NRC PUBLIC MEETING HANDOUT

June 13, 2019

Technical Specification (TS) Changes Based on Revised Fuel Handling Accident Analysis and Adoption of TSTFs 51, 272, 286, 471, and 571-T

ARKANSAS NUCLEAR ONE – UNIT 2

Example Exercise

3/4.9 REFUELING OPERATIONS

BORON CONCENTRATION

LIMITING CONDITION FOR OPERATION

3.9.1 ~~With the reactor vessel head unbolted or removed, T~~the boron concentration of the reactor coolant system and the refueling canal shall be maintained uniform and sufficient to ensure that the more restrictive of following reactivity conditions is met:

E / DOD 13

a. Either a K_{eff} of 0.95 or less, which includes a 1% $\Delta k/k$ conservative allowance for uncertainties, or

b. A boron concentration of $\geq$ 2500 ppm, which includes a 50 ppm conservative allowance for uncertainties.

APPLICABILITY: MODE 6*.

ACTION:

With the requirements of the above specification not satisfied, immediately suspend all operations involving ~~CORE ALTERATIONS or~~ positive reactivity changes and initiate and continue boration at $\geq$ 40 gpm of $\geq$ 2500 ppm boric acid solution until K_{eff} is reduced to $\leq$ 0.95 or the boron concentration is restored to $\geq$ 2500 ppm, whichever is the more restrictive. The provisions of Specification 3.0.3 are not applicable.

471

SURVEILLANCE REQUIREMENTS

4.9.1.1 The more restrictive of the above two reactivity conditions shall be determined prior to:

a. Removing or unbolting the reactor vessel head, and

b. Withdrawal of any CEA in excess of 3 feet from its fully inserted position within the reactor pressure vessel.

4.9.1.2 The boron concentration of the reactor coolant and the refueling canal shall be determined by chemical analysis in accordance with the Surveillance Frequency Control Program.

* ~~The reactor shall be maintained in MODE 6 when the reactor vessel head is unbolted or removed~~Only applicable to the refueling canal when connected to the RCS.

272 / DOD 4

3.9 REFUELING OPERATIONS

3.9.1 Boron Concentration

LCO 3.9.1 Boron concentrations of the Reactor Coolant System, [the refueling canal, and the refueling cavity] shall be maintained within the limit specified in the COLR.

APPLICABILITY: MODE 6.

----------NOTE----------
Only applicable to the refueling canal and refueling cavity when connected to the RCS.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Boron concentration not within limit.	A.1 Suspend CORE ALTERATIONS.	Immediately
	AND	
	A.2.1 Suspend positive reactivity additions.	Immediately
	AND	
	A.3.2 Initiate action 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

TSTF-272, Rev. 1

3.9 REFUELING OPERATIONS

3.9.1 Boron Concentration

LCO 3.9.1 Boron concentrations of the Reactor Coolant System, [the refueling canal, and the refueling cavity] shall be maintained within the limit specified in the COLR.

APPLICABILITY: MODE 6.

Insert 1

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Boron concentration not within limit.	A.1 Suspend CORE ALTERATIONS.	Immediately
	AND	
	A.2 Suspend positive reactivity additions.	Immediately
	AND	
	A.3 Initiate action 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

Insert 1

---------- NOTE ----------
Only applicable to the refueling canal and refueling cavity when connected to the RCS.

Insert 2

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

Insert 3

Prior to re-connecting portions of the refueling canal or the refueling cavity to the RCS, this SR must be met per SR 3.0.4. If any dilution activity has occurred while the cavity or canal were disconnected from the RCS, this SR ensures the correct boron concentration prior to communication with the RCS.

is not acceptable without crediting the filtration capability of the CREVS. Therefore, the CREVS radiation monitors will continue to be required to be operable during the movement of irradiated fuel assemblies or movement of new fuel assemblies over irradiated fuel assemblies, regardless of the time after shutdown, in order to provide Control Room Operators radiological protection during FHA events. This is more restrictive than the allowances provided by the ITS (TSTF-51) and is considered an acceptable difference.

