1101 Market Street, Chattanooga, Tennessee 37402

CNL-16-078

May 11, 2016

10 CFR 50.90

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Browns Ferry Nuclear Plant, Units 1, 2, and 3
Renewed Facility Operating License Nos. DPR-33, DPR-52, and DPR-68
NRC Docket Nos. 50-259, 50-260, and 50-296

Subject: **Response to NRC Request for Additional Information Related to License Amendment Request for Adding New Specifications to Technical Specification 3.3.8.3 (BFN-TS-486) (CAC Nos. MF6738, MF6739, and MF6740) - Letter 3**

References:

1. Letter from TVA to NRC, CNL-15-073, "Application to Modify the Browns Ferry Nuclear Plant, Units 1, and 2 Technical Specifications by Adding New Specification TS 3.3.8.3, 'Emergency Core Cooling System Preferred Pump Logic, Common Accident Signal (CAS) Logic, and Unit Priority Re-Trip Logic,' and Unit 3 TS by adding New Specification TS 3.3.8.3, 'Common Accident Signal (CAS) Logic, and Unit Priority Re-Trip Logic,' (BFN-TS-486)," dated September 16, 2015 (ML15260B125)
2. Letter from NRC to TVA, "Browns Ferry Nuclear Plant, Units 1, 2, and 3 - Request for Additional Information Related to License Amendment Request for Adding New Specifications to Technical Specification 3.3.8.3 (CAC Nos. MF6738, MF6739, and MF6740)," dated March 21, 2016 (ML16074A126)
3. Letter from TVA to NRC, CNL-16-066, "Response to NRC Request for Additional Information Related to License Amendment Request for Adding New Specifications to Technical Specification 3.3.8.3 (BFN-TS-486) (CAC Nos. MF6738, MF6739, and MF6740) - Letter 1," dated April 15, 2016 (ML16106A323)

By letter dated September 16, 2015 (Reference 1), Tennessee Valley Authority (TVA) submitted a license amendment request (LAR) for Browns Ferry Nuclear Plant (BFN), Units 1, 2, and 3, to revise the BFN, Units 1 and 2, Technical Specifications (TS) by adding a new specification governing the safety functions for the Emergency Core Cooling System (ECCS) Preferred Pump Logic, Common Accident Signal Logic, and the Unit Priority Re-Trip Logic. In addition, the LAR relocated the BFN, Unit 3 requirements for Common Accident Signal Logic and Unit Priority Re-trip Logic to a new specification governing the safety functions for the Common Accident Signal Logic, and the Unit Priority Re-Trip Logic for consistency with the changes to the BFN, Units 1 and 2 TS.

By letter dated March 21, 2016 (Reference 2), the Nuclear Regulatory Commission (NRC) requested additional information to support the review of the LAR. The required dates for responding to the requests for additional information varied from April 15, 2016, to May 25, 2016.

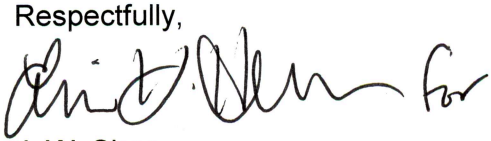
Enclosure 1 provides the third set of TVA responses to some of the requests for additional information (RAIs) identified in the Reference 2 letter. The due dates for the RAIs were revised from the Reference 2 letter and detailed in the Reference 3 letter. As stated in the Reference 3 letter, the responses provided in Enclosure 1 to this letter are due by May 11, 2016. Enclosure 2 provides a listing of the RAIs contained in the Reference 2 letter and the date of the TVA response to each of the RAIs.

Consistent with the standards set forth in Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50.92(c), TVA has determined that the additional information, as provided in this letter, does not affect the no significant hazards consideration associated with the proposed application previously provided in Reference 1.

There are no new regulatory commitments associated with this submittal. Please address any questions regarding this request to Edward D. Schrull at (423) 751-3850.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 11th day of May 2016.

Respectfully,



J. W. Shea
Vice President, Nuclear Licensing

Enclosures

cc: See page 3

Enclosures: 1. TVA Responses to NRC Request for Additional Information: Set 3
2. Summary of BFN Request for Additional Information Response Dates

cc (Enclosure):

NRC Regional Administrator - Region II
NRC Resident Inspector – Browns Ferry Nuclear Plant
NRC Project Manager – Browns Ferry Nuclear Plant
State Health Officer, Alabama Department of Public Health

**ENCLOSURE 1**

**TENNESSEE VALLEY AUTHORITY**

**BROWNS FERRY NUCLEAR PLANT UNITS 1, 2, AND 3**

**TVA Responses to NRC Request for Additional Information: Set 3**

The following overview of the Browns Ferry Nuclear Plant (BFN) Electrical Power System is provided to assist in understanding TVA's response to these Requests for Additional Information (RAIs). The BFN 4kV Unit Boards supply offsite power to safety and non-safety related boards, components and systems. These boards are normally supplied from the 500kV distribution system via each unit's Main Bank Transformer and Unit Station Service Transformers (USSTs). An alternate supply is also available from the 161kV offsite circuits via the two Common Station Service Transformers (CSSTs) to the 4kV Start Buses 1A and 1B. The 4kV Start Buses are common to all three units and are an alternate supply for all of the 4kV Unit Boards and 4kV Common Boards. On a loss of the normal offsite power supply to a 4kV Shutdown Board, the transfer to an alternate offsite power source is performed on Unit 1/2 by transfer of the upstream 4kV Shutdown buses and on Unit 3 by transfer of the upstream 4kV Unit Boards that supply the 4kV Shutdown Boards and the safety related Emergency Core Cooling System (ECCS) loads. Refer to Figures 1 and 2 for simplified sketches of the BFN Unit 1/2 and Unit 3 electrical distribution system.

**FIGURE 1 - UNIT 1 AND 2 POWER DISTRIBUTION SYSTEM SKETCH**

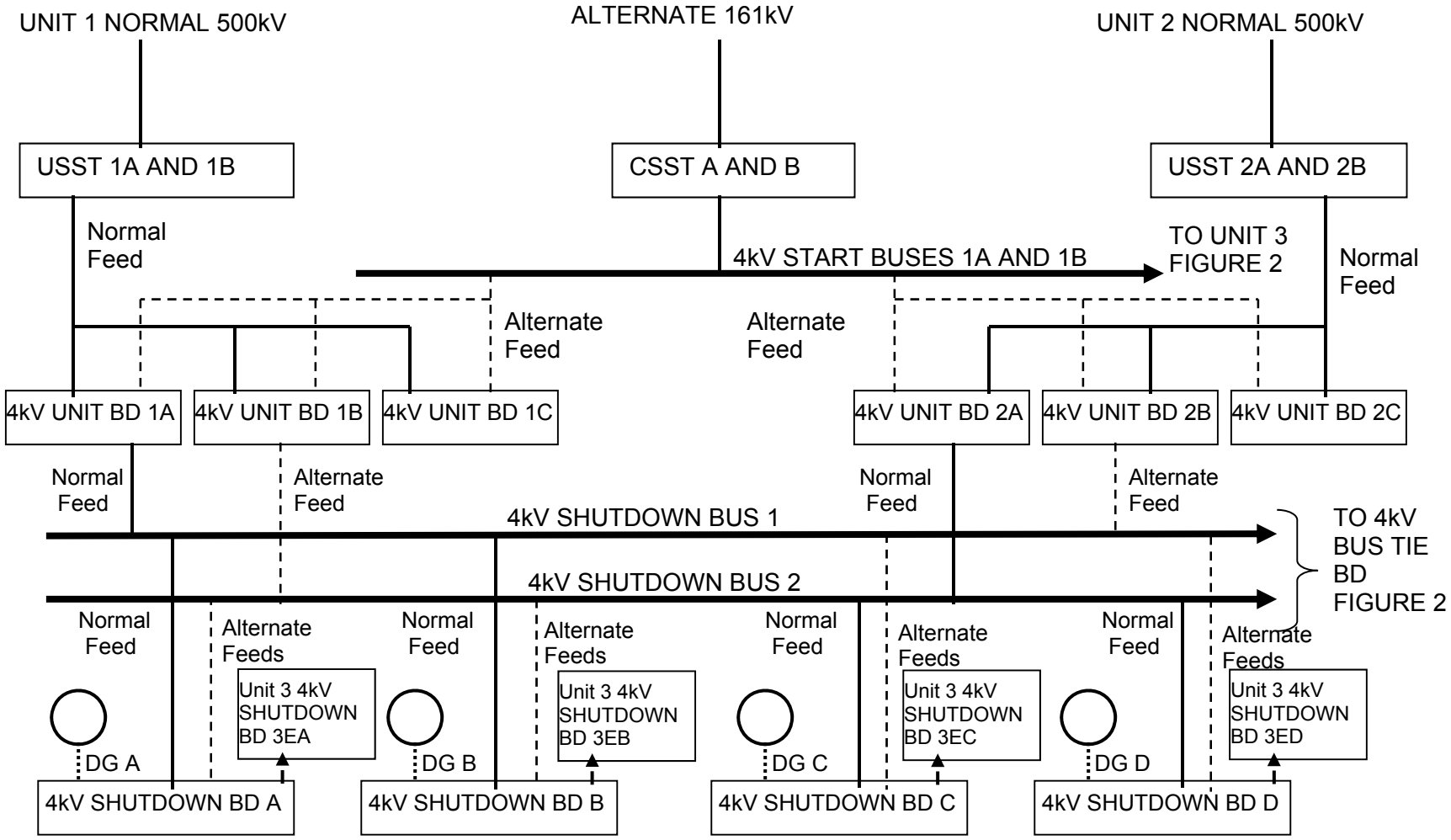
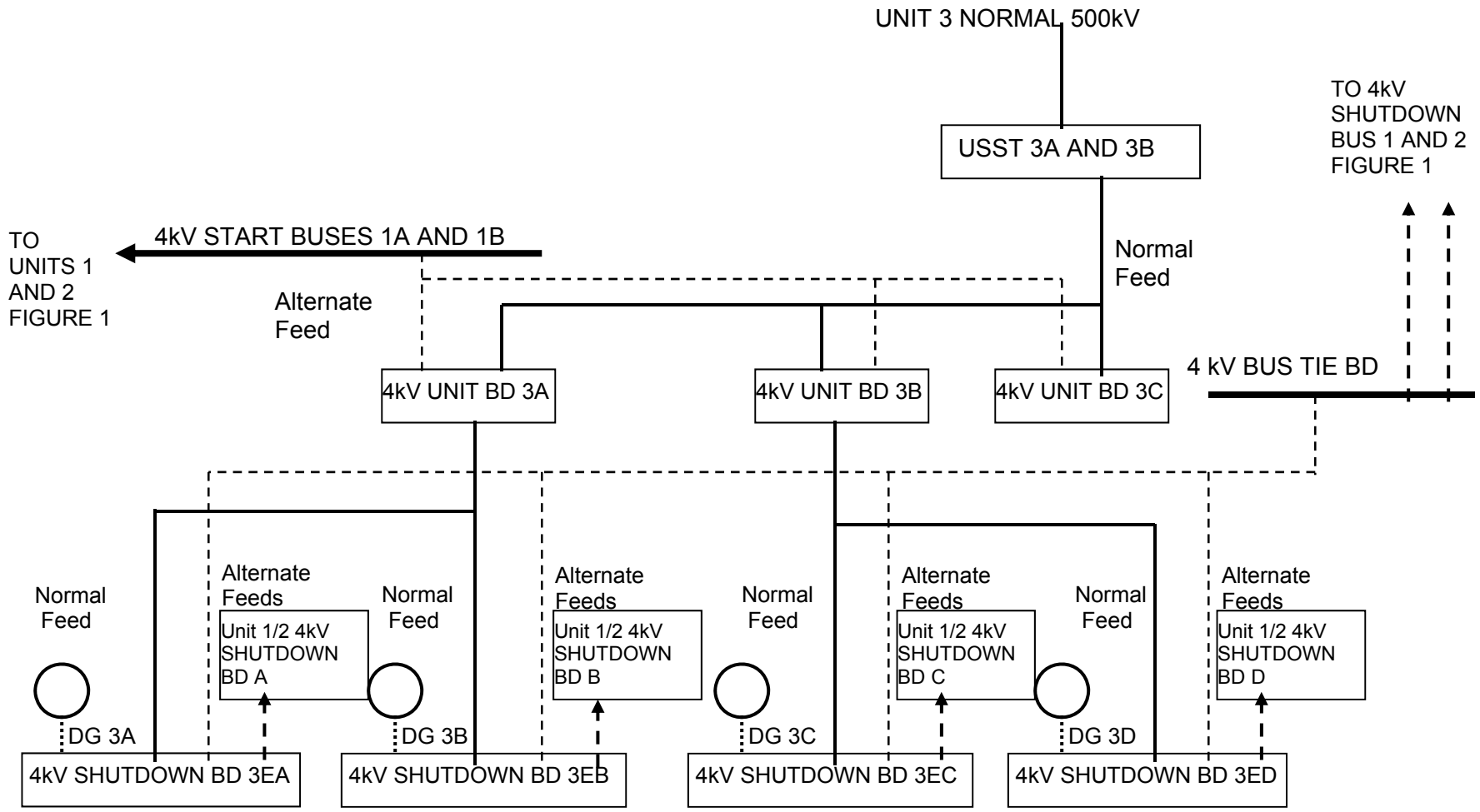


**FIGURE 2 - UNIT 3 POWER DISTRIBUTION SYSTEM SKETCH**



***Electrical Engineering Branch (EEEB) RAI-1***

*In the presentation slides provided by TVA during the public meeting, slide 9 states that the CAS blocks the 4 kV shutdown board auto transfer logic, and blocks the 4 kV degraded voltage trips.*

***EEEB RAI 1.a***

*Explain how the CAS blocks the 4 kV shutdown board auto transfer logic and blocks the 4 kV degraded voltage trips. Also, explain the purpose of these CAS blocks and clarify whether the CAS affects the degraded voltage signal that initiates the emergency diesel generator.*

**TVA Response**

Due to the differences in the Unit 1/2 power distribution system and the Unit 3 power distribution system, the response to EEEB RAI 1.a is separated into a discussion for Units 1 and 2, followed by a discussion for Unit 3.

**Units 1 and 2**

The 4kV Shutdown Board auto-transfer logic in the original BFN design was provided as a defense in depth function during non-accident conditions in the event of an upstream 4kV Shutdown Bus failure (Unit 1/2). With no accident signal present, the 4kV Shutdown Board would automatically transfer to the opposite division's Unit 1/2 4kV Shutdown Bus. However, the Unit 1/2 4kV Shutdown Buses do not have sufficient capacity to support both divisions of ECCS loads in the event of an accident. Therefore, the 4kV Shutdown Board auto-transfer logic is not credited for any safety related function and is blocked by Unit 1, 2 or 3 Common Accident Signal (CAS) by energizing the 43S bus transfer relays (type HEA lockout relays).

The 4 kV degraded voltage trips described on slide 9 of the February 1, 2016, public meeting presentation are the undervoltage load shed trips on 4 kV Shutdown Boards A, B, C, and D, Unit 1/2 CAS Relays CASA-1 and CASB-1 block the undervoltage load shed trips after diesel generator voltage is available and supplying the loads to maximize the reliability of the ECCS loads on the 4 kV Shutdown Boards when supplied by the diesel generators. The degraded voltage relays that initiate start of the Diesel Generators and closes the Diesel Generator breaker to supply the 4kV Shutdown Boards are separate relays and are not affected by the CAS logic.

The normal offsite power supply for the Unit 1/2 Division I safety related boards is from the 500 kV switchyard bay 21, through USST 1B (X-winding) to 4kV Unit Board 1A, which normally supplies 4kV Shutdown Bus 1. The normal offsite power supply for the Unit 1/2 Division II safety related boards is from the 500 kV switchyard bay 24, through USST 2B (X-winding) to 4kV Unit Board 2A, which normally supplies 4kV Shutdown Bus 2. If power is lost to 4kV Shutdown Bus 1 from 4kV Unit Board 1A, it will automatically transfer to its alternate supply from 4kV Shutdown Board 2B which is supplied by USST 2B (Y-winding). If power is lost to 4kV Shutdown Bus 2 from 4kV Unit Board 2A, it will automatically transfer to its alternate supply from 4kV Shutdown Board 1B which is supplied by USST 1B (Y-winding).

The Division I Unit 1/2 4kV Shutdown Boards A and B are normally supplied by the 4kV Shutdown Bus 1. An alternate supply is available from the Division II 4kV Shutdown Bus 2, but is not credited for any safety related function. The Division II Unit 1/2 4kV Shutdown Boards C and D are normally supplied by the 4kV Shutdown Bus 2. An alternate supply is available from the Division I 4kV Shutdown Bus 1, but is not credited for any safety related function. The Unit 1/2 4kV Shutdown Buses do not have sufficient capacity to support both divisions of ECCS loads in the event of an accident so this alternate supply is not credited during an accident.

On a Unit 1, 2 or 3 accident signal (low reactor water level, or low reactor pressure coincident with high drywell pressure), the common accident signal logic (CASA or CASB) initiates to block the 4kV Shutdown Board auto-transfer logic and also trips open the 4kV Shutdown Board alternate breaker if it were closed. This prevents an overload condition on the 4kV Shutdown Bus if more than two 4kV Shutdown Boards had been aligned to the same 4kV Shutdown Bus as a single shutdown bus cannot supply both Division I and Division II loads. The CAS logic energizes the Unit 1/2 bus transfer relays 43SA, 43SB, 43SC, and 43SD, which sets the transfer logic to manual.

