This document analyzes the questions posed by the NRC in the inspection report that resulted from NRC Triennial Fire Protection Inspection 2003-007.

The NRC Inspection Report states in part, "Appendix R, Section III.G.1 of 10 CFR Part 50, requires that one train of systems needed to achieve and maintain hot shutdown conditions must be free of fire damage. Section III.G.2 states that cables or equipment, including associated nonsafety-related circuits that could prevent operation or cause mal-operation due to fire damage of redundant trains of systems necessary to achieve and maintain hot shutdown conditions must be protected. The Callaway Updated Final Safety Analysis Report allows either "free of fire damage, or a diverse means will be provided." The team identified some associated circuit issues that are neither protected from fire damage nor provided with a diverse means of providing the function. Specific examples of equipment or associated cables located within the fire areas reviewed by the team that could affect the safe shutdown process included:

Fire Area A-21 -possible loss-of-seal water injection capability to any one of the four reactor coolant pumps, which could lead to seal failure; and inability to isolate anyone of the four main steam isolation valves or main feedwater isolation valves, which could lead to overcooling of the reactor coolant system.

Fire Area A-18 - loss of thermal barrier cooling to any one of four reactor coolant pumps, which could lead to seal failure; spurious opening of a pressurizer spray valve or the pressurizer auxiliary spray valve, which could lead to uncontrolled depressurization and overfilling of the reactor coolant system; spurious opening of a containment emergency recirculation sump isolation valve that could divert water from the refueling water storage tank to the containment sump and make it unavailable for coolant inventory control; spurious opening of a reactor head vent flow path, causing a loss-of-coolant and uncontrolled depressurization; and spurious closing of either steam admission valves to the turbine driven auxiliary feedwater pump, making it unavailable for decay heat removal.

Are Area C-9 - spurious closure of a volume control tank outlet valve, causing a loss of charging, affecting reactor coolant inventory control and reactor coolant pump seal cooling

The NRC report goes on to state, "This finding is unresolved pending additional action by the NRC." The enforcement section of the report states, "Failure to either protect these associated circuits from spurious operation or otherwise prevent them from affecting safe shutdown is an apparent violation of Appendix R, Section II.G.2. In accordance with the NRC Enforcement Manual, Section 8.1.7 .1.a, this apparent violation will be treated as an unresolved item pending development of an industry method to resolve these types of issues; Unresolved Item 05000483/2003-007-01, Failure to Protect Associated Circuits. The determination of the safety significance and disposition of this apparent violation will be performed after the NRC develops additional guidance for addressing associated circuit issues."

E-1

This analysis uses the guidance of RIS 2004-03, specifically, that "intra-cable shorting is the most probable cause of spurious actuations." Where intra-cable shorting is defined as conductor-to conductor shorts within a multi-conductor cable. Callaway uses thermoset cables in the power block and considers cable to cable to shorting not probable per the guidance of RIS 2004-03.

Each of these items is addressed in detail below. This analysis was prepared by Mike Yungbluth, Electrical Design Engineer, and was reviewed by Rich McCann, Electrical Consulting Systems Engineer. Input was also provided by other site experts.

NRC Concern: A fire in area A-21 could cause a loss of seal water injection capability to any of the four reactor coolant pumps, which could lead to seal failure. Okay

Component Identification: BBHV8351A, BBHV8351B, BBHV8351C, BBHV8351D,

Fire Area: A-21

Drawing References: M-22BB03, E-23BB04, E-23BB04A, M-22BB03A

Cables: 4BBG04AA/B/C, 4BBG04BA/B/C, 4BBG04CA/B/C, 4BBG04DA/B/C,

Normal Valve Position: OPEN

Analysis:
Valves BBHV8351A, BBHV8351B, BBHV8351C and BBHV8351D are identified as safe shutdown components and therefore are not considered "associated circuits."

Cables for the RCP seal water supply isolation valves, BBHV8351A, BBHV8351B, BBHV8351C, and BBHV8351D all exist in fire area A-21.

Appendix 5.4A of the FSAR, Safe Shutdown, states that Boron will be added through one of two diverse flow paths in the charging system. One of these is the reactor coolant pump seals and the other is the boron injection path. In the case of spurious operation of valve BBHV8351A, BBHV8351B, BBHV8351C or BBHV8351D, the boron injection path will be utilized to deliver a controlled flow of borated water.

Per Appendix 5.4A, the reactor coolant pump seals require cooling by either seal injection or component cooling water during hot standby. During spurious operation of valve BBHV8351A, BBHV8351B, BBHV8351C or BBHV8351D, component cooling water will be utilized to cool the reactor coolant pump seals.

