Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381-2000

November 5, 2010

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

Watts Bar Nuclear Plant, Unit 2
NRC Docket No. 50-391

Subject: WATTS BAR NUCLEAR PLANT (WBN) UNIT 2 – FIRE PROTECTION PROGRAM (TAC NO. ME0853) – COMMITMENT TO PROVIDE MULTIPLE SPURIOUS OPERATION (MSO) EVALUATION

Reference: TVA letter dated August 20, 2010, "Watts Bar Nuclear Plant (WBN) Unit 2 - Fire Protection Program (TAC NO. ME0853) – Commitment To Provide Additional Information On Multiple Spurious Operation (MSO) Scenarios"

The purpose of this letter is to submit Revision 1 to the WBN Unit 2 MSO Evaluation. This revision resulted from comments received during several conference calls with NRC focused on its review of the initial version of the MSO evaluation submitted on August 20, 2010 (Reference). Specifically, revisions include:

1. Adding the three missing "resolutions" to the summary tables
2. Deleting reference to WBN Unit 1 PERs that do not apply to Unit 2
3. Adding "modifications in work" to the resolution summary table
4. Noting the Unit 1 approval of Operator Manual Actions that are being credited to resolve MSO scenarios

The Enclosure contains Revision 1 to the WBN Unit 2 MSO Evaluation. There are no new regulatory commitments contained in this letter.

If you have any questions, please contact William Crouch at (423) 365-2004.

I declare under the penalty of perjury that the foregoing is true and correct. Executed on the 5th day of November, 2010.

Sincerely,

M. Bajestani

Masoud Bajestani
Watts Bar Unit 2 Vice President

Enclosure: WBN Unit 2 Multiple Spurious Operation Evaluation, Report R1976-20-01, Revision 1, dated October 2010

A006
NRR

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ENCLOSURE

TVA LETTER DATED NOVEMBER 5, 2010
WATTS BAR NUCLEAR PLANT (WBN) UNIT 2 – FIRE PROTECTION PROGRAM
(TAC NO. ME0853) – COMMITMENT TO PROVIDE ADDITIONAL INFORMATION ON
MULTIPLE SPURIOUS OPERATION (MSO) SCENARIOS

WBN Unit 2 Multiple Spurious Operation Evaluation

Report R1976-20-01, Revision 1, dated October 2010

ENGINEERING PLANNING AND MANAGEMENT, INC.

TENNESSEE VALLEY AUTHORITY

WATTS BAR NUCLEAR PLANT

UNIT 2

MULTIPLE SPURIOUS OPERATION EVALUATION

Report: R1976-20-01

Title: MULTIPLE SPURIOUS OPERATION EVALUATION

Revision: 1

Date: October 2010

Prepared by	Charles Brush	C. E. Brush	10-21-2010
	Signature	Print	Date
Reviewed by	Franklin Tanner	F. W. Tanner	10-22-2010
	Signature	Print	Date

EPM

Engineering Planning and Management, Inc.

Executive Summary

This report evaluates multiple fire induced spurious failures at Watts Bar Nuclear Plant – Unit 2 as required by Nuclear Regulatory Commission (NRC) Regulatory Guide 1.189, Rev. 2. Based on the results of the Multiple Spurious Operations Expert Panel conducted at the plant for Unit 1, various scenarios were identified and were reviewed for WBN Unit 2. Most of these scenarios were resolved by the existing baseline Fire Safe Shutdown (FSSD) analysis. Resolutions are provided for the unresolved scenarios in Appendices B and C.

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1.0 PURPOSE

This report provides the result of the evaluation of Watts Bar (WBN) Unit 2 for issues resulting from the publication of Nuclear Regulatory Commission (NRC) Regulatory Guide 1.189 Rev. 2 (RG 1.189) (Ref. 1). Specifically, Section 5.3 of RG 1.189 discusses an allowable approach to address multiple fire induced circuit failures. This report identifies scenarios that may be caused by multiple circuit failures and evaluates each scenario to determine if, in fact, it is a concern. For any concern identified, resolutions are provided to address the concern.

2.0 RESULTS

Appendices B and C summarize the resolutions resulting from the review of Regulatory Guide 1.189 Multiple Spurious Operation (MSO) requirements at WBN-2. Concerns were identified in a few plant areas and for different post-fire scenarios. Where concerns were identified, resolutions were provided to eliminate the concern. Many of the resolutions were identified by the baseline post fire safe shutdown analysis (FSSD) and resulting plant modifications are in process. Such resolutions are included in this report for completeness.

The review of the MSO scenarios is attached as Appendix A. The scenarios selected for review is the same set of scenarios that were determined to be applicable to WBN unit 1 by the MSO Expert Panel. This list was based on the Pressurized Water Reactor Owner's Group (PWROG) generic list of multiple spurious operations. The Sequoyah (dual unit) MSO list was compared to the WBN Unit 1 list and no additional scenarios were identified due to dual unit operation.

3.0 BACKGROUND

RG 1.189 was issued by the Nuclear Regulatory Commission (NRC) in November 2009. RG 1.189 provides guidance for nuclear power plants that are not transitioning their fire protection licensing basis to a performance-based standard under 10CFR50.48(c) and National Fire Protection Association (NFPA) standard 805 (Ref. 2)

RG 1.189 formalized the requirements for addressing multiple fire induced circuit failures, or MSOs and multiple concurrent hot shorts. RG 1.189 endorsed portions of NEI 00-01 Rev. 2 (Ref. 4) as an acceptable approach to address these issues. NEI 00-01 allows the use of an expert panel to identify plant specific scenarios that might be caused by MSOs.

TVA recently reviewed MSOs in accordance with RG 1.189 for Watts Bar Unit 1 and its sister plant, Sequoyah Units 1 and 2. Construction of Watts Bar Unit 2 is nearing completion and is proceeding through the licensing process. Most of the multiple spurious operation scenarios were previously addressed in the baseline post fire safe shutdown analysis of WBN-2. Those that were not in the baseline analysis will be incorporated into the final post fire safe shutdown analysis as applicable.

4.0 SCOPE

This report evaluates the MSO scenarios selected for SQN Units 1 and 2 and for WBN Unit 1. The evaluation determines whether the scenario is applicable to WBN Unit 2 and how WBN-2 complies with each scenario.

5.0 METHODOLOGY

Starting from the WBN Unit 1 MSO information, the WBN-2 MSO evaluation used following the general process in the evaluation of each scenario.

1. For each scenario or issue, components were identified whose failure would cause the particular scenario or issue to occur.
2. These components were arranged in a logical relationship.
3. For components already included in the FSSD analysis, the associated cables already identified and located by fire zone/analysis volume. The MSO functional requirement for the component was compared to the FSSD functional requirement to ensure the appropriate cables were included in the evaluation.
4. For newly identified components (not included in the FSSD), or components with new functional requirements associated cables were identified and located by fire zone/analysis volume.
5. Cable and cable location information is maintained in the System Assurance & Fire Protection Engineering (SAFE) database (FSSD analysis).
6. For each Fire Area where MSO components could fail due to cable fire damage, an evaluation was performed to determine the impact of multiple fire induced faults.

6.0 OPERATOR MANUAL ACTIONS

Operator Manual Actions (OMA) identified in the baseline Post Fire Safe Shutdown (FSSD) analysis were identified and credited where applicable to resolve the MSO scenarios. Operator manual actions credited in the Unit 2 MSO evaluations are the same or similar to those previously approved for Unit 1 and also credited in the corresponding Unit 1 MSO evaluation.

7.0 REFERENCES

7.1 NRC Regulatory Guide 1.189, Fire Protection For Nuclear Power Plants, Revision 2 dated October 2009

7.2 NRC Enforcement Guidance Memorandum 09-002, Enforcement Discretion for Fire Induced Circuit Faults, dated May 14, 2009

7.3 NEI 00-01, Guidance for Post Fire Safe Shutdown Circuit Analysis, Revision 2 dated May 2009

7.4 Calculation EDQ00099920090012, Unit 1 and 2 Appendix R Safe Shutdown Analysis

8.0 RECORD OF REVISIONS

Revision	Description of Change
1	Noted that previously identified plant design changes are included and credited in this report. (see section 2.0 and scenarios 22, 32, 54, 54a, 54b, 54c, & 54d) Noted that operator actions credited for MSO resolutions were the same as OMA's previously approved for Unit 1. (see section 6.0 and scenarios 2, 10, 12, 20, 27, 28, 30, 31, 35a, 54, 54a, 54b, 54c, & 54d) Removed reference to Unit 1 Problem Evaluation Reports that are not applicable to Unit 2. (see scenarios 27 & 28) Appendix B – Added resolutions for scenarios 13a, 22, 32, 54, 54a, 54b, 54c, & 54d Appendix C – Added resolution for scenario 15a.

Appendix A

UNIT 2 MSO EVALUATION

1.0 PWROG Scenario 1: Primary Inventory Control - Loss of all reactor coolant pump (RCP) seal cooling due to spurious closure of RCP seal injection header valve(s) concurrent with spurious isolation of component cooling water (CCW) to the thermal barrier heat exchanger.

1.1. Description: Spurious isolation of reactor coolant pumps seal injection header flow AND spurious isolation of component cooling water (CCW) to the thermal barrier heat exchanger

1.2. Notes:

- Scenario causes loss of all RCP seal cooling and subsequent increase in RCP seal leakage, challenging the reactor coolant system (RCS) Inventory Control Function.
- Westinghouse Tech Bulletin 04-22 Rev. 1 provides a summary of the issue. Tech Bulletin references provide additional detail. B&W plants with Westinghouse designed seals may have similar concerns.
- Seal injection flow isolation can occur at main header or at supply to each individual pump. In addition, scenarios that cause loss of all charging (i.e., multiple pump failure due to loss of suction, non-spurious pump failures such as loss of power, etc.) can also cause loss of seal injection.
- Loss of all seal cooling to any individual RCP is a problem (i.e., does not have to occur on all RCPs to be a problem)
- Westinghouse plants refer to Letter #OG-09-156 Revision 1 of White Paper on Westinghouse Reactor Coolant Pump Seal Behavior for Fire Scenarios
- * CE plants generally do not have seal injection and can lose seal cooling for an extended period of time without increased seal leakage. These plants can lose all seal cooling due to spurious isolation of CCW.
- Refer to WCAP-16175.

1.3. WBN Unit 2 Safe Shutdown Compliance:

1.3.1. Seal Injection Header Isolation can only be accomplished by closing flow control valve (FCV) FCV-062-093. FCV-062-093 is an air operated valve which is normally open and fails full open on loss of control air or electrical power. The valve has a pneumatic stop to ensure valve will always allow a minimum seal injection flow.

1.3.2. Loss of suction to the centrifugal charging pump (CCP) has been reviewed and determined that one CCP will always survive considering multiple spurious closure of either volume control tank (VCT) suction valve, loss of either refueling water storage tank (RWST) suction valves, loss of or multiple spurious start of CCPs, spurious safety injection (SI), and loss of CCP heating ventilation and cooling (HVAC). For analysis volume (AV)-106, fire on the RWST suction valves, VCT must be isolated and RWST established by locally opening either suction valve within 70 minutes.

1.3.3. Thermal barrier cooling (TBC) is not credited in any AVs.

1.3.4. Unit 2 compliance strategy is the same as Unit 1 except that Unit 1 credits TBC for some AVs.

2.0 PWROG Scenario 2: Primary Inventory Control - Loss of all reactor coolant pump (RCP) seal cooling due to charging flow diversion concurrent with spurious isolation of component cooling water (CCW) to the thermal barrier heat exchanger.

2.1. Description:

Spurious opening of charging injection valve(s) causing diversion flow away from seals AND Spurious isolation of component cooling water (CCW) to the thermal barrier heat exchanger

2.2. Notes:

- Scenario causes loss of all RCP seal cooling and subsequent increase in RCP seal leakage, challenging the RCS Inventory Control Function.
- Westinghouse Tech Bulletin 04-22 Rev. 1 provides a summary of the issue. Tech Bulletin references provide additional detail. B&W plants with Westinghouse designed seals may have similar concerns.
- Seal injection flow isolation can occur at main header or at supply to each individual pump. In addition, scenarios that cause loss of all charging (i.e., multiple pump failure due to loss of suction, non-spurious pump failures such as loss of power, etc.) can also cause loss of seal injection.
- Loss of all seal cooling to any individual RCP is a problem (i.e., does not have to occur on all RCPs to be a problem)
- Westinghouse plants refer to Letter #OG-09-156 Revision 1 of White Paper on Westinghouse Reactor Coolant Pump Seal Behavior for Fire Scenarios.

- * CE plants generally do not have seal injection and can lose seal cooling for an extended period of time without increased seal leakage. These plants can lose all seal cooling due to spurious isolation of CCW.

- Refer to WCAP-16175.

2.3. WBN Unit 2 Safe Shutdown Compliance:

2.3.1. Cable separation ensures closure of at least one of the Injection Header Isolation valves (2-FCV-62-90-A or 2-FCV-62-91-B) except for a fire where the valves are located (AV-099). For AV-099 the baseline FSSD analysis credits closing a manual valve (2-ISV-62-537 or -539) in series with the injection header isolation valves but located in a different fire zone within 18 minutes. This OMA was previously approved for Unit 1.

2.3.2. The only fires that could cause the boron injection tank (BIT) outlet isolation valves 2-FCV-63-25-A or 2-FCV-63-26-B to spuriously open is a fire in their respective Reactor Motor Operated Valve (RMOV) board rooms (AV-072, -073, -074). The baseline FSSD ANALYSIS credits isolating the BIT path via the following manual valve operations; Open 2-ISV-62-526 or -534; Close 2-ISV-62-527, -533, and -535. These valves are not located in AV-072, -073, or 0-74. The time requirement for these actions is 18 minutes. This OMA was previously approved for Unit 1.

2.3.3. TBC is not credited for any AVs.

2.3.4. Unit 2 compliance strategy is the same as Unit 1 except that Unit 1 credits TBC for some AVs.

3.0 PWROG Scenario 3: Primary Inventory Control - Spurious re-initiation of reactor coolant pump seal injection / thermal barrier cooling results in failure of the RCP seals due to thermal shock.

3.1. Description:

Loss of all seal cooling to reactor coolant pump(s) (see PWR Owners Group scenarios #1 and #2) AND (Spurious re-initiation of seal injection OR spurious re-initiation of component cooling water (CCW) to the thermal barrier heat exchanger)

3.2. Notes:

- Scenario is assumed to cause RCP seal failure and a subsequent RCP seal loss of cooling accident (LOCA), challenging the RCS Inventory Control Function.

- Westinghouse Tech Bulletin 04-22 Rev. 1 (Reference 11) provides summary of issue. Tech Bulletin references provide additional detail.

- Westinghouse plants please refer to Letter #OG-09-156 Revision 1 of White Paper on Westinghouse Reactor Coolant Pump Seal Behavior for Fire Scenarios.

- * CE plants generally do not have seal injection and can lose seal cooling for an extended period of time without increased seal leakage. These plants can lose all seal cooling due to spurious isolation of CCW. Refer to WCAP-16175.

3.3. WBN Unit 2 Safe Shutdown Compliance:

3.3.1. Based on Scenario 1 & 2 discussions, there will not be a sustained loss of seal injection, so this scenario is not applicable.

