Watts Bar Nuclear Plant (WBN)
Proposed License Approach Regarding a Change for the WBN Units 1 and 2 Technical Specification (TS) 3.3.2 Table 1 Function 6.e “Auxiliary Feedwater Auto - Start from Loss of Main Feedwater Pumps”

August 11, 2020

Agenda

- Opening Remarks
- Background
- Need for Change
- Proposed design change
- Proposed TS changes
- License Amendment Request (LAR) Schedule Milestones
- Closing Remarks

Opening Remarks

- Purpose of the meeting is to discuss a proposed change to WBN Units 1& 2 TS 3.3.2 Table 1 Function 6.e “Auxiliary Feedwater Auto - Start from Loss of Main Feedwater Pumps.”
  - Similar presentation provided to NRC on May 27, 2020.
- Proposed TS change will allow the use of the standby main feedwater pump (SBMFWP) as the normal means for starting up and shutting down the plant.
- Proposed design change to the AFW Auto-start Logic to support the LAR. Design change will be implemented during the WBN 1 Cycle 17 Refueling Outage (U1R17) scheduled for October 2021.

Background

- WBN TS 3.3.2 Table 1 Function 6.e, Trip of all Turbine Driven Main Feedwater Pumps (TDMFWPs), for Auxiliary Feedwater (AFW) auto-start function is an anticipatory function that provides early actuation of the AFW system to mitigate the consequences of a loss of normal feedwater

- For the WBN “Loss of Normal Feedwater” event, the credit AFW safety function actuation is from the AFW auto-start on low-low steam generator (SG) level (TS 3.3.2 Table 1 Function 6.b). This engineered safety feature actuation system (ESFAS) meets all requirements for reliable power supplies, separation, redundancy, testability, seismic and environmental qualifications as specified in 10 CFR 50.55a(h)(2), Protection Systems.

Background

- The WBN main feedwater system (MFW) is designed to supply a sufficient quantity of feedwater to the SG secondary side during plant normal operating conditions.
- The WBN MFW system consists of two TDMFWPs arranged in parallel with a single SBMFWP, two injection water pumps, three (parallel string) high-pressure FW heaters, and associated piping and instrumentation.
- The TDMFWPs are variable speed feed pumps with each pump can provide up to 67% capacity
- The two TDMFWPs variable speed main feedwater pumps are capable of delivering feedwater to the four SGs under all expected operating conditions.
- The electric motor-driven SBMFWP can provide approximately 15% to 18% capacity
- During certain times of the year, to improve plant efficiency, the standby main feedwater pump is used to supplement MFP flow at high plant loads.
- The SBMFP will automatically start if one of the TDMFPs trip above 67% power.

Background

- The electric motor driven SBMFWP does not interface with the MFP Trip for AFW Auto-Start Logic
- The original design basis for WBN allowed the electric motor driven SBMFWP to be used for normal plant startup and shutdown (up to 15% thermal power) while a TDMFWP(s) were being placed or removed from service.
- NUREG 0847, Safety Evaluation Report Related to the Operation of Watts Bar Nuclear Plant Units 1 and 2 Docket Nos. 50-390 and 50-391, dated June 1982 (ML072060490),Section 10.4.7:
  - *The use of the standby feedwater pump is the normal means for starting up and shutting down the plant. This pump is also automatically activated in the event of the loss of one main feedwater pump. This is accompanied by an automatic turbine runback to 85 percent of load if the power level is above 80 percent of full power. Should main feedwater flow continue to decrease, the auxiliary feedwater system will automatically activate when the low-low steam generator level is reached. The auxiliary feedwater system (see Section 10.4.9) automatically provides flow to the steam generators for decay heat removal upon the loss of normal feedwater supply.*
- Additional Regulatory Background at the end of the presentation