- Unit 1/2 Relay CASA-8 (contacts 1-2) or CASB-8 (contacts 1-2):
  Energizes relay 43SA (set to manual) to inhibit the 4KV Shutdown Board A auto transfer to its alternate feed from Shutdown Bus 2, breaker 1716
- Unit 1/2 Relay CASA-6 (contacts 1-2) or CASB-6 (contacts 1-2):
  Energizes relay 43SB (sets to manual) to inhibit the 4KV Shutdown Board B auto transfer to its alternate feed from Shutdown Bus 2, breaker 1714
- Unit 1/2 Relay CASA-3 (contacts 5-6) or CASB-3 (contacts 5-6):
  Energizes relay 43SC (sets to manual) to inhibit the 4KV Shutdown Board C auto transfer to its alternate feed from Shutdown Bus 1, breaker 1624
- Unit 1/2 Relay CASA-7 (contacts 5-6) or CASB-7 (contacts 5-6):
  Energizes relay 43SD (set to manual) to inhibit the 4KV Shutdown Board D auto transfer to its alternate feed from Shutdown Bus 1, breaker 1618

**Unit 3**

The 4kV Shutdown Board auto-transfer logic in the original BFN design was provided as a defense in depth function in the event of an upstream 4kV Unit Board failure. On a loss of the normal power supply from the 4kV Unit Board and the 4kV Unit Board failed to transfer to the 4kV Start Bus, the 4kV Shutdown Board would automatically transfer to the 4kV Bus Tie Board. After five seconds this transfer would be blocked by a Unit 1, 2 or 3 CAS by energizing the 43S bus transfer relays (type HEA lockout relays) to prevent spurious board transfers after the ECCS pumps had started during an accident.

The 4 kV degraded voltage trips described on slide 9 of the February 1, 2016, public meeting presentation are the undervoltage load shed trips on 4 kV Shutdown Boards 3EA, 3EB, 3EC, and 3ED, Unit 3 CAS Relays CASA-1 and CASB-1 block the undervoltage load shed trips after diesel generator voltage is available and supplying the loads to maximize the reliability of the ECCS loads on the 4 kV Shutdown Boards when supplied by the diesel generators. The degraded voltage relays that initiate start of the Diesel Generators and close the Diesel Generator breakers to supply the 4kV Shutdown Boards are separate relays and are not affected by the CAS logic.

The 4kV Bus Tie Board is no longer credited as a qualified alternate power source to Unit 3 and is normally de-energized. Therefore, the 4kV Shutdown Board auto-transfer logic is no

longer credited for any safety related function. The Unit 3 4kV Shutdown Board auto-transfer logic would only have functioned if the 4kV Bus Tie Board was energized due to an abnormal electrical plant alignment.

The normal offsite power supply for Unit 3 is from the 500 kV switchyard bay 26, through the USST 3B to 4kV Unit Board 3A and 3B to the Unit 3 4kV Shutdown Boards. The alternate offsite power supply for Unit 3 is from the 161 kV transmission network, through the CSSTs A and B to start bus 1A and 1B, to the 4kV Unit Boards. If power is lost to 4kV Unit Board 3A from 22kV/4kV USST 3B (X-winding), it will automatically transfer to its alternate supply from 4kV Start Bus 1A supplied by CSST A. If power is lost to 4kV Unit Board 3B from 22kV/4kV USST 3B (Y-winding), it will automatically transfer to its alternate supply from 4kV Start Bus 1B supplied by CSST B.

The Division I Unit 3 4kV Shutdown Boards 3EA and 3EB are normally supplied by the 4kV Unit Board 3A. The Division II Unit 3 4kV Shutdown Boards 3EC and 3ED are normally supplied by the 4kV Unit Board 3B.

On a Unit 1, 2 or 3 accident signal (low reactor water level, or low reactor pressure coincident with high drywell pressure) the common accident signal logic (CASA or CASB) initiates after five seconds to block the 4kV Shutdown Board auto-transfer logic and also trips open the 4kV Shutdown Board alternate breaker if it were closed. This prevents overloading the 4kV Bus Tie Board if the electrical system is in an abnormal alignment such that the board was energized. This block of the auto transfer logic was delayed by five seconds in the original design to allow the shutdown boards to transfer to their alternate supply if voltage was available on the 4kV Bus Tie Board. The auto transfer logic is blocked after five seconds to ensure that a single failure of the transfer logic does not cause a transfer to a dead bus after Residual Heat Removal (RHR) and Core Spray have initiated. The common accident signal logic energizes the Unit 3 bus transfer relays 43SEA, 43SEB, 43SEC, and 43SED which sets the transfer logic to manual.

- Unit 3 Relay CASA -1 (contacts 1-2) energizes relay BBTD-A time delay Breaker Blocking Transfer time delay. After five seconds, BBTD-A energizes relay BBRA-1.
- Unit 3 Relay CASB -1 (contacts 1-2) energizes relay BBTD-B time delay Breaker Blocking Transfer time delay. After five seconds, BBTD-B energizes relay BBRB-1.
- Relay BBRA-1 or BBRB-1 energizes the 43SEA, 43SEB, 43SEC and 43SED relays to set the automatic transfer functions to manual after five seconds.

***EEEB RAI 1.b***

*The following is stated in the Updated Final Safety Analysis Report (UFSAR), Section 8.4.5.2:*

> *Each board and the startup bus has its source breakers interlocked to prevent paralleling power sources, and each is provided with manual and automatic bus transfer schemes. Automatic transfers are initiated by generator and transformer protective relays, degraded under voltage on 4160-V shutdown boards and loss of voltage at the normal supply (except for loss of voltage on 4160-V unit board 1A, 1B, 2A, and 2B). Transfer is blocked through manually-reset lockout relays in case of faulted bus. Each bus section is provided with a manual-automatic transfer selector switch.*

*The above paragraph does not state that automatic transfer at the 4 kV shutdown board is blocked by CAS. Clarify whether CAS blocks the automatic transfer at the 4 kV shutdown board.*

**TVA Response**

Due to the differences in the Unit 1/2 power distribution system and the Unit 3 power distribution system, the response to EEEB RAI 1.b is separated into a discussion for Units 1 and 2, followed by a discussion for Unit 3.

**Units 1 and 2**

The normal operating position of the 4kV Shutdown Board 43S bus transfer relays (type HEA lockout relays) is MANUAL (i.e., trip and lockout position), thus inhibiting the 4kV Shutdown Board auto-transfer. Although the CAS logic function to block the 4kV Shutdown Board auto-transfer will still initiate on an accident signal, the 43S auto-transfer relays (i.e., Unit 1/2 Relays 43SA, 43SB, 43SC, and 43SD) will normally already be in the lockout position. With the transfer relays placed in the MANUAL trip and lockout position, a loss of control power would not prevent the operators from taking manual control of the 4kV Shutdown Board Normal and Alternate supply breakers.

**Unit 3**

Because the 4kV Bus Tie Board is normally de-energized, the Unit 3 4kV Shutdown Board auto-transfer logic is effectively blocked and is no longer credited for any safety related function.

***EEEB RAI 2***

*Presentation slide 9 also states that CAS trips the RHRSW (Residual Heat Removal Service Water) Pumps A2 and C2. Explain the purpose of CAS tripping the RHRSW Pumps A2 and C2. Also explain why the CAS tripping does not apply to the other set of RHRSW Pumps B2 and D2.*

**TVA Response**

Due to the distribution of loads from Units 1 and 2 in the original BFN design, the load on 4kV Shutdown Bus 1 has historically been greater than the load on 4kV Shutdown Bus 2. As Unit 1 components and systems were returned to service, the loads on 4kV Shutdown Bus 1 were increased such that if a Loss of Coolant Accident (LOCA) with normal power available were to occur in either Units 1 or 2, 4kV Shutdown Bus 1 would be overloaded. To prevent this overload condition during an accident, the CAS Logic was modified to provide a 4kV Load Shed signal to trip RHR Service Water (RHRSW) pumps A2 and C2, Raw Cooling Water (RCW) pump 1D, and Fire Pumps A, B and C.

RHRSW pumps B2 and D2 are not supplied from 4kV Shutdown Bus 1 and do not need to be tripped to prevent the overload condition on Shutdown Bus 1.

RHRSW pumps A2 and C2 are not used for Emergency Equipment Cooling Water (EECW) and do not receive an automatic start signal so these pumps will not automatically restart after they are tripped. RCW pump 1D is not required for accident mitigation and does not receive an automatic start signal. However, the Fire Pumps A, B and C do receive an automatic start signal on a fire protection system initiation signal if fire header pressure is less than 120 psig. The existing CAS Logic prevents Fire Pumps A, B and C from automatically re-starting on the diesel generators with an accident signal and a loss of offsite power (the pumps would have tripped on the loss of offsite power if running). This logic is

modified so that the Fire Pumps A, B and C are tripped on a CAS, and are prevented from automatically re-starting for an accident with either normal power available, or on a loss of offsite power. Although Fire Pump C is not powered from 4kV Shutdown Bus 1, it is tripped if running so that there is not an operational difference between how Fire Pump C operates during an accident as compared to Fire Pumps A and B. The operation of the diesel fire pump is not affected by the CAS logic.

***EEEB RAI 3***

*Assuming loss-of-offsite power event, provide the latest summary of loadings of all eight emergency diesel generators (EDGs) with the PPL, for first 24 hours duration, assuming:*

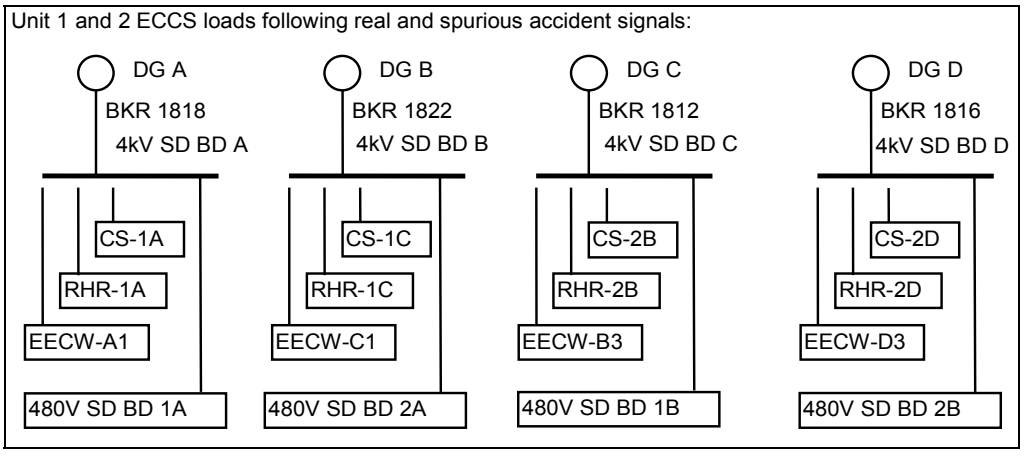
*a. LOCA in Unit 1, followed by spurious accident in Unit 2;*
*b. Spurious accident in Unit 1, followed by LOCA in Unit 2;*
*c. LOCA in Unit 1 and loss of an EDG; and,*
*d. LOCA in Unit 2 and loss of an EDG.*

*Only worst case loading combinations from a or b and from c or d may be provided.*

**TVA Response**

**EEEB RAI 3 Cases a and b**

With an accident signal present in both Units 1 and 2 (one real and one spurious), the ECCS Preferred Pump Logic (PPL) will dedicate the Division I RHR pumps 1A and 1C to Unit 1 and Division II RHR pumps 2B and 2D to Unit 2. The Division I Core Spray pumps 1A and 1C are dedicated to Unit 1, while the Division II Core Spray pumps 2B and 2D are dedicated to Unit 2. These are considered the preferred pumps. The non-preferred pumps, Unit 1 Division II and Unit 2 Division I, are tripped if running and are blocked from automatically starting.




The Diesel Load Study for Units 1 and 2 has evaluated a Unit 1 LOCA with a spurious accident signal in Unit 2. The Units 1 and 2 ECCS loads that are started on the onsite Diesel Generators are the same for a LOCA in Unit 1 followed by a spurious accident signal in Unit 2, or for a spurious accident signal in Unit 1 followed by a LOCA in Unit 2. Therefore, the Diesel Generator loading for the scenarios in EEEB RAI 3 Cases a and b are the same. Unit 3 is assumed to be in a Loss of Offsite Power (LOOP) event as evaluated in the Diesel Load Study for Unit 3. For Units 1 and 2, the LOCA and spurious accident signal would

result in the automatic starting of the ECCS pumps. The 4kV RHR pumps, Core Spray pumps and RHRSW pumps aligned for EECW would automatically start and represent the major loads on the Unit 1/2 Diesel Generators. On Unit 3, only the 4kV RHRSW pumps aligned for EECW would automatically start and represent the major loads on the Unit 3 Diesel Generators. After the large 4kV ECCS pumps are started, the 480V loads necessary for safe shutdown are automatically energized.

Unit 1/2 – Maximum Starting plus Running Load (0-3 minutes)

| Case | DG A | DG B | DG C | DG D | Instantaneous Cold Rating |
|---|---|---|---|---|---|
| kW Unit 1 LOCA with Spurious Accident Signal on Unit 2 | 2870 | 2604 | 2727 | 2822 | 2850 |

Unit 2 LOCA with spurious accident signal on Unit 1 would result in the same diesel generator loads because the same ECCS loads are started and assigned to Units 1 and 2.

Diesel Generator A transient loadings are slightly over the 2850 kW rating for the first three minutes. This assumes the worst case random loads including the control bay elevator are running. This transient overload condition has been evaluated as acceptable in the Diesel Load Study for Unit 1 and 2.

Unit 3 – Maximum Starting plus Running Load (0-3 minutes)

| Case | DG 3A | DG 3B | DG 3C | DG 3D | Instantaneous Cold Rating |
|---|---|---|---|---|---|
| kW Unit 3 LOOP | 1523 | 617 | 1530 | 824 | 2850 |

Unit 1/2 – Maximum Starting plus Running Load (>3 minutes)

| Case | DG A | DG B | DG C | DG D | Instantaneous Hot Rating |
|---|---|---|---|---|---|
| kW Unit 1 LOCA with Spurious Accident Signal on Unit 2 | 2870 | 2604 | 2727 | 2822 | 3048 |

Unit 2 LOCA with spurious accident signal on Unit 1 would result in the same diesel generator loads because the same ECCS loads are started and assigned to Units 1 and 2. No additional loads are started after three minutes.

Unit 3 – Maximum Starting plus Running Load (>3 minutes)

| Case | DG 3A | DG 3B | DG 3C | DG 3D | Instantaneous Hot Rating |
|---|---|---|---|---|---|
| kW Unit 3 LOOP | 2321 | 1726 | 2380 | 1937 | 3048 |

Unit 1/2 – Maximum Running Load (0 minutes – 2 hours)

| Cases | DG A | DG B | DG C | DG D | Short Time Rating (derated) |
|---|---|---|---|---|---|
| kW Unit 1 LOCA with Spurious Accident Signal on Unit 2 | 2639 | 2426 | 2436 | 2587 | 2800 |
| KVA Unit 1 LOCA with Spurious | 2917 | 2754 | 2744 | 2938 | 3575 |

| | | | | | |
|---|---|---|---|---|---|
| Accident Signal on Unit 2 | | | | | |

Unit 2 LOCA with spurious accident signal on Unit 1 would result in the same diesel generator loads because the same ECCS loads are started and assigned to Units 1 and 2.

Unit 3 – Maximum Running Load (0 minutes – 2 hours)

| Cases | DG 3A | DG 3B | DG 3C | DG 3D | Short Time Rating (derated) |
|---|---|---|---|---|---|
| kW Unit 3 LOOP | 2109 | 1473 | 2154 | 1804 | 2800 |
| KVA Unit 3 LOOP | 2370 | 1595 | 2415 | 1968 | 3575 |

Unit 1/2 – Maximum Running Load (> 2 hours)

| Cases | DG A | DG B | DG C | DG D | Continuous Rating (derated) |
|---|---|---|---|---|---|
| kW Unit 1 LOCA with Spurious Accident Signal on Unit 2 | 2320 | 2130 | 1981 | 2257 | 2550 |
| KVA Unit 1 LOCA with Spurious Accident Signal on Unit 2 | 2550 | 2414 | 2213 | 2554 | 3250 |

Unit 2 LOCA with spurious accident signal on Unit 1 would result in the same diesel generator loads because the same ECCS loads are started and assigned to Units 1 and 2.

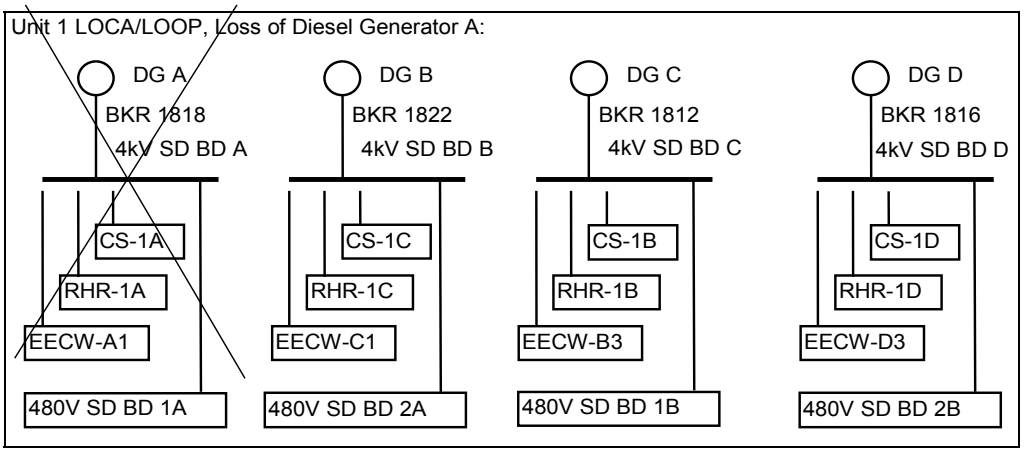
Unit 3 – Maximum Running Load (> 2 hours)

| Cases | DG 3A | DG 3B | DG 3C | DG 3D | Continuous Rating (derated) |
|---|---|---|---|---|---|
| kW Unit 3 LOOP | 1896 | 1473 | 1911 | 1804 | 2550 |
| KVA Unit 3 LOOP | 2117 | 1595 | 2130 | 1968 | 3250 |

Extended Operation (> 24 hours)

If it becomes necessary to establish Suppression Pool Cooling on Units 1 and 2 simultaneously, operators may need to parallel the Unit 1/2 Diesel Generators with their respective Unit 3 Diesel Generators in accordance with the BFN Loss of Off-Site Power / Station Blackout procedure. This will allow a Unit 1 and a Unit 2 RHR pump to be operated off the same 4kV Shutdown Board and support extended operation without overloading the Diesel Generators.

