TDAFW

On August 23, 2000, while raising the turbine-driven Auxiliary Feedwater (TDAFW) pump speed from approximately 1400 rpm to its rated speed of 4400 rpm, the control room operator noted that the turbine speed would at times not respond to the motion of the speed control switch and at other times raise in spurts. Also during the start, a senior reactor operator in the pump room noted that at times the speed control servo motor was turning without any corresponding motion of the turbine governor steam valve. These observations were documented in CR-08-23. Engineering personnel and the Shift Manager evaluated the condition and concluded that the observed governor valve response was consistent with the expected response in that, at certain points, substantial motion of the speed control servo motor is necessary to cause a perceptible change in governor steam valve position. The corrective action assignment for CR-08-23 was to have the system engineer observe the next periods of pump operation.

The next operation of the TDAFW pump was a regularly scheduled surveillance test performed on November 20, 2000. During the test, the turbine was started and warmed up at its minimum operating speed of approximately 1400 rpm. Following the warmup, control room operators were unable to increase turbine speed above its starting speed through operation of the TDAFW pump speed control switch. The discharge pressure of the pump at that speed was 200 psig, which was insufficient pressure for the pump to provide feedwater to the steam generators. The licensee declared the pump inoperable and documented the surveillance test failure in CR-11-20.

The TDAFW pump speed control switch in the control room operates a speed control servo motor mounted on the turbine governor. The servo motor is connected through reduction gears and a mechanical coupling to the manual speed control knob on the governor, which positions the governor steam valve. The manual speed control knob is held on the governor shaft by a self-locking nut and Belleville washers. The knob is keyed to the shaft through an outward bend in the clutch spring that engages a groove on the inner surface of the knob.

Following the surveillance test failure, the licensee disassembled the speed control servo motor and the associated coupling. The mechanic performing the disassembly found the self-locking nut loose and the outward bend in the clutch spring sheared off. Because of the lack of engagement between the manual speed control knob and the governor shaft, the servo motor could not turn the governor shaft. The inspector concluded that this failure mechanism would not readily allow recovery of the pump by local manipulation of the speed control knob.

