6-4-03

INPUT FOR
MCGUIRE FIRE PROTECTION INSPECTION REPORT 2003-007
by
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.03 Post-Fire SSD Circuit Analysis

a. Inspection Scope

The team reviewed the adequacy of separation and fire barriers provided for the power and control cabling of equipment relied on for SSD during a fire in the selected fire areas/zones. On a sample basis, the team reviewed the SSA and the electrical schematics for power and control circuits of SSD components, and looked for the potential effects of open circuits, shorts to ground, and hot shorts. This review focused on the cabling of selected components for the charging/safety injection system, RCS and AFW system. The team traced the routing of cables by using the cable schedule and conduit and tray drawings. Walkdowns were performed to compare cables indicated on the drawings with actual plant installation. Circuit and cable routings were reviewed for the following equipment:

- 0RN4AC, Turbine-driven AFW Suction Supply Valve;
- 2CA0007A, Turbine-driven AFW Isolation Valve
- 2CA009B, Motor-driven AFW Isolation Valve
- 2CFLT6080, 6090, 6100, 6110, Steam Generator Level;
- 2NCLT5151, Pressurizer Level;
- 2NC34A, 33A, Pressurizer Power-operated Relief Valve and Isolation Valve;
- 2NC272AC, 273AC, Reactor Vessel Head Vent Valves;
- 2NVPU0046, Standby Makeup Pump (SMP);
- 2NV94AC, Chemical and Volume Control Containment Isolation Valve;
- 2NV842AC, Chemical and Volume Control Isolation Valve;
- 2NV1012C, Chemical and Volume Control Isolation Valve;
- Pressurizer Heaters #28, #55, #56

The team also reviewed studies of overcurrent protection on both alternating current (AC) and direct current (DC) systems to identify whether fire induced faults could result in defeating the safe shutdown functions.

b. Findings

There were findings associated with the 2CA0007A, 2NC34A and 2NC33A valves, however these are discussed in Section 04.

04. Alternative Post-Fire Safe Shutdown Capability

a. Inspection Scope

The list of components given in the scope of Section 03 were also reviewed in relation to alternative post-fire safe shutdown capability.

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The team reviewed completed surveillances for instruments required during SSS operation to verify that surveillances were being completed in accordance with Selected Licensee Commitments MNS-SLC-16.9.7, Standby Shutdown System.

b. Findings

1. Requirements Relative to the Number of Spurious Operations that Must be Postulated

Introduction: An unresolved item was identified involving the number of concurrent spurious operations associated with a particular component or set of components that must be postulated. Resolution of the unresolved item is pending review by NRC staff.

Description: The licensee's fire protection analysis included the concept that only one spurious operation due to fire damage need be postulated. This concept became evident during review of the pressurizer PORVs. There are three sets of PORV/isolation valves on the pressurizer of each unit. Should operators in the control room become aware of a fire in any area of the plant through a fire alarm or the plant communications system, they would respond by following the instructions in AP-45. Depending on the location of the fire, AP-45 may direct the operator to close the PORV isolation valves within ten minutes. The concept of this time critical action is that spurious opening of the PORV or damage to the isolation valve circuit would not occur in the first ten minutes of a fire being detected. [insert docketed reference here] Then with the block valve closed it would take two spurious operations to breach the RCS pressure boundary, namely one block valve opening and its associated PORV opening. The concept of only one spurious operation need be postulated meant that closing the block valve was sufficient in itself to ensure the desired result. They did not need to take any other action such as de-energizing the isolation valves or the PORVs. This concept is not necessarily in concert with NRC requirements for protection of cables.

The team reviewed the control circuits and cable routing information for valve 2NC34A, pressurizer PORV, and 2NC33A its associated isolation valve. They observed that cables for both the PORV and isolation valve are routed in FA-13, FA-16/18 and FA-24. When the control circuit for the PORV is analyzed and considering that the cables are armored type cables (except in the control room) one can conclude that, for these three fire areas, spurious opening of the PORV could only occur for the fire in FA-24, the control room. Considering this information, the team postulated the following scenario. A fire starts in the control room. Operators close the isolation valves per AP-45 within ten minutes. Later, isolation valve 2NC33A spuriously opens due to a fire induced short-circuit. Operators take no action to counter the spurious opening of the isolation valve because they have no information that it occurred. Subsequently PORV 2NC34A spuriously opens due to a fire induced short-circuit. At this point, it would be possible to close the PORV by opening the appropriate circuit breaker at the 125 VDC distribution panel. This would take time, and it is not covered by the fire response procedure. Before the PORV can be re-closed, the fire has progressed and the decision is made to abandon the control room and shutdown using the SSS. The PORV would now be closed by operating the control room/SSS transfer switch as directed by AP-24. The situation now is that the PORV/isolation valves were opened for a period of time and the RCS is may not be at normal level and pressure. The standby makeup pump has

relatively low capacity and may not have the capacity to maintain hot shutdown in this scenario, and RCS variable parameters may be outside the requirements of Appendix R, i.e. outside the range predicted for a loss of offsite power. For example, an open PORV following a reactor trip could result in pressurizer level lower than that predicted for a trip caused by a loss of offsite power.