**EEEB RAI 3 Case c**




The Diesel Load Study for Unit 1 and 2 has evaluated Unit 1 LOCA/LOOP with Unit 2 assumed to be in a LOOP event. Unit 3 is assumed to be in a LOOP event as evaluated in the Diesel Load Study for Unit 3. For Unit 1, the LOCA would result in the automatic starting of the ECCS pumps. The 4kV RHR pumps, Core Spray pumps and RHRSW pumps aligned for EECW would automatically start and represent the major loads on the Unit 1/2 Diesel Generators. On Unit 3, only the 4kV RHRSW pumps aligned for EECW would automatically start and represent the major loads on the Unit 3 Diesel Generators. After the large 4kV ECCS pumps are started, the 480V loads necessary for safe shutdown are automatically energized.

The loss of Diesel Generator A or C would have the worst case effect on available ECCS systems during a Unit 1 LOCA/LOOP as these Diesel Generators also supply the Unit 1 480V Shutdown Boards. The 480V Shutdown Boards supply the RHR-Low Pressure Coolant Injection (LPCI) and Core Spray injection valves, and other valves needed to support their ECCS function. For a loss of Diesel Generator A, only Division II ECCS RHR-LPCI and Core Spray would be available for Unit 1.

Unit 1/2 – Maximum Starting plus Running Load (0-3 minutes)

| Case | DG A | DG B | DG C | DG D | Instantaneous Cold Rating |
|---|---|---|---|---|---|
| kW Unit 1 LOCA | 2870 | 2704 | 2745 | 2814 | 2850 |

Diesel Generator A transient loadings are slightly over the 2850 kW rating for the first three minutes. This assumes the worst case random loads including the control bay elevator are running. This transient overload condition has been evaluated as acceptable in the Diesel Load Study for Unit 1 and 2.

Unit 3 – Maximum Starting plus Running Load (0-3 minutes)

| Case | DG 3A | DG 3B | DG 3C | DG 3D | Instantaneous Cold Rating |
|---|---|---|---|---|---|
| kW Unit 3 LOOP | 1523 | 617 | 1530 | 824 | 2850 |

Unit 1/2 – Maximum Starting plus Running Load (>3 minutes)

| Case | DG A | DG B | DG C | DG D | Instantaneous Hot Rating |
|---|---|---|---|---|---|
| kW Unit 1 LOCA | 2870 | 2704 | 2745 | 2814 | 3048 |

No additional loads are started after three minutes.

Unit 3 – Maximum Starting plus Running Load (>3 minutes)

| Case | DG 3A | DG 3B | DG 3C | DG 3D | Instantaneous Hot Rating |
|---|---|---|---|---|---|
| kW Unit 3 LOOP | 2321 | 1726 | 2380 | 1937 | 3048 |

Unit 1/2 – Maximum Running Load (0 minutes – 2 hours)

| Cases | DG A | DG B | DG C | DG D | Short Time Rating (derated) |
|---|---|---|---|---|---|
| kW Unit 1 LOCA | 2639 | 2566 | 2452 | 2725 | 2800 |
| KVA Unit 1 LOCA | 2917 | 2927 | 2711 | 3058 | 3575 |

Unit 3 – Maximum Running Load (0 minutes – 2 hours)

| Cases | DG 3A | DG 3B | DG 3C | DG 3D | Short Time Rating (derated) |
|---|---|---|---|---|---|
| kW Unit 3 LOOP | 2109 | 1473 | 2154 | 1804 | 2800 |
| KVA Unit 3 LOOP | 2370 | 1595 | 2415 | 1968 | 3575 |

Unit 1/2 – Maximum Running Load (> 2 hours)

| Cases | DG A | DG B | DG C | DG D | Continuous Rating (derated) |
|---|---|---|---|---|---|
| kW Unit 1 LOCA | 2320 | 2262 | 2000 | 2459 | 2550 |
| KVA Unit 1 LOCA | 2550 | 2579 | 2187 | 2758 | 3250 |

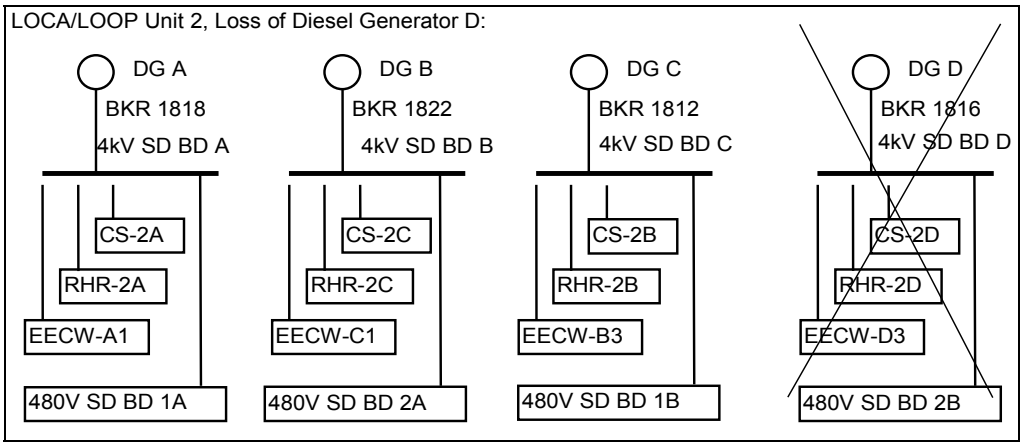
Unit 3 – Maximum Running Load (> 2 hours)

| Cases | DG 3A | DG 3B | DG 3C | DG 3D | Continuous Rating (derated) |
|---|---|---|---|---|---|
| kW Unit 3 LOOP | 1896 | 1473 | 1911 | 1804 | 2550 |
| KVA Unit 3 LOOP | 2117 | 1595 | 2130 | 1968 | 3250 |

Extended Operation (> 24 hours)

If it becomes necessary to establish Suppression Pool Cooling on Units 1 and 2 simultaneously, operators may need to parallel the Unit 1/2 Diesel Generators with their respective Unit 3 Diesel Generators in accordance with the BFN Loss of Off-Site Power / Station Blackout procedure. This will allow a Unit 1 and a Unit 2 RHR pump to be operated off the same 4kV Shutdown Board and support extended operation without overloading the Diesel Generators.

**EEEB RAI 3 Case d**




The Diesel Load Study for Unit 1 and 2 evaluated a Unit 2 LOCA/LOOP with Unit 1 assumed to be in a LOOP event. Unit 3 is assumed to be in a LOOP event as evaluated in the Diesel Load Study for Unit 3. For Unit 2, the LOCA would result in the automatic starting of the ECCS pumps. The 4kV RHR pumps, Core Spray pumps and RHRSW pumps aligned for EECW would automatically start and represent the major loads on the Unit 1/2 Diesel Generators. On Unit 3, only the 4kV RHRSW pumps aligned for EECW would automatically start and represent the major loads on the Unit 3 Diesel Generators. After the large 4kV ECCS pumps are started, the 480V loads necessary for safe shutdown are automatically energized.

The loss of Diesel Generator B or D would have the worst case effect on available ECCS systems during a Unit 2 LOCA/LOOP as these Diesel Generators also supply the Unit 2 480V Shutdown Boards. The 480V Shutdown Boards supply the RHR-LPCI and Core Spray injection valves, and other valves needed to support their ECCS function. For a loss of Diesel Generator D, only Division I ECCS RHR-LPCI and Core Spray would be available for Unit 2.

Unit 1/2 – Maximum Starting plus Running Load (0-3 minutes)

| Case | DG A | DG B | DG C | DG D | Instantaneous Cold Rating |
|---|---|---|---|---|---|
| kW Unit 2 LOCA | 2875 | 2623 | 2722 | 2838 | 2850 |

Diesel Generator A transient loadings are slightly over the 2850 kW rating for the first three minutes. This assumes the worst case random loads including the control bay elevator are running. This transient overload condition has been evaluated as acceptable in the Diesel Load Study for Unit 1 and 2.

Unit 3 – Maximum Starting plus Running Load (0-3 minutes)

| Case | DG 3A | DG 3B | DG 3C | DG 3D | Instantaneous Cold Rating |
|---|---|---|---|---|---|
| kW Unit 3 LOOP | 1523 | 617 | 1530 | 824 | 2850 |

Unit 1/2 – Maximum Starting plus Running Load (>3 minutes)

| Case | DG A | DG B | DG C | DG D | Instantaneous Hot Rating |
|---|---|---|---|---|---|
| kW Unit 2 LOCA | 2875 | 2623 | 2722 | 2838 | 3048 |

No additional loads are started after three minutes.

Unit 3 – Maximum Starting plus Running Load (>3 minutes)

| Case | DG 3A | DG 3B | DG 3C | DG 3D | Instantaneous Hot Rating |
|---|---|---|---|---|---|
| kW Unit 3 LOOP | 2321 | 1726 | 2380 | 1937 | 3048 |

Unit 1/2 – Maximum Running Load (0 minutes – 2 hours)

| Cases | DG A | DG B | DG C | DG D | Short Time Rating (derated) |
|---|---|---|---|---|---|
| kW Unit 2 LOCA | 2722 | 2444 | 2642 | 2609 | 2800 |
| KVA Unit 2 LOCA | 3021 | 2726 | 3001 | 2965 | 3575 |

Unit 3 – Maximum Running Load (0 minutes – 2 hours)

| Cases | DG 3A | DG 3B | DG 3C | DG 3D | Short Time Rating (derated) |
|---|---|---|---|---|---|
| kW Unit 3 LOOP | 2109 | 1473 | 2154 | 1804 | 2800 |
| KVA Unit 3 LOOP | 2370 | 1595 | 2415 | 1968 | 3575 |

Unit 1/2 – Maximum Running Load (> 2 hours)

| Cases | DG A | DG B | DG C | DG D | Continuous Rating (derated) |
|---|---|---|---|---|---|
| kW Unit 2 LOCA | 2465 | 2148 | 2182 | 2279 | 2550 |
| KVA Unit 2 LOCA | 2731 | 2386 | 2462 | 2581 | 3250 |

Unit 3 – Maximum Running Load (> 2 hours)

| Cases | DG 3A | DG 3B | DG 3C | DG 3D | Continuous Rating (derated) |
|---|---|---|---|---|---|
| kW Unit 3 LOOP | 1896 | 1473 | 1911 | 1804 | 2550 |
| KVA Unit 3 LOOP | 2117 | 1595 | 2130 | 1968 | 3250 |

Extended Operation (> 24 hours)

If it becomes necessary to establish Suppression Pool Cooling on Units 1 and 2 simultaneously, operators may need to parallel the Unit 1/2 Diesel Generators with their respective Unit 3 Diesel Generators in accordance with the BFN Loss of Off-Site Power / Station Blackout procedure. This will allow a Unit 1 and a Unit 2 RHR pump to be operated off the same 4kV Shutdown Board and support extended operation without overloading the Diesel Generators.

***EEEB RAI 4***

*The BFN UFSAR, Section 8.4.4, "Safety Design Basis," states:*

> *The normal and alternate offsite power circuits for each unit shall each be sufficient to supply the power to shut down the unit and maintain it in a safe condition under normal or accident situations. One of these circuits shall be available within a few seconds following a LOCA to assure that core cooling, containment integrity, and other vital safety functions are maintained. The other circuit shall be available in sufficient time to assure that plant safety design limits are not exceeded. Only one unit is assumed to be in an accident condition.*

***EEEB RAI 4.a***

*Explain how the above design-basis criteria continues to be satisfied with the PPL. Also, explain whether single failure in the offsite power system circuits has been considered while analyzing accident conditions with the PPL (when the accident loads are fed from offsite power system circuits).*

**TVA Response**

The normal offsite power supply for the Unit 1/2 Division I safety related boards is from the 500 kV switchyard bay 21, through the USST 1B (X-winding) to 4kV Unit Board 1A which normally supplies 4kV Shutdown Bus 1 and the Division I 4kV Shutdown Boards A and B. If the ECCS PPL is initiated, the Division I ECCS pumps supplied from 4kV Shutdown Boards A and B are assigned as the preferred pumps for Unit 1 and the Unit 2 Division I pumps are tripped if running and blocked from automatically starting. If power is lost to 4kV Shutdown Bus 1 from 4kV Unit Board 1A, it will automatically transfer to its alternate supply from 4kV Shutdown Board 2B, which is supplied by USST 2B (Y-winding). Therefore, the Unit 1 ECCS pumps will be supplied by the alternate offsite power supply from USST 2B and the BFN UFSAR Section 8.4.4 design-basis criteria is satisfied.

The normal offsite power supply for the Unit 1/2 Division II safety related boards is from the 500 kV switchyard bay 24, through USST 2B (X-winding) to 4kV Unit Board 2A which normally supplies 4kV Shutdown Bus 2 and the Division II 4kV Shutdown Boards C and D. If the ECCS PPL is initiated, the Division II ECCS pumps supplied from 4kV Shutdown Boards C and D are assigned as the preferred pumps for Unit 2 and the Unit 1 Division II pumps are tripped if running and blocked from automatically starting. If power is lost to 4kV Shutdown Bus 2 from 4kV Unit Board 2A, it will automatically transfer to its alternate supply from 4kV Shutdown Board 1B which is supplied by USST 1B (Y-winding). Therefore, the Unit 2 ECCS pumps will be supplied by the alternate offsite power supply from USST 1B and the BFN UFSAR Section 8.4.4 design-basis criteria is satisfied.

Single failures in the offsite power system circuits have been considered while analyzing accident conditions with the ECCS PPL (when the accident loads are fed from offsite power system circuits) for both normal and alternate electrical plant alignments. This analysis is documented in the Failure Modes and Effects Analysis (FMEA) in TVA Calculation, ND-Q0999-940013, "Reliability Analysis of the Pre-Accident and Common Accident Signal Logic for BFN Units 1, 2 and 3."

***EEEB RAI 4.b***

*TS Bases 3.8.1 stated:*

> *The Class 1E AC distribution system is divided into redundant divisions, so loss of any one division does not prevent the minimum safety functions from being performed. Each of four 4.16kV shutdown boards has two offsite power supplies available and a single DG [diesel generator]. Only offsite power delivered through the normal feeder breakers can be credited since common accident signal (CAS) logic (CAS A/CAS B) will trip the alternate breaker. This prevents an overload condition if all shutdown boards had been aligned to the same shutdown bus, and thus to the same transformer winding.*

*Based on the above, it appears that even though each 4.16 kV shutdown board is provided with two offsite circuits, only one normally closed offsite circuit can be credited in case of an accident.*

*Considering this, explain the purpose of the following statement in the UFSAR, Section 8.4.4, "Safety Design Basis": "The other circuit shall be available in sufficient time to assure the plant safety design limits are not exceeded."*

**TVA Response**

The Division I Unit 1/2 4kV Shutdown Boards A and B are normally supplied by the 4kV Shutdown Bus 1. An alternate supply is available from the Division II 4kV Shutdown Bus 2, but is not credited for any safety related function. The Division II 4kV Shutdown Bus 2 does not have sufficient capacity to support the Division II ECCS loads on the 4kV Shutdown Boards C and D, and the Division I ECCS loads on 4kV Shutdown Board A or B if one of the Division I 4kV Shutdown Boards were to be aligned to 4kV Shutdown Bus 2 by closing its alternate supply breaker. Therefore, the 4kV Shutdown Board A and B power supply through its alternate feeder breaker is not credited for any safety related function and is tripped open by the CAS.

The Division II Unit 1/2 4kV Shutdown Boards C and D are normally supplied by the 4kV Shutdown Bus 2. An alternate supply is available from the Division I 4kV Shutdown Bus 1, but is not credited for any safety related function. The Division I 4kV Shutdown Bus 1 does not have sufficient capacity to support the Division I ECCS loads on the 4kV Shutdown Boards A and B, and the Division II ECCS loads on 4kV Shutdown Board C or D if one of the Division II 4kV Shutdown Boards were to be aligned to 4kV Shutdown Bus 1 by closing its alternate supply breaker. Therefore, the 4kV Shutdown Board C and D power supply through its alternate feeder breaker is not credited for any safety related function and is tripped open by the CAS.

Although the 4kV Shutdown Boards alternate feeder breakers are tripped by the CAS logic, the automatic transfer of the upstream 4kV Shutdown Buses or 4kV Unit Boards satisfies the UFSAR Section 8.4.4, Safety Design Basis: "The other circuit shall be available in sufficient time to assure the plant safety design limits are not exceeded."

***Instrumentation and Controls Branch (EICB)-RAI-1***

*The LAR describes that the core spray system is initiated by sensors and relays based on low reactor water level (Level 1 setpoint) or high drywell pressure, coincident with low reactor pressure. These same sensors and relays are used to initiate the CAS and the LAR references the UFSAR, Section 7.4. One of the functions of the CAS is to send a signal to start all eight Unit 1, 2, and 3 DGs. The UFSAR (BTN [sic] 25; page 7.4-18) also refers formally to a signal labeled "Pre-Accident Signal" (note all first letters are capitalized giving the impression this is a specific signal) that is generated by low reactor water level (Level 1 setpoint) or high drywell pressures and sends a signal to start all eight Unit 1, 2, and 3 DGs. The use of the "Pre-Accident Signal" term was not discussed in the LAR. Is this "Pre-Accident Signal" a separate duplicate signal and part of the logic system?*

**TVA Response**

The Common Accident Signal logic (CASA and CASB) and the Pre-Accident Signal (PASA and PASC) are generated by the same low reactor vessel water level (Level 1 setpoint) or high drywell pressure transmitters and analog trip unit (ATU) signals. However, the Core Spray Relays that initiate the CAS and PAS logic are different.

- CASA – Core Spray Relay 14A-K11A
- CASB – Core Spray Relay 14A-K11B

- PASA – Core Spray Relay 14A-K35A
- PASC – Core Spray Relay 14A-K35B

The circuity that performs the CAS functions is different from the PAS circuitry and has separate power supplies. The PAS sends a signal (redundant to the CAS start signal) to start all eight Unit 1/2 and Unit 3 diesel generators. PAS is considered a defense in depth feature and as such, was not included in the License Amendment Request (LAR). This feature anticipates an event and starts all eight diesels so that they are ready for electrical loading when required by the load sequencing logic. Note that the EECW pumps will also automatically start from the Diesel Generators run recognition relays.

The PAS functions are separated between two PAS systems Unit 1/2 and Unit 3, each with two redundant divisions;

- Unit 1/2 PASA and PASC – Initiates start of the Unit 1/2 Diesel Generators
- Unit 3 PASA and PASC – Initiates start of the Unit 3 Diesel Generators

An accident signal from any unit would initiate both the Unit 1/2 and Unit 3 PAS systems.