3.3.2. Unit 2 compliance strategy is the same as Unit 1 except that Unit 1 credits TBC for some AVs.

4.0 PWROG Scenario 4: Primary Inventory Control - Catastrophic RCP Seal Failure

4.1. Description:

Loss of all seal cooling to reactor coolant pump(s) (see PWR Owners Group scenarios #1 and #2) AND Fire prevents tripping the reactor coolant pumps OR spurious start of a reactor coolant pump(s)

4.2. Notes:

- Scenario causes catastrophic RCP seal failure and subsequent RCP seal LOCA, challenging the RCS Inventory Control Function.

- Westinghouse Tech Bulletin 04-22, Rev. 1 provides summary of issue. Tech Bulletin references provide additional detail. Additionally refer to Letter #OG-09-156, Revision 1 of White Paper on Westinghouse Reactor Coolant Pump Seal Behavior for Fire Scenarios.

- Refer to WCAP-16175 for RCP seal behavior on loss of seal cooling at CE plants.

4.3. WBN Unit 2 Safe Shutdown Compliance:

4.3.1. As discussed in Scenarios 1 & 2, RCP seal flow is always credited. The cables associated with the RCPs which can cause a spurious start of the pump or prevent the pump from being tripped are entirely contained inside the Control or Turbine Building. For all AVs except Control Building the RCPs are tripped from the main control room (MCR) panels. For a Control Building fire, the RCPs and the normal and alternate supply breakers feeding the 6.9kv RCP board would be tripped prior to evacuating the control room. Additionally local action at the 6.9kv RCPs board ensures that the RCP breakers remain tripped.

4.3.2. Unit 2 compliance strategy is the same as Unit 1 except that Unit 1 credits TBC for some AVs.

5.0 PWROG Scenario 5: Primary Inventory Control - Loss of all reactor coolant pump (RCP) seal cooling concurrent with spurious operation of the number 1 seal leakoff valve results in failure of RCP seal number 2

5.1. Description:

Spurious isolation of reactor coolant pumps seal injection header flow

AND

Spurious isolation of component cooling water (CCW) to the thermal barrier heat exchanger

5.2. Notes:

- Isolation of the No. 1 seal leakoff line during a loss of all seal cooling event would force the No. 2 RCP seal into a high pressure mode of operation at high temperature, which is beyond the design bases of the No. 2 seal. This could cause failure of the No. 2 seal and increase RCP seal leakage.
- Westinghouse Tech Bulletin 04-22, Rev. 1 provides summary of issue. Tech Bulletin references provide additional detail.
- Also reference Letter WOG-05-163 DW-04-004 "Isolation RCP#1 Seal Leakoff" and Letter #OG-09-156 Revision 1 of White Paper on Westinghouse Reactor Coolant Pump Seal Behavior for Fire Scenarios.
- This scenario would apply to B&W plants with Westinghouse designed RCP seals.

5.3. WBN Unit 2 Safe Shutdown Compliance:

5.3.1. As discussed in Scenarios 1 & 2, RCP seal flow is always credited.

5.3.2. Isolation of No. 1 seal leakoff (2-FCV-62-9, -22, -35, and -48) is an Unanalyzed Condition in Unit 2 baseline FSSD analysis. These FCVs are normally open and fail open on loss of air or electric power.

5.3.3. Resolution: add the Reactor Building Control Air header isolation valves (2-FCV-32-80-A, -102-B) to the FSSD analysis. Close these valves from MCR in all analysis volumes where failure of No. 1 leak off valves is possible. Trip

the RCPs for any analysis volumes where isolation of the reactor building control air headers may not be possible.

5.3.4. WBN Unit 1 identified this condition in PER 227833.

5.3.5. Unit 2 compliance strategy is the same as Unit 1 except that Unit 1 credits tripping the RCPs for all AV's where the seal leak off valve could spuriously close.

6.0 PWROG Scenario 6: Primary Inventory Control - Failure to isolate / spurious opening of normal letdown active isolation valves

6.1. Description:

Spurious opening of (or failure to close) letdown isolation valve(s)

AND

Spurious opening of (or failure to close) letdown orifice valve(s)

6.2. Notes:

- Scenario causes loss of RCS inventory, challenging the RCS Inventory Control Function.
- In a typical Post-Fire Safe Shutdown (PFSS) Analysis, the Chemical and Volume Control System (CVCS) downstream of the letdown isolation valve(s) and upstream of the Volume Control Tank (VCT) isolation valve(s) is not evaluated, and the RCS inventory (letdown) is conservatively assumed lost and unavailable for makeup. In reality, additional failures downstream of the letdown isolation valves would have to occur for this RCS inventory to be unavailable for makeup.
- Also note that the letdown isolation valves and letdown orifice valves are often interlocked such that the isolation valves will not open without the orifice valves being open. Letdown failure to isolate can be a single spurious operation with interlocked valves.
- Note B&W plants do not have letdown orifice valves. Scenario applicable to B&W is spurious operation of multiple letdown isolation valves.

6.3. WBN Unit 2 Safe Shutdown Compliance:

6.3.1. Normal Letdown is isolated by closure of series valves 2-FCV-62-69-A or 2-FCV-62-70-A from the control room. Continued isolation is assured by removing power from 2-FSV-62-69-A via 2-HS-62-69B-A located in 757-A24. Cables from the handswitch to the solenoid are in dedicated conduit with no energized cables to prevent spurious operation via hot short. If 2-HS-62-69B-A is inaccessible due to fire in 757-A24, 2-FCV-62-70-A will be closed from the main control room. Cables for FCV-62-70-A are not in 757-A24.

6.3.2. Unit 2 compliance strategy is the same as Unit 1.

7.0 PWROG Scenario 7: Primary Inventory Control - Normal letdown fails to isolate and inventory is lost to the pressurizer relief tank (PRT)

7.1. Description:

Letdown fails to isolate (see scenario #6)

AND

Spurious closure of downstream containment isolation valve.

7.2. Notes:

- Scenario causes letdown flow to Pressurizer Relief Tank (PRT) through relief valve. This letdown flow is assumed unavailable for RCS makeup.

7.3. WBN Unit 2 Safe Shutdown Compliance:

7.3.1. Normal Letdown is isolated by closure of series valves 2-FCV-62-69-A or 2-FCV-62-70-A from the control room. Continued isolation is assured by removing power from 2-FSV-62-69-A via 2-HS-62-69B-A located in 757-A24. Cables from the handswitch to the solenoid are in dedicated conduit with no energized cables to prevent spurious operation via hot short. If 2-HS-62-69B-A is inaccessible due to fire in 757-A24, 2-FCV-62-70-A will be closed from the main control room. Cables for FCV-62-70-A are not in 757-A24.

7.3.2. Unit 2 compliance strategy is the same as Unit 1.

8.0 PWROG Scenario 8 Primary Inventory Control - Excess letdown fails to isolate

8.1. Description:

Spurious opening of (or failure to close) of multiple in-series excess letdown isolation valves

8.2. Notes:

- Scenario causes loss of RCS inventory to the CVCS system, challenging the RCS Inventory Control Function. The RCS inventory (letdown) is conservatively assumed lost and unavailable for makeup. In reality, additional failures downstream of the excess letdown isolation valves would have to occur for this RCS inventory to be unavailable for makeup.

- This scenario often requires three spurious operations.

8.3. WBN Unit 2 Safe Shutdown Compliance:

8.3.1. Cables for 2-FCV-62-56 are routed in dedicated conduit with no energized circuits to cause spurious opening due to hot shorts.

8.3.2. Unit 2 compliance strategy is the same as Unit 1.

9.0 PWROG Scenario 9: Primary Inventory Control - Spurious valve operation results in loss of all high head RCS makeup flow paths

9.1. Description:

Spurious isolation of reactor coolant pump (RCP) seal injection flow path AND / OR Spurious isolation of normal charging flow path AND / OR Spurious isolation of charging injection flow path

9.2. Notes:

- Scenario isolates all high head RCS makeup flow paths, challenging the RCS Inventory Control Function.

- Each flow path contains a number of series and/or parallel valves. P&ID review is required to identify each relevant combination of valves.

- Note that isolation of all RCS makeup may also involve non-spurious failures. For example, the charging injection valves are normally closed, and a fire-induced loss of valve power (not a spurious operation) would cause these valves to fail

closed. On the other hand, these valves could spuriously close after they have been opened.

- *Note CE plants generally do not have seal injection.

9.3. WBN Unit 2 Safe Shutdown Compliance:

9.3.1. Seal Injection Header Isolation can only be accomplished by closing FCV-062-093. FCV-062-093 is an air operated valve which is normally open and fails full open on loss of control air or electrical power. The valve has a pneumatic stop to ensure valve will always allow a minimum seal injection flow.

9.3.2. No credit is taken for charging through the BIT flowpath or normal charging flowpath in the FSSD ANALYSIS.

9.3.3. Unit 2 compliance strategy is the same as Unit 1 except that Unit 1 credits TBC for some AVs.

10.0 PWROG Scenario 10: Primary Inventory Control - Spurious isolation of Makeup Tank (MUT) / Volume Control Tank (VCT) outlet valve(s) concurrent with spurious isolation of suction valves to the refueling water storage tank (RWST) results in damage to charging pump(s) when they are in normal operation (aligned to the MUT / VCT)

10.1. Description:

Spurious isolation of suction from the MUT / VCT to running charging pump(s) when the charging pump(s) is aligned to the VCT

AND

Spurious isolation of (or failure to open) suction from the RWST to the running charging pump(s)

10.2. Notes:

- Scenario causes charging pump failure, challenging the RCS Inventory Control Function. This is especially challenging if the credited charging pump is running at the time of the fire.

- Can be a single spurious scenario if the RWST valves are normally closed motor operated valves (MOVs) and they are not interlocked with the VCT outlet valves.

- Note that spurious starting of idle charging pump(s) may cause failure of additional pumps. Spurious pump starting can occur for several reasons,

including fire damage to control circuitry or an inadvertent Engineered Safety Features Actuation System (ESFAS) signal.

- Note that valve interlocks may prevent scenario if they prevent VCT and RWST outlets from both being in closed position simultaneously.

10.3. WBN Unit 2 Safe Shutdown Compliance:

10.3.1. Spurious closure of the VCT isolation valves will automatically open the opposite train RWST suction valve. This automatic interlock has been evaluated in the FSSD analysis and is operable except for the following AVs.

10.3.2. For AV-106, where the RWST suction valves are located, one of the VCT isolation valves must be closed and RWST established by manually opening either suction valve within 70 minutes. TBC not available. This OMA was previously approved for Unit 1.

10.3.3. This SCENARIO is only addressing spurious valve closure resulting in CCP suction isolation. Gas ingestion into CCP's will be addressed elsewhere.

10.3.4. Unit 2 compliance strategy is the same as Unit 1 except that TBC and associated operator manual actions are not credited for Unit 2.

11.0 PWROG Scenario 11: Primary Inventory Control - Spurious isolation of two parallel refueling water storage tank (RWST) suction valves results in failure of running charging pump(s) when the charging pump(s) is aligned to the RWST

11.1. Description:

Initial condition is charging pump running and drawing suction from the RWST. Spurious isolation of two parallel RWST outlet valves.

11.2. Notes:

- Scenario causes loss of charging pump suction, causing subsequent pump cavitation and failure. This challenges the RCS Inventory Control Function.

- Note that spurious starting of idle charging pump(s) may cause failure of additional pumps. Spurious pump starting can occur for several reasons, including fire damage to control circuitry or an inadvertent ESFAS signal.

11.3. WBN Unit 2 Safe Shutdown Compliance:

11.3.1. See Scenario 10 for discussion.

11.3.2. For AV-106, fire on the RWST suction valves, both CCPs are available.

11.3.3. Unit 2 compliance strategy is the same as Unit 1.

12.0 PWROG Scenario 12: Primary Inventory Control - Spurious opening (or failure to close) of multiple series VCT outlet valves

12.1. Description:

Spurious opening (or failure to close) of multiple in-series volume control tank (VCT) outlet valves

12.2. Notes:

- Scenario causes VCT drain down and hydrogen cover gas entrainment into charging pump suction, ultimately causing charging pump failure and challenging the RCS Inventory Control Function. This is especially challenging if the credited charging pump is running at the time of the fire. Note this scenario assumes that VCT makeup has been isolated (i.e., letdown isolated).

- Note that spurious starting of idle charging pump(s) may cause failure of additional pumps. Spurious pump starting can occur for several reasons, including fire damage to control circuitry or an inadvertent ESFAS signal.

- Potential resolution is comparison of charging pump suction header pressure provided by the RWST versus the VCT. Specifically, the RWST may provide sufficient pressure such that the check valve to the VCT remains seated and hydrogen is not entrained into the pump suction.

12.3. WBN Unit 2 Safe Shutdown Compliance:

12.3.1. For AV-111, fire on the VCT isolation valves and VCT vent valves (2-FCV-62-1228-A and 2-FCV-62-1229-B), one each of the VCT isolation and vent valves must be closed within 70 minutes. The closure of the VCT vent valves is to ensure the line going to the charging suction is water solid. One RWST suction valve is available to be opened from the main control room to provide suction to the CCP.

12.3.2. Manual closure of one of the VCT isolation valves will be required for other analysis volumes due to cable damage, but AV-111 is the most time limiting. This OMA was previously approved for Unit 1.

12.3.3. Unit 2 compliance strategy is the same as Unit 1.

13.0 PWROG Scenario 13: Primary Inventory Control - Failure to isolate / spurious opening of normal letdown active isolation valves concurrent with spurious isolation of component cooling water (CCW) to the letdown heat exchanger results in failure of charging pump(s)

13.1. Description:

Letdown fails to isolate (see PWR Owners Group scenario #66)

AND

Spurious isolation of component cooling water (CCW) to the letdown heat exchanger

13.2. Notes:

- Scenario causes elevated charging pump suction temperature and subsequent pump failure. Charging pump failure challenges the RCS Inventory Control Function. This is especially challenging if the credited charging pump is running at the time of the fire.

- Starting of additional charging pumps can cause failure of additional pumps. Spurious pump starting can occur for several reasons, including fire damage to control circuitry or an inadvertent ESFAS signal

13.3. WBN Unit 2 Safe Shutdown Compliance:

13.3.1. Normal Letdown is isolated by closure of series valves 2-FCV-62-69-A or 2-FCV-62-70-A from the control room. Continued isolation is assured by removing power from 2-FSV-62-69-A via 2-HS-62-69B-A located in 757-A24. Cables from the handswitch to the solenoid are in dedicated conduit with no energized cables to prevent spurious operation via hot short. If 2-HS-62-69B-A is inaccessible due to fire in 757-A24 (AV-057), closure of 2-FCV-62-70-A is assured by operating 2-XS-62-70-A located in 757-A27 (AV-048).

13.3.2. In addition, 2-TCV-70-192 (CCS discharge from the non-regenerative letdown heat exchanger) will be added to the FSSD analysis. This valve can be opened by 2-HIC-62-78A in MCR for all AVs except AV-038 and AV-048 (757-A27). As stated above, valves 2-FCV-62-69-A or 2-FCV-62-70-A can be closed to isolate letdown for AV-038 and AV-048.