TSTF-51 also made like changes to ITS 3.7.11, "Control Room Emergency Air Cleanup System (CREACS)" (equivalent to the ANO-2 CREVS) and ITS 3.7.12, "Control Room Emergency Air Temperature Control System (CREATCS)" (equivalent to the ANO-2 Control Room Emergency Air Conditioning System or CREACS). The "recently" term is also not adopted for ANO-2 TS 3.7.6.1, "Control Room Emergency Ventilation and Air Conditioning System," consistent with the above discussion.

2. ANO-2 TS 3.1.1.3, "Boron Dilution," does not exist in the ITS. This specification is intended to verify mixing flow is available (minimum of 2000 gpm) whenever a reduction in RCS boron is being performed. The Action associated with this specification is similar to other TSs (both ITS and ANO-2 specific) in that a reduction in boron concentration is not allowed when the minimum RCS flow rate is not met. TSTF-286 modified this Action type to allow boron reductions provided SDM requirements are maintained. Entergy proposes to adopt the TSTF-286 changes for this Action and has determined that this difference meets the intent of the ITS (TSTF-286).

   Note that the TSTF-286 related markups refer to only the Modes 3, 4, and 5 SDM requirements (ITS 3.1.1). Because ANO-2 TS 3.1.1.3 is applicable in all Modes, references to all ANO-2 SDM related TSs are included in the Action markup. This is an administrative difference which ensures the intent of TSTF-286 is maintained.

3. With reference to ITS 3.4.6, "RCS Loops – Mode 4," the TSTF-286 related markups refer to the SDM requirements of ITS 3.1.1, which are applicable in Modes 3, 4, and 5. Because the ANO-2 SDM TS for Mode 5 is separate from the SDM requirements for other Modes, reference to both ANO-2 SDM TSs are included in the Action markup. This is an administrative difference which ensures the intent of TSTF-286 is maintained.

   In addition, the ITS contains individual specifications for RCS Loops in Mode 4, Mode 5 – Loops Filled, and Mode 5 – Loops Not Filled. All Mode 4 and Mode 5 RCS Loops requirements are contained in a single ANO-2 specification 3.4.1.3, "Reactor Coolant System – Shutdown." Therefore, the TSTF-286 RCS Loop related changes are effectively captured in this single ANO-2 TS for the three aforementioned ITS Modes.

DOD

4. With reference to ITS 3.9.1, "Boron Concentration," TSTF-272 added a Note that stated the LCO was only applicable when the "refueling canal and reactor cavity" were connected to the RCS. ANO-2 TSs and procedures, with respect to RCS and boron concentrations, refer only to the "refueling canal," i.e., the reactor cavity is assumed to be enveloped within the meaning of "refueling canal." At ANO-2, there is no physical separation between the refueling canal and the reactor cavity. In addition, the equivalent ITS LCO contains these terms in brackets, as each would be site specific. Based on the above, the "reactor cavity" phrase is omitted from adoption of the ITS TSTF-272 equivalent. This is an administrative/editorial difference and continues to meet the intent of TSTF-272.

12. *TS 3.8.2.2 A.C. Distribution – Shutdown*

The phrase "and energized" is removed from the Action associated with this TS. A bus that is de-energized cannot be performing its specified safety function and, therefore, cannot be operable. This phrase does not appear in the other shutdown electrical specifications or the ITS. Entergy considers this change administrative/editorial in nature in that the specified safety function of the required equipment is unchanged by removal of this phrase.

DOD

13. *TS 3.9.1 Boron Concentration*

For consistency with other ANO-2 TSs and the ITS, reference to "reactor coolant" in the LCO of ANO-2 TS 3.9.1 is revised to "reactor coolant system" (emphasis added). This change is administrative in nature.