***E*ICB-RAI-2**

*In the LAR, Section 4.1, "System Description," under "Unit Priority Re-Trip Logic," the first sentence states, "Following an initiation of a CAS on either Unit 2 or 3 (which trips all eight DG output breakers), subsequent accident signal trips of the DG output breakers are blocked." Considering the twin-like relationship between BFN, Unit 1 and Unit 2, should this actually state something to the effect, "Following an initiation of a CAS on either Unit 2 or Unit 3, or either Unit 1 or Unit 3 (either combination, which will trip all eight DG output breakers), subsequent accident signal trips of the DG output breakers are blocked?"*

**TVA Response**

The Unit Priority Re-Trip (UPRT) logic ensures that the diesels are able to support the required ECCS loads in the event of a spurious accident signal from the non-accident unit as described in the UFSAR, Section 8.5.4.2. The non-accident unit's diesel generators are also required to supply common equipment such as EECW pumps, Standby Gas Treatment (SBGT) and Control Room Emergency Ventilation System (CREVS) that is needed to support the accident unit. The following discussion is provided to clarify the CAS relationships between the BFN units.

Unit 1 and 3 Accident Signals or Unit 2 and 3 Accident Signals

On the first accident signal (real or spurious), the initiation of the CAS logic from the Core Spray initiation signal results in starting all eight Unit 1/2 and Unit 3 diesel generators. Any diesel generator output breakers that are closed are tripped open by the CAS logic so that the accident loads are properly sequenced onto the 4kV Shutdown boards. Any subsequent trips by the CAS logic are blocked. On the second accident signal (real or spurious), the UPRT logic is initiated from the RHR-LPCI initiation signal and removes the CAS block of the Diesel Generator breaker trip signal and re-trips only the four Diesel Generator breakers on the unit with the second accident signal (real or spurious). Unit 3 will only re-trip the Unit 3 Diesel Generator Breakers. Unit 1 or Unit 2 will only re-trip the Unit 1/2 Diesel

Generator Breakers. The loads in the unit with the second accident signal will then be re-sequenced onto the diesels for that unit.

Unit 1 and 2 Accident Signals

On the first accident signal (real or spurious), the initiation of the CAS logic from the Core Spray initiation signal results in starting all eight Unit 1/2 and Unit 3 diesel generators. Any diesel generator output breakers that are closed are tripped open by the CAS logic so that the accident loads are properly sequenced onto the 4KV Shutdown boards. Any subsequent trips by the CAS logic are blocked. On the second accident signal (real or spurious) the UPRT logic is initiated from the RHR-LPCI initiation signal and removes the CAS block of the Diesel Generator breaker trip signal and re-trips only the two Diesel Generator breakers assigned to that unit by the ECCS PPL. Unit 1 will only re-trip the Division I Unit 1/2 Diesel Generator Breakers. Unit 2 will only re-trip the Division II Unit 1/2 Diesel Generator Breakers. The loads in the unit with the second accident signal will then be re-sequenced onto the diesels for that unit.

***Probabilistic Risk Assessment (PRA) Licensing Branch (APLA) RAI 4***

*The CAS system, the Pre-Accident Signal (PAS) system, and the UPRTL [Unit Priority Re-Trip Logic] system respond to LOCA scenarios, including feedwater and steamline break. Explain how one or more of PPL divisions unavailable affects the functions of the CAS, PAS, and the UPRTL systems.*

**TVA Response**

The ECCS PPL function is performed by Core Spray and RHR-LPCI system relays and components. Most of these components only provide an ECCS PPL function and do not have to operate for a normal RHR and Core Spray initiation with only one accident signal and no RHR or Core Spray pumps running on the non-accident unit.

The RHR and Core Spray components that only provide an ECCS PPL function have no effect on the functions of the CAS and PAS logic. However, there is an effect on the function of the UPRT for Unit 1 and 2 accident signals as follows.

Proposed PPL Logic Technical Specification (TS) LCO verses RHR or Core Spray TS

If an entire division of components that provide the ECCS PPL function is inoperable (e.g., loss of control power or out of service for maintenance), the corresponding division of RHR or Core Spray would also be inoperable and the appropriate Condition(s) of TS 3.4.7, "Residual Heat Removal (RHR) Shutdown Cooling System - Hot Shutdown," TS 3.4.8, "Residual Heat Removal (RHR) Shutdown Cooling System - Cold Shutdown," TS 3.5.1, "ECCS - Operating," and TS 3.5.2, "ECCS - Shutdown," as applicable, would be entered in addition to proposed TS 3.3.8.3, Condition A. For inoperable RHR and Core Spray components that only provide an ECCS PPL or UPRT function, the proposed TS 3.3.8.3 Conditions would be entered (see below). However, inoperable Core Spray relay 14A-K11A(B) would also make the affected division of Core Spray inoperable so Condition A of TS 3.5.1 or TS 3.5.2, as applicable, would also be entered. Inoperable RHR relay 10A-K36A(B) would also make the affected division of RHR inoperable so the appropriate Conditions of TS 3.4.7, TS 3.4.8, TS 3.5.1 and TS 3.5.2, as applicable, would also be entered (see below).

The following Core Spray and RHR components provide the ECCS PPL Function:

- Unit 1 RHR relay 10A-K73A(B) or Core Spray relay 14A-K11A(B) provide redundant initiation signals to both the Unit 2 RHR and Core Spray ECCS PPL logic. If relay 14A-K11A(B) is inoperable, the affected division of Core Spray would also be inoperable. Therefore, Condition A of TS 3.5.1 or TS 3.5.2, as applicable, would also apply.
- Unit 2 RHR relay 10A-K73A(B) or Core Spray relay 14A-K11A(B) provide redundant initiation signals to both the Unit 1 RHR and Core Spray ECCS PPL logic. If relay 14A-K11A(B) is inoperable, the affected division of Core Spray would also be inoperable. Therefore, Condition A of TS 3.5.1 or TS 3.5.2, as applicable, would also apply.
- Core Spray relays 14A-K11A(B) and 14A-K10A(B) assign the Division I Core Spray pumps as the Unit 1 Preferred Pumps and Division II Core Spray pumps as the Unit 2 Preferred Pumps. Core Spray relay 14A-K11A(B) also initiates the CAS logic. Core Spray relay 14A-K35A(B) initiates the PAS logic but does not perform an ECCS PPL function. If relay 14A-K11A(B) is inoperable, the affected division of Core Spray is would also be inoperable. Therefore, Condition A of TS 3.5.1 or TS 3.5.2, as applicable, would also apply.
- RHR relays 10A-K36A(B) and 10A-K73A(B) assign the Division I RHR pumps as the Unit 1 Preferred Pumps and Division II RHR pumps as the Unit 2 Preferred Pumps. RHR Relay 10A-K74A(B) assigns the Diesel Generator Breaker UPRT for Unit 1 to re-trip the Division I diesel breakers and Unit 2 to re-trip the Division II diesel breakers on a Unit 1/2 real and spurious accident signal If 10A-K36A(B) is inoperable, the affected division of RHR would also be inoperable and TS 3.4.7, TS 3.4.8 TS 3.5.1 and TS 3.5.2, as applicable, would also apply. The other relays listed only provide the ECCS PPL function and if inoperable, the proposed TS 3.3.8.3 would apply.
- Core Spray Pump trip and lock out relays 14A-K24A(B), 14A-K127A(B) 14A-K128A(B), 14A-K129A(B) and 14A-K130A(B) only provide an ECCS PPL function and if inoperable, the proposed TS 3.3.8.3 would apply.
- RHR Pump trip and lock out by 10A-K74A(B), 10A-K216A(B), 10A-K217A(B), 10A-K218A(B) and 10A-K219A(B) only provide an ECCS PPL function and if inoperable, the proposed TS 3.3.8.3 would apply.
- The UPRT function is initiated by RHR relays 10A-K36A(B), 10A-K104A(B)(C)(D), 10A-K132A(B), 10A-K133A(B), 10A-K134A(B) and 10A-K135A(B). The RHR UPRT signal resets the Diesel Generator Breaker TSCRN relay (one for each Diesel Generator breaker) to trip the breaker from the pre-existing CASA(B) trip signal. The opening of the diesel breakers re-energizes the TSCRN relays to block further CASA(B) trips of the diesel breakers If RHR relay 10A-K36A(B) is inoperable, the affected division of RHR would also be inoperable and the appropriate Conditions of TS 3.4.7, TS 3.4.8 TS 3.5.1 and TS 3.5.2, as applicable, would also apply. The other relays listed only provide the UPRT function and if inoperable, the proposed TS 3.3.8.3 would apply.

***APLA-RAI-6***

*The LAR in Section 3.0, "Background," discusses (1) a potential overloading of diesel generators if the ECCS pumps were started out of their required sequence; and (2) overloading of a diesel if an RHR pump was allowed to start on a diesel that was already loaded with any large 4 kV load, as well as the potential to overload affected shutdown boards with normal power available if an RHR pump were to start on a board already loaded with a CS pump and an emergency equipment cooling water pump.*
*The LAR also states:*

> *Following the shutdown of all three BFN units in 1986, a Condition Adverse to Quality Report was initiated to document that the AC power supply system and ECCS initiation logic could not accommodate various combinations of spurious and real accident signals as described in the UFSAR Section 8.5.2. As part of the Base Line Commitment process, TVA identified that modification of the BFN Accident Signal Logic and Unit 1/2 ECCS PPL would be required to support continued multi-unit operations.*

*The PPL modification appears to be part of the resolution of the power reliability issues. It is not clear that the reliability of normal and emergency power has been analyzed with respect to the CAS, PAS, or UPRTL functions, or for additional equipment out-of-service for maintenance (other than PPL-related components) that would not load onto the bus. The reliability of normal and emergency power, given PPL division(s) inoperable as allowed by the proposed TS LCO, should be appropriately accounted for in the PRA.*

*Address the following related to the reliability of the power sources:*

***APLA RAI 6.a***

*It appears that the Unit 1/2 PPL modification is related to resolving the power reliability issues described in the LAR. Discuss whether the proposed TS changes allowing PPL division(s) to be inoperable at-power or during shutdown modes can affect the reliability of normal or emergency power for the accident unit(s). If so, explain the scenarios.*

**TVA Response**

The ECCS PPL function is performed by Core Spray and RHR-LPCI system relays and components. The ECCS PPL initiation signal from Unit 1 to Unit 2, and from Unit 2 to Unit 1 is provided by redundant relays:

- Unit 1 RHR relay 10A-K73A(B) or Core Spray relay 14A-K11A(B) provide redundant initiation signals to both the Unit 2 RHR and Core Spray PPL logic
- Unit 2 RHR relay 10A-K73A(B) or Core Spray relay 14A-K11A(B) provide redundant initiation signals to both the Unit 1 RHR and Core Spray PPL logic

Therefore, if the RHR relay failed to initiate the ECCS PPL function in the opposite unit's RHR logic, the redundant Core Spray relay would still initiate the signal. If the Core Spray relay failed to initiate the ECCS PPL function in the opposite unit's Core Spray logic, the redundant RHR relay would still initiate the signal.

After the ECCS PPL initiation signal is received from the opposite unit, the Core Spray and RHR components that only provide an ECCS PPL function would only adversely affect a single division of the RHR or Core Spray initiation logic. Therefore, a failure of a single

ECCS PPL system would only adversely affect the Division I 4kV Shutdown Boards, or the Division II 4kV Shutdown Boards as described in the scenarios provided in the TVA response to APLA RAI 6.b.

Note that Core Spray relays 14A-K11A(B) perform other functions within the Core Spray system and if one of them is inoperable making the ECCS PPL Core Spray initiation signal to the opposite unit inoperable, this would also make the affected division of Core Spray inoperable. Therefore, Condition A of TS 3.5.1 or TS 3.5.2, as applicable, would be entered in addition to the proposed TS 3.3.8.3, Condition A. RHR relays 10A-K36A(B) perform other functions within the RHR-LPCI system and if one of them is inoperable making the ECCS PPL and UPRT initiation signal to the Diesel Generator breakers inoperable, this would also make the affected division of RHR inoperable. Therefore, the appropriate Condition(s) of TS 3.4.7, TS 3.4.8, TS 3.5.2, and TS 3.5.2, as applicable, would be entered in addition to the proposed TS 3.3.8.3, Condition A as discussed in the TVA response to APLA RAI 4.

***APLA RAI 6.b***

*Discuss the normal or emergency power reliability impacts, if any, given PPL division(s) inoperable and a CAS, PAS, or UPRTL signal is received. If there are any impacts, explain the scenarios.*

**TVA Response**

The RHR and Core Spray components that only provide an ECCS PPL function have no effect on the functions of the CAS and PAS logic. However, there is an effect on the function of the UPRT for Unit 1 and 2 accident signals as described in the following scenarios.

BFN UFSAR Table 6.5-3 defines the minimum number of ECCS sub-systems required to be available as evaluated in the BFN accident analysis. The single failure of a battery is bounding and is used for the acceptance criteria for the minimum number of ECCS sub-systems in the following ECCS PPL and UPRT scenarios tables.

SINGLE FAILURE EVALUATION USED FOR LOCA ANALYSIS

| Assumed Failure | Remaining Systems*,† | | Disposition |
|---|---|---|---|
| | Recirculation Suction Break‡ | Recirculation Discharge Break | |
| Battery SF-BATT\|BA§ | 6 Automatic Depressurization System (ADS), 1 Low Pressure Core Spray (LPCS), 2 LPCI | 6 ADS, 1 LPCS | Analyze |
| Battery SF-BATT\|BB§ | 4 ADS**, High Pressure Coolant Injection (HPCI), 1 LPCS, 2 LPCI | 4 ADS**, HPCI, 1 LPCS | Analyze |
| Battery SF-BATT\|BC§,†† | 4 ADS, HPCI, 1 LPCS, 3 LPCI | 4 ADS, HPCI, 1 LPCS, 1 LPCI | Bounded by SF-BATT\|BB |
| SF-LOCA (U1 & 2 only) | 6 ADS, HPCI, 1 LPCS, 2 LPCI | 6 ADS, HPCI, 1 LPCS | Bounded by SF-BATT\|BA and SF-BATT\|BB |
| SF-LPCI (Injection Valve) | 6 ADS, HPCI, 2 LPCS, 2 LPCI | 6 ADS, HPCI, 2 LPCS | Bounded by SF-BATT\|BA and SF-BATT\|BB |

| | | | |
|---|---|---|---|
| SF-DGEN (Diesel Generator) | 6 ADS, HPCI, 1 LPCS, 2 LPCI | 6 ADS, HPCI, 1 LPCS | Bounded by SF-BATT\|BA and SF-BATT\|BB |
| SF-HPCI | 6 ADS, 2 LPCS, 4 LPCI | 6 ADS, 2 LPCS, 2 LPCI | Bounded by SF-BATT\|BA |
| SF-ADS\|IL‡‡ (Initiation Logic) | 4 ADS, HPCI, 2 LPCS,4 LPCI | 4 ADS, HPCI, 2 LPCS, 2 LPCI | Bounded by SF-BATT\|BB |
| SF-ADS\|SV (Single Valve) | 5 ADS, HPCI, 2 LPCS, 4 LPCI | 5 ADS, HPCI, 2 LPCS, 2 LPCI | Bounded by SF-BATT\|BB |

* Each LPCS means operation of two core spray pumps in a system. It is assumed that both pumps in a system must operate to take credit for core spray cooling or inventory makeup. Furthermore, 2 LPCI refers to two LPCI pumps into one loop, 3 LPCI refers to two LPCI pumps into one loop and one LPCI pump into one loop. 4 LPCI refers to four LPCI pumps into two loops, two per loop.

† 4 ADS, 5 ADS, and 6 ADS means the number of ADS valves available for automatic activation.

‡ Systems remaining, as identified in this table for recirculation suction line breaks, are applicable to other non-ECCS line breaks. For a LOCA from an ECCS line break, the systems remaining are those listed for recirculation suction breaks, less the ECCS in which the break is assumed.

§ SF-BATT|BX (X=A, B, or C) is the single failure of a Unit Battery that results in the loss of a downstream unitized 250V DC RMOV Board A, B, or C.

** A single failure of 250V RMOV Board B results in the loss of the normal power supply to ADS logic. Units 1, 2, and 3 are designed with an automatic transfer scheme for ADS logic power to provide four ADS valves for this board failure.

†† Unit 3 systems remaining. Conservative for Units 1 and 2.

‡‡ A special case of ADS failure involves failure of initiation logic. However, 4 ADS valves are single failure proof, and will still function automatically.