Background

- NRC documented concerns on the use of the SBMFWP for reactor startup beginning in 2006 since the SBMFWP does not interface to the auxiliary feedwater water (AFW) automatic start logic.
- TS change 08-07 denoted that the SBMFWP pump was originally designed to provide feed flow during startup and shutdown conditions below 15% rated thermal power (RTP) and to accommodate loss of one TDMFP above 67% RTP. Due to the non-compliance issues addressed in NRC Inspection Reports 2006-004 and 2008-003, the AFW motor driven pumps and the TDMFPs would be used for normal plant startup and shutdown in compliance with the proposed change.
- The AFW motor driven pumps and the TDMFWPs are used for normal plant startup and shutdown in compliance with TS 3.3.2 Table 1 Function 6.e

Need for Change

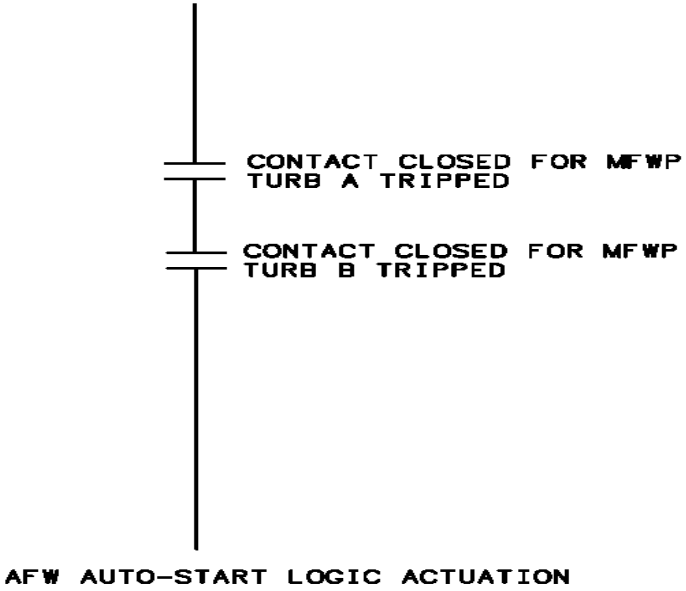
- Presently, the AFW motor driven pumps and the TDMFWPs are used for normal plant startup and shutdown in compliance with TS 3.3.2 Table 1 Function 6.e
  - During startup, with the use of the AFW motor driven pumps, steam generator water level and feedwater control at low reactor thermal power (2-3%) power can be challenging
  - Feedwater swings affect temperature and power which is not ideal at low powers with tight control bands
- A TDMFWP is placed in service at low reactor thermal power (~4%). However, it is ideal for a steam driven pump, which impacts reactivity, to be placed in service at a higher RTP (>5% Mode 1).
- With the use of the SBMFWP for startup activities
  - SBMFWP would be placed in service to control SG level from Mode 3 to Mode 1 ~15% power.
  - At 10% -15% rated thermal power, a TDMFP would be placed in service in Mode 1 to control SG water levels
  - Once the TDMFP is operating, the SBMFP would be removed from service.
- The use of the SBMFWP during start up activities would simplify startup activities with the elimination of the need to swap between AFW level control valves and MFW bypass valves in Mode 2 (2-3% RTP).

Proposed Design Approach

- Revise the AFW Auto-start Logic
  - The addition of SBMFWP power supply breaker contact interface to the AFW Auto-start Logic
  - The breaker contact will close when breaker is open.
  - This will make the AFW auto-start logic initiate from the trip of all MFW pumps both TDMFPs and the SBMFP
  - The SBMFP trip channel will be provided with a handswitch that allows the operations staff to place the channel in trip when the SBMFP is not operable.
- The revised circuitry will remain as an anticipatory AFW auto-start function and will not be credited in the WBN accident analyses.