Analysis: The team was not certain whether the licensee's analysis of circuits for spurious operation was consistent with the requirements for independence of cables, systems or components in the area under consideration as stipulated by Appendix R, III.G.3 and III.L. In the example of the PORVs described above, if more than one spurious operation would occur, the dedicated shutdown capability (SSS) would not be independent from the control room in that a fire in the control room could result in conditions outside of those specified in III.L. If more than one spurious operation must be considered then there would be a violation of Appendix R requirements having more than minor significance. The equipment reliability objective of the cornerstones of mitigating systems and barrier integrity could be affected.

Enforcement: In the case of the PORV/isolation valve circuits, operation of the SSS may not be independent of the fire area as required by III.G.3 depending on whether more than one spurious operation must be postulated. Review of this matter by the NRC will determine whether a violation has occurred. If a violation has occurred, the significance will be determined. The issue is identified as URI 50-369, 370/03-07-01, Requirements Relative to the Number of Spurious Operations that must be Postulated.

2. Valve 2CA0007A

Introduction: A finding of potentially greater than very low safety significance was identified in that a valve in the auxiliary feedwater system was not included in the safe shutdown analysis and it could spuriously close due to a fire in the main control room. Spurious closure of this valve could damage the turbine driven auxiliary feedwater pump, thus seriously degrading the core residual heat removal function of the safe shutdown system. This is a URI pending completion of the SDP.

Description: Valve 2CA0007A is a motor operated valve in the flow path from the 300,000 gallon auxiliary feedwater storage tank to the turbine driven auxiliary feedwater pump. The valve is open during normal plant operation. 2CA0007A is important to safe shutdown for fire areas where the safe shutdown system (SSS) will be used. The importance is derived from fact that the SSS uses the TDAFW pump for decay heat removal and potential for spurious closure of the valve. The team found that the safe shutdown analysis for Unit 2 did not recognize valve 2CA0007A. It was not listed in Appendix E, list of important equipment, nor Appendix F, list of potential problem cables.

One scenario could be a fire starts in the control room which leads to a plant trip and loss of offsite power. In this case, the TDAFW pump would receive an automatic start from the "LOOP on safety-related bus" logic or possibly "low steam generator level" due to loss of the feedwater pump. Even though the safe shutdown analysis for a fire in the control room ultimately relies on the SSS, operators may remain in the control room if they believe the plant is still under control. The TDAFW pump could be running and

taking suction from the auxiliary feedwater storage tank with flow through 2CA0007A. Since control wires to the open/close control switch for this valve run in the control room (in single-conductor plug cable, bundled in groups of approximately 30 wires), the valve could spuriously close due to fire induced short-circuit between two of the wires. Spurious closure of the valve would shut off all flow through the pump. Assuming that the TDAFW pump is damaged by spurious closure of 2CA0007A and if plant conditions deteriorated due to progressing fire in the control room forcing evacuation and transfer of plant shutdown to the SSS, the ability to remove decay heat would be seriously degraded.

Besides the control room, there are open/close switches for this valve at auxiliary feedwater panel 2A and the auxiliary feedwater turbine control panel (2AFPT). Cable 2*CA517 runs between area terminal cabinet 2ATC2 and the auxiliary feedwater panel 2A, and it runs through fire area FA-4. Cable 2*CA519 runs between area terminal cabinet 2ATC2 and panel 2AFPT, and it runs through fire area FA-4. Cable 2*CA557 contains power and control for the valve, and represents a potential for spurious operation of the valve. Therefore a fire in FA-4 could also result in spurious closure of valve 2CA0007A. This could lead to problems similar to that described above for the control room fire. It is not expected that a fire in FA-4 would lead to a loss of offsite power. However, a problem scenario could be as follows: If the fire becomes severe and the decision is made to use the SSS, procedures direct the operator to trip the normal feedwater pump. This could cause low steam generator level which in turn will auto start the TDAFW pump. If 2CA0007A has already spuriously closed, the pump has no through flow upon starting.

Analysis: The team determined that this finding was associated with the "equipment performance" attribute and affected the objective of the mitigating systems cornerstone to ensure the availability, reliability and capability of systems that respond to initiating events, and is therefore greater than minor. For a severe fire in the control room, the control room would be abandoned and the safe shutdown facility would be used to maintain hot shutdown. The safe shutdown facility relies on the turbine driven auxiliary feedwater pump for the decay heat removal function. With the decay heat removal function seriously degraded and other mitigating systems potentially affected by a severe control room fire or Fire Area FA-4, the finding had a potential safety significance greater than very low.