Effect of ECCS PPL Inoperable with an Accident and Spurious Accident Signal

Combinations of real and spurious signals without the ECCS PPL function available, and the effect of the ability of the plant to support ECCS loads are summarized as follows.

| LOCA in Unit 1 with a Spurious Accident Signal from Unit 2 | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 1) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 1 Division I Core Spray PPL Component Inoperable | Unit 1 Core Spray Relays 14A-K10A or 14A-K11A are inoperable and do not function to prevent the Unit 2 accident signal from tripping and blocking the restart of the Unit 1 Division I Core Spray pumps. The Unit 2 PPL signal could block and prevent the Unit 1 Core Spray pumps in Division I and Division II from starting. Unit 1 RHR Division I would not be affected. Unit 1 RHR Division II would be blocked by the Unit 2 PPL signal.<br>The Unit 1 Preferred Core Spray Pumps in Division I are affected and will not start. | Recirculation discharge line break: ADS, HPCI<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop). | No |

| LOCA in Unit 1 with a Spurious Accident Signal from Unit 2 | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 1) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 2 Division I Core Spray PPL Component Inoperable | Unit 2 Core Spray Relays 14A-K24A, 14A-K127A, 14A-K128A, 14A-K129A or 14A-K130A are inoperable and do not function to trip or prevent the Unit 2 Division I Core spray pumps from starting. Both Unit 1 and 2 Core Spray pumps could attempt to start on 4kV Shutdown Boards A and B. Results in overloading Diesel Generator A and B and the loss of 4kV Shutdown Board A and B.<br>The Unit 1 Preferred RHR and Core Spray Pumps in Division I are lost. | Recirculation discharge line break: ADS, HPCI<br>Recirculation suction line break: ADS, HPCI. | No |
| Unit 1 Division I RHR PPL Component Inoperable | Unit 1 RHR Relays 10A-K36A or 10A-K73A are inoperable and do not function to prevent the Unit 2 accident signal from tripping and blocking the restart of the Unit 1 Division I pumps. The Unit 2 PPL signal could block and prevent the Unit 1 RHR pumps in Division I and Division II from starting. Unit 1 Core Spray Division I would not be affected. Unit 1 Core Spray Division II would be blocked by the Unit 2 PPL signal.<br>The Unit 1 Preferred RHR Pumps in Division I are affected and will not start. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop Core Spray (2 pumps in loop). | No |
| Unit 2 Division I RHR PPL Component Inoperable | Unit 2 RHR Relays 10A-K74A, 10A-K216A, 10A-K217A, 10A-K218A or 10A-K219A are inoperable and do not function to trip or prevent the Unit 2 Division I pumps from starting. Both Unit 1 and 2 RHR pumps could attempt to start on 4kV Shutdown Boards A and B. Results in overloading Diesel Generator A and B and the loss of 4kV Shutdown Board A and B.<br>The Unit 1 Preferred RHR and Core Spray Pumps in Division I are lost. | Recirculation discharge line break: ADS, HPCI<br>Recirculation suction line break: ADS, HPCI. | No |
| Unit 1 Division I RHR UPRT Component Inoperable<br><br>Unit 1 real accident signal followed by Unit 2 spurious signal | Unit 1 RHR Relay 10A-K74A is inoperable and does not function to prevent the Unit 2 accident signal from re-tripping the Division I Diesel Generators A and B. With a UPRT component inoperable, if the second accident signal was the spurious signal from Unit 2, it could re-trip the Division I Diesel Generators after the Unit 1 Division I ECCS pumps had started and were supplying the accident on Unit 1.<br>The Unit 1 Preferred RHR and Core Spray Pumps in Division I would start but would trip and attempt to restart on the UPRT signal.<br>Although the minimum number of Unit 1 Division I ECCS pumps and systems described in the UFSAR would initially start, they would be tripped then attempt to restart on the UPRT signal. This has not been analyzed in the BFN accident and diesel loading analysis and therefore cannot be credited. | The Unit 1 preferred Pumps in Division I are affected.<br>The following will initially start, but trip on the UPRT signal then attempt to restart:<br>Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | No |

| LOCA in Unit 1 with a Spurious Accident Signal from Unit 2 | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 1) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 1 Division I RHR UPRT Component Inoperable<br><br>Unit 2 spurious signal followed by Unit 1 real accident signal | Unit 1 RHR Relays 10A-K104A, 10A-K104C, 10A-K132A, 10A-K133A, 10A-K134A or 10A-K135A are inoperable and do not function to re-trip the Division I Diesel Generators A or B. With a UPRT component inoperable, if the first accident signal was the spurious signal from Unit 2, EECW pumps could be loaded on the Division I Diesel Generators A and B and are not load shed by the UPRT logic. Note that the Unit 2 Division I RHR and Core Spray will still be tripped by the PPL logic. The Unit 1 Preferred RHR and Core Spray Pumps in Division I would attempt to start on the Diesel Generators already loaded with EECW pumps. Results in overloading Diesel Generator A and B and the loss of 4kV Shutdown Board A and B.<br>The Unit 1 Preferred RHR and Core Spray Pumps in Division I are lost. | Recirculation discharge line break: ADS, HPCI<br>Recirculation suction line break: ADS, HPCI. | No |
| Unit 2 Division I RHR UPRT Component Inoperable | Unit 2 RHR Relays 10A-K104A, 10A-K104C, 10A-K132A, 10A-K133A, 10A-K134A or 10A-K135A are inoperable and do not function to re-trip the Division I Diesel Generators A or B. The Unit 1 PPL logic and UPRT logic will still function to trip the Division I Diesel Generators and load shed the Unit 2 Division I RHR and Core Spray pumps on the Unit 1 accident signal.<br>The Unit 1 Preferred RHR and Core Spray Pumps in Division I are not affected and are available. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |
| Unit 1 Division II Core Spray PPL Component Inoperable | Unit 1 Core Spray Relays 14A-K24B, 14A-K127B, 14A-K128B, 14A-K129B or 14A-K130B are inoperable and do not function to trip or prevent the Unit 1 Division II Core spray pumps from starting. Both Unit 1 and 2 Core Spray pumps could attempt to start on 4kV Shutdown Boards C and D. Results in overloading Diesel Generator C and D and the loss of 4kV Shutdown Board C and D.<br>The Unit 1 Preferred RHR and Core Spray Pumps in Division I are not affected and are available. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |
| Unit 2 Division II Core Spray PPL Component Inoperable | Unit 2 Core Spray Relays 14A-K10B or 14A-K11B are inoperable and do not function to prevent the Unit 1 accident signal from tripping and blocking the restart of the Unit 2 Division II Core Spray pumps. The Unit 1 PPL signal could block and prevent the Unit 2 Core Spray pumps in Division I and Division II from starting.<br>The Unit 1 Preferred RHR and Core Spray Pumps in Division I are not affected and are available. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |

| LOCA in Unit 1 with a Spurious Accident Signal from Unit 2 | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 1) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 1 Division II RHR PPL Component Inoperable | Unit 1 RHR Relays 10A-K74B, 10A-K216B, 10A-K217B, 10A-K218B or 10A-K219B are inoperable and do not function to trip or prevent the Unit 1 Division II pumps from starting. Both Unit 1 and 2 RHR pumps could attempt to start on 4kV Shutdown Boards C and D. Results in overloading Diesel Generator C and D and the loss of 4kV Shutdown Board C and D.<br>The Unit 1 Preferred RHR and Core Spray Pumps in Division I are not affected and are available. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |
| Unit 2 Division II RHR PPL Component Inoperable | Unit 2 RHR Relays 10A-K36B or 10A-K73B are inoperable and do not function to prevent the Unit 1 accident signal from tripping and blocking the restart of the Unit 2 Division II pumps. The Unit 1 PPL signal could block and prevent the Unit 2 RHR pumps in Division I and Division II from starting.<br>The Unit 1 Preferred RHR and Core Spray Pumps in Division I are not affected and are available. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |
| Unit 1 or 2 Division II RHR UPRT Component Inoperable | A Unit 1 or 2 Division II UPRT component is inoperable. The Division II Diesel Generators could be affected but would have no effect on the Division I Diesel Generators supplying the ECCS components on Unit 1.<br>The Unit 1 Preferred RHR and Core Spray Pumps in Division I are not affected and are available. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |
| Unit 1 Division I and Division II Core Spray PPL Components Inoperable | Unit 1 Core Spray Relays 14A-K10A or 14A-K11A are inoperable and do not function to prevent the Unit 2 accident signal from tripping and blocking the restart of the Unit 1 Division I Core Spray pumps. The Unit 2 PPL signal could block and prevent the Unit 1 Core Spray pumps in Division I and Division II from starting. Unit 1 RHR Division I would not be affected. Unit 1 Core Spray Division II would not be blocked by the Unit 2 PPL signal.<br>The Unit 1 Preferred Core Spray Pumps in Division I are affected and will not start.<br>Unit 1 Core Spray Relays 14A-K24B, 14A-K127B, 14A-K128B, 14A-K129B or 14A-K130B are inoperable and do not function to trip or prevent the Unit 1 Division II Core spray pumps from starting. Both Unit 1 and 2 Core Spray pumps could attempt to start on 4kV Shutdown Boards C and D. Results in overloading Diesel Generator C and D and the loss of 4kV Shutdown Board C and D. | Recirculation discharge line break: ADS, HPCI<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop). | No |

| LOCA in Unit 1 with a Spurious Accident Signal from Unit 2 | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 1) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 1 Division I and Division II RHR PPL Components Inoperable | Unit 1 RHR Relays 10A-K36A or 10A-K73A are inoperable and do not function to prevent the Unit 2 accident signal from tripping and blocking the restart of the Unit 1 Division I pumps. The Unit 2 PPL signal could block and prevent the Unit 1 RHR pumps in Division I and Division II from starting. Unit 1 Core Spray Division I would not be affected. Unit 1 RHR Division II would not be blocked by the Unit 2 PPL signal.<br>The Unit 1 Preferred RHR Pumps in Division I are affected and will not start.<br>Unit 1 RHR Relays 10A-K74B, 10A-K216B, 10A-K217B, 10A-K218B or 10A-K219B are inoperable and do not function to trip or prevent the Unit 1 Division II pumps from starting. Both Unit 1 and 2 RHR pumps could attempt to start on 4kV Shutdown Boards C and D. Results in overloading Diesel Generator C and D and the loss of 4kV Shutdown Board C and D. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop)<br>Recirculation suction line break: ADS, HPCI, One loop Core Spray (2 pumps in loop). | No |
| Unit 2 Division I and Division II Core Spray PPL Components Inoperable | Unit 2 Core Spray Relays 14A-K24A, 14A-K127A, 14A-K128A, 14A-K129A or 14A-K130A are inoperable and do not function to trip or prevent the Unit 2 Division I Core spray pumps from starting. Both Unit 1 and 2 Core Spray pumps could attempt to start on 4kV Shutdown Boards A and B. Results in overloading Diesel Generator A and B and the loss of 4kV Shutdown Board A and B.<br>The Unit 1 Preferred RHR and Core Spray Pumps in Division I are lost.<br>Unit 2 Core Spray Relays 14A-K10B or 14A-K11B are inoperable and do not function to prevent the Unit 1 accident signal from tripping and blocking the restart of the Unit 2 Division II Core Spray pumps. The Unit 1 PPL signal could block and prevent the Unit 2 Core Spray pumps in Division II from starting. | Recirculation discharge line break: ADS, HPCI<br>Recirculation suction line break: ADS, HPCI. | No |
| Unit 2 Division I and Division II RHR PPL Components Inoperable | Unit 2 RHR Relays 10A-K74A, 10A-K216A, 10A-K217A, 10A-K218A or 10A-K219A are inoperable and do not function to trip or prevent the Unit 2 Division I pumps from starting. Both Unit 1 and 2 RHR pumps could attempt to start on 4kV Shutdown Boards A and B. Results in overloading Diesel Generator A and B and the loss of 4kV Shutdown Board A and B.<br>The Unit 1 Preferred RHR and Core Spray Pumps in Division I are lost.<br>Unit 2 RHR Relays 10A-K36B or 10A-K73B are inoperable and do not function to prevent the Unit 1 accident signal from tripping and blocking the restart of the Unit 2 Division II pumps. The Unit 1 PPL signal could block and prevent the Unit 2 RHR pumps in Division II from starting. | Recirculation discharge line break: ADS, HPCI<br>Recirculation suction line break: ADS, HPCI. | No |

| LOCA in Unit 1 with a Spurious Accident Signal from Unit 2 | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 1) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 1 Division I Core Spray and Division I RHR PPL Components Inoperable | Unit 1 Core Spray relay 14A-K11A and RHR relay 10A-K73A are inoperable and fail to initiate the Unit 2 Division I Core Spray and RHR PPL logic. Both Unit 1 and 2 RHR and Core Spray pumps could attempt to start on 4kV Shutdown Boards A and B. Results in overloading Diesel Generator A and B and the loss of 4kV Shutdown Board A and B.<br>The Unit 1 Preferred RHR and Core Spray Pumps in Division I are lost. | Recirculation discharge line break: ADS, HPCI<br>Recirculation suction line break: ADS, HPCI | No |
| Unit 1 Division II Core Spray and Division II RHR PPL Components Inoperable | Unit 1 Core Spray Relays 14A-K24B, 14A-K127B, 14A-K128B, 14A-K129B or 14A-K130B are inoperable and do not function to trip or prevent the Unit 1 Division II Core spray pumps from starting. Unit 1 RHR Relays 10A-K74B, 10A-K216B, 10A-K217B, 10A-K218B or 10A-K219B are inoperable and do not function to trip or prevent the Unit 1 Division II pumps from starting. Both Unit 1 and 2 RHR and Core Spray pumps could attempt to start on 4kV Shutdown Boards C and D. Results in overloading Diesel Generator C and D and the loss of 4kV Shutdown Board C and D.<br>The Unit 1 Preferred RHR and Core Spray Pumps in Division I are not affected and are available. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |
| Unit 2 Division I Core Spray and Division I RHR PPL Components Inoperable | Unit 2 Core Spray Relays 14A-K24A, 14A-K127A, 14A-K128A, 14A-K129A or 14A-K130A are inoperable and do not function to trip or prevent the Unit 2 Division I Core spray pumps from starting. Unit 2 RHR Relays 10A-K74A, 10A-K216A, 10A-K217A, 10A-K218A or 10A-K219A are inoperable and do not function to trip or prevent the Unit 2 Division I pumps from starting. Both Unit 1 and 2 RHR and Core Spray pumps could attempt to start on 4kV Shutdown Boards A and B. Results in overloading Diesel Generator A and B and the loss of 4kV Shutdown Board A and B.<br>The Unit 1 Preferred RHR and Core Spray Pumps in Division I are lost. | Recirculation discharge line break: ADS, HPCI<br>Recirculation suction line break: ADS, HPCI | No |
| Unit 2 Division II Core Spray and Division II RHR PPL Components Inoperable | Unit 2 Core Spray relay 14A-K11B and RHR relay 10A-K73B are inoperable and fail to initiate the Unit 1 Division II Core Spray and RHR PPL logic. The Unit 2 Division II PPL signal to initiate the Unit 1 Division II PPL logic would not function. Both Unit 1 and 2 RHR and Core Spray pumps could attempt to start on 4kV Shutdown Boards C and D. Results in overloading Diesel Generator C and D and the loss of 4kV Shutdown Board C and D.<br>The Unit 1 Preferred RHR and Core Spray Pumps in Division I are not affected and are available. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |

| LOCA in Unit 2 with a Spurious Accident Signal from Unit 1 | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 2) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 1 Division I Core Spray PPL Component Inoperable | Unit 1 Core Spray Relays 14A-K10A or 14A-K11A are inoperable and do not function to prevent the Unit 2 accident signal from tripping and blocking the restart of the Unit 1 Division I Core Spray pumps. The Unit 2 PPL signal could block and prevent the Unit 1 Core Spray pumps in Division I and Division II from starting.<br>The Unit 2 Preferred RHR and Core Spray Pumps in Division II are not affected and are available. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |
| Unit 2 Division I Core Spray PPL Component Inoperable | Unit 2 Core Spray Relays 14A-K24A, 14A-K127A, 14A-K128A, 14A-K129A or 14A-K130A are inoperable and do not function to trip or prevent the Unit 2 Division I Core spray pumps from starting. Both Unit 1 and 2 Core Spray pumps could attempt to start on 4kV Shutdown Boards A and B. Results in overloading Diesel Generator A and B and the loss of 4kV Shutdown Board A and B.<br>The Unit 2 Preferred RHR and Core Spray Pumps in Division II are not affected and are available. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |
| Unit 1 Division I RHR PPL Component Inoperable | Unit 1 RHR Relays 10A-K36A or 10A-K73A are inoperable and do not function to prevent the Unit 2 accident signal from tripping and blocking the restart of the Unit 1 Division I pumps. The Unit 2 PPL signal could block and prevent the Unit 1 RHR pumps in Division I and Division II from starting.<br>The Unit 2 Preferred RHR and Core Spray Pumps in Division II are not affected and are available. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |
| Unit 2 Division I RHR PPL Component Inoperable | Unit 2 RHR Relays 10A-K74A, 10A-K216A, 10A-K217A, 10A-K218A or 10A-K219A are inoperable and do not function to trip or prevent the Unit 2 Division I pumps from starting. Both Unit 1 and 2 RHR pumps could attempt to start on 4kV Shutdown Boards A and B. Results in overloading Diesel Generator A and B and the loss of 4kV Shutdown Board A and B.<br>The Unit 2 Preferred RHR and Core Spray Pumps in Division II are not affected and are available. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |
| Unit 1 or 2 Division I RHR UPRT Component Inoperable | A Unit 1 or 2 Division I UPRT component is inoperable. The Division I Diesel Generators could be affected but would have no effect on the Division II Diesel Generators supplying the ECCS components on Unit 2.<br>The Unit 2 Preferred RHR and Core Spray Pumps in Division II are not affected and are available. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |

| LOCA in Unit 2 with a Spurious Accident Signal from Unit 1 | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 2) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 1 Division II Core Spray PPL Component Inoperable | Unit 1 Core Spray Relays 14A-K24B, 14A-K127B, 14A-K128B, 14A-K129B or 14A-K130B are inoperable and do not function to trip or prevent the Unit 1 Division II Core spray pumps from starting. Both Unit 1 and 2 Core Spray pumps could attempt to start on 4kV Shutdown Boards C and D. Results in overloading Diesel Generator C and D and the loss of 4kV Shutdown Board C and D.<br>The Unit 2 Preferred RHR and Core Spray Pumps in Division II are lost. | Recirculation discharge line break: ADS, HPCI<br>Recirculation suction line break: ADS, HPCI. | No |
| Unit 2 Division II Core Spray PPL Component Inoperable | Unit 2 Core Spray Relays 14A-K10B or 14A-K11B are inoperable and do not function to prevent the Unit 1 accident signal from tripping and blocking the restart of the Unit 2 Division II Core Spray pumps. The Unit 1 PPL signal could block and prevent the Unit 2 Core Spray pumps in Division I and Division II from starting.<br>The Unit 2 Preferred Core Spray Pumps in Division II are affected and will not start. | Recirculation discharge line break: ADS, HPCI<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop). | No |
| Unit 1 Division II RHR PPL Component Inoperable | Unit 1 RHR Relays 10A-K74B, 10A-K216B, 10A-K217B, 10A-K218B or 10A-K219B are inoperable and do not function to trip or prevent the Unit 1 Division II pumps from starting. Both Unit 1 and 2 RHR pumps could attempt to start on 4kV Shutdown Boards C and D. Results in overloading Diesel Generator C and D and the loss of 4kV Shutdown Board C and D.<br>The Unit 2 Preferred RHR and Core Spray Pumps in Division II are lost. | Recirculation discharge line break: ADS, HPCI<br>Recirculation suction line break: ADS, HPCI. | No |
| Unit 2 Division II RHR PPL Component Inoperable | Unit 2 RHR Relays 10A-K36B or 10A-K73B are inoperable and do not function to prevent the Unit 1 accident signal from tripping and blocking the restart of the Unit 2 Division II pumps. The Unit 1 PPL signal could block and prevent the Unit 2 RHR pumps in Division I and Division II from starting. Unit 2 Core Spray Division II would not be affected. Unit 2 Core Spray Division I would be blocked by the Unit 1 PPL signal.<br>The Unit 2 Preferred RHR Pumps in Division II are affected and will not start. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop Core Spray (2 pumps in loop). | No |