During a fire in area A-21, separation group one component cooling water components will be used for reactor coolant pump thermal barrier seal cooling during safe shutdown. Separation group one valve cables for this flow path do not exist in fire area A-21.

Were unaware until JRI issued

NRC Concern: A fire in area A-21 could cause an inability to isolate any one of the four main steam isolation valves which could lead to overcooling of the reactor coolant system.

Component Identification: ABHV0011, ABHV0014, ABHV0017, ABHV0020

Fire Area: A-21

Drawing References: M-22AB02, M-22AB03, M-628-00019, E-23AB26, E-23AB27, E-23AB28, E-23AB29, J-1065-00004, J-1065-00005, J-1065-00008, J-1065-00009,

Cables: 4ABK27AC, 4ABK27AK, 4ABK27BC, 4ABK27BK, 4ABK28AB, 4ABK28AC, 4ABK28AH, 4ABK28AJ, 4ABK28BB, 4ABK28BC, 4ABK28BH, 4ABK28BJ, 4ABK29AC, 4ABK29AG, 4ABK29AH, 4ABK29BC, 4ABK29BG, 4ABK29BH

Normal Valve Position: Open

Analysis:
Separation group 4 cables for the main steam isolation valves (MSIV) are routed through fire area A-21. Each MSIV has an active side and a stand-by side. Cables for the active side of valves ABHV0011 and ABHV0017 are routed through fire area A-21. Cables for the stand-by side of valves ABHV0014 and ABHV0020 are routed through fire area A-21. If a fire in area A-21 were to cause spurious opening of ABHV0011 or ABHV0017, the fast close feature of the stand-by side, which does not have cabling in area A-21, would be utilized to close the valves. If a fire in area A-21 were to cause spurious opening of ABHV0014 or ABHV0020, the fast close feature of the active side, which does not have cabling in area A-21, would be utilized to close the valves. This design ensures that Callaway can safely isolate all of the main steam isolation valves if there is a fire in area A-21.

- What fire areas are SB side of 0011 & 0017
active side of 0014 & 0020

Area #5
A-23
Each Valve
Sep 1 & Sep 4
w/in Cubicles
MSIVs

NRC Concern: A fire in area A-21 could cause an inability to isolate any one of the main feedwater isolation valves, which could lead to overcooling of the reactor coolant system.

Component Identification: AEFV0039, AEFV0040, AEFV0041, AEFV0042

Fire Area: A-21 okay

Drawing References: M-22AE02, M-630-00095, E-23AE13, E-23AE16, E-23AE17

Cables: 4AEK16AB, 4AEK16AC, 4AEK16AH, 4AEK16BB, 4AEK16BC, 4AEK16BH

Normal Valve Position: Open

Analysis:
Each feedwater isolation valve can be actuated by one of two trains. In the case of a fire in area A-21 causing damage to separation group 4 cables, the separation group 1 cables which do not exist in area A-21, would be used to close the main feedwater isolation valves.

What area are the MFIV, MSIV & RCP Seal

NRC Concern: A fire in area A-18 could cause a loss of thermal barrier cooling to any one of the four reactor coolant pumps, which could lead to seal failure.

Component Identification: BBHV0013, BBHV0014, BBHV0015, BBHV0016

Fire Area: A-18 okay

Drawing References: M-22BB03A, E-23BB03

Cables: 1BBG03AA, 1BBG03AB, 1BBG03BA, 1BBG03BB, 1BBG03CA, 1BBG03CB, 1BBG03DA, 1BBG03DB

Normal Valve Position: Open

Analysis:
A fire in area A-18 will not cause valve BBHV0013, BBHV0014, BBHV0015, or BBHV0016 to operate. Refer to drawing E-23BB03. The following cables are routed through fire area A-18: the phase wires for the motor (A, B, C), X1, 2, 1, 21, 3G, 3R. A short in these cables could cause the limit switch to be bypassed. However, it is not possible for power to be directly shorted to coil 42 O or 42 C during a fire in area A-18 since the coil conductors are not in this fire area. The hand switch contacts and the 42 auxiliary contacts are not in fire area A-18. The cabling between these contacts and the 42 O and C coils are not in A-18.

Per Appendix 5.4A of the FSAR, the reactor coolant pump seals require cooling by either seal injection or component cooling water during hot standby. In the case of inadvertent operator action closing valve BBHV0013, BBHV0014, BBHV0015, or BHV0016, seal injection via the charging pumps will be utilized to cool the reactor coolant pump seals.