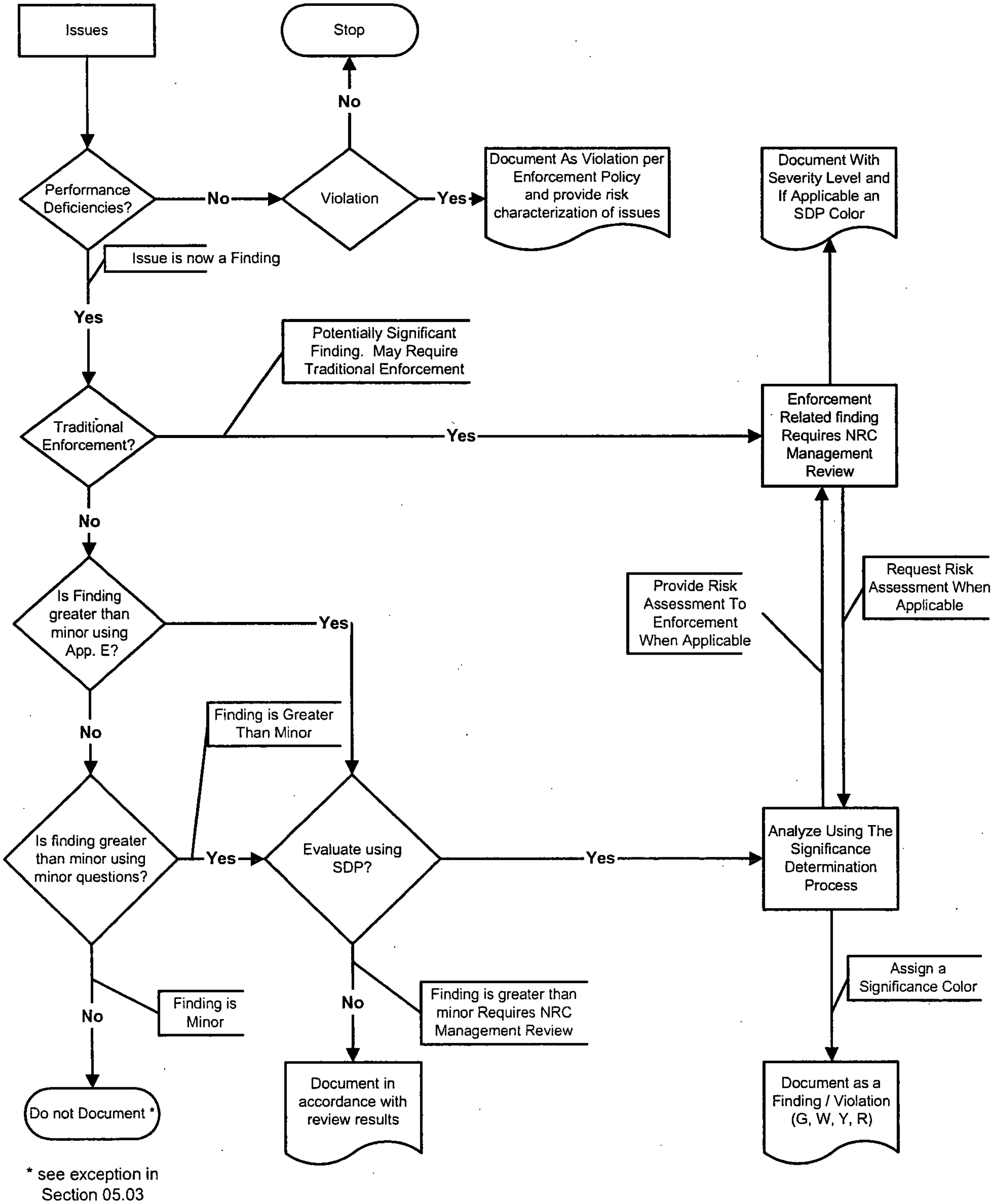
Note: It is difficult to prove that the pump was inoperable on 8/23/2000. The time difference between 8/23/2000 (assuming operability on 8/23) and 11/20/2000 is 88 days. Using the t/2 rule, the exposure time is 44 days, and you should use this number in your calculations.

F-2

APPENDIX B
Issue Screening

Use Figure 1 and the questions listed below to determine if a finding has sufficient significance to warrant further analysis or documentation.

Figure 1



SDP PHASE 1 SCREENING WORKSHEET FOR INITIATING EVENTS, MITIGATION SYSTEMS, AND BARRIERS CORNERSTONES
Reference/Title (LER #, Inspection Report #, etc):
Performance Deficiency (concise statement clearly stating deficient licensee performance): Improper Corrective action resulted in an unrecognized failure of the TDAFW speed circuitry.
Factual Description of Condition (statement of facts known about the condition that resulted from the performance deficiency, without hypothetical failures included): The TDAFW pump was inoperable due to speed control circuit failures. The pumps would not develop sufficient discharge pressure and could not feed the steam generators.
System(s)/Train(s) Degraded by Condition: TADFW
Licensing Basis Function of System(s)/Train(s): SG feed during loss of MFW events.
Other Safety Function of System(s)/Train(s): SBLOCA heat removal, SBO heat removal.
Maintenance Rule Category (check one): ☒ risk-significant ☐ non risk-significant
Time condition existed or is assumed to have existed: 44 days