| LOCA in Unit 2 with a Spurious Accident Signal from Unit 1 | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 2) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 2 Division II RHR UPRT Component Inoperable<br><br>Unit 2 real accident signal followed by Unit 1 spurious signal | Unit 2 RHR Relay 10A-K74B is inoperable and does not function to prevent the Unit 1 accident signal from re-tripping the Division II Diesel Generators C and D. With a UPRT component inoperable, if the second accident signal was the spurious signal from Unit 1, it could re-trip the Division II Diesel Generators after the Unit 2 Division II ECCS pumps had started and were supplying the accident on Unit 2.<br>The Unit 2 Preferred RHR and Core Spray Pumps in Division II would start but would trip and attempt to restart on the UPRT signal.<br>Although the minimum number of Unit 2 Division II ECCS pumps and systems described in the UFSAR would initially start, they would be tripped then attempt to restart on the UPRT signal. This has not been analyzed in the BFN accident and diesel loading analysis and therefore cannot be credited. | The Unit 1 preferred Pumps in Division II are affected.<br>The following will initially start, but trip on the UPRT signal then attempt to restart:<br>Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | No |
| Unit 2 Division II RHR UPRT Component Inoperable<br><br>Unit 1 spurious signal followed by Unit 2 real accident signal | Unit 2 RHR Relays 10A-K104B, 10A-K104D, 10A-K132B, 10A-K133B, 10A-K134B or 10A-K135B are inoperable and do not function to re-trip the Division II Diesel Generators C or D. With a UPRT component inoperable, if the first accident signal was the spurious signal from Unit 1, EECW pumps could be loaded on the Division II Diesel Generators C and D and are not load shed by the UPRT logic. Note that the Unit 1 Division II RHR and Core Spray will still be tripped by the PPL logic.<br>The Unit 2 Preferred RHR and Core Spray Pumps in Division II would attempt to start on the Diesel Generators already loaded with EECW pumps. Results in overloading Diesel Generator C and D and the loss of 4kV Shutdown Board C and D.<br>The Unit 2 Preferred RHR and Core Spray Pumps in Division II are lost. | Recirculation discharge line break: ADS, HPCI<br>Recirculation suction line break: ADS, HPCI. | No |
| Unit 1 Division II RHR UPRT Component Inoperable | Unit 1 RHR Relays 10A-K104B, 10A-K104D, 10A-K132B, 10A-K133B, 10A-K134B or 10A-K135B are inoperable and do not function to re-trip the Division II Diesel Generators C or D. The Unit 2 PPL logic and UPRT logic will still function to trip the Division II Diesel Generators and load shed the Unit 1 Division II RHR and Core Spray pumps on the Unit 2 accident signal.<br>The Unit 2 Preferred RHR and Core Spray Pumps in Division II are not affected and are available. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |

| LOCA in Unit 2 with a Spurious Accident Signal from Unit 1 | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 2) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 1 Division I and Division II Core Spray PPL Components Inoperable | Unit 1 Core Spray Relays 14A-K24B, 14A-K127B, 14A-K128B, 14A-K129B or 14A-K130B are inoperable and do not function to trip or prevent the Unit 1 Division II Core spray pumps from starting. Both Unit 1 and 2 Core Spray pumps could attempt to start on 4kV Shutdown Boards C and D. Results in overloading Diesel Generator C and D and the loss of 4kV Shutdown Board C and D.<br>The Unit 2 Preferred RHR and Core Spray Pumps in Division II are lost.<br>Unit 1 Core Spray Relays 14A-K10A or 14A-K11A are inoperable and do not function to prevent the Unit 2 accident signal from tripping and blocking the restart of the Unit 1 Division I Core Spray pumps. The Unit 2 PPL signal could block and prevent the Unit 1 Core Spray pumps in Division I from starting. | Recirculation discharge line break: ADS, HPCI<br>Recirculation suction line break: ADS, HPCI. | No |
| Unit 1 Division I and Division II RHR PPL Components Inoperable | Unit 1 RHR Relays 10A-K74B, 10A-K216B, 10A-K217B, 10A-K218B or 10A-K219B are inoperable and do not function to trip or prevent the Unit 1 Division II pumps from starting. Both Unit 1 and 2 RHR pumps could attempt to start on 4kV Shutdown Boards C and D. Results in overloading Diesel Generator C and D and the loss of 4kV Shutdown Board C and D.<br>The Unit 2 Preferred RHR and Core Spray Pumps in Division II are lost.<br>Unit 1 RHR Relays 10A-K36A or 10A-K73A are inoperable and do not function to prevent the Unit 2 accident signal from tripping and blocking the restart of the Unit 1 Division I pumps. The Unit 2 PPL signal could block and prevent the Unit 1 RHR pumps in Division I from starting. | Recirculation discharge line break: ADS, HPCI<br>Recirculation suction line break: ADS, HPCI. | No |
| Unit 2 Division I and Division II Core Spray PPL Components Inoperable | Unit 2 Core Spray Relays 14A-K10B or 14A-K11B are inoperable and do not function to prevent the Unit 1 accident signal from tripping and blocking the restart of the Unit 2 Division II Core Spray pumps. The Unit 1 PPL signal could block and prevent the Unit 2 Core Spray pumps in Division I and Division II from starting. Unit 2 RHR Division II would not be affected.<br>The Unit 2 Preferred Core Spray Pumps in Division II are affected and will not start.<br>Unit 2 Core Spray Relays 14A-K24A, 14A-K127A, 14A-K128A, 14A-K129A or 14A-K130A are inoperable and do not function to trip or prevent the Unit 2 Division I Core spray pumps from starting. Both Unit 1 and 2 Core Spray pumps could attempt to start on 4kV Shutdown Boards A and B. Results in overloading Diesel Generator A and B and the loss of 4kV Shutdown Board A and B. | Recirculation discharge line break: ADS, HPCI<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop). | No |

| LOCA in Unit 2 with a Spurious Accident Signal from Unit 1 | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 2) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 2 Division I and Division II RHR PPL Components Inoperable | Unit 2 RHR Relays 10A-K36B or 10A-K73B are inoperable and do not function to prevent the Unit 1 accident signal from tripping and blocking the restart of the Unit 2 Division II pumps. The Unit 1 PPL signal could block and prevent the Unit 2 RHR pumps in Division I and Division II from starting. Unit 2 Core Spray Division II would not be affected. Unit 2 RHR Division I would not be blocked by the Unit 1 PPL signal.<br>The Unit 2 Preferred RHR Pumps in Division II are affected and will not start.<br>Unit 2 RHR Relays 10A-K74A, 10A-K216A, 10A-K217A, 10A-K218A or 10A-K219A are inoperable and do not function to trip or prevent the Unit 2 Division I pumps from starting. Both Unit 1 and 2 RHR pumps could attempt to start on 4kV Shutdown Boards A and B. Results in overloading Diesel Generator A and B and the loss of 4kV Shutdown Board A and B. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop)<br>Recirculation suction line break: ADS, HPCI, One loop Core Spray (2 pumps in loop). | No |
| Unit 1 Division I Core Spray and Division I RHR PPL Components Inoperable | Unit 1 Core Spray relay 14A-K11A and RHR relay 10A-K73A are inoperable and fail to initiate the Unit 2 Division I Core Spray and RHR PPL logic. Both Unit 1 and 2 Core Spray and RHR pumps could attempt to start on 4kV Shutdown Boards A and B. Results in overloading Diesel Generator A and B and the loss of 4kV Shutdown Board A and B.<br>The Unit 2 Preferred RHR and Core Spray Pumps in Division II are not affected and are available. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |
| Unit 1 Division II Core Spray and Division II RHR PPL Components Inoperable | Unit 1 Core Spray Relays 14A-K24B, 14A-K127B, 14A-K128B, 14A-K129B or 14A-K130B are inoperable and do not function to trip or prevent the Unit 1 Division II Core spray pumps from starting. Unit 1 RHR Relays 10A-K74B, 10A-K216B, 10A-K217B, 10A-K218B or 10A-K219B are inoperable and do not function to trip or prevent the Unit 1 Division II pumps from starting. Both Unit 1 and 2 RHR and Core Spray pumps could attempt to start on 4kV Shutdown Boards C and D. Results in overloading Diesel Generator C and D and the loss of 4kV Shutdown Board C and D.<br>The Unit 2 Preferred RHR and Core Spray Pumps in Division II are lost. | Recirculation discharge line break: ADS, HPCI<br>Recirculation suction line break: ADS, HPCI | No |

| LOCA in Unit 2 with a Spurious Accident Signal from Unit 1 | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 2) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 2 Division I Core Spray and Division I RHR PPL Components Inoperable | Unit 2 Core Spray Relays 14A-K24A, 14A-K127A, 14A-K128A, 14A-K129A or 14A-K130A are inoperable and do not function to trip or prevent the Unit 2 Division I Core spray pumps from starting. Unit 2 RHR Relays 10A-K74A, 10A-K216A, 10A-K217A, 10A-K218A or 10A-K219A are inoperable and do not function to trip or prevent the Unit 2 Division I pumps from starting. Both Unit 1 and 2 RHR and Core Spray pumps could attempt to start on 4kV Shutdown Boards A and B. Results in overloading Diesel Generator A and B and the loss of 4kV Shutdown Board A and B.<br>The Unit 2 Preferred RHR and Core Spray Pumps in Division II are not affected and are available. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |
| Unit 2 Division II Core Spray and Division II RHR PPL Components Inoperable | Unit 2 Core Spray relay 14A-K11B and RHR relay 10A-K73B are inoperable and fail to initiate the Unit 1 Division II Core Spray and RHR PPL logic. The Unit 2 Division II PPL signal to initiate the Unit 1 Division II PPL logic would not function. Both Unit 1 and 2 RHR and Core Spray pumps could attempt to start on 4kV Shutdown Boards C and D. Results in overloading Diesel Generator C and D and the loss of 4kV Shutdown Board C and D.<br>The Unit 2 Preferred RHR and Core Spray Pumps in Division II are lost. | Recirculation discharge line break: ADS, HPCI<br>Recirculation suction line break: ADS, HPCI | No |

Effect of ECCS PPL Inoperable with One Unit in Shutdown

RHR or Core Spray pumps could be running in the opposite (non-accident) unit for shutdown cooling or testing at the time that an accident occurred. If there is an accident signal present in one unit, all RHR and Core Spray pumps in the opposite unit are tripped (if running) by the ECCS PPL so that all of the RHR and Core Spray pumps in the accident unit can start to mitigate the consequences of the accident. The ECCS PPL will only block the non-preferred pumps from automatically starting if an accident signal is subsequently received in the opposite unit. The scenarios considered are two RHR pumps running (one in each division) for two loop shutdown cooling, or two Core Spray pumps in the same division running for testing in the shutdown unit. The effect of two RHR pumps running in the same division is the same as for two Core Spray pumps.

| LOCA in Unit 1 While Operating, Unit 2 Shutdown with Two RHR Pumps (One in Each Division) Running for Two Loop Shutdown Cooling or Two Core Spray Pumps Running in the Same Division for Testing | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 1) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 1 Division I Core Spray PPL Component Inoperable | Unit 1 Core Spray relay 14A-K11A is inoperable and fails to initiate the Unit 2 Division I Core Spray and RHR PPL logic. The Unit 2 PPL logic would still be initiated from the redundant Unit 1 RHR relay (10A-K73A) and function to trip and prevent restarting the Unit 2 Core Spray pumps if they were running.<br>The Unit 1 ECCS Pumps are not affected. | Recirculation discharge line break: ADS, HPCI, One loop LPCI (two pump in the loop), Two loops Core Spray (2 pumps in each loop).<br>Recirculation suction line break: ADS, HPCI, Two loops LPCI (two pumps in each loop), Two loops Core Spray (2 pumps in each loop). | Yes |
| Unit 2 Division I Core Spray PPL Component Inoperable | Unit 2 Core Spray Relays 14A-K24A, 14A-K127A, 14A-K128A, 14A-K129A or 14A-K130A are inoperable and do not function to trip or prevent the Unit 2 Division I Core spray pumps from starting. All Unit 1 Core Spray pumps would attempt to start on the 4kV Shutdown Boards. If Unit 2 Core Spray pumps were running on 4kV Shutdown Boards A and B (e.g., for testing) and the Unit 2 pumps were not tripped, the boards would be overloaded. Results in overloading Diesel Generator A and B and the loss of 4kV Shutdown Board A and B. The Unit 2 pumps on 4kV Shutdown Boards C and D will still be tripped by the Division II PPL Signal.<br>The Unit 1 Division II ECCS Pumps are not affected and would start. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in the loop), One loop Core Spray (2 pumps in loop). | Yes |
| Unit 1 Division I RHR PPL Component Inoperable | Unit 1 RHR relay 10A-K73A is inoperable and fails to initiate the Unit 2 Division I Core Spray and RHR PPL logic. The Unit 2 PPL logic would still be initiated from the redundant Unit 1 Core Spray relay (14A-K11A) and function to trip and prevent restarting the Unit 2 RHR pumps if they were running. Unit 1 ECCS would not be affected.<br>The Unit 1 ECCS Pumps are not affected. | Recirculation discharge line break: ADS, HPCI, One loop LPCI (two pump in the loop), Two loops Core Spray (2 pumps in each loop).<br>Recirculation suction line break: ADS, HPCI, Two loops LPCI (two pumps in each loop), Two loops Core Spray (2 pumps in each loop). | Yes |
| Unit 2 Division I RHR PPL Component Inoperable | Unit 2 RHR Relays 10A-K74A, 10A-K216A, 10A-K217A, 10A-K218A or 10A-K219A are inoperable and do not function to trip or prevent the Unit 2 Division I pumps from starting. All Unit 1 RHR pumps would attempt to start on the 4kV Shutdown Boards. If Unit 2 RHR pumps were running on 4kV Shutdown Boards A or B, and C or D (e.g., one pump in each division for two loop shutdown cooling) and the Unit 2 pumps were not tripped, the boards would be overloaded. Results in overloading Diesel Generator A or B, and the loss of 4kV Shutdown Board A or B. If 4kV Shutdown Board A was lost the Division I 480V Shutdown Board 1A supply to the Division I LPCI and Core Spray injection valves would also be lost. The Unit 2 pumps on 4kV Shutdown Boards C or D will still be tripped by the Division II PPL Signal.<br>The Unit 1 Division II ECCS Pumps are not affected and would start. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |

| LOCA in Unit 1 While Operating, Unit 2 Shutdown with Two RHR Pumps (One in Each Division) Running for Two Loop Shutdown Cooling or Two Core Spray Pumps Running in the Same Division for Testing | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 1) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 1 or 2 Division I RHR PPL-UPRT Component Inoperable | The UPRT function is only needed in the event of a spurious accident signal. There is no effect on Unit 1 ECCS pumps.<br>The Unit 1 ECCS Pumps are not affected. | Recirculation discharge line break: ADS, HPCI, One loop LPCI (two pump in the loop), Two loops Core Spray (2 pumps in each loop).<br>Recirculation suction line break: ADS, HPCI, Two loops LPCI (two pumps in each loop), Two loops Core Spray (2 pumps in each loop). | Yes |
| Unit 1 Division II Core Spray PPL Component Inoperable | Unit 1 Core Spray relay 14A-K11B is inoperable and fails to initiate the Unit 2 Division II Core Spray and RHR PPL logic. The Unit 2 PPL logic would still be initiated from the redundant Unit 1 RHR relay (10A-K73B) and function to trip and prevent restarting the Unit 2 Core Spray pumps if they were running. Unit 1 ECCS would not be affected.<br>The Unit 1 ECCS Pumps are not affected. | Recirculation discharge line break: ADS, HPCI, One loop LPCI (two pump in the loop), Two loops Core Spray (2 pumps in each loop).<br>Recirculation suction line break: ADS, HPCI, Two loops LPCI (two pumps in each loop), Two loops Core Spray (2 pumps in each loop). | Yes |
| Unit 2 Division II Core Spray PPL Component Inoperable | Unit 2 Core Spray Relays 14A-K24B, 14A-K127B, 14A-K128B, 14A-K129B or 14A-K130B are inoperable and do not function to trip or prevent the Unit 2 Division II Core spray pumps from starting. All Unit 1 Core Spray pumps would attempt to start on the 4kV Shutdown Boards. If Unit 2 Core Spray pumps were running on 4kV Shutdown Boards C and D (e.g., for testing) and the Unit 2 pumps were not tripped, the boards would be overloaded. Results in overloading Diesel Generator C and D and the loss of 4kV Shutdown Board C and D. The Unit 2 pumps on 4kV Shutdown Boards A and B will still be tripped by the Division I PPL Signal.<br>The Unit 1 Division I ECCS Pumps are not affected and would start. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in the loop), One loop Core Spray (2 pumps in loop). | Yes |
| Unit 1 Division II RHR PPL Component Inoperable | Unit 1 RHR relay 10A-K73B is inoperable and fails to initiate the Unit 2 Division II Core Spray and RHR PPL logic. The Unit 2 PPL logic would still be initiated from the redundant Unit 1 Core Spray relay (14A-K11B) and function to trip and prevent restarting the Unit 2 RHR pumps if they were running.<br>The Unit 1 ECCS Pumps are not affected. | Recirculation discharge line break: ADS, HPCI, One loop LPCI (two pump in the loop), Two loops Core Spray (2 pumps in each loop).<br>Recirculation suction line break: ADS, HPCI, Two loops LPCI (two pumps in each loop), Two loops Core Spray (2 pumps in each loop). | Yes |