The current LCO for ANO-2 TS 3.9.1 includes the following phrase:

> *With the reactor vessel head unbolted or removed…*

In addition, the current Applicability Note in ANO-2 TS 3.9.1 states:

> *The reactor shall be maintained in MODE 6 when the reactor vessel head is unbolted or removed.*

These statements are a repeat of the TS Definition of "Mode 6". Section 1 of the ANO-2 TSs (Definitions), Table 1.1 states:

6	*REFUELING***	*≤ 0.95 0*	*≤ 140 °F*

*** Reactor vessel head unbolted or removed and fuel in the vessel.*

No other Mode 6 related specifications in the ANO-2 TSs or the ITS include this redundant information. Therefore, the current TS 3.9.1 Applicability Note is replaced with the Note from TSTF-272, which eliminates the above redundant phrase. In addition, the similar phrase in the LCO of TS 3.9.1 is deleted. Entergy's adoption of the TSTF-272 Note is in accordance with the TSTF. The deletion of redundant information is an administrative change and in no way changes the current requirements of the specification.

14. *TS 3.9.4 Containment Building Penetration*

For consistency, "containment" is revised in the Applicability, Action, and SR of ANO-2 TS 3.9.4 to "Containment Building." This is an editorial change only and has no impact on the intent of the specification.

15. *TS 3.9.9 Water Level – Reactor Vessel*

With regard to reactor vessel water level, the phrase "elevation corresponding to the" top of irradiated fuel is added to the LCO. This ensures that proper water level is established prior to initiating refueling of the reactor core following a defueled condition. At this point in an outage, there is no fuel in the core and, based on current LCO wording, verifying 23 feet of water "above fuel in the core" would not be possible. The addition of the aforementioned phrase removes ambiguity in this regard. Entergy considers this change to be an enhancement.

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NRC Public Meeting

Technical Specification (TS) Changes Based on Revised Fuel Handling Accident Analysis and Adoption of TSTFs 51, 272, 286, 471, and 571-T

ARKANSAS NUCLEAR ONE – UNIT 2

June 13, 2019

1:30 – 3:30 pm (EDT)

ANO-2 TS Changes due to FHA and TSTFs

		TSTFs						
	FHA	51	272	286	471	571-T	C	E
TS 1.12 CORE ALTERATION					X			
TS 3.1.1.3 RCS Dilution Flow Rate				(X)			X	X
TS 3.3.3.1 Radiation Monitoring	X	X					X	X
TS 3.4.1.2 RCS Loops – Mode 3				X				X
TS 3.4.1.3 RCS Loops – Modes 4 and 5				X			X	
TS 3.7.6.1 CREVS and CREACS	X							
TS 3.8.1.2 AC Sources – Shutdown	X			X	X			
TS 3.8.2.2 AC Distribution – Shutdown	X			X	X		X	
TS 3.8.2.4 DC Sources/Distribution – Shutdown	X			X	X			
TS 3.9.1 Boron Concentration			X		X			X
TS 3.9.2 Source Range Instrumentation	X	X			X	X		
TS 3.9.4 Containment Building Penetration	X	X						X
TS 3.9.5 Communications	X	(X)			(X)			
TS 3.9.8.1 Shutdown Cooling – Normal Level				X				
TS 3.9.9 Water Level – Reactor Vessel		X					X	

Fuel Handling Accident (FHA) Analysis Changes vs. TS Task Force (TSTF) Adoptions

C = Clarification (technical correction)

E = Editorial (administrative such as spelling)

() = Applicable but not included in TSTF markup

ANO-2 TS Changes due to FHA and TSTFs

FUEL HANDLING ACCIDENT ANALYSIS

Analysis revised as part of adoption of Alternate Source Terms (AST)

Old analysis assumed damage to 60 fuel rods in a single assembly

New analysis assumes all rods in both the dropped and impacted assembly damaged

Requires updating 8 TSs associated with the movement of fuel

EXAMPLE

Applicability: **During movement~~handling~~ of irradiated fuel assemblies or movement of new fuel assemblies over irradiated fuel assemblies**

ANO-2 TS Changes due to FHA and TSTFs

TSTFs 51 and 471

TSTF 51 removed the Defined Term "Core Alteration" from TSs and replaced with the "movement of recently irradiated fuel assemblies"

Because TSTF 51 inadvertently missed some uses of the "Core Alteration" term, TSTF 471 was issued to remove any remaining references of this defined term.