13.3.3. Unit 2 compliance strategy is the same as Unit 1.

13a.0 PWROG Scenario 13a: Charging Pump Runout

Note: PWROG Rev. 1 (6/5/09) Scenario No. 14 and 52 (partial)

13a.1 Description:

Scenario causes charging pump runout and failure. Pump(s) must be running when RCS is at a depressurized condition. Unintentional RCS depressurization could occur due to spurious opening of pressurizer power operated relief valves (PORVs), for example. Charging pump(s) can spuriously start if they are not already running. Scenario may also require failure of other components (e.g., charging flow control valve, etc.).

13a.2 Notes:

- Scenario causes charging pump runout and failure. Pump(s) must be running when RCS is at a depressurized condition. Unintentional RCS depressurization could occur due to spurious opening of pressurizer PORV(s), for example. Charging pump(s) can spuriously start if they are not already running. Scenario may also require failure of other components (e.g., charging flow control valve, etc.).

13a.3 WBN Unit 2 Safe Shutdown Compliance:

13a.3.1 This scenario should be within the bounds of CCP operation during the large break LOCA analysis. This is being confirmed for WBN Unit 1 and the result will be applicable to Unit 2 as well. Confirmation will be completed prior to Unit 2 fuel load.

14.0 PWROG Scenario 14: Primary Inventory Control - Spurious opening of Containment sump motor operated isolation valves (including residual heat removal (RHR) and containment spray (CS) suction valves) results in gravity draining of refueling water (borated water) storage tank (RWST / BWST) inventory to the Containment sump

Note: PWROG Rev. 1 (6/5/09) Scenario No. 15

14.1. Description: Spurious opening of multiple in-series containment sump valves

14.2. Notes:

- Scenario causes a pumped RWST draindown via the containment spray ring. The RWST inventory ultimately settles to the containment sump. Since typical PFSS analyses do not credit alignment of the containment sump, the RWST inventory is

assumed unavailable for RCS makeup, challenging the RCS Inventory Control Function.

- Note that either the RHR pumps or the containment spray pumps could cause this RWST pumped diversion to the spray ring.

- Note that the spurious pump starting can occur for several reasons, including fire damage to control circuitry or inadvertent ESFAS signal.

14.3. WBN Unit 2 Safe Shutdown Compliance:

14.3.1. CS/RHR containment sump valves have been evaluated with the in-series CS/RHR Pump Suction valves to ensure RWST drain down does not occur. The CS/RHR containment sump valves 2-FCV-72-44-A, -45-B and 2-FCV-63-72-A, -73-B are normally closed. For AV-072 and AV-073, 2-FCV-63-73-B could spuriously open, but 2-FCV-74-21-B isolates the sump via MCR operator action.

14.3.2. Unit 2 compliance strategy is the same as Unit 1.

15.0 PWROG Scenario 15: Primary Inventory Control - Spurious start of containment spray pump(s) concurrent with spurious opening of associated pump discharge valve results in transferring refueling water (borated water) storage tank (RWST / BWST) inventory to the Containment sump

Note: PWROG Rev. 1 (6/5/09) Scenario No. 16

15.1. Description:

Spurious starting of containment spray pump(s)

AND

Spurious opening of the associate pump discharge valve(s) AND / OR containment spray header valve(s)

15.2. Notes:

- Scenario causes a pumped RWST draindown via the containment spray ring. The RWST inventory ultimately settles to the containment sump. Since typical PFSS analyses do not credit alignment of the containment sump, the RWST inventory is assumed unavailable for RCS makeup, challenging the RCS Inventory Control Function.

- Note that either the RHR pumps or the containment spray pumps could cause this RWST pumped diversion to the spray ring.

- Note that the spurious pump starting can occur for several reasons, including fire damage to control circuitry or inadvertent ESFAS signal.

15.3. WBN Unit 2 Safe Shutdown Compliance:

15.3.1. For all AVs except AV-042 and AV-057, either the containment spray pump trip circuits are available and the pumps can be tripped from the control room or the containment spray header isolation valves are closed which will prevent RWST draindown via containment spray ring. For a fire inside the applicable pumps board room A (AV-042) and B (AV-057), the board supplies are tripped at their upstream boards feeder breakers (normal, auxiliary, maintenance) within 10 minutes and the emergency diesel generator (EDG) for that board is shutdown. The diesel kill switches on both 0-M-26 and 0-L-4 are cabled thru and selected from the associated board rooms and as such cannot assure functionality. The resolution is to add a switch to L-11A and/or L-11B that would select between main control room and auxiliary control room and would be powered from a 125V Vital Battery Board feed whose cable would not be routed in the board room. Associated cables to the MCR and DG building would be routed outside the board room. This is required for each of the four EDGs.

15.3.2. WBN Unit 1 identified this condition in PER227839.

15.3.3. Unit 2 compliance strategy is the same as Unit 1.

15a.0 SCENARIO 15a : Primary Inventory Control - Spurious start of residual heat removal (RHR / shutdown cooling (SDC) / low pressure safety injection (LPSI) pump(s) concurrent with spurious opening of containment spray header valve(s) results in transferring refueling water (borated water) storage tank (RWST / BWST) inventory to the Containment sump. Note: PWOG Rev.1 (6/5/09) Scenario No. 16.

15a.1 Description:

Spurious starting of residual heat removal (RHR / shutdown cooling (SDC) / low pressure safety injection (LPSI) pump(s)

AND

Spurious opening of the associate pump discharge valve(s)

AND / OR

Containment spray header valve(s)

15a.2 Notes:

- Scenario causes a pumped RWST draindown via the containment spray ring. The RWST inventory ultimately settles to the containment sump. Since typical PFSS analyses do not credit alignment of the containment sump, the RWST inventory is assumed unavailable for RCS makeup, challenging the RCS Inventory Control Function.

- Note that either the RHR pumps or the containment spray pumps could cause this RWST pumped diversion to the spray ring.

- Note that the spurious pump starting can occur for several reasons, including fire damage to control circuitry or inadvertent ESFAS signal.

15a.3 WBN Unit 2 Safe Shutdown Compliance:

15a.3.1 For all AVs except AV-057, either the RHR pumps are available or the containment spray header isolation valves are closed which will prevent RWST draindown via containment spray ring. For a fire inside pump board room B (AV-057), the board's supplies are tripped at their upstream board's feeder breakers (normal, auxiliary, maintenance) within 10 minutes and the emergency diesel generator is shutdown. The diesel kill switches on both 0-M-26 and 0-L-4 are cabled thru and selected from the associated board rooms and as such cannot assure functionality. The resolution is to add a switch to L-11A and/or L-11B that would select between main control room and auxiliary control room and would be powered from a 125V Vital Battery Board feed whose cable would not be routed in the board room. Associated cables to the MCR and DG building would be routed outside the board room. This is required for each of the four EDGs.

15a.3.2 Unit 2 compliance strategy is the same as Unit 1.

16.0 PWROG Scenario 16: Primary Inventory Control - Spurious opening of shutdown cooling suction line isolation valves (interfacing systems LOCA)

Note: PWROG Rev. 1 (6/5/09) Scenario No. 17.

16.1. Description:

Spurious opening of multiple in-series RHR suction valves from the RCS

16.2. Notes:

- Scenario causes interfacing system LOCA, challenging the RCS Inventory Control Function.
- The valve operators are typically maintained de-energized during normal plant operation. If so, spurious operation of each valve would generally require three proper phase hot shorts.
- Note B&W plants have three series valves.
- From a Fire PRA perspective, this interfacing system LOCA scenario generally screens out if at least two series valves are normally de-energized.
- From a PFSS analysis perspective, this is classified as a high/low pressure interface and maintaining the valves de-energized generally complies with fire protection regulatory requirements.

16.3. WBN Unit 2 Safe Shutdown Compliance:

16.3.1. RHR suction valves (interface with RCS) 2-FCV-74-1-A and 2-FCV-74-9-B are in-parallel and in-series with valves 2-FCV-74-8-A and 2-FCV-74-2-B. These valves are administratively locked in the closed position with the power removed during normal operation. The power will not be restored until the valves are required for RHR. The power cable for valves 2-FCV-74-1-A and 2-FCV-74-9-B are routed in separate dedicated conduit with no other cables such that spurious operation due to hot shorts is not possible.

16.3.2. Unit 2 compliance strategy is the same as Unit 1.

17.0 PWROG Scenario 17: Primary Inventory Control - Spurious operation of pressurizer PORV(s) / PORV block valve(s) given that the associated PORV block valve is open

Note: PWROG Rev. 1 (6/5/09) Scenario No. 18

17.1. Description:

Spurious opening of multiple (two or three) pressurizer PORVs with corresponding block valves in their normal, open position

17.2. Notes:

- Scenario causes loss of RCS inventory through the pressurizer PORVs, challenging the RCS Inventory Control Function. Scenario also causes pressurizer depressurization, challenging the RCS Pressure Control Function.
- Note some CE plants do not have any PORVs. Scenario would not be applicable to these plants.
- Note B&W plants only have one PORV. Scenario would not be applicable to these plants.

17.3. WBN Unit 2 Safe Shutdown Compliance:

17.3.1. PORVs 2-PCV-68-334-B and 2-PCV-68-340-A are in series with Block valves 2-FCV-68-332-B and 2-FCV-68-333-A respectively. Cables for PORVs 2-PCV-68-334-B and 2-PCV-68-340-A are routed in dedicated conduit, thus spurious operation is not possible. The PORVs and their associated Block valves are routed through primary containment penetrations which are separated such that a fire on one penetration will not spuriously open both the PORV and associated Block valve.

17.3.2. Unit 2 compliance strategy is the same as Unit 1.

18.0 PWROG Scenario 18: Primary Inventory Control - Spurious operation of pressurizer PORV(s) / PORV block valve(s) given that the associated PORV block valve is closed.

Note: PWROG Rev. 1 (6/5/09) Scenario No. 19

18.1. Description:

Spurious opening of pressurizer PORV(s)

AND

Spurious opening of pressurizer PORV block valve(s) after the block valve(s) has been closed

18.2. Notes:

- Scenario causes loss of RCS inventory through the pressurizer PORV(s), challenging the RCS Inventory Control Function. Scenario also causes pressurizer depressurization, challenging the RCS Pressure Control Function.

- In this scenario, operators may have closed the block valve either to 1) mitigate a fire-induced PORV LOCA or as a 2) pre-emptive action to prevent PORV LOCA from occurring. The first spurious operation is the PORV and the second is the block valve that has been closed.

- Note that the initial PORV LOCA, caused by spurious operation of PORV alone, is a single spurious since block valve is normally open.

18.3. WBN Unit 2 Safe Shutdown Compliance:

18.3.1. See Scenario 17 discussion.

19.0 PWROG Scenario 19: Primary Inventory Control - Spurious operation of reactor vessel head vent valves

Note: PWROG Rev. 1 (6/5/09) Scenario No. 20

19.1. Description:

Spurious opening of multiple reactor head vent valves

Note: PWROG Rev. 1 (6/5/09) Scenario No. 20

19.2. Notes:

- Scenario causes loss of RCS inventory through open reactor head vent flowpath(s), challenging the RCS Inventory Control Function.

- Spurious operation of one head vent flowpath generally requires two spurious operations. Likewise, spurious operation of two head vent flowpaths generally requires four spurious operations.

- Note B&W plants only have one head vent flowpath. Hot leg vents should be also be evaluated for B&W plants.

- From a PRA perspective, note that this scenario may screen out due to the low RCS inventory loss rate through these flowpaths. The scenario may also screen if the head vent valves are normally de-energized.

- From a PFSS analysis perspective, a head vent LOCA may be acceptable if the available makeup mass flow rate exceeds the LOCA mass flow rate.

19.3. WBN Unit 2 Safe Shutdown Compliance:

19.3.1. Reactor Upper Head Vent valves 2-FSV-68-394-A, -395-B, -396-B, -397-A are administratively closed (Modes 1 through 4) with control circuits disabled

(switch 2-SW-68-394, -395 are in "off" position). In addition, the power cables for 2-FSV-68-396, -397 are routed in dedicated conduits with no energized circuits and cables are protected at penetrations with radiant energy shields. This will preclude these valves spuriously opening and causing loss of RCS inventory through open reactor head vent flow paths.

19.3.2. Unit 2 compliance strategy is the same as Unit 1.

20.0 PWROG Scenario 20: Primary Inventory Control - Spurious operation of high head charging pumps challenges pressurizer safety valves

Note: PWROG Rev. 1 (6/5/09) Scenario No. 21

20.1. Description:

Spurious starting of additional high head charging pump(s)

AND

Spurious opening of additional RCS makeup flow paths (i.e., charging injection)

20.2. Notes:

- Scenario causes increasing RCS inventory, leading to a water solid pressurizer and PORV or safety valve opening. This scenario challenges both RCS Inventory and RCS Pressure Control Functions.
- Similar to inadvertent SI.
- Note that the spurious pump starting can occur for several reasons, including fire damage to control circuitry or an inadvertent ESFAS signal.
- Also note that other failures (spurious or non-spurious) in the makeup control system could contribute to this scenario.

20.2.1. See Scenario 2 for BIT isolation.

20.3. WBN Unit 2 Safe Shutdown Compliance:

20.3.1. Either CCP 2-MTR-62-104-B or 2-MTR-62-108-A is credited in all fire areas for makeup and seal injection (cooling). The normal charging path and BIT injection path are closed to prevent pressurizer overfill. Spurious start of the non-credited charging pump is not explicitly modeled in the FSSD ANALYSIS. However, operating both pumps would not have a detrimental effect on seal injection flow since this would result in a slight increase in both flow and pressure.

20.3.2. The normal charging path can be isolated by closing either 2-FCV-62-90-A or 2-FCV-62-91-B. At least one of these valves is available in all AVs except AV-099 where both valves are located. An 18 minute local operator action to close manual valve 2-ISV-62-537 or 2-ISV-62-539 is credited for AV-099 in the baseline analysis. This OMA was previously approved for Unit 1.

20.3.3. The only fires that could cause the BIT outlet isolation valves FCV-63-25-A, -26-B to open is a fire in their respective board rooms (AV-072, -073, -074). The baseline analysis credits 18 minute local operator actions to manually operate the following manual valves: Open 2-ISV-62-526 or -534; Close 2-ISV-62-527, 533, and -535. This OMA was previously approved for Unit 1.

20.3.4. In summary, two charging pumps running with only the seal injection flowpath available would result in a slight increase in both flows and pressure; but not expected to challenge pump minimum flow.

20.3.5. Unit 2 compliance strategy is the same as Unit 1.

21.0 PWROG Scenario 21: Primary Inventory Control - Spurious opening of active valves in primary sample lines

Note: PWROG Rev. 1 (6/5/09) Scenario No. 22

21.1. Description:

Spurious opening of RCS sample valve(s) (i.e., hot leg, pressurizer liquid space, pressurizer steam space, etc.)

AND

Spurious opening of inside containment isolation valve

AND

Spurious opening of outside containment isolation valve

AND

Spurious opening of downstream sample valve(s)

21.2. Notes:

- Scenario causes loss of reactor coolant through the primary sample system, challenging the RCS Inventory Control Function.