Per FSAR Appendix section 5.4A.3 the reactor coolant pumps are not required for safe shutdown due to natural circulation.

Manual action?

SSD Path

NRC Concern: A fire in area A-18 could cause a spurious opening of a pressurizer spray valve or the pressurizer auxiliary spray valve, which could lead to uncontrolled depressurization and overfilling of the reactor coolant system.

Component Identification: BBPCV0455B, BBPCV0455C, BGHV8145

Fire Area: A-18

Drawing References: M-22BB02, M-22BB01, M-22BG01, E-23BG19, E-23BB19, 8756D37 S027, 54A0202

Cables: 5BBI19AA, 5BBI19BA, 5BGK19AA

Normal Valve Position: Closed

Analysis:
The pressurizer spray valve, the pressurizer auxiliary spray valve, and their associated cables are not listed as safe shutdown components.

The pressurizer spray valves, BBPCV0455B and BBPCV0455C, are air-operated valves with reverse acting operators. A 4 mA control signal will cause the valves to close. If the 5BBI19AA and 5BBI19BA control cables for valves BBPCV0455B and BBPCV0455C which are routed through fire area A-18 are subjected to fire, the valve would be subjected to zero voltage in the case of a short or an open and would cause the valve to close.

During shut down, the reactor coolant pumps are not operating. Since the source of water for pressurizer spray is the cold leg of reactor coolant pumps A and B, there would be inadequate pressure to cause significant flow to the pressurizer spray valves. The auxiliary spray valves use the charging pumps as its source.

Refer to drawing E-23BG19. The cable for the auxiliary spray valve, BGHV8145, that transits through fire area A-18 is 5BGK19AA. The conductors of cable 5BGK19AA that exist in fire area A-18 are 2, N2, 3G and 3R. If a short were to occur between wire 2 and either 3R or 3G the indicating lamps and the valve would be essentially connected in series. A degraded voltage condition would exist that would not be sufficient to operate the solenoid valve. The indicator lamps utilize a 120PSB incandescent bulb with a filament resistance of 4800 ohms. The coil resistance of the valve is approximately 691 ohms. In this situation, the valve, which normally operates on 125 VDC would be subjected to less than 16 volts. This voltage is well below the threshold of 90 volts required to operate the valve.

The conductor on the positive side of the hand switch for BGHV8145 does not exist in fire area A-18 and therefore cannot cause the valve to energize during a fire in area A-18.

A fire in area A-18 affecting cables for the pressurizer spray valve or the pressurizer auxiliary spray valve would not lead to uncontrolled depressurization and overfilling of the reactor coolant system.

NRC Concern: A fire in area A-18 could cause a spurious opening of a containment emergency recirculation sump isolation valve that could divert water from the refueling water storage tank to the containment sump and make it unavailable for coolant inventory control.

Component Identification: EJHV8811A

Fire Area: A-18 See LER 206-001-01

Drawing References: M-22EJ01, M-22BN01, E-23EJ06A

Cables: 1EJG06AC/D/F/G/J/K

Normal Valve Position: Closed

Analysis:
Valve EJHV8811A is normally closed and valve BNHV8812A is normally open. These valves supply a suction source of water to the RHR pump. A fire in area A-18 affecting cables 1EJG06AC or 1EJG06AG could cause EJHV8811A to spuriously open. The control operator response to the off normal spurious operation would be to close BNHV8812A which would terminate the RWST drain down to the containment sump. Cables for BNHV8812A are not in fire area A-18. RWST and containment sump level indication would be available to the control room operator to diagnose spurious operation.

manual action? is this allowed?

NRC Concern: A fire in area A-18 could cause a spurious opening of a reactor head vent flow path, causing a loss of coolant and uncontrolled depressurization.

Component Identification: BBHV8001A, BBHV8002A, BBHV8001B, BBHV8002B,

Fire Area: A-18 ohy

Drawing References: M-22BB04, E-23BB30, M-22BB01

Other References: Letter to NRC dated September 22, 1981 from Nicholas Petrick to Harold Denton concerning SLNRC 81-82.

Cables: 1BBK30AA, 1BBK30CA

Normal Valve Position: Closed

Analysis:
Refer to drawings M-22BB04 and E-23BB30. Cables for head vent valves BBHV8001A and BBHV8002A transit through fire area A-18. Since these valves are connected in series, both valves would have to be open for a reactor head vent path to exist.