In accordance with TSTF 51, two commitments are adopted:

- **During the movement of irradiated or recently irradiated fuel assemblies, availability of ventilation and radiation monitoring systems that aid in minimizing offsite dose consequences in the event of a fuel handling accident will be considered.**
- **During the movement of irradiated or recently irradiated fuel assemblies, methods will be established that permit prompt closure of the containment building in the event of a fuel handling accident.**

EXAMPLE

Applicability: **During ~~CORE ALTERATIONS~~movement of recently irradiated fuel assemblies or movement of new fuel assemblies over recently irradiated fuel assemblies**

ANO-2 TS Changes due to FHA and TSTFs

TSTF 272

TSTF 272 corrected a deficiency related to the refueling boron TS in Mode 6.

This TS Limiting Condition for Operation (LCO) sets limits on boron concentration for the reactor coolant AND the refueling canal, but did not address conditions when the reactor vessel head is installed but not tensioned (unit remains in Mode 6).

The TSTF adds a Note stating the boron limit is not applicable to the refueling canal when not in communication with the reactor coolant system.

EXAMPLE

LCO: ~~**With the reactor vessel head unbolted or removed, T**~~**the boron concentration of the reactor coolant and the refueling canal shall be maintained uniform and sufficient to ensure that the more restrictive of the following reactivity conditions is met**

Note: ~~**The reactor shall be maintained in Mode 6 when the reactor vessel head is unbolted or removed**~~**Only applicable to the refueling canal when connected to the RCS.**

ANO-2 TS Changes due to FHA and TSTFs

TSTF 286 and 571-T

TSTF 286 addressed Limiting Conditions for Operation (LCOs) and Actions related to positive reactivity additions to the RCS to permit operators to control RCS inventory and temperature while maintaining positive control of core reactivity.

On November 7, 2013, the NRC staff expressed concern with the Actions related to conditions where one source range neutron flux monitor is inoperable. During movement of fuel assemblies, sources, and reactivity control components with one monitor inoperable, there is the potential for the operable monitor to become effectively decoupled from the core reactivity condition.

TSTF-571-T modified the source range neutron flux monitor specification to prohibit the movement of fuel assemblies, sources, and reactivity control components when a source range monitor is inoperable. A provision was included to allow such movement, if it is needed, to repair the inoperable monitor or to place a reactivity-related component in a safe condition.

ANO-2 TS Changes due to FHA and TSFs

TSTF 286 and 571-T

In letter dated October 4, 2018 (Reference 11), the NRC concluded that adoption of TSTF-571-T would resolve the previously identified concerns.

286 EXAMPLE

ACTION: **Suspend ~~all~~ operations that would cause~~involving~~ introduction of coolant into the RCS with~~areduction in~~ boron concentration less than required to meet SDM of LCO 3.1.1.1~~of the Reactor Coolant System~~.**

571-T EXAMPLE

ACTION: **Suspend movement of fuel, sources, and reactivity control components within the reactor vessel[1].**

Note 1: **Fuel assemblies, sources, and reactivity control components may be moved if necessary to restore an inoperable source range neutron flux monitor or to complete movement of a component to a safe condition.**

ANO-2 TS Changes due to FHA and TSTFs

General Content

The revised FHA analysis is discussed in detail with reference to the approved use of AST for ANO-2, including discussion of control of heavy loads in accordance with NUREG 0612.

Each TSTF is likewise discussed in detail.

The above discussion are followed by a Discussion of Differences (DODs) similar to that used in ITS conversion submittals.

While the FHA changes are straight-forward, each TS page affected by the FHA or TSTF changes is annotated and tied to a discussion in the body of the letter.