- From a PRA perspective, scenario will generally screen due to requirement of 3+ spurious operations and the small magnitude of the leak. Also note that existing thermal hydraulic evaluation of loss of coolant through head vents may bound loss of coolant via the primary sample system.

- Scenario can be screened from consideration if a manual isolation valve prevents the flow. Scenario may also screen if it is within a closed loop capable of withstanding expected pressure.

21.3. WBN Unit 2 Safe Shutdown Compliance:

21.3.1. The RCS Hot Leg Loops 1 and 3, Pressurizer Liquid, and Pressurizer Gas primary sample isolation valves are not included in FSSD ANALYSIS. Each sample line consists of three in-series normally closed valves (fail close on loss of power or control air) and a manual isolation valve that could be closed in the Hot Sample room. The sample lines are closed loop design with the liquid samples return to the volume control tank and the gas sample to the gas analyzer vent header except when a local sample is taken in the hot sample room. Therefore, a failure would require spurious operation of three in-series normally closed valves and a break in the sample line. In addition, a manual isolation valve for each sample line can be closed in Hot Sample Room. Also, the sample lines are 3/8 inch OD, thus the magnitude of the leak is small and need not be considered.

21.3.2. Unit 2 compliance strategy is the same as Unit 1.

22.0 PWROG Scenario 22: Decay Heat Removal - Spurious opening of atmospheric relief valve(s) upstream of the main steam isolation valves (MSIVs)

Note: PWROG Rev. 1 (6/5/09) Scenario No. 23

22.1. Description:

Spurious opening of atmospheric relief valve(s) (also sometimes called atmospheric dump valves) upstream of the main steam isolation valves (MSIVs)

22.2. Notes:

- Scenario causes RCS over-cooling. Also, the overcooling can cause RCS shrinkage, causing low pressurizer level, and challenging the RCS Inventory Control Function.

- Note that spurious operation of each individual steam dump valve may require multiple hot shorts.

- Note some B&W designs do not have MSIVs.

22.3. WBN Unit 2 Safe Shutdown Compliance:

22.3.1. Based on the baseline FSSD the following design change has been issued. A third "C" solenoid opposite train from the existing "A & B" solenoid valves is being added to the Unit 2 design. It is located in a separate fire zone and its cables are routed separately from the "A & B" solenoid valves for each PORV. For all AVs except the Control Building a MCR operator action will close the PORV's via either the "B" or "C" solenoid valve. For a Control Building fire the PORV's are closed by pressure indicating controllers in the backup control panel.

22.3.2. Unit 2 compliance strategy is the same as Unit 1.

23.0 PWROG Scenario 23: Decay Heat Removal - Failure to close or spurious opening of main steam isolation valves with concurrent failure of downstream steam relief valve(s) to close

Note: PWROG Rev. 1 (6/5/09) Scenario No. 24

23.1. Description:

Main steam isolation valve(s) (MSIV(s)) spuriously open OR fail to close

AND
Valve(s) for downstream steam load(s) (e.g., condenser steam dumps, turbine inlet valves, some atmospheric relief / dump valves, etc.) spuriously open OR fail to close

23.2. Notes:

- Scenario causes RCS over-cooling. Also, the overcooling can cause RCS shrinkage, causing low pressurizer level, and challenging the RCS Inventory Control Function.
- Note that spurious opening, or failure to close, each individual MSIV may require multiple hot shorts. In addition, re-opening an MSIV once it has been closed may be very difficult due to differential pressure across valve.
- Note some B&W designs do not have MSIVs.

23.3. WBN Unit 2 Safe Shutdown Compliance:

23.3.1. The MSIVs can be closed from the main control room except for AV-038, -096, -112, -112A, -113, -114S, -116. As an alternate the steam load valves (MS Cool Down, MS Dump, Main FW Pump Turb HP Stop & Control, Main Turb Stop & Control, MSR Control & Low Power Bypass Control) (TBISOL)

are available and can be closed by MCR operator action for these AV's. For a Control Building fire the MSIV can be operated from the backup control room.

23.3.2. Unit 2 compliance strategy is the same as Unit 1.

24.0 PWROG Scenario 24: Decay Heat Removal - Failure to close or spurious opening of main steam isolation valves with concurrent failure of downstream steam relief valve(s) to close

Note: PWROG Rev. 1 (6/5/09) Scenario No. 25

24.1. Description:

Main steam isolation valve(s) (MSIV(s)) bypass valves spuriously open OR fail to close

AND

Valve(s) for downstream steam load(s) (e.g., condenser steam dumps, turbine inlet valves, some atmospheric relief / dump valves, etc.) spuriously open OR fail to close

24.2. Notes:

- Scenario may cause RCS over-cooling. Also, the overcooling can cause RCS shrinkage, causing low pressurizer level, and challenging the RCS Inventory Control Function
- Note, depending on size and number of bypass lines failing open, scenario may not cause overcooling.
- Note some B&W designs do not have MSIVs.

24.3. WBN Unit 2 Safe Shutdown Compliance:

24.3.1. Electric power is removed from the steam line warming valves (2-FCV-1-147-A, -148-B, -149-A, -150-B) by administrative control of local control switches (2-HS-1-147B, -148B, -149B, -150B) during normal power operation to prevent spurious opening due to Appendix R fire.

24.3.2. Unit 2 compliance strategy is the same as Unit 1.

25.0 PWROG Scenario 25: Decay Heat Removal - Spurious operation of main steam header drain valve(s)

Note: PWROG Rev. 1 (6/5/09) Scenario No. 26

25.1. Description:

Spurious operation of main steam header drain valve(s)

25.2. Notes:

- Scenario may cause RCS over-cooling. Also, the overcooling can cause RCS shrinkage, causing low pressurizer level, and challenging the RCS Inventory Control Function.

- Thermal hydraulic analysis may show that the drain valve flowpath is not large enough to be a problem.

25.3. WBN Unit 2 Safe Shutdown Compliance:

25.3.1. Not Applicable. WBN has no solenoid valves associated with the Main Steam Drains (in Aux. Bldg.), these are manual valves that are locked closed, and the DRVs and ISVs are not Appendix R equipment.

25.3.2. Unit 2 compliance strategy is the same as Unit 1.

26.0 PWROG Scenario 26: Decay Heat Removal - Spurious operation / failure to operate of active steam supply valves fails the turbine driven auxiliary (emergency) feedwater pump (AFW / EFW)

Note: PWROG Rev. 1 (6/5/09) Scenario No. 27

26.1. Description:

Spurious isolation of redundant steam supply valves to turbine driven AFW pump.

26.2. Notes:

- Scenario causes turbine driven AFW pump loss of function, which challenges the Decay Heat Removal Function.

26.3. WBN Unit 2 Safe Shutdown Compliance:

26.3.1. The turbine driven auxiliary feedwater pump (TDAFWP) is credited in AV-026, AV-038, and AV-117. The steam supply valves are operational for AV-026 and

AV-117. For AV-026, 2-FCV-1-51-S requires local operator action within 20 minutes. For AV-038 fire damage to the following cables could isolate the steam supply to the TDAFWP.

Resolution: Relocate cables 2V2635B, 2V2633B, 2V2623A, 2V1831A, 2PV83A, 2V1832A, 2V1833A, 2V2625A, 2V2621A out of AV-038.

26.3.2. Unit 2 compliance strategy is the same as Unit 1.

26a PWROG Scenario 26a: Decay Heat Removal - Spurious operation / failure to isolate steam to non-credited TDAFW pump

Note: PWROG Rev. 1 (6/5/09) Scenario No. 26 (partial)

26a.1 Description:

Failure to isolate steam to non-credited TD AFW pump.

26a.2 Notes:

- Scenario may cause RCS over-cooling. Also, the overcooling can cause RCS shrinkage, causing low pressurizer level, and challenging the RCS Inventory Control Function.
- Thermal hydraulic analysis may show that the drain valve flowpath is not large enough to be a problem..

26a.3 WBN Unit 2 Safe Shutdown Compliance:

26a.3.1 The motor driven auxiliary feedwater pumps (MDAFWPs) are credited in all AV's except AV-026, AV-038, and AV-117. For all other analysis volumes, at least one of the TDAFWP steam supply valves 2-FCV-1-17-A, 2-FCV-1-18-B, or 2-FCV-1-52 can be closed from the MCR to isolate steam to the non-credited TDAFWP. Although the TDAFWP can be driven by steam from either SG1 or SG4 the FSSD analysis only credits SG1. Spurious opening of 2-FCV-1-16-B (SG4) is not of concern because the steam supply valves listed above are down stream of the SG selection valves (2-FCV-1-15-A & 2-FCV-1-16-B).

26a.3.2 The baseline FSSD Analysis does not specifically evaluate shutting the non-credited TDAFWP steam supply valves; however, as described above that capability does exist. This problem is identified in WBN Unit 1 PER 227804.

Resolution: Add evaluation of steam supply isolation of the non-credited TDAFWP to the FSSD analysis.

26a.3.3 Unit 2 compliance strategy is the same as Unit 1.

27.0 PWROG Scenario 27: Decay Heat Removal - Spurious closure of auxiliary (emergency) feedwater pump (AFW / EFW) active discharge valve(s)

Note: PWROG Rev. 1 (6/5/09) Scenario No. 28

27.1. Description:

Spurious closure of multiple valves in AFW pump discharge flow path(s)

27.2. Notes:

- Scenario isolates AFW flow to the steam generator(s), challenging the Decay Heat Removal Function.
- AFW flow isolation can occur due to several combinations of valve closures in the pump discharge and/or discharge cross-connect flow paths. Review P&IDs to identify specific valves.

27.3. WBN Unit 2 Safe Shutdown Compliance:

27.3.1. WBN auxiliary feedwater (AFW) system consists of 1 TDAFWP feeding all four SGs and 2 MDAFWPs feeding 2 SGs each. The TDAFWP is credited in AV-026, AV-038, and AV-117. The MDAFWPs are credited for the remaining AVs. The TDAFWP and the MDAFWPs both require operator manual operation of steam generator level control valves within 20 minutes due primarily to loss of control air. This OMA was previously approved for Unit 1.

27.3.2. WBN Unit 1 identified the control air problem in PER 226948 as an enhancement. The PER will explore the possibility of reducing the control air problem. This scenario is resolved for Unit 1 by existing approved operator manual actions. Similar operator manual actions will be credited for Unit 2

27.3.3. Unit 2 compliance strategy is the same as Unit 1.

28.0 PWROG Scenario 28: Decay Heat Removal - Spurious operation / failure to operate of active steam supply valves fails the turbine driven auxiliary (emergency) feedwater pump (AFW / EFW) concurrent with spurious isolation of the AFW / EFW discharge flow path

Note: PWROG Rev. 1 (6/5/09) Scenario No. 29

28.1. Description:

Spurious closure of steam supply valve(s) to turbine driven AFW / EFW pump

AND

Spurious isolation of AFW / EFW pump discharge flow path(s)

28.2. Notes:

- Scenario isolates AFW flow to the steam generator(s) and causes turbine driven AFW pump loss of function, challenging the Decay Heat Removal Function.

28.3. WBN Unit 2 Safe Shutdown Compliance:

28.3.1. As discussed in scenarios 26 and 26a the TD AFW pump and associated FCVs and level control valves (LCVs) are credited in AV-026, AV-038, and AV-117. For all AVs except AV-026, AV-038, and AV-117, the MD AFW pumps are available.

28.3.2. The TDAFWP and MDAFWPs LCV's require manual operation at the valves due primarily to loss of control air within 20 minutes. This OMA was previously approved for Unit 1.

28.3.3. WBN Unit 1 identified the loss of control air problem in PER 226948 as an enhancement. The PER will explore the possibility of reducing the control air problem. The scenario is resolved for Unit 1 by existing approved operator manual actions. Similar operator manual actions will be credited for Unit 2.

28.3.4. Unit 2 compliance strategy is the same as Unit 1.

29.0 PWROG Scenario 29: Decay Heat Removal - Auxiliary (emergency) feedwater (AFW / EFW) flow diversion to non-credited steam generator(s)

Note: PWROG Rev. 1 (6/5/09) Scenario No. 30

29.1. Description:

Combination of spurious valve operations in the AFW / EFW pump discharge flowpaths to the steam generators

29.2. Notes:

- Scenario causes AFW flow diversion to a non-credited steam generator(s), challenging the Decay Heat Removal Function. A steam generator may be "non-

credited" by the FSSD analysis for a number of reasons including unavailability of instrumentation, failure of steam dumps on that loop, etc.

- Scenario may be a single spurious event in some cases.
- Also note that plants with unit-crossties may be subject to flow diversion to steam generators for another unit.

29.3. WBN Unit 2 Safe Shutdown Compliance:

29.3.1. The FSSD ANALYSIS ensured that two credited SGs had AFW flow either from the MDAFWP or TDAFWP.

29.3.2. As discussed in scenarios 26 and 26a, the TDAFWP is credited in AV-026, AV-038, and AV-117. The steam supply valves are operational for these AVs. For AV-026, 2-FCV-1-51-S requires local operator action within 20 minutes. In addition, the MDAFWPs are stopped from the MCR, thus preventing flow diversion to the non-credited SGs.

29.3.3. The MDAFWPs are credited with the remaining AVs. The non-credited MDAFWP can be stopped either in the MCR or in the associated shutdown board room. The non-credited TDAFWP can be isolated from the MCR by closing one of the TDAFWP steam supply valves 2-FCV-1-17-A, 2-FCV-1-18-B, or 2-FCV-1-52, thus preventing flow diversion to the non-credited SGs.

29.3.4. Pressure control valves (PCVs) 2-PCV-3-122 and 2-PCV-3-132 are modeled in the FSSD ANALYSIS and are designed to prevent MD AFW pump runout.

29.3.5. Unit 2 compliance strategy is the same as Unit 1.

30.0 PWROG Scenario 30: Decay Heat Removal - Auxiliary (emergency) feedwater (AFW / EFW) pump failure due to runout following spurious full opening of multiple AFW / EFW flow control and / or isolation valves

Note: PWROG Rev. 1 (6/5/09) Scenario No. 31

30.1. Description:

Spurious full opening of multiple EFW / AFW flow control and / or isolation valves

30.2. Notes:

- Scenario may cause AFW pump runout and failure, challenging the Decay Heat Removal Function.

- Note that this scenario may occur even without spurious operations if the fail-safe position of relevant valves is full open.

30.3. WBN Unit 2 Safe Shutdown Compliance:

30.3.1. The TDAFWP and MDAFWP mini-flow lines contain breakdown orifices.

30.3.2. For the TDAFWP the credited SGs LCVs will be modulated locally via N2 stations within 20 minutes. Speed control of the TDAFWP is included as part of the FSSD ANALYSIS. Local control of the TDAFWP (credited for AV-026, AV-038, and AV-117) prevents turbine overspeed.

30.3.3. For the MDAFWPs, the credited pump discharge PCV and SG LCVs will be modulated locally at the valve by manual valves within 20 minutes. There are no AVs crediting a MDAFWP where its associated discharge PCV fails open. Therefore, MDAFWP runout is not an issue. This OMA was previously approved for Unit 1.