| LOCA in Unit 1 While Operating, Unit 2 Shutdown with Two RHR Pumps (One in Each Division) Running for Two Loop Shutdown Cooling or Two Core Spray Pumps Running in the Same Division for Testing | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 1) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 2 Division II RHR PPL Component Inoperable | Unit 2 RHR Relays 10A-K74B, 10A-K216B, 10A-K217B, 10A-K218B or 10A-K219B are inoperable and do not function to trip or prevent the Unit 2 Division II pumps from starting. All Unit 1 RHR pumps would attempt to start on the 4kV Shutdown Boards. If Unit 2 RHR pumps were running on 4kV Shutdown Boards A or B, and C or D (e.g., one pump in each division for two loop shutdown cooling) and the Unit 2 pumps were not tripped, the boards would be overloaded. Results in overloading Diesel Generator C or D, and the loss of 4kV Shutdown Board C or D. If 4kV Shutdown Board C was lost the Division II 480V Shutdown Board 1B supply to the Division II LPCI and Core Spray injection valves would also be lost. The Unit 2 pumps on 4kV Shutdown Boards A or B will still be tripped by the Division I PPL Signal.<br>The Unit 1 Division I ECCS Pumps are not affected and would start. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |
| Unit 1 or 2 Division II RHR UPRT Component Inoperable | The UPRT function is only needed in the event of a spurious accident signal. There is no effect on Unit 1 ECCS pumps.<br>The Unit 1 ECCS Pumps are not affected. | Recirculation discharge line break: ADS, HPCI, One loop LPCI (two pump in the loop), Two loops Core Spray (2 pumps in each loop).<br>Recirculation suction line break: ADS, HPCI, Two loops LPCI (two pumps in each loop), Two loops Core Spray (2 pumps in each loop). | Yes |
| Unit 1 Division I and Division II Core Spray PPL Components Inoperable | Unit 1 Core Spray relays 14A-K11A and 14A-K11B are inoperable and fail to initiate the Unit 2 Division I and II Core Spray and RHR PPL logic. The Unit 2 PPL logic would still be initiated from the redundant Unit 1 RHR relays (10A-K73A and 10A-K73B) and function to trip and prevent restarting the Unit 2 Core Spray pumps if they were running.<br>The Unit 1 ECCS Pumps are not affected. | Recirculation discharge line break: ADS, HPCI, One loop LPCI (two pump in the loop), Two loops Core Spray (2 pumps in each loop).<br>Recirculation suction line break: ADS, HPCI, Two loops LPCI (two pumps in each loop), Two loops Core Spray (2 pumps in each loop). | Yes |
| Unit 1 Division I and Division II RHR PPL Components Inoperable | Unit 1 RHR relays 10A-K73A and 10A-K73B are inoperable and fail to initiate the Unit 2 Division I and II Core Spray and RHR PPL logic. The Unit 2 PPL logic would still be initiated from the redundant Unit 1 Core Spray relays (14A-K11A and 14A-K11B) and function to trip and prevent restarting the Unit 2 RHR pumps if they were running.<br>The Unit 1 ECCS Pumps are not affected. | Recirculation discharge line break: ADS, HPCI, One loop LPCI (two pump in the loop), Two loops Core Spray (2 pumps in each loop).<br>Recirculation suction line break: ADS, HPCI, Two loops LPCI (two pumps in each loop), Two loops Core Spray (2 pumps in each loop). | Yes |

| LOCA in Unit 1 While Operating, Unit 2 Shutdown with Two RHR Pumps (One in Each Division) Running for Two Loop Shutdown Cooling or Two Core Spray Pumps Running in the Same Division for Testing | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 1) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 2 Division I and Division II Core Spray PPL Components Inoperable | Unit 2 Core Spray Relays 14A-K24A, 14A-K127A, 14A-K128A, 14A-K129A or 14A-K130A are inoperable and do not function to trip the Unit 2 Division I Core spray pumps. Unit 2 Core Spray Relays 14A-K24B, 14A-K127B, 14A-K128B, 14A-K129B or 14A-K130B are inoperable and do not function to trip the Unit 2 Division II Core spray pumps. All Unit 1 Core Spray pumps would attempt to start on the 4kV Shutdown Boards. If Unit 2 Core Spray pumps were running on 4kV Shutdown Boards A and B, or C and D (e.g., for testing), the Unit 2 pumps would not be tripped and the boards would be overloaded. Results in overloading Diesel Generator A and B, or C and D, and the loss of 4kV Shutdown Board A and B, or C and D.<br>The Unit 1 Division I or II ECCS Pumps are not affected (depending on which Unit 2 Core Spray pumps are running). | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in the loop), One loop Core Spray (2 pumps in loop). | Yes |
| Unit 2 Division I and Division II RHR PPL Components Inoperable | Unit 2 RHR Relays 10A-K74A, 10A-K216A, 10A-K217A, 10A-K218A or 10A-K219A are inoperable and do not function to trip the Unit 2 Division I RHR pumps. Unit 2 RHR Relays 10A-K74B, 10A-K216B, 10A-K217B, 10A-K218B or 10A-K219B are inoperable and do not function to trip the Unit 2 Division II RHR pumps. All Unit 1 RHR pumps would attempt to start on the 4kV Shutdown Boards. If Unit 2 RHR pumps were running on 4kV Shutdown Boards A or B, and C or D (e.g., one pump in each division for two loop shutdown cooling), the Division I and II Unit 2 pumps would not be tripped and the boards would be overloaded. Results in overloading Diesel Generator A or B, and C or D, and the loss of 4kV Shutdown Board A or B, and C or D. Depending on which boards were lost, could lose both Unit 1 480V Shutdown Boards and LPCI and Core Spray injection valves.<br>The Unit 1 Division I and II Core Spray pumps will not start. Two Unit 1 RHR pumps would start, one in each division but would not inject to the core. | Recirculation discharge line break: ADS, HPCI<br>Recirculation suction line break: ADS, HPCI. | No |

| LOCA in Unit 1 While Operating, Unit 2 Shutdown with Two RHR Pumps (One in Each Division) Running for Two Loop Shutdown Cooling or Two Core Spray Pumps Running in the Same Division for Testing | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 1) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 1 Division I Core Spray and Division I RHR PPL Components Inoperable | Unit 1 Core Spray relays 14A-K11A and RHR relay 10A-K73A are inoperable and fail to initiate the Unit 2 Division I Core Spray and RHR PPL logic. The Unit 2 Division I PPL logic would not be initiated from the Unit 1 PPL signal. Any running Unit 2 Division I RHR or Core Spray pumps would not be tripped.<br>Worst case would be Unit 2 pumps running on both 4kV Shutdown Boards A and B. If Unit 2 Core Spray pumps were running on 4kV Shutdown Boards A and B (e.g., for testing), the Unit 2 pumps would not be tripped and the boards would be overloaded. The Unit 2 pumps on 4kV Shutdown Boards C and D will still be tripped by the Division II PPL Signal. Results in overloading Diesel Generator A and B, and the loss of 4kV Shutdown Board A and B.<br>The Unit 1 Division II ECCS Pumps are not affected and would start. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |
| Unit 1 Division II Core Spray and Division II RHR PPL Components Inoperable | Unit 1 Core Spray relays 14A-K11B and RHR relay 10A-K73B are inoperable and fail to initiate the Unit 2 Division II Core Spray and RHR PPL logic. The Unit 2 Division II PPL logic would not be initiated from the Unit 1 PPL signal. Any running Unit 2 Division II RHR or Core Spray pumps would not be tripped.<br>Worst case would be Unit 2 pumps running on both 4kV Shutdown Boards C and D. If Unit 2 Core Spray pumps were running on 4kV Shutdown Boards C and D (e.g., for testing), the Unit 2 pumps would not be tripped and the boards would be overloaded. The Unit 2 pumps on 4kV Shutdown Boards A and B will still be tripped by the Division I PPL Signal. Results in overloading Diesel Generator C and D, and the loss of 4kV Shutdown Board C and D.<br>The Unit 1 Division I ECCS Pumps are not affected and would start. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |

| LOCA in Unit 1 While Operating, Unit 2 Shutdown with Two RHR Pumps (One in Each Division) Running for Two Loop Shutdown Cooling or Two Core Spray Pumps Running in the Same Division for Testing | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 1) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 2 Division I Core Spray and Division I RHR PPL Components Inoperable | Unit 2 Core Spray Relays 14A-K24A, 14A-K127A, 14A-K128A, 14A-K129A or 14A-K130A are inoperable and do not function to trip the Unit 2 Division I Core spray pumps. Unit 2 RHR Relays 10A-K74A, 10A-K216A, 10A-K217A, 10A-K218A or 10A-K219A are inoperable and do not function to trip the Unit 2 Division I RHR pumps. Any running Unit 2 Division I RHR or Core Spray pumps would not be tripped.<br>Worst case would be Unit 2 pumps running on both 4kV Shutdown Boards A and B. If Unit 2 Core Spray pumps were running on 4kV Shutdown Boards A and B (e.g., for testing), the Unit 2 pumps would not be tripped and the boards would be overloaded. The Unit 2 pumps on 4kV Shutdown Boards C and D will still be tripped by the Division II PPL Signal. Results in overloading Diesel Generator A and B, and the loss of 4kV Shutdown Board A and B.<br>The Unit 1 Division II ECCS Pumps are not affected and would start. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |
| Unit 2 Division II Core Spray and Division II RHR PPL Components Inoperable | Unit 2 Core Spray Relays 14A-K24B, 14A-K127B, 14A-K128B, 14A-K129B or 14A-K130B are inoperable and do not function to trip the Unit 2 Division II Core spray pumps. Unit 2 RHR Relays 10A-K74B, 10A-K216B, 10A-K217B, 10A-K218B or 10A-K219B are inoperable and do not function to trip the Unit 2 Division II RHR pumps. Any running Unit 2 Division II RHR or Core Spray pumps would not be tripped.<br>Worst case would be Unit 2 pumps running on both 4kV Shutdown Boards C and D. If Unit 2 Core Spray pumps were running on 4kV Shutdown Boards C and D (e.g., for testing), the Unit 2 pumps would not be tripped and the boards would be overloaded. The Unit 2 pumps on 4kV Shutdown Boards A and B will still be tripped by the Division I PPL Signal. Results in overloading Diesel Generator C and D, and the loss of 4kV Shutdown Board C and D.<br>The Unit 1 Division I ECCS Pumps are not affected and would start. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |

| LOCA in Unit 2 While Operating, with Unit 1 Shutdown with Two RHR Pumps (One in Each Division) Running for Two Loop Shutdown Cooling or Two Core Spray Pumps Running in the Same Division for Testing | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 1) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 1 Division I Core Spray PPL Component Inoperable | Unit 1 Core Spray Relays 14A-K24A, 14A-K127A, 14A-K128A, 14A-K129A or 14A-K130A are inoperable and do not function to trip or prevent the Unit 1 Division I Core spray pumps from starting. All Unit 2 Core Spray pumps would attempt to start on the 4kV Shutdown Boards. If Unit 1 Core Spray pumps were running on 4kV Shutdown Boards A and B (e.g., for testing) and the Unit 1 pumps were not tripped, the boards would be overloaded. Results in overloading Diesel Generator A and B and the loss of 4kV Shutdown Board A and B. The Unit 1 pumps on 4kV Shutdown Boards C and D will still be tripped by the Division II PPL Signal.<br>The Unit 2 Division II ECCS Pumps are not affected and would start. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in the loop), One loop Core Spray (2 pumps in loop). | Yes |
| Unit 2 Division I Core Spray PPL Component Inoperable | Unit 2 Core Spray relay 14A-K11A is inoperable and fails to initiate the Unit 1 Division I Core Spray and RHR PPL logic. The Unit 1 PPL logic would still be initiated from the redundant Unit 2 RHR relay (10A-K73A) and function to trip and prevent restarting the Unit 1 Core Spray pumps if they were running.<br>The Unit 2 ECCS Pumps are not affected. | Recirculation discharge line break: ADS, HPCI, One loop LPCI (two pump in the loop), Two loops Core Spray (2 pumps in each loop).<br>Recirculation suction line break: ADS, HPCI, Two loops LPCI (two pumps in each loop), Two loops Core Spray (2 pumps in each loop). | Yes |
| Unit 1 Division I RHR PPL Component Inoperable | Unit 1 RHR Relays 10A-K74A, 10A-K216A, 10A-K217A, 10A-K218A or 10A-K219A are inoperable and do not function to trip the Unit 1 Division I RHR pumps from starting. All Unit 2 RHR pumps would attempt to start on the 4kV Shutdown Boards. If Unit 1 RHR pumps were running on 4kV Shutdown Boards A or B, and C or D (e.g., one pump in each division for two loop shutdown cooling) and the Unit 1 pumps were not tripped, the boards would be overloaded. Results in overloading Diesel Generator A or B, and the loss of 4kV Shutdown Board A or B. If 4kV Shutdown Board B was lost the Division I 480V Shutdown Board 2A supply to the Division I LPCI and Core Spray injection valves would also be lost. The Unit 1 pumps on 4kV Shutdown Boards C or D will still be tripped by the Division II PPL Signal.<br>The Unit 2 Division II ECCS Pumps are not affected and would start. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |
| Unit 2 Division I RHR PPL Component Inoperable | Unit 2 RHR relay 10A-K73A is inoperable and fails to initiate the Unit 1 Division I Core Spray and RHR PPL logic. The Unit 1 PPL logic would still be initiated from the redundant Unit 2 Core Spray relay (14A-K11A) and function to trip and prevent restarting the Unit 1 RHR pumps if they were running.<br>The Unit 2 ECCS Pumps are not affected. | Recirculation discharge line break: ADS, HPCI, One loop LPCI (two pump in the loop), Two loops Core Spray (2 pumps in each loop).<br>Recirculation suction line break: ADS, HPCI, Two loops LPCI (two pumps in each loop), Two loops Core Spray (2 pumps in each loop). | Yes |

| LOCA in Unit 2 While Operating, with Unit 1 Shutdown with Two RHR Pumps (One in Each Division) Running for Two Loop Shutdown Cooling or Two Core Spray Pumps Running in the Same Division for Testing | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 1) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 1 or 2 Division I RHR UPRT Component Inoperable | The UPRT function is only needed in the event of a spurious accident signal. There is no effect on Unit 2 ECCS pumps.<br>The Unit 2 ECCS Pumps are not affected. | Recirculation discharge line break: ADS, HPCI, One loop LPCI (two pump in the loop), Two loops Core Spray (2 pumps in each loop).<br>Recirculation suction line break: ADS, HPCI, Two loops LPCI (two pumps in each loop), Two loops Core Spray (2 pumps in each loop). | Yes |
| Unit 1 Division II Core Spray PPL Component Inoperable | Unit 1 Core Spray Relays 14A-K24B, 14A-K127B, 14A-K128B, 14A-K129B or 14A-K130B are inoperable and do not function to trip the Unit 1 Division II Core spray pumps. All Unit 2 Core Spray pumps would attempt to start on the 4kV Shutdown Boards. If Unit 1 Core Spray pumps were running on 4kV Shutdown Boards C and D (e.g., for testing) and the Unit 1 pumps were not tripped, the boards would be overloaded. Results in overloading Diesel Generator C and D and the loss of 4kV Shutdown Board C and D. The Unit 1 pumps on 4kV Shutdown Boards A and B will still be tripped by the Division I PPL Signal.<br>The Unit 2 Division I ECCS Pumps are not affected and would start. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in the loop), One loop Core Spray (2 pumps in loop). | Yes |
| Unit 2 Division II Core Spray PPL Component Inoperable | Unit 2 Core Spray relay 14A-K11B is inoperable and fails to initiate the Unit 1 Division II Core Spray and RHR PPL logic. The Unit 1 PPL logic would still be initiated from the redundant Unit 2 RHR relay (10A-K73B) and function to trip and prevent restarting the Unit 1 Core Spray pumps if they were running.<br>The Unit 2 ECCS Pumps are not affected. | Recirculation discharge line break: ADS, HPCI, One loop LPCI (two pump in the loop), Two loops Core Spray (2 pumps in each loop).<br>Recirculation suction line break: ADS, HPCI, Two loops LPCI (two pumps in each loop), Two loops Core Spray (2 pumps in each loop). | Yes |
| Unit 1 Division II RHR PPL Component Inoperable | Unit 1 RHR Relays 10A-K74B, 10A-K216B, 10A-K217B, 10A-K218B or 10A-K219B are inoperable and do not function to trip the Unit 1 Division II pumps. All Unit 2 RHR pumps would attempt to start on the 4kV Shutdown Boards. If Unit 1 RHR pumps were running on 4kV Shutdown Boards A or B, and C or D (e.g., one pump in each division for two loop shutdown cooling) and the Unit 1 pumps were not tripped, the boards would be overloaded. Results in overloading Diesel Generator C or D, and the loss of 4kV Shutdown Board C or D. If 4kV Shutdown Board D was lost the Division I 480V Shutdown Board 2B supply to the Division II LPCI and Core Spray injection valves would also be lost. The Unit 1 pumps on 4kV Shutdown Boards A or B will still be tripped by the Division I PPL Signal.<br>The Unit 2 Division I ECCS Pumps are not affected and would start. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |

| LOCA in Unit 2 While Operating, with Unit 1 Shutdown with Two RHR Pumps (One in Each Division) Running for Two Loop Shutdown Cooling or Two Core Spray Pumps Running in the Same Division for Testing | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 1) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 2 Division II RHR PPL Component Inoperable | Unit 2 RHR relay 10A-K73B is inoperable and fails to initiate the Unit 1 Division II Core Spray and RHR PPL logic. The Unit 1 PPL logic would still be initiated from the redundant Unit 2 Core Spray relay (14A-K11B) and function to trip and prevent restarting the Unit 1 RHR pumps if they were running.<br>The Unit 2 ECCS Pumps are not affected. | Recirculation discharge line break: ADS, HPCI, One loop LPCI (two pump in the loop), Two loops Core Spray (2 pumps in each loop).<br>Recirculation suction line break: ADS, HPCI, Two loops LPCI (two pumps in each loop), Two loops Core Spray (2 pumps in each loop). | Yes |
| Unit 1 or 2 Division II RHR UPRT Component Inoperable | The UPRT function is only needed in the event of a spurious accident signal. There is no effect on Unit 2 ECCS pumps.<br>The Unit 2 ECCS Pumps are not affected. | Recirculation discharge line break: ADS, HPCI, One loop LPCI (two pump in the loop), Two loops Core Spray (2 pumps in each loop).<br>Recirculation suction line break: ADS, HPCI, Two loops LPCI (two pumps in each loop), Two loops Core Spray (2 pumps in each loop). | Yes |
| Unit 1 Division I and Division II Core Spray PPL Components Inoperable | Unit 1 Core Spray Relays 14A-K24A, 14A-K127A, 14A-K128A, 14A-K129A or 14A-K130A are inoperable and do not function to trip the Unit 1 Division I Core spray pumps. Unit 1 Core Spray Relays 14A-K24B, 14A-K127B, 14A-K128B, 14A-K129B or 14A-K130B are inoperable and do not function to trip the Unit 1 Division II Core spray pumps. All Unit 2 Core Spray pumps would attempt to start on the 4kV Shutdown Boards. If Unit 1 Core Spray pumps were running on 4kV Shutdown Boards A and B, or C and D (e.g., for testing), the Unit 1 pumps would not be tripped and the boards would be overloaded. Results in overloading Diesel Generator A and B, or C and D, and the loss of 4kV Shutdown Board A and B, or C and D.<br>The Unit 2 Division I or II ECCS Pumps are not affected (depending on which Unit 1 Core Spray pumps are running). | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in the loop), One loop Core Spray (2 pumps in loop). | Yes |