CORNERSTONES AND FUNCTIONS DEGRADED AS A RESULT OF DEFICIENCY (☒) Check the appropriate boxes		
INITIATING EVENTS CORNERSTONE	**MITIGATION SYSTEMS CORNERSTONE**	**BARRIERS CORNERSTONE**
☐ Primary System LOCA initiator contributor - (e.g., RCS leakage from pressurizer heater sleeves, RPV piping penetrations, CRDM nozzles, PORVs, SRVs, ISLOCA issues, etc.) ☐ Transient initiator contributor (e.g., reactor/turbine trip, loss of offsite power, loss of service water, main steam/feedwater piping degradations, etc.) ☐ Fire initiator contributor (e.g., transient loadings and combustibles, hotwork) ☐ Internal/external flooding initiator contributor	☒ Core Decay Heat Removal Degraded ☒ Short Term Heat Removal Degraded ☐ Primary (e.g., Safety Inj, [main feedwater, HPCI, and RCIC - BWR only]) ____ High Pressure ____ Low Pressure ☒ Secondary - PWR only (e.g. AFW, main feedwater, ADVs) ☐ Long Term Heat Removal Degraded (e.g., ECCS sump recirculation, suppression pool) ☐ Reactivity Control Degraded ☐ Seismic/Fire/Flood/Severe Weather Protection Degraded	☐ RCS Boundary as a mitigator following plant upset (e.g., pressurized thermal shock). Note: all other RCS boundary issues, such as leaks, will be considered under the Initiating Events Cornerstone. ☐ Containment Barrier Degraded ☐ Reactor Containment Degraded ___ Actual Breach or Bypass ___ Heat Removal, Hydrogen or Pressure Control Degraded ☐ Control Room, Aux Bldg/Reactor Bldg, or Spent Fuel Bldg Barrier Degraded ☐ Fuel Cladding Barrier Degraded

SDP PHASE 1 SCREENING WORKSHEET FOR IE, MS, and B CORNERSTONES

Check the appropriate boxes ✔

IF the finding is assumed to degrade:

1. fire protection defense-in-depth strategies involving: detection, suppression (equipment for both manual and automatic), barriers, fire prevention and administrative controls, and post fire safe shutdown systems, **THEN STOP. Go to** IMC 0609, Appendix F. Issues related to performance of the fire brigade are not included in Appendix F and require NRC management review.

2. steam generator tube integrity, **THEN STOP. Go to** IMC 0609, Appendix J.

3. the safety of an operating reactor, **THEN IDENTIFY** the degraded cornerstone(s):

   - ☐ Initiating Event
   - ☒ Mitigation Systems
   - ☐ RCS Barrier (e.g., PTS issues)
   - ☐ Fuel Barrier
   - ☐ Containment Barriers

IF TWO OR MORE of the above cornerstones are degraded → **THEN STOP. Go to Phase 2.**

IF ONLY ONE of the above cornerstones is degraded, **THEN CONTINUE** in the appropriate column on page 4 of 5 of this worksheet.

NOTE: When assessing the significance of a finding affecting multiple cornerstones, the finding should be assigned to the cornerstone that best reflects the dominant risk of the finding.

Page 3 of 5

Initiating Events Cornerstone	Mitigation Systems Cornerstone	RCS Barrier or Fuel Barrier	Containment Barriers Cornerstone
LOCA Initiators 1. Assuming worst case degradation, would the finding result in exceeding the Tech Spec limit for identified RCS leakage or could the finding have likely affected other mitigation systems resulting in a total loss of their safety function. ☐ **If YES → Stop. Go to Phase 2.** ☐ If NO, screen as Green. Transient Initiators 1. Does the finding contribute to both the likelihood of a reactor trip AND the likelihood that mitigation equipment or functions will not be available? ☐ **If YES→Stop. Go to Phase 2.** ☐ If NO, screen as Green. External Event Initiators 1. Does the finding increase the likelihood of a fire or internal/external flood? ☐ **If YES** → Use the IPEEE or other existing plant-specific analyses to identify core damage scenarios of concern and factors that increase the frequency. Provide this input for **Phase 3** analysis. ☐ If NO, screen as Green.	1. Is the finding a design or qualification deficiency confirmed not to result in loss of operability per "Part 9900, Technical Guidance, Operability Determination Process for Operability and Functional Assessment." 2. ☐ **If YES, screen as Green.** ☒ If NO, continue. 2. Does the finding represent a loss of system safety function? ☐ **If YES → Stop. Go to Phase 2.** ☒ If NO, continue. 3. Does the finding represent actual loss of safety function of a single Train, for > its Tech Spec Allowed Outage Time? ☒ **If YES → Stop. Go to Phase 2.** ☐ If NO, continue. 4. Does the finding represent an actual loss of safety function of one or more non-Tech Spec Trains of equipment designated as risk-significant per 10CFR50.65, for >24 hrs? ☐ **If YES → Stop. Go to Phase 2.** ☐ If NO, continue. 5. Does the finding screen as potentially risk significant due to a seismic, flooding, or severe weather initiating event, using the criteria on page 5 of this Worksheet? ☐ **If YES** → Use the IPEEE or other existing plant-specific analyses to identify core damage scenarios of concern and provide this input for **Phase 3** analysis. ☐ If NO, screen as Green.	1. RCS Barrier (e.g.,pressurized thermal shock issues) Stop. Go to Phase 3. 2. Fuel Barrier Screen as Green.	1. Does the finding only represent a degradation of the radiological barrier function provided for the control room, or auxiliary building, or spent fuel pool, or SBGT system (BWR)? ☐ **If YES** → screen as Green. ☐ If NO, continue. 2. Does the finding represent a degradation of the barrier function of the control room against smoke or a toxic atmosphere? ☐ **If YES → Stop. Go to Phase 3.** ☐ If NO, continue. 3. Does the finding represent an actual open pathway in the physical integrity of reactor containment, or involve an actual reduction in defense-in-depth for the atmospheric pressure control or hydrogen control functions of the reactor containment? ☐ **If YES → Stop. Go to Appendix H of IMC 0609.** ☐ If NO, screen as Green.