The conductors of cables 1BBK30AA for valve BBHV8001A and 1BBK30CA for valve BBHV8002A that exist in fire area A-18 are 2, N2, 3G and 3R. If a short were to occur between wire 2 and either 3R or 3G the indicating lamp and the valve would essentially be connected in series. A degraded voltage condition would exist that would not be sufficient to operate the solenoid valve. The indicator lamps utilize a 120PSB incandescent bulb with a filament resistance of 4800 ohms. The coil resistance of the valve is approximately 125 ohms. In this situation, the valve, which normally operates on 125 VDC, would be subjected to less than 4 volts. This voltage is well below the threshold of 55 volts required to operate the valve.

The conductor on the positive side of the hand switch for valves BBHV8001A and BBHV8002A does not exist in fire area A-18 and therefore cannot cause the valve to energize during a fire in area A-18.

A drilled restriction 3/8" in diameter exists in the head vent flow path which will limit the loss of coolant and uncontrolled depressurization in the event that two valves in series were to open.

Even though valves BBHV8001A and BBHV8002A are the same separation group, all circuits are routed separately. Similarly, even though valves BBHV8001B and BBHV8002B are the same separation group, all circuits are routed separately.

The above analysis indicates that Callaway will be able to safely shut down the plant in the case of a fire in area A-18 that affects the cabling of the reactor head vent valves.

NRC Concern: A fire in area A-18 could cause spurious closing of either of the steam admission valves to the turbine auxiliary feedwater pump, making it unavailable for decay heat removal.

Component Identification: ABHV0005, ABHV0006

Fire Area: A-18

Drawing References: M-22AB02, E-23AB01

Cables: 2ABK01AF, 2ABK01BF

Normal Valve Position: Closed

Analysis:
Valves ABHV0005 and ABHV0006 are identified as safe shutdown components in Table 9.5B-2 of the FSAR and therefore are not considered "associated circuits."

Refer to schematic drawing E-23AB01. The conductors of cables 2ABK01AF and 2ABK01BF that exist in fire area A-18 are 1, 22, 13R, 13G, 23R, 23G, N2, and N3. If a short were to occur between wire 1 or 22 and either 13R, 13G, 23R, or 23G a degraded voltage condition would exist that would not be sufficient to operate the solenoid valve. A short between these conductors would connect the lamps and the valve in series. The indicator lamps utilize a 120PSB incandescent bulb with a filament resistance of 4800 ohms. The coil resistance of the valve is approximately 900 ohms. In this situation, the valve, which normally operates on 125 VDC, would be subjected to less than 20 volts. This voltage is well below the threshold of 90 volts required to operate the valve.

As described in FSAR A.18.7.2, the turbine-driven auxiliary feed pump is not used to safely shut down the plant for a fire in area A-18. Secondary side heat removal is accomplished using motor-driven auxiliary feed pump B.

The above analysis indicates that Callaway will be able to safely shut down the plant in the case of a fire in area A-18 that affects the cabling of the steam admission valves to the turbine auxiliary feedwater pump.

W & O/O LOOP

Protected Train Open cabling

NRC Concern: A fire in area C-9 could cause spurious closing of a volume control tank outlet valve, causing a loss of charging, affecting reactor coolant inventory control and reactor coolant pump seal cooling.

Component Identification: BGLCV0112B

Fire Area: C-9

Drawing References: E-23BG12, E-23BN01, M-22BN01, M-22BG03

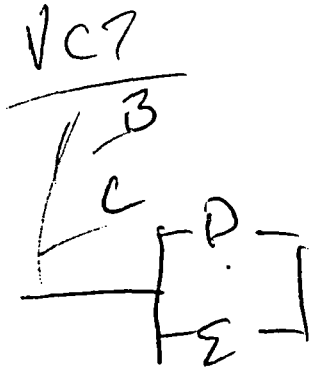
Cables: 1BGG12AA/B/C/D/E

Normal Valve Position: Open

Analysis:
Cable failure for cable 1BGG12AC could cause BGLCV0112B to spuriously close. The control room operator response to this off normal spurious operation would be to open B train valve BNLCV0112E which would provide the suction source (RWST) of water to the B Centrifugal Charging Pump. Cables for BNLCV0112E are not in fire area C-9. B train valve BGLCV0112C provides VCT outlet isolation if required.

The above analysis indicates that Callaway will be able to safely shut down the plant in the case of a fire in area C-9 that affects the cabling of the volume control tank outlet valve.

normal ckin - closed?



Revised RIS 2004-003
- applies to all circuits
- allows for EnF Discretion if the licensee has taken CAs, has a reasonable resolution & submits to a resolution

If Manual Actions implemented they must meet guidance of pp 17-6