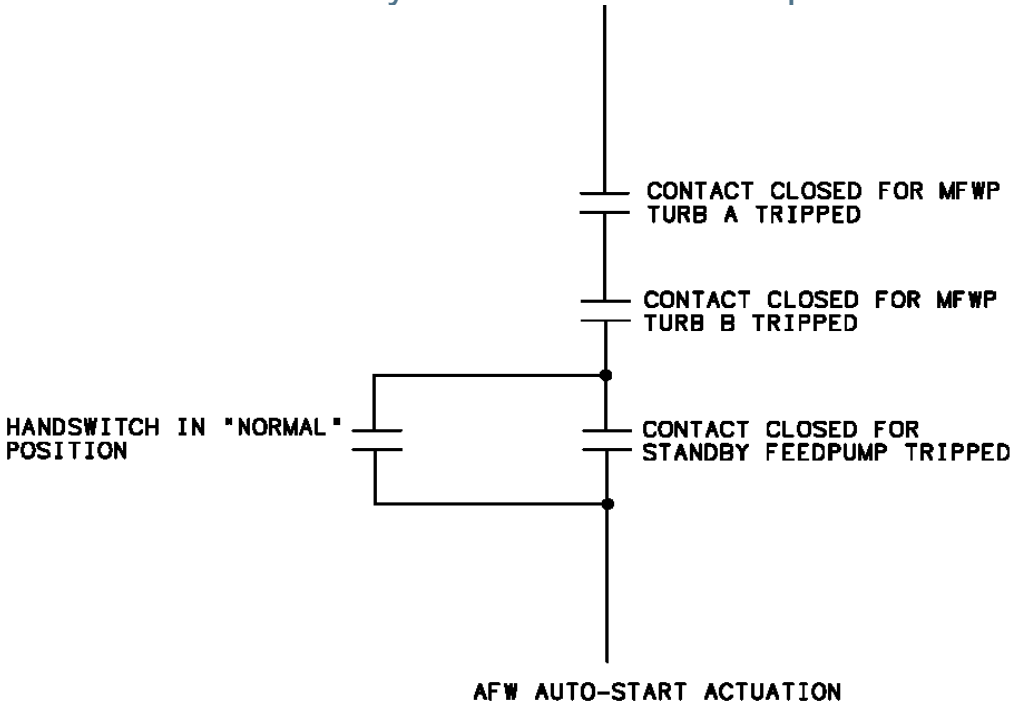
Proposed Design Change

Existing AFW Auto-Start initiation Logic



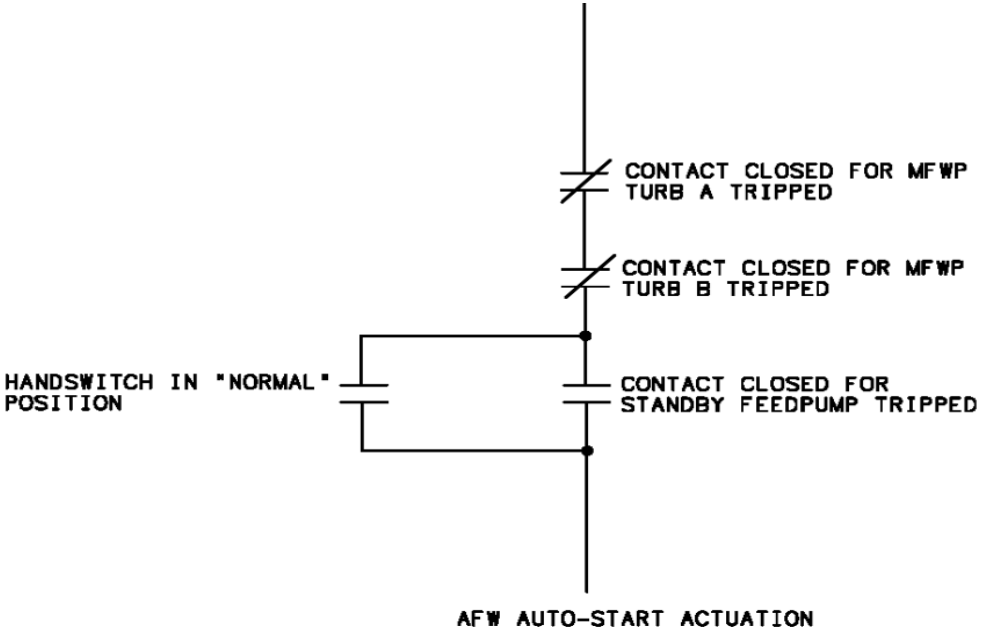
Proposed Design Change

Proposed design for AFW auto-start initiation logic with the addition of the Standby Main Feedwater Trip channel