Annotations include, for example:

- **"DOD 5" (for Discussion of Difference 5, where the ANO-2 change differs from the subject TSTF while the intent of the TSTF remains met)**
- **"286" (where TSTF wording is like-for-like for given TSTF)**
- **"FHA" (for FHA applicability changes)**
- **"E" or "C" (for editorial or clarification changes)**

ANO-2 TS Changes due to FHA and TSTFs

Example Markup

3.1.1.3 The flow rate of reactor coolant through the R~~r~~eactor C~~c~~oolant S~~s~~ystem (RCS) shall be ≥ 2000 gpm whenever a reduction in ~~Reactor Coolant System~~ boron concentration is being made.

E / DOD 9

APPLICABILITY: ALL MODES.

ACTION:

With the flow rate of reactor coolant through the RCS~~reactor coolant system~~ < 2000 gpm, immediately suspend all operations that would cause introduction of coolant into the RCS with~~involving a reduction in~~ boron concentration less than that required to meet the minimum required boron concentration of LCO 3.1.1.1, LCO 3.1.1.2, or LCO 3.9.1, as applicable~~of the Reactor Coolant System~~.

286 / E / DOD 2

C / DOD 2

SURVEILLANCE REQUIREMENTS

4.1.1.3 The flow rate of reactor coolant through the RCS~~reactor coolant system~~ shall be determined to be ≥ 2000 gpm within one hour prior to the start of and in accordance with the Surveillance Frequency Control Program during a reduction in the R~~eactor Coolant System~~ boron concentration by either:

ANO-2 TS Changes due to FHA and TSTFs

DODs

DOD 9: **Because TSTF 286 (and the ITS) utilizes the acronym "RCS" in lieu of "reactor coolant system," TS 3.1.1.3 use of the "reactor coolant system" phrase is replaced with "RCS" following its first use in the LCO. This change is administrative in nature. Note that "Reactor Coolant System" in the TS 3.1.1.3 Action is shown deleted as part of changes associated with TSTF 286 adoption.**

DOD 2: **ANO-2 TS 3.1.1.3, "Boron Dilution," does not exist in the ITS. This specification is intended to verify mixing flow is available (minimum of 2000 gpm) whenever a reduction in RCS boron is being performed. The Action associated with this specification is similar to other TSs (both ITS and ANO-2 specific) in that a reduction in boron concentration is not allowed when the minimum RCS flow rate is not met. TSTF-286 modified this Action type to allow boron reductions provided SDM requirements are maintained. Entergy proposes to adopt the TSTF-286 changes for this Action and has determined that this difference meets the intent of the ITS (TSTF-286).**

Note that the TSTF-286 related markups refer to only the Modes 3, 4, and 5 SDM requirements (ITS 3.1.1). Because ANO-2 TS 3.1.1.3 is applicable in all Modes, references to all ANO-2 SDM related TSs are included in the Action markup. This is an administrative difference which ensures the intent of TSTF-286 is maintained.

ANO-2 TS Changes due to FHA and TSTFs

Information Alignment

As part of submittal development, the following steps were utilized with respect to the actual proposed TS changes, which may also aid in the review process:

- **The CE TS markup pages from each TSTF were printed.**
- **The TS markups pages from the ANO-2 submittal were printed.**
- **The DOD section of the ANO-2 submittal was printed.**
- **Using the above printed material, each ANO-2 TS markup page was compared against each relevant TSTF markup page and any associated DOD contained in the ANO-2 letter to ensure all changes were incorporated correctly and any differences were accompanied by an associated DOD.**
- **Each change on a given ANO-2 TS markup page was circled (by hand) following confirmation that all changes were appropriately incorporated and discussed within the DOD section of the letter, as necessary.**

The above process permitted efficient review of both accuracy and completeness to support the proposed changes.

ANO-2 TS Changes due to FHA and TSTFs

Summary Information

To aid in NRC review:

- **The basis/justification associated with previous approval of each TSTF and the FHA is provided.**
- **Dates and ML references are provided for TSTF/FHA related correspondence.**
- **The three NSHC questions discussed for each TSTF and the FHA individually.**
- **As stated previously, an evaluation of other load drops is included (beyond fuel assembly drops).**

ANO-2 TS Changes due to FHA and TSTFs

COMMENTS?

QUESTIONS?