30.3.4. Unit 2 compliance strategy is the same as Unit 1.

31.0 PWROG Scenario 31: Decay Heat Removal - Spurious opening of condenser hotwell makeup control valve results in gravity draining condensate storage tank (CST) inventory to the hotwell

Note: PWROG Rev. 1 (6/5/09) Scenario No. 32

31.1. Description:

Spurious opening of valves between the Condensate Storage Tank (CST) and condenser hotwell.

31.2. Notes:

- Scenario causes inadvertent draining of CST inventory to the condenser. This CST inventory becomes unavailable as an AFW source, challenging the Decay Heat Removal Function.

- In some plants, this requires spurious operation of multiple valves. In other plants, this only requires spurious operation of one valve. And in other plants, this may occur due to loss of instrument air or a non-spurious valve failure (e.g., loss of air / power).

- Other CST draindown paths may exist. P&ID review required.

- Some plants may have a standpipe that prevents the CST from draining below a certain level.

31.3. WBN Unit 2 Safe Shutdown Compliance:

31.3.1. Valve 2-LCV-2-9 is not part of the FSSD ANALYSIS. The Hotwell makeup can not lower the CST level below the minimum volume required for supply to AFW (standpipe protected volume). The valve is normally shut and fails closed on loss of air and power. AFW pump suction can be aligned to the ERCW discharge header from the MCR within 120 minutes for all analysis volumes except AV-026, AV-069, AV-037, AV-037A, AV-038, and AV-072 which credit local operator manual actions for pump suction alignment. Per technical specification basis the CST standpipe protected volume is sufficient for more than 120 minutes. This OMA was previously approved for Unit 1.

31.3.2. Unit 2 compliance strategy is the same as Unit 1.

32.0 PWROG Scenario 32: Decay Heat Removal - Spurious pump(s) operation / failure to trip pump(s) results in steam generator(s) overfill / overcooling

Note: PWROG Rev. 1 (6/5/09) Scenario No. 33

32.1. Description:

Scenario can occur due to various combinations of spurious AFW / EFW pump starts, spurious opening (or failure to close) of valves in AFW / EFW pump discharge flowpaths and spurious opening of main feedwater (MFW) isolation valves with MFW pump(s) running.

32.2. Notes:

- Scenario causes RCS over-cooling and/or steam generator overfill, both challenging the Decay Heat Removal Function. RCS over-cooling can cause RCS shrinkage and low pressurizer level. Steam generator overfill can affect operability of turbine-driven AFW pump.

- Note that the spurious pump starting can occur for several reasons, including fire damage to control circuitry or an inadvertent ESFAS signal.

32.3. WBN Unit 2 Safe Shutdown Compliance:

32.3.1. This scenario is not specifically addressed in the baseline post fire safe shutdown analysis. Resolution: Add steam generator overfill scenario to FSSD to document the evaluation.

32.3.2. As discussed in scenario 29, the TDAFWP is credited in AV-026, AV-038, and AV-117. The steam supply valves are operational for these AVs. For AV-026, 2-FCV-1-51-S requires local operator action within 20 minutes. In

addition, the MDAFWPs can be stopped from the MCR, thus preventing steam generator overfill.

32.3.3. The MDAFWPs are credited with the remaining AVs. The non-credited MDAFWP can be stopped either from the MCR or the associated 6.9KV shutdown board room. Steam flow to the non-credited TDAFWP can be isolated from the MCR by closing either of the TDAFWP steam supply valves 2-FCV-1-17-A, -18-B, -52,.

32.3.4. As noted above, the credited MDAFWP or TDAFWP can be stopped within 20 minutes.

32.3.5. The MFW valves are included in FSSD analysis and close on FW isolation with no spurious operation except for Control Building fire. For Control Building fire, MFW isolation is ensured by operator action at the backup control stations. Based on the baseline FSSD analysis a design change has been issued to modify the bypass feedwater line isolation and regulating valve control circuits to ensure line isolation for all postulated fire locations.

32.3.6. WBN Unit 1 identified this condition in PER 227804.

32.3.7. Unit 2 compliance strategy is the same as Unit 1.

33.0 PWROG Scenario 33: Decay Heat Removal - Spurious operation of steam generator blowdown valves with subsequent loss of steam generator(s) inventory

Note: PWROG Rev. 1 (6/5/09) Scenario No. 34

33.1. Description:

Spurious opening of, or failure to close, multiple series steam generator blowdown valves

33.2. Notes:

- Scenario causes drain down of steam generator inventory through the blowdown system, challenging the Decay Heat Removal Function.
- The number of valves required to spuriously open varies by plant design.
- B&W plants generally do not have a steam generator blowdown system. However, some B&W plants with replacement steam generators may have this system.
- Potential Resolution: Scenario may screen if available AFW mass flow rate exceeds steam generator inventory mass loss rate through blowdown.

33.3. WBN Unit 2 Safe Shutdown Compliance:

33.3.1. Each pair of Steam Generator Blowdown Containment Isolation Valves was evaluated in the FSSD ANALYSIS to ensure closure of at least one SGBD valve in each flow path. MCR operator actions will close the SGBD CIVs within 71 minutes. For Control Building fire, the valve controls will be transferred to and closed from the backup control panel.

33.3.2. Unit 2 compliance strategy is the same as Unit 1 except that Unit 2 rerouted cables to ensure closure of SGBD CIVs from the control room rather than credit operator manual actions.

34.0 PWROG Scenario 34: Decay Heat Removal - Spurious opening of active valves in secondary sampling system(s) causes loss of steam generator(s) inventory

Note: PWROG Rev. 1 (6/5/09) Scenario No. 35

34.1. Description:

Spurious opening of steam generator sample valve(s) inside containment

AND

Spurious opening of isolation valve(s) outside containment

AND

Spurious opening of downstream sample valve(s)

34.2. Notes:

- Scenario causes drain down of steam generator inventory through the sample system, challenging the Decay Heat Removal Function.
- From a PRA perspective, scenario will generally screen due to requirement of 3+ spurious operations and the small magnitude of leak.
- Scenario can be screened from consideration if a manual isolation valve prevents the flow or if the system is closed loop capable of withstanding expected pressure.
- Scenario may also screen if available AFW mass flow rate exceeds steam generator inventory mass loss rate through the sample system.
- B&W plants sample directly from the steam generator (i.e., not through blowdown system).

34.3. WBN Unit 2 Safe Shutdown Compliance:

34.3.1. Each pair of SG Drum/BLDN Sample Line CIVs was evaluated in the FSSD ANALYSIS to ensure closure of at least one CIV valve in each flow path. MCR operator actions will close the SGBD CIV valves. For fires in AV-076 (Control Building), AV-006, AV-025, AV-025C, AV-026, AV-026A, AV-038, AV-115, a handswitch located outside the control building will ensure closure of the Train A CIV valves. This action must be completed within 71 minutes.

34.3.2. Unit 2 compliance strategy is the same as Unit 1.

35.0 PWROG Scenario 35: Primary Pressure Control - Spurious operation of active normal pressurizer spray valves concurrent with inability to trip operating reactor coolant pump(s) (RCPs) from the Control Room

Note: PWROG Rev. 1 (6/5/09) Scenario No. 36

35.1. Description:

Spurious opening of normal pressurizer spray valve(s)

AND

Inability to trip / failure to trip, or spurious operation of, RCP(s)

AND

Inoperability of pressurizer heater(s)

35.2. Notes:

- Scenario causes a RCS pressure transient, challenging the RCS Pressure Control Function. Typical PFSS analyses address this issue; PRAs often consider scenario negligible since there is no real threat of core uncovery.
- Potential candidate for generic analysis to evaluate various spray / heater combinations and show no adverse impact on safe shutdown capability.
- Note that spurious opening of failure to isolate pressurizer auxiliary spray would have similar consequence; however this is typically a single spurious scenario.

35.3. WBN Unit 2 Safe Shutdown Compliance:

35.3.1. The cables associated with the RCPs which can cause a spurious start of the pump or prevent the pump from being tripped are entirely contained inside the Control or Turbine Building. For all AVs requiring the RCP's to be tripped except Control Building, the RCPs are tripped from MCR panels. For a Control Building fire, the RCPs are tripped by control room switches, the RCP board normal and alternate supply breakers are also tripped at the Electrical Control Board (in the control room), and a local action at the 6.9KV RCP Board ensures the RCP's do not restart. (Reference Scenario 4)

35.3.2. The PZR Spray valves 2-PCV-68-340B, and 2-PCV-68-340D could spuriously open in AV-025, -025C, -026, -037, -037C, -38, -115, -117, -118. The RCPs are tripped via MCR operator action.

35.3.3. The PZR Heaters could spuriously operate in AV-036, -037, -037C, -038, -044, AV-042, -045, -048, -053, -055, AV-057, -62, -70, -71. They can be tripped from the MCR. For fires in the 6.9KV shutdown board rooms (AV-042, AV-057) the board will be de-energized by tripping the supply breakers and the EDG.

35.3.4. Unit 2 compliance strategy is the same as Unit 1.

35a.0 PWROG Scenario 35a: Primary Pressure Control - Spurious operation of auxiliary pressurizer spray valves with charging pumps in operations

Note: PWROG Rev. 1 (6/5/09) Scenario No. 36

35a.1 Description:

Spurious opening of auxiliary pressurizer spray valve(s)

AND

Inoperability of pressurizer heater(s).

35a.2 Notes:

- Scenario causes a RCS pressure transient, challenging the RCS Pressure Control Function. Typical PFSS analyses address this issue; PRAs often consider scenario negligible since there is no real threat of core uncovery.
- Potential candidate for generic analysis to evaluate various spray / heater combinations and show no adverse impact on safe shutdown capability.
- Note that spurious opening of failure to isolate pressurizer auxiliary spray would have similar consequence; however this is typically a single spurious scenario.

35a.3 WBN Unit 2 Safe Shutdown Compliance:

35a.3.1 The charging header isolation valves 2-FCV-62-90-A, -91-B can be closed from MCR in all AVs except AV-099 to isolate the auxiliary pressurizer spray line. For AV-099, both the charging header isolation valves 2-FCV-62-90-A, -91-B fail. An 18 minute local operator action to close manual valve 2-ISV-62-537 or 2-ISV-62-539 is credited for AV-099 in the baseline analysis. This OMA was previously approved for Unit 1.

35a.3.2 Unit 2 compliance strategy is the same as Unit 1.

36.0 PWROG Scenario 36: Primary Pressure Control - Spurious operation of multiple pressurizer heater banks

Note: PWROG Rev. 1 (6/5/09) Scenario No. 37

36.1. Description:

Spurious operation of multiple pressurizer heaters

AND

Inoperability of pressurizer spray and auxiliary spray

36.2. Notes:

- Scenario causes a RCS pressure transient, challenging the RCS Pressure Control Function. RCS pressure increase could cause PORV(s) and/or safety valve(s) to open.

36.3. WBN Unit 2 Safe Shutdown Compliance:

36.3.1. The capability to Trip PZR the Heaters is evaluated in the FSSD analysis. The heaters can be tripped from the MCR (most AV's) or locally at the 6.9kv SD boards (AV-036, -037, -037C, -038, -044, -045, -048, -053, -055, -62, -70, -71).For fires involving the 6.9kv shutdown board rooms (AV-042, AV-057) the boards are de-energized by tripping the all of the supply breakers (normal, alternate, maintenance) and the EDG. The diesel kill switches on both 0-M-26 and 0-L-4 are cabled thru and selected from the associated board rooms and as such cannot assure functionality. The resolution is to add a switch to L-11A and/or L-11B that would select between main control room and auxiliary control room and would be powered from a 125V Vital Battery Board feed whose cable would not be routed in the board room. Associated cables to the

MCR and DG building would be routed outside the board room. This is required for each of the four EDGs.

36.3.2. WBN Unit 1 identified this condition in PER227839.

36.3.3. Unit 2 compliance strategy is the same as Unit 1.

37.0 PWROG Scenario 37: Reactivity Control - Inadvertent injection of undiluted makeup water / inadvertent injection of makeup water with very low boron concentration

Note: PWROG Rev. 1 (6/5/09) Scenario No. 38

37.1. Description:

Unborated water supply to the RCS can occur due to combinations of the following:

-Spurious start of reactor makeup pump(s) (supplies unborated water to the VCT),

-Spurious opening of valves between reactor makeup pump(s) and VCT,

-Spurious full opening of the reactor makeup flow control valve,

-Spurious closure of the boric acid flow control valve.

37.2. Notes:

- Scenario decreases RCS boron concentration, potentially causing reactivity increase, and challenging the Reactivity Control Function.
- The reactor makeup flow control valve would normally provide the setpoint flowrate instead of being fully open.
- Potential Solution: The maximum flow from the reactor makeup pump may be limited due to the plant specific design (e.g., installation of a flow orifice to limit the pump's maximum flow, boron dilution protection system, etc.).
- Potential Solution: The reactivity increase may occur at a very slow rate, allowing operators sufficient time to mitigate.

37.3. WBN Unit 2 Safe Shutdown Compliance:

37.3.1. The primary makeup pumps (2-MTR-81-3 and 2-MTR-81-7) are tripped within 15 minutes from the main control room or from their 480vac MCC to ensure the reactor coolant system boron concentration is maintained. Main control room trip capability is available for all fires except analysis volumes AV-026, AV-038, and AV-057. The 15 minute time is conservatively based on all charging pumps running and both the normal makeup and the injection path open (235 gpm makeup). With both paths isolated as described below makeup is only through the RCP seals (less than 40 gpm) which increases the allowable time to trip the makeup pumps to 60 minutes or more.

37.3.2. The normal makeup path will be isolated by promptly closing 2-FCV-62-90-A or 2-FCV-62-91-B from the main control room except for a fire on the valves (AV-099). Therefore the normal makeup path can be isolated from the main control room for AV-026, AV-038, and AV-057, thereby allowing more time to trip the normal makeup pumps.

37.3.3. The injection path (BIT) valve (2-FCV-63-25-B and 2-FCV-63-26-A) control circuits have been modified such that they will not spuriously open except for a fire on their MCCs which are located in AV-072 & -073 and AV-074 respectively. Therefore the BIT path can be isolated from the main control room for AV-026, AV-038, and AV-057, thereby allowing more time to trip the normal makeup pumps.

37.3.4. Unit 2 compliance strategy is the same as Unit 1.

38.0 PWROG Scenario 38: Reactivity Control - Fire prevents reactor trip

Note: PWROG Rev. 1 (6/5/09) Scenario No. 39

38.1. Description:

Fire damage to the reactor protection system (RPS) may prevent reactor trip. For example, hot shorts may prevent tripping of the RPS motor generator (MG) sets.

38.2. Notes:

- BWRs have identified scenarios where fire-induced hot shorts could prevent all control rod groups from inserting when required. Reference NRC Information Notice 2007-07.

- No cases at PWRs were identified by the survey results that supported this MSO list. However, each plant should consider performing a review to determine if scenario is plausible at their plant. Note that this review may have already been performed for the disposition of Information Notice 2007-07.

38.3. WBN Unit 2 Safe Shutdown Compliance:

38.3.1. The post fire safe shutdown analysis demonstrates that at least one train of the reactor trip switchgear can be tripped from the main control room for all AVs with the possible exception of AV-115 where the reactor trip switchgear is located.