Proposed Design Change

Design for AFW auto-start initiation logic when the SBMFP is supplying feedwater to the SGs



Proposed TS Changes

- TS 3.3.2 Table 1 Function 6.e will be revised to denote the AFW Automatic start will include:
  - The Trip of all MFW Pumps
    - » The trip of both TDMFPs
    - » And
    - » The trip of the SBMFP
- The applicability of the SBMFP trip channel would be Modes 1 and 2.
- A new TS 3.3.2 condition will be added to address inoperability of the SBMFP trip function.
- Associated changes to the TS Bases

Proposed TS Changes for WBN 1 (markup)

Table 3.3.2-1 (page 5 of 7)
Engineered Safety Feature Actuation System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	NOMINAL TRIP SETPOINT
6. Auxiliary Feedwater (continued)						
c. Safety Injection	Refer to Function 1 (Safety Injection) for all initiation functions and requirements.					
d. Loss of Offsite Power	1, 2 ,3	4 per bus	F	Refer to Function 4 of Table 3.3.5-1 for SRs and Allowable Values		
e.. Trip of all Main Feedwater ~~Turbine Driven Main Feedwater~~ Pumps	~~1(i), 2(i)~~	~~1 per pump~~	~~J~~	~~SR 3.3.2.8~~ ~~SR 3.3.2.9~~ ~~SR 3.3.2.10~~	~~≥ 48 psig~~	~~50 psig~~
(1) Turbine Driven Main Feedwater Pumps	1(i), 2	1 per pump	J	SR 3.3.2.8 SR 3.3.2.9 SR 3.3.2.10	≥ 48 psig	50 psig
and						
(2) Standby Main Feedwater Pump	1, 2	1	P	SR 3.3.2.8 SR 3.3.2.10	NA	NA
f. Auxiliary Feedwater Pumps Train A and B Suction Transfer on Suction Pressure - Low	1, 2, 3, 4(k)	3	B	SR 3.3.2.6 SR 3.3.2.9 SR 3.3.2.10	A) ≥ 0.5 psig B) ≥ 1.33 psig	A) 1.2 psig B) 2.0 psig
7. Automatic Switchover to Containment Sump						
a. Automatic Actuation Logic and Actuation Relays	1, 2, 3, 4	2 trains	C	SR 3.3.2.2 SR 3.3.2.3 SR 3.3.2.5	NA	NA

(continued)

(i) Entry into Condition J may be suspended for up to 4 hours when placing the second Turbine Driven Main Feedwater (TDMFW) Pump in service or removing one of two TDMFW pumps from service.

(j) ~~When one or more Turbine Driven Feedwater Pump(s) are supplying feedwater to steam generators~~Deleted.

(k) When steam generators are relied on for heat removal.

Proposed TS Changes for WBN 1 (markup)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
O. One MSVV Room Water Level High channel inoperable.	----------NOTE---------- The inoperable channel may be bypassed for up to 12 hours for surveillance testing of other channels. ---------- O.1 Place channel in trip OR O.2 Be in MODE 3	 72 hours 78 hours
P. One Standby Main Feedwater Pump trip channel inoperable	P.1 Place channel in trip. OR P.2 Be in MODE 3.	48 hours 54 hours

Proposed TS Changes for WBN 2 (markup)

Table 3.3.2-1 (page 6 of 8)
Engineered Safety Feature Actuation System Instrumentation

	FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	NOMINAL TRIP SETPOINT
6.	Auxiliary Feedwater (continued)						
d.	Loss of Offsite Power	1, 2, 3	4 per bus	F	Refer to Function 4 of Table 3.3.5-1 for SRs and Allowable Values. Notes (b) and (c) are applicable to SR 3.3.5.2 for this function.		
e.	Trip of all ~~Turbine Driven~~ Main Feedwater Pumps						
	(1) Turbine Driven Main Feedwater Pumps	1 [j], 2~~[k]~~	1 per pump	J	SR 3.3.2.8 [b],[c] SR 3.3.2.9 [b],[c] SR 3.3.2.10	≥43.3 psig	50 psig
	and						
	(2) Standby Main Feedwater Pumps	1, 2	1	P	SR 3.3.2.8 SR 3.3.2.10	NA	NA
f.	Auxiliary Feedwater Pumps Train A and B Suction Transfer on Suction Pressure - Low	1, 2, 3, 4[m]	3	B	SR 3.3.2.6 SR 3.3.2.9 [b],[c] SR 3.3.2.10	A) ≥ 0.5 psig B) ≥ 1.33 psig	A) 1.2 psig B) 2.0 psig
7.	Automatic Switchover to Containment Sump						
a.	Automatic Actuation Logic and Actuation Relays	1, 2, 3, 4	2 trains	C	SR 3.3.2.2 SR 3.3.2.3 SR 3.3.2.5	NA	NA
b.	Refueling Water Storage Tank (RWST) Level - Low	1, 2, 3, 4	4	K	SR 3.3.2.1 SR 3.3.2.4 [b],[c] SR 3.3.2.9 [b],[c] SR 3.3.2.10	≥155.6 inches from Tank Base	158 inches from Tank Base
	Coincident with Safety Injection	Refer to Function 1 (Safety Injection) for all initiation functions and requirements.					
	and						
	Coincident with Containment Sump Level - High	1, 2, 3, 4	4	K	SR 3.3.2.1 SR 3.3.2.4 [b],[c] SR 3.3.2.9 [b],[c] SR 3.3.2.10	≥ 37.2 inches above el. 702.8 ft	38.2 inches above el. 702.8 ft

(continued)

Proposed TS Changes for WBN 2 (markup)

ESFAS Instrumentation
3.3.2

(b) If the as found channel setpoint is outside its redefined as found tolerance, then the channel shall be evaluated to verify that it is functioning as required before returning the channel to service.

(c) The instrument channel setpoint shall be reset to a value that is within the as left tolerance around the Nominal Trip Setpoint (NTSP) at the completion of the surveillance; otherwise, the channel shall be declared inoperable. The methodologies used to determine the as found and as left tolerances for the NTSP are specified in FSAR Section 7.1.2.

(j) Entry into Condition J may be suspended for up to 4 hours when placing the second Turbine Driven Main Feedwater (TDMFW) Pump in service or removing one of two TDMFW pumps from service.

(k) ~~When one or more Turbine Driven Feedwater Pump(s) are supplying feedwater to steam generators~~Deleted.

(m) When steam generators are being relied on for heat removal.

Proposed TS Changes for WBN 2 (markup)

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
N. One Vessel ΔT channel inoperable.	----------NOTE---------- One channel may be bypassed for up to 12 hours for surveillance testing. ----------		
	N.1	Set the Trip Time Delay threshold power level for (T_s) and (T_m) to 0% power.	72 hours
	OR		
	N.2	Be in MODE 3.	78 hours
O. One MSVV Room Water Level High channel inoperable.	----------NOTE---------- The inoperable channel may be bypassed for up to 12 hours for surveillance testing of other channels. ----------		
	O.1	Place channel in trip.	72 hours
	OR		
	O.2	Be in MODE 3.	78 hours
P. One Standby Main Feedwater Pump trip channel inoperable.	P.1	Place channel in trip.	48 hours
	OR		
	P.2	Be in MODE 3.	54 hours

Proposed TS Changes for WBN 1 (final)

Table 3.3.2-1 (page 5 of 7)
Engineered Safety Feature Actuation System Instrumentation

	FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	NOMINAL TRIP SETPOINT
6.	Auxiliary Feedwater (continued)						
	c. Safety Injection	Refer to Function 1 (Safety Injection) for all initiation functions and requirements.					
	d. Loss of Offsite Power	1, 2 ,3	4 per bus	F	Refer to Function 4 of Table 3.3.5-1 for SRs and Allowable Values		
	e.. Trip of all Main Feedwater Pumps						
	(1) Turbine Driven Main Feedwater Pumps	1[(i)], 2	1 per pump	J	SR 3.3.2.8 SR 3.3.2.9 SR 3.3.2.10	≥ 48 psig	50 psig
	and						
	(2) Standby Main Feedwater Pump	1, 2	1	P	SR 3.3.2.8 SR 3.3.2.10	NA	NA
	f. Auxiliary Feedwater Pumps Train A and B Suction Transfer on Suction Pressure - Low	1, 2, 3, 4[(k)]	3	B	SR 3.3.2.6 SR 3.3.2.9 SR 3.3.2.10	A) ≥ 0.5 psig B) ≥ 1.33 psig	A) 1.2 psig B) 2.0 psig
7.	Automatic Switchover to Containment Sump						
	a. Automatic Actuation Logic and Actuation Relays	1, 2, 3, 4	2 trains	C	SR 3.3.2.2 SR 3.3.2.3 SR 3.3.2.5	NA	NA

(continued)

(i) Entry into Condition J may be suspended for up to 4 hours when placing the second Turbine Driven Main Feedwater (TDMFW) Pump in service or removing one of two TDMFW pumps from service.

(j) Deleted.

(k) When steam generators are relied on for heat removal.

Proposed TS Changes for WBN 1 (final)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
O. One MSVV Room Water Level High channel inoperable.	----------NOTE---------- The inoperable channel may be bypassed for up to 12 hours for surveillance testing of other channels. ----------	
	O.1 Place channel in trip.	72 hours
	OR	
	O.2 Be in MODE 3.	78 hours
P. One Standby Main Feedwater Pump trip channel inoperable	P.1 Place channel in trip.	48 hours
	OR	
	P.2 Be in MODE 3.	54 hours

Proposed TS Changes for WBN 2 (final)

SURVEILLANCE REQUIREMENTS (continued)

Table 3.3.2-1 (page 6 of 8)
Engineered Safety Feature Actuation System Instrumentation

	FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	NOMINAL TRIP SETPOINT
6.	Auxiliary Feedwater (continued)						
	d. Loss of Offsite Power	1, 2, 3	4 per bus	F	Refer to Function 4 of Table 3.3.5-1 for SRs and Allowable Values. Notes (b) and (c) are applicable to SR 3.3.5.2 for this function.		
	e. Trip of all Main Feedwater Pumps						
	(1) Turbine Driven Main Feedwater Pumps	1 [(j)], 2	1 per pump	J	SR 3.3.2.8 [(b)(c)] SR 3.3.2.9 [(b)(c)] SR 3.3.2.10	≥43.3 psig	50 psig
	and						
	(2) Standby Main Feedwater Pumps	1, 2	1	P	SR 3.3.2.8 SR 3.3.2.10	NA	NA
	f. Auxiliary Feedwater Pumps Train A and B Suction Transfer on Suction Pressure - Low	1, 2, 3, 4 [(m)]	3	B	SR 3.3.2.6 SR 3.3.2.9 [(b)(c)] SR 3.3.2.10	A) ≥ 0.5 psig B) ≥ 1.33 psig	A) 1.2 psig B) 2.0 psig
7.	Automatic Switchover to Containment Sump						
	a. Automatic Actuation Logic and Actuation Relays	1, 2, 3, 4	2 trains	C	SR 3.3.2.2 SR 3.3.2.3 SR 3.3.2.5	NA	NA
	b. Refueling Water Storage Tank (RWST) Level - Low	1, 2, 3, 4	4	K	SR 3.3.2.1 SR 3.3.2.4 [(b)(c)] SR 3.3.2.9 [(b)(c)] SR 3.3.2.10	≥155.6 inches from Tank Base	158 inches from Tank Base
	Coincident with Safety Injection	Refer to Function 1 (Safety Injection) for all initiation functions and requirements.					
	and						
	Coincident with Containment Sump Level - High	1, 2, 3, 4	4	K	SR 3.3.2.1 SR 3.3.2.4 [(b)(c)] SR 3.3.2.9 [(b)(c)] SR 3.3.2.10	≥ 37.2 inches above el. 702.8 ft	38.2 inches above el. 702.8 ft

(continued)

Proposed TS Changes for WBN 2 (final)

ESFAS Instrumentation
3.3.2

(b) If the as found channel setpoint is outside its redefined as found tolerance, then the channel shall be evaluated to verify that it is functioning as required before returning the channel to service.