SDP PHASE 1 SCREENING WORKSHEET FOR IE, MS, and B CORNERSTONES

Seismic, Flooding, and Severe Weather Screening Criteria

1. Does the finding involve the loss or degradation of equipment or function specifically designed to mitigate a seismic, flooding, or severe weather initiating event (e.g., seismic snubbers, flooding barriers, tornado doors)?

   ☐ **If YES** ➛ continue to question 2
   ☐ If NO ➛ skip to question 3

2. If the equipment or safety function is assumed to be completely failed or unavailable, are ANY of the following three statements TRUE? The loss of this equipment or function by itself, during the external initiating event it was intended to mitigate

   a) would cause a plant trip or any of the Initiating Events used by Phase 2 for the plant in question;

   b) would degrade **two or more** Trains of a multi-train safety system or function;

   c) would degrade one or more Trains of a system that supports a safety system or function.

   ☐ **If YES** ➛ the finding is potentially risk significant due to external initiating event core damage sequences - return to page 4 of this Worksheet
   ☐ If NO, screen as Green

3. Does the finding involve the total loss of any safety function, identified by the licensee through a PRA, IPEEE, or similar analysis, that contributes to external event initiated core damage accident sequences (i.e., initiated by a seismic, flooding, or severe weather event)?

   ☐ **If YES** ➛ the finding is potentially risk significant due to external initiating event core damage sequences - return to page 4 of this Worksheet
   ☐ If NO, screen as Green

Result of Phase 1 screening process:

☐ **Screen as Green** ☒ **Go to Phase 2** ☐ **Go to Phase 3**

Important Assumptions: No credit given for operator recovery.