| LOCA in Unit 2 While Operating, with Unit 1 Shutdown with Two RHR Pumps (One in Each Division) Running for Two Loop Shutdown Cooling or Two Core Spray Pumps Running in the Same Division for Testing | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 1) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 1 Division I and Division II RHR PPL Components Inoperable | Unit 1 RHR Relays 10A-K74A, 10A-K216A, 10A-K217A, 10A-K218A or 10A-K219A are inoperable and do not function to trip the Unit 1 Division I RHR pumps. Unit 1 RHR Relays 10A-K74B, 10A-K216B, 10A-K217B, 10A-K218B or 10A-K219B are inoperable and do not function to trip the Unit 1 Division II RHR pumps. All Unit 2 RHR pumps would attempt to start on the 4kV Shutdown Boards. If Unit 1 RHR pumps were running on 4kV Shutdown Boards A or B, and C or D (e.g., one pump in each division for two loop shutdown cooling), the Division I and II Unit 1 pumps would not be tripped and the boards would be overloaded. Results in overloading Diesel Generator A or B, and C or D, and the loss of 4kV Shutdown Board A or B, and C or D.<br>Depending on which boards were lost, could lose both Unit 2 480V Shutdown Boards and LPCI and Core Spray injection valves.<br>The Unit 2 Division I and II Core Spray pumps will not start. Two Unit 2 RHR pumps would start, one in each division but would not inject to the core. | Recirculation discharge line break: ADS, HPCI<br>Recirculation suction line break: ADS, HPCI | No |
| Unit 2 Division I and Division II Core Spray PPL Components Inoperable | Unit 2 Core Spray relays 14A-K11A and 14A-K11B are inoperable and fail to initiate the Unit 1 Division I and II Core Spray and RHR PPL logic. The Unit 1 PPL logic would still be initiated from the redundant Unit 2 RHR relays (10A-K73A and 10A-K73B) and function to trip and prevent restarting the Unit 1 Core Spray pumps if they were running.<br>The Unit 2 ECCS Pumps are not affected. | Recirculation discharge line break: ADS, HPCI, One loop LPCI (two pump in the loop), Two loops Core Spray (2 pumps in each loop).<br>Recirculation suction line break: ADS, HPCI, Two loops LPCI (two pumps in each loop), Two loops Core Spray (2 pumps in each loop). | Yes |
| Unit 2 Division I and Division II RHR PPL Components Inoperable | Unit 2 RHR relays 10A-K73A and 10A-K73B are inoperable and fail to initiate the Unit 1 Division I and II Core Spray and RHR PPL logic. The Unit 1 PPL logic would still be initiated from the redundant Unit 2 Core Spray relays (14A-K11A and 14A-K11B) and function to trip and prevent restarting the Unit 1 RHR pumps if they were running.<br>The Unit 2 ECCS Pumps are not affected. | Recirculation discharge line break: ADS, HPCI, One loop LPCI (two pump in the loop), Two loops Core Spray (2 pumps in each loop).<br>Recirculation suction line break: ADS, HPCI, Two loops LPCI (two pumps in each loop), Two loops Core Spray (2 pumps in each loop). | Yes |

| LOCA in Unit 2 While Operating, with Unit 1 Shutdown with Two RHR Pumps (One in Each Division) Running for Two Loop Shutdown Cooling or Two Core Spray Pumps Running in the Same Division for Testing | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 1) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 1 Division I Core Spray and Division I RHR PPL Components Inoperable | Unit 1 Core Spray Relays 14A-K24A, 14A-K127A, 14A-K128A, 14A-K129A or 14A-K130A are inoperable and do not function to trip the Unit 1 Division I Core spray pumps. Unit 1 RHR Relays 10A-K74A, 10A-K216A, 10A-K217A, 10A-K218A or 10A-K219A are inoperable and do not function to trip the Unit 1 Division I RHR pumps. Any running Unit 1 Division I RHR or Core Spray pumps would not be tripped.<br>Worst case would be Unit 1 pumps running on both 4kV Shutdown Boards A and B. If Unit 1 Core Spray pumps were running on 4kV Shutdown Boards A and B (e.g., for testing), the Unit 1 pumps would not be tripped and the boards would be overloaded. The Unit 1 pumps on 4kV Shutdown Boards C and D will still be tripped by the Division II PPL Signal. Results in overloading Diesel Generator A and B, and the loss of 4kV Shutdown Board A and B.<br>The Unit 2 Division II ECCS Pumps are not affected and would start. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |
| Unit 1 Division II Core Spray and Division II RHR PPL Components Inoperable | Unit 1 Core Spray Relays 14A-K24B, 14A-K127B, 14A-K128B, 14A-K129B or 14A-K130B are inoperable and do not function to trip the Unit 1 Division II Core spray pumps. Unit 1 RHR Relays 10A-K74B, 10A-K216B, 10A-K217B, 10A-K218B or 10A-K219B are inoperable and do not function to trip the Unit 1 Division II RHR pumps. Any running Unit 1 Division II RHR or Core Spray pumps would not be tripped.<br>Worst case would be Unit 1 pumps running on both 4kV Shutdown Boards C and D. If Unit 1 Core Spray pumps were running on 4kV Shutdown Boards C and D (e.g., for testing), the Unit 1 pumps would not be tripped and the boards would be overloaded. The Unit 1 pumps on 4kV Shutdown Boards A and B will still be tripped by the Division I PPL Signal. Results in overloading Diesel Generator C and D, and the loss of 4kV Shutdown Board C and D.<br>The Unit 2 Division I ECCS Pumps are not affected and would start. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |

| LOCA in Unit 2 While Operating, with Unit 1 Shutdown with Two RHR Pumps (One in Each Division) Running for Two Loop Shutdown Cooling or Two Core Spray Pumps Running in the Same Division for Testing | | | |
|---|---|---|---|
| ECCS PPL or UPRT Inoperable | Potential Effect on ECCS and 4kV Shutdown Boards | ECCS Pumps and Sub-Systems Available to Accident Unit (Unit 1) | Satisfies required ECCS in UFSAR Table 6.5-3. |
| Unit 2 Division I Core Spray and Division I RHR PPL Components Inoperable | Unit 2 Core Spray relays 14A-K11A and RHR relay 10A-K73A are inoperable and fail to initiate the Unit 1 Division I Core Spray and RHR PPL logic. The Unit 1 Division I PPL logic would not be initiated from the Unit 2 PPL signal. Any running Unit 1 Division I RHR or Core Spray pumps would not be tripped.<br>Worst case would be Unit 1 pumps running on both 4kV Shutdown Boards A and B. If Unit 1 Core Spray pumps were running on 4kV Shutdown Boards A and B (e.g., for testing), the Unit 1 pumps would not be tripped and the boards would be overloaded. The Unit 1 pumps on 4kV Shutdown Boards C and D will still be tripped by the Division II PPL Signal. Results in overloading Diesel Generator A and B, and the loss of 4kV Shutdown Board A and B.<br>The Unit 2 Division II ECCS Pumps are not affected and would start. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |
| Unit 2 Division II Core Spray and Division II RHR PPL Components Inoperable | Unit 2 Core Spray relays 14A-K11B and RHR relay 10A-K73B are inoperable and fail to initiate the Unit 1 Division II Core Spray and RHR PPL logic. The Unit 1 Division II PPL logic would not be initiated from the Unit 2 PPL signal. Any running Unit 1 Division II RHR or Core Spray pumps would not be tripped.<br>Worst case would be Unit 1 pumps running on both 4kV Shutdown Boards C and D. If Unit 1 Core Spray pumps were running on 4kV Shutdown Boards C and D (e.g., for testing), the Unit 1 pumps would not be tripped and the boards would be overloaded. The Unit 1 pumps on 4kV Shutdown Boards A and B will still be tripped by the Division I PPL Signal. Results in overloading Diesel Generator C and D, and the loss of 4kV Shutdown Board C and D.<br>The Unit 2 Division I ECCS Pumps are not affected and would start. | Recirculation discharge line break: ADS, HPCI, One loop Core Spray (2 pumps in loop).<br>Recirculation suction line break: ADS, HPCI, One loop LPCI (two pumps in loop), One loop Core Spray (2 pumps in loop). | Yes |

***APLA RAI 6.c***

*If PPL division(s) loads and other large bus load(s) are out-of-service for maintenance, discuss whether the reliability of sequencing on loads following an accident signal can be impacted by not having enough loads on the bus. If so, explain the scenarios.*

**TVA Response**

There is no minimum loading requirement on the normal off site power supplies to the 4kV Shutdown Boards or for the onsite Diesel Generators. The onsite Diesel Generator voltage

regulators are designed to accommodate zero load to full rated load conditions. The onsite Diesel Generators are started by the CAS or PAS signal in the event of an accident. They will initially operate at zero load with the Diesel Generator breakers open. If the normal offsite power supply to the 4kV Shutdown Board is lost, the Shutdown Board under-voltage relays will trip open the normal offsite power supply breaker and close the Diesel Generator breaker. As the large ECCS loads are sequenced onto the Diesel Generators, the voltage regulators and frequency (speed) control will automatically adjust the Diesel Generator to supply the loads as they are added. Therefore, there is no effect on the electrical system if large loads (i.e., ECCS pumps) were out of service so that the loads on the 4kV Shutdown Boards were reduced below what they would normally be.

***APLA-RAI-7***

*The LAR states, for the proposed TS 3.3.8.3:*

> *The division(s) of ECCS PPL required to be operable during operation in Modes 4 and 5 dependent on the configuration of the RHR or Core Spray pumps required to be operable, or in operation.*

*The LAR does not discuss shutdown risk. Explain why shutdown risk is not included in the LAR; otherwise, discuss your shutdown risk assessment. The LAR states that, "The opposite unit RHR pumps that are tripped by the ECCS Preferred Pump Logic are locked out from manually re-starting for 60 seconds." Include this impact on RHR cooling in your discussion, as well as your assessment of the reliability of recovering RHR manually prior to boiling. Discuss shutdown risk results as part of APLA-RAI-14.*

**TVA Response**

The ECCS PPL function is performed by Core Spray and RHR system relays and components. If an entire division of components that provide the ECCS PPL function is inoperable due to maintenance activities during shutdown (e.g., removal of control power for maintenance), the corresponding division of RHR or Core Spray is also inoperable and the appropriate Conditions of TS 3.4.7, TS 3.4.8, TS 3.5.1, and TS 3.5.2, as applicable, are also entered in addition to proposed TS 3.3.8.3, Condition A (refer to the TVA response to APLA RAI 4).

If the RHR or Core Spray pumps were operating in the shutdown unit for shutdown cooling or testing, the division of RHR or Core Spray logic (including the ECCS PPL logic) would have to be energized and available to support operation of the pumps. If there is an accident signal present in one unit with no spurious accident signal, all RHR and Core Spray pumps in the opposite unit are tripped (if running) by the ECCS PPL so that all of the RHR and Core Spray pumps in the accident unit can start to mitigate the consequences of the accident. The non-accident unit RHR pumps that are tripped by the ECCS PPL are locked out from manually re-starting for 60 seconds. This time delay allows the major ECCS loads that are automatically started (and most of the 480V loads that are load shed then automatically re-started) to load onto the Boards prior to allowing the operators to manually re-start the RHR to re-establish shutdown cooling. The CAS logic also provides a 4kV Load Shed signal to trip the RHRSW pumps A2 and C2 that may be in service for shutdown cooling to prevent overloading 4kV Shutdown Bus 1. If either Unit 1 or 2 is in shutdown cooling using RHRSW pumps A2 and/or C2 and the CAS logic initiates, these pumps are tripped and a loss of shutdown cooling will occur.

The operator response to a loss of shutdown cooling is controlled by BFN Abnormal Operating Instructions (AOIs). Operators in the non-accident unit are able to manually restart the tripped RHR or RHRSW pumps to restore shutdown cooling when loads on the accident unit can accommodate the non-accident unit's pumps. This is not a required immediate action in the AOI. There is sufficient time for operators to restore shutdown cooling without adversely affecting the unit in shutdown cooling. Operator actions are dependent on whether the reactor vessel head is still installed and tensioned.

After shutdown, reactor cooling is initially performed by bleeding steam to the main condensers. Low pressure permissive pressure switches prevent placing shutdown cooling in service if reactor pressure is ≥105 psig. However, by procedure, shutdown cooling is not placed in service until reactor pressure has decreased to approximately 20 psig. BFN procedures also require that reactor vessel temperature shall be maintained less than 100°F after the vessel head studs have been detensioned.

If the reactor vessel head studs are still tensioned and shutdown cooling cannot be immediately restored, the AOIs direct the operators to reestablish the lineup to the main condenser to provide cooling by bleeding steam, if needed. If the reactor vessel head studs have been detensioned, the operators calculate a heatup curve based on actual measurements, or by a conservative estimate taken from the AOIs. The AOIs provide an estimated maximum heatup rate based on the number of days after shutdown. The worst case heatup rate provided by the AOIs is 48°F/hour with the reactor vessel at normal water level. If reactor water temperature was at 100°F with the vessel head detensioned, operators would have over two hours to restart the RHR or RHRSW pumps that may have been tripped by the CAS or ECCS PPL signal to restore shutdown cooling prior to reaching 212°F. If the vessel head is removed and water level flooded with the fuel pool gates out, the maximum heatup rate from the AOIs is 10°F/hour which would provide operators even more time to restore the tripped pumps.

While the ECCS PPL or CAS logic could result in a loss of shutdown cooling between Units 1 and 2, the plant response to an ECCS PPL or CAS initiated loss of shutdown cooling is bounded by the other events that could also result in the loss of shutdown cooling, such as a Primary Containment Isolation System (PCIS) Group 2 Isolation, Loss of RHRSW or loss of an RHR pump. The operators have sufficient time to restore shutdown cooling or establish an alternate cooling path in accordance with the AOIs prior to exceeding the time to boil.

**ENCLOSURE 2**

**Tennessee Valley Authority Browns Ferry Nuclear Plant, Units 1, 2, and 3**

**Summary of BFN Request for Additional Information Response Dates**

| Request for Additional Information (RAI) Question Number | Due Date | Actual Date of Response |
|---|---|---|
| Electrical Engineering Branch (EEEB) | | |
| EEEB RAI 1 | May 11, 2016 | CNL-16-078, May 11, 2016 |
| EEEB RAI 2 | May 11, 2016 | CNL-16-078, May 11, 2016 |
| EEEB RAI 3 | May 11, 2016 | CNL-16-078, May 11, 2016 |
| EEEB RAI 4 | May 11, 2016 | CNL-16-078, May 11, 2016 |
| Instrumentation and Controls Branch (EICB) | | |
| EICB RAI 1 | May 11, 2016 | CNL-16-078, May 11, 2016 |
| EICB RAI 2 | May 11, 2016 | CNL-16-078, May 11, 2016 |
| EICB RAI 3 | June 16, 2016 | |
| Probabilistic Risk Assessment Branch (PRA) Licensing Branch (APLA) | | |
| APLA RAI 1 | April 15, 2016 | CNL-16-066, April 15, 2016 |
| APLA RAI 2 | April 15, 2016 | CNL-16-066, April 15, 2016 |
| APLA RAI 3 | April 15, 2016 | CNL-16-066, April 15, 2016 |
| APLA RAI 4 | May 11, 2016 | CNL-16-078, May 11, 2016 |
| APLA RAI 5 | June 16, 2016 | |
| APLA RAI 6a | May 11, 2016 | CNL-16-078, May 11, 2016 |
| APLA RAI 6b | May 11, 2016 | CNL-16-078, May 11, 2016 |
| APLA RAI 6c | May 11, 2016 | CNL-16-078, May 11, 2016 |
| APLA RAI 6d | June 16, 2016 | |
| APLA RAI 7 | May 11, 2016 | CNL-16-078, May 11, 2016 |
| APLA RAI 8 | April 15, 2016 | CNL-16-066, April 15, 2016 |
| APLA RAI 9 | April 15, 2016 | CNL-16-066, April 15, 2016 |

| Request for Additional Information (RAI) Question Number | Due Date | Actual Date of Response |
|---|---|---|
| APLA RAI 10 | April 29, 2016 | CNL-16-076, April 29, 2016 |
| APLA RAI 11 | April 29, 2016 | CNL-16-076, April 29, 2016 |
| APLA RAI 12 | May 25, 2016 | |
| APLA RAI 13a | June 16, 2016 | |
| APLA RAI 13b | May 25, 2016 | |
| APLA RAI 13c | May 25, 2016 | |
| APLA RAI 14 | June 16, 2016 | |
| APLA RAI 15 | May 25, 2016 | |
| APLA RAI 16 | April 29, 2016 | CNL-16-076, April 29, 2016 |

Summary

April 15, 2016: APLA RAI 1, 2, 3, 8, 9
April 29, 2016: APLA RAI 10, 11, 16
May 11, 2016: APLA RAI 4, 6a, 6b, 6c, 7; EEEB RAI 1, 2, 3, 4; EICB RAI 1, 2
May 25, 2016: APLA RAI 12, 13b, 13c, 15
June 16, 2016: APLA RAI 5, 6d,13a, 14; EICB RAI 3