(c) The instrument channel setpoint shall be reset to a value that is within the as left tolerance around the Nominal Trip Setpoint (NTSP) at the completion of the surveillance; otherwise, the channel shall be declared inoperable. The methodologies used to determine the as found and as left tolerances for the NTSP are specified in FSAR Section 7.1.2.

(j) Entry into Condition J may be suspended for up to 4 hours when placing the second Turbine Driven Main Feedwater (TDMFW) Pump in service or removing one of two TDMFW pumps from service.

(k) Deleted.

(m) When steam generators are being relied on for heat removal.

Proposed TS Changes for WBN 2 (final)

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
N. One Vessel ΔT channel inoperable.	----------NOTE---------- One channel may be bypassed for up to 12 hours for surveillance testing. ----------		
	N.1	Set the Trip Time Delay threshold power level for (T_s) and (T_m) to 0% power.	72 hours
	OR		
	N.2	Be in MODE 3.	78 hours
O. One MSVV Room Water Level High channel inoperable.	----------NOTE---------- The inoperable channel may be bypassed for up to 12 hours for surveillance testing of other channels. ----------		
	O.1	Place channel in trip.	72 hours
	OR		
	O.2	Be in MODE 3.	78 hours
P. One Standby Main Feedwater Pump trip channel inoperable.	P.1	Place channel in trip.	48 hours
	OR		
	P.2	Be in MODE 3.	54 hours

LAR Schedule Milestones

- August 4, 2020 – LAR pre-submittal meeting with NRC
- September 1, 2020 – LAR submittal.
- NRC approval of LAR within one year from the date of the submittal (Requested). 30-day implementation period
- October 2021 – Scheduled start of WBN U1R17 outage


TVA

Regulatory Background

2004

- TVA submits TS-04-013
- Clarification of AFW start from TDMFP

2006

- TVA withdraws TS-04-013
- NRC issues NCV 05000390/2006004-04 for failing to have AFW start signal
- NRC Integrated Inspection Report 05000390/20060004 and 05000391/2006004

2008

- NRC issues NCV 05000390/2008003-1 for violation of TS 3.0.4
- Entered Modes 2&1 without operable channel for auto start of AFW
- NRC Integrated Inspection Report 05000390/20080003 and 05000391/2008003
- TVA submits WBN-08-07 AFW auto-start upon trip of TDMFP

2009

- NRC issues License amendment 75 for TS 3.3.2.Table 1 Function 6.e
- Present License condition

2015

- NRC Issues IN 2015-05 " INOPERABILITY OF AUXILIARY AND EMERGENCY FEEDWATER AUTO-START CIRCUITS ON LOSS OF MAIN FEEDWATER PUMPS"
- WBN Issue discussed

Regulatory Background

- NRC documented concerns on the use of the SBMFP for reactor startup beginning in 2006 since the SBMFP does not interface to the auxiliary feedwater water (AFW) automatic start logic.
- Due to the non-compliance issues addressed in NRC Inspection Reports 2006-004 and 2008-003, TVA submitted TS Change 08-07 “AFW Auto-start Upon Trip of the Turbine Driven Main Feedwater Pumps”
- TS change 08-07 denoted that the SBMFP pump was originally designed to provide feed flow during startup and shutdown conditions below 15% rated thermal power (RTP) and to accommodate loss of one TDMFP above 67% RTP. Due to the non-compliance issues addressed in NRC Inspection Reports 2006-004 and 2008-003, the AFW motor driven pumps and the TDMFPs would be used for normal plant startup and shutdown in compliance with the proposed change.
- The AFW motor driven pumps and the TDMFPs are used for normal plant startup and shutdown in compliance with TS 3.3.2 Table 1 Function 6.e