Enforcement: 10 CFR 50, Appendix R, II.B. requires that a fire hazards analysis shall be performed by qualified fire protection and reactor systems engineers to determine the consequences of fire in any location of the plant on the ability to safely shutdown the reactor. The licensee's analysis designated the control room and FA-4 as dedicated/alternative shutdown areas. Appendix R, III.G.3 requires that the dedicated/alternative shutdown capability and its associated circuits be independent of cables, systems or components in the area under consideration. Contrary to these requirements, valve 2CA0007A was not included in the fire hazards analysis resulting in the dedicated/alternative shutdown system (SSS) not being independent from fire areas FA-24 and FA-4 in that a fire in these areas could result in spurious closure of the valve. This in turn could lead to damage to the turbine driven auxiliary feedwater pump which is an important part of the dedicated/alternative shutdown system. Pending determination

of the safety significance, this finding is identified as URI 50-370/03-07-02, Spurious Closure of Valve 2CA0007A Could Lead to Damage of the TDAFW Pump.

08 Cold Shutdown Repairs

a. Inspection Scope

The team reviewed the licensee's SSA and existing plant procedures to determine if any repairs were necessary to achieve cold shutdown, and if needed, the equipment and procedures required to implement those repairs were available onsite.

b. Findings

No findings of significance were identified.

**List of Inspection Documents Reviewed**

**COMPLETED MAINTENANCE AND SURVEILLANCE TEST PROCEDURES/RECORDS**

Work Order 98410020, PT 2NCLP5151, SSF Pressurizer Level, dated 3/13/02
Work Order 98410021, PT 2NCLP5121 NC Loop D Hot Leg W/R Pressure, dated 3/13/02
Work Order 98410083, PM 2CFLP6110, S/G D W/R Level, dated 2/28/02
Work Order 98410084, PM 2CFLP6100, S/G C W/R Level, dated 3/5/02
Work Order 98410085, PM 2CFLP6090, S/G B W/R Level, dated 3/1/02
Work Order 98410086, PM 2CFLP6080, S/G A W/R Level, dated 2/28/02

**CABLE INSTALLATION DATA FOR THE FOLLOWING COMPONENTS**

2CA0007A,
2CA009B,
2CFLT6080, 6090, 6100, 6110
2NC272AC, 273AC
2NC33A, 35B
2NCLT5151
2NV1012C
2NV842AC
2NV94AC
2NVPU0046
ORN4AC

**ELEMENTARY DIAGRAMS**

MCEE-138-00.02, Turbine-driven AFW Suction Supply Valve, Rev. 5
MCEE-138-00.04, Turbine-driven AFW Suction Supply Valve, Rev. 11
MCEE-138-00-01, Turbine-driven AFW Suction Supply Valve, Rev. 5
MCEE-211-00.52, Pressurizer Heaters, Rev. 2
MCEE-211-00.52-01, Pressurizer Heaters, Rev 9
MCEE-211-00.52-02, Pressurizer Heaters, Rev. 8

MCEE-211-00.52-03, Pressurizer Heaters, Rev. 9
MCEE-211-00.52-04, Pressurizer Heaters, Rev. 4
MCEE-211-00.52-05, Pressurizer Heaters, Rev. 3
MCEE-244-02.01, Steam Generator Level and Pressurizer Level, Rev. 4
MCEE-247-10.00, Motor-driven AFW Isolation Valve, Rev. 0
MCEE-247-20.00, Turbine-driven AFW Isolation Valve, Rev. 0
MCEE-247-20.01, Turbine-driven AFW Isolation Valve, Rev. 0
MCEE-247-32.00, Turbine-driven AFW Isolation Valve, Rev. 1
MCEE-247-33.00, Turbine-driven AFW Isolation Valve, Rev. 0A
MCEE-250-00.03, Pressurizer Power-operated Relief Valve
MCEE-250-00.03-01, Pressurizer Power-operated Relief Valve
MCEE-250-00.06, Pressurizer Power-operated Relief Valve Isolation Valve
MCEE-250-00.24, Unit 2 Chemical and Volume Control Isolation Valve, Rev. 01
MCEE-250-00.28, Reactor Vessel Head Vent Valves, Rev. 6
MCEE-250-00.29, Reactor Vessel Head Vent Valves, Rev. 5
MCEE-250-00.33, Reactor Vessel Head Vent Valves, Rev. 5
MCEE-257.00.54, Chemical and Volume Control Containment Isolation Valve, Rev. 3
MCEE-257-00.24, Chemical and Volume Control Containment Isolation Valve, Rev. 5
MCEE-257-00.50, Unit 2 Chemical and Volume Control Isolation Valve, Rev. 6
MCEE-257-00.52, Chemical and Volume Control Isolation Valve, Rev. 1
MCEE-257-00.55, Standby Makeup Pump, Rev. 1