Performed by: ______________________ Date: ____________

Type of Remaining Mitigation Capability	Remaining Mitigation Capability Credit X = - $\log_{10}$(failure prob)
Recovery of Failed Train Operator action to recover failed equipment that is capable of being recovered after an initiating event occurs. Action may take place either in the control room or outside the control room and is assumed to have a failure probability of approximately 0.1 when credited as "Remaining Mitigation Capability." Credit should be given only if the following criteria are satisfied: (1) sufficient time is available; (2) environmental conditions allow access, where needed; (3) procedures describing the appropriate operator actions exist; (4) training is conducted on the existing procedures under similar conditions; and (5) any equipment needed to perform these actions is available and ready for use.	1
1 Automatic Steam-Driven (ASD) Train A collection of associated equipment that includes a single turbine-driven component to provide 100% of a specified safety function. The probability of such a train being unavailable due to failure, test, or maintenance is assumed to be approximately 0.1 when credited as "Remaining Mitigation Capability."	1
1 Train A collection of associated equipment (e.g., pumps, valves, breakers, etc.) that together can provide 100% of a specified safety function. The probability of this equipment being unavailable due to failure, test, or maintenance is approximately 1E-2 when credited as "Remaining Mitigation Capability."	2
1 Multi-Train System A system comprised of two or more trains (as defined above) that are considered susceptible to common cause failure modes. The probability of this equipment being unavailable due to failure, test, or maintenance is approximately 1E-3 when credited as "Remaining Mitigation Capability," regardless of how many trains comprise the system.	3
2 Diverse Trains A system comprised of two trains (as defined above) that are not considered to be susceptible to common cause failure modes. The probability of this equipment being unavailable due to failure, test, or maintenance is approximately 1E-4 when credited as "Remaining Mitigation Capability."	4 (=2+2)
Operator Action Credit Major actions performed by operators during accident scenarios (e.g., primary heat removal using bleed and feed, etc.). These actions are credited using three categories of human error probabilities (HEPs). These categories are Operator Action = 1 which represents a failure probability between 5E-2 and 0.5, Operator Action = 2 which represents a failure probability between 5E-3 and 5E-2, and Operator Action = 3 which represents a failure probability between 5E-4 and 5E-3.	1, 2, or 3

Table 4 - Remaining Mitigation Capability Credit

AFW Issue Summary

RESULTS	SEQUENCES	NUMBER (INPUT TO COUNTING RULE WORKSHEET)
12	SORV3, SORV7 LCCW7, LCCW9	4 (N/A FOR COUNTING RULE WORKSHEET)
11	SORV4 LCCW8, LCCW10	3 (N/A FOR COUNTING RULE WORKSHEET)
10	SLOCA3, SLOCA7 MLOCA3, SGTR6, SGTR9 LCCW11 LEAC5, LEAC6, LEAC7	9 (N/A FOR COUNTING RULE WORKSHEET)
9	SLOCA4 SGTR7, SGTR8 MSLB2, MSLB4 LIA1, LIA3	7
8	TRANS1, TRANS3 LOOP1, LOOP3 ATWS2, LOOP7 LIA2, MSLB3, LOOP5	9
7	TRANS2 TPCS1, TPCS3 LOOP2, LOOP 6 LBDC1, LBDC2, LBDC3	8
6	TPCS2 LOOP8	2
5	LSWS7 LBDC4	2

Counting Rule Worksheet		
Step	**Instructions**	
(1)	Enter the number of sequences with a risk significance equal to 9.	(1) 7
(2)	Divide the result of Step (1) by 3 and round down.	(2) 2
(3)	Enter the number of sequences with a risk significance equal to 8.	(3) 9
(4)	Add the result of Step (3) to the result of Step (2).	(4) 11
(5)	Divide the result of Step (4) by 3 and round down.	(5) 3
(6)	Enter the number of sequences with a risk significance equal to 7.	(6) 8
(7)	Add the result of Step (6) to the result of Step (5).	(7) 11
(8)	Divide the result of Step (7) by 3 and round down.	(8) 3
(9)	Enter the number of sequences with a risk significance equal to 6.	(9) 2
(10)	Add the result of Step (9) to the result of Step (8).	(10) 5
(11)	Divide the result of Step (10) by 3 and round down.	(11) 1
(12)	Enter the number of sequences with a risk significance equal to 5.	(12) 2
(13)	Add the result of Step (12) to the result of Step (11).	(13) 3
(14)	Divide the result of Step (13) by 3 and round down.	(14) 1
(15)	Enter the number of sequences with a risk significance equal to 4.	(15) 0
(16)	Add the result of Step (15) to the result of Step (14).	(16) 1

- [redacted]
- If the result of Step 13 is greater than zero, then the risk significance of the inspection finding is at least of substantial safety significance (YELLOW).
- If the result of Step 10 is greater than zero, then the risk significance of the inspection finding is at least of low to moderate safety significance (WHITE).
- If the result of Steps 10, 13, and 16 are zero, then the risk significance of the inspection finding is of very low safety significance (GREEN).

Phase 2 Result: ☐ **GREEN** ☐ **WHITE** ☐ **YELLOW** [redacted]

Table 6 - Counting Rule Worksheet