. 10 CFR 50, Appendix A, GDC 26.

2. FSAR Section 7.4, “Systems Required for Safe Shutdown.”