**FLOW DIAGRAMS**

MCFD-1574-01.00, Nuclear Service Water, Rev. 6
MCFD-1574-01.01, Nuclear Service Water, Rev. 10
MCFD-2574-02.00, Nuclear Service Water, Rev. 12
MCFD-2574-02.01, Nuclear Service Water, Rev. 2
MCFD-2592-01.01, Auxiliary Feedwater System, Rev. 13
MCFD-2592-02.00, Auxiliary Feedwater System, Rev. 2

**CABLE ROUTING DIAGRAMS**

MC-1710-04.08, Battery Room Junction Points El. 747, Rev. 15
MC-1710-04.09, Battery Room Junction Points El. 746, Rev. 23
MC-1710-04.10, Battery Room Junction Points El. 745, Rev. 20
MC-1710-04.11, Battery Room Junction Points El. 744, Rev. 24
MC-1710-04.12, Battery Room Junction Points El. 743, Rev. 22
MC-1710-04.13, Battery Room Junction Points El. 742, Rev. 24
MC-1710-04.14, Battery Room Junction Points El. 741, Rev. 23
MC-1710-04.15, Battery Room Junction Points El. 740, Rev. 23
MC-2901-01.01, Auxiliary Building Plan Below El. 733'+0, Rev. 44
MC-2907-01.01, Penetration and Switchgear Rooms Plan Below El. 776'+0, Rev. 25

**CORRECTIVE ACTION ITEMS (PIPs) GENERATED DURING THE INSPECTION**

M-03-02084, Request for determination if there are any fire scenarios that could cause a total loss of suction to the Unit 2 TDCA pump for SSF designated areas.

M-03-02086, Determine difference between AP-24 action and App. R DBD position
M-03-02091, Unit 1 and Unit 2 HVAC areas do not have fire detectors.
M-03-02092, Discrepancies between the control drawings and the fire plans.
M-03-02093, MC-1384-07-15-01 does not appear to show the floor ceiling of Room 805A as a fire boundary.
M-03-02106, NRC plant walkdown showed B train cables in A SWGR room F/A which are not previously identified.
M-03-02115, The App. R logic diagrams were not updated when the NSM for the 300k CA tank was added.
M-03-02118, App. R logics for auxiliary feedwater do not show 2CA7.
M-03-02249, Detector Zones 203 and 204 are not listed in SLC 16.9.6, Table 16.9.6-1.
M-03-02275, Calculation MCC 1223.48-00-0030 in support of sprinkler system design over Nuclear Service Water Pumps needs revising.
M-03-02294, SLC Table 16.9.7.1 appears to be missing some information.

**OTHER DOCUMENTS**

MNS-SLC-16.9.7, Standby Shutdown System, Rev. 25 (Selected Licensee Commitments)

**CALCULATIONS**

MCC-1223.42-00-0030, Documentation of the Adequacy of the Assured Suction Sources to the CA Pumps, Rev. 8
MCC-1223.04-00-0010, Determine the Reactor Coolant Pump Sealwater Flow Requirements for the SSF Auxiliary Makeup Pump, Type II

**CORRECTIVE ACTION ITEMS (PIPs) REVIEWED DURING THE INSPECTION**

M-97-03311, All three CA pumps may have been dead headed during the Unit 1 reactor trip recovery
M-02-05031, RO closed 1CA-2 (Unit 1 CA pumps suction from CA storage tank iso.) due to incorrectly performing conflicting procedures concurrently. This resulted in temporary low suction flow to the running "1B" CA motor driven pump during the performance of EFS testing
M-02-05096, Important information on system problem [PIP M-02-05031] was not documented for proper resolution
M-00-01900, Unit 1 CA pumps normal suction sources were inadvertently isolated following a reactor trip and automatically aligned to RN
M-99-03926, Per CNS PIP C99-0606, the effect of warmer seal injection water on the RCP seals during an SSF event was not adequately taken into consideration on Standby Makeup Pump capacity. The same issue may apply to McGuire
M-02-01708, It has been discovered that pressurizer ambient heat losses are greater than calculated in OSC-3144 impacting SSF ASW system operability (TS 3.10.1 and TS 3.4.9)
M-02-03214, Engineering review of SSS DBD and NC DBD identified errors related to the pressurizer heater requirements
M-00-04516, The heater capacity of the SSF may not be adequate due to the increase in leakage from the safety valve
M-00-04491, NRC Appendix R inspection in certain fire areas determined the potential for NC PORV and block valve actuation. We need to evaluate this cabling as to "if" this will occur. If

this can occur, this needs to be evaluated for compliance with APP R

**PROCEDURES**

PT/1/A/4150/001B, Reactor Coolant Leakage Calculation, Rev 47