38.3.2. For AV-115 reactor trip is confirmed by tripping the normal and alternate supplies to the control rod MG sets, 2-MTR-85-1A and 2-MTR-85-1B, at the 480vac unit boards in the turbine building within 15 minutes.

38.3.3. For Control Building fire reactor trip is initiated and confirmed prior to evacuating the control room.

38.3.4. Unit 2 compliance strategy is the same as Unit 1.

39.0 PWROG Scenario 39: Support Systems - Spurious loss of component cooling water (CCW) either as an entire system or to individual headers (including potential water hammer events)

Note: PWROG Rev. 1 (6/5/09) Scenario No. 40

39.1. Description:

CCW flow can be isolated via several combinations of spurious valve closures. Pertinent valves include:

-CCW pump discharge valves,

-CCW pump crosstie valves,

-CCW heat exchanger inlet valves,

-CCW heat exchanger outlet valves,

-CCW heat exchanger crosstie valves,

-Etc.

39.2. Notes:

- Scenarios cause failure of CCW function to provide cooling to safe shutdown loads.
- Review P&IDs to identify relevant valve combinations.

39.3. WBN Unit 2 Safe Shutdown Compliance:

39.3.1. Spurious loss of Component Cooling System (CCS) is prevented by removing power from the motor operated valves that could isolate CCS flow or provide flow diversion. The CCS pump supply (inlet) and discharge are open with power removed. CCS heat exchanger inlet and outlet valves are open with power removed. Cross tie valves between units and heat exchangers are closed with power removed. Isolation valves in supply lines serving the charging pumps, safety injection pumps, RHR pumps and Containment Spray pumps are open with power removed.

39.3.2. The following individual load valves are powered and are evaluated for spurious operation in the post fire safe shutdown analysis:

CCS Heat Exchanger B (Unit 2 train A loads):

0-FCV-70-194-B, normally open supply to spent fuel pool heat exchanger B.

2-FCV-70-156-A, normally closed RHR heat exchanger 2A outlet valve.

2-FCV-70-133-A & 2-FCV-70-134-B, normally open thermal barrier cooling supply valves

CCS Heat Exchanger C (both units train B loads):

2-FCV-70-153-B, normally closed RHR heat exchanger 2B outlet valve.

1-FCV-70-153-B, RHR normally open heat exchanger 1B outlet valve.

39.3.3. Unit 2 compliance strategy is the same as Unit 1.

40.0 PWROG Scenario 40: Support Systems - Spurious loss of component cooling water (CCW) to individual critical loads (including potential water hammer events)

Note: PWROG Rev. 1 (6/5/09) Scenario No. 41

40.1. Description:

Spurious isolation of CCW cooling to individual redundant loads including lube oil coolers, RHR heat exchangers, etc.

40.2. Notes:

- Scenario isolates CCW cooling to redundant loads causing safe shutdown equipment inoperability of redundant trains.
- For example, a plant may have two redundant charging pumps. Each charging pump may have a lube oil system that is cooled by the corresponding train of CCW. If CCW flow to both lube oil coolers spuriously isolates, then both charging pumps would become inoperable.
- All credited CCW loads should be reviewed.

40.3. WBN Unit 2 Safe Shutdown Compliance:

40.3.1. See scenario 39.

41.0 PWROG Scenario 41: Support Systems - Component cooling water (CCW) flow diversion to non-credited loop(s)

Note: PWROG Rev. 1 (6/5/09) Scenario No. 42

41.1. Description:

Flow diversion can occur via several combinations of spurious valve operations in the CCW pump discharge and CCW loop crosstie flowpaths. Review P&IDs to identify relevant combinations.

41.2. Notes:

- Scenario causes CCW flow to be diverted to the non-credited loop. This ultimately prevents CCW cooling of credited safe shutdown loads.
- Review P&IDs to identify relevant valve combinations.

41.3. WBN Unit 2 Safe Shutdown Compliance:

41.3.1. Spurious loss of Component Cooling System (CCS) is prevented by removing power from the motor operated valves that could isolate CCS flow or provide flow diversion. The CCS pump supply (inlet) and discharge are open with power removed. CCS heat exchanger inlet and outlet valves are open with power removed. Cross tie valves between units and heat exchangers are closed with power removed. Isolation valves in supply lines serving the charging pumps, safety injection pumps, RHR pumps and Containment Spray pumps are open with power removed.

41.3.2. The following individual load valves are powered and are evaluated for spurious operation in the safe shutdown analysis:

CCS Heat Exchanger B (Unit 2 train A loads):

0-FCV-70-194-A, normally open supply to spent fuel pool heat exchanger B.

2-FCV-70-156-A, normally closed RHR heat exchanger 2A outlet valve.

2-FCV-70-133-A & 2-FCV-70-134-B, normally open thermal barrier cooling supply valves

CCS Heat Exchanger C (both units train B loads):

2-FCV-70-153-B, normally closed RHR heat exchanger 2B outlet valve.

1-FCV-70-153-B, RHR normally open heat exchanger 1B outlet valve.

41.3.3. CCS normally closed valves 1-FCV-70-143-A, -85-B (Excess Letdown Heat Exchanger Containment Isolation Valves) are not included in FSSD analysis because the additional 232 gpm load would not impact the CCS pumps.

41.3.4. Unit 2 compliance strategy is the same as Unit 1.

42.0 PWROG Scenario 42: Support Systems - Spurious loss of safety-related service water (SW) either as an entire system or to individual headers (including potential water hammer events)

Note: PWROG Rev. 1 (6/5/09) Scenario No. 43

42.1. Description:

Safety related service water (sometimes called, "essential," service water) flow to credited loads can be isolated via several combinations of spurious valve closures.

Pertinent valves include:

-SW pump discharge valves,

-SW pump crosstie valves,

-SW heat exchanger inlet valves,

-SW heat exchanger outlet valves,

-SW heat exchanger crosstie valves,

Review P&IDs to identify relevant combinations.

42.2. Notes:

- Scenario causes isolation of ESW, which can fail cooling to the CCW system and other safe shutdown components directly cooled by ESW (e.g., EDG cooling).
- All credited ESW loads should be reviewed for spurious isolation.

42.3. WBN Unit 2 Safe Shutdown Compliance:

42.3.1. ERCW pump availability is evaluated in the FSSD analysis to ensure that at least 2 of the 4 pumps of the credited train are available for all fire scenarios.

42.3.2. Pump discharge (strainer inlet) and header isolation valves are open with power removed to prevent spurious closure and ensure ERCW flowpath.

42.3.3. FCV-67-66-A and FCV-67-B for both units are open with power removed to ensure ERCW flow to emergency diesel generators.

42.3.4. FCV-67-127-A and FCV-67-128-B for both units are open with power removed to ensure ERCW flow to critical air conditioning equipment.

42.3.5. Potential flow diversion to Containment Spray heat exchangers due to spurious opening of in-series valves FCV-67-123-B and -124-B or FCV-67-125-A and -126-A for both units is evaluated in FSSD analysis.

42.3.6. Supply and discharge valves for each of the three CCS heat exchangers are evaluated in the FSSD analysis to ensure ERCW flow is available for the credited safe shutdown components. Valve control circuits are modified to minimize spurious operation potential.

42.3.7. Unit 2 compliance strategy is the same as Unit 1.

43.0 PWROG Scenario 43: Support Systems - Spurious loss of safety-related service water (SW) to individual critical loads (including potential water hammer events)

Note: PWROG Rev. 1 (6/5/09) Scenario No. 44

43.1. Description:

Spurious isolation of safety related service water (SW) cooling to redundant loads including component cooling water (CCW) heat exchangers and emergency diesel generator cooling (EDG) cooling.

43.2. Notes:

- Scenario isolates ESW cooling to redundant loads causing safe shutdown equipment failure on redundant trains.
- For example, redundant EDGs may be cooled by ESW. If ESW flow to both EDGs spuriously isolates, then both EDGs could fail.
- All credited ESW loads should be reviewed.

43.3. WBN Unit 2 Safe Shutdown Compliance:

43.3.1. See Scenario 42.

44.0 PWROG Scenario 44: Support Systems - Safety related service water (SW) flow diversion to non-credited loops / loads

Note: PWROG Rev. 1 (6/5/09) Scenario No. 45

44.1. Description:

Flow diversion can occur via several combinations of spurious valve operations in the service water pump discharge and loop crosstie flowpaths. Review P&IDs to identify relevant combinations.

44.2. Notes:

- Scenario causes ESW flow to be diverted to a non-credited loop or system. This ultimately prevents ESW cooling of credited loads.
- Review P&IDs to identify relevant valve combinations.

44.3. WBN Unit 2 Safe Shutdown Compliance:

44.3.1. The only significant potential flow diversion are the Containment Spray heat exchangers each of which is isolated by 2 normally closed motor operated valves. These valves are included in the FSSD analysis and evaluated for spurious opening. If both valves for a heat exchanger could spuriously open additional ERCW flow capacity is ensured. The Unit 2 valves are modified to minimize spurious opening potential.

44.3.2. Unit 2 compliance strategy is the same as Unit 1.

45.0 PWROG Scenario 45: Support Systems - Non-critical components inadvertently loaded onto credited emergency diesel generator(s) (EDGs)

Note: PWROG Rev. 1 (6/5/09) Scenario No. 46

45.1. Description:

Additional components load onto credited diesel generator

45.2. Notes:

- Scenario causes diesel generator overloading and failure.
- Scenario very site specific. Interlocks may prevent this from occurring.

45.3. WBN Unit 2 Safe Shutdown Compliance:

45.3.1. See scenario 46.

46.0 PWROG Scenario 46: Support Systems - Emergency diesel generator(s) (EDGs) overloading

Note: PWROG Rev. 1 (6/5/09) Scenario No. 47

46.1. Description:

Emergency diesel generator (EDG) overloading

46.2. Notes:

- Scenarios cause diesel generator overloading and failure.
- Scenarios very site specific. Interlocks may prevent these from occurring.
- In addition to Scenario 45, overloading may also occur if proper load sequencing is bypassed via hot shorts, causing simultaneous loading of multiple components onto the EDG.

46.3. WBN Unit 2 Safe Shutdown Compliance:

46.3.1 An investigation was initiated to determine the effects of MSOs on each EDG with respect to overloading the EDG. This was accomplished by examining: 1) the control cables for each 6.9kv load fed from each shutdown board to determine if the load could be spuriously started and loaded on the board at some time other than as analyzed in the Appendix R EDG loading calculation or the EDG loading analysis; and 2) load shed cables and control room cables for large 480v non-Appendix R loads to determine which fires could prevent the load from being shed or spuriously energized. This examination was performed for each EDG separately by looking at all fire zones that credited a specific EDG. Results for each EDG are as follows:

1A-A For fire in 737-A1AN (AV-37C)

RHR pump 1-MTR-74-10-A could spuriously start by interaction with control cable 1PP580A in this fire zone. This spurious operation was considered and the loading was accounted for in Appendix R Diesel Generator Load Study calculation WPEVAR9503001. Results of this calculation show that this spurious start did not overload the EDG. This interaction was resolved in the Appendix R safe shutdown analysis by MOA 311. There are no load shed cable interactions for 1A-A. There are no corrective actions needed.

1A-A For fire in 757-A1 (AV-45)

Pressurizer Heater 1-HTR-68-341A/A1-A7 could spuriously come on by interaction with control cable 1PP802A in this fire zone. This spurious operation was considered and the loading was accounted for in Appendix R Diesel Generator Load Study calculation WPEVAR9503001. Results of this calculation show that this spurious start did not overload the EDG. This interaction was resolved in the Appendix R safe shutdown analysis by MOA 276. There are no load shed cable interactions for 1A-A. There are no corrective actions needed.

1A-A For fire in 757-A5 (AV-53)

SI pump 1-MTR-63-10-A and CS pump 1-MTR-72-27-A could spuriously start by interaction with their local control switch control cables 1PP602A and 1PP627A respectively. These cables are being removed and the control switches deleted by DCN 54912. There are no load shed cable interactions for 1A-A. There are no corrective actions needed.

1B-B For fire in 737-A1A and 737-A1AN (AV-36)

The following interactions exist:

SI pump 1-MTR-63-15-B cable 1PP615B – control cable to MCR and 1PP617B to 1-R-51. (local control switch cable 1PP614B to be deleted by DCN 54912). Spurious start of the SI pump has been resolved by tripping the pump from the MCR or locally via MOA 513 within 60 minutes.

Pzr Htr 1-HTR-68-341H/C1-C6 cable 1PP842 – control cable to MCR

SF Pit pump 0-MTR-78-9-B cable 1PL4896B – load shed to low voltage switchgear (LVSG)

Cont & Ser Air Comp B 0-MTR-32-26 cable 1PL5092 – load shed to LVSG

Shutdown board (SDBD) Rm Chil pkg 0-MTR-31-49/2-B cable 1PL5204B – load shed to LVSG and 1PL5201B (in 737-A1A only) to MCR.

AB Gen Exhaust fan 1B 1-MTR-30-162 cable 1PL5175 (in 737-A1A only) - control cable to MCR

AB Gen Sup fan 1B 1-MTR-30-102 cable 1PL5167 – load shed to LVSG and 1PL5165 (in 737-A1A only) to MCR

Collectively these loads represent a presently unanalyzed loading on the EDG. An informal evaluation indicates that this additional load may be able to meet the steady state rating of the EDG. However, if this additional loading were applied at the same time and on top of the worst case normal loading step, the maximum step load increase rating would be exceeded. Therefore, the resolution is to either reroute out of the fire zones (AV-036) or protect with fire wrap cables 1PP842, 1PL4896B, 1PL5092, 1PL5204B, 1PL5201B, 1PL5175, 1PL5165, and 1PL5167.

1B-B For fire in 757-A28 (AV-49)

Pressurizer Heater 1-HTR-68-341D/B1-B7 could spuriously come on by fire on cable 1PP822B in fire zone 757-A28. This interaction was resolved by MOA 277 to trip the heaters at the 6.9kv SDBD. There are no 480v load shed cables in this fire zone. No further corrective action is needed.

1B-B For fire zone 757-A2 (AV-42)

The following interactions exist:

SF Pit pump 0-MTR-78-9-B cable 1PL4896B – load shed to LVSG

Cont & Ser Air Comp B 0-MTR-32-26 cable 1PL5092 – load shed to LVSG

SDBD Rm Chil pkg 0-MTR-31-49/2-B cable 1PL5204B – load shed to LVSG and 1PL5201B to MCR.

AB Gen Exhaust fan 1B 1-MTR-30-162 cable 1PL5175 -control cable to MCR and 1PL6010B – load shed to LVSG

AB Gen Sup fan 1B 1-MTR-30-102 cable 1PL5167 – load shed to LVSG and 1PL5165 to MCR

Collectively these loads represent a presently unanalyzed loading on the EDG. An informal evaluation indicates that this additional load may be able to meet the steady state rating of the EDG. However, if this additional loading were applied at the same time and on top of the worst case normal loading step, the maximum step load increase rating would be exceeded. Therefore, the resolution is to either reroute out of the fire zones or protect with fire wrap cables 1PL4896B, 1PL5092, 1PL5204B, 1PL5201B, 1PL5175, 1PL6010B, 1PL5165, and 1PL5167.

2A-A For fire in 737-A1AN and 737-A1BN (AV-37C)

The following interactions exist:

SI pump 2-MTR-63-10-A cable 2PP603A – control cable to MCR. EDCR 54636 is rerouting out of these fire zones.

CS pump 2-MTR-72-27-A cable 2PP628A – control cable to MCR. EDCR 54636 is rerouting out of these fire zones.

RHR pump 2-MTR-74-10-A cable 2PP578A – control cable to MCR. EDCR 54636 is rerouting out of these fire zones.

Pzr Htr 2-HTR-68-341F/D1-D6 cable 2PP862 – control cable to MCR. Currently MOA 1296 turns off the htr at the SDBD.

SDBR Chiller A-A 0-MTR-31-36/2-A cable 2PL5133A – load shed cable to LVSG

AB Gen Sup Fan 2A 2-MTR-30-104 cable 2PL5145 – control cable to MCR

The resolution is to reroute or protect cables 2PL5133A and 2PL5145 in these fire zones.

2A-A For fire in 772-A15A1

The following interactions exist:

SFP pump A-A 0-MTR-78-12-A cable 2PL4896A – load shed cable to LVSG

CCS pump 2-MTR-70-59-A cable 2PL4729A – load shed cable to LVSG

The resolution is to either reroute out of the fire zones or protect with fire wrap cables 2PL4896A and 2PL4729A.

2A-A For fire in 757-A1 (AV-45)

The only interaction in this zone is AB Gen Supply Fan 2A, 2-MTR-30-104; cable 2PL5147 which is the load shed cable to the LVSG. This load is 100 HP and the EDG has the capacity to add this load. The resolution is to formally include this load in calculation WBPEVAR9503001.

2A-A For fire in 757-A24 (AV-57)

The only interaction in this zone is AB Gen Supply Fan 2A, 2-MTR-30-104; cable 2PL5145 which is the MCR control cable to the LVSG and 2PL5147 which is the load shed cable to the LVSG. This load is 100 HP and the EDG has the capacity to add this load. The resolution is to formally include this load in calculation WBPEVAR9503001.

2B-B No interactions exist.

46.3.2 Overall long term resolution in addition to that mentioned above is to include in the FSSD analysis all cables that could spuriously start or prevent removing a large load to/from an EDG. These cables would be analyzed with the specific EDG for which they are associated.

46.3.3 WBN Unit 1 identified this condition in PER227839.

46.3.4 Unit 2 compliance strategy is the same as Unit 1. However, the increased board loading for dual unit operation caused additional cable reroutes.

47.0 PWROG Scenario 47: Support Systems - Spurious start of an emergency diesel generator(s) (EDGs) with concurrent failure to provide required cooling

Note: PWROG Rev. 1 (6/5/09) Scenario No. 48

47.1. Description:

Fire spuriously starts an emergency diesel generator(s)

AND

MOVs providing required cooling water to the emergency diesel generator(s) either fail to open or spuriously close

47.2. Notes:

- The fire causes startup of the Emergency Diesel Generator and spurious isolation of ESW cooling (See Scenarios 43 & 45). Running the Emergency Diesel Generator with a loss of cooling water could trip and/or damage the diesel on high temperature.

47.3. WBN Unit 2 Safe Shutdown Compliance:

47.3.1. Valves are maintained open with power removed (breaker open) at the MCC. There are no powered valves that could spuriously close and prevent flow from ERCW to the EDGs.

47.3.2. Unit 2 compliance strategy is the same as Unit 1.

48.0 PWROG Scenario 48: Support Systems - Non-synchronous paralleling of emergency diesel generator(s) (EDGs) with on-site and off-site sources through spurious circuit breaker operations

Note: PWROG Rev. 1 (6/5/09) Scenario No. 49

48.1. Description:

Non-synchronous paralleling of emergency diesel generator(s) (EDGs) with on-site and off-site sources through spurious circuit breaker operations.

48.2. Notes:

- Non-synchronous paralleling of EDG with on-site and off-site sources through spurious breaker operations

48.3. WBN Unit 2 Safe Shutdown Compliance:

48.3.1. The EDG breaker cannot be closed spuriously to parallel a running DG with offsite power for the credited boards for all fires zones. Cables associated with the EDG breaker CLOSE circuit that can spuriously close the breaker are routed outside all fires zones that credit the associated board. Also, the EDG breaker cannot be closed spuriously to a dead DG for credited boards for all fires zones due to internal board interlocks not subject to external cabling.

48.3.2. Unit 2 compliance strategy is the same as Unit 1.

49.0 PWROG Scenario 49: Other Scenarios - Spurious isolation of various combinations of pump(s) suction valve(s)

Note: PWROG Rev. 1 (6/5/09) Scenario No. 50

49.1. Description:

Note: Spurious operation of powered (i.e., MOVs, AOVs, SOVs) pump(s) suction valve(s) is most likely already included in the PRA logic and the safe shutdown cable analysis.

49.2. Notes:

- Suction flow paths for all credited pumps should be reviewed for MSO scenarios causing loss of suction and pump failure. An example of a pump suction MSO was previously identified in which both the VCT outlet valve(s) and RWST outlet valve(s) spuriously close.

- Another example involves pump suction cross-connect valves. Three pumps may be supplied from a common suction header that includes several cross connect valves. If two valves spuriously isolate, the pump drawing suction from the common header between the two isolated valves can lose suction and fail.

- The spurious operation of idle pumps after suction has been spuriously isolated should also be considered. Spurious pump starting can occur for several reasons, including fire damage to control circuitry or an inadvertent ESFAS signal.

49.3. WBN Unit 2 Safe Shutdown Compliance:

49.3.1. The primary pumps including associated suction and cross-connect valves that should be evaluated are the CCPs, CCS Pumps, and TDAFW/MDAFW Pumps, and ERCW Pumps. The CCPs are addressed in scenarios 10 (1, 3, 11, 12); the CCS pumps are addressed in scenarios 39, 42; the ERCW Pumps are addressed in scenario 42, and TDAFW/MDAFW are addressed in scenarios 26, 28, 31.

49.3.2. Unit 2 compliance strategy is the same as Unit 1.

50.0 PWROG Scenario 50: Other Scenarios - Spurious isolation of various combinations of pump(s) discharge valve(s)

Note: PWROG Rev. 1 (6/5/09) Scenario No. 51

50.1. Description:

Note: Spurious operation of powered (i.e., MOVs, AOVs, SOVs) pump(s) discharge valve(s) are most likely already included in the PRA logic and the safe shutdown cable analysis.

50.2. Notes:

- Scenario causes pump operation at shutoff head and subsequent inoperability. All credited pumps should be reviewed for this scenario.

- Note that spurious starting of idle pump(s), in combination with isolation of discharge flow and recirculation, may cause inoperability of additional pumps.

Spurious pump starting can occur for several reasons, including fire damage to control circuitry or a spurious ESFAS signal.

50.3. WBN Unit 2 Safe Shutdown Compliance:

50.3.1. The primary pumps including associated discharge and cross-connect valves that should be evaluated are the CCPs, CCS Pumps, ERCW Pumps, and TDAFW/MDAFW Pumps. The CCPs are addressed in scenario 9; the CCS pumps are addressed in scenarios 39, 42; the ERCW Pumps are addressed in scenario 42, and TDAFW/MDAFW are addressed in scenarios 27, 29.

50.3.2. Unit 2 compliance strategy is the same as Unit 1.

51.0 PWROG Scenario 51: Other Scenarios - Pump failure due to spurious closure of discharge valve(s) concurrent with failure to open or spurious closure of required minimum recirculation flow path(s)

Note: PWROG Rev. 1 (6/5/09) Scenario No. 51

51.1. Description:

Spurious isolation of pump discharge flow path

AND

Spurious isolation of recirculation valve(s)

51.2. Notes:

- Scenario causes pump failure. All credited pumps should be reviewed for this scenario.
- Operation at shutoff head can occur, for example, if pump discharge flow spuriously isolates with the recirculation valves closed. Run-out can occur, for example, if the discharge header is at reduced pressure conditions.
- Note that spurious starting of idle pump(s), in combination with isolation of discharge flow and recirculation, may cause failure of additional pumps. Spurious pump starting can occur for several reasons, including fire damage to control circuitry or an inadvertent ESFAS signal.

51.3. WBN Unit 2 Safe Shutdown Compliance:

51.3.1. The primary pumps including associated discharge and recirculation valves that should be evaluated are the CCPs, CCS Pumps, and TDAFW/MDAFW Pumps. The discharge valves for CCPs are addressed in scenario 9;

Containment Spray pump discharge valves are addressed in scenarios 39 & 42; and the auxiliary feedwater pump discharge valves are addressed in scenarios 27 and 29. The CCPs recirculation valves 1-FCV-62-98-A, -99-B are Locked Open. The CCS pumps and the TDAFW/MDAFW recirculation lines contain only normally open manual valves.

51.3.2. RHR pump spurious start concurrent with closure of the recirculation valves is evaluated in the FSSD analysis.

51.3.3. Unit 2 compliance strategy is the same as Unit 1.

51a.0 PWROG Scenario xx: Other Scenarios - Spurious start of high head charging pump(s) concurrent with closing of required minimum flow path valve(s) results in failure of the pump(s)

51a.1 Description:

High head charging pump(s) spuriously starts

AND

Recirculation flow path valve(s) fails to open OR transfers closed

51a.2 Notes:

This scenario results in failure of the high head charging pump(s).

51a.3 WBN Unit 2 Safe Shutdown Compliance:

51a.3.1 The centrifugal charging pump recirculation valves, 2-FCV-62-98-A and -99-B are open with power removed.

51a.3.2 Overheating of the charging pump suction due to loss of component cooling system (CCS) flow to the seal water return heat exchanger has been addressed in the FSSD analysis.

51a.3.3 Loss of suction to the CCP has been reviewed and determined that one CCP will always survive considering multiple spurious of either VCT suction valve , loss of either RWST suction valves, loss of or multiple spurious start of CCPs, spurious SI, and loss of CCP HVAC. For AV-106, fire on the RWST suction valves, VCT must be isolated and RWST established by opening either suction valve within 70 minutes.

51a.3.4 Unit 2 compliance strategy is the same as Unit 1.

51b.0 PWROG Scenario 51b: Other Scenarios - Spurious start of high pressure safety injection pump(s) concurrent with closing of required minimum flow path valve(s) results in failure of the pump(s)

51b.1 Description:

High pressure safety injection pump(s) spuriously starts

AND

Recirculation flow path valve(s) fails to open OR transfers closed

51b.2 Notes:

This scenario results in failure of the high head injection pump(s).

51b.3 WBN Unit 2 Safe Shutdown Compliance:

51b.3.1 The safety injection pumps are intermediate head injection pumps and are not actively credited in the FSSD analysis. The FSSD analysis ensures that the pumps are stopped prior to decreasing RCS pressure below the SI pump injection pressure (60 minutes).

51b.3.2 Unit 2 compliance strategy is the same as Unit 1.

51c.0 PWROG Scenario 51c: Other Scenarios - Spurious operation of residual heat removal (RHR) shutdown cooling (SDC) / low pressure safety injection pump(s) concurrent with failure of associated minimum flow path valve(s) to open results in failure of the pump(s)

51c.1 Description:

Residual heat removal (RHR) / shutdown cooling (SDC) / low pressure safety injection pump(s) spuriously starts

AND

Recirculation flow path valve(s) fails to open OR transfers closed

51c.2 Notes:

None

51c.3 WBN Unit 2 Safe Shutdown Compliance:

51c.3.1 RHR pump spurious start concurrent with closure of the recirculation valves is evaluated in the FSSD analysis.

51c.3.2 Unit 2 compliance strategy is the same as Unit 1.

52.0 PWROG Scenario 52: Other Scenarios - Loss of credited heating, ventilation and air conditioning (HVAC) to component(s)

Note: PWROG Rev. 1 (6/5/09) Scenario No. 54

52.1. Description:

Spurious isolation of HVAC to credited loads

52.2. Notes:

- Perform review to identify spurious failures that could cause isolation of HVAC to credited loads. Credited loads may include pump rooms, switchgear rooms and rooms containing solid state control systems. Examples of spurious failures include spurious damper isolation and spurious isolation of cooling flow to chillers.

- One should expect to find disconnects between PRA and safe shutdown success criteria with respect to HVAC requirements. While one might expect to find instances where the safe shutdown analysis requires HVAC and the PRA does not (i.e., where the safe shutdown analysis is more conservative), we have encountered at least one instance where the opposite was true (i.e., the PRA was more conservative and required pump room HVAC that the safe shutdown analysis did not require).

52.3. WBN Unit 2 Safe Shutdown Compliance:

52.3.1. The HVAC systems (including ERCW supply, temperature control valves and dampers) listed below are included in the FSSD analysis to ensure adequate cooling for credited equipment for each fire scenario:

Lower Compartment coolers

Control Rod Drive Mechanism coolers

Main Control Room coolers

RHR Pump Room coolers

Centrifugal Charging Pump Room coolers

TDAFW Pump Room Exhaust Fan

CCS & MDAFW area coolers

Diesel Generator Building exhaust fans

Shutdown Board Transformer Rm exhaust fans

52.3.2. Unit 2 compliance strategy is the same as Unit 1.

53.0 PWROG Scenario 53: Other Scenarios - Spurious motor operated valve (MOV) operation concurrent with fire-induced failure of torque and / or limit switches

Note: PWROG Rev. 1 (6/5/09) Scenario No. 55

53.1. Description:

Spurious motor-operated valve operation

AND

Wire-to-wire short(s) bypass torque and limit switches

53.2. Notes:

- General scenario is that fire damage to motor-operated valve circuitry causes spurious operation. If the same fire causes wire-to-wire short(s) such that the valve torque and limit switches are bypassed, then the valve motor may stall at the end of the valve cycle. This can cause excess current in the valve motor windings as well as valve mechanical damage. This mechanical damage may be sufficient to prevent manual operation of the valve.

- This scenario only applies to motor-operated valves.

- This generic issue may have already been addressed during disposition of NRC Information Notice 92-18. This disposition should be reviewed in the context of multiple spurious operations and multiple hot shorts.

53.3. WBN Unit 2 Safe Shutdown Compliance:

53.3.1. WBN's standard MOV control circuit design provides full compliance with IN 92-18. Damage from a control building fire cannot bypass the valve end of travel limit/torque switch.

53.3.2. Resolution: For all MOV's required to be manually operated to achieve safe shutdown following a fire outside the control building, perform a review to ensure that, if the limit/torque switch could be bypassed, the MOV motor torque will not damage the valve operator such that the valve cannot be manually operated.

53.3.3. WBN Unit 1 identified this condition in PER 227808.

53.3.4. Unit 2 compliance strategy is the same as Unit 1.

54.0 PWROG Scenario 54: Other Scenarios - Spurious engineered safeguards actuation signal (ESFAS)

Note: PWROG Rev. 1 (6/5/09) Scenario No. 56

54.1. Description:

Fire induced spurious ESFAS signal

54.2. Notes:

- Fire-induced spurious ESFAS signals (e.g., safety injection, containment isolation, etc), combined with other fire-induced failures, can adversely affect safe shutdown capability. An example of a fire-induced ESFAS signal is a fire causing open circuits on 2/4 main steam pressure instruments on one loop resulting in a spurious safety injection signal. ESFAS signals can result from open circuits, shorts to ground, and/or hot shorts. Fire-induced failure of instrument inverters may also cause spurious ESFAS signals. The plant should perform a systematic review to assess the potential for fire-induced spurious ESFAS to adversely affect safe shutdown capability. Some examples are shown in PWR Owners Group scenarios 51a, 54b, 54c, 54d and 54e.

54.3. WBN Unit 2 Safe Shutdown Compliance:

54.3.1. Based on the baseline FSSD design changes have been issued to provide adequate physical separation between redundant sensing instruments and cables such that fire damage cannot cause a spurious engineering safeguards actuation signal (ESFAS) except for a control building fire. The control building is an alternative shutdown area. For control building fires the control room will be abandoned and safe shutdown achieved from the backup control stations.

54.3.2. Unit 2 compliance strategy is the same as Unit 1 except that Unit 1 credits operator manual actions to mitigate the effects of fire induced spurious ESFAS actuation signals for a few AVs.

54a.0 PWROG Scenario 54a: Other Scenarios - Spurious start of makeup / injection pump(s) due to a spurious safety injection signal with concurrent spurious isolation of pump suction valve(s)

Note: PWROG Rev. 1 (6/5/09) Scenario No. 56a

54a.1 Description:

Spurious safety injection signal

AND

Spurious isolation of makeup pump suction

54a.2 Notes:

Safety injection signal starts multiple RCS makeup pumps. Fire causes makeup pump suction valves to fail closed. Scenario results in cavitation / inoperability of multiple RCS makeup pumps.

54a.3 WBN Unit 2 Safe Shutdown Compliance:

54a.3.1 Based on the baseline FSSD design changes have been issued to provide adequate physical separation between redundant sensing instruments and cables such that fire damage cannot cause a spurious engineering safeguards actuation signal (ESFAS) except for a control building fire. The control building is an alternative shutdown area. For control building fires the control room will be abandoned and safe shutdown achieved from the backup control stations.

54a.3.2 Unit 2 compliance strategy is the same as Unit 1 except that Unit 1 credits operator manual actions to mitigate the effects of fire induced spurious ESFAS actuation signals for a few AVs.

54b.0 PWROG Scenario 54b: Other Scenarios - Spurious isolation of reactor coolant pump(s) thermal barrier cooling due to a spurious containment isolation signal with a concurrent isolation of seal injection

Note: PWROG Rev. 1 (6/5/09) Scenario No. 56c (similar)

54b.1 Description:

Spurious containment isolation signal isolates component cooling water (CCW) to the thermal barrier heat exchangers for all reactor coolant pumps (RCPs)

AND

Spurious isolation of seal injection header flow

54b.2 Notes:

Scenario causes loss of all RCP seal cooling and subsequent RCP Seal LOCA.

54b.3 WBN Unit 2 Safe Shutdown Compliance:

54b.3.1 Based on the baseline FSSD design changes have been issued to provide adequate physical separation between redundant sensing instruments and cables such that fire damage cannot cause a spurious engineering safeguards actuation signal (ESFAS) except for a control building fire. The control building is an alternative shutdown area. For control building fires the control room will be abandoned and safe shutdown achieved from the backup control stations.

54b.3.2 Unit 2 compliance strategy is the same as Unit 1 except that Unit 1 credits operator manual actions to mitigate the effects of fire induced spurious ESFAS actuation signals for a few AVs.

54c.0 PWROG Scenario 54c: Other Scenarios - Spurious isolation of reactor coolant pump(s) thermal barrier cooling due to a spurious containment isolation signal with a concurrent isolation of charging

Note: PWROG Rev. 1 (6/5/09) Scenario No. 56c

54c.1 Description:

Spurious containment isolation signal isolates CCW to the thermal barrier heat exchangers for all RCPs

AND

Spurious opening of charging injection valve(s) causing insufficient flow to seals

54c.2 Notes:

Scenario causes loss of all RCP seal cooling and subsequent RCP Seal LOCA.

54c.3 WBN Unit 2 Safe Shutdown Compliance:

54c.3.1 Based on the baseline FSSD design changes have been issued to provide adequate physical separation between redundant sensing instruments and cables such that fire damage cannot cause a spurious engineering safeguards actuation signal (ESFAS) except for a control building fire. The control building is an alternative shutdown area. For control building fires the control room will be abandoned and safe shutdown achieved from the backup control stations.

54c.3.2 Unit 2 compliance strategy is the same as Unit 1 except that Unit 1 credits operator manual actions to mitigate the effects of fire induced spurious ESFAS actuation signals for a few AVs.

54d.0 PWROG Scenario 54d: Other Scenarios - Spurious start of containment spray pump(s) due to a spurious containment spray signal

Note: PWROG Rev. 1 (6/5/09) Scenario No. 56d

54d.1 Description:

Spurious high containment pressure on multiple channels causing spurious containment spray signal

54d.2 Notes:

Scenario causes a pumped RWST drain down via the containment spray pumps and containment spray ring.

54d.3 WBN Unit 2 Safe Shutdown Compliance:

54d.3.1 Based on the baseline FSSD design changes have been issued to provide adequate physical separation between redundant sensing instruments and cables such that fire damage cannot cause a spurious engineering safeguards actuation signal (ESFAS) except for a control building fire. The control building is an alternative shutdown area. For control building fires the control room will be abandoned and safe shutdown achieved from the backup control stations.

54d.3.2 For all AVs except AV-042 and AV-057, either the containment spray pumps can be tripped from the main control room or the containment spray header isolation valves are closed which will prevent RWST drain down via the containment spray ring. For a fire inside the 6.9kv shutdown board room A (AV-042) and B (AV-057), the board is de-energized by tripping the feeder breakers (normal, auxiliary, maintenance) and the EDG within 10 minutes. De-energizing the board stops the containment spray pump.

54d.3.3 Unit 2 compliance strategy is the same as Unit 1 except that Unit 1 credits operator manual actions to mitigate the effects of fire induced spurious ESFAS actuation signals for a few AVs.

54e.0 PWROG Scenario 54e: Other Scenarios - Spurious opening of PORV(s) due to spurious high pressurizer pressure signals on multiple channels

Note: PWROG Rev. 1 (6/5/09) Scenario No. 56e

54e.1 Description:

Spurious high pressurizer pressure on multiple channels causes high pressurizer pressure signal

54e.2 Notes:

Spurious high pressurizer pressure on multiple channels causes high pressurizer pressure signal

54e.3 WBN Unit 2 Safe Shutdown Compliance:

54e.3.1 Spurious opening of the PORVs is evaluated in the FSSD analysis. The pressure sensing instrumentation and cables are included in the analysis. For every fire scenario either the PORV or its in-line block valve is credited for maintaining RCS pressure. See scenarios 17 and 18 for additional details.

54e.3.2 Unit 2 compliance strategy is the same as Unit 1.

54f.0 PWROG Scenario 54f: Other Scenarios - Spurious Recirculation Actuation Signal (RAS) starting and aligning pumps to a dry containment sump.

Added on 6/5/09 NEI 00-01 Rev 2 list (Item 56f)

54f.1 Description:

Spurious Recirculation Actuation Signal (RAS) starting and aligning pumps to a dry containment sump.

54f.2 Notes:

- None

54f.3 WBN Unit 2 Safe Shutdown Compliance:

54f.3.1 WBN design, upon a high containment sump level, in conjunction with a low RWST level and SI signal, will initiate closure of the RHR pump suction valve and open the containment sump valves (concurrently). There are no AVs where a high containment sump level will occur. In addition, a Unit 2 spurious SI signal can only occur with a fire in the Control Building. For a control building fire the containment sump level and RHR pump suction valves will be transferred to and controlled from the backup control stations.

54f.3.2 There are no AVs where a spurious start of RHR pump occurs concurrently with a spurious closure of the respective suction valve (2-FCV-74-3-A, -21-B). The common suction valve from the RWST (2-FCV-63-1) is open with power removed.

54f.3.3 Unit 2 compliance strategy is the same as Unit 1 except that Unit 1 credits operator manual actions to mitigate the effects of fire induced spurious ESFAS actuation signals for a few AVs.

Appendix B
UNIT 2 RESOLUTIONS

MSO#	Resolutions	Comment
5	Resolution Control Air header isolation valves to Reactor Building (2-FCV-32-80-A, -102-B) be added to FSSD ANALYSIS. Close these valves from MCR upon failure of No. 1 leakoff valves. Add leakoff valves to analysis and isolate control air header (via control room action) for fire zones where spurious closure of seal leak off valves is possible.	Unit 1 PER 227833
13a	Verify that CCP operation during the large break LOCA analysis bounds CCP operation for scenario 13a. This is being confirmed for WBN Unit 1 and the result will be applicable to Unit 2 as well. Confirmation will be completed prior to Unit 2 fuel load.	
22	Based on the baseline FSSD the following design change has been issued. A third "C" solenoid opposite train from the existing "A & B" solenoid valves is being added to the Unit 2 design. It is located in a separate fire zone and its cables are routed separately from the "A & B" solenoid valves for each PORV.	Previously identified design change
26	For AV-038 fire damage to the following cables could spuriously isolate the steam supply to the TDAFW pump. Resolution: relocate cables 2V2635B, 2V2633B, 2V2623A, 2V1831A, 2PV83A, 2V1832A, 2V1833A, 2V2625A, 2V2621A out of AV-038.	
26a	Resolution: Add evaluation of non-credited TDAFWP steam supply isolation to the FSSD analysis.	Unit 1 PER 227804
32	Resolution: Add steam generator overfill scenario to FSSD to document compliance.	
32	Based on the baseline FSSD analysis a design change has been issued to modify the bypass feedwater line isolation and regulating valve control circuits to ensure line isolation for all postulated fire locations.	Previously identified design change
46	6.9kv SDBD 2A-A; AV-37C -- The following interactions exist:SI pump 2-MTR-63-10-A cable 2PP603A – control cable to MCR. EDCR 54636 is rerouting out of these fire zones.CS pump 2-MTR-72-27-A cable 2PP628A – control cable to MCR. EDCR 54636 is rerouting out of these fire zones.RHR pump 2-MTR-74-10-A cable 2PP578A – control cable to MCR. EDCR 54636 is rerouting out of these fire zones.Pzr Htr 2-HTR-68-341F/D1-D6 cable 2PP862 – control cable to MCR. Currently MOA 1296 turns off the htr at the SDBD.SDBR Chiller A-A 0-MTR-31-36/2-A cable 2PL5133A – load shed cable to LVSGAB Gen Sup Fan 2A 2-MTR-30-104 cable 2PL5145 – control cable to MCR. The resolution is to reroute or protect cables 2PL5133A and 2PL5145 in these fire zones (AV-037C).	Unit 1 PER 227839

MSO#	Resolutions	Comment
46	6.9kv SDBD 2A-A; AV-072--The following interactions exist: SFP pump A-A 0-MTR-78-12-A cable 2PL4896A – load shed cable to LVSG CCS pump 2-MTR-70-59-A cable 2PL4729A – load shed cable to LVSG The resolution is to either reroute out of the fire zones or protect with fire wrap cables 2PL4896A and 2PL4729A	Unit 1 PER227839
46	6.9kv SDBD 2A-A; AV-045--The only interaction in this zone is AB Gen Supply Fan 2A, 2-MTR-30-104; cable 2PL5147 which is the load shed cable to the LVSG. This load is 100 HP and the EDG has the capacity to add this load. The resolution is to formally include this load in calculation WBPEVAR9503001.	Unit 1 PER227839
46	6-9kv SDBD 2A-A; AV-057 -- The only interaction in this zone is AB Gen Supply Fan 2A, 2-MTR-30-104; cable 2PL5145 which is the MCR control cable to the LVSG and 2PL5147 which is the load shed cable to the LVSG. This load is 100 HP and the EDG has the capacity to add this load. The resolution is to formally include this load in calculation WBPEVAR9503001.	Unit 1 PER227839
53	Resolution: For all MOV's required to be manually operated to achieve safe shutdown following a fire outside the control building, perform a review to ensure that, if the limit/torque switch could be bypassed, the MOV motor torque will not damage the valve operator such that the valve cannot be manually operated.	Unit 1 PER 227808
54 54a 54b 54c 54d	Based on the baseline FSSD design changes have been issued to provide adequate physical separation between redundant sensing instruments and cables such that fire damage cannot cause a spurious engineering safeguards actuation signal (ESFAS) except for a control building fire. The control building is an alternative shutdown area. For control building fires the control room will be abandoned and safe shutdown achieved from the backup control stations.	Previously identified design change

Appendix C
UNIT 1/COMMON RESOLUTIONS

MSO#	Resolutions	Comment
15 15a 36	The diesel kill switches on both 0-M-26 and 0-L-4 are cabled thru and selected from the associated board rooms and as such cannot assure functionality. The resolution is to add a switch to L-11A and/or L-11B that would select between main control room and auxiliary control room and would be powered from a 125V Vital Battery Board feed whose cable would not be routed in the board room. Associated cables to the MCR and DG building would be routed outside the board room. This is required for each of the four EDGs.	Unit 1 PER 227839
46	6.9kv SDBD 1B-B; AV-036 -- The following interactions exist: SI pump 1-MTR-63-15-B cable 1PP615B – control cable to MCR and 1PP617B to 1-R-51. (cable 1PP614B deleted by DCN 54912). Spurious start resolved by tripping the pump within 60 minutes Pzr Htr 1-HTR-68-341H/C1-C6 cable 1PP842 – control cable to MCR SF Pit pump 0-MTR-78-9-B cable 1PL4896B – load shed to LVSG Cont & Ser Air Comp B 0-MTR-32-26 cable 1PL5092 – load shed to LVSG SDBD Rm Chil pkg 0-MTR-31-49/2-B cable 1PL5204B – load shed to LVSG and 1PL5201B to MCR. AB Gen Exhaust fan 1B 1-MTR-30-162 cable 1PL5175 -control cable to MCR AB Gen Sup fan 1B 1-MTR-30-102 cable 1PL5167 – load shed to LVSG and 1PL5165 to MCR The resolution is to either reroute or fire wrap cables 1PP842, 1PL4896B, 1PL5092, 1PL5204B, 1PL5201B, 1PL5175, 1PL5165, and 1PL5167.	Unit 1 PER 227839
46	6.9kv SDBD 1B-B; AV-042 -- The following interactions exist: SF Pit pump 0-MTR-78-9-B cable 1PL4896B – load shed to LVSG Cont & Ser Air Comp B 0-MTR-32-26 cable 1PL5092 – load shed to LVSG SDBD Rm Chil pkg 0-MTR-31-49/2-B cable 1PL5204B – load shed to LVSG and 1PL5201B to MCR. AB Gen Exhaust fan 1B 1-MTR-30-162 cable 1PL5175 -control cable to MCR and 1PL6010B load shed to LVSG AB Gen Sup fan 1B 1-MTR-30-102 cable 1PL5167 – load shed to LVSG and 1PL5165 to MCR The resolution is to either reroute or fire wrap cables 1PL4896B, 1PL5092, 1PL5204B, 1PL5201B, 1PL5175, 1PL6010B, 1PL5165, and 1PL5167.	Unit 1